

National Inventory Report

Greenhouse Gas Sources and Sinks in the Republic of Moldova 1990-2022

Submission to the United Nations Framework Convention on Climate Change

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FOREWORD

On March 16, 1995, the Republic of Moldova ratified the United Nations Framework Convention on Climate Change (UNFCCC). In conformity with Articles 4(1)(a) and 12(1)(a) of the Convention, the non-Annex I Parties shall provide information to the Conference of the Parties (COP) regarding emissions (by types of sources) and sinks (by types of removals) of all greenhouse gases (GHG) that do not come under the Montreal Protocol.

This Report has been developed within the 'Republic of Moldova: Enabling Activities for the Preparation of the First Biennial Transparency Report to the United Nations Framework Convention on Climate Change' Project, implemented by the Public Institution 'Environmental Projects National Implementation Office' (PI 'EPNIO') of the Ministry of Environment (MoEnv) and the United Nations Environment Programme (UNEP), with financial support of the Global Environment Facility (GEF), from August 2022 through March 2025.

The National Inventory Report (NIR) reflects the efforts made by the National GHG Inventory Team throughout 2023-2024 years.

In addition to the GHG emissions inventory results in the Republic of Moldova, the NIR also contains relevant information such as the analysis of recent trends in GHG emissions and sinks, the analysis of key categories, additional sectoral data utilized in emission inventory, data regarding the activities related to inventory quality control and uncertainty management.

The UNFCCC stipulates that greenhouse gas emissions are to be monitored under the application of a set of methodologies and guidelines developed by the Intergovernmental Panel on Climate Change (IPCC) and approved by the UNFCCC.

These guidelines describe how to assess GHG emissions, as well as the structure of national communications, biennial transparency reports and national inventory reports. They serve as an effective tool which generates multiple indicators utilized to compare the performances of the Parties of the UNFCCC.

The Convention also obliges its Parties to continuously improve the quality of national inventories. Among other initiatives which are part of the answer that the Republic of Moldova has to offer to the phenomenon of climate change, the assessment of emissions increases its ability to monitor and report GHG emissions, both nationally and internationally.

Since the first national inventory for the period from 1990 through 1998 was published, an impressive number of people in the Republic of Moldova have expressed interest for the climate change phenomenon, and particularly, for greenhouse gas emissions. Although this interest generated numerous research activities, only a limited number has focused on the process of quantitative evaluation of emissions and development of national emission factors.

Albeit there will always be uncertainties with respect to the assessment of emissions, the monitoring process will continue, both in the Republic of Moldova, and internationally, in order to improve inventory quality and reduce greenhouse gas associated uncertainties.

An independent internal audit of the quality of the national inventory of the Republic of Moldova for the period 1990-2022 was conducted in June 2024 by relevant national experts representing universities as well as research and development institutes, who were not involved in the national inventory compilation phase of the current inventory cycle.

The findings of these audits have led to the identification of priority areas, both in view of improving the quality of activity data, as well as methodological approaches and emission factors utilized in the assessment of emissions (by types of sources) and sinks (by types of removals) within the greenhouse gas national inventory of the Republic of Moldova.

Dorin POVERJUC
Director,
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LIST OF ACRONYMS, ABBREVIATIONS AND UNITS

ABS	Acrylonitrile Butadiene Styrene
AEZ	Agro-Ecological Zones
ALRC	Agency for Land Relations and Cadastre
AR4	IPCC 4th Assessment Report (IPCC, 2007)
AR5	IPCC 5th Assessment Report (IPCC, 2014)
AR6	IPCC 6th Assessment Report (IPCC, 2021)
$Area_{(T)}$	Area sown with crop *T*
$Area\ burnt_{(T)}$	Annual area of crop *T* burnt (stubble fields burning)
a.s.	active substance
ASH	Ash content of the manure in per cent
ASM	Academy of Science of Moldova
ATD	Atmospheric Deposition
ATU	Autonomous Territorial Unit
ATULBD	Administrative-Territorial Units on the Left Bank of the Dniester
B	Billion
B_0	Maximum methane producing capacity
BEF_I	Biomass expansion factor for conversion of annual net increment to aboveground tree biomass increment
BOD	Biochemical Oxygen Demand
BOF	Basic Oxygen Furnaces
BUR	Biennial Update Report
BW	Average live body weight of animal
c	Flight cycle: cruise
°C	Degrees Celsius
C_a	Animal Feeding Situation Coefficient
CA	Hornbeam species (Carpinus ssp.)
CAA	Civil Aviation Authority
CCO	Climate Change Office
CDM	Kyoto Protocol Clean Development Mechanism
C_f	Burning coefficient (used to keep account of incomplete burning related aspects)
CF	Carbon fraction in biomass
c.f.	conventional fuel
CHP	Combined Heat and Power Plant
CIS	Commonwealth of Independent States
CKD	Cement Kiln Dust
COD	Chemical Oxygen Demand
COP	Conference of the Parties
COPERT	Calculation of Air Pollutant Emissions from Road Transport (COPERT) is an MS Windows Software Program aiming at the calculation of air pollutant emissions from road transport
CORINAIR	Atmospheric Emission Inventory Guidebook, developed by the European Environment Agency with support from United Nations Economic Commission for Europe
cm	Centimetre
CM	Constant Mass
cm^2	Square centimetre
CMIP5	Coupled Model Intercomparison Project Phase 5
CR	Crop Residues
CRF	Common Reporting Format tables
$Crop_{(T)}$	Harvested annual dry matter yield for crop *T*
CS	Country Specific
CU	Cullet Ratio
CW	Clinical Waste
CW	Constructed wetlands
D	Default
DCM	Dichloromethane
DDOC	Decomposable Degradable Organic Carbon
D_{ind}	Degradable organic component in wastewater
dal	Decaliter
DE	Digestible energy
DEPA	Danish Environment Protection Agency

DOC	Degradable Organic Carbon
DOC_F	Dissimilated DOC fraction
DOM	Dissolved Organic Matter
dm	Dry matter
DRY	Dry matter fraction of harvested crop T
DS	Fraction of organic component removed with sludge
EAF	Electric Arc Furnace
EB	Energy Balance
EE	Eastern Europe
EEA	European Environment Agency
EF	Emission Factor
EMEP	European Monitoring and Evaluation Programme
EPNIO	Environmental Projects National Implementation Office
EPS	Expanded Polystyrene
eq	Equivalent
ETBE	Ethyl tert-butyl ether
EU	European Union
EV_{milk}	Net energy required to produce 1kg of milk
f	Force
F	Methane fraction in biogas
F_{AM}	Quantity of nitrogen incorporated in soil with manure
F_{COMP}	Annual amount of total compost N applied to soils
F_{CR}	Annual amount of N in crop residues returned to soils
FIE	Foreign Invested Enterprise
F_{ON}	Annual amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils
F_{OOA}	Annual amount of other organic amendments used as fertilizer
F_{PRP}	Annual amount of other organic amendments used as fertilizer
F_{SEW}	Annual amount of total sewage N that is applied to soils
F_{SN}	Annual amount of synthetic fertilizer N applied to soils
F_{SOM}	Annual amount of N in mineral soils that is mineralized, in association with loss of soil C from soil organic matter as a result of changes to land use or management
FAO	Food and Agriculture Organization of the United Nations
FG	Volume of fuel wood gathering
FOD	First Order Decay Method
FR	Species of ash tree (Fraxinus spp.)
Frac	Fraction
$Frac_{GASF}$	Fraction of synthetic fertilizer N that volatilizes as NH3 and NOx
$Frac_{GASM}$	Per cent of managed manure nitrogen that volatilizes as NH_3 and NO_x
$Frac_{LEACH}$	Per cent of managed manure nitrogen losses due to runoff and leaching
$Frac_{Renew\ (T)}$	Fraction of total area under crop *T* that is renewed annually
$Frac_{Remove\ (T)}$	Fraction of above-ground residues of crop *T* removed annually for purposes such as feed, fuel for heating and cooking, bedding and construction
FRMI	Forest Research and Management Institute
FSV	Facilitative Sharing of Views
g	Grams
G_w	Average annual above and belowground biomass increment
Gcal	Gigacalorie
g.c.e.	Grams coal equivalent
GCM	Global Climate Models
GDP	Gross Domestic Product
GE	Gross Energy
GEF	Global Environment Facility
Gg	Gigagram
GHG	Greenhouse Gas
GIES	General Inspectorate for Emergency Situations of the Ministry of Internal Affairs
GPG	Good Practice Guidance
GPPS	General Purpose Polystyrene
GT	Gigatonne
GWP	Global Warming Potential
H	Annually extracted volume, round wood

ha	Hectare
HDP	High Density Polyethylene
HFC	Hydrofluorocarbons
HIPS	High Impact Polystyrene
hl	Hectolitre
HP	Heat Plant
HP	Horsepower
ICA	International Consultation and Analysis
I_v	Average annual net increment in volume suitable for industrial processing
IE	Included Elsewhere
IEF	Implied Emission Factor
IEP	Inspectorate for Environmental Protection
INDC	Intended National Determined Contributions
IPCC	Intergovernmental Panel for Climate Change
IPS	Isotactic Polystyrene
ISIC	International Standard Industrial Classification of All Economic Activities
ISW	Industrial Solid Waste
JSC	Joint Stock Company
k	Methane generation rate constant
kg	Kilogram
kgf	kilogram-force
KC	Key Category
km	Kilometre
km^2	Square kilometre
km/h	kilometres per hour
kN.	kilonewton
kPa	Kilopascal
kt	kiloton
kW	Kilowatt
kWh	Kilowatt-hour
l	Liter
L	Level
L_0	Methane Generation Potential
LB	Left bank of the Dniester River
LKD	Lime Kiln Dust
$L_{fellings}$	Annual carbon loss due to commercial felling
LDP	Low Density Polyethylene
LDLP	Low Density Linear Polyethylene
LEDS	Low Emission Development Strategy
LPG	Liquefied Petroleum Gas
Ltd.	Limited Liability Company
LTO	Landing Take-Off cycle
LULUCF	Land Use, Land Use Change and Forest
m	Meter
m^2	Square meter
m^3	Cubic meter
MARDE	Ministry of Agriculture, Regional Development and Environment
MBT	Mechanical-Biological Treatment
MCF	Methane Correction Factor
MCFP	Moldova Community Forestry Project
MD	Moldova
M.E.	Municipal Enterprise
MxE	Mixed Enterprise
mg	Milligram
mil.	Million
MJ	Megajoule
mm	millimetres
MMS	Manure Management Systems
MoEnv	Ministry of Environment
MOP	Meeting of the Parties to the Kyoto Protocol

MR	Methane emissions recovered from wastewater treatment and sludge
MSCP	Moldova Soil Conservation Project
$MS_{(T,S)}$	Fraction of total annual nitrogen excretion for each livestock species/category *T* that is managed in manure management System *S*
MSU	Moldova State University
MSW	Municipal Solid Waste (fraction of waste disposed of in landfills)
MSW	Moldova Steel Works
MTBE	Methyl tert-butyl ether
MTPP	Moldovan Thermal Power Plant in Dnestrovsk
Mt	Megatons = 10^6 tons
MW_{anim}	Mature body weight of an adult animal
MW	Megawatt
N	Nitrogen
$N_{AG\ (T)}$	N content of above-ground residues for crop *T*
NAER	National Agency for Energy Regulation
$N_{BG\ (T)}$	N content of below-ground residues for crop *T*
$N_{\ bedding\ MS}$	Amount of nitrogen from bedding to be applied for solid storage
$N_{\ MMS\ Avb}$	Amount of managed manure nitrogen available for application to managed soils
NA	Non-Applicable
NAMA	National Appropriate Mitigation Actions
Nex	Nitrogen excretion rate
NBS	National Bureau of Statistics
NCPH	National Centre for Public Health
NFSA	National Food Safety Agency
NC	National Communication
NE	Non-Estimated
NE_a	Net Energy for animal activity
NE_g	Net Energy needed for growth
NE_l	Net Energy for lactation
NE_m	Net Energy required by the animal for maintenance
NE_p	Net Energy required for pregnancy
NE_{work}	Net Energy for work
NE_{wool}	Net Energy required to produce a year of wool
NFR	Nomenclature for Reporting
NIR	National Inventory Report
NIS	National Inventory System
NO	Not Occurring
NMRS	National Monitoring and Reporting System
$N_{(T)}$	Number of head of livestock species/category *T* in the country
ODP	Ozone-Depleting Potential
ODS	Ozone-Depleting Substances
OHF	Open-hearth furnace
OX	oxidation factor
p	*p* value – the value of a statistical test: the lowest value of the significance level for which the extracted information from the sample is significant (true H_0 is rejected); $p < 0.05$ is considered statistically significant
P.	Page
PA	Species of sycamore maple tree (*Acer spp.*)
PDD	Project Design Document
PE	Polyethylene
P_{EQ}	Population equivalent number
PERC	Tetrachlorethylene
PET	Polyethylene terephthalate
PI	Species of pine (*Pinus spp.*)
P.I.	Public Institutions
PJ	Petajoule
PL	Species of poplar (*Populus spp.*)
ppb	Parts per billion of volume
ppm	Parts per million of volume
PPP	Public-Private Partnership
ppt	Parts per trillion of volume
q	Quintal (100 kg)

QA	Quality Assurance
QC	Quality Control
QU	Species of oak (*Quercus spp.)*
R	Root-to-shoot ratio
RA	Reference Approach
$R_{AG\,(T)}$	Ratio of above-ground residues dry matter to harvested yield for crop *T*
$R_{BG\,(T)}$	Ratio of below-ground residues to harvested yield for crop *T*
RB	Right bank of the Dniester River
RCP	Representative Concentration Pathway
REG	Ratio of net energy available for growth in a diet to digestible energy consumed
REM	Ratio between the accessible energy from the diet needed to maintain the animals and the digestible energy consumed
RM	Republic of Moldova
S	Animal waste management systems
SA	Sectoral Approach
SA	Species of willow (*Salix spp.*)
SAR	Second Assessment Report (IPCC, 1996)
SC	Species of acacia (*Robinia spp.*)
SHS	State Hydrometeorological Service
SM	Emissions from sludge treatment
SN	Synthetic Nitrogen Fertilizers
SNAP	Selected Nomenclature for Air Pollution
SPIBAHVM	Scientific and Practical Institute of Biotechnologies in Animal Husbandry and Veterinary Medicine
SOC	soil organic carbon
SOE	State Owned Enterprise
SOM	soil organic matter
SS	Sewage sludge
SS_{ix}	Fraction of anaerobically treated sludge
SSPS	Shared Socioeconomic Pathway Scenarios
SWDS	Solid Waste Disposal Sites
σ	Standard Error
t	Tonne
T	Trend
T1	Tier 1
T2	Tier 2
TCA	Trichloroethane
TAM	Typical animal mass
TAR	Third Assessment Report (IPCC, 2001)
TC	Trading company
t.c.e.	Tons of coal equivalent
TE	Species of linden tree (*Tilia spp.*)
TJ	Terajoule
TM	Emissions from wastewater and sludge treatment
TOS	Total organic waste in sludge
TOW	Total organic waste in wastewater
TRI	Trichloroethylene
TTE	Team of Technical Experts
TUM	Technical University of Moldova
UCTE	Union for the Coordination of Transmission of Electricity
UL	Species of elm tree (*Ulmus spp.*)
UM	Unit of measurement
UN	United Nations
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
USA	United States of America
US EPA	United States Environmental Protection Agency
US $	US Dollar
VS	Volatile solid excretion per day
W	Animal Body Weight

WB	World Bank
WBTP	Wastewater Biological Treatment Plant
WE	Western Europe
WG	Daily weight gain
W_{ind}	Amount of wastewater generated per unit of industrial output
WM	Emissions from wastewater handling
WS_{ix}	Fraction of wastewater treated anaerobically
WTP	Wastewater treatment plant
x	Average value
Y_m	Methane conversion factor
Yield Fresh $_{(T)}$	Harvested fresh yield for crop *T*
%	Per cent

CHEMICAL FORMULAS

Al_2O_3	Aluminium oxide
$CaCO_3$	Limestone
$CaCO_3 \bullet MgCO_3$	Dolomite
CaO	Lime
CaO • MgO	Dolomitic lime
$CBrClF_2$	Halon 1211
$CBrClF_3$	Halon 1301
CCl_3F	CFC-11
CCl_2F_2	CFC-12
CCl_2CClF_2	CF-113
CCl_4	Carbon Tetrachloride
CF_4	Perfluoromethane
C_2F_6	Perfluoroethane
C_3F_8	Perfluoropropane
C_4F_{10}	Perfluorobutane
$c\text{-}C_4F_8$	Perfluorocyclobutane
C_5F_{12}	Perfluoropentane
C_6F_{14}	Perfluorohexane
CFC	Chlorofluorocarbons
CH_4	Methane
$C_6H_{12}O_6$	Glucose
C_2H_5OH	Ethanol
$CHClF_2$	HCFC-22
CH_2FCF_3	HFC-134a
CHF_3	HFC-23
CH_2F_3	HFC-32
C_2HF_5	HFC-125
CH_3CCl_2F	HCFC-141b
CH_3CClF_2	HCFC-142b
CF_3CH_3	HFC-143a
CH_3CHF_2	HFC-152a
CF_3CHFCF_3	HFC-227ea
$CF_3CH_2CF_3$	HFC-236fa
$CHF_2CH_2CF_3$	HFC-245fa
$CH_3CF_2CH_2CF_3$	HFC-365mfc
$CF_3CHFCHFCF_2CF_3$	HFC-43-10mee
CO	Carbon monoxide
CO_2	Carbon dioxide
$CO(NH_2)_2$	Urea (carbamide)
Fe_2O_3	Iron oxide
HFC	Hydrofluorocarbons
HNO_3	Nitric acid
MgO	Magnesium oxide
NF_3	Nitrogen trifluoride
Na_2CO_3	Sodium carbonate

NaOH	Sodium Hydroxide (caustic soda)
NH_3	Ammonia
NH_4^+	Ammonium cation
NH_4NO_3	Ammonia Nitrate
$NH_4H_2PO_4$	Monoammonium phosphate
$(NH_4)_2HPO_4$	Diammonium phosphate
NMVOC	Non methane volatile organic compounds
NO_x	Nitrogen Oxides
NO_3^-	Nitrate
N_2O	Nitrous oxide
N_2O_{ATD}	Indirect N_2O emissions produced from deposition of nitrogen as ammonia (NH_3), oxides of N (NO_x), and their products (NH_4^+ and NH_x^-)
N_2O_{CR}	N_2O emissions from crop residues returned to soils annually
N_2O_{DIR}	Direct N_2O emissions
N_2O_{IND}	Indirect N_2O emissions
N_2O_L	Indirect N_2O emissions due to leaching and runoff from manure management in the country
N_2O_{ON}	N_2O emissions from applied organic N fertilizer
N_2O_{PRP}	N_2O emissions from urine and manure inputs to grazed soils
N_2O_{SN}	N_2O emissions from synthetic fertilizer N
N_2O_{SOM}	N_2O emissions from nitrogen mineralization associated with loss of soil carbon due to land management change
O_3	Ozone
PFC	Perfluorocarbons
SF_6	Sulphur hexafluoride
SiO_2	Silicon oxide
SO_2	Sulphur dioxide

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EXECUTIVE SUMMARY

ES.1. The Convention, Kyoto Protocol, Paris Agreement and Party Commitments

The ultimate objective of the Convention is aimed *'to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'*. UNFCCC entered into force on 21 March 1994. To date, 198 countries are Parties to the Convention[1]. It was signed by the Republic of Moldova on June 12, 1992, and it was ratified by the Parliament on March 16, 1995.

Article 4, paragraph 1(a) and Article 12, paragraph 1(a) of the UNFCCC stipulate that each Party has to make available to the Conference of the Parties (COP) '*a national inventory of anthropogenic emissions by sources and removals by sinks, of all greenhouse gases uncontrolled by the Montreal Protocol, to the extent of its capacities, using comparable methodologies to be agreed upon and encouraged by the Conference of the Parties; likewise, a general description of steps taken or envisaged by the Party to implement the Convention, as well as any other information that the Party deems relevant to achieving the objective of the Convention and suitable for inclusion in its Communication, including, should it be feasible, relevant data for the assessment of global emission trends*'.

The main mechanism for making this information available is the National Communications (NCs). COP 2 (Geneva, 1996) adopted the Guidelines on National Communications for non-Annex I Parties (Decision 10/CP.2). In conformity with the respective Guidelines, from 1998 to 2000, under the UNDP-GEF Project *'Enabling Activities for the preparation of the First National Communication to the UNFCCC'*, the Republic of Moldova developed its First National Communication (NC1) to the UNFCCC, submitted to the COP 6 (The Hague, 2000).

The COP 8 (New Delhi, 2002) adopted new Guidelines for the preparation of NCs for non-Annex I Parties (Decision 17/CP.8). In conformity with these Guidelines, from 2005 to 2009, the Republic of Moldova prepared the Second National Communication (NC2); from 2010 to 2014 – the Third National Communication (NC3); from 2014 to 2018 – the Fourth National Communication (NC4); and from 2019 to 2023 – the Fifth National Communication (NC5) of the Republic of Moldova to the UNFCCC.

With reference to the UNFCCC implementation instruments, it should be noted that the Kyoto Protocol was adopted at the COP 3 (Kyoto, 1997), an instrument which sets binding targets for the Parties under the Convention, by committing highly industrialised countries and countries with economies in transition (37 highly industrialized countries and the European Union) included in Annex I to the Convention, to reduce total direct GHG emissions by at least 5 per cent compared to 1990 levels over the period January 1, 2008 – December 31, 2012 (the first period of the Kyoto Protocol commitment).

The Republic of Moldova ratified the Kyoto Protocol on February 13, 2003. As a non-Annex I Party, the Republic of Moldova had no commitments to reduce GHG emissions under the Kyoto Protocol's first commitment period.

The COP 13 held in Bali in December 2007 adopted The Bali Action Plan. At this COP, developing countries agreed for the first time to develop and implement National Appropriate Mitigation Actions (NAMA), in the context of sustainable development, supported through technology transfer, appropriate funding and capacity building actions.

The COP 15, held in Copenhagen in December 2009, approved and proposed for implementation a policy statement adopted in support of limiting global warming to no more than 2°C compared to pre-industrial level, in the context of equity and sustainable development. This statement, known as the *Copenhagen Accord*, reaffirms development issues in the context of climate change, including through the implementation of Low Emission Development Strategies (LEDS). In January 2010, the Republic of Moldova associated itself with the Copenhagen Accord.

[1] <https://unfccc.int/process-and-meetings/what-is-the-united-nations-framework-convention-on-climate-change>

From 2010 to 2012, the Republic of Moldova drafted the 'LEDS until the year 2020', a strategic document that was to allow the country to adjust its development path towards a low carbon economy and to achieve a green sustainable development, based on the socio-economic and development priorities of the country. Likewise, LEDS 2020 was to contribute to achieving global objectives, providing strategic national context for the mitigation efforts, for which countries receive international support for appropriate mitigation actions at national level. The LEDS 2020 project contained a set of measures that were set to contribute to the reduction of greenhouse gas emissions, the quantification of the corresponding reduction of GHG emissions for each measure, and the financial requirements for their implementation. The strategy stipulated the implementation procedure, deadlines, as well as provisions with respect to the monitoring, measurement, reporting and verification of the results obtained. LEDS was to be examined and approved by Government Decision in 2013, which only happened towards the end of 2016, and the strategy implementation period was subsequently extended until the end of 2030[2].

The COP 16 held in Cancun in December 2010, adopted the Cancun Agreements, which encourage developing countries to prepare Low Emission Development Strategies (LEDS) for sustainable development and to undertake National Appropriate Mitigation Actions (NAMAs). The Cancun Agreements highlight the fact that '*stopping climate change requires a paradigm shift towards building a low-carbon emissions society, which offers substantial opportunities and ensures continued economic growth and sustainable development*'.

At COP 16, the periodicity of preparing national communications for non-Annex I countries was also established (Decision 1/CP.16). In line with this, non-Annex I Parties are to prepare and submit *National Communications* to the UNFCCC Secretariat every four years as well as *Biennial Update Reports (BURs)* every two years. The inventory section of the BUR should contain a *National Inventory Report* as a summary or as a technical annex, expected to present in a detailed and transparent manner the procedure for completing the national inventory of anthropogenic GHG emissions by sources or removals of carbon dioxide by sink, including information on emissions trends, key categories, activity data, emission factors, assessment methodologies, quality assurance and quality control, uncertainties, recalculations and planned improvements, for each source or sink category included in the national inventory.

The COP 17 held in Durban in 2011 adopted the *Guidelines on preparing and reporting Biennial Update Reports to the UNFCCC for non-Annex I Parties* (Decision 2/CP.17 and Annex 3 to this Decision). In accordance with the existing capacities at national level and at the level of international support obtained for reporting, non-Annex I Parties had to submit their First Biennial Update Report to the UNFCCC Secretariat by the end of December 2014. The Report is to be submitted to the Secretariat every two years as a stand-alone report or as a summary of the National Communications, should their reporting years coincide.

The Republic of Moldova initiated the process of preparing the First Biennial Update Report in July 2014 and managed to submit it to the UNFCCC Secretariat on April 5, 2016. The First Biennial Update Report of the RoM to the UNFCCC (2016) was submitted to the UNFCCC Secretariat together with two technical annexes – the National Inventory Report: 1990-2013, Sources of Greenhouse Gas Emissions and Sinks in the Republic of Moldova (2015) and the Report on the National Inventory System in the Republic of Moldova (2015).

Regarding the non-Annex I Parties, the COP 17 in Durban approved (Decision 2/CP.17 and Annex IV) the Modalities and Guidelines for International Consultation and Analysis (ICA) consisting of two steps: (i) the Technical Analysis of BURs and (ii) a Facilitative Sharing of Views (FSV) among Parties on the content of BURs and the results of Technical Analysis. The international consultation process aims to enhance transparency and accountability of information reported in BURs by non-Annex I Parties. The technical analysis will be conducted by a Team of Technical Experts (TTE) and will be initiated within six months of the BUR's official submission to the Secretariat.

[2] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369528>

As for the First Biennial Update Report of the Republic of Moldova to the UNFCCC, its technical assessment by the TTE took place between the 19 and 23 September 2016, the summary report being published on the UNFCCC Secretariat's web page on February 20, 2017[3]. The FSV among UNFCCC Parties on the content of the BUR1 of the RoM and the results of technical analysis was carried out during the 3rd FSV workshop, organized by the UNFCCC Secretariat on May 15, 2017, in Bonn, Germany[4].

The COP 18 (Doha, 2012) adopted the *Doha Amendment to the Kyoto Protocol* which establishes a second commitment period (January 1, 2013-December 31, 2020) for the Parties included in Annex I of the Kyoto Protocol; adds a revised list of greenhouse gases to be reported by Annex I countries in the second commitment period; and a series of amendments to several articles of the Kyoto Protocol regarding the first commitment period and which were to be reviewed to remain valid in the second commitment period. Under Doha Amendment to the Kyoto Protocol, within the second commitment period, highly industrialised countries are to reduce their greenhouse gas emissions by at least 18% compared to 1990 levels. The Doha Amendment came into effect on December 31, 2020.

At COP 19 (Warsaw, 2013), the Parties agreed to communicate their intended nationally determined contributions (NDC 1.0) (Decision 1/CP.19), in order to include them into the new Climate Agreement to be considered and adopted by the COP 21 (Paris, 2015), which is to cover a new commitment period (January 1, 2021-December 31, 2030) with respect to the reduction of GHG emissions. Likewise, the COP 19 in Warsaw adopted *General guidelines for domestic measurement, reporting and verification of domestically supported nationally appropriate mitigation actions by developing country Parties* (Decision 21/CP.19). This document provided a solid foundation for the Paris Agreement.

At COP 20 which took place in Lima (2014), the Parties agreed over *the Lima Call for Climate Action* and were repeatedly invited (Decision 1/CP.20) to communicate their intended nationally determined contributions to the UNFCCC Secretariat in order to achieve the objectives of the Convention as set out in Article 2. According to *the Lima Call for Climate Action*, countries were invited to communicate their intended nationally determined contributions by March 31, 2015, the deadline for the submission being September 30, 2015. The UNFCCC Secretariat was asked to prepare a synthesis report on the global aggregate effect of the INDCs by November 1, 2015.

The Paris Agreement was signed by the Prime Minister of the Republic of Moldova in New York on September 21, 2016, and was subsequently ratified by the Parliament by Law No. 78 of 04.05.2017 for the ratification of the Paris Agreement (Official Monitor No. 162-170 of 26.05.2017[5].

On the 25th of September 2015, the Republic of Moldova communicated its intended Nationally Determined Contribution (NDC 1.0)[6] and the accompanying information to facilitate clarity, transparency, and understanding, with reference to decisions 1/CP.19 and 1/CP.20, according to which the Republic of Moldova intends to achieve the unconditional target of reducing its greenhouse gas emissions by 64% compared to 1990 levels by 2030, and will make great efforts to reduce its GHG emissions by 67% compared to 1990 levels. The respective reduction commitment expressed above could be increased conditionally up to 78%, in accordance with this global agreement which addresses important topics including low-cost financial resources, technology transfer, and technical cooperation, the access depending on the challenges of global climate change. GHG emissions reduction targets have been set in an emissions budget which covers the period from January 1, 2021, to December 31, 2030. The GHG emission reduction targets, set out in the NDC 1.0 of the Republic of Moldova (2015), were subsequently officially approved at national level through the Government Decision No. 1470 of 30.12.2016 on the approval of the Low Emissions Development Strategy of the Republic of Moldova by 2030 and the Action Plan for its implementation[7].

[3] <http://unfccc.int/files/national_reports/non-annex_i_parties/biennial_update_reports/submitted_burs/application/pdf/mda.pdf>

[4] The conclusions of the 3rd FSV seminar regarding the BUR1 of the RM under the UNFCCC and the results of the technical assessment are available at: <http://unfccc.int/files/national_reports/non-annex_i_parties/ica/facilitative_sharing_of_views/application/pdf/20170529_mda_v04.pdf>; the RM's presentation at the 3rd FSV seminar is available at: <http://unfccc.int/files/national_reports/non-annex_i_parties/ica/facilitative_sharing_of_views/application/pdf/moldova_fsv_workshop_presentation_15.05.2017.pdf>, and the video recording of the presentation and the interventions of the Parties are available at: <https://www.youtube.com/playlist?list=PL-m2oy1bnLzpmdRpG2pTBzUeOH3qrXlZt>

[5] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=370323>

[6] <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Republic%20of%20Moldova/1/INDC_Republic_of_Moldova_25.09.2015.pdf>

[7] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369528>

On March 4, 2020, the Republic of Moldova submitted the updated version of its national determined contribution (NDC 2.0) to the UNFCCC Secretariat[8], according to which the Republic of Moldova intends to step up with much more ambitious GHG emission reduction targets by 2030. The unconditional target is thereby to increase from 64-67% to 70% compared to the level recorded in the base year (1990), and the conditional target is to increase from 78% to 88% compared to the level recorded in 1990. The new GHG emission reduction targets were officially introduced into the Low Emissions Development Programme until 2030, approved through the Government Decision No. 659 of 06.09.2023[9].

The Second Biennial Update Report of the Republic of Moldova to the UNFCCC was submitted to the UNFCCC Secretariat on the December 27, 2018, and later, the two technical annexes: National Inventory Report: 1990-2016, Sources of Greenhouse Gas Emissions and Sinks in the Republic of Moldova on January 24, 2019; and the Report on the National Inventory System in the Republic of Moldova – 2018, on February 26, 2019, respectively. The technical assessment of the BUR2 of the RoM to the UNFCCC, conducted by the TTE, took place between May 27-31, 2019, the Summary Report being published on the UNFCCC Secretariat's web page on October 28, 2019[10]. FSV among UNFCCC Parties on the content of the Second Biennial Update Report of the RoM and results of technical analysis was carried out during the 9th FSV workshop, held online by the UNFCCC Secretariat between November 24-27, 2020[11].

The Third Biennial Update Report of the RoM to the UNFCCC was submitted to the UNFCCC Secretariat on December 21, 2021, along with two technical annexes: National Inventory Report: 1990-2019, Sources of Greenhouse Gas Emissions and Sinks in the Republic of Moldova and the Report on the National Inventory System in the Republic of Moldova – 2021[12]. The technical assessment of the BUR3 of the RoM to the UNFCCC, conducted by a team of technical experts, took place between June 20-24, 2022, the summary report being published on the UNFCCC Secretariat's web page on November 8, 2022[13]. FSV among UNFCCC Parties on the content of the Third Biennial Update Report of the RoM and results of technical analysis was carried out during the 14th FSV workshop, held by the UNFCCC Secretariat between June 6-7, 2023, in Bonn, Germany[14].

ES.2. Inventory Process in the Republic of Moldova

The Ministry of Environment (MoEnv) is the state authority responsible for the development and promotion of policies and strategies addressing environment protection, rational use of natural resources and biodiversity conservation. On behalf of the Government of the Republic of Moldova, the MoEnv oversees the implementation of international environment treaties to which the Republic of Moldova is a Party (including the Rio Conventions). The representative of the Ministry of Environment is also the National Focal Point to the UNFCCC[15].

According to Government Decision No. 549 of 13.06.2018 on the creation, organizing and functioning of the Environment Agency[16], which has been assigned the following competencies *in the field of atmospheric air protection and climate change*: the implementation of provisions and policy documents and international environmental treaties to which the RoM is a party regarding the quality and protection of atmospheric air and ozone layer; *GHG emissions reduction and adaptation to climate change*: the preparation and submission of information on their implementation to the MoEnv; participation within the *National Commission for Climate Change*; ensuring the implementation of the *monitoring, reporting and verification system for GHG emissions*; *collecting, centralizing, validating and processing data and required information for inventories and reports on atmospheric pollutants and GHG emis-*

[8] <https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx>
[9] <https://www.legis.md/cautare/getResults?doc_id=139980&lang=ro>.
[10] <https://unfccc.int/sites/default/files/resource/tasr2_2019_MDA.pdf>, <https://unfccc.int/ICA-cycle2>.
[11] The conclusions to the 9th FSV seminar regarding the BUR2 of the RM to the UNFCCC and the results of the technical assessment are available at: <https://unfccc.int/ICA-cycle2>, including the RM's presentation at the 9th FSV seminar and the video recording of the presentation and interventions of the Parties.
[12] <https://unfccc.int/BURs>.
[13] <https://unfccc.int/sites/default/files/resource/tasr2022_MDA.pdf>, <https://unfccc.int/ICA-cycle3>.
[14] The conclusions to the 14th FSV seminar regarding the BUR3 of the RM to the UNFCCC and the results of the technical assessment are available at: <https://unfccc.int/ICA-cycle3>, including the RM's presentation at the 14th FSV seminar and the video recording of the presentation and interventions of the Parties.
[15] <https://unfccc.int/process/parties-non-party-stakeholders/parties/national-focal-point>
[16] <https://www.legis.md/cautare/getResults?doc_id=119162&lang=ro>.

sions; providing technical support to the MoEnv for the development of *NCs and BURs* according to UNFCCC provisions.

At the same time, in accordance with Government Decision No. 1277 of 26.12.2018 on the establishment and operation of the National Monitoring and Reporting System (NMRS) on greenhouse gas emissions and other information relevant to climate change, the Environment Agency has been designated as the competent authority responsible for ensuring the operation of the NMRS on greenhouse gas emissions and other information relevant to climate change, providing that the operation of the NMRS is carried out at the expense and within the resources approved in the state budget of the institutions that are parties to the system, as well as other sources provided by law, including from external financing (*activities carried out on the basis of technical assistance and capacity building projects*).

Between 2019-2013, within the Environment Agency, the Environmental Policy Implementation Department was responsible for ensuring the operation of the NMRS on greenhouse gas emissions and other information relevant to climate change. Starting from 2024, this responsibility was transferred to the Environmental Quality Monitoring Department.

At the same time, in accordance with Government Decision No. 1249 of 19.12.2018 on the establishment and functioning of the Public Institution 'Environmental Projects National Implementation Office' (P.I. 'EPNIO')[17], which has the task of supporting the MoEnv and organizational units in its area of competence, with the purpose of efficient implementation of financial and technical assistance projects, external and internal, in the field of environmental protection (environmental protection, *climate change*; sustainable use of natural resources), in accordance with the provisions of regulatory documents on implementation of the requirements of international conventions to which the Republic of Moldova is a party and the alignment with international standards in the field of environmental protection.

As competent authority responsible for the operation of the National Monitoring and Reporting System on greenhouse gas emissions and other information relevant to climate change, the Environment Agency has requested that P.I. 'EPNIO', under Letter No. 3471 of 25.09.2019, examine and identifies opportunities of providing the necessary support for the accomplishment of commitments in the field of climate change by organizing the entire preparation process of national reports of the Republic of Moldova to the UNFCCC, in accordance with the rules, procedures and decisions of the Conference of the Parties to the UNFCCC.

From February 2004 to December 2018, the Climate Change Office, within the MoEnv, and recently (from January 2019 to July 2020) within the P.I. 'EPNIO' was responsible for activities associated with the preparation of National Communications, Biennial Update Reports, National Inventory Reports and national inventories of GHG emissions.

Starting with the second half of 2020, the national GHG inventory team within P.I. 'EPNIO' is responsible for estimating emissions by source categories and removals by sink categories, key category analysis, inventory quality control and verification activities, uncertainty analysis, documentation and archiving of information associated with the preparation of the national GHG inventory.

In the process of preparing the national GHG inventory, the National GHG Inventory Team employs a centralized approach consisting of the National Inventory Report (NIR), drafted in accordance with the structure established in Decision 5/CMA.3 and Common Reporting Tables.

The Report has the following structure: Executive Summary, Chapter 1 'National Circumstances, Institutional Arrangements and Cross-Cutting Information', Chapter 2 'Trends in Greenhouse Gas Emissions', Chapter 3 'Sector 1: Energy', Chapter 4 'Sector 2: Industrial Processes and Product Use', Chapter 5 'Sector 3: Agriculture', Chapter 6 'Sector 4: Land Use, Land-Use Change and Forestry', Chapter 7 'Sector 5: Waste', Chapter 8 'Recalculations of GHG Emissions and Planned Improvements', 'Annexes' and 'References'.

[17] <https://www.legis.md/cautare/getResults?doc_id=113696&lang=ro>.

Emissions of direct greenhouse gases (CO_2, CH_4, N_2O, HFC, PFC and SF_6) were estimated based on methodologies contained in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, whereas indirect emissions (NOx, CO, NMVOC and SO_2) were estimated based on methodologies according to the EEA/EMEP Air Pollutant Emission Inventory Guidebook (2019, 2023).

Activity data used in this report are based on officially published data, such as national and international statistics publications; scientific literature, national legislation acts, data provided by the ministries and subordinate institutions, central administrative authorities, and economic agents.

ES.3. Trends in Direct Greenhouse Gas Emissions

In comparison with the base year level (1990), by 2022, the Republic of Moldova had reduced its total GHG emissions by circa 71.5% (Table ES-1).

Table ES-1: Total GHG emissions in the RoM and accompanying variables between 1990-2022

	1990	1995	2000	2005	2010	2015	2020	2021	2022
Population, million inhabitants	**4.36**	**4.35**	**4.30**	**4.09**	**3.69**	**3.35**	**3.11**	**3.09**	**3.03**
Compared to 1990, %		-0.3	-1.3	-6.3	-15.5	-23.3	-28.7	-29.1	-30.6
Inter-annual fluctuation, %		-0.1	-0.3	-3.4	-2.1	-0.8	-1.3	-0.5	-2.1
Total emissions, Mt CO_2 eq.	**45.48**	**17.94**	**11.22**	**13.18**	**13.50**	**13.16**	**13.39**	**14.61**	**12.95**
Compared to 1990, %		-60.6	-75.3	-71.0	-70.3	-71.1	-70.6	-67.9	-71.5
Inter-annual fluctuation, %		-16.1	-7.4	3.0	5.7	-0.8	-1.6	9.1	-11.3
GHG per capita, t per capita	**10.43**	**4.12**	**2.61**	**3.23**	**3.66**	**3.93**	**4.31**	**4.72**	**4.28**
Compared to 1990, %		-60.4	-75.0	-69.1	-64.9	-62.3	-58.7	-54.7	-59.0
Inter-annual fluctuation, %		-16.0	-7.2	6.6	7.9	0.0	-0.3	9.7	-9.5
GDP, billion 2015 US $	**11.24**	**4.44**	**3.91**	**5.51**	**6.45**	**7.75**	**8.46**	**9.64**	**9.05**
Compared to 1990, %		-60.6	-65.2	-51.0	-42.6	-31.1	-24.7	-14.3	-19.5
Inter-annual fluctuation, %		-1.3	2.1	7.5	7.1	-0.3	-7.4	13.9	-6.1
GHG emission intensity, kg CO_2 eq./2015 US $	**4.05**	**4.04**	**2.87**	**2.39**	**2.09**	**1.70**	**1.58**	**1.52**	**1.43**
Compared to 1990, %		0.0	-29.1	-40.8	-48.3	-58.0	-60.9	-62.5	-64.6
Inter-annual fluctuation, %		-15.0	-9.3	-4.2	-1.3	-0.4	6.3	-4.3	-5.6
Imported energy, million t.c.e.	**16.70**	**5.11**	**2.54**	**3.12**	**2.59**	**2.52**	**3.16**	**3.46**	**3.52**
Compared to 1990, %		-69.4	-84.8	-81.3	-84.5	-84.9	-81.1	-79.3	-78.9
Inter-annual fluctuation, %		11.0	-18.0	4.2	-8.2	-2.1	8.9	9.5	1.6
Consumed energy, million t.c.e.	**15.05**	**5.09**	**2.65**	**3.26**	**3.76**	**3.83**	**4.08**	**4.45**	**3.96**
Compared to 1990, %		-66.2	-82.4	-78.4	-75.0	-74.5	-72.9	-70.4	-73.7
Inter-annual fluctuation, %		9.7	-20.2	6.3	27.1	0.4	-2.7	9.1	-11.0
Produced electricity, billion kWh	**15.69**	**6.17**	**3.62**	**4.22**	**6.12**	**6.05**	**6.28**	**6.81**	**5.85**
Compared to 1990, %		-60.7	-76.9	-73.1	-61.0	-61.4	-60.0	-56.6	-62.7
Inter-annual fluctuation, %		-25.8	-11.8	1.1	-1.3	12.5	10.3	8.4	-14.1
Consumed electricity, billion kWh	**11.43**	**7.02**	**4.51**	**5.84**	**5.26**	**5.46**	**5.47**	**5.84**	**5.67**
Compared to 1990, %		-38.5	-60.5	-48.9	-54.0	-52.3	-52.2	-48.9	-50.3
Inter-annual fluctuation, %		-3.9	-4.4	-3.1	-0.9	-8.7	-0.8	6.9	-2.9
Produced heat, million Gcal	**22.21**	**9.83**	**4.99**	**5.32**	**4.60**	**3.98**	**3.78**	**4.25**	**3.67**
Compared to 1990, %		-55.8	-77.6	-76.0	-79.3	-82.1	-83.0	-80.9	-83.5
Inter-annual fluctuation, %		30.9	-26.0	8.2	5.4	-2.1	-2.6	12.4	-13.6
Consumed heat, million Gcal	**20.98**	**8.80**	**4.50**	**4.77**	**3.99**	**3.47**	**3.38**	**3.77**	**3.29**
Compared to 1990, %		-58.1	-78.5	-77.3	-81.0	-83.4	-83.9	-82.0	-84.3
Inter-annual fluctuation, %		32.1	-23.6	8.4	4.1	-3.1	-1.9	11.7	-12.8

References: [1]Economic Research Service US Department of Agriculture (<http://www.ers.usda.gov/data-products/international-macroeconomic-data-set.aspx>); [2]Statistical Yearbooks of the RoM (<https://statistica.gov.md/pageview.php?l=ro&idc=263&id=2193>) and ATULBD (<http://www.mepmr.org/pechatnye-izdaniya/statisticheskij-ezhegodnik-pmr>); [3]Energy Balances of the RoM for 1990, 1993-20222 and Statistical Yearbooks of ATULBD for 1998, 2000-2021.

Table ES-1 reveals an obvious correlation between the reduction of GHG emissions during the last 30 years and the reduction of some important socioeconomic indicators: the real value of the GDP decreased during this period by 19.5%, population – by 30.6%, intensity of GHG emissions (CO_2 eq./GDP) – by 64.6%, consumption of primary energy resources – by 73.7%, energy import – by 78.9%, electricity consumption – by 50.3%, and heat consumption – by 84.3%

The significant reduction of socio-economic indicators between 1990 and 2022 is a consequence of the profound transformation processes common for the transition from a centralized economy to a mar-

ket economy, especially after the dissolution of the Soviet Union and the Declaration of Independence of the Republic of Moldova on August 27, 1991. In 1990, the country had medium-low incomes while today it is considered one of the countries with the lowest incomes per capita in Europe. Even before 1991, there were some tendencies of economic decline, but the separation from the USSR accelerated the process considerably. The real GDP level decreased continuously from 1990 to 1999, and in 1991 it fell to as little as 34% compared to1990.

The reasons for the economic collapse were numerous. First, the country had been fully integrated in the USSR economic system, and the independence resulted, among others, in the cessation of any subsidies or cash transfers from the centralized government. Second, the end of the Soviet Era with its well-established commercial links resulted in the emergence of numerous obstacles for free movement of goods, and access restrictions introduced by the emerging markets. Third, the lack of domestic energy resources and raw materials in the country contributed considerably to the nation's strong dependence on other former Soviet Republics. This dependence affected consumers' capacity to pay for the energy used due to the increased prices of energy resources (e.g., from 1997 to 2022, natural gas tariffs increased by circa 14 times; electricity tariffs – by circa 13-15 times; gasoline, diesel and liquefied gas prices increased by circa 2.0-2.5 times), given that most energy resources were imported. On the other hand, without applying cross subsidizations policies, the current energy prices incentivized the population to take strong energy efficiency measures in the RoM, which led to a significant decrease in energy intensity, declining since 2006 with an average annual negative growth of circa 1.6%.

Simultaneously, between 2000-2022, the real GDP increased from circa 3.91 to 9.05 billion US dollars updated to 2015 levels, and the real GDP per capita increased from 936 to 2,750 US dollars updated to 2015 levels. The considerable increase in real GDP achieved since 2000 seems to show that the economy has developed in the right direction albeit we must remember that in 2022 the real GDP reached only 80.4% of the level recorded in the base year (1990). We must mention that from 2000 to 2022, the consumption of primary energy resources had increased by 49.5%; whereas the intensity of emissions (CO_2eq/GDP) decreased by 50.1%, indicating signs of decoupling of economic growth from increasing GHG emissions, by 15.4% between 2000-2022 (Figure ES-1).

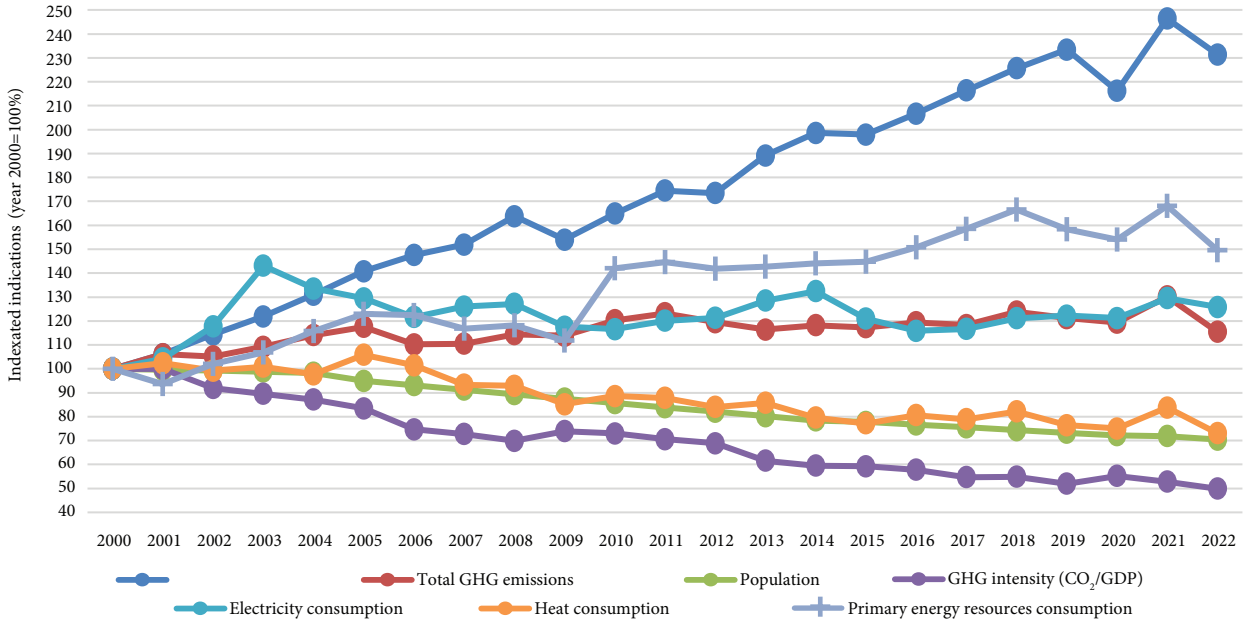


Figure ES-1: Trends in total GHG emissions and associated variables in the Republic of Moldova between 2000-2022.

In 2022, the share of CO_2 emissions in the total national direct GHG emissions accounted for circa 72.6%, the share of CH_4 accounted for circa 17.7%, N_2O emissions accounted for 7.9% of the total, whereas the share of F-gases (HFC, PFC, SF_6) is completely insignificant – only circa 1.8% of the total (Figure ES-2).

Approximately 69.2% of the net national direct GHG emissions in 2022 originated from Sector 1 'Energy'. Other relevant direct GHG sources are Sector 5 'Waste' (10.8% of the total), Sector 3 'Agriculture' (10.1% of the total) and Sector 2 'Industrial Processes and Product Use' (6.7% of the total) (Figure ES-3).

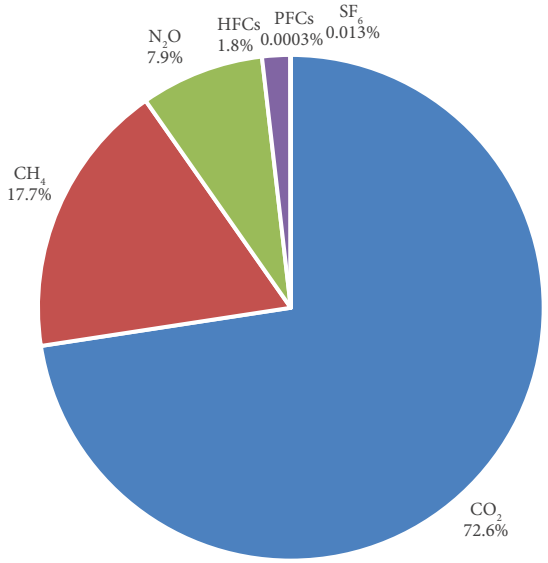


Figure ES-2: Share of direct GHG emissions in the structure of total GHG emissions in the Republic of Moldova in 2022.

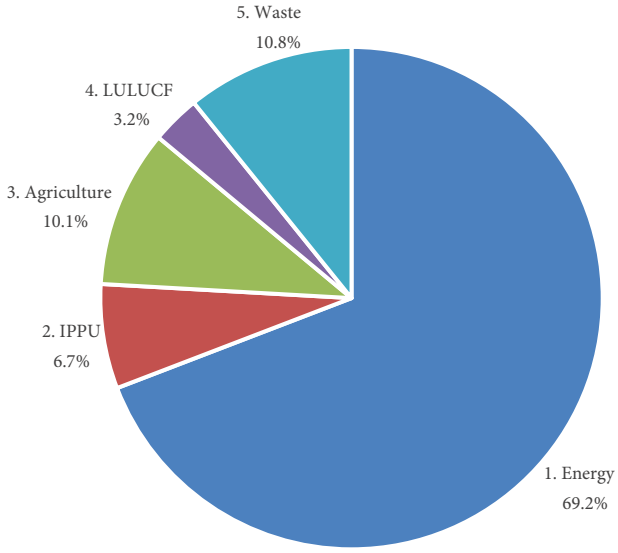


Figure ES-3: Sectoral breakdown of the total national GHG emissions in the Republic of Moldova in 2022.

Table ES-2 shows total and net national direct GHG emissions in the Republic of Moldova in 2022. Table ES-3 shows the evolution of total direct GHG emissions and removals in the Republic of Moldova between 1990-2022.

As shown in the Table ES-3, the total direct GHG emissions (without LULUCF) had decreased during the period under review by 71.5%, from 45.48 Mt CO_2 equivalent in 1990 to 12.95 Mt CO_2 equivalent in 2022 (GHG emissions had decreased in 2022 by another 11.3% as compared to 2021).

At the same time, net GHG emissions (with LULUCF) had decreased by 69.5% over the same period, from 43.81 Mt CO_2 equivalent in 1990 to 13.37 Mt CO_2 equivalent in 2022 (in 2022 the net GHG emissions had decreased by 8.8% as compared to 2021).

It should be noted that GHG emissions from Sector 1 'Energy' had decreased by 75.1% between 1990-2022 (decreased in 2022 by 11.6% as compared to 2021), emissions from Sector 2 'Industrial Processes and Product Use' had decreased by circa 43.9% (decreased in 2022 by 9.7% as compared to 2021), emissions from Sector 3 'Agriculture' had decreased by 73.4% (decreased in 2022 by 19.2% as compared to 2021), net removals from Sector 4 'LULUCF' had decreased by 125.1% (net GHG emissions increased 8.6 times as compared to 2021), respectively emissions from Sector 5 'Waste' decreased by 14.5% (decreased by 1.8% as compared to 2021).

Between 1990-2022 the most significant reductions of direct GHG emissions by source categories had been registered in the following categories: 1A5 'Other' (-97.7%), 4G 'Harvested Wood Products' (-96.9%), 4C 'Grasslands' (-89.8%), 3B 'Manure Management' (-86.3%), 4D 'Wetlands' (-84.8%), 1A1 'Energy Industries' (-84.3%), 3A 'Enteric Fermentation' (-83.1%), 1B2 'Fugitive Emissions from Oil and Natural Gas' (-77.0%), 1A4 'Other Sectors' (-71.8%), 1A2 'Manufacturing Industries and Construction' (-64.6%), 2A 'Mineral Industry' (-63.3%), 2C 'Metal Industry' (-57.2%), 3D 'Agricultural Soils' (-44.3%), 1A3 'Transport' (-42.5%), 4A 'Forest Land' (-37.9%), 2D 'Non-Energy Products from Fuels and Solvent Use' (-32.1%), 5D 'Wastewater Treatment and Discharge' (-31.9%), 2G 'Other Product Manufacture and Use' (-27.8%), 4B 'Cropland' (-27.4%) and 4E 'Settlements' (-20.3%).

From 2021 to 2022, an increase in emissions from the following source categories had been recorded in: 3H 'Urea Application' (+21.8%), 2F 'Product Use as Substitutes for ODS' (+10.1%), 4F 'Other Land' (+6.7%), 5B 'Biological Treatment of Solid Waste' (+4.0%), 4E 'Settlements' (+2.2%), 4D 'Wetlands' (+1.4%) and 4B 'Cropland' (+1.0%).

Table ES-2: The Republic of Moldova's Total Direct GHG Emissions in 2022

GREENHOUSE GAS EMISSIONS SOURCES	CO_2	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalent (kt)								
1. Energy	**8,705.13**	**444.76**	**99.77**						**9,249.65**
A. Fuel Combustion (sectoral approach)	8,703.60	211.59	99.77						9,014.96
1. Energy Industries	3,341.56	2.43	1.94						3,345.93
2. Manufacturing Industries and Construction	669.56	1.20	1.53						672.30
3. Transport	2,724.89	13.78	38.11						2,776.78
4. Other Sectors	1,964.95	194.13	58.16						2,217.25
5. Other	2.64	0.04	0.03						2.70
B. Fugitive Emissions from Fuels	1.52	233.17	0.00						234.70
1. Solid Fuels	NO	NO	NO						NO
2. Oil and Natural Gas	1.52	233.17	0.00						234.70
C. CO_2 Transport and Storage	NO								NO
2. Industrial Processes and Product Use	**663.47**	**NO**	**NO**	**234.84**	**0.04**	**NO**	**1.65**	**NO**	**900.00**
A. Mineral Industry	491.38								491.38
B. Chemical Industry	NO	NO	NO						NO
C. Metal Industry	12.20	NO	NO	NO	NO	NO	NO	NO	12.20
D. Non-Energy Products from Fuels and Solvent Use	159.11	NO	NO						159.11
E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS				234.84	NO	NO	NO	NO	234.84
G. Other Product Manufacture and Use	0.78	NO	NO	NO	0.04	NO	1.65	NO	2.47
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**22.66**	**461.17**	**873.26**						**1,357.09**
A. Enteric Fermentation		414.83							414.83
B. Manure Management		46.34	135.05						181.39
C. Rice Cultivation		NO							NO
D. Agricultural Soils		NO	738.21						738.21
E. Prescribed Burning of Savannas		NO	NO						NO
F. Field Burning of Agricultural Residues		IE	IE						IE
G. Liming	NO								NO
H. Urea Application	22.66								22.66
I. Other Carbon-Containing Fertilizers	NO, NE								NO, NE
J. Other	NO	NE	NE						NO
4. LULUCF	**258.39**	**1.52**	**160.76**						**420.66**
A. Forest Land	-1,592.42	1.16	0.61						-1,590.66
B. Cropland	1,730.18	0.36	0.09						1,730.63
C. Grasslands	-123.13	NE	NE						-123.13
D. Wetlands	-84.25	NE	NE						-84.25
E. Settlements	27.50	NO, NE	160.06						187.56
F. Other Land	304.27	NE	NE						304.27
G. Harvested Wood Products	-3.78								-3.78
H. Other	NE	NE	NE						NE
5. Waste	**9.89**	**1,384.13**	**51.07**						**1,445.09**
A. Solid Waste Disposal		1,130.39							1,130.39
B. Biological Treatment of Solid Waste		1.38	0.78						2.16
C. Incineration and Open Burning of Waste	9.89	5.68	0.94						16.51
D. Wastewater Treatment and Discharge		246.68	49.34						296.03
E. Other	NO	NO	NO						NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:									
International Bunkers	**145.60**	**0.09**	**1.26**						**146.96**
International Aviation	142.05	0.08	1.24						143.37
International Navigation	3.56	0.01	0.03						3.59
Multilateral Operations	**NO**	**NO**	**NO**						**NO**
CO_2 Emissions from Biomass	**2,429.50**								**2,429.50**
CO_2 Captured and Stored	NO								NO
Long-term Storage of C in waste disposal sites	NO								NE
Indirect N_2O emissions			213.70						213.70
Indirect CO_2 emissions	151.27								151.27
Total (without LULUCF)									**12,951.83**
Total (with LULUCF)									**13,372.49**

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring.

Table ES-3: The Republic of Moldova's national direct GHG emissions between 1990-2022

GREENHOUSE GAS EMISSIONS SOURCES	1990	1995	2000	2005	2010	2015	2020	2021	2022
	CO_2 equivalent (kt)								
1. Energy	**37,087.56**	**12,467.03**	**7,018.53**	**8,935.27**	**9,574.49**	**9,317.70**	**9,466.98**	**10,460.91**	**9,249.65**
A. Fuel Combustion (sectoral approach)	36,066.86	11,639.59	6,274.33	7,984.74	8,832.63	8,597.45	9,193.48	10,182.87	9,014.96
1. Energy Industries	21,359.99	7,191.16	3,159.28	3,233.22	4,053.06	3,688.43	3,638.38	3,936.22	3,345.93
2. Manufacturing Industries and Construction	1,904.84	382.22	520.27	575.18	517.00	654.13	694.91	757.79	672.30
3. Transport	4,830.86	1,658.41	1,004.59	1,864.52	2,185.47	2,305.29	2,508.94	2,775.47	2,776.78
4. Other Sectors	7,855.70	2,281.29	1,553.40	2,285.56	2,049.60	1,947.77	2,350.07	2,711.79	2,217.25
5. Other	115.46	126.51	36.78	26.26	27.51	1.83	1.19	1.60	2.70
B. Fugitive Emissions from Fuels	1,020.70	827.44	744.21	950.54	741.85	720.25	273.49	278.04	234.70
1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Oil and Natural Gas	1,020.70	827.44	744.21	950.54	741.85	720.25	273.49	278.04	234.70
C. CO_2 Transport and Storage	NO	NO	NO	NO	NO	NO	NO	NO	NO
2. Industrial Processes and Product Use	**1,605.24**	**456.56**	**315.31**	**570.74**	**553.69**	**749.79**	**970.54**	**996.76**	**900.00**
A. Mineral Industry	1,338.96	351.66	240.78	439.19	405.39	507.99	538.63	582.07	491.38
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Industry	28.50	26.24	36.27	41.94	9.70	17.28	18.70	22.26	12.20
D. Non-Energy Products from Fuels and Solvent Use	234.36	76.56	32.64	68.19	66.32	84.58	203.98	176.31	159.11
E. Electronic Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS	NO	0.94	4.66	20.20	70.54	137.88	206.62	213.27	234.84
G. Other Product Manufacture and Use	3.42	1.17	0.97	1.22	1.74	2.06	2.61	2.84	2.47
H. Other	NA	NA	NA	NA	NA	NA	NA	NO	NO
3. Agriculture	**5,101.04**	**3,220.29**	**2,178.48**	**2,070.93**	**1,804.19**	**1,655.97**	**1,479.01**	**1,679.02**	**1,357.09**
A. Enteric Fermentation	2,452.16	1,812.26	1,216.08	1,034.91	802.68	694.45	434.00	429.07	414.83
B. Manure Management	1,323.77	690.57	397.14	394.82	359.11	292.96	199.38	194.35	181.39
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1,324.53	717.39	564.83	641.03	640.65	657.32	803.13	1,036.99	738.21
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	IE	IE	IE	IE	IE	IE	IE	IE	IE
G. Liming	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Urea Application	0.58	0.06	0.44	0.17	1.74	11.24	42.50	18.61	22.66
I. Other Carbon-Containing Fertilizers	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE	NO, NE
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
4. LULUCF	**-1,676.01**	**-2,058.69**	**-2,156.04**	**-1,699.22**	**-1,256.74**	**-1,202.92**	**-22.06**	**49.11**	**420.66**
A. Forest Land	-2,563.08	-2,045.06	-2,307.44	-2,409.49	-2,484.02	-2,158.40	-1,886.09	-1,919.47	-1,590.66
B. Cropland	2,382.50	1,319.84	1,224.00	1,272.01	1,271.86	1,112.68	1,630.01	1,713.81	1,730.63
C. Grasslands	-1,205.69	-1,601.10	-1,291.95	-1,058.12	-691.99	-418.46	-223.15	-138.64	-123.13
D. Wetlands	-555.38	-469.44	-328.42	-187.41	-46.40	-82.79	-82.81	-83.05	-84.25
E. Settlements	235.46	329.96	363.44	308.41	275.13	207.99	176.16	183.61	187.56
F. Other Land	152.36	401.13	178.52	416.50	441.48	86.82	329.13	285.13	304.27
G. Harvested Wood Products	-122.18	5.97	5.81	-41.11	-22.80	49.24	34.69	7.73	-3.78
H. Other	NE	NO	NE	NE	NE	NE	NE	NE	NE
5. Waste	**1,690.28**	**1,791.14**	**1,708.15**	**1,607.45**	**1,563.54**	**1,439.62**	**1,475.44**	**1,471.47**	**1,445.09**
A. Solid Waste Disposal	1,228.09	1,388.07	1,318.27	1,195.79	1,196.05	1,098.55	1,156.70	1,144.56	1,130.39
B. Biological Treatment of Solid Waste	2.39	1.11	0.92	1.06	1.72	2.11	2.19	2.08	2.16
C. Incineration and Open Burning of Waste	25.01	25.21	25.03	23.90	21.39	18.97	17.48	16.79	16.51
D. Wastewater Treatment and Discharge	434.80	376.76	363.93	386.70	344.38	319.99	299.06	308.05	296.03
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
6. Other	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
Memo Items:									
International Bunkers	**193.68**	**35.05**	**63.73**	**38.36**	**41.49**	**58.86**	**41.73**	**161.61**	**146.96**
International Aviation	193.68	35.05	63.73	38.36	41.49	57.45	35.52	153.02	143.37
International Navigation	NO	NO	NO	NO	NO	1.41	6.21	8.60	3.59
Multilateral Operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
CO_2 Emissions from Biomass	**232.81**	**230.05**	**272.37**	**307.39**	**341.05**	**1,436.50**	**2,992.97**	**2,904.28**	**2,429.50**
CO_2 Captured and Stored	NO	NO	NO	NO	NO	NO	NO	NO	NO
Long-term Storage of C in waste disposal sites	NE	NE	NE	NE	NE	NE	NE	NE	NE
Indirect N_2O emissions	664.92	350.51	238.46	256.59	249.71	232.67	240.64	284.38	213.70
Indirect CO_2 emissions	207.55	65.45	28.60	61.06	59.38	77.88	196.38	168.17	151.27
Total (without LULUCF)	**45,484.11**	**17,935.02**	**11,220.47**	**13,184.39**	**13,495.90**	**13,163.08**	**13,391.96**	**14,608.16**	**12,951.83**
Total (with LULUCF)	**43,808.10**	**15,876.32**	**9,064.43**	**11,485.17**	**12,239.16**	**11,960.16**	**13,369.90**	**14,657.27**	**13,372.49**

Abbreviations: IE – Included Elsewhere; NE – Not Estimated; NO – Not Occurring.

ES.4. Trends in indirect GHG emissions

Despite not being considered greenhouse gases, photochemically active gases such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) contribute to global warming indirectly. These gases are considered as ozone precursors influencing the formation and destruction of ozone in the atmosphere. Mainly, they persist in exhaust fumes generated by transport units, as well as by fossil fuel combustion in stationary sources, solvent consumption and other household products, etc.

The national GHG inventory of the RoM includes emissions of the following ozone and aerosol precursors: NO_x, CO, NMVOC and SO_2. Between 1990 and 2022, total NO_x emissions had decreased by circa 72.7%: from 95.63 kt in 1990 to 26.12 kt in 2022; total CO emissions had decreased by 57.0%: from 278.81 kt in 1990 to 119.88 kt in 2022; NMVOC emissions had decreased by 35.3%: from 141.54 kt in 1990 to 91.58 kt in 2022; while SO_2 emissions had decreased by 96.7%: from 150.86 kt in 1990 to 4.96 kt in 2022.

ES.5. Key Category Analysis

Following the key category analysis, carried out for the years 1990 and 2022 using the key categories calculation tool developed by the United States Environmental Protection Agency (US EPA) (Key Categories Analysis Tool v2.8)[18], without LULUCF, by applying the Tier 1 methodological approach– 20 key categories by level (L) and 19 key categories by trend (T), by applying the Tier 2 methodological approach – 18 key categories by level assessment (L) and 16 key categories by trend (T); with LULUCF, by applying the Tier 1 methodological approach – 27 key categories by level (L) and 23 key categories by trend (T), and by applying the Tier 2 methodological approach – 22 key categories by level (L) and 18 key categories by trend (T), respectively.

ES.6. Quality Assurance, Quality Control and Improvements

As part of the continuous effort to create a qualitative, transparent and credible inventory, the Republic of Moldova developed a 'Quality Assurance and Quality Control Plan'.

Its key features include detailed procedures and typical forms for verification and quality control, with the application of the Tier 1 (general procedures) and Tier 2 (specific procedures for individual source categories) methodological approaches, in order to standardise the process of implementing quality assurance and quality control activities of the national inventory; likewise, the technical review (audit) performed by personnel not directly involved in the process of preparing and developing the national inventory; checking the quality of activity data, including by comparing data sets obtained from different sources; as well as the continuous documentation of the development process of the national inventory.

The inventory quality assurance activity was carried out with the support provided by specialists representing the Technical University of Moldova – sector 1 'Energy' and sector 2 'Industrial Processes and Product Use'; Scientific and Practical Institute of Biotechnologies in Animal Husbandry and Veterinary Medicine – sector 3 'Agriculture'; Forest Research and Management Institute of Moldsilva Agency – sector 4 'LULUCF'; and by an independent consultant in the field of environmental protection for sector 5 'Waste', respectively.

The national inventory of the RoM largely represents a complete register of greenhouse gases. Despite the effort to include all existing source and sink categories in the inventory, certain gaps still persist in it, most of them being determined by the lack of activity data for the estimation of the respective emissions/removals. The national GHG inventory team will continue the activity of identifying the necessary information for the estimation of GHG emissions/removals from these source categories.

[18] US EPA's Key Category Calculation Tool v2.8, <https://www.epa.gov/ghgemissions/toolkit-building-national-ghg-inventory-systems>

CHAPTER 1. NATIONAL CIRCUMSTANCES, INSTITUTIONAL ARRANGEMENTS AND CROSS-CUTTING INFORMATION

1.1. General Background Information on the Phenomenon of Climate Change

1.1.1. Climate Change and Greenhouse Effect

Under the UNFCCC, climate change is defined as '*a change of climate which is attributed directly or indirectly to human activity, which alters the composition of the global atmosphere, being an additional effect to natural climate variability observed over comparable time periods*'. Human activities change atmospheric concentrations and distribution of greenhouse gases and aerosols. These changes can produce a radiant force by either changing the solar radiation reflection and absorption, or emission and absorption of terrestrial radiation.

Box 1-1: Climate change – definitions and evolution scenarios

To better understand the definition of climate change, it is important to perceive the difference between the notions of 'weather' and 'climate'. Weather is a condition of the atmosphere at a certain time and in a certain place, perceived as a change of temperature, air pressure, humidity, wind speed, nebulosity, and precipitations. The notion of 'weather' is used when the above-mentioned conditions are related to short periods of time. The notion of climate usually refers to the average state of weather in a certain region of the world which persists over a longer period (at least 30 years). So, climate may be defined as a weather pattern, characteristic to a certain region of the world. Elements of the climate are precipitations, temperature, humidity, solar radiation, wind speed and such phenomena as fog, frost, hoarfrost, hail and others. Climate change refers to long-term changes in weather patterns caused by both natural phenomena (astronomical: solar activity, the influence of some planets, etc.; geological-geophysical: the change of the Earth's axial tilt, the change of the Earth's orbit and others; geographical: changes of the structure of the active surface – volcanic eruptions, massive landslides), and phenomena of anthropogenic nature (induced by humans), such as pollution of terrestrial atmosphere (change of the global atmosphere composition by generating GHGs).

In accordance with the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC, 2021), each of the past four decades has been successively warmer than any decade since 1850. During the first two decades of the 21st century, the global surface temperature was 0.99°C [between 0.84 and 1.10] higher than between 1850-1900. Simultaneously, the global surface temperature was 1.09°C [between 0.95 and 1.20] higher between 2011 and 2020 than between 1850 and 1900.

Between 1901 and 2018, the sea level had risen by 20 cm [between 15 and 25]. Between 1901 and 1971, the average sea level rise was circa 1.3 mm/year [between 0.6 and 2.1], rising to 1.9 mm/year [between 0.8 and 2.9] between 1971 and 2006, and to 3.7 mm/year [between 3.2 and 4.2] between 2006 and 2018. It is highly likely that anthropogenic activities are the mainspring of global glacier retreat from 1990 onwards and the reduction of the Arctic Ocean's ice surface between 1979-1988 and 2010-2019 (by circa 40% in September and by circa 10% in March). Between 2011 and 2020, the average annual arctic sea ice reached its lowest level since 1850. During the summer season, the Arctic Sea ice was smaller than at any time in the last 1000 years. The global phenomenon of synchronous glacier retreat observed since 1950 is unprecedented in the last 2000 years.

Heat waves (excessively hot weather) have become more frequent and intense in most terrestrial regions since 1950, while cold waves (excessively cold weather) have become less frequent and less severe. Simultaneously, marine heatwaves have doubled in frequency since 1980. Also, the frequency and intensity of abundant rainfall events have increased since 1950 in most terrestrial areas, for which observational data is sufficient to analyse weather trends.

In accordance with the Sixth Assessment Report (AR6) of the Intergovernmental Panel on Climate Change (IPCC, 2021), it is expected that the global surface temperature will continue to rise until at least the mid-21st century in all Shared Socioeconomic Pathway Scenarios considered. The average global temperature will exceed 1.5-2.0°C in the 21st century unless deep reductions in CO_2 and other greenhouse gas emissions take place in the coming decades. Compared to the period 1850-1900, the average global surface temperature between 2081-2100 will most likely be 1.0°C-1.8°C higher in the very low GHG emission scenario (SSP1.0-1.9), 2.1°C-3.5°C higher in the medium GHG emission scenario (SSP2.0-4.5) and 3.3°C-5.7°C higher in the high GHG emission scenario (SSP5.0-8.5). The last time when the global surface temperature was maintained at 2.5°C above the level recorded in 1850-1900 was 3 million years ago.

It is highly likely that heavy rainfalls will intensify and become more frequent in most terrestrial regions. On a global scale, extreme daily precipitation events are expected to intensify by circa 7% for every 1°C of global warming. It has also been envisaged that the share of tropical cyclones of maximum intensity (category 4-5) will increase as global warming intensifies.

It is estimated that global warming will further amplify the rate of permafrost thaw and loss of seasonal snow, land ice, and Arctic Sea ice. By 2050, the Arctic will be virtually ice-free in September. The global water cycle will continue to intensify as global temperatures rise, precipitation and surface water flows are envisaged to become more variable in most land regions over the seasons and year-on-year.

Compared to 1995-2014, in the last two decades of the 21st century (2081-2100), the global annual average precipitations are projected to rise by 0-5% in the very low GHG emission scenario (SSP1.0-1.9), by 1.5-8% in the medium GHG emission scenario (SSP2.0-4.5) and by 1-13% in the very high GHG emission scenario (SSP5.0-8.5).

Global average sea level will continue to rise in the 21st century. Compared to 1995-2014, the global average sea level rise toward 2100 will be 28-55 cm in the very low GHG emission scenario (SSP1.0-1.9), 44-76 cm in the medium GHG emission scenario (SSP2.0-4.5) and 63-101 cm in the very high GHG emission scenario (SSP5.0-8.5).

By the end of the 21st century, the frequency of natural disasters (floods, droughts, heat waves, hurricanes, tornados, etc.) is expected to grow. In some regions, their impact could be devastating, while other regions could benefit from climate change. The impact will depend on the form and magnitude of these changes, and in the case of adverse effects, of the ability of natural and anthropogenic systems to adapt to climate change.

In other words, the greenhouse effect of the atmosphere is similar to the effect that can be observed in greenhouses when the function of the glass or polyethylene is taken over in the atmosphere by greenhouse gases. Short-wave solar radiation freely penetrates the greenhouse gases, reaching the Earth's surface, and warming it. Long-wave radiation (infrared rays) emitted by the Earth's surface is captured by these gases and is partially sent back to the Earth's surface. Consequently, the average atmospheric temperature is by 33°C warmer than it would be in the absence of the greenhouse effect. Basically, this phenomenon makes life on Earth possible.

1.1.2. Greenhouse Gases

The most important greenhouse gas in the atmosphere is water vapours (H_2O), responsible for approximately 2/3 of the total greenhouse effect. The content of water in the atmosphere is not directly influenced by anthropogenic activities, but is determined by the natural water cycle, or, simply, the difference between evaporation and precipitation.

Carbon dioxide (CO_2) has a 30% share in the greenhouse effect, while methane (CH_4), nitrous oxide (N_2O) and ozone (O_3) taken together account for 3%. The group of artificial substances (man-made): chlorofluorocarbons (CFCs) and their substitute, hydrofluorocarbons (HCFCs, HFCs) and other substances, as well as perfluorocarbons (PFCs) and sulphur hexafluoride (SF_6) are also attributed to direct GHGs. There are other photochemically active gases, such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) (i.e. substances such as: propane, butane, and ethane), which are not attributed to direct GHGs, but have an indirect contribution to the greenhouse effect. Such gases influence the formation and destruction of ozone in the atmosphere in the presence of solar rays (ultraviolet radiation) and are considered ozone precursors in the troposphere.

Though greenhouse gases are considered natural components of the air, their presence in the atmosphere is strongly affected by anthropogenic activities. Increased concentrations of GHG in the atmosphere (caused by emissions of anthropogenic origin) contribute to the enhanced greenhouse effect, thus leading to additional warming of the atmosphere. The GHG concentration in the atmosphere is determined by the difference between GHG emissions and removals. It has been established with certainty that the GHG concentrations in atmosphere have increased significantly in comparison with pre-industrial level. From 1750 to the beginning of 2024, the concentration of CO_2 had thereby increased by circa 153.3%, the concentration of CH_4 – by 264.7%, and the concentration of N_2O – by circa 125.0%[19] (Table 1-1). These trends can be largely attributed to human activities – fossil fuel combustion and continuous deforestation of forest lands, in particular.

Table 1-1: Tropospheric concentration (in the Northern Hemisphere), concentration change rate and direct GHG lifetime in the troposphere

Greenhouse Gases	Preindustrial tropospheric concentration (1850-1900)	Tropospheric concentration at the beginning of 2024	GWP (100-yr time horizon) (IPCC, 2014)	Tropospheric life-time (years)
Carbon dioxide (CO_2)	278.3 ppm	426.6 ppm	1	~ 50-200
Methane (CH_4)	729.2 ppb	1930.6 ppb	28	11.8
Nitrous oxide (N_2O)	270.1 ppb	337.5 ppb	265	109

Note: ppm – concentration in parts per million of volume; ppb - concentration in parts per billion of volume.

[19] <https://www.esrl.noaa.gov/gmd/ccgg/trends/>.

In the year 2022, globally, the amount of annual carbon dioxide emissions from fossil fuel burning was about 36.8 gigatons (Gt)[20], 0.3 Gt more than the level recorded in 2021. The most important sources of carbon dioxide emissions are fossil fuel combustion, deforestation, and industrial processes (for example, cement production). The carbon dioxide lifetime in the atmosphere varies between 50 and 200 years. It can be removed from atmosphere through a complex set of natural sink mechanisms. Also, it is considered that circa 26% of the emitted carbon dioxide can be absorbed by oceans. Photosynthesis, particularly in sea vegetation and plankton is an important, albeit transitory, mechanism of CO_2 emissions removal, because after the perishing of plants, carbon dioxide is again emitted into the atmosphere.

The concentration of methane in the atmosphere is affected in proportion of circa 60% by anthropogenic activities such as rice cultivation, animal breeding (enteric fermentation and manure management), coal, oil and natural gas extraction, transportation and distribution of natural gases, solid waste disposal on lands, biomass combustion, etc. The breakdown of methane in the atmosphere takes place through chemical reactions (by means of OH radicals). The lifetime of CH_4 in the atmosphere is circa 11.8 years. The global annual CH_4 emissions into the atmosphere, only from the Energy Sector, account for circa 135 Mt[21], given that the Energy Sector is responsible for circa 40% of global methane emissions of anthropogenic origin, only the Agriculture Sector having a greater contribution[22]. The latest published reports[23] indicate a level of global methane emissions of circa 360 Mt (uncertainty range: 340-380 Mt).

It has been established that circa 43% of the atmospheric N_2O is of anthropogenic origin[24], originating from the use of synthetic nitrogen fertiliser, soil cultivation, animal breeding (manure management), wastewater treatment, adipic acid and nitric acid production, fossil fuels combustion, waste incineration and biomass combustion. The other 57% of the atmospheric N_2O originates from soil and denitrification of water in anaerobic conditions. N_2O breaks down photochemically in the atmosphere. Global annual N_2O emissions from anthropogenic activities are estimated to account for circa 7.3 Mt[25].

HFCs (hydrofluorocarbons), PFCs (perfluorocarbons) and SF_6 (sulphur hexafluoride) are greenhouse gases of anthropogenic origin. HFCs are predominantly used to replace ozone-depleting chemicals but are also emitted in the HCFC-22 production process. PFCs and SF_6 are emitted in various industrial processes, including the production of aluminium and magnesium, production of semiconductors, transmission and distribution of electricity, etc. All these gases have a long lifetime in the atmosphere and are characterized by a considerable capacity of absorbing infrared radiation, so that in the future they could have a considerable impact on the global warming phenomenon.

1.1.3. Convention, Kyoto Protocol, Paris Agreement and Commitments of Parties

The United Nations Framework Convention on Climate Change (UNFCCC) was adopted on May 9, 1992, at the UN Conference on Environment and Sustainable Development in Rio de Janeiro, being regarded as a response of the international community to the global warming phenomenon caused by air pollution and the increased concentration of greenhouse gases in the atmosphere.

The ultimate objective of the Convention is aimed *'to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system*'. The UNFCCC entered into force on March 21, 1994. To-date, 198 countries are Parties to the Convention. The Republic of Moldova signed the Convention on June 12, 1992, and it was ratified by the Parliament on March 16, 1995.

Article 4, paragraph 1(a) and Article 12, paragraph 1(a) of the UNFCCC stipulate that each Party has to make available to the Conference of the Parties (COP) '*a national inventory of anthropogenic emissions by sources and removals by sinks, of all greenhouse gases uncontrolled by the Montreal Protocol, to the extent its capacities permit, using comparable methodologies to be agreed upon by the Conference of*

[20] <https://library.wmo.int/viewer/68532/download?file=GHG-19_en.pdf&type=pdf&navigator=1>
[21] <https://www.iea.org/news/methane-emissions-remained-stubbornly-high-in-2022-even-as-soaring-energy-prices-made-actions-to-reduce-them-cheaper-than-ever>
[22] <https://www.iea.org/reports/global-methane-tracker-2023/overview>
[23] <https://www.globalmethanepledge.org/sites/default/files/documents/2023-11/UNEP%20CCAC%282022%29GMA%20BASELINE%20EMISSIONS%20REPORT%20-%20FULL.pdf>
[24] <https://www.wmo.int/pages/mediacentre/press_releases/pr_1002_en.html>, <https://library.wmo.int/index.php?lvl=notice_display&id=21795#.YIKYFaFDOUk>.
[25] <https://library.wmo.int/viewer/68532/download?file=GHG-19_en.pdf&type=pdf&navigator=1>.

the Parties; also, a general description of steps taken or envisaged by the Party to implement the Convention; and any other information that the Party considers relevant to the achievement of the objective of the Convention and suitable for inclusion in its Communication, including, if feasible, relevant data for calculations of global anthropogenic emission trends'.

The main mechanism for making this information available is national communications. COP 2 (Geneva, 1996) adopted the Guidelines on national communications for non-Annex I Parties (Decision 10/CP 2). In accordance with the respective Guidelines, from 1998 to 2000, under the UNDP-GEF Project '*Enabling Activities for the preparation of the First National Communication to the UNFCCC*', the Republic of Moldova developed its First National Communication (NC1) to the UNFCCC, submitted to the COP 6 (The Hague, 2000).

The COP 8 (New Delhi, 2002) adopted new Guidelines on National Communications for non-Annex I Parties (Decision 17/CP 8). In conformity with these Guidelines, between 2005-2009, the Republic of Moldova developed its Second National Communication (NC2); between 2010-2014 – the Third National Communication (NC3); between 2014-2018 – the Fourth National Communication (NC4); and between 2019-2023 – the Fifth National Communication (NC5).

With reference to UNFCCC implementation instruments, it should be noted that the COP 3 (Kyoto, 1997) adopted the Kyoto Protocol[26], which represents an instrument setting binding targets for the Parties under the Convention, by committing highly industrialised countries and economies in transition (a total of 37 highly industrialised countries and the European Union) included in Annex I to Convention, to reduce total emissions of direct GHG by at least 5% compared to 1990 levels over the five-year period: January 1, 2008-December 31, 2012 (the first commitment period of the Kyoto Protocol). The Republic of Moldova ratified the Kyoto Protocol on February 13, 2003. As a non-Annex I Party, the Republic of Moldova had no commitments to reduce GHG emissions under the Kyoto Protocol.

According to the Bali Action Plan, adopted at the 13th Conference of Parties to the UNFCCC (2007), developing countries agreed for the first time to develop and implement *National Appropriate Mitigation Actions* in the context of sustainable development, supported by technology transfer, adequate financing and capacity-building actions.

The COP 15 held in Copenhagen in December 2009 approved and proposed for implementation a policy statement adopted in support of limiting global warming to no more than 2°C compared to pre-industrial level, in the context of equity and sustainable development. This statement is known as the *Copenhagen Accord* and it reaffirms development issues in the context of climate change, including through the implementation of Low Emission Development Strategies (LEDS). The Republic of Moldova associated itself to the Copenhagen Accord in January 2010.

Between 2010 and 2012, the Republic of Moldova drafted the LEDS 2020 project, a strategic document that was to allow the country to adjust its development path towards a low carbon economy and to achieve a green sustainable development, based on the socio-economic and development priorities of the country. Likewise, LEDS 2020 was to contribute to achieving global objectives, providing strategic national context for the mitigation efforts, for which countries receive international support for appropriate mitigation actions at national level. LEDS 2020 was developed in accordance with the provisions of 'Climate Change' chapter of the EU Association Agreement.

The LEDS 2020 project contained a set of measures that were set to contribute to the reduction of greenhouse gas emissions, the quantification of the corresponding reduction of emissions for each measure, and the financial requirements for their implementation. The measures proposed in the LEDS 2020 Action Plan included national appropriate mitigation actions (NAMAs), as provided for non-Annex I Parties to the UNFCCC. LEDS 2020 also provided information on implementation procedures and timeframes, as well as provisions on monitoring, measurement, reporting and assessment of the results.

[26] The Kyoto Protocol came into force on February 16, 2005, 90 days after its ratification by the Russian Federation in November 2004, thus covering at least 55 Parties to the Convention, including Annex I countries, which contribute to at least 55% of total carbon dioxide emissions recorded in 1990.

The Strategy was drafted by the MoEnv, the process being guided by the Inter-Ministerial Working Group on Climate Change with support from the UNDP country office. This process involved extensive consultations with all parties, represented by ministries, research institutions, donor organizations, NGOs and civil society. It was anticipated that LEDS 2020 would be approved by the Government by the end of 2013, which did not happen until the end of 2016, and the LEDS implementation period was subsequently extended until the end of 2030[27].

The COP 16, held in Cancun in December 2010, adopted the Cancun Agreements, which encourage developing countries to prepare LEDS for sustainable development and to undertake NAMAs. The Cancun Agreements highlight the fact that '*stopping climate change requires a paradigm shift towards building a low-carbon emissions society, which offers substantial opportunities and ensures continued economic growth and sustainable development*'.

At COP 16, the periodicity of preparing National Communications for non-Annex I countries was also established (Decision 1/CP.16). In line with this, non-Annex I Parties are to prepare and submit *National Communications* to the UNFCCC Secretariat every four years as well as *Biennial Update Reports (BURs)* every two years. The inventory section of the BUR should contain a *National Inventory Report* as a summary or as a technical annex, expected to present in a detailed and transparent manner the procedure for completing the national inventory of anthropogenic GHG emissions by sources or removals of carbon dioxide by sink, including information on emissions trends, key categories, activity data, emission factors, assessment methodologies, quality assurance and quality control, uncertainties, recalculations and planned improvements, for each source or sink category included in the national inventory.

The COP 17 held in Durban in 2011 adopted the *Guidelines on preparing and reporting Biennial Update Reports to the UNFCCC for non-Annex I Parties* (Decision 2/CP.17 and Annex 3 to this Decision). In accordance with the existing capacities at national level and at the level of international support obtained for reporting, non-Annex I Parties had to submit their BUR1 to the UNFCCC Secretariat by the end of December 2014. A BUR should be submitted to the Secretariat every two years as a standalone report or as a summary of the National Communications, should their reporting years coincide.

The Republic of Moldova initiated the process of preparing its BUR1 in July 2014 and managed to submit it to the UNFCCC Secretariat on April 5, 2016. The 1st BUR of the RoM to the UNFCCC was submitted to the UNFCCC Secretariat together with two technical annexes – the National Inventory Report: 1990-2013, Sources of Greenhouse Gas Emissions and Sinks in the Republic of Moldova and the Report on the National Inventory System in the Republic of Moldova.

Regarding the non-Annex I Parties, the COP 17 in Durban approved (Decision 2/CP.17 and Annex IV) the Modalities and Guidelines for International Consultation and Analysis (ICA) consisting of two steps: (i) the Technical Analysis of BURs and (ii) a Facilitative Sharing of Views (FSV) among Parties on the content of BURs and the results of Technical Analysis. The international consultation process aims to enhance transparency and accountability of information reported in BURs by non-Annex I Parties. The technical analysis will be conducted by a Team of Technical Experts (TTE) and will be initiated within six months of the BUR's official submission to the Secretariat.

As for the BUR1 of the RoM to the UNFCCC, its technical analysis by the team of technical experts took place between 19-23 September 2016, with the summary report being published on the UNFCCC Secretariat's web page on February 20, 2017[28]. The FSV among UNFCCC Parties on the content of the BUR1 of the RoM and the results of technical analysis was carried out during the 3rd FSV workshop, organized by the UNFCCC Secretariat on May 15, 2017, in Bonn, Germany[29].

The COP 18 (Doha, 2012) adopted the *Doha Amendment to the Kyoto Protocol* which establishes a second commitment period (January 1, 2013-December 31, 2020) for the Parties included in Annex

[27] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=369528>.
[28] <http://unfccc.int/files/national_reports/non-annex_i_parties/biennial_update_reports/submitted_burs/application/pdf/mda.pdf>.
[29] The conclusions of the 3rd FSV seminar regarding the BUR1 of the RM under the UNFCCC and the results of the technical assessment are available at: <http://unfccc.int/files/national_reports/non-annex_i_parties/ica/facilitative_sharing_of_views/application/pdf/20170529_mda_v04.pdf>; the RM's presentation at the 3rd FSV seminar is available at: <http://unfccc.int/files/national_reports/non-annex_i_parties/ica/facilitative_sharing_of_views/application/pdf/moldova_fsv_workshop_presentation_15.05.2017.pdf>, and the video recording of the presentation and the interventions of the Parties are available at: <https://www.youtube.com/playlist?list=PL-m2oy1bnLzpmdRpG2pTBzUeOH3qrXlZt>

I to the Kyoto Protocol; adds a revised list of greenhouse gases to be reported by Annex I countries in the second commitment period; and a series of amendments to several articles of the Kyoto Protocol which specifically refer to certain issues related to the first commitment period and which were to be revised in order to remain valid during the second commitment period. By December 21, 2012, the UN General Secretary, acting as depositary, presented the Doha Amendment to the Kyoto Protocol to all Parties of the UNFCCC, in accordance with provisions of Articles 20 and 21 of the Protocol. Under the Doha Amendment, within the second commitment period, highly industrialised countries should reduce their greenhouse gas emissions by at least 18% compared to 1990 levels. The Doha Amendment came into effect on December 31, 2020.

At COP 19 (Warsaw, 2013), the Parties agreed to communicate their intended nationally determined contributions (iNDC or NDC 1.0) (Decision 1/CP.19), in order to include them into the new Climate Agreement to be considered and adopted by the COP 21 (Paris, 2015), which is to cover a new commitment period (January 1, 2021-December 31, 2030) with respect to the reduction of GHG emissions. Likewise, the COP 19 in Warsaw adopted *General guidelines for domestic measurement, reporting and verification of domestically supported nationally appropriate mitigation actions by developing country Parties* (Decision 21/CP.19). This document provided a solid foundation for the Paris Agreement.

At COP 20 (Lima, 2014), the Parties agreed over the *Lima Call for Climate Action* and were repeatedly invited to communicate their intended nationally determined contributions to the UNFCCC Secretariat (Decision 1/CP.20) to achieve the objective of the Convention as set out in Article 2. The Parties agreed that in order to facilitate clarity, transparency and understanding, the iNDC (NDC 1.0) may include, as appropriate, inter alia: quantifiable information on the reference point; time frames and/or periods for implementation; scope (including gases and sectors) type of contribution and coverage; planning processes in the context of approving intended nationally determined contributions; key assumptions and methodological approaches including those for estimating and accounting for anthropogenic greenhouse gas emissions and, as appropriate, removals; and information on the country's considerations on how fair and ambitious its intended nationally determined contribution is, considering country specific circumstances; and how the Party considers that its intended nationally determined contribution will facilitate the achievement of the objective of the Convention as set out in Article 2. In accordance with the *Lima Call for Climate Action*, countries were invited to communicate their iNDCs (NDCs 1.0) contributions by March 31, 2015, the deadline for the presentation being September 30, 2015. The UNFCCC Secretariat was asked to prepare a synthesis report on the aggregate effect of the iNDCs (NDCs 1.0) by November 1, 2015.

The Paris Agreement was signed by the Prime Minister of the Republic of Moldova in New York on September 21, 2016, and was subsequently ratified by the Parliament by Law No. 78 of 04.05.2017 for the ratification of the Paris Agreement[30].

On the 25th of September 2015, the Republic of Moldova communicated its intended Nationally Determined Contribution (iNDC or NDC 1.0)[31] and the accompanying information to facilitate clarity, transparency, and understanding, with reference to decisions 1/CP.19 and 1/CP.20, according to which the Republic of Moldova intends to achieve the unconditional target of reducing its greenhouse gas emissions by 64% compared to 1990 levels by 2030, and will make great efforts to reduce its GHG emissions by 67% compared to 1990 levels. The respective reduction commitment expressed above could be increased conditionally up to 78%, in accordance with this global agreement which addresses important topics including low-cost financial resources, technology transfer, and technical cooperation, the access depending on the challenges of global climate change. GHG emissions reduction targets have been set in an emissions budget which covers the period from January 1, 2021, to December 31, 2030. The GHG emission reduction targets, set out in the NDC 1.0 of the RoM, were subsequently officially approved at national level by Government Decision No. 1470 of 30.12.2016 on the approval of the Low Emissions Development Strategy of the Republic of Moldova by 2030 and the Action Plan for its implementation[32].

[30] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=370323>
[31] <http://www4.unfccc.int/submissions/INDC/Published%20Documents/Republic%20of%20Moldova/1/INDC_Republic_of_Moldova_25.09.2015.pdf>
[32] <https://www.legis.md/cautare/getResults?doc_id=114408&lang=ro>

On March 4, 2020, the Republic of Moldova submitted the updated version of its national determined contribution (NDC 2.0) to the UNFCCC Secretariat[33], according to which the Republic of Moldova intends to step up with much more ambitious GHG emission reduction targets by 2030. The unconditional target is thereby to increase from 64-67% to 70% compared to the level recorded in the base year (1990), and the conditional target is to increase from 78% to 88% compared to the level recorded in 1990. The new GHG emission reduction targets were introduced into the Low Emissions Development Programme until 2030, approved by Government Decision No. 659 of 06.09.2023[34].

The BUR2 of the RoM to the UNFCCC was submitted to the UNFCCC Secretariat on the December 27, 2018, and sometime later its two technical annexes: National Inventory Report: 1990-2016, Sources of Greenhouse Gas Emissions and Sinks in the Republic of Moldova on January 24, 2019; and the Report on the National Inventory System in the Republic of Moldova – 2018, on February 26, 2019, respectively. The technical assessment of the BUR2 of the RoM to the UNFCCC, conducted by the TTE, took place between May 27-31, 2019, the summary report being published on the UNFCCC Secretariat's web page on October 28, 2019[35]. FSV among UNFCCC Parties on the content of the BUR2 of the RoM and results of technical analysis was carried out during the 9th FSV workshop, held online by the UNFCCC Secretariat between November 24-27, 2020[36].

The BUR3 of the RoM to the UNFCCC was submitted to the UNFCCC Secretariat on December 21, 2021, along with its two technical annexes: National Inventory Report: 1990-2019, Sources of Greenhouse Gas Emissions and Sinks in the Republic of Moldova, and the Report on the National Inventory System in the Republic of Moldova – 2021[37]. The technical assessment of the BUR3 of the RoM to the UNFCCC, conducted by a team of technical experts, took place between June 20-24, 2022, the Summary Report being published on the UNFCCC Secretariat's web page on November 8, 2022[38]. FSV among UNFCCC Parties on the content of the BUR3 of the RoM and results of technical analysis was carried out during the 14th FSV workshop, held by the UNFCCC Secretariat between June 6-7, 2023, in Bonn, Germany[39].

1.1.4. The Republic of Moldova's Relative Contribution to Global Warming

The Republic of Moldova's historic contribution to global warming is low. In 2022, the country generated only circa 0.022% of total global emissions[40]. CO_2 emissions of fossil origin per capita in 2022 in the Republic of Moldova were twice lower than the global average (2.17 t CO_2 per capita compared to 4.84 t CO_2 per capita)[41]. Likewise, the Republic of Moldova has a low level of historical cumulative CO_2 emissions recorded since 1750, below 0.076% of global cumulative CO_2 emissions[42].

1.2. Description of National Circumstances and Institutional Arrangements

1.2.1. National Competent Authority

The Ministry of Environment (MoEnv) is the state authority responsible for the development and promotion of policies and strategies addressing environment protection, natural resources, climate change.

On behalf of the Government of the Republic of Moldova, the MoEnv oversees the implementation of international environment treaties to which the RoM is a Party (including the Rio Conventions). The representative of the MoEnv is also the National Focal Point to the UNFCCC[43].

According to Government Decision No. 549 of 13.06.2018 on the creation, organizing and functioning of the Environment Agency[44], which has been assigned the following competencies *in the field of*

[33] <https://www4.unfccc.int/sites/NDCStaging/Pages/All.aspx>
[34] <https://www.legis.md/cautare/getResults?doc_id=139980&lang=ro>.
[35] <https://unfccc.int/sites/default/files/resource/tasr2_2019_MDA.pdf>, <https://unfccc.int/ICA-cycle2>.
[36] The conclusions to the 9th FSV seminar regarding the BUR2 of the RM to the UNFCCC and the results of the technical assessment are available at: <https://unfccc.int/ICA-cycle2>, including the RM's presentation at the 9th FSV seminar and the video recording of the presentation and interventions of the Parties.
[37] <https://unfccc.int/BURs>.
[38] <https://unfccc.int/sites/default/files/resource/tasr2022_MDA.pdf>, <https://unfccc.int/ICA-cycle3>.
[39] The conclusions to the 14th FSV seminar regarding the BUR3 of the RM to the UNFCCC and the results of the technical assessment are available at: <https://unfccc.int/ICA-cycle3>, including the RM's presentation at the 14th FSV seminar and the video recording of the presentation and interventions of the Parties.
[40] GHG emissions for all countries. 2023 Report. <https://edgar.jrc.ec.europa.eu/report_2023>
[41] GHG emissions for all countries. 2023 Report. <https://edgar.jrc.ec.europa.eu/report_2023>
[42] Our World in Data. CO2 and Greenhouse Gas Emissions database. By: Hannah Ritchie, Pablo Rosado and Max Roser. <https://ourworldindata.org/co2-emissions>.
[43] <https://unfccc.int/process/parties-non-party-stakeholders/parties/national-focal-point>
[44] <https://www.legis.md/cautare/getResults?doc_id=119162&lang=ro>

atmospheric air protection and climate change: the implementation of provisions and policy documents and international environmental treaties to which the RoM is a party regarding the quality and protection of atmospheric air and ozone layer; *GHG emissions reduction and adaptation to climate change*: the preparation and submission of information on their implementation to the MoEnv; participation within the *National Commission for Climate Change*; ensuring the implementation of *the monitoring, reporting and verification system for GHG emissions*; *collecting, centralizing, validating and processing data and required information for inventories and reports on atmospheric pollutants and GHG emissions*; providing technical support to the MoEnv for the development of *national communications and biennial update reports* according to UNFCCC provisions.

At the same time, in accordance with Government Decision no. 1277 of 26.12.2018 on the establishment and operation of the National Monitoring and Reporting System (NMRS) on greenhouse gas emissions and other information relevant to climate change, the Environment Agency has been designated as the competent authority responsible for ensuring the operation of the NMRS on greenhouse gas emissions and other information relevant to climate change, providing that the operation of the NMRS is carried out at the expense and within the resources approved in the state budget of the institutions that are parties to the system, as well as other sources provided by law, including from external financing (*activities carried out on the basis of technical assistance and capacity building projects*).

Between 2019-2023, within the Environment Agency, the Environmental Policy Implementation Department was responsible for ensuring the operation of the NMRS on greenhouse gas emissions and other information relevant to climate change. Starting from 2024, this responsibility was transferred to the Environmental Quality Monitoring Department.

At the same time, in accordance with Government Decision No. 1249 of 19.12.2018 on the establishment and functioning of the Public Institution 'Environmental Projects National Implementation Office' (P.I. 'EPNIO')[45], which has the task of supporting the MoEnv and organizational units in its area of competence, with the purpose of efficient implementation of financial and technical assistance projects, external and internal, in the field of environmental protection (environmental protection, *climate change*; sustainable use of natural resources), in accordance with the provisions of regulatory documents on implementation of the requirements of international conventions to which the Republic of Moldova is a party and the alignment with international standards in the field of environmental protection, whereas the main tasks of the P.I. 'EPNIO' are: efficient implementation of projects in its competency area in accordance with established objectives; supervision and quality control of provided services, submission of work and provision of goods within established deadlines; management of financial resources allocated to projects in its competency areas, in accordance with the assistance agreements and the approved budget; administration of the National Environmental Fund; drafting project proposals in the fields of competence, coordinated at each stage with the MoEnv; preparing and presenting progress reports in the implementation of projects and the use of financial means intended for projects.

The management body of the P.I. 'EPNIO' includes the Director of the institution (executive body) and, respectively, a Supervisory Committee – a high-level collegial body who leads and supervises the activity of the institution. The committee consists of 5 members, appointed for a 4-year term. The nominal composition of the Committee members is established by Order of the Minister of Environment, with mandatory inclusion of at least one representative each from the Ministry of Finance, Environment Agency, academia, and civil society. The position of Chairperson of the Committee is exercised by the Minister of Environment, who chairs the meetings of the Committee and exercises other established duties. In the absence of the Chairperson of the Committee, the meeting shall be chaired by one of the members, elected by the members attending the meeting.

The NMRS on greenhouse gas emissions and other information relevant to climate change to the UNFCCC, approved by GD No. 1277 of 26.12.2018, includes, as integral parts, two subsystems:

[45] <https://www.legis.md/cautare/getResults?doc_id=113696&lang=ro>.

1. The national inventory system, which provides the institutional, legal and procedural framework established for estimating anthropogenic emissions by sources and removals by sinks by all greenhouse gases compiled in the national GHG emission inventory, and for reporting and archiving information regarding the inventory, in accordance with decisions taken under the UNFCCC and the Paris Agreement.
2. The national system for policies, measures, and projections, which provides the institutional, legal, and procedural framework for assessing progress in implementing climate change mitigation policies, for making projections of anthropogenic emissions by sources or removals of greenhouse gas emissions by sinks.

The implementation of the NMRS ensures the appropriate collection, processing of data and information which are necessary for: (1) the development and reporting of the national inventory; (2) the development and reporting of projections of anthropogenic emissions by sources or removals by sinks of greenhouse gases; (3) evaluating and reporting the progress made in achieving the objectives of the national contribution determined in the Paris Agreement and any updates thereof; progress made in the implementation of the long-term low-carbon development strategy (LT-LEDS) and any updates thereof; climate change vulnerabilities, climate change impacts and progress in implementing adaptation actions; the aggregated financial and technological support, received from industrially developed countries, mentioned in Annex I to the UNFCCC, respectively offered to developing countries, which are not included in this annex, for the implementation of climate change mitigation and adaptation actions, of technical assistance and capacity building projects in the field of climate change; primary improvement measures regarding the implementation of reporting requirements.

In the context of GD No. 1277 of 26.12.2018, the NMRS aims to ensure transparent, accurate, consistent and comprehensive monitoring and reporting on greenhouse gases to the UNFCCC Secretariat, using planned reporting tools, including actions taken to adapt to the consequences of climate change, respectively, to ensure evaluation, reporting and verification of information on national progress in meeting the commitments under the UNFCCC, the Paris Agreement and the decisions taken under them.

Regarding the National Inventory System (NIS), it is designed and managed to ensure adherence to transparency, consistency, comparability, completeness principles in the preparation of the national inventory of greenhouse gas emissions, in accordance with the provisions of the 2006 IPCC Guidelines on development of national greenhouse gas inventories.

The Environment Agency, as competent authority, in direct collaboration with responsible authorities and institutions that are part of the NMRS and with the support of the Central Authority for the sustainable management of natural resources, environment protection and climate change (MoEnv), ensures the organization and operation of the NIS, by periodically improving the institutional, legal, and procedural framework, in accordance with the national and international legal framework.

Within the NIS, the competent authority shall develop the national greenhouse gas emissions inventory every two years (starting from 2025 – annually). The data of the national inventory are presented according to the format set out in Table 1 of Annex 1 to GD no. 1277 of 26.12.2018. In the case of direct GHG emissions, the national inventory is compiled in accordance with the 2006 IPCC Guidelines, using the reporting software recommended by the IPCC and the UNFCCC, while in the case of indirect GHG emissions, the national inventory is compiled in accordance with the updated editions of the EEA/EMEP Air Pollutant Emission Inventory Guidebook, the technical guideline for inventory of national emissions, published and regularly updated by the European Environment Agency under the European Monitoring and Assessment Program.

Based on the National Inventory of Greenhouse Gas Emissions, the competent authority shall be responsible for compiling the National Inventory Report (NIR) every two years (starting from 2025 – annually) using the structure set out in the relevant decisions of the Conferences of Parties signatories to the UNFCCC, namely: (1) 'Executive Summary'; (2) 'National Circumstances, Institutional

Arrangements and Cross-Cutting Information'; (3) Trends in GHG emissions; (4) 'Energy' Sector; (5) 'Industrial Processes and Product Use' Sector; (6) 'Agriculture' Sector; (7) 'LULUCF' Sector; (8) 'Waste' Sector; (9) 'Recalculations and Planned Improvements'; (10) 'References'; and (11) 'Annexes'.

The competent authority publishes the National Inventory Report (NIR) on its official website (<http://am.gov.md/>) every two years (starting from 2025 – annually), as well as the national inventory of greenhouse gas emissions in CRF table format. The CRF tables, approved by the decisions adopted within the Conferences of the Parties to the UNFCCC and the Conferences of the Parties to the Paris Agreement, will present trends in greenhouse gas emissions by gas type and sectoral activity.

The competent authority ensures the quality of national inventories by covering the planning, preparation, and management stages, which include collection of activity data, appropriate selection of estimation methods and emission factors, estimation of anthropogenic greenhouse gas emissions, implementation of uncertainty analysis, activities for quality assurance and quality control, as well as data verification procedures included in the national inventory.

At the *planning* stage for the national inventory, the following activities are to be performed:

1. allocation of financial resources necessary for the development of the national inventory, establishing the responsibilities of the personnel involved in the preparation of the national inventory, including for the collection of activity data, selection of emission factors and estimation methods, implementation of quality assurance and quality control measures, key category analysis, uncertainty analysis, recalculations and planned improvements, for each source or sink category included in the national inventory;
2. development, update and periodical approval of the QA/QC plan which describes specific QA procedures to be implemented during the inventory development process, and the description of the overall and specific QC procedures to be implemented when developing the national inventory and establish quality objectives;
3. analysis of ways to improve the quality of activity data, emission factors, estimation methods and other relevant technical elements of the national inventory of anthropogenic greenhouse gas emissions;
4. publication on the official website of the competent authority the postal and electronic addresses, including the one at which the information contained in the national inventory is made available;
5. establishment of procedures regarding the process of examining and approving the national inventory, prior to its submission to the UNFCCC Secretariat and to the Energy Community (EnC) Secretariat.

At the *preparation* stage of the national inventory, the following activities are to be performed:

1. identification of key categories by following the methods described in the 2006 IPCC Guidelines;
2. collection of activity data and emission factors and processing information, so as to ensure the application of selected methods for estimating the level of greenhouse gas emissions;
3. estimation of anthropogenic emissions from sources and removals by sinks of all greenhouse gases in accordance with the default calculation methods (Tier 1) set out in the 2006 IPCC Guidelines, applying higher ranking calculation methods (Tier 2 or 3) to key categories;
4. quantitative estimation of the uncertainty of the inventory as a whole and for each category separately according to the 2006 IPCC Guidelines;
5. recalculation, if necessary, of estimates of the level of anthropogenic emissions from sources and removals by sinks of greenhouse gases in accordance with the 2006 IPCC Guidelines;
6. compilation of the national inventory in accordance with the decisions adopted under the UNFCCC and the Paris Agreement;
7. implementation of general QC procedures (tier 1) in accordance with the approved QA/QC Plan following the 2006 IPCC Guidelines;

8. application of specific QC procedures (tier 2) in accordance with the approved QA/QC Plan, both for key categories and categories in which methodological revisions occurred, as well as for activity data and emission factors in accordance with the 2006 IPCC Guidelines;
9. evaluation of the inventory by an independent third party, or a TTE representative who is not involved in its preparation before submission to the central authority for the sustainable management of natural resources, environment protection and climate change;
10. an extensive review of the inventory for key categories, as well as for categories in which the methodological approaches and/or activity data and/or emission factors were revised;
11. re-evaluation of the inventory planning process in order to meet the established quality objectives established in the QA/QC Plan, taking into account recommendations from the actions laid down above in pt. 9) and 10), and of the results of periodic internal assessments of the national inventory preparation process.

At the *management* stage of the national inventory, the following activities are to be performed

1. periodically archive and store the national inventory and the information which was the basis of its development, including:
   - all disaggregated emission factors, activity data, and documentation about how these factors and data have been generated and aggregated for the preparation of the inventory;
   - internal documentation on QA/QC procedures;
   - documentation on external and internal reviews, identification of annual key categories and planned inventory improvements;
2. provide the teams of technical of experts (TTE) responsible for the assessment process and international analysis with access to the information utilised in the development of the national inventory, as well as with information on the NSMR;
3. respond to clarification requests as soon as possible, during the assessment process and international analysis, from the team of technical experts regarding the information in the national inventory, in accordance with the UNFCCC provisions and decisions under the Paris Agreement.

The competent authority shall communicate to the central authority for natural resources and environment (MoEnv) the following information by 15 December of the year in which the report is made (year X):

1. the level of anthropogenic emissions of direct greenhouse gases – carbon dioxide [CO_2], methane [CH_4], nitrous oxide [N_2O], hydrofluorocarbons [HFCs], perfluorocarbons [PFCs], sulphur hexafluoride [SF_6], nitrogen trifluoride [NF_3] – recorded 2 years prior to the year in which the reporting is made (year X-2);
2. the level of anthropogenic emissions of indirect greenhouse gases – carbon monoxide [CO], nitrogen oxides [NO_x], non-methane volatile organic compounds [NMVOC] and sulphur dioxide [SO_2] – recorded 2 years prior to the year in which the reporting is made (year X-2);
3. accounting of emissions and removals from land use, land-use change and forestry sector, recorded two years prior to the year in which the reporting is made (year X-2);
4. any recalculations and/or amendments to the information provided for in pt. 1)-3), covering the period between the base year (1990) and 3 years prior to the year in which the reporting is made (year X-3);
5. information regarding relevant inventory indicators, recorded 2 years prior to the year in which the reporting is made (year X-2);
6. information on QA/QC plan, a general assessment of uncertainty and as well as any other relevant elements comprised in the National Inventory Report;
7. information regarding the assessment of completeness of the national inventory, specifying in particular: the categories that were reported as not estimated (marked 'NE'), and the geographical coverage of the national inventory of anthropogenic greenhouse gas emissions, respectively;

8. the information on the results of the checks in text form, specifying the level of detail, the compared datasets and reports, the results of the checks and explanations for the main inconsistencies, as well as the reasons why the checks were considered not relevant, if they had not been carried out;
9. the information on the results of the checks in text form, specifying the differences between the reference approach calculated based on data included in the national inventory of anthropogenic greenhouse gas emissions and the reference approach calculated based on national statistics in the field of energy; for differences greater than ±2% of the national total apparent consumption of fossil fuels at the aggregate level for all categories of fossil fuels for the year X-2, explanations and quantitative information are to be presented;
10. the measures taken to improve inventory estimates, especially in inventory areas that have been the subject of changes or recommendations following external technical assessments, covering both the issues raised for the first time in the latest external technical assessment report, as well as those taken from previous external technical assessment reports;
11. the real or estimated allocation of emissions reported by operators of stationary installations under Law no. 227/2022 regarding industrial emissions to the source categories from the national greenhouse gas inventory and the ratio between these verified emissions and the total greenhouse gas emissions reported within the respective source categories, for year X-2; should it be relevant, the results of the checks carried out regarding the consistency of the emissions reported in the national greenhouse gas inventory, for year X-2, with the verified emissions reported;
12. a description of the changes to the national inventory system, should there be any.

The central authority for natural resources and environment (MoEnv) shall submit to the UNFCCC Secretariat, based on data provided by the competent authority, prior to 31 December of the year in which the reporting is made (year X), the complete greenhouse gases national inventory for the period starting with base year (1990) and ending with year X-2.

The competent authority shall make the information on greenhouse gas emissions available to the public, in accordance with the provisions of GD No. 1277 of 26.12.2018 on the establishment and operation of the National Monitoring and Reporting System on greenhouse gas emissions and other information relevant to climate change.

1.2.2. Institutional Arrangements

The list of competent authorities and institutions which are part of the NMRS on greenhouse gas emissions, as well as other information relevant to climate change in accordance with Annex No. 2 to GD No. 1277 of 26.12.2018, comprises:

1. Specialized central public authorities:
   1) Ministry of Environment;
   2) Ministry of Agriculture and Food industry;
   3) Ministry of Economic Development and Digitalisation;
   4) Ministry of Infrastructure and Regional Development;
   5) Ministry of Finance;
   6) Ministry of Health;
   7) Ministry of Defence;
   8) Ministry of Foreign Affairs and European Integration;
   9) Ministry of Education and Research;
   10) Ministry of Energy.
2. Public authorities subordinated to ministries:
   1) Environment Agency;
   2) National Agency for Regulation of Nuclear and Radiological Activities;

3) Environmental Protection Inspectorate;

4) Public Institution 'Environmental Projects National Implementation Office';

5) Civil Aviation Authority;

6) Naval Agency of the Republic of Moldova;

7) Customs Service;

8) Agency for Energy Efficiency (reorganized in December 2023 into the National Centre for Sustainable Energy);

9) National Agency for Public Health;

10) 'Moldsilva' Agency;

11) State Hydrometeorological Service;

12) 'Waters of Moldova' Agency.

3. Central public authorities:

   1) National Bureau of Statistics;

   2) Agency for Land Relations and Cadastre;

   3) Agency for Medicines and Medical Devices;

   4) Public Services Agency;

   5) National Agency for Food Safety.

4. State-owned enterprises (SOE) and joint stock companies (JSC) subordinated to specialized public authorities and companies with shares of state-owned capital:

   1) SOE 'State Road Administration';

   2) SOE 'Ungheni River Harbour';

   3) SOE 'Molovata Ferry';

   4) SOE 'Forestry Research and Management Institute';

   5) SOE 'Moldova Railways';

   6) SOE 'Chisinau Glass Factory';

   7) SOE 'Moldelectrica', Chisinau;

   8) JSC 'RED-Nord', Balti;

   9) JSC 'TERMOELECTRICA', Chisinau;

   10) JSC 'CHP-North', Balti;

   11) JSC 'Moldovagaz'.

As competent authority responsible for the operation of the National Monitoring and Reporting System on greenhouse gas emissions and other information relevant to climate change, the Environment Agency, under Letter No. 3471 of 25.09.2019 to the P.I. 'EPNIO', requested the examination and identification of the possibility of providing the necessary support for carrying out responsibilities in the field of climate change by organizing the entire process of developing the Republic of Moldova's Reports to the UNFCCC, in accordance with the rules, procedures and decisions of the Conference of the Parties to the UNFCCC. For this purpose, P.I 'EPNIO' has been given the authority to:

- to request and receive, directly or through the Environment Agency, information from central public authorities, local public authorities, organizations and institutions, economic operators working in fields holding primary information needed to complete these two national reports;
- to collect, process and validate the data and information necessary for the preparation of national inventories and reports on greenhouse gas emissions;
- to train specialists from the Environment Agency to work with collected data and information in order to develop their capacities in targeted fields.

The 'Climate Change' Office, previously within the MoEnv (February 2004 - December 2018), and more recently also within the P.I. 'EPNIO' (January 2019 - July 2020), was responsible for activities associated with the preparation of NCs, BURs, NIRs and national inventories of GHG emissions. Starting with the second half of 2020, within the P.I. 'EPNIO', the national GHG inventory team is responsible for assessing emissions by source category and removals by sink category, analysing of key emission sources, activities for verification and control of the inventory quality, uncertainty assessment, documentation and archiving of information associated with the process of preparing the national inventory of GHG emissions, the development of NCs, BURs and NIRs.

Figure 1-1 schematically defines the institutional arrangements for the NMRS of the RoM.

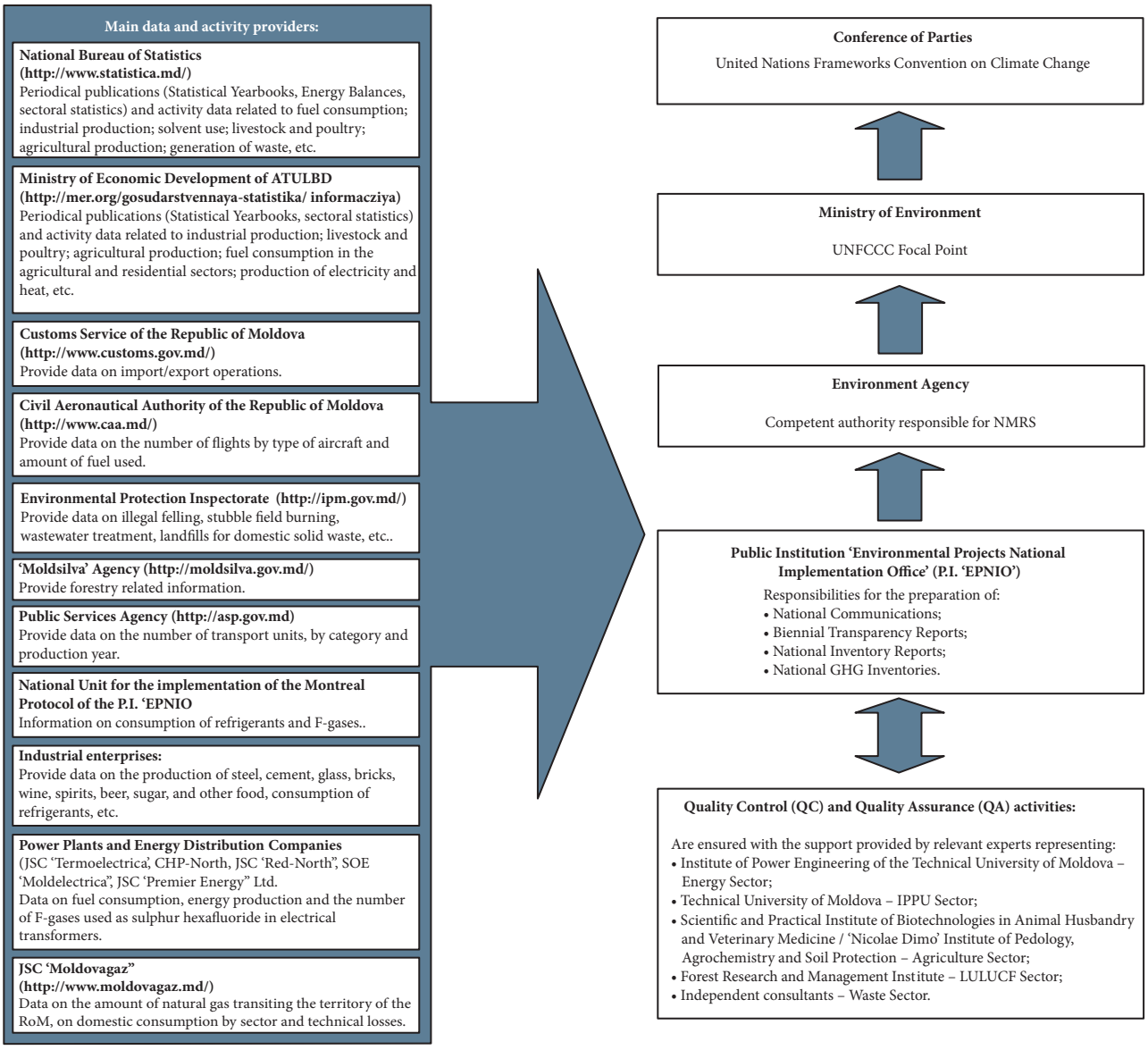


Figure 1-1: Institutional arrangements for the NMRS of the Republic of Moldova.

The functional responsibilities of the participants in the process are briefly described as follows:

- The Coordinator of the National GHG Inventory is responsible for the coordination of the inventory preparation process, supervising the estimation of emissions by individual source categories and removals by individual sink categories, key category analysis, uncertainty analysis interpretation, coordinating QA/QC activities, archiving the data used in the inventory preparation process, synthesis of sectoral reports – which serve as basis for compiling the NIR, and 'GHG National Inventory' chapters in Biennial Transparency Reports and National Communications, respectively;
- The national experts are responsible for the process of estimating emissions by individual source categories and removals by individual sink categories at sectoral level (Sector 1 'Energy', Sector

2 'Industrial Processes and Product Use', Sector 3 'Agriculture', Sector 4 'LULUCF' and Sector 5 'Waste'); national experts are responsible for the preparation of sectoral chapters in the National Inventory Report; likewise, they are responsible for activity data (AD) collection, application of decision trees in terms of selecting suitable estimation methods and EFs, estimating emission uncertainties by individual source category, as well as for taking correction measures as a response to QA/QC activities.

The activity data necessary for the compilation of the national inventory are available in the Statistical Yearbooks, Energy Balances, sectoral-statistical publications, as well as in the 'Statbank' database[46], managed by the National Bureau of Statistics (NBS) of the Republic of Moldova.

For the period until 1992, the information is available for the whole territory of the Republic of Moldova, and only for the right bank of the Dniester River, without Transnistria, since 1993 (further referred to as Administrative Territorial Units on the Left Bank of the Dniester).

The statistical data for the left bank of the Dniester are available in the Statistical Yearbooks of ATULBD[47], and in other relevant sectoral-statistical publications available on the web page of the Ministry of Economic Development of ATULBD[48].

Additional statistical information can be obtained upon request from several partner institutions, with the status of data providers, in accordance with provisions of GD No. 1277 of 26.12.2018 on the establishment and operation of the NMRS, including:

- from the Ministry of Health and the Agency for Medicines and Medical Devices: data on the use of pressurized aerosols with HFCs as a propellant;
- from the Ministry of Defence: information on the amount of fuel used for military transportation;
- from the Customs Service: statistics on the import/export operations in the RoM;
- from the Public Services Agency: information on the number of transport units registered, by category and production year;
- from the Naval Agency and SOE 'Ungheni Harbor' and SOE 'Molovata Ferry': information on the amount of fuel used to ensure the operation of naval transportation;
- from the Civil Aviation Authority: information on the amount of fuel used in air transportation (civil and international aviation) and the number of flights by type of aircraft;
- from the Agency for Land Relations and Cadastre: information on land-use by category of use;
- from 'Moldsilva' Agency: information on forestry related statistics;
- from the Environmental Protection Inspectorate: information on illegal felling and stubble field burning;
- from the National Unit for the implementation of the Montreal Protocol of P.I. 'EPNIO': data on import and use of refrigerants in refrigeration and air conditioning equipment;
- from the SOE 'Moldova Railways': data on the amount of fuel consumed for the provision of railway transportation services, as well as on the rolling stock used at the enterprise;
- from the SOE 'State Road Administration': data on the amount of road asphalt produced and used in the Republic of Moldova;
- from JSC 'Moldovagaz': information on the amount of natural gas transited on the territory of the RoM, on the consumption of natural gas in the national economy at sectoral level, as well as on technical losses;
- from Power Plants (JSC 'TERMOELECTRICA' and CHP-North): information on the production of electricity and heat as well as on the amount of fuel consumption;

[46] National Bureau of Statistics of the RM, on-line database: <https://statistica.gov.md/ro/banca-de-date-statistice-78.html>
[47] The P.I. 'EPNIO' has copies of the Statistical Yearbooks of ATULBD for the years 2000-2020, covering activity data for 1990 and the period 1995-2020.
[48] Ministry of Economy of ATULBD: <http://mer.gospmr.org/gosudarstvennaya-sluzhba-statistiki/informacziya.html>.

- from enterprises specialized in the transportation and distribution of electricity (SOE 'Moldelectrica', JSC 'Premier Energy', JSC 'RED-Nord'): data on the amount of PFCs and SF_6 used in electrical transformers;
- from industrial enterprises (JSC 'Lafarge Ciment Moldova', JSC 'Macon', SOE 'Chisinau Glass Factory', JSC 'Vetropack Chisinau', etc.): information on the amount of fuel used, industrial output and on the number of mineral resources used.

1.2.3. Inventory Preparation Process

The P.I. 'EPNIO' applies a centralised approach in the process of preparing the national inventory, which consists of the National Inventory Report (NIR) and Common Reporting Tables (Annex 6). The process of preparing the national inventory is presented schematically in Figure 1-2.

The Coordinator of the National GHG Inventory is responsible for compiling the assessments and ensuring consistency and quality of the inventory by producing the NIR and Chapters 2 'National Inventory of GHGs' from the BTRs and NCs. Estimation of emissions by individual source categories and removals by individual sink categories is the responsibility of national experts who are more familiar with individual features of source/sink categories.

The national experts, under direct guidance of the Coordinator of the National GHG Inventory, decide, by applying decision trees, on employing the best estimation methodology, and collect AD necessary for the assessment.

For most source and sink categories, methodologies used in the previous inventory cycle are applied. The collection of new AD is required for a more recent period under review or for the entire period under review if historical AD were amended or recalculated.

Should an estimation for a new source/sink category be made, or a higher tier methodology be used, the Coordinator, together with the national experts, decide which estimation methodology would be applicable, collect most reasonable AD and EFs, calculate GHG emissions, assess uncertainties, ensure verification procedures, QA/QC procedures, including by technical review of the results obtained by relevant independent experts, who work for research and academic institutions, ministries and subordinated institutions, central administrative authorities and/or the private sector.

National experts produce explanatory texts for the research on estimation of emissions by individual source categories and removals by individual sink categories, as well as annexes to these, likewise, indicating the bibliography used.

The Coordinator of the National GHG Inventory is responsible for collecting and reviewing these materials, to draft the NIR's sectoral chapters (Chapter 3 'Energy', Chapter 4 'Industrial Processes and Product Use', Chapter 5 'Agriculture', Chapter 6 'LULUCF', Chapter 7 'Waste').

The Coordinator of the National GHG Inventory is also responsible for drafting other chapters of the National inventory Report (Executive Summary, Chapter 1 'National Circumstances, Institutional Arrangements and Cross-Cutting Information', Chapter 2 'Trends in National GHG Emissions', Chapter 8 'Recalculations and Planned Improvements', 'References' and 'Annexes'), as well as for verifying the correctness of key category analysis, in accordance with the 2006 IPCC Guidelines.

The NIR is produced in compliance with the general structure established in Decision 5/CMA.3. In addition, the Common Reporting Tables are compiled (see Annex 6).

The Coordinator of the National GHG Inventory has to monitor the compilation of CRT Tables, to ensure consistency of results. National experts perform uncertainty assessment, as well as verification and QA/QC activities, under the guidance of the Coordinator of the National GHG Inventory.

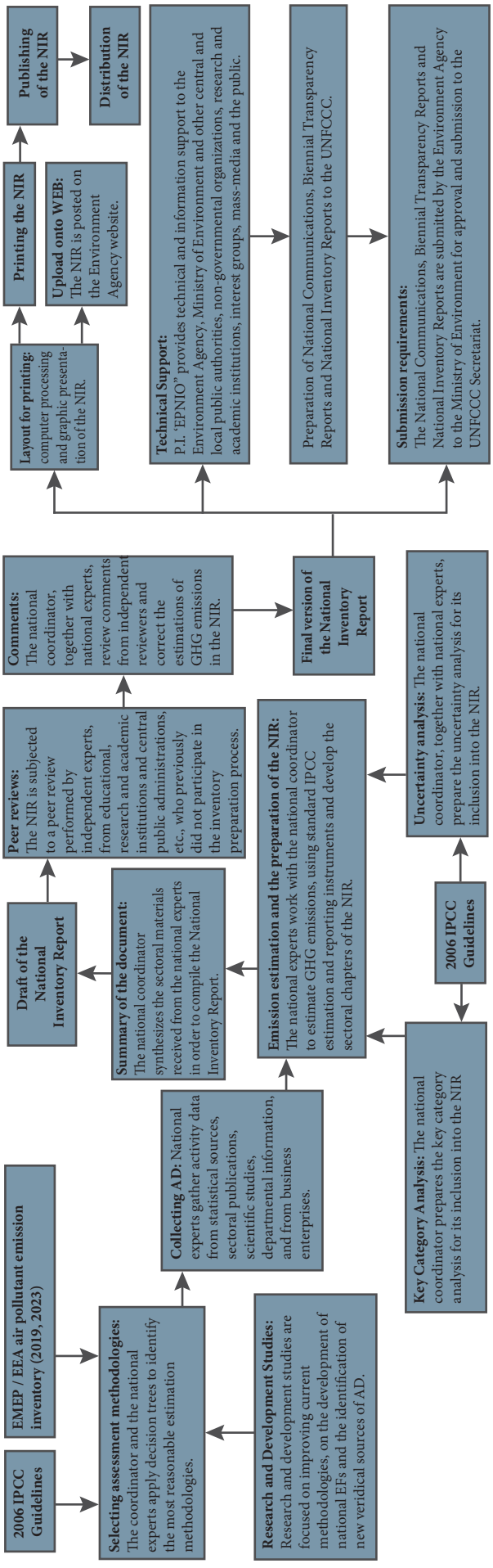


Figure 1-2: Inventory process in the Republic of Moldova.

The first *QA/QC Plan* was produced in 2006 within the UNDP-GEF Regional Project '*Capacity Building for Improving the Quality of the National GHG Inventories (Central Europe and CIS countries)*' and complied under the 2006 IPCC Guidelines. Subsequently, it was periodically updated during the national GHG inventory processes.

During the peer reviews, the draft version of the NIR is sent to a group of independent experts (on condition they did not participate in the preparation of the National GHG Inventory in the respective inventory cycle). The purpose of the inventory peer reviews is to receive comments on quality of the draft version from relevant experts in the areas of major interest, particularly on the relevance of methodological approaches, EFs and AD used. The received comments are reviewed and, should it be necessary, estimations are corrected based on explanatory notes.

1.2.4. Formal Consideration and Approval

After considering comments and proposals for improvement or revision received as a result of the technical review process, the national GHG inventory team within the P.I. 'EPNIO' prepares the final version of the NIR, which is then submitted to the Environment Agency for consideration and approval. Subsequently, the NIR together with the BTR and/or NC are submitted by the Environment Agency to the MoEnv for approval, before submitting them to the UNFCCC Secretariat.

1.2.5. Archiving information

The archiving of materials used in the process of developing the national inventory is carried out both in electronic format and in the traditional way (on paper). The national GHG inventory team of the P.I. 'EPNIO' and the staff of Environment Agency owns the documentation used in its compilation.

1.3. Methodologies and Data Sources

The national inventory is structured to match the reporting requirement of the UNFCCC and is divided in five sectors: (1) Energy, (2) Industrial Processes and Product Use, (3) Agriculture, (4) Land Use, Land-Use Change and Forestry, and (5) Waste. Each of these sectors is further subdivided by source categories (Table 1-2).

Table 1-2: Summary of methods and EFs used for the preparation of the national inventory of the Republic of Moldova

Source and Sink Categories	CO_2		CH_4		N_2O		HFC		PFC		SF_6	
	Methods	EF	Methods	EF	Methods	EF	Methods	EF	Methods	EF	Methods	EF
1. Energy												
A. Fuel Combustion	T1	D, CS	T1	D	T1	D						
1. Energy Industries	T1	D, CS	T1	D	T1	D						
2. Manufacturing Industries and Construction	T1	D, CS	T1	D	T1	D						
3. Transport	T1	D, CS	T1	D	T1	D						
4. Other Sectors	T1	D, CS	T1	D	T1	D						
5. Other	T1	D, CS	T1	D	T1	D						
B. Fugitive Emissions from Fuels	T1	D, CS	T1	D	T1	D						
1. Solid Fuels	NO	NO	NO	NO	NO	NO						
2. Oil and Natural Gas	T1	D, CS	T1	D	T1	D						
C. CO_2 Transport and Storage	NO	NO										
2. Industrial Processes and Product Use												
A. Mineral Industry	T2, T1	D, CS	NA	NA	NA	NA						
B. Chemical Industry	NO	NO	NO	NO	NO	NO						
C. Metal Industry	T2	CS, D	NO	NO	NO	NO						
D. Non-Energy Products from Fuels and Solvent Use	T2, T1	D	NA	NA	NO	NO						
E. Electronic Industry	NA	NA	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
F. Product Use as Substitutes for ODS	NA	NA	NA	NA	NA	NA	T2, T1	CS, D	NA	NA	NA	NA
G. Other Product Manufacture and Use	T2, T1	D	NA	NA	T1	D	NA	NA	T1	D	T1	D
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
3. Agriculture												
A. Enteric Fermentation			T2, T1	D, CS	NA	NA						
B. Manure Management			T2, T1	D, CS	T2, T1	D, CS						
C. Rice Cultivation			NO	NO	NA	NA						
D. Agricultural Soils			NA	NA	T1, T3	D, CS						
E. Prescribed Burning of Savannas			NO	NO	NA	NA						
F. Field Burning of Agricultural Residues			IE	IE	IE	IE						
G. Liming	NO	NO	NA	NA	NA	NA						
H. Urea Application	T1	D	NA	NA	NA	NA						
I. Other Carbon-Containing Fertilisers	NO	NO	NA	NA	NA	NA						
J. Other	NO	NO	NO	NO	NO	NO						
4. LULUCF												
A. Forest Land	T3, T2, T1	D, CS	T1	D	T1	D						
B. Cropland	T2, T1	D, CS	T1	D	T1	D						
C. Grassland	T2	CS	NE	NE	NE	NE						
D. Wetlands	T2, T1	D, CS	NE	NE	NE	NE						
E. Settlements	T2, T1	D, CS	NE	NE	T1	D						
F. Other Land	T2, T1	D, CS	NE	NE	NE	NE						
G. Harvested Wood Products	T1	D	NA	NA	NA	NA						
H. Other	NO	NO	NO	NO	NO	NO						
5. Waste												
A. Solid Waste Disposal	NA	NA	T3	D, CS	NA	NA						
B. Biological Treatment of Solid Waste	NA	NA	T1	D	T1	D						
C. Incineration and Open Burning of Waste	T1	D	T1	D	T1	D						
D. Wastewater Treatment and Discharge	NA	NA	T1	D, CS	T1	D						
E. Other	NO	NO	NO	NO	NO	NO						
6. Other	NO	NO	NO	NO	NO	NO						
Memo Items												

Source and Sink Categories	CO_2		CH_4		N_2O		HFC		PFC		SF_6	
	Methods	EF	Methods	EF	Methods	EF	Methods	EF	Methods	EF	Methods	EF
International Bunkers	T2, T1	D, CS	T1	D	T1	D						
Multilateral Operations	NO	NO	NO	NO	NO	NO						
CO_2 Emissions from Biomass	T1	D, CS	IE	IE	IE	IE						
CO_2 Captured and Stored	NO	NO	NA	NA	NA	NA						

Abbreviations: T1 – Tier 1 Method; T2 – Tier 2 Method; C – EMEP/EEA; CS – Country Specific; D – Default; IE – Included Elsewhere; NA – Not Applicable; NE – Not Estimates; NO – Not Occurring.

Emissions of direct (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) (no NF_3 emissions have been recorded in the RoM so far) greenhouse gases were estimated based on methodologies available in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, while indirect emissions (NO_x, CO, NMVOC, and SO_2) were estimated based on methodologies according to the EEA/EMEP Air Pollutant Emission Inventory Guidebook (2019, 2023).

Generally, a GHG inventory can be defined as a '*comprehensive account of anthropogenic sources of emissions and removals by sinks and associated data from source and sink categories within the inventory area over a specified time frame*'.

The inventory may be carried out using a 'top-down', 'bottom-up', or a combination approach. The Republic of Moldova's national inventory is prepared using a 'top-down' approach, providing estimates of GHG emissions at a national level. Ideally, a GHG inventory should be developed by using direct measurements of emissions and removals from individual source categories or sinks in the country, considering the methodological approach 'bottom-up'.

The national GHG inventory team is continuously working to improve accuracy, completeness and transparency of its inventory. Currently, it has not been possible to apply a bottom-up approach, even if for some sectors the emissions assessment is based on known individual sources from a geographical point of view.

To the extent possible, AD used in this report are based on officially published data: national (Statistical Yearbooks of the RoM, and of the Administrative-Territorial Units on the Left Bank of the Dniester River, respectively, Energy Balances, etc.) and international statistical publications (UN FAO on-line database), publications of academic, research and development institutions ('Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection of the State University of Moldova, Institute of Ecology and Geography of the State University of Moldova, Institute of Power Engineering of the Technical University of Moldova, Forest Research and Management Institute of 'Moldsilva' Agency, etc.), AD provided by ministries and subordinate institutions (Ministry of Defence, Ministry of Health), AD provided by administrative authorities subordinated to ministries (Environment Agency, Environmental Protection Inspectorate, Customs Service, 'Moldsilva' Agency, State Hydrometeorological Service), AD from central administrative authorities (National Bureau of Statistics, Agency for Land Relations and Cadastre, Public Services Agency, Naval Agency, Civil Aeronautical Authority, Medicines and Medical Devices Agency, National Food Safety Agency), AD obtained from companies and businesses associations (SOE 'Moldova Railways', JSC 'Moldovagaz', JSC 'Lafarge Cement (Moldova)', JSC 'Macon', SOE 'Chisinau Glass Factory', JSC 'Vetropack Chisinau', etc.).

1.4. Key Category Analysis

According to the 2006 IPCC Guidelines, it is good practice to identify key categories, including to help prioritise efforts to improve the overall quality of the national inventory.

A key category is defined as a 'category which is prioritised within the national inventory system because its estimate has a significant influence on a country's total direct greenhouse gases both in terms of the absolute annual level of emissions, and the trend in emissions over a certain period'.

Table 1-3, respectively Annex 1, presents the results of key category analysis of the National GHG Inventory for the years 1990 and 2022, without LULUCF – using the Tier 1 methodological approach – 20 key categories by level (L) and 20 key categories by trend (T); using the Tier 2 methodological

approach – 18 key categories by level (L) and 16 key categories by trend (T); with LULUCF, using the Tier 1 methodological approach – 27 key categories by level (L) and 23 key categories by trend (T), respectively, using the Tier 2 methodological approach – 22 key categories by level (L) and 18 key categories by trend (T).

Table 1-3: Results of Key Category Analysis of the National Inventory for the years 1990 and 2022, using the Tier 1 and 2 methodological approaches

IPCC Categories	Key Categories	Gas	Without LULUCF				With LULUCF			
			T1		T2		T1		T2	
			L	T	L	T	L	T	L	T
1A1	Energy industries – liquid fuels	CO_2	X	X	X	X	X	X	X	X
1A1	Energy industries – gaseous fuels	CO_2	X	X	X	X	X	X	X	X
1A1	Energy industries – solid fuels	CO_2	X	X	X	X	X	X	X	X
1A2	Manufacturing industries and construction	CO_2	X	X	X	X	X	X	X	X
1A3b	Road transportation	CO_2	X	X	X	X	X	X	X	X
1A3c	Railways	CO_2	X	X			X	X		
1A4	Other sectors	CO_2	X	X	X		X	X	X	
1A4	Other sectors	CH_4	X	X	X	X	X	X	X	X
1B2	Fugitive emissions from oil and natural gas	CH_4	X	X	X	X	X		X	
2A1	Cement production	CO_2	X	X			X	X		
2D	Non-energy products from fuels and solvent use	CO_2	X	X		X	X			
2F1	Product uses as substitutes for ODS – refrigeration and air conditioning	HFC	X	X	X	X	X	X	X	X
2F2	Product uses as substitutes for ODS – foam blowing	HFC		X	X	X			X	
3A	Enteric fermentation	CH_4	X	X	X	X	X	X	X	X
3B	Manure management	CH_4	X	X	X	X	X	X		
3B1	Direct N_2O emissions from manure management	N_2O	X		X		X		X	
3B5	Indirect N_2O emissions from manure management	N_2O	X		X		X		X	
3Da	Direct N_2O emissions from managed soils	N_2O	X	X	X	X	X	X	X	X
3Db	Indirect N_2O emissions from managed soils	N_2O	X	X	X	X	X		X	X
4A1	Forest lands remaining forest lands	CO_2					X	X	X	X
4A2	Land converted to forest land	CO_2					X	X	X	X
4B1	Cropland remaining cropland	CO_2					X	X	X	X
4C2	Land converted to grassland	CO_2					X	X	X	X
4D2	Land converted to wetlands	CO_2					X	X		X
4E2	Land converted to settlements	N_2O					X	X		
4F2	Land converted to other land	CO_2					X	X	X	
4G	Harvested wood products	CO_2						X		X
5A	Solid waste disposal	CH_4	X	X	X	X	X	X	X	X
5D	Wastewater treatment and disposal	CH_4	X	X	X	X	X	X	X	X

Abbreviations L – Level Assessment; T – Trend Assessment; T1 – Tier 1; T2 – Tier 2

Key category analysis was performed using the key category calculation tool developed by the US Environmental Protection Agency[49].

Following the recommendations set in the 2006 IPCC Guidelines, the inventory was first disaggregated by source categories which were further used to identify key categories.

Source categories were defined in conformity with the following guidelines:

1. emissions/removals from individual source/sink categories identified according to standard classification, were expressed in CO_2 equivalent units, estimated by using the GWP for a period of 100 years;
2. source/sink categories have been identified for each gas separately, as the methodological approaches used, emission factors and uncertainties vary significantly for different direct greenhouse gases;
3. source and sink categories that use the same emission factors based on common methodological approaches were aggregated before analysis.

[49] US EPA's Key Category Calculation Tool v2.8, <https://www.epa.gov/ghgemissions/toolkit-building-national-ghg-inventory-systems>

Key categories were identified from two perspectives:

1. based on the level contribution of each category in the structure of total national emissions; and
2. based on the trend of the contribution of each category in the structure of total national emissions during the period under review (in order to identify the absolute changes recorded: reductions or increases).

The percentage share to both levels (L) and trends (T) was calculated and sorted from greatest to least. When a Tier 1 methodological approach was used, a 95% cumulative contribution threshold was used in this analysis to define the maximum limit for key category identification; when a Tier 2 methodological approach was used, respectively, (considering AD and EF uncertainties used to estimate GHG emissions for individual source/sink categories), a 90% cumulative contribution threshold was used in this analysis to define the maximum limit for the key category identification.

1.5. Quality Assurance and Quality Control

Following the recommendations in the 2006 IPCC Guidelines, national inventories have to be transparent, well documented, consistent, complete, comparable, assessed for uncertainties, subject to verification and QA/QC.

The 2006 IPCC Guidelines defines the QA/QC terms as follows:

- *Quality Control* (QC) is a system of routine technical activities to measure and control the quality of the inventory as it is being developed. A basic QC system should provide routine and consistent checks to ensure data integrity, correctness, and completeness; identify and address errors and omissions; and document and archive inventory material and record all QC activities.
- *Quality Assurance* (QA) comprises a planned system of review procedures conducted by personnel not directly involved in the inventory compilation and development process.

As a part of continuous efforts to develop a transparent and reliable inventory, the Republic of Moldova developed a '*Quality Assurance and Quality Control Plan*'.

The key attributes of the '*QA/QC Plan*' include detailed specific procedures (Figure 1-3) and standard verification and quality control forms and checklists (see Annex 4), by using Tier 1 (general procedures) and Tier 2 (source-specific procedures) methodological approaches, that serve to standardize the process of implementing quality assurance and quality control activities meant to ensure the quality of the national inventory; peer review carried out by experts not directly involved in the national inventory development process; data quality check including by comparing the sets of data obtained from different sources; inventory planning and coordination at an inter-institutional level; as well as the continuous documentation and archiving of all materials used in the national inventory preparation process.

It is well known that the development of the inventory implies a huge amount of information that has to be gathered, handled and stored. The process sustainability is ensured through a good management and archiving of materials used along the inventory process.

In the RoM, the National Inventory Team has a sufficiently transparent documentation allowing to fully reproduce GHG emissions estimates. A standard system for documenting and archiving numeric and qualitative information, in compliance with the 2006 IPCC Guidelines recommendations was used.

The activity data sources were documented by inserting references to these. Estimation methods and EF sources and their selection justification are documented in the corresponding chapters of the NIR.

Recalculations made are documented and justified both in sectoral Chapters (3-7), as well as in Chapter 8 'Recalculations of GHG Emissions and Planned Improvements' of the NIR.

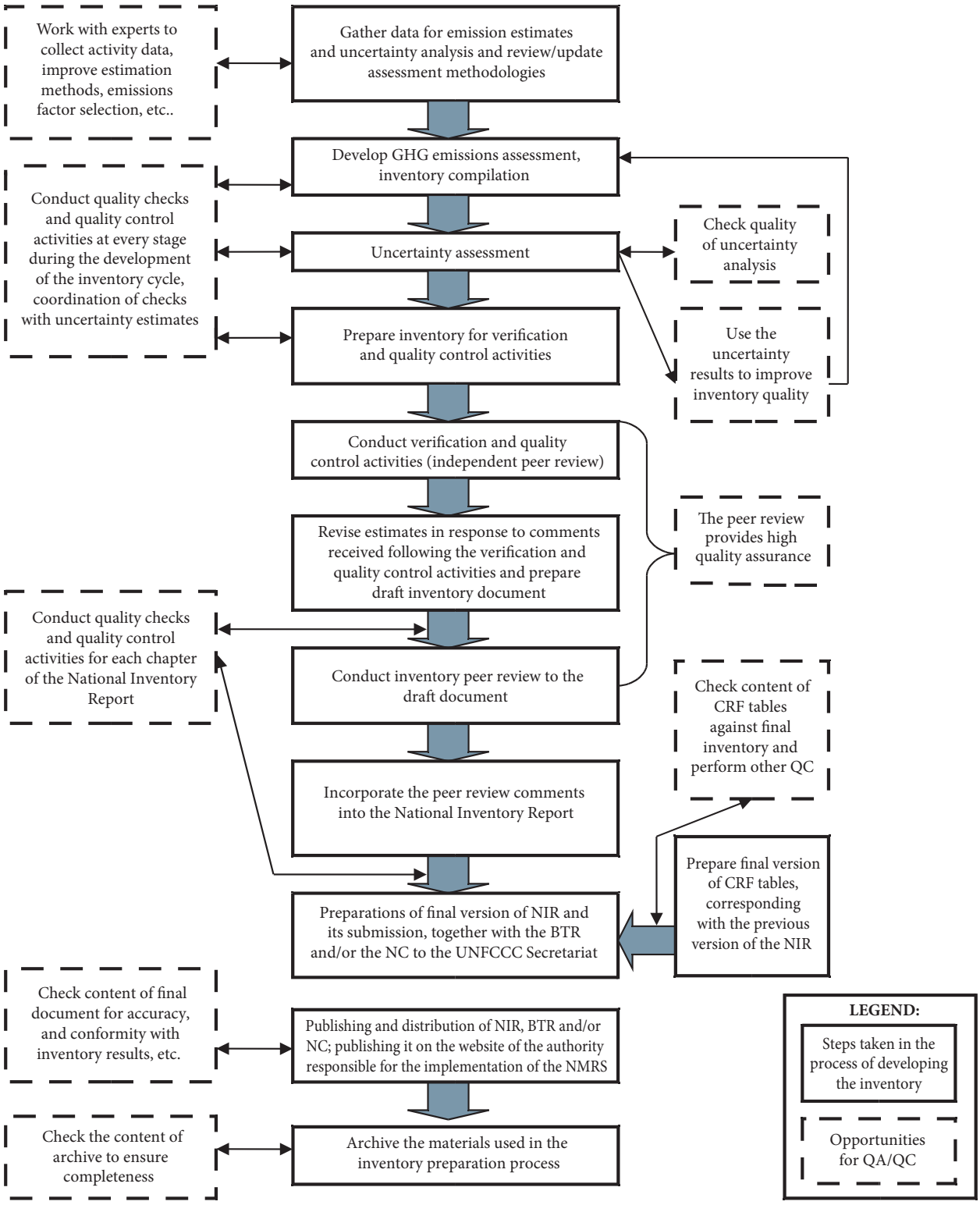


Figure 1-3: The role of QA/QC activities in the national inventory preparing process

Individual source and sink categories related documentation include: (1) list of personnel responsible for estimates and individual responsibilities as per Terms of Reference; (2) reference sources for the activity data used; (3); justification of EF estimation methods selection; (4) samples of GHG emissions estimation process; (5) uncertainty assessment results by individual source categories; (6) annexes; (7) references.

Summing up, we can assert that transparency and credibility of the national inventory are ensured through: (1) the ability to demonstrate, through appropriate documentation, transparency of the inventory development process; (2) further improvements of the inventory process and its basic products; and (3) ensuring that the inventory process employed quantifiable approaches allowing to which led to obtaining comparable results for all source categories.

It is obvious that in comparison with the previous inventory cycles, through continuous integration of QA/QC activities, the RoM ensures a better-quality inventory.

1.6. Uncertainty Assessment

Uncertainty assessment is an essential element of a complete and transparent emissions inventory. Uncertainty information is not intended to challenge the validity of inventory estimates, but to help prioritize efforts to improve the accuracy of future inventories and guide future decisions on choosing the most suitable assessment methodologies.

While the National GHG Inventory Team assessed GHG emissions with the highest possible accuracy, the results obtained have a certain degree of uncertainty.

Some estimates, such as those for CO_2 emissions from fossil fuel combustion or from cement production are considered to have minimal uncertainty associated with them. For other source categories, however, because of relatively low-quality activity data, the use of emission factors used by default or an incomplete understanding of how emissions are generated increases the uncertainty surrounding the estimates presented.

Additional research in the following areas could help reduce uncertainty in the national inventory:

- *Incorporating excluded emission sources.* Quantitative estimates for some of the source and sink categories are not available currently.
- *Improving the accuracy of emission factors.* Further research is needed in some cases to improve the accuracy of emission factors used to calculate emissions from specific sources (for example, the accuracy of current emission factors applied to fugitive CH_4 emissions from oil and natural gas, CO_2 emissions from solvent use and other products, indirect N_2O emissions from manure management, and indirect N_2O emissions from agricultural soils, etc.).
- *Collecting more detailed activity data.* Albeit methodologies for estimating emissions for some sources exist, problems arise in obtaining activity data, particularly the ability to estimate emissions of F-gases within Sector 2 'IPPU'.

The overall inventory uncertainty was estimated using the Tier 1 methodological approach in the 2006 IPCC Guidelines (results are presented in Annex 2, in accordance with the format of Table 3.2, Chapter 3, Vol. I of the 2006 IPCC Guidelines). An estimate of the overall quantitative uncertainty of the inventory is shown in Table 1-4, as well.

Table 1-4: Estimated overall quantitative uncertainty by direct GHG in the national inventory, estimated using the Tier 1 methodological approach

	CO_2	CH_4	N_2O	Total
Level uncertainty	±4.68	±26.33	±22.61	±6.02
Trend uncertainty	±1.45	±9.83	±9.52	±1.89

Emissions estimated in the national GHG inventory currently reflect the best practices available; in some cases, however, estimates are based on approximate assessment methodologies, and incomplete activity data. As soon as new information becomes available in the future, the national GHG inventory team will continue to improve inventory quality, by revising and recalculating GHG emission estimates.

1.7. Inventory completeness

The national GHG inventory is, mostly, a complete inventory of the following direct GHGs – CO_2, CH_4, N_2O, HFC, PFC and SF_6. The national inventory also includes ozone precursors and aerosols such as: CO, NO_x, NMVOC and SO_2. Despite the effort to cover all existent sources and sinks, the inventory still has some gaps, most of which being determined by the lack of activity data required to estimate certain emissions (e.g., HFC emissions from source categories 2F5 'Solvents' and 2F6 'Other uses'). As part of the inventory improvement plan, in the future inventory cycles, the national inventory team will continue their efforts to identify new and relevant data for the GHG emissions/removals assessment from the respective categories.

1.8. Metrics

The radiative forcing effect of a gas in the atmosphere is a reflection of its ability to cause atmospheric heating. We refer to direct radiative forcing when the gas is a GHG and to indirect radiative forcing when the chemical transformation of the original gas produces one or more greenhouse gases, or when a gas influences the atmospheric lifetime of other gases. The concept of 'global warming potential' (GWP) was developed to allow scientists and policymakers to compare the capacity of each GHG to trap heat in the atmosphere. By definition, the Global Warming Potential is the ratio of the time-integrated radiative forcing from a pulse emission of 1 kg of a substance, relative to that of 1 kg of carbon dioxide, over a fixed horizon period. In other words, GWP is a relative measurement of the warming effect that a radiative gas (GHG) can have on the surface of the troposphere. 'Global Warming Potential' considers both the instantaneous radiative forcing due to the cumulative increase in the concentration of greenhouse gases in the atmosphere and the lifetime of these gases in the atmosphere. In this report, the 'GWP' values for a period of 100 years from the Fifth Assessment Report of the Intergovernmental Panel on Climate Change are used (IPCC AR5, 2014) (Table 1-5).

Table 1-5: GWP for a period of 100 years and the atmospheric lifetime of direct greenhouse gases[50]

GHG	Chemical formula	Lifetime, according to AR6	SAR	TAR	AR4	AR5	AR6
Carbon dioxide	CO_2	50-200	1	1	1	1	1
Methane	CH_4	11.8	21	23	25	28	27.9
Nitrous oxide	N_2O	109	310	296	298	265	273
Nitrogen trifluoride	NF_3	569	NA	10800	17200	16100	17400
Sulphur hexafluoride	SF_6	1000	23900	22200	22800	23500	25200
Hydrofluorocarbons (HFC)							
HFC-23	CHF_3	228	11700	12000	14800	12140	14600
HFC-32	CH_2F_3	5.4	650	550	675	677	771
HFC-125	C_2HF_5	30	2800	3400	3500	3170	3740
HFC-134a	$C_2H_2F_2$ (CH_2FCF_3)	14	1300	1300	1430	1300	1526
HFC-143a	$C_2H_3F_3$ (CF_3CH_3)	51	3800	4300	4470	4800	5810
HFC-152a	C_2H4F_2 (CH_3CHF_2)	1.6	140	120	124	138	164
HFC-227ea	CF_3CHFCF_3	36	2900	3500	3220	3350	3600
HFC-236fa	$CF_3CH_2CF_3$	213	6300	9400	9810	8060	8690
HFC-245fa	$CHF_2CH_2CF_3$	7.9	NA	950	1030	858	962
HFC-365mfc	$CH_3CF_2CH_2CF_3$	8.9	NA	890	794	804	914
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	17	1300	1500	1640	1650	1600
Perfluorocarbons (PFC)							
Tetrafluoromethane	CF_4	50000	6500	5700	7390	6630	7380
Hexafluoroethane	C_2F_6	10000	9200	11900	12200	11100	12400
Octafluoropropane	C_3F_8	2600	7000	8600	8830	8900	9290
Perfluorobutane	C_4F_{10}	2600	7000	8600	8860	9200	1000
Perfluoropentane	C_5F_{12}	4100	7500	8900	9160	8550	9220
Perfluorohexane	C_6F_{14}	3100	7400	9000	9300	7910	8620

Sources: SAR – Second Assessment Report of the IPCC (1996), TAR – Third Assessment Report of the IPCC (2001), AR4 – Fourth Assessment Report of the IPCC (2007), AR5 – Fifth Assessment Report of the IPCC (2014) and AR6 – Sixth Assessment Report of the IPCC (2021).

1.9. Applied Flexibilities

In the current inventory cycle, there was no need to apply the flexibility clause.

[50] <http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Annex-6-Additional-Information.pdf>

CHAPTER 2. TRENDS IN GREENHOUSE GAS EMISSIONS AND REMOVALS

2.1. Summary of Direct GHG Emission Trends

Between 1990 and 2022, the evolution of total direct greenhouse gas emissions, expressed in CO_2 equivalent, recorded a decreasing trend in the Republic of Moldova, emissions having decreased by 71.5%: from 45.48 Mt CO_2 equivalent in 1990 to 12.95 Mt CO_2 equivalent in 2022, while the net greenhouse gas emissions having decreased for the same period by 69.5%: from 43.81 Mt CO_2 equivalent in 1990 to 13.37 Mt CO_2 equivalent in 2022 (Figure 2-1).

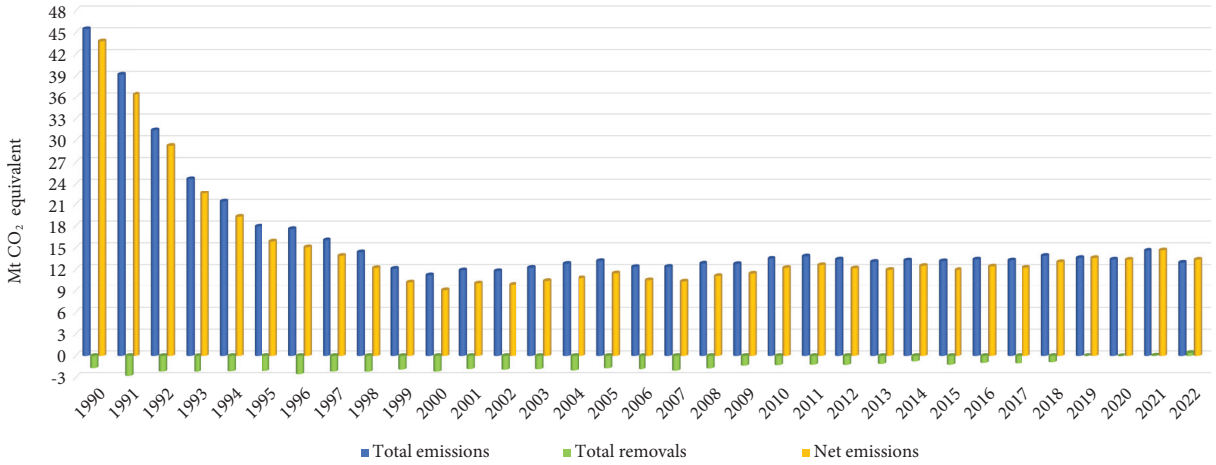


Figure 2-1: Total national direct greenhouse gas emissions, net GHG emissions and removals between 1990-2022.

The most significant reductions in direct GHG emissions by source category were recorded during the 1990-2022 period in the following categories: 1A5 'Other' (-97.7%), 4G 'Harvested Wood Products' (-96.9%), 4C 'Grassland' (-89.8%), 3B 'Manure Management' (-86.3%), 4D 'Wetlands' (-84.8%), 1A1 'Energy Industries' (-84.3%), 3A 'Enteric Fermentation' (-83.1%), 1B2 'Fugitive Emissions from Oil and Natural Gas' (-77.0%), 1A4 'Other Sectors' (-71.8%), 1A2 'Manufacturing Industries and Construction' (-64.7%), 2A 'Mineral Industry' (-63.3%), 2C 'Metal Industry' (-57.2%), 3D 'Agricultural Soils' (-44.3%), 1A3 'Transport' (-42.5%), 4A 'Forest Land' (-37.9%), 2D 'Non-energy Products from Fuels and Solvent Use' (-32.1%), 5D 'Wastewater Treatment and Discharge' (-31.9%), 2G 'Other Product Manufacture and Use' (-27.8%), 4B 'Cropland' (-27.4%) and 4E 'Settlements' (-20.3%).

Between 2021 and 2022, there has been an increase in emissions from the following source categories: 1A5 'Other' (+69.2%), 3H 'Urea Application' (+21.8%), 2F 'Product Use as Substitutes for ODS' (+10.1%), 4F 'Other Land' (+6.7%), 5B 'Biological Treatment of Solid Waste' (+4.0%), 4E 'Settlements' (+2.2%), 4D 'Wetlands' (+1.4%) and 4B 'Cropland' (+1.0%).

2.2. Emission Trends by Gas

Over the 1990-2022 period, total CO_2 emissions (without LULUCF) had decreased by about 74.6% (from circa 37.00 Mt in 1990 to 9.40 Mt in 2022). CH_4 emissions (without LULUCF) had decreased by about 61.8% (from circa 6.00 Mt CO_2 equivalent in 1990 to 2.29 Mt CO_2 equivalent in 2022), and N_2O emissions (without LULUCF) had decreased by 58.7%, respectively (from circa 2.48 Mt CO_2 equivalent in 1990 to 1.02 Mt CO_2 equivalent in 2022) (Table 2-1).

Table 2-1: Direct GHG Emissions in the RoM between 1990-2022, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2 (without LULUCF)	37.00	31.31	24.14	18.09	15.06	11.94	11.81	10.73	9.27	7.26	6.51
CO_2 (with LULUCF)	35.17	28.40	21.82	15.72	12.75	9.66	9.07	8.34	6.84	5.12	4.09
CH_4 (without LULUCF)	6.00	5.61	5.36	4.98	4.89	4.64	4.58	4.14	3.99	3.84	3.74
CH_4 (with LULUCF)	6.00	5.61	5.37	4.99	4.90	4.64	4.58	4.14	3.99	3.84	3.74

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
N_2O (without LULUCF)	2.48	2.30	1.93	1.63	1.43	1.35	1.20	1.17	1.13	1.02	0.96
N_2O (with LULUCF)	2.63	2.46	2.12	1.83	1.64	1.58	1.44	1.41	1.38	1.28	1.22
HFCs	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00
PFCs	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total (without LULUCF)	**45.48**	**39.21**	**31.44**	**24.70**	**21.38**	**17.94**	**17.59**	**16.04**	**14.39**	**12.12**	**11.22**
Total (with LULUCF)	**43.81**	**36.47**	**29.30**	**22.53**	**19.28**	**15.88**	**15.08**	**13.90**	**12.22**	**10.24**	**9.06**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
CO_2 (without LULUCF)	7.15	6.91	7.58	8.10	8.44	7.77	8.16	8.53	8.57	9.22	9.52
CO_2 (with LULUCF)	5.08	4.76	5.50	5.85	6.48	5.70	5.89	6.57	7.01	7.73	8.09
CH_4 (without LULUCF)	3.72	3.80	3.70	3.67	3.68	3.53	3.33	3.30	3.19	3.19	3.22
CH_4 (with LULUCF)	3.73	3.80	3.70	3.67	3.68	3.53	3.33	3.30	3.19	3.19	3.22
N_2O (without LULUCF)	1.03	1.08	0.96	1.02	1.04	1.03	0.86	0.96	0.95	1.02	1.00
N_2O (with LULUCF)	1.29	1.34	1.22	1.28	1.30	1.28	1.11	1.20	1.18	1.25	1.22
HFCs	0.01	0.01	0.01	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08
PFCs	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00
SF_6	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (without LULUCF)	**11.90**	**11.80**	**12.25**	**12.80**	**13.18**	**12.37**	**12.39**	**12.84**	**12.77**	**13.50**	**13.82**
Total (with LULUCF)	**10.10**	**9.91**	**10.44**	**10.81**	**11.49**	**10.54**	**10.37**	**11.13**	**11.45**	**12.24**	**12.62**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
CO_2 (without LULUCF)	9.21	8.86	8.85	9.02	9.09	8.69	9.29	9.36	9.66	10.63	9.40
CO_2 (with LULUCF)	7.78	7.58	7.92	7.65	7.97	7.53	8.29	9.22	9.49	10.52	9.66
CH_4 (without LULUCF)	3.15	3.03	3.08	3.01	3.05	3.19	3.16	2.77	2.42	2.42	2.29
CH_4 (with LULUCF)	3.15	3.04	3.08	3.01	3.05	3.19	3.16	2.77	2.42	2.42	2.29
N_2O (without LULUCF)	0.95	1.07	1.23	0.99	1.11	1.23	1.27	1.27	1.10	1.35	1.02
N_2O (with LULUCF)	1.16	1.26	1.41	1.16	1.27	1.38	1.42	1.42	1.25	1.50	1.18
HFCs	0.09	0.10	0.11	0.14	0.15	0.16	0.17	0.20	0.21	0.21	0.23
PFCs	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SF_6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total (without LULUCF)	**13.40**	**13.06**	**13.27**	**13.16**	**13.40**	**13.27**	**13.90**	**13.60**	**13.39**	**14.61**	**12.95**
Total (with LULUCF)	**12.18**	**11.97**	**12.52**	**11.96**	**12.44**	**12.26**	**13.04**	**13.60**	**13.37**	**14.66**	**13.37**

Abbreviations: NA –Not Applicable; NO –Not Occurring.

Halocarbons emissions (HFCs, PFCs) and sulphur hexafluoride (SF_6) emissions have been recorded beginning with 1995, considered as a starting year for monitoring F-gases (HFCs, PFCs and SF_6) (no NF_3 emissions have been recorded so far in the RoM). The evolution of these emissions denotes a steady upward trend in recent years, though their share in the total national GHG emissions structure is insignificant for now.

Carbon dioxide continues to be the most important source of total national direct greenhouse gas emissions. Figure 2-2 shows the fluctuation of direct GHG emissions in the structure of total national GHG emissions in 1990 and 2022.

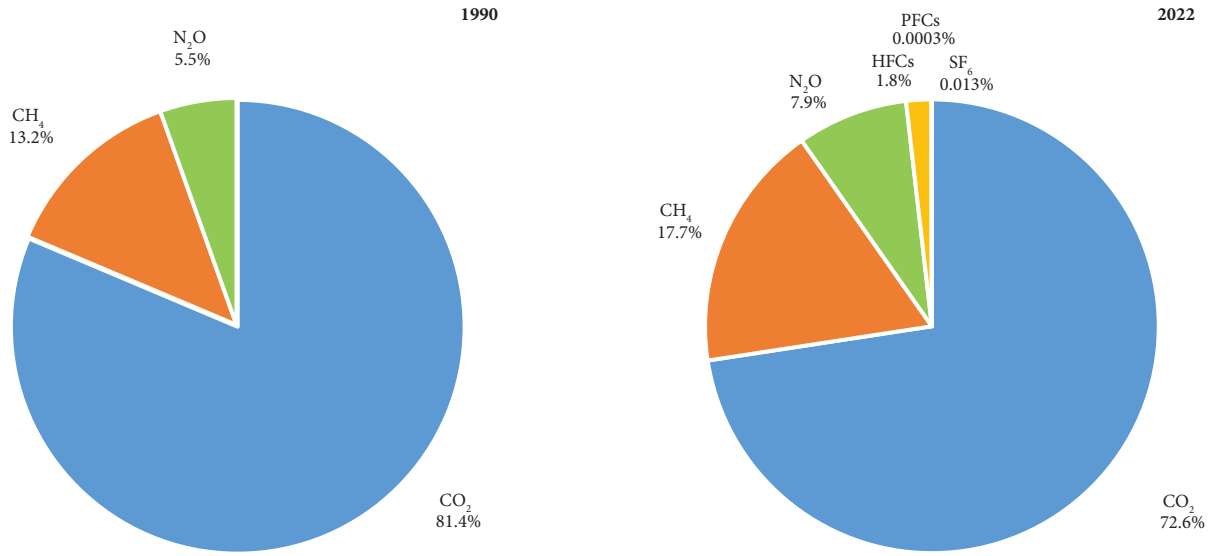


Figure 2-2: Direct GHGs share in the structure of total GHG emissions in the RoM in 1990 and 2022.

In 2022, the source categories with the highest share in the structure of total CO_2 emissions were: 1A1 'Energy Industries' (34.6% of the total), 1A3 'Transport' (28.2% of the total), 1A4 'Other Sectors' (20.3% of the total), 4B 'Cropland' (17.9% of the total), 4A 'Forest Land' (-16.5% of the total), 1A2 'Manufacturing Industries and Construction' (6.9% of the total), 2A 'Mineral Industry' (5.1% of the total), 4F 'Other Land' (3.1% of the total), 2D 'Non-energy Products from Fuels and Solvent Use' (1.6% of the total), 4C 'Grassland' (-1.3% of the total) and 4D 'Wetlands' (-0.9% of the total) (Figure 2-3).

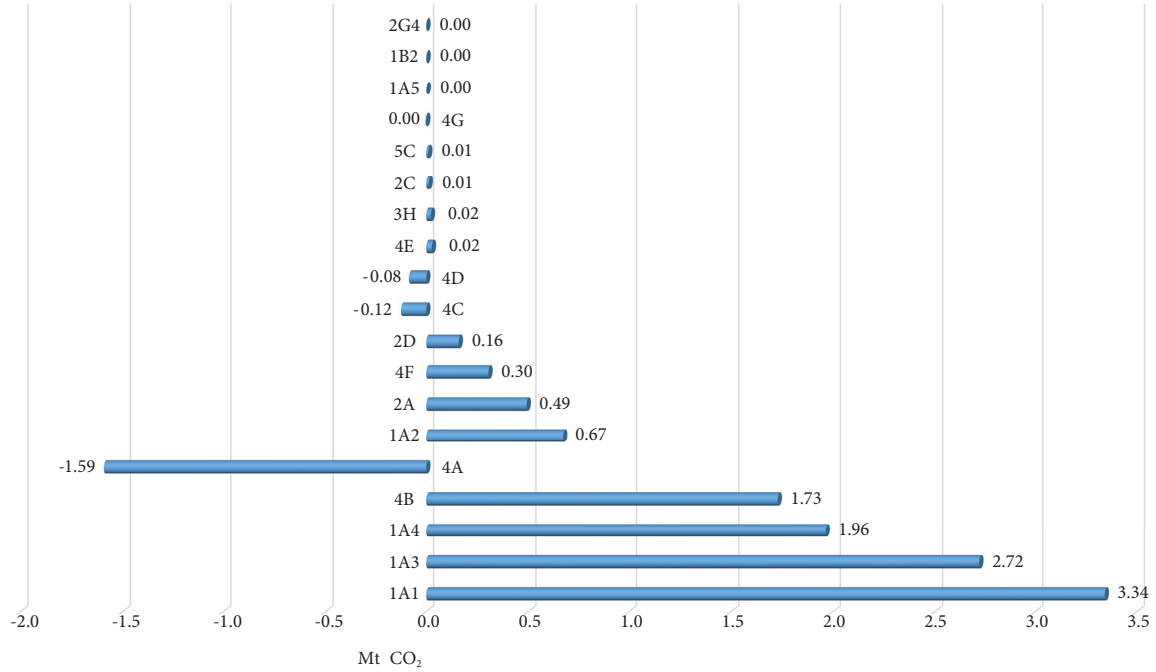


Figure 2-3: Share of source categories in the structure of total CO_2 emissions in 2022.

The source categories with the highest share in the structure of total CH_4 emissions in 2022 were: 5A 'Solid Waste Disposal' (49.3% of the total), 3A 'Enteric Fermentation' (18.1% of the total), 5D 'Wastewater Treatment and Discharge' (10.8% of the total), 1B2 'Fugitive Emissions from Oil and Natural Gas' (10.2% of the total), 1A4 'Other Sectors' (8.5% of the total), 3B 'Manure Management' (2.0% of the total) and 1A3 'Transport' (0.6% of the total) (Figure 2-4).

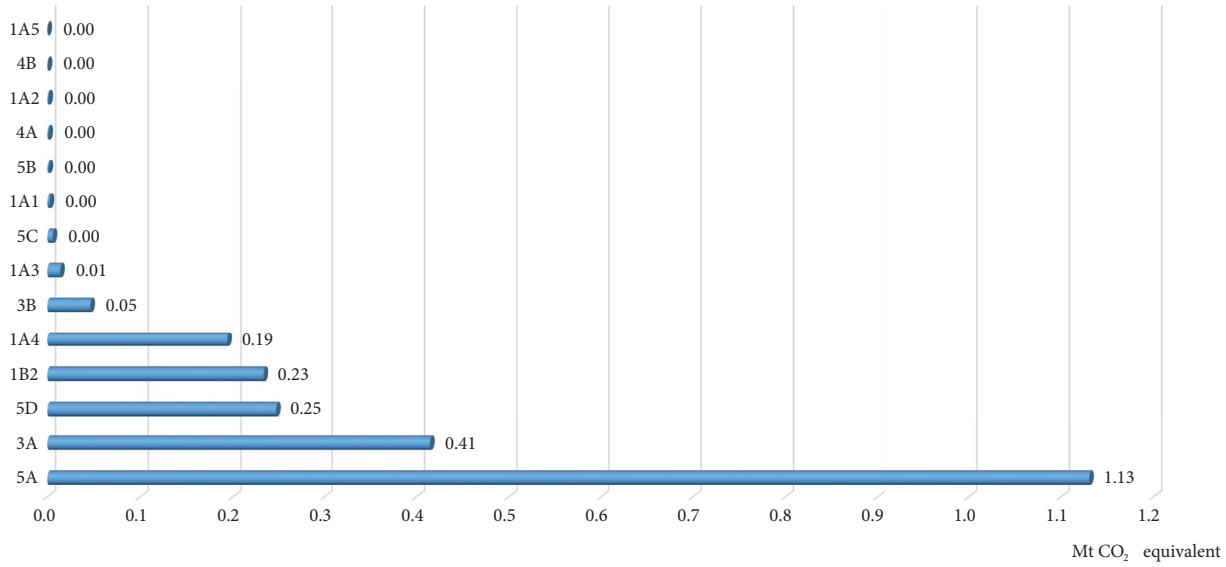


Figure 2-4: Share of source categories in the structure of total CH_4 emissions in 2022.

In 2022, the source categories with the highest share in the structure of total N_2O emissions were: 3D 'Agricultural Soils' (62.3% of the total), 4E 'Settlements' (13.5% of the total), 3B 'Manure Management' (11.4% of the total), 1A4 'Other Sectors' (4.9% of the total), 5D 'Wastewater Treatment and Discharge' (4.2% of the total) and 1A3 'Transport' (3.2% of the total) (Figure 2-5).

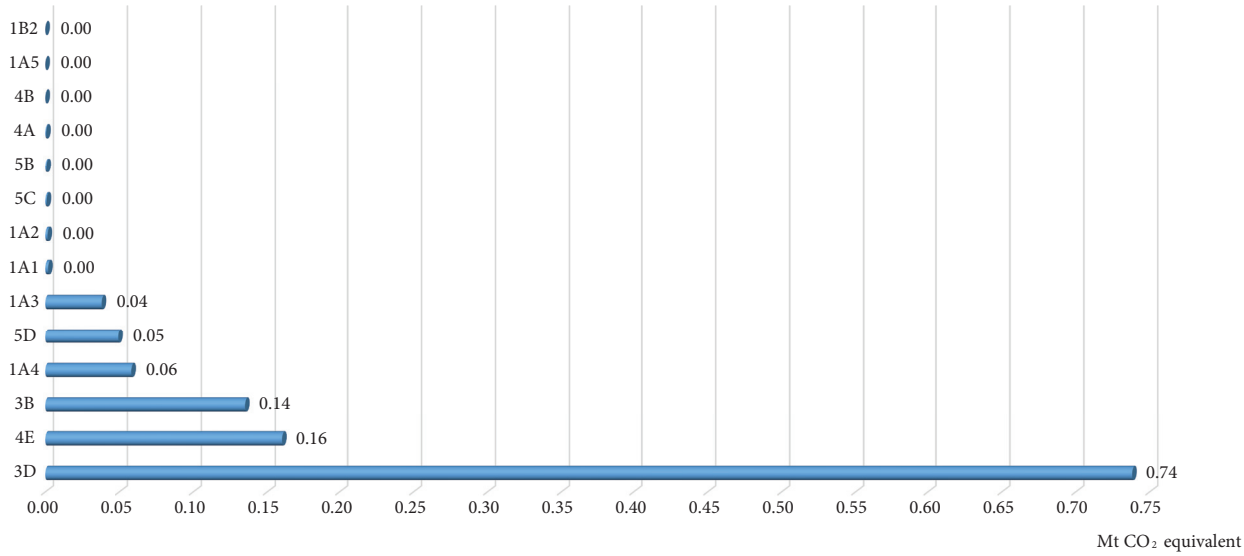


Figure 2-5: Share of source categories in the structure of total N_2O emissions in 2022.

2.3. Emission Trends by Sources

GHG emission assessment was conducted for five sectors: (1) 'Energy', (2) 'Industrial Processes and Product Use', (3) 'Agriculture', (4) 'Land Use, Land-Use Change and Forestry' (LULUCF) and (5) 'Waste'. Interpretation of GHG emissions inventory results under LULUCF sector is different from other sectors: positive figures indicate that this sector is a net source of emissions, while negative figures indicate that the sector is a net sink of CO_2 removals.

Over the 1990-2022 period, total GHG emissions tended to decrease; thus, emissions from the energy sector decreased by 75.1%, those from the IPPU sector – by 43.9%, from the agriculture sector – by 73.4%, from the LULUCF sector – by 125.1%, and those from the waste sector – by 14.5% (Table 2-2).

Table 2-2: Evolution of direct GHG emissions by sector between 1990-2022, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1. Energy	37.09	31.35	24.50	18.32	15.45	12.47	12.46	11.18	9.71	7.70	7.02
2. Industrial Processes and Product Use	1.61	1.41	0.82	0.74	0.56	0.46	0.42	0.45	0.38	0.34	0.32
3. Agriculture	5.10	4.73	4.36	3.84	3.58	3.22	2.92	2.63	2.55	2.34	2.18
4. LULUCF	-1.68	-2.74	-2.14	-2.16	-2.10	-2.06	-2.51	-2.15	-2.17	-1.88	-2.16
5. Waste	1.69	1.72	1.75	1.80	1.79	1.79	1.79	1.78	1.76	1.74	1.71
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1. Energy	7.65	7.44	8.13	8.64	8.94	8.07	8.25	8.54	8.96	9.57	9.88
2. Industrial Processes and Product Use	0.32	0.37	0.40	0.47	0.57	0.68	0.93	1.02	0.52	0.55	0.65
3. Agriculture	2.26	2.33	2.10	2.08	2.07	2.03	1.65	1.71	1.74	1.80	1.73
4. LULUCF	-1.80	-1.89	-1.82	-1.99	-1.70	-1.82	-2.02	-1.71	-1.32	-1.26	-1.20
5. Waste	1.68	1.66	1.63	1.61	1.61	1.59	1.56	1.56	1.56	1.56	1.55
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
1. Energy	9.55	9.12	9.13	9.32	9.48	9.16	9.64	9.45	9.47	10.46	9.25
2. Industrial Processes and Product Use	0.67	0.72	0.75	0.75	0.73	0.75	0.93	0.95	0.97	1.00	0.90
3. Agriculture	1.64	1.76	1.94	1.66	1.74	1.83	1.81	1.71	1.48	1.68	1.36
4. LULUCF	-1.22	-1.09	-0.75	-1.20	-0.96	-1.01	-0.86	0.00	-0.02	0.05	0.42
5. Waste	1.54	1.47	1.45	1.44	1.45	1.53	1.52	1.50	1.48	1.47	1.45

The energy sector is the most important source of total national direct greenhouse gas emissions, its share varying during the 1990-2022 period between 84.7% and 69.2%. Other relevant sources of direct greenhouse gas emissions are the agriculture, waste and IPPU sectors (Figure 2-6).

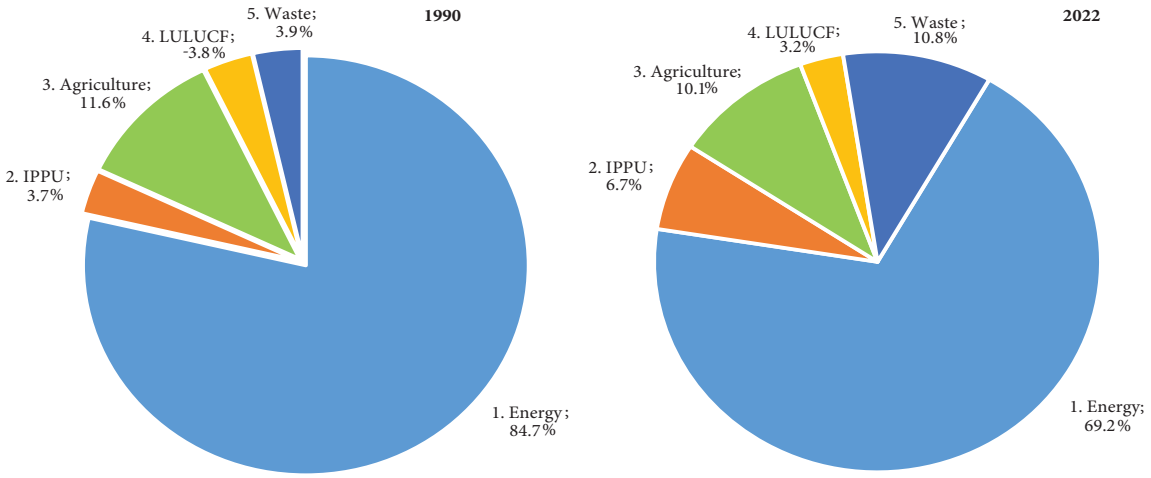


Figure 2-6: Sectoral breakdown in the structure of net national GHG emissions in the Republic of Moldova in 1990 and 2022.

Throughout the study period, except for years 2021 and 2022, the LULUCF sector was a net source of carbon removals. With the reduction of direct greenhouse gas emissions at national level, the relevance of this sector in the structure of net greenhouse gas emissions at national level showed a similar trend: in 1990, about 3.8% of the total GHG emissions were removed at national level, whereas in 2022 this sector contributed with circa 3.2% of net GHG emissions at national level.

2.3.1. Sector 1 'Energy'

The energy sector is the most important source of national GHG emissions. The sector includes emissions from stationary and mobile combustion of fuels for energy (97.5 of total sectoral emissions in 2022), as well as fugitive emissions from oil and natural gas production, processing, transportation, storage, delivery and distribution (2.5% of total sectoral emissions in 2022) (Figure 2-7, Table 2-3).

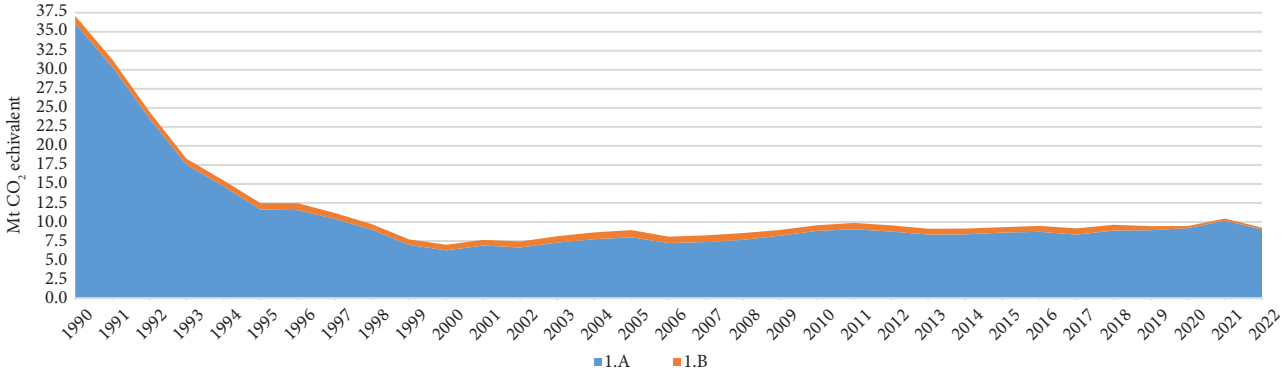


Figure 2-7: Total GHG emissions generated in Sector 1 'Energy' in the RoM, 1990-2022.

Overall, these emissions accounted for circa 69.2% of the net national direct GHG emissions in 2022. During the 1990-2022 period, total direct GHG emissions from the energy sector had decreased by 75.1%: from 37.09 Mt CO_2 equivalent in 1990 to 9.25 Mt CO_2 equivalent in 2022.

Table 2-3: Direct GHG emissions from Sector 1 'Energy' over the period 1990-2022, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2021	2022
1. Energy	**37.09**	**12.47**	**7.02**	**8.94**	**9.57**	**9.32**	**9.47**	**10.46**	**9.25**
1A. Fuel Combustion	**36.07**	**11.64**	**6.27**	**7.98**	**8.83**	**8.60**	**9.19**	**10.18**	**9.01**
1A.1. Energy Industries	21.36	7.19	3.16	3.23	4.05	3.69	3.64	3.94	3.35
1A.2. Manufacturing Industries and Construction	1.90	0.38	0.52	0.58	0.52	0.65	0.69	0.76	0.67
1A.3. Transport	4.83	1.66	1.00	1.86	2.19	2.31	2.51	2.78	2.78
1A.4. Other Sectors	7.86	2.28	1.55	2.29	2.05	1.95	2.35	2.71	2.22
1A.5. Other	0.12	0.13	0.04	0.03	0.03	0.00	0.00	0.00	0.00
1B. Fugitive Emissions from Fuels	**1.02**	**0.83**	**0.74**	**0.95**	**0.74**	**0.72**	**0.27**	**0.28**	**0.23**
1B.1. Solid Fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO
1B.2. Oil and Natural Gas	1.02	0.83	0.74	0.95	0.74	0.72	0.27	0.28	0.23
1C. CO_2 Transport and Storage	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Abbreviations: NO – Not Occurring.

The most important source category within the energy sector is category 1A1 'Energy Industries', with a share of circa 36.2% of the total from this sector, in 2022 (57.6% in 1990). Other relevant sources are categories: 1A3 'Transport' – with a share of 30.0% of the total (13.0% in 1990), 1A4 'Other Sectors' – with a share of circa 24.0% of the total (21.2% in 1990), and 1A2 'Manufacturing Industries and Construction' – with a share of circa 7.3% of the total (5.1% in 1990) (Figure 2-8).

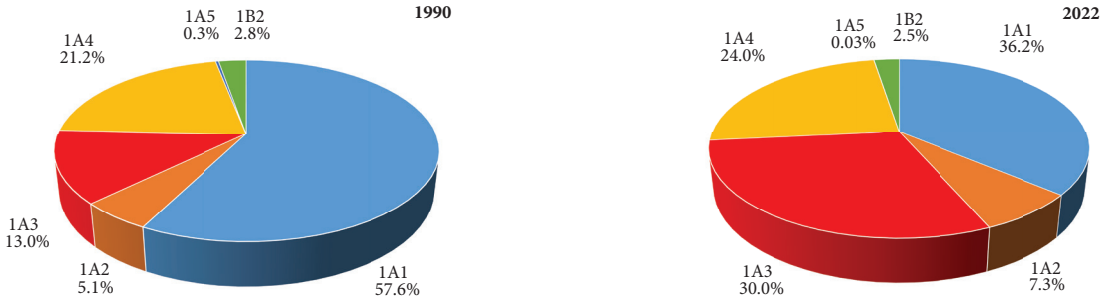


Figure 2-8: Share of total direct GHG emissions by source category in the energy sector in 1990 and 2022.

2.3.2. Sector 2 'Industrial Processes and Product Use'

Sector 2 'IPPU' is a relevant source of national GHG emissions, and includes emissions from non-energy industrial activities. In 2022, this sector had a share of about 6.7% of total national GHG emissions (3.7% in 1990). Between 1990 and 2022, total GHG emissions from this sector decreased by 43.9%: from 1.6 Mt CO_2 equivalent in 1990 to 0.9 Mt CO_2 equivalent in 2022 (Table 2-4, Figure 2-9).

Between 2008 and 2009, these emissions decreased by 48% because of the economic crisis that significantly affected the industrial sector of the country. Subsequently, between 2010 and 2021, direct GHG emissions from the sector showed a slight increasing trend, mainly due to an increase in the production of cement, lime, glass, steel, as well as due to increase in halocarbon consumption. Between 2021 and 2022, total GHG emissions from the sector decreased by 9.7%.

Table 2-4: Direct GHG emissions from Sector 2 'IPPU' between 1990-2022, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2021	2022
2. Industrial Processes and Product Use	**1.61**	**0.46**	**0.32**	**0.57**	**0.55**	**0.75**	**0.97**	**1.00**	**0.90**
A. Mineral Industry	1.34	0.35	0.24	0.44	0.41	0.51	0.54	0.58	0.49
B. Chemical Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
C. Metal Industry	0.03	0.03	0.04	0.04	0.01	0.02	0.02	0.02	0.01
D. Non-Energy Products from Fuels and Solvent Use	0.23	0.08	0.03	0.07	0.07	0.08	0.20	0.18	0.16
E. Electronic Industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Product Use as Substitutes for ODS	NO	0.00	0.00	0.02	0.07	0.14	0.21	0.21	0.23
G. Other Product Manufacture and Use	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
H. Other	NA	NA	NA	NA	NA	NA	NA	NA	NA

Abbreviations: NA – Not Applicable); NO – Not Occurring.

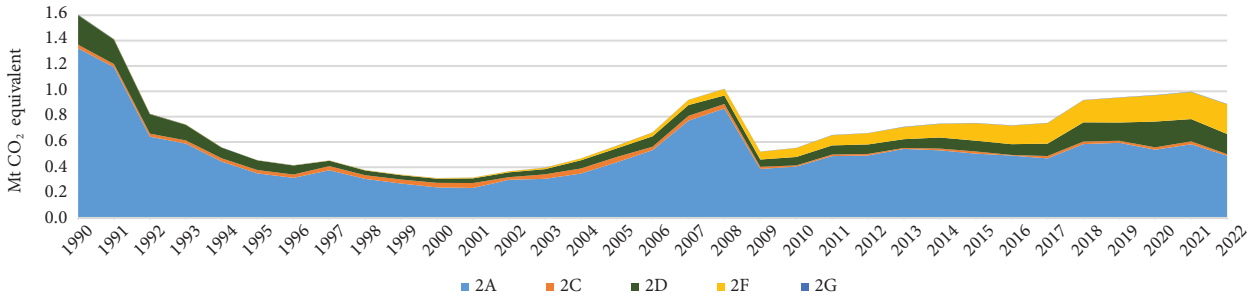


Figure 2-9: Total GHG emissions generated from Sector 2 'IPPU' in the RoM between 1990-2022.

Within Sector 2 'IPPU', the most important source category is 2A1 'Cement Production', with a share of about 45.4% of the total from this sector in 2022 (60.5% in 1990). Other relevant source categories in 2022 were 2D3 'Solvent Use' – with a share of 16.7% of the total (12.7% in 1990), 2F1 'Refrigeration and Air Conditioning' – with a share of about 17.3% of the total, 2F2 'Foam Blowing Agents' – with a share of 8.3% of the total, 2A3 'Glass production' – with a share of 4.1% of the total (1.7% in 1990), 2A2 'Lime production' – with a share of 3.1% of the total (16.5% in 1990), 2C1 'Iron and steel production'

– with a share of 1.4% of the total (1.8% in 1990), and 2A4 'Other process uses of carbonates' – with a share of 2.0% of the total (4.7% in 1990) (Figure 2-10).

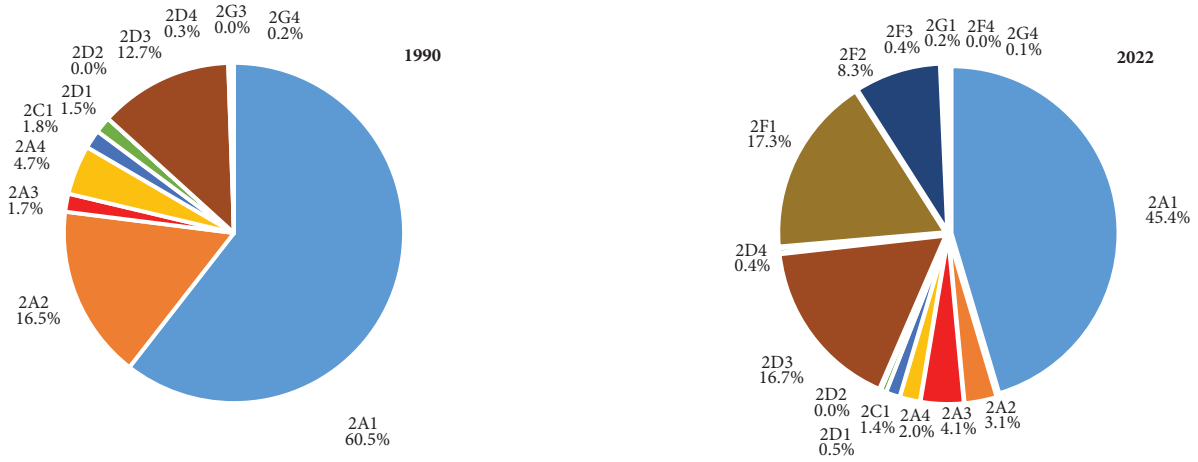


Figure 2-10: Total GHG emissions by source category in Sector 2 'IPPU' in 1990 and 2022.

2.3.3. Sector 3 'Agriculture'

Sector 3 'Agriculture' is an important contributor of direct GHG emissions: CH_4 emissions from 'Enteric fermentation' (category 3A) and 'Manure management' (category 3B), N_2O emissions from 'Manure management' (category 3B) and 'Agricultural soils' (category 3D), and CO_2 emissions from 'Urea application' (category 3H), respectively. In the RoM there are no emissions recorded from source categories 3C 'Rice cultivation', 3E 'Prescribed burning of savannas', 3G 'Liming', 3I 'Other carbon-containing fertilizers' and 3J 'Other'. As for the emissions from 3F 'Field burning of agricultural residues', these are monitored in the LULUCF sector, under category 4B 'Cropland'.

In 2022, the agriculture sector had a share of about 10.1% of total national direct GHG emissions (11.6% in 1990). Over the period 1990-2022, total direct GHG emissions from the respective sector decreased by circa 73.4%: from 5.10 Mt CO_2 equivalent in 1990 to 1.36 Mt CO_2 equivalent in 2022 (Table 2-5, Figure 2-11), mainly due to the decrease in such indicators as: livestock and poultry populations, the amount of synthetic nitrogen and organic fertilizers applied to soils, the amount of agricultural crop residues returned to soils and the increase in carbon losses from mineral soils and changes of tillage practices.

Table 2-5: Direct GHG emissions from Sector 3 'Agriculture' between 1990-2022, Mt CO_2 equivalent

	1990	1995	2000	2005	2010	2015	2020	2021	2022
3. Agriculture	**5.10**	**3.22**	**2.18**	**2.07**	**1.80**	**1.66**	**1.48**	**1.68**	**1.36**
A. Enteric Fermentation	2.45	1.81	1.22	1.03	0.80	0.69	0.43	0.43	0.41
B. Manure Management	1.32	0.69	0.40	0.39	0.36	0.29	0.20	0.19	0.18
C. Rice Cultivation	NO	NO	NO	NO	NO	NO	NO	NO	NO
D. Agricultural Soils	1.32	0.72	0.56	0.64	0.64	0.66	0.80	1.04	0.74
E. Prescribed Burning of Savannas	NO	NO	NO	NO	NO	NO	NO	NO	NO
F. Field Burning of Agricultural Residues	IE	IE	IE	IE	IE	IE	IE	IE	IE
G. Liming	NO	NO	NO	NO	NO	NO	NO	NO	NO
H. Urea Application	0.00	0.00	0.00	0.00	0.00	0.01	0.04	0.02	0.02
I. Other Carbon-Containing Fertilisers	NO	NO	NO	NO	NO	NO	NO	NO	NO
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO

Abbreviations: IE – Included Elsewhere); NO – Not Occurring.

Between 2021 and 2022, direct greenhouse gas emissions from the agriculture sector decreased by about 19.2%, mainly due to unfavourable agrometeorological conditions caused by the drastic drought which affected the Republic of Moldova, the reduction of livestock and poultry populations and the amounts of synthetic nitrogen fertilizers applied to soils.

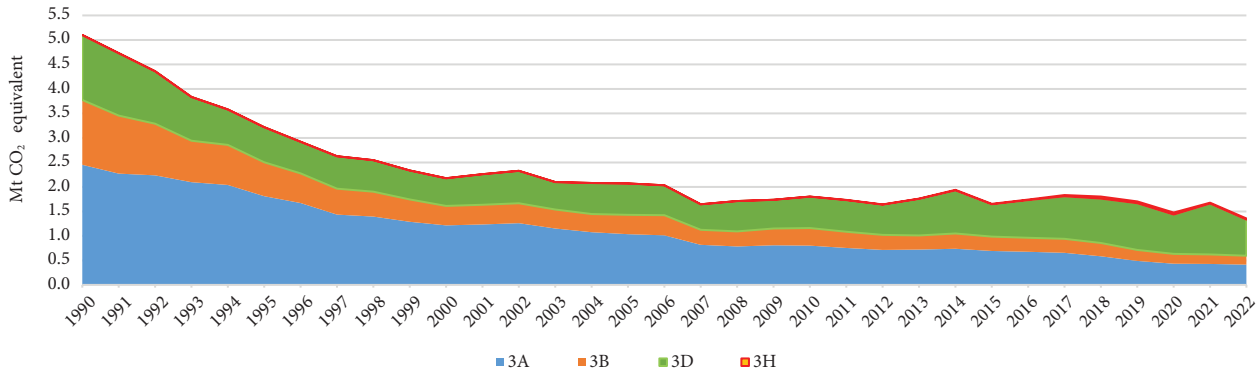


Figure 2-11: Total direct GHG emissions generated from Sector 3 'Agriculture' in the RoM, 1990-2020.

In 2022, the most important source category was 3D 'Agricultural soils', with a share of about 54.4% of the total from this sector (26.0% in 1990). Other relevant source categories are 3A 'Enteric fermentation' – with a share of 30.6% of the total (48.1% in 1990), and 3B 'Manure management' – with a share of about 13.4% of the total (26.0% in 1990) (Figure 2-12). The share of category 3H 'Urea application' is currently insignificant at sectoral level, however, it shows a continuous upward trend.

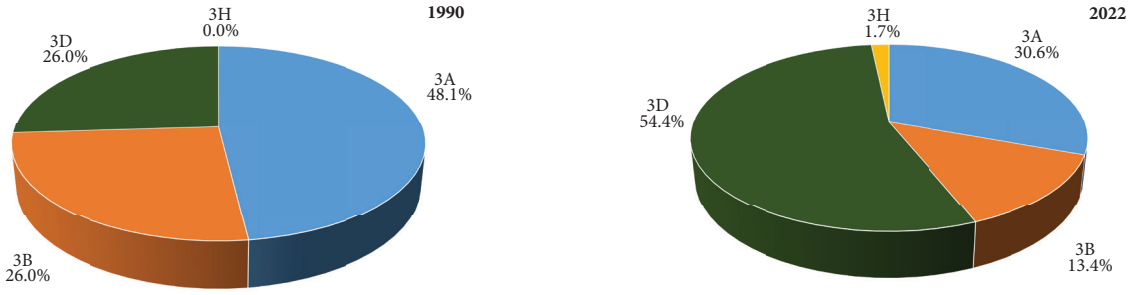


Figure 2-12: Share of source categories in the total structure of total GHG emissions from Sector 3 'Agriculture' in the Republic of Moldova in 1990 and 2022.

2.3.4. Sector 4 'Land Use, Land-Use Change and Forestry'

In the period 1990-2020, the LULUCF sector was a source of net carbon removals in the Republic of Moldova. In 2021, this sector became a net source of emissions nationwide. Between 1990 and 2022, the evolution of net CO_2 removals/emissions recorded a downward trend, decreasing from -1.68 Mt CO_2 equivalent in 1990 to +0.42 Mt CO_2 equivalent in 2022 (Table 2-6, Figure 2-13). This is mainly due to changes in the use and management practices of cropland (category 4B), which led to a significant reduction in organic carbon reserves in agricultural soils[51], thus changing the humus balance from positive to negative and/or to deeply negative. The process was also influenced by some changes in forest land (category 4A), such as the increase in the volume of authorized wood harvested, the substantial increase in the volume of illegal felling, the increase in the conversion of cropland to forest land, etc.

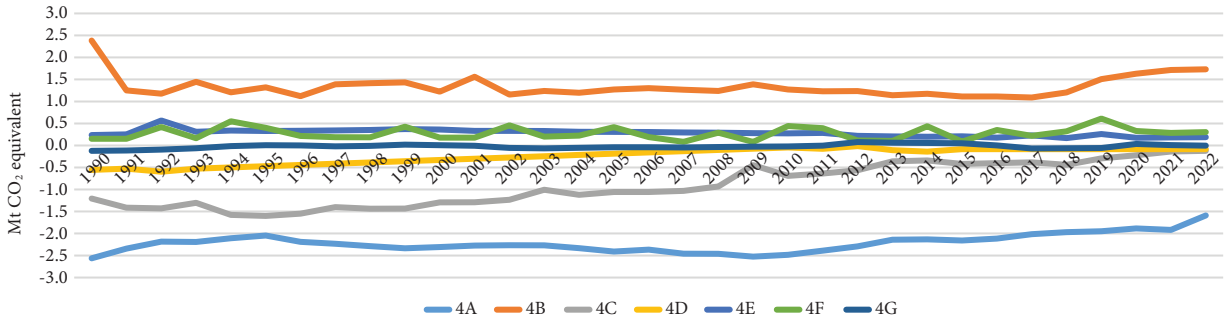


Figure 2-13: Direct GHG emissions/removals in Sector 4 'LULUCF' by source/sink category between 1990-2022.

[51] Carbon of organic origin and nitrogen in the soil are closely dependent on the humus content of the soil; losses of carbon through the process of oxidation as a result of changes in agricultural land use and soil management practices are accompanied by the simultaneous mineralization (biochemical decomposition) of nitrogen.

Table 2-6: Emissions and removals in Sector 4 'LULUCF' between 1990-2022, Mt CO_2 equivalent

Source category	1990	1995	2000	2005	2010	2015	2020	2021	2022
4. LULUCF	**-1.68**	**-2.06**	**-2.16**	**-1.70**	**-1.26**	**-1.20**	**-0.02**	**0.05**	**0.42**
A. Forest Land	-2.56	-2.05	-2.31	-2.41	-2.48	-2.16	-1.89	-1.92	-1.59
B. Cropland	2.38	1.32	1.22	1.27	1.27	1.11	1.63	1.71	1.73
C. Grassland	-1.21	-1.60	-1.29	-1.06	-0.69	-0.42	-0.22	-0.14	-0.12
D. Wetlands	-0.56	-0.47	-0.33	-0.19	-0.05	-0.08	-0.08	-0.08	-0.08
E. Settlements	0.24	0.33	0.36	0.31	0.28	0.21	0.18	0.18	0.19
F. Other Land	0.15	0.40	0.18	0.42	0.44	0.09	0.33	0.29	0.30
G. Harvested Wood Products	-0.12	0.01	0.01	-0.04	-0.02	0.05	0.03	0.01	0.00
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO

Abbreviations: NO – Not Occurring.

In 2022, the main source of CO_2 emission removal in Sector 4 'LULUCF' was category 4A 'Forest land' (forests, forest belts, etc.) with a share of 39.5% of the total (35.5% in 1990), followed by 4C 'Grassland' – with a share of about 3.1% (16.7% in 1990), and 4D 'Wetlands' – with a share of about 2.1% (7.7% in 1990). Category 4B 'Cropland' is a net source of emissions in Sector 4 'LULUCF', with a share of 43.0% (33.0% in 1990), followed by category 4F 'Other land' – with a share of circa 7.6% (2.1% in 1990), and category 4E 'Settlements' – with a share of about 4.7 percent (3.3 percent in 1990) (Figure 2-14).

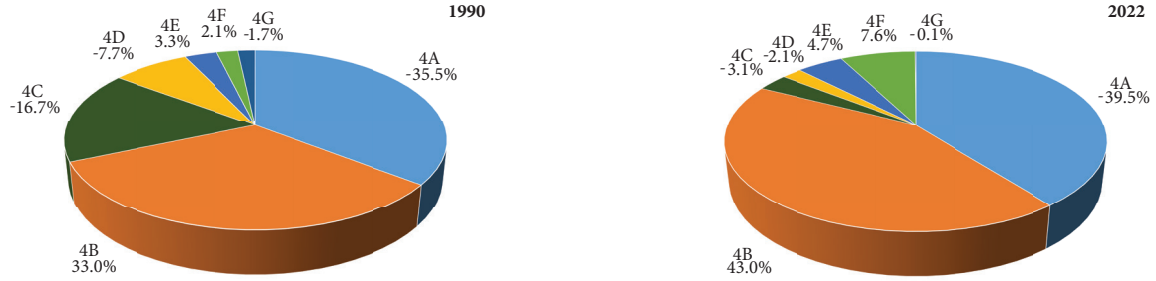


Figure 2-14: Net CO_2 emissions and removals by source and sink categories in Sector 4 'LULUCF' in 1990 and 2022.

2.3.5. Sector 5 'Waste'

Sector 5 'Waste' is an important source of national GHG emissions: CO_2 emissions from 5C 'Incineration and open burning of waste', methane emissions from 5A 'Solid waste disposal', 5B 'Biological treatment of solid waste', 5C 'Incineration and open burning of waste' and 5D 'Wastewater treatment and discharge', respectively N_2O emissions from 5B 'Biological treatment of solid waste', 5C 'Incineration and open burning of waste' and 5D 'Wastewater treatment and discharge'. There are no emissions recorded from category 5E 'Other'.

In 2022, waste sector had a share of about 10.8% of the total national direct GHG emissions (3.9% in 1990). In the period 1990-2022, total direct GHG emissions from this sector decreased by about 14.5%: from 1.69 Mt CO_2 equivalent in 1990 to 1.45 Mt CO_2 equivalent in 2022 (Table 2-7). Between 2021 and 2022, direct GHG emissions generated by waste sector decreased by about 1.8%.

Table 2-7: Direct GHG emissions from Sector 5 'Waste' between 1990-2022, Mt CO_2 equivalent

Source Categories	1990	1995	2000	2005	2010	2015	2020	2021	2022
5. Waste	**1.69**	**1.79**	**1.71**	**1.61**	**1.56**	**1.44**	**1.48**	**1.47**	**1.45**
A. Solid Waste Disposal	1.23	1.39	1.32	1.20	1.20	1.10	1.16	1.14	1.13
B. Biological Treatment of Solid Waste	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
C. Incineration and Open Burning of Waste	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.02
D. Wastewater Treatment and Discharge	0.43	0.38	0.36	0.39	0.34	0.32	0.30	0.31	0.30
E. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO

Abbreviations: NO – Not Occurring.

The decreasing trend of total direct GHG emissions from Sector 5 'Waste', could be explained by the economic decline recorded in the Republic of Moldova during the transition to the market economy,

by a significant drop in the population number, well-being of the population, and by the capacity to generate household waste, respectively (Figure 2-15).

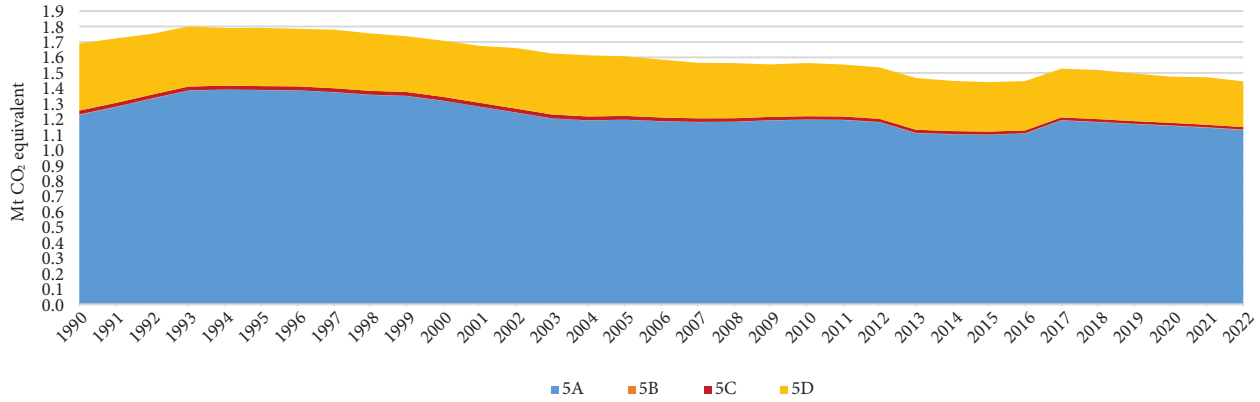


Figure 2-15: Direct GHG emissions from Sector 5 'Waste' in the RoM between 1990-2022.

In 2022, the most important source category in this sector was category 5A 'Solid waste disposal', with a share of circa 78.2% of the total sectoral emissions (72.7% in 1990), followed by category 5D 'Wastewater treatment and discharge' – with a share of circa 20.5% of the total (25.7% in 1990), and category 5C 'Incineration and open burning of waste', respectively – with a share of circa 1.1% of the total (1.5% in 1990) (Figure 2-16).

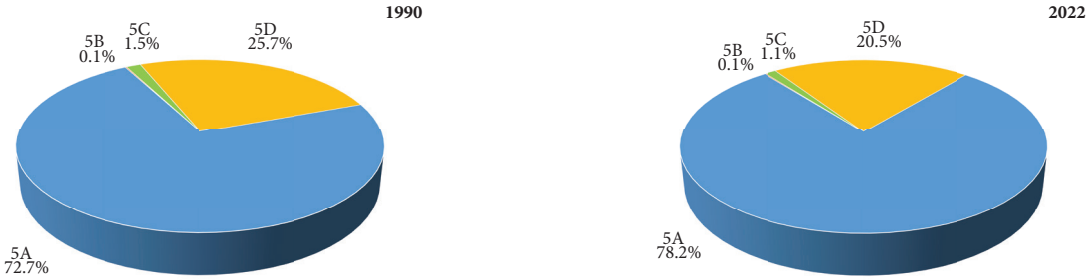


Figure 2-16: Share of total direct GHG emissions by source category from Sector 5 'Waste' in the Republic of Moldova in 1990 and 2022.

2.4. Indirect GHG emissions trends

Though not considered greenhouse gases, photochemically active gases such as carbon monoxide (CO), nitrogen oxides (NO_x) and non-methane volatile organic compounds (NMVOC) contribute indirectly to the greenhouse effect in the atmosphere. These gases are considered as ozone precursors, influencing the formation and destruction of the ozone in the atmosphere. They are mainly emitted from exhaust fumes in transportation, fossil fuel combustion in stationary sources, solvent use and other household products, etc. Thus, the national GHG inventory of the Republic of Moldova includes emissions of the following ozone and aerosol precursors: NO_x, CO, NMVOC and SO_2.

Over the period 1990-2022, total nitrogen oxide emissions had decreased by circa 72.7%: from 95.63 kt in 1990 to 26.12 kt in 2022, total carbon monoxide emissions had decreased by circa 57.0%: from 278.81 kt in 1990, to 119.88 kt in 2022, total NMVOC emissions had decreased by circa 35.3%: from 141.54 kt in 1990 to 91.56 kt in 2022, and sulphur dioxide emissions had decreased by circa 96.7%: from 150.86 kt in 1990 to 4.96 kt in 2022 (Table 2-8).

Table 2-8: Evolution of total indirect GHG (NO_x, CO and NMVOC) and SO_2 emissions (without LULUCF) in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NO_x	95.63	78.54	58.60	46.57	36.79	31.01	29.12	26.07	21.87	16.05	14.86
CO	278.81	203.73	130.67	66.77	74.00	63.41	76.60	70.43	54.26	42.25	39.97
NMVOC	141.54	114.31	90.34	71.40	52.56	48.15	46.45	31.76	27.72	23.39	22.90
SO_2	150.86	124.99	92.19	72.68	57.58	32.01	32.16	16.90	12.65	5.99	4.61

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NO_x	15.94	16.99	17.96	19.27	20.00	18.99	19.92	20.75	19.38	21.32	21.95
CO	38.90	45.37	55.17	52.20	54.35	54.82	49.46	52.08	50.32	52.72	55.41
NMVOC	24.47	26.79	27.72	39.33	42.06	47.45	47.26	40.85	35.51	40.31	43.15
SO_2	4.09	4.98	6.51	5.63	5.33	5.48	4.16	5.75	5.32	5.46	5.59
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NO_x	20.77	21.03	20.93	22.18	23.09	23.34	25.06	25.27	25.44	28.65	26.12
CO	54.08	54.80	82.02	86.48	89.76	112.30	161.70	145.93	140.68	142.94	119.88
NMVOC	44.45	43.55	55.96	53.88	55.23	64.68	95.67	89.49	114.76	104.17	91.58
SO_2	5.67	13.26	5.22	4.87	4.08	4.95	4.34	5.05	4.16	6.73	4.96

In 2022, the source categories with the highest share in the structure of total nitrogen oxides emissions were: 1A3 'Transport' (41.4% of the total), 1A4 'Other sectors' (24.6% of the total), 1A1 'Energy industries' (20.6% of the total), 2A 'Mineral industry' (6.6% of the total), and 1A2 'Manufacturing industries and construction' (6.0% of the total) (Figure 2-17).

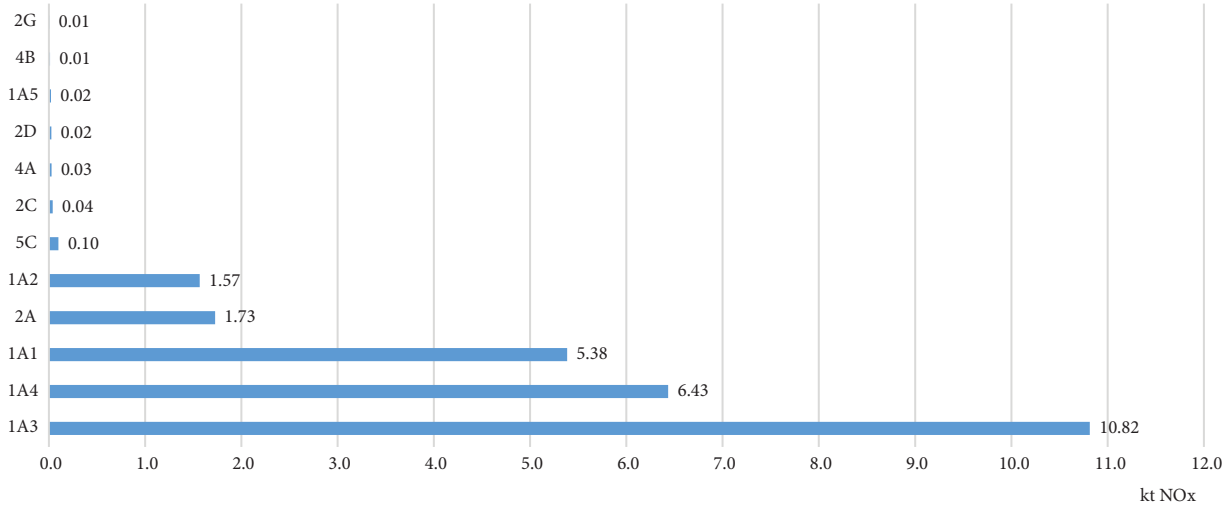
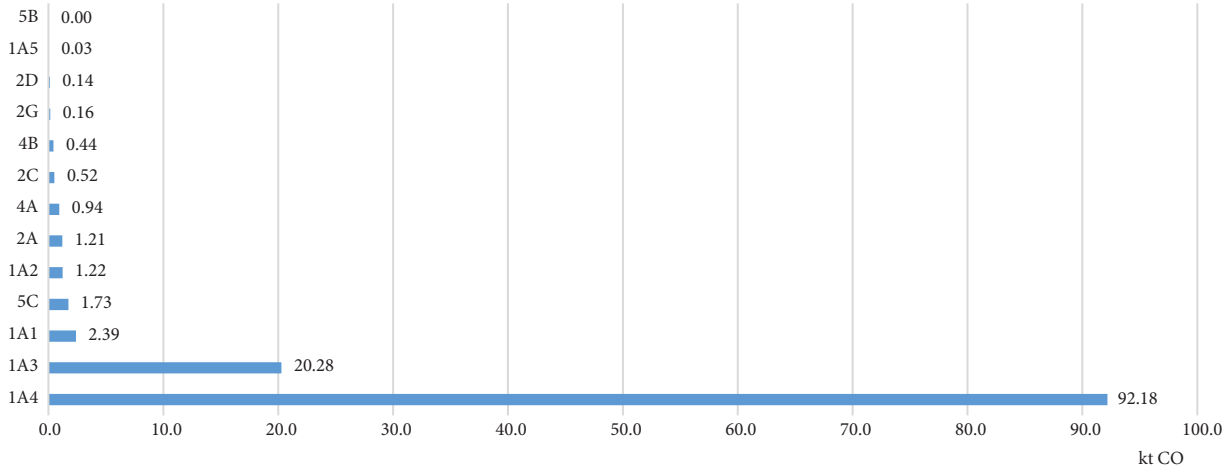


Figure 2-17: Total NO_x emissions by source category in 2022.

The source categories with the highest share in the structure of CO emissions in 2022 were: 1A4 'Other sectors' (76.0% of the total), 1A3 'Transport' (16.7% of the total), 1A1 'Energy industries' (2.0% of the total), 5C 'Incineration and open burning of waste' (1.4% of the total), 1A2 'Manufacturing industries and construction' (1.0% of the total), and 2A 'Mineral industry' (1.0% of the total) (Figure 2-18).



Figur3 2-18: Total CO emissions by source category in 2022.

In 2022, the source categories with the highest share in the structure of non-methane volatile organic compounds emissions were: 2D 'Non-energy products from fuels and solvent use' (74.7% of the total), 1A4 'Other sectors; (15.1% of the total), 2H 'Other' (food and alcoholic beverages) (4.1% of the total), 1A3 'Transport' (2.9% of the total), and 5A 'Solid waste disposal' (1.6% of the total) (Figure 2-19).

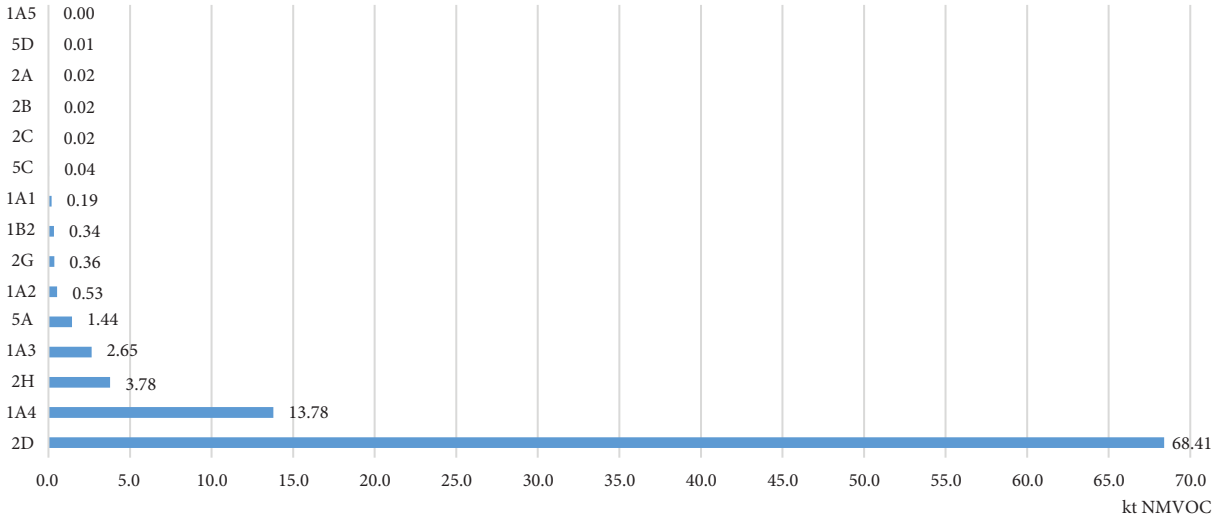


Figure 2-19: Total NMVOC emissions by source category in 2022.

The source categories with the highest share in the structure of sulphur dioxide emissions in 2022 were: 1A4 'Other sectors' (46.5% of the total), 1A1 'Energy Industries (27.8% of the total)', 2A 'Mineral industry' (15.6% of the total) and 1A2 'Manufacturing industries and construction' (9.3% of the total) (Figure 2-20).

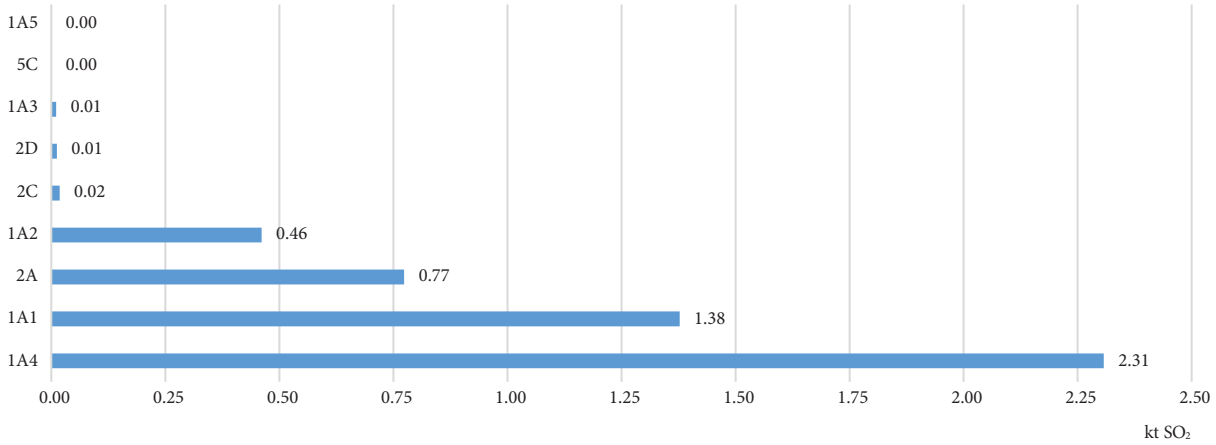


Figure 2-20: Total SO_2 emissions by source category in 2022.

CHAPTER 3. SECTOR 1 'ENERGY'

3.1. Overview

Sector 1 'Energy' includes GHG emissions resulting from electricity and heat production activities, and fuel combustion for energy generation purposes. Methodological guidance used fot the inventory of GHG emissions includes the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) (for the estimation of direct GHG emissions) and the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2023) (for the estimation of indirect GHG emissions).

Under the national GHG inventory, Sector 1 'Energy' covers GHG emissions generated by the following source categories:

Sub-sector 1A 'Fuel Combustion'

- 1A1 'Energy Industries' (1A1a 'Main Activity Electricity and Heat Production', 1A1b 'Petroleum Refining', 1A1c 'Manufacture of Solid Fuels');
- 1A2 'Manufacturing Industries and Construction';
- 1A3 'Transport' (1A3a 'Civil Aviation', 1A3b 'Road Transportation', 1A3c 'Railways', 1A3d 'Navigation', 1A3e 'Other Transportation');
- 1A4 'Other Sectors' (1A4a 'Commercial/Institutional', 1A4b 'Residential', 1A4c 'Agriculture/Forestry/Fishing');
- 1A5 'Other'.

Sub-sector 1B 'Fugitive Emissions from Fuels'

- 1B2 'Oil and Natural Gas'.

'Memo items'

- 'International Aviation';
- 'CO_2 Emissions from Biomass'.

A brief overview, methodological issues, uncertainty assessment and times-series consistency, QA/QC and verification, and information regarding recalculations made and planned improvements are described for each source category in this sector.

3.1.1. Summary of Emission Trends

Between 1990 and 2022, the total GHG emissions from Sector 1 'Energy' recorded a downward trend, decreasing by 75.1% (Table 3-1, Figure 3-1).

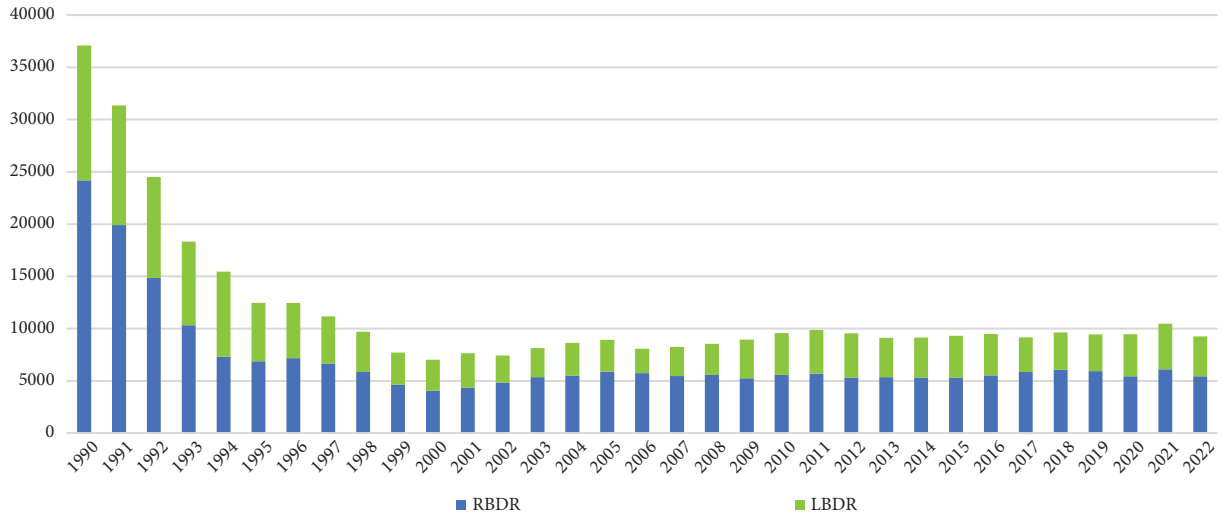


Figure 3-1: Total direct GHG emissions from Sector 1 'Energy' between 1990 and 2022, kt CO_2 equivalent (RBDR – Right Bank of the Dniester River, LBDR – Left Bank of the Dniester River).

Table 3-1: Total direct GHG emissions from Sector 1 'Energy' between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Sector 1 'Energy', kt CO_2 equivalent	37,087.56	31,348.82	24,501.07	18,321.97	15,453.99	12,467.03	12,462.93	11,181.69	9,708.68	7,704.88	7,018.53
%, compared to 1990	100.00	84.53	66.06	49.40	41.67	33.62	33.60	30.15	26.18	20.77	18.92
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Sector 1 'Energy', kt CO_2 equivalent	7,647.24	7,437.76	8,130.01	8,637.54	8,935.27	8,070.72	8,247.81	8,544.04	8,955.84	9,574.49	9,875.71
%, compared to 1990	20.62	20.05	21.92	23.29	24.09	21.76	22.24	23.04	24.15	25.82	26.63
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Sector 1 'Energy', kt CO_2 equivalent	9,553.17	9,116.08	9,131.98	9,317.70	9,478.03	9,158.19	9,641.29	9,450.40	9,466.98	10,460.91	9,249.65
%, compared to 1990	25.76	24.58	24.62	25.12	25.56	24.69	26.00	25.48	25.53	28.21	24.94

The evolution of total direct GHG emissions from these regions recorded similar trends between 1990 and 2022 (Table 3-2). The share of direct GHG emissions varied over the period 1990-2022 on the right bank of the Dniester, from 65.2% to 58.8%, whereas on the left bank of the Dniester – from 34.8% to 41.2%.

Table 3-2: Total direct GHG emissions from Sector 1 'Energy' on the RBDR and LBDR between 1990 and 2022

	Total GHG emissions, kt CO_2 equivalent			% of the total		% compared to 1990		
	RBDR	LBDR	RoM	RBDR	LBDR	RBDR	LBDR	RoM
1990	24,187.64	12,899.92	37,087.56	65.2	34.8	100.0	100.0	100.0
1991	19,897.31	11,451.50	31,348.82	63.5	36.5	82.3	88.8	84.5
1992	14,853.09	9,647.98	24,501.07	60.6	39.4	61.4	74.8	66.1
1993	10,317.74	8,004.23	18,321.97	56.3	43.7	42.7	62.0	49.4
1994	7,323.92	8,130.07	15,453.99	47.4	52.6	30.3	63.0	41.7
1995	6,872.93	5,594.09	12,467.03	55.1	44.9	28.4	43.4	33.6
1996	7,164.24	5,298.69	12,462.93	57.5	42.5	29.6	41.1	33.6
1997	6,665.28	4,516.41	11,181.69	59.6	40.4	27.6	35.0	30.1
1998	5,849.98	3,858.70	9,708.68	60.3	39.7	24.2	29.9	26.2
1999	4,618.81	3,086.07	7,704.88	59.9	40.1	19.1	23.9	20.8
2000	4,070.29	2,948.24	7,018.53	58.0	42.0	16.8	22.9	18.9
2001	4,356.25	3,290.99	7,647.24	57.0	43.0	18.0	25.5	20.6
2002	4,848.44	2,589.32	7,437.76	65.2	34.8	20.0	20.1	20.1
2003	5,365.31	2,764.70	8,130.01	66.0	34.0	22.2	21.4	21.9
2004	5,500.75	3,136.78	8,637.54	63.7	36.3	22.7	24.3	23.3
2005	5,887.75	3,047.52	8,935.27	65.9	34.1	24.3	23.6	24.1
2006	5,743.25	2,327.48	8,070.72	71.2	28.8	23.7	18.0	21.8
2007	5,469.12	2,778.69	8,247.81	66.3	33.7	22.6	21.5	22.2
2008	5,567.48	2,976.57	8,544.04	65.2	34.8	23.0	23.1	23.0
2009	5,255.12	3,700.72	8,955.84	58.7	41.3	21.7	28.7	24.1
2010	5,559.94	4,014.55	9,574.49	58.1	41.9	23.0	31.1	25.8
2011	5,707.49	4,168.22	9,875.71	57.8	42.2	23.6	32.3	26.6
2012	5,313.55	4,239.62	9,553.17	55.6	44.4	22.0	32.9	25.8
2013	5,356.76	3,759.31	9,116.08	58.8	41.2	22.1	29.1	24.6
2014	5,302.28	3,829.70	9,131.98	58.1	41.9	21.9	29.7	24.6
2015	5,311.05	4,006.65	9,317.70	57.0	43.0	22.0	31.1	25.1
2016	5,528.25	3,949.77	9,478.03	58.3	41.7	22.9	30.6	25.6
2017	5,854.65	3,303.54	9,158.19	63.9	36.1	24.2	25.6	24.7
2018	6,059.01	3,582.28	9,641.29	62.8	37.2	25.1	27.8	26.0
2019	5,927.60	3,522.80	9,450.40	62.7	37.3	24.5	27.3	25.5
2020	5,449.75	4,017.22	9,466.98	57.6	42.4	22.5	31.1	25.5
2021	6,112.39	4,348.52	10,460.91	58.4	41.6	25.3	33.7	28.2
2022	5,441.13	3,808.52	9,249.65	58.8	41.2	22.5	29.5	24.9

Compared to 1990 year level, direct GHG emissions had decreased significantly by 2022: CO_2 emissions constituted circa 24.6% of the reference year level, CH_4 emissions – 31.9%, N_2O emissions – 32.5%, and total direct GHG emissions – 24.9% (Table 3-3, Figure 3-2).

Table 3-3: Total direct GHG emissions from Sector 1 'Energy' in the RoM between 1990 and 2022

	Sector 1 'Energy', kt CO_2 equivalent				% of the total			%, compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	35,384.04	1,396.21	307.30	37,087.56	95.41	3.76	0.83	100.00	100.00	100.00	100.00
1991	29,884.36	1,235.57	228.88	31,348.82	95.33	3.94	0.73	84.46	88.49	74.48	84.53
1992	23,300.20	1,041.06	159.81	24,501.07	95.10	4.25	0.65	65.85	74.56	52.00	66.06
1993	17,333.44	856.01	132.51	18,321.97	94.60	4.67	0.72	48.99	61.31	43.12	49.40
1994	14,492.41	841.40	120.18	15,453.99	93.78	5.44	0.78	40.96	60.26	39.11	41.67
1995	11,471.70	881.26	114.07	12,467.03	92.02	7.07	0.91	32.42	63.12	37.12	33.62
1996	11,375.14	988.56	99.23	12,462.93	91.27	7.93	0.80	32.15	70.80	32.29	33.60
1997	10,258.32	832.50	90.87	11,181.69	91.74	7.45	0.81	28.99	59.63	29.57	30.15
1998	8,874.91	763.08	70.69	9,708.68	91.41	7.86	0.73	25.08	54.65	23.00	26.18
1999	6,903.73	752.83	48.32	7,704.88	89.60	9.77	0.63	19.51	53.92	15.72	20.77
2000	6,188.57	786.86	43.10	7,018.53	88.17	11.21	0.61	17.49	56.36	14.03	18.92
2001	6,818.02	784.96	44.26	7,647.24	89.16	10.26	0.58	19.27	56.22	14.40	20.62
2002	6,537.00	843.89	56.87	7,437.76	87.89	11.35	0.76	18.47	60.44	18.50	20.05
2003	7,178.52	896.20	55.29	8,130.01	88.30	11.02	0.68	20.29	64.19	17.99	21.92
2004	7,626.66	954.89	55.99	8,637.54	88.30	11.06	0.65	21.55	68.39	18.22	23.29
2005	7,871.74	1,007.54	55.99	8,935.27	88.10	11.28	0.63	22.25	72.16	18.22	24.09
2006	7,113.56	899.82	57.35	8,070.72	88.14	11.15	0.71	20.10	64.45	18.66	21.76
2007	7,250.36	942.02	55.44	8,247.81	87.91	11.42	0.67	20.49	67.47	18.04	22.24
2008	7,547.68	940.00	56.37	8,544.04	88.34	11.00	0.66	21.33	67.32	18.34	23.04
2009	8,093.50	811.10	51.24	8,955.84	90.37	9.06	0.57	22.87	58.09	16.67	24.15
2010	8,718.00	800.72	55.77	9,574.49	91.05	8.36	0.58	24.64	57.35	18.15	25.82
2011	8,926.20	892.18	57.34	9,875.71	90.39	9.03	0.58	25.23	63.90	18.66	26.63
2012	8,613.94	885.74	53.49	9,553.17	90.17	9.27	0.56	24.34	63.44	17.40	25.76
2013	8,224.92	833.02	58.14	9,116.08	90.22	9.14	0.64	23.24	59.66	18.92	24.58
2014	8,190.75	876.65	64.58	9,131.98	89.69	9.60	0.71	23.15	62.79	21.01	24.62
2015	8,391.24	855.52	70.94	9,317.70	90.06	9.18	0.76	23.71	61.27	23.08	25.12
2016	8,484.95	916.98	76.10	9,478.03	89.52	9.67	0.80	23.98	65.68	24.76	25.56
2017	8,070.00	999.94	88.25	9,158.19	88.12	10.92	0.96	22.81	71.62	28.72	24.69
2018	8,482.65	1,057.18	101.46	9,641.29	87.98	10.97	1.05	23.97	75.72	33.02	26.00
2019	8,560.27	788.83	101.30	9,450.40	90.58	8.35	1.07	24.19	56.50	32.96	25.48
2020	8,842.15	526.32	98.50	9,466.98	93.40	5.56	1.04	24.99	37.70	32.05	25.53
2021	9,817.04	531.66	112.21	10,460.91	93.85	5.08	1.07	27.74	38.08	36.51	28.21
2022	8,705.13	444.76	99.77	9,249.65	94.11	4.81	1.08	24.60	31.85	32.47	24.94

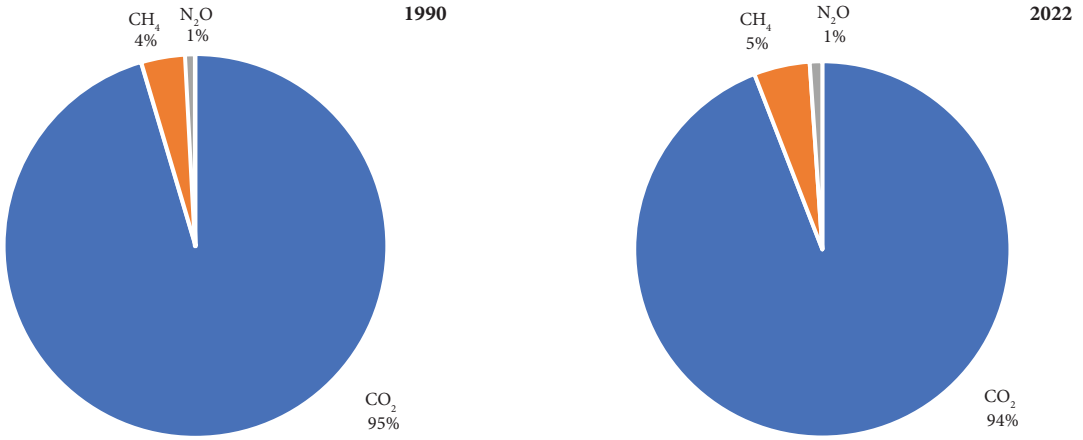


Figure 3-2: Share of direct GHG emissions from Sector 1 'Energy' in total direct GHG emissions in 1990 and 2022, % of total.

Direct GHG emissions varied between 1990-2022: on the RBDR – between 24,187.6 and 5,441.1 kt CO_2 equivalent, whereas on the LBDR between 12,899.9 and 3,808.5 kt CO_2 equivalent (Table 3-4).

Table 3-4: Direct GHG emissions from Sector 1 'Energy' between 1990 and 2022 by region, kt CO_2 equivalent

	RBDR				LBDR				RoM	% of the total	
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	Total	RBDR	LBDR
1990	22,548.16	1,383.15	256.33	24,187.64	12,835.89	13.06	50.97	12,899.92	37,087.56	65.2	34.8
1991	18,487.75	1,225.13	184.43	19,897.31	11,396.60	10.44	44.46	11,451.50	31,348.82	63.5	36.5
1992	13,694.83	1,032.68	125.58	14,853.09	9,605.37	8.38	34.23	9,647.98	24,501.07	60.6	39.4
1993	9,365.05	849.58	103.10	10,317.74	7,968.39	6.43	29.41	8,004.23	18,321.97	56.3	43.7
1994	6,478.61	749.72	95.59	7,323.92	8,013.80	91.68	24.59	8,130.07	15,453.99	47.4	52.6
1995	5,969.69	813.01	90.23	6,872.93	5,502.01	68.25	23.83	5,594.09	12,467.03	55.1	44.9
1996	6,175.94	910.02	78.28	7,164.24	5,199.20	78.54	20.95	5,298.69	12,462.93	57.5	42.5
1997	5,846.97	745.38	72.93	6,665.28	4,411.35	87.12	17.94	4,516.41	11,181.69	59.6	40.4
1998	5,109.64	683.70	56.65	5,849.98	3,765.28	79.38	14.04	3,858.70	9,708.68	60.3	39.7
1999	3,905.58	674.97	38.26	4,618.81	2,998.14	77.86	10.07	3,086.07	7,704.88	59.9	40.1
2000	3,322.82	712.69	34.78	4,070.29	2,865.75	74.17	8.32	2,948.24	7,018.53	58.0	42.0
2001	3,618.57	702.05	35.62	4,356.25	3,199.45	82.90	8.63	3,290.99	7,647.24	57.0	43.0
2002	4,019.41	780.64	48.39	4,848.44	2,517.60	63.24	8.48	2,589.32	7,437.76	65.2	34.8
2003	4,489.42	827.87	48.02	5,365.31	2,689.09	68.33	7.27	2,764.70	8,130.01	66.0	34.0
2004	4,574.11	878.36	48.29	5,500.75	3,052.54	76.53	7.71	3,136.78	8,637.54	63.7	36.3
2005	4,906.21	932.53	49.01	5,887.75	2,965.52	75.01	6.99	3,047.52	8,935.27	65.9	34.1
2006	4,849.63	842.87	50.75	5,743.25	2,263.93	56.95	6.60	2,327.48	8,070.72	71.2	28.8
2007	4,546.49	873.87	48.76	5,469.12	2,703.87	68.15	6.68	2,778.69	8,247.81	66.3	33.7
2008	4,650.89	866.99	49.59	5,567.48	2,896.78	73.00	6.78	2,976.57	8,544.04	65.2	34.8
2009	4,492.97	717.94	44.21	5,255.12	3,600.53	93.16	7.02	3,700.72	8,955.84	58.7	41.3
2010	4,813.06	700.06	46.82	5,559.94	3,904.94	100.66	8.95	4,014.55	9,574.49	58.1	41.9
2011	4,871.74	787.89	47.87	5,707.49	4,054.46	104.30	9.47	4,168.22	9,875.71	57.8	42.2
2012	4,489.26	780.25	44.03	5,313.55	4,124.68	105.49	9.45	4239.62	9,553.17	55.6	44.4
2013	4,551.36	759.72	45.69	5,356.76	3,673.57	73.30	12.45	3,759.31	9,116.08	58.8	41.2
2014	4,465.04	782.03	55.21	5,302.28	3,725.72	94.62	9.36	3,829.70	9,131.98	58.1	41.9
2015	4,493.28	756.62	61.15	5311.05	3,897.96	98.90	9.79	4,006.65	9,317.70	57.0	43.0
2016	4,639.68	819.52	69.06	5,528.25	3,845.27	97.46	7.04	3,949.77	9,478.03	58.3	41.7
2017	4,858.85	914.16	81.63	5,854.65	3,211.15	85.77	6.62	3,303.54	9,158.19	63.9	36.1
2018	5,000.28	964.00	94.73	6,059.01	3,482.37	93.17	6.73	3,582.28	9,641.29	62.8	37.2
2019	5,141.11	692.19	94.29	5,927.60	3,419.15	96.64	7.01	3,522.80	9,450.40	62.7	37.3
2020	4,933.73	424.45	91.58	5,449.75	3,908.42	101.88	6.92	4,017.22	9,466.98	57.6	42.4
2021	5,583.85	424.63	103.91	6,112.39	4,233.19	107.03	8.29	4,348.52	10,460.91	58.4	41.6
2022	4,997.85	350.91	92.37	5,441.13	3,707.27	93.85	7.40	3,808.52	9,249.65	58.8	41.2

Compared to 1990 year level, GHG emissions in the RoM had decreased significantly by 2022: CO_2 emissions constituted 24.6% of the reference year level, CH_4 and N_2O emissions – 31.9% and 32.5%, NO_x emissions – 26.4%, CO emissions – 42.9%, NMVOC emissions – 54.9%, and SO_2 emissions – 2.8% (Table 3-5).

Table 3-5: GHG emissions from Sector 1 'Energy' in the RoM between 1990-2022

	Sector 1 'Energy', kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	35,384.04	49.86	1.16	91.72	270.67	31.87	149.47	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	29,884.36	44.13	0.86	74.95	196.18	23.17	123.69	84.5	88.5	74.5	81.7	72.5	72.7	82.8
1992	23,300.20	37.18	0.60	56.59	124.61	15.07	91.50	65.8	74.6	52.0	61.7	46.0	47.3	61.2
1993	17,333.44	30.57	0.50	44.67	60.89	8.21	72.01	49.0	61.3	43.1	48.7	22.5	25.8	48.2
1994	14,492.41	30.05	0.45	35.25	68.52	8.83	57.04	41.0	60.3	39.1	38.4	25.3	27.7	38.2
1995	11,471.70	31.47	0.43	29.65	58.20	7.27	31.51	32.4	63.1	37.1	32.3	21.5	22.8	21.1
1996	11,375.14	35.31	0.37	27.92	71.30	8.71	31.74	32.1	70.8	32.3	30.4	26.3	27.3	21.2
1997	10,258.32	29.73	0.34	24.66	64.80	7.96	16.40	29.0	59.6	29.6	26.9	23.9	25.0	11.0
1998	8,874.91	27.25	0.27	20.61	49.10	6.33	12.18	25.1	54.7	23.0	22.5	18.1	19.9	8.2
1999	6,903.73	26.89	0.18	14.92	36.98	5.01	5.59	19.5	53.9	15.7	16.3	13.7	15.7	3.7
2000	6,188.57	28.10	0.16	13.57	34.60	4.90	4.07	17.5	56.4	14.0	14.8	12.8	15.4	2.7
2001	6,818.02	28.03	0.17	14.70	33.43	4.82	3.58	19.3	56.2	14.4	16.0	12.4	15.1	2.4
2002	6,537.00	30.14	0.21	15.59	40.70	5.89	4.39	18.5	60.4	18.5	17.0	15.0	18.5	2.9
2003	7,178.52	32.01	0.21	16.53	49.75	7.05	5.93	20.3	64.2	18.0	18.0	18.4	22.1	4.0
2004	7,626.66	34.10	0.21	17.69	46.42	7.07	4.98	21.6	68.4	18.2	19.3	17.1	22.2	3.3
2005	7,871.74	35.98	0.21	18.14	48.37	7.21	4.57	22.2	72.2	18.2	19.8	17.9	22.6	3.1

	Sector 1 'Energy', kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2006	7,113.56	32.14	0.22	17.00	49.26	7.33	4.70	20.1	64.4	18.7	18.5	18.2	23.0	3.1
2007	7,250.36	33.64	0.21	17.39	42.76	6.73	3.23	20.5	67.5	18.0	19.0	15.8	21.1	2.2
2008	7,547.68	33.57	0.21	18.05	45.40	7.32	4.79	21.3	67.3	18.3	19.7	16.8	23.0	3.2
2009	8,093.50	28.97	0.19	17.96	45.68	7.18	4.80	22.9	58.1	16.7	19.6	16.9	22.5	3.2
2010	8,718.00	28.60	0.21	19.82	48.31	7.21	4.88	24.6	57.3	18.1	21.6	17.8	22.6	3.3
2011	8,926.20	31.86	0.22	20.17	50.69	7.81	4.89	25.2	63.9	18.7	22.0	18.7	24.5	3.3
2012	8,613.94	31.63	0.20	19.08	49.57	7.62	5.04	24.3	63.4	17.4	20.8	18.3	23.9	3.4
2013	8,224.92	29.75	0.22	19.17	50.58	7.56	12.54	23.2	59.7	18.9	20.9	18.7	23.7	8.4
2014	8,190.75	31.31	0.24	19.11	77.65	11.71	4.53	23.1	62.8	21.0	20.8	28.7	36.8	3.0
2015	8,391.24	30.55	0.27	20.39	82.09	12.44	4.17	23.7	61.3	23.1	22.2	30.3	39.0	2.8
2016	8,484.95	32.75	0.29	21.41	86.00	13.18	3.43	24.0	65.7	24.8	23.3	31.8	41.4	2.3
2017	8,070.00	35.71	0.33	21.69	108.10	16.39	4.31	22.8	71.6	28.7	23.6	39.9	51.4	2.9
2018	8,482.65	37.76	0.38	23.03	157.08	23.91	3.54	24.0	75.7	33.0	25.1	58.0	75.0	2.4
2019	8,560.27	28.17	0.38	23.30	141.58	21.18	4.30	24.2	56.5	33.0	25.4	52.3	66.5	2.9
2020	8,842.15	18.80	0.37	23.44	136.21	20.43	3.33	25.0	37.7	32.1	25.6	50.3	64.1	2.2
2021	9,817.04	18.99	0.42	26.56	138.38	20.67	5.90	27.7	38.1	36.5	29.0	51.1	64.9	3.9
2022	8,705.13	15.88	0.38	24.22	116.11	17.50	4.16	24.6	31.9	32.5	26.4	42.9	54.9	2.8

The evolution of direct and indirect GHG emissions is shown in Table 3-6.

Table 3-6: GHG emissions from Sector 1 'Energy', by region, between 1990 and 2022, kt

	RBDR							LBDR						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	22,548.16	49.40	0.97	64.43	255.81	30.07	75.03	12,835.89	0.47	0.19	27.29	14.87	1.79	74.44
1991	18,487.75	43.75	0.70	50.80	184.34	21.76	58.02	11,396.60	0.37	0.17	24.15	11.84	1.41	65.67
1992	13,694.83	36.88	0.47	36.76	115.63	14.02	40.91	9,605.37	0.30	0.13	19.84	8.98	1.05	50.59
1993	9,365.05	30.34	0.39	27.92	54.92	7.50	25.50	7,968.39	0.23	0.11	16.74	5.96	0.72	46.51
1994	6,478.61	26.78	0.36	19.26	62.38	7.93	17.26	8,013.80	3.27	0.09	15.99	6.14	0.90	39.78
1995	5,969.69	29.04	0.34	18.43	44.57	6.28	12.49	5,502.01	2.44	0.09	11.23	13.64	0.99	19.02
1996	6,175.94	32.50	0.30	17.40	60.75	7.85	14.37	5,199.20	2.80	0.08	10.52	10.55	0.86	17.36
1997	5,846.97	26.62	0.28	16.31	52.20	6.98	10.32	4,411.35	3.11	0.07	8.35	12.60	0.98	6.08
1998	5,109.64	24.42	0.21	13.67	39.16	5.46	7.77	3,765.28	2.84	0.05	6.93	9.94	0.88	4.41
1999	3,905.58	24.11	0.14	9.68	30.68	4.38	5.53	2,998.14	2.78	0.04	5.24	6.30	0.63	0.05
2000	3,322.82	25.45	0.13	8.59	29.46	4.31	4.02	2,865.75	2.65	0.03	4.98	5.15	0.59	0.05
2001	3,618.57	25.07	0.13	9.16	27.99	4.17	3.53	3,199.45	2.96	0.03	5.54	5.44	0.65	0.05
2002	4,019.41	27.88	0.18	11.00	35.58	5.26	4.34	2,517.60	2.26	0.03	4.59	5.12	0.64	0.05
2003	4,489.42	29.57	0.18	11.80	44.11	6.36	5.88	2,689.09	2.44	0.03	4.73	5.64	0.69	0.05
2004	4,574.11	31.37	0.18	12.46	41.04	6.29	4.93	3,052.54	2.73	0.03	5.23	5.37	0.78	0.05
2005	4,906.21	33.30	0.18	13.04	43.13	6.45	4.54	2,965.52	2.68	0.03	5.10	5.24	0.76	0.03
2006	4,849.63	30.10	0.19	13.02	44.80	6.64	4.68	2,263.93	2.03	0.02	3.98	4.46	0.69	0.02
2007	4,546.49	31.21	0.18	12.69	38.07	6.03	3.20	2,703.87	2.43	0.03	4.70	4.69	0.69	0.02
2008	4,650.89	30.96	0.19	13.04	40.56	6.58	4.76	2,896.78	2.61	0.03	5.01	4.85	0.73	0.03
2009	4,492.97	25.64	0.17	11.81	39.89	6.45	4.77	3,600.53	3.33	0.03	6.15	5.80	0.73	0.03
2010	4,813.06	25.00	0.18	13.02	42.18	6.43	4.86	3,904.94	3.59	0.03	6.80	6.13	0.77	0.03
2011	4,871.74	28.14	0.18	13.25	44.58	6.90	4.86	4,054.46	3.72	0.04	6.91	6.10	0.90	0.03
2012	4,489.26	27.87	0.17	12.07	44.08	6.80	4.69	4,124.68	3.77	0.04	7.00	5.49	0.83	0.35
2013	4,551.36	27.13	0.17	12.34	45.73	6.90	5.97	3,673.57	2.62	0.05	6.83	4.85	0.67	6.57
2014	4,465.04	27.93	0.21	12.51	71.88	10.92	4.42	3,725.72	3.38	0.04	6.61	5.77	0.79	0.11
2015	4,493.28	27.02	0.23	13.44	76.15	11.70	4.08	3,897.96	3.53	0.04	6.95	5.94	0.74	0.09
2016	4,639.68	29.27	0.26	14.72	80.76	12.49	3.22	3,845.27	3.48	0.03	6.68	5.24	0.69	0.22
2017	4,858.85	32.65	0.31	16.02	103.42	15.77	4.27	3,211.15	3.06	0.02	5.67	4.69	0.62	0.04
2018	5,000.28	34.43	0.36	16.95	152.09	23.25	3.49	3,482.37	3.33	0.03	6.08	4.99	0.66	0.05
2019	5,141.11	24.72	0.36	17.25	136.37	20.49	4.26	3,419.15	3.45	0.03	6.06	5.21	0.70	0.04
2020	4,933.73	15.16	0.35	16.64	130.94	19.74	3.30	3,908.42	3.64	0.03	6.79	5.28	0.69	0.04
2021	5,583.85	15.17	0.39	19.10	132.59	19.91	4.04	4,233.19	3.82	0.03	7.46	5.78	0.76	1.85
2022	4,997.85	12.53	0.35	17.68	110.75	16.78	4.14	3,707.27	3.35	0.03	6.55	5.36	0.72	0.02

Figures 3-3 and 3-4 and Table 3-7 shows the evolution of GHG emissions at source category level within Sector 1 'Energy' between 1990 and 2022, and the share of each source category from the total in the respective period.

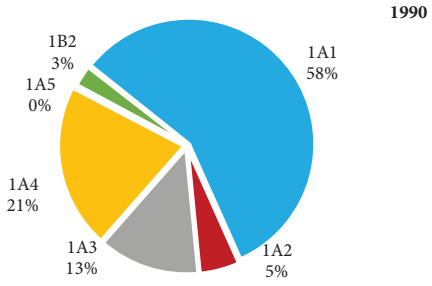


Figure 3-3: The share of different source categories in the structure of total direct GHG emissions from energy secor in 1990, % of total.

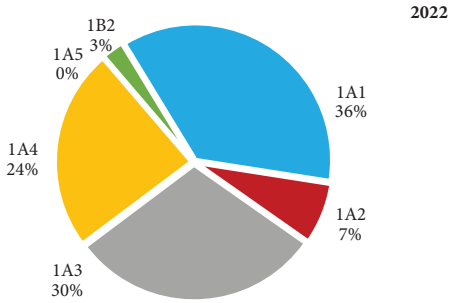


Figure 3-4: The share of different source categories in the structure of total direct GHG emissions from energy sector in 2022, % of total.

The source category with the largest share in national direct GHG emissions recorded in energy sector is 1A1 'Energy Industries', which decreased from 57.6% (1990) to la 36.2% (2022).

Table 3-7: Direct GHG emissions by source category in Sector 1 'Energy' between 1990-2022

	Sector 1 'Energy', kt CO_2 equivalent							Share of each category, % of the total					
	1A1	1A2	1A3	1A4	1A5	1B2	Total	1A1	1A2	1A3	1A4	1A5	1B2
1990	21,359.99	1,904.84	4,830.86	7,855.70	115.46	1,020.70	37,087.56	57.59	5.14	13.03	21.18	0.31	2.75
1991	18,980.28	1,273.22	3,762.74	6,259.50	107.48	965.59	31,348.82	60.55	4.06	12.00	19.97	0.34	3.08
1992	15,703.31	924.48	2,694.66	4,228.10	78.47	872.04	24,501.07	64.09	3.77	11.00	17.26	0.32	3.56
1993	12,676.53	612.12	1,916.56	2,238.79	94.26	783.70	18,321.97	69.19	3.34	10.46	12.22	0.51	4.28
1994	9,990.25	739.14	1,654.26	2,226.08	88.99	755.27	15,453.99	64.65	4.78	10.70	14.40	0.58	4.89
1995	7,191.16	382.22	1,658.41	2,281.29	126.51	827.44	12,467.03	57.68	3.07	13.30	18.30	1.01	6.64
1996	7,123.27	322.02	1,617.58	2,411.51	82.76	905.78	12,462.93	57.16	2.58	12.98	19.35	0.66	7.27
1997	5,625.19	548.02	1,553.23	2,609.85	77.41	767.99	11,181.69	50.31	4.90	13.89	23.34	0.69	6.87
1998	4,844.34	523.97	1,396.45	2,154.67	73.64	715.61	9,708.68	49.90	5.40	14.38	22.19	0.76	7.37
1999	3,664.61	474.57	931.24	1,874.96	49.77	709.73	7,704.88	47.56	6.16	12.09	24.33	0.65	9.21
2000	3,159.28	520.27	1,004.59	1,553.40	36.78	744.21	7,018.53	45.01	7.41	14.31	22.13	0.52	10.60
2001	3,681.88	601.33	1,086.09	1,488.25	43.86	745.82	7,647.24	48.15	7.86	14.20	19.46	0.57	9.75
2002	2,936.75	410.94	1,440.38	1,815.02	40.10	794.56	7,437.76	39.48	5.53	19.37	24.40	0.54	10.68
2003	3,040.33	439.42	1,624.14	2,163.57	28.79	833.76	8,130.01	37.40	5.40	19.98	26.61	0.35	10.26
2004	3,110.75	444.58	1,827.10	2,326.51	28.00	900.60	8,637.54	36.01	5.15	21.15	26.93	0.32	10.43
2005	3,233.22	575.18	1,864.52	2,285.56	26.26	950.54	8,935.27	36.18	6.44	20.87	25.58	0.29	10.64
2006	2,495.89	635.44	1,785.12	2,277.37	39.46	837.45	8,070.72	30.93	7.87	22.12	28.22	0.49	10.38
2007	2,893.79	801.69	1,891.74	1,722.83	45.08	892.70	8,247.81	35.09	9.72	22.94	20.89	0.55	10.82
2008	2,994.57	887.09	1,995.91	1,733.67	44.13	888.68	8,544.04	35.05	10.38	23.36	20.29	0.52	10.40
2009	3,840.36	503.39	1,961.51	1,883.51	10.59	756.49	8,955.84	42.88	5.62	21.90	21.03	0.12	8.45
2010	4,053.06	517.00	2,185.47	2,049.60	27.51	741.85	9,574.49	42.33	5.40	22.83	21.41	0.29	7.75
2011	3,750.68	577.13	2,319.77	2,378.26	19.94	829.95	9,875.71	37.98	5.84	23.49	24.08	0.20	8.40
2012	3,808.15	539.60	2,034.45	2,345.27	7.00	818.70	9,553.17	39.86	5.65	21.30	24.55	0.07	8.57
2013	3,605.95	575.00	2,143.31	2,024.94	2.39	764.49	9,116.08	39.56	6.31	23.51	22.21	0.03	8.39
2014	3,560.48	564.08	2,180.29	2,075.21	2.42	749.49	9,131.98	38.99	6.18	23.88	22.72	0.03	8.21
2015	3,688.43	654.13	2,305.29	1,947.77	1.83	720.25	9,317.70	39.59	7.02	24.74	20.90	0.02	7.73
2016	3,648.99	643.57	2,478.57	1,934.72	1.22	770.95	9,478.03	38.50	6.79	26.15	20.41	0.01	8.13
2017	2,999.89	661.07	2,500.58	2,188.91	1.17	806.57	9,158.19	32.76	7.22	27.30	23.90	0.01	8.81
2018	3,258.96	751.30	2,579.00	2,290.05	1.19	760.78	9,641.29	33.80	7.79	26.75	23.75	0.01	7.89
2019	3,127.91	718.39	2,662.34	2,412.41	1.25	528.10	9,450.40	33.10	7.60	28.17	25.53	0.01	5.59
2020	3,638.38	694.91	2,508.94	2,350.07	1.19	273.49	9,466.98	38.43	7.34	26.50	24.82	0.01	2.89
2021	3,936.22	757.79	2,775.47	2,711.79	1.60	278.04	10,460.91	37.63	7.24	26.53	25.92	0.02	2.66
2022	3,345.93	672.30	2,776.78	2,217.25	2.70	234.70	9,249.65	36.17	7.27	30.02	23.97	0.03	2.54

Compared to the level recorded in 1990, by 2022, the share of certain categories had increased in the structure of total sectoral direct GHG emissions: 1A2 'Manufacturing Industries and Construction' (from 5.1% to 7.3%), 1A3 'Transport' (from 13.0% to 30.0%), 1A4 'Other Sectors' (from 21.2% to 24.0%), while the share of category 1B2 'Fugitive Emissions from Oil and Natural Gas' has decreased from 2.8% to 2.5% (Table 3-4, Figure 3-5).

The share of sub-sector 'Stationary combustion', with GHG emissions from source categories 1A1, 1A2, 1A4 and 1A5, had decreased from 82% (1990) to 65% (2022) (Figure 3-6).

Respectively, the share of GHG emissions originating from sub-sector 'Mobile combustion', source categories 1A3, 1A4 and 1A5, increased from about 18% (1990) to 35% (2022) (Table 3-8).

Table 3-8: GHG emissions from 'Stationary combustion' and 'Mobile combustion' within Sector 1 'Energy' between 1990-2022

	Sector 1 'Energy', kt CO_2 equivalent			% of total		%, compared to 1990	
	Stationary	Mobile	Total	Stationary	Mobile	Stationary	Mobile
1990	29,632.45	6,434.41	36,066.86	82.2	17.8	100.0	100.0
1991	25,580.00	4,803.23	30,383.23	84.2	15.8	86.3	74.6
1992	20,294.78	3,334.24	23,629.03	85.9	14.1	68.5	51.8
1993	15,051.51	2,486.75	17,538.26	85.8	14.2	50.8	38.6
1994	12,355.59	2,343.13	14,698.72	84.1	15.9	41.7	36.4
1995	9,200.97	2,438.62	11,639.59	79.0	21.0	31.1	37.9
1996	9,314.95	2,242.19	11,557.14	80.6	19.4	31.4	34.8
1997	8,239.24	2,174.46	10,413.70	79.1	20.9	27.8	33.8
1998	7,139.75	1,853.33	8,993.08	79.4	20.6	24.1	28.8
1999	5,738.02	1,257.14	6,995.16	82.0	18.0	19.4	19.5
2000	5,022.21	1,252.11	6,274.33	80.0	20.0	16.9	19.5
2001	5,570.28	1,331.13	6,901.41	80.7	19.3	18.8	20.7
2002	4,918.94	1,724.26	6,643.20	74.0	26.0	16.6	26.8
2003	5,415.15	1,881.10	7,296.25	74.2	25.8	18.3	29.2
2004	5,672.76	2,064.18	7,736.94	73.3	26.7	19.1	32.1
2005	5,910.28	2,074.45	7,984.74	74.0	26.0	19.9	32.2
2006	5,237.77	1,995.50	7,233.28	72.4	27.6	17.7	31.0
2007	5,270.12	2,085.00	7,355.12	71.7	28.3	17.8	32.4
2008	5,477.38	2,177.99	7,655.37	71.5	28.5	18.5	33.8
2009	6,086.38	2,112.98	8,199.36	74.2	25.8	20.5	32.8
2010	6,478.27	2,354.37	8,832.63	73.3	26.7	21.9	36.6
2011	6,560.67	2,485.09	9,045.77	72.5	27.5	22.1	38.6
2012	6,541.41	2,192.70	8,734.11	74.9	25.1	22.1	34.1
2013	6,034.88	2,316.26	8,351.14	72.3	27.7	20.4	36.0
2014	5,987.50	2,394.77	8,382.27	71.4	28.6	20.2	37.2
2015	6,053.59	2,539.54	8,593.12	70.4	29.6	20.4	39.5
2016	5,998.99	2,703.60	8,702.59	68.9	31.1	20.2	42.0
2017	5,539.81	2,807.55	8,347.36	66.4	33.6	18.7	43.6
2018	5,993.13	2,883.97	8,877.10	67.5	32.5	20.2	44.8
2019	5,910.92	3,009.62	8,920.55	66.3	33.7	19.9	46.8
2020	6,338.44	2,853.05	9,191.50	69.0	31.0	21.4	44.3
2021	6,957.25	3,224.37	10,181.62	68.3	31.7	23.5	50.1
2022	5,861.08	3,152.47	9,013.54	65.0	35.0	19.8	49.0

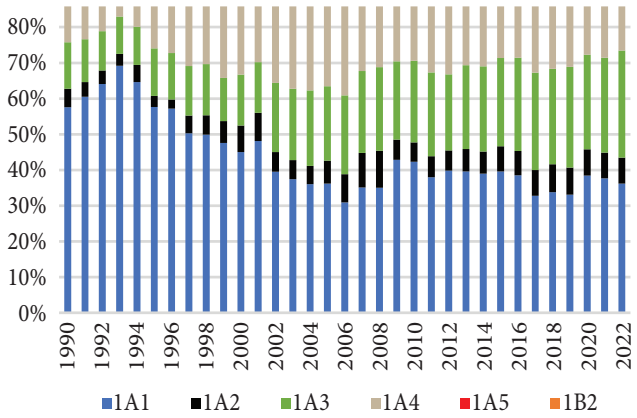


Figure 3-5: The share of different source categories in the structure of total direct GHG emissions from Sector 1 'Energy' between 1990 and 2022, % of total.

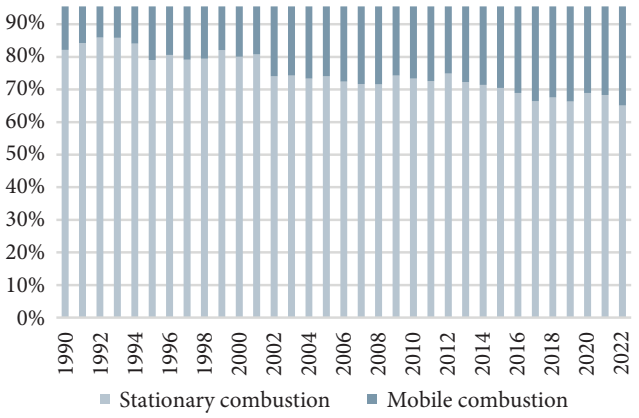


Figure 3-6: The share of direct GHG emissions from categories 'Stationary combustion' and 'Mobile combustion' in Sector 1 'Energy', % of total from the total in sub-sector 1A.

In the structure of the total GHG emissions originating from Sector 1 'Energy', the share of fugitive emissions from sub-sector 1B 'Fugitive emissions from fuels' recorded an downward trend – from 2.8% in 1990 to 2.5% in 2022.Respectively, the share of GHG emissions originating from sub-sector 1A 'Fuel Combustion' increased from 97.2% in 1990 to 97.5% in 2022 (Figure 3-7, Table 3-9).

Table 3-9: Direct GHG emissions from sub-sectors 1A 'Fuel Combustion' and 1B 'Fugitive Emissions from Fuels' within Sector 1 'Energy' between 1990-2022

	Sector 1 'Energy', kt CO_2 equivalent			% of total		%, compared to 1990		
	1A Fuel Combustion	1B Fugitive Emissions	Total	1A Fuel Combustion	1B Fugitive Emissions	1A Fuel Combustion	1B Fugitive Emissions	Total
1990	36,066.86	1,020.70	37,087.56	97.2	2.8	100.0	100.0	100.0
1991	30,383.23	965.59	31,348.82	96.9	3.1	84.2	94.6	84.5
1992	23,629.03	872.04	24,501.07	96.4	3.6	65.5	85.4	66.1
1993	17,538.26	783.70	18,321.97	95.7	4.3	48.6	76.8	49.4
1994	14,698.72	755.27	15,453.99	95.1	4.9	40.8	74.0	41.7
1995	11,639.59	827.44	12,467.03	93.4	6.6	32.3	81.1	33.6
1996	11,557.14	905.78	12,462.93	92.7	7.3	32.0	88.7	33.6
1997	10,413.70	767.99	11,181.69	93.1	6.9	28.9	75.2	30.1
1998	8,993.08	715.61	9,708.68	92.6	7.4	24.9	70.1	26.2
1999	6,995.16	709.73	7,704.88	90.8	9.2	19.4	69.5	20.8
2000	6,274.33	744.21	7,018.53	89.4	10.6	17.4	72.9	18.9
2001	6,901.41	745.82	7,647.24	90.2	9.8	19.1	73.1	20.6
2002	6,643.20	794.56	7,437.76	89.3	10.7	18.4	77.8	20.1
2003	7,296.25	833.76	8,130.01	89.7	10.3	20.2	81.7	21.9
2004	7,736.94	900.60	8,637.54	89.6	10.4	21.5	88.2	23.3
2005	7,984.74	950.54	8,935.27	89.4	10.6	22.1	93.1	24.1
2006	7,233.28	837.45	8,070.72	89.6	10.4	20.1	82.0	21.8
2007	7,355.12	892.70	8,247.81	89.2	10.8	20.4	87.5	22.2
2008	7,655.37	888.68	8,544.04	89.6	10.4	21.2	87.1	23.0
2009	8,199.36	756.49	8,955.84	91.6	8.4	22.7	74.1	24.1
2010	8,832.63	741.85	9,574.49	92.3	7.7	24.5	72.7	25.8
2011	9,045.77	829.95	9,875.71	91.6	8.4	25.1	81.3	26.6
2012	8,734.47	818.70	9,553.17	91.4	8.6	24.2	80.2	25.8
2013	8,351.58	764.49	9,116.08	91.6	8.4	23.2	74.9	24.6
2014	8,382.49	749.49	9,131.98	91.8	8.2	23.2	73.4	24.6
2015	8,597.45	720.25	9,317.70	92.3	7.7	23.8	70.6	25.1
2016	8,707.08	770.95	9,478.03	91.9	8.1	24.1	75.5	25.6
2017	8,351.62	806.57	9,158.19	91.2	8.8	23.2	79.0	24.7
2018	8,880.51	760.78	9,641.29	92.1	7.9	24.6	74.5	26.0
2019	8,922.30	528.10	9,450.40	94.4	5.6	24.7	51.7	25.5
2020	9,193.48	273.49	9,466.98	97.1	2.9	25.5	26.8	25.5
2021	10,182.87	278.04	10,460.91	97.3	2.7	28.2	27.2	28.2
2022	9,014.96	234.70	9,249.65	97.5	2.5	25.0	23.0	24.9

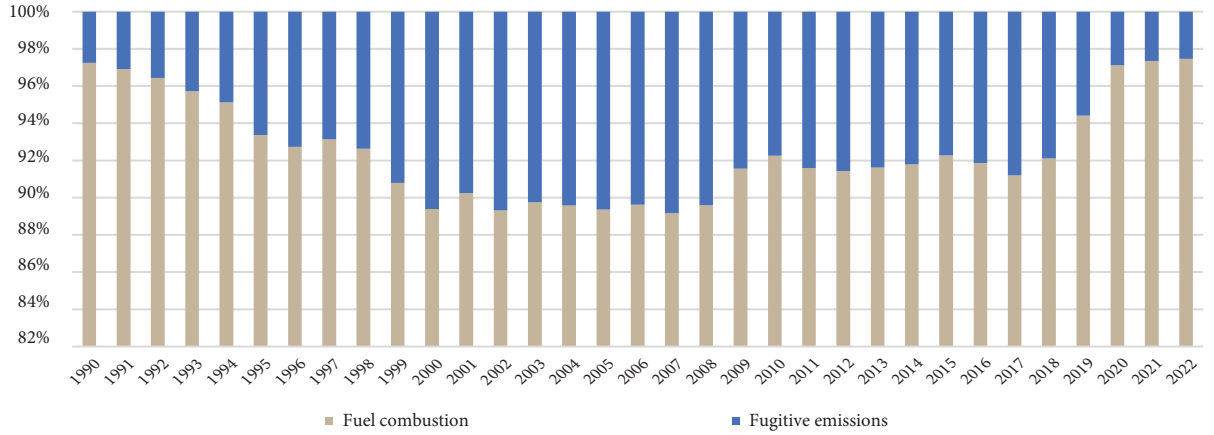


Figure 3-7: Share of GHG emissions from sub-sectors 1A 'Fuel Combustion' and 1B 'Fugitive Emissions from Fuels' within Sector 1 'Energy' for the period 1990-2022, % of total.

3.1.2. Key Categories

The results of key category analysis (with LULUCF), which were carried out following a Tier 1 approach are provided in Annex 1 of this Report. Table 3-10 provides information on identified key categories (assessment by level – L, and trend – T) in Sector 1 'Energy'.

Table 3-10: Key categories in Sector 1 'Energy'

IPCC Category	GHG	Source Category	Key Categories	Comments
1.A.1	CO_2	CO_2 Emissions from Energy Industries	Yes (L, T)	The Tier 1 method was used. There are no national emission factors available to use the Tier 2 method whereas for the Tier 3 method there are insufficient activity data necessary, disaggregated by sub-category.
1.A.1	CH_4	CH_4 Emissions from Energy Industries	No	
1.A.1	N_2O	N_2O Emissions from Energy Industries	No	
1.A.2	CO_2	CO_2 Emissions from Manufacturing Industries and Construction	Yes (L, T)	The Tier 1 method was used. There are no national EFs available to use the Tier 2 method whereas for the Tier 3 method there are insufficient AD necessary, disaggregated by sub-category (at energy installations at industrial enterprises).
1.A.2	CH_4	CH_4 Emissions from Manufacturing Industries and Construction	No	
1.A.2	N_2O	N_2O Emissions from Manufacturing Industries and Construction	No	
1.A.3a	CO_2	CO_2 Emissions from Civil Aviation	No	
1.A.3a	CH_4	CH_4 Emissions from Civil Aviation	No	
1.A.3a	N_2O	N_2O Emissions from Civil Aviation	No	
1.A.3b	CO_2	CO_2 Emissions from Road Transportation	Yes (L, T)	The Tier 1 method was used. It should be mentioned that the COPERT model is currently being studied (AD collection), which is equivalent to a Tier 3 method.
1.A.3b	CH_4	CH_4 Emissions from Road Transportation	No	
1.A.3b	N_2O	N_2O Emissions from Road Transportation	No	
1.A.3c	CO_2	CO_2 Emissions from Railways	Yes (L, T)	The Tier 1 method was used. It should be mentioned that, in the past few years, the share of this category in the Energy Sector is low (less than 1%). In such situations, using a high-rank method is not cost efficient.
1.A.3c	CH_4	CH_4 Emissions from Railways	No	
1.A.3c	N_2O	N_2O Emissions from Railways	No	
1.A.3d	CO_2	CO_2 Emissions from Water-borne Navigation	No	
1.A.3d	CH_4	CH_4 Emissions from Water-borne Navigation	No	
1.A.3d	N_2O	N_2O Emissions from Water-borne Navigation	No	
1.A.3e	CO_2	CO_2 Emissions from Other Transportation	No	
1.A.3e	CH_4	CH_4 Emissions from Other Transportation	No	
1.A.3e	N_2O	N_2O Emissions from Other Transportation	No	
1.A.4	CO_2	CO_2 from Other Sectors	Yes (L, T)	The Tier 1 method was used. There are no national EFs available to use the Tier 2 method whereas for the Tier 3 method there are insufficient AD necessary.
1.A.4	CH_4	CH_4 from Other Sectors	Yes (L, T)	The Tier 1 method was used. There are no national EFs available to use the Tier 2 method whereas for the Tier 3 method there are insufficient activity data necessary.
1.A.4	N_2O	N_2O from Other Sectors	No	
1.A.5	CO_2	CO_2 Emissions from Other works and energy needs	No	
1.A.5	CH_4	CH_4 Emissions from Other works and energy needs	No	
1.A.5	N_2O	N_2O Emissions from Other works and energy needs	No	
1.B.2	CO_2	CO_2 Fugitive Emissions from Oil and Natural Gas	No	
1.B.2	CH_4	CH_4 Fugitive Emissions from Oil and Natural Gas	Yes (L, T)	The Tier 1 method was used. There are no national EFs available to use the Tier 2 method whereas for the Tier 3 method there are insufficient AD necessary. In the past few years, the share of this category in the Energy Sector is low (less than 2%). In such situations, using a high-rank method is not cost efficient.
1.B.2	N_2O	N_2O Fugitive Emissions from Oil and Natural Gas	No	

3.1.3. Methodological Issues

Under Sector 1 'Energy', GHG emissions originating from 5 source categories were estimated within sub-sector 1A 'Fuel Combustion' (1A1, 1A2, 1A3, 1A4, and 1A5), 1 source category within sub-sector

1B 'Fugitive Emissions from Fuels' (1B2), and 2 source categories under Memo Items ('International Aviation', and 'CO_2 Emissions from Biomass').

GHG emissions originating from Sector 1 'Energy' were estimated following a Tier 1 approach, except for 'International Aviation', for which a Tier 2 methodology was applied (Table 3-11).

Table 3-11: Methods used to estimate GHG emissions from Sector 1 'Energy'

IPCC Categories	Source Category	Method	EF
1.A.1	Energy Industries	T1	D, CS
1.A.2	Manufacturing Industries and Construction	T1	D, CS
1.A.3	Transport (Civil Aviation, Road Transportation, Railways, Navigation, Pipeline Transport)	T1	D, CS
1.A.4	Other Sectors (Commercial/Institutional, Residential, Agriculture/Forestry/Fishing)	T1	D, CS
1.A.5	Other (Stationary/Mobile)	T1	D, CS
1.B.2	Fugitive Emissions from Oil and Natural Gas	T1	D
Memo items	International Aviation	T2	D, CS
Memo items	International Water-borne Navigation	T1	D, CS
Memo items	CO_2 Emissions from Biomass	T1	D, CS

Abbreviations: T1 – Tier 1; T2 – Tier 2; EF – Emission Factors; D – Default Values; CS – Country Specific.

For natural gas, country specific net annual average calorific values were used.

The basic equation used to estimate GHG emissions is described below:

$$GHG\ Emissions = \Sigma\ (Fuel\ Consumption_{\ j} \bullet Emission\ Factor_{\ j}),$$

where: j – type of fuel.

The main source of reference for activity data used for estimating GHG emissions under the Sector 1 'Energy' in the RoM is the National Bureau of Statistics (NBS), through its annual publication – Energy Balances for the years 1990, 1993-2022 (the Energy Balances for 2022 is presented in Annex 5-1.1) and Statistical Yearbooks, including those of ATULBD (activity data regarding fuel consumption on the territory on the Left Bank of the Dniester River are available in Annex 5-1.2).

In order to estimate emissions from all source categories within this sector, a large amount of detailed information on fuel consumption is needed. The main source of information is the Energy Balances. At the same time, the information provided directly by enterprises in the field of energy, transport, as well as ministries and agencies is also useful. The legal base for data requests is ensured under Law No. 93 of 26.05.2017 on Official Statistics, as well as Law No. 148 of 09.06.2023 on access to the public interest information.

The list of organisations that provide primary data for Sector 1 'Energy' is presented below:

1. National Bureau of Statistics, Direction for Industry, Energy and Construction Statistics;
2. JSC 'Termoelectrica';
3. JSC 'CHP-North';
4. Ministry of Energy;
5. Ministry of Defence, Service for Ecology and Environmental Protection;
6. Customs Service;
7. Public Services Agency;
8. Civil Aeronautical Authority;
9. SOE 'Moldova Railways';
10. 'Ungheni River Port';
11. 'Giurgiulesti International Free Port';
12. SOE 'Bacul Molovata';
13. 'Danube Logistics' Ltd.;
14. JSC 'Moldovagaz';
15. 'Moldovatransgaz' Ltd.;

16. 'Vestmoldtransgaz' Ltd.;
17. Environmental Protection Inspectorate;
18. Institute of Power Engineering of the Technical Unviersity of Moldova.

It should be noted that the Energy Balance (EB) for the year 1990 ensures geographical coverage of the entire country, while the EBs for the period 1993-2022 covered only the territory on the RBDR (in 1991-1992, the EBs were not published; it should also be noted that for 1990 and 1993-2014, the EBs were generated by the NBS in an MS DOS format, and only since 2015 were they generated and provided to users in the MS Excel format, which facilitates the data analysis and information use). The estimation of GHG emissions was based on CS values (Table 3-12).

Table 3-12: Emission factors and other relevant parameters used to estimate GHG emissions from Sector 1 'Energy'

Fuel Type	Net Calorific Value (CS Values), TJ/kt		Net Calorific Value, TJ/kt		Emission Factors, t C/TJ		Carbon oxidation fraction	
	Ranges according to the BNS	Value used	IPCC, 1997	IPCC, 2006	IPCC, 1997	IPCC, 2006	IPCC, 1997	IPCC, 2006
Coal	15.40 - 29.13		18.58				0.98	1
Anthracite	22.83 - 29.13		18.58	26.7	26.8	26.8	0.98	1
Brown Coal, including:	6.31 - 15.37		14.65	11.9	27.6	27.6	0.98	1
from Donetsk Coal Basin	25.70	25.70			26.8		0.98	1
from Kuznetsk Coal Basin	25.44	25.44			26.8		0.98	1
from the Ukrainian Coal Basin	6.31 - 11.68	11.68			27.6		0.98	1
from Kansk-Acinsk Coal Basin	15.14	15.14			25.8		0.98	1
Coal Briquettes	17.75	17.75		20.7	25.8	26.6	0.98	1
Coke	26.41 - 29.05	26.41	18.58	28.2	25.8	25.8	0.98	1
Diesel	42.54	42.54	43.33	43.0	20.2	20.2	0.99	1
Fuel for Oven	42.54	42.54			21.1		0.99	1
Residual Fuel Oil	39.02 - 40.20	40.20	40.19	40.4	21.1	21.1	0.99	1
Fuel for Engines	41.96	41.96			20.0		0.99	1
Including Jet engines	43.13				19.5		0.99	1
Aviation Gasoline	43.72	43.72	44.80	44.3	18.9	19.1	0.99	1
Gasoline	43.72	43.72	44.80	44.3	18.9	18.9	0.99	1
Kerosene	43.13	43.13	44.75	43.8	19.6	19.6	0.99	1
Lubricants	42.19	42.19	40.19	40.2	20.0	20.0	0.99	1
Bitumen	39.61	39.61	40.19	40.2	22.0	22.0	0.99	1
Other Oil Products	40.19	40.19	40.19	40.2	20.0	20.0	0.99	1
Natural Gas	33.15 - 34.03	33.86	33.70	48.0	15.3	15.3	0.995	1
Liquefied Petroleum Gases	46.06	46.06	47.31	47.3	17.2	17.2	0.99	1
Fuelwood	12.32	12.32	15	15.6	29.9	30.5	0.98	1
Agricultural Residues	14.67	14.67	15.2		29.9		0.98	1

Source: Instructions for Compiling the Statistical Report nr.1-EBs 'Energy Balance', approved by Order No. 88 of 24.09.2018 of the National Bureau of Statistics of the RM <https://statistica.gov.md/pageview.php?l=ro&id=6867&idc=627>.

In the Statistical Report No. 1-EB 'Energy Balance' and the 'Instructions for compiling the Statistical Report No. 1-EB', respectively, average calorific values are available for converting quantitative indicators for fuel from natural units to coal equivalent units (Table 3-13).

Table 3-13: The calculation method for the average calorific values based on the instructions for compiling the Statistical Report No. 1-EB 'Energy Balance'

Fuel Type	Unit	Average calorific values for converting natural fuels to coal equivalent units	Average calorific values, TJ/kt (estimated using the conversion factor 29.31 TJ/ktce)
Coal – total (from 0.778 to 0.993 kcal/t)			
Donetsk Coal	t	0.876	25.70
Coal rich in volatile matter	t	0.816	23.94
Long Flame Coal	t	0.782	22.94
Anthracite AS	t	0.888	26.05
Anthracite AK	t	0.993	29.13
Kuznetsk Coal	t	0.867	25.44
Lignite (from 0.215 to 0.524 kcal/t)			

Fuel Type	Unit	Average calorific values for converting natural fuels to coal equivalent units	Average calorific values, TJ/kt (estimated using the conversion factor 29.31 TJ/ktce)
Kansk-Acinsk Coal	t	0.516	15.14
Podmoskovnii Lignite	t	0.335	9.83
Ukrainian Brown Lignite	t	0.307	9.01
Brown Coal Briquettes	t	0.605	17.75
Coking Coal	t	0.990	29.05
Petroleum	t	1.430	41.96
Diesel	t	1.450	42.54
Fuel for Oven	t	1.450	42.54
Residual Fuel Oil	t	1.370	40.20
Fuel for Jet Engines	t	1.470	43.13
Fuel for Diesel Engines	t	1.430	41.96
Aviation Gasoline	t	1.490	43.72
Gasoline	t	1.490	43.72
Kerosene for Tractors	t	1.470	43.13
Kerosene for lighting	t	1.470	43.13
Kerosene for Aviation	t	1.470	43.13
Lubricants	t	1.438	42.19
Bitumen	t	1.350	39.61
White-Spirit	t	1.474	43.25
Paraffin	t	1.479	43.39
Processed Oils	t c.e.	1.000	29.34
Other Oil Products	t	1.000	29.34
Natural Gas	1000 m^3 comp.	1.154	33.86
Liquefied Petroleum Gases	t	1.570	46.06
Fuelwood	1000 m^3 comp.	0.266	7.80
Wood Waste	t c.e.	1.000	29.31
Agricultural Fuel Residues	t c.e.	1.000	29.31
Other types of fuel	t c.e.	1.000	29.31
Electricity	million kWh	0.123	3.61
Heat	thousand Gcal	0.143	4.20

Source: <https://www.statistica.gov.md/>.

The table below shows source categories in Sector 1 'Energy' for which statistical data regarding the territory on the LBDR are available (Table 3-14).

Table 3-14: Source categories in Sector 1 'Energy' for which statistical data regarding the territory on the LBDR are available

Source Categories	RBDR	LBDR	Statistical data for the LBDR, by fuels and the period for which data are available
1A1. Energy Industries	*	*	
1A1a. Main Activity Electricity and Heat Production	*	*	
1A1ai Electricity Generation	*	*	Coal, residual fuel oil:1990-1998, 2008-2019; natural gas: 1990-2021*
1A1aii Heat and Power Generation	*	NO	Not Occurring
1A1aiii Heat Plants	*	*	Coal, residual fuel oil:1990-1998, 2008-2019; natural gas: 1994-2021
1A1b Petroleum Refining	*	NO	
1A1c Manufacture of Solid Fuels and Other Energy Industries	*	NO	
1A2. Manufacturing Industries and Construction	*	*	Natural gas: 1994-2022; Coal, fuel oil: 2008-2021; LPG: 2011-2021
a. Iron and Steel	*	*	
b. Non-Ferrous Metals	*	*	
c. Chemicals	*	*	
d. Pulp, Paper and Print	*	*	
e. Food Processing, Beverages and Tobacco	*	*	
f. Non-Metallic Minerals	*	*	
g. Transport Equipment	*	*	
h. Machinery	*	*	
i. Mining and Quarrying	*	*	
j. Wood and Wood Products	*	*	
k. Construction	*	*	

Source Categories	RBDR	LBDR	Statistical data for the LBDR, by fuels and the period for which data are available
l. Textile and Leather	*	*	
m. Non-specified Industries	*	*	
1A3. Transport	*	*	
a. Civil Aviation	*	NO	
b. Road Transportation	*	*	Natural gas, LPG: 2009-2016
c. Railways	*	*	
d. Water-borne Navigation	*	*	
e i. Pipeline Transport	*	*	
e ii Off-road Transport	NA	NA	
e iii Other Transport	NO	NO	
1A4. Other Sectors	*	*	
a. Commercial/Institutional	*	*	Natural gas: 1999-2022, LPG: 2011-2022; Coal, fuel oil: 2008-2022
b. Residential	*	*	Natural gas, LPG: 1995-2022; fuelwood: 2008-2022
c i. Agriculture/Forestry/Fishing (stationary)	*	*	Fuel oil: 2008-2013; coal: 2008-2022
c ii. Agriculture/Forestry/Fishing (mobile)	*	*	Gasoline, diesel: 1995-2015, for 2016-2020 – Not Occurring.
1A5. Other	*	*	
a. Mobile	*	NO	
b. Stationary	*	NO	
1B. Fugitive Emissions from Fuels	*	*	
1B1. Solid Fuels	NO	NO	
a. Coal mining	NO	NO	
b. Solid Fuel Transformation	NO	NO	
c. Other	NO	NO	
1B2. Oil, Natural Gas and Fugitive Emissions from Energy Production	*	*	
a. Oil	*	NO	
b. Natural Gas	*	*	
c. Venting and Flaring	*	*	
d. Other	NO	NO	
1C. CO_2 Transport and Storage	**NO**	**NO**	
1. CO_2 Transport	NO	NO	
2. CO_2 Transport Injection and Storage	NO	NO	
3. Other	NO	NO	
Memo Items: [1]	*	**NO**	
International Bunkers	*	NO	
International Aviation	*	NO	
International Water-borne Navigation	*	NO	
Multilateral Operations	NO	NO	
CO_2 Emissions from Biomass	*	*	Fuelwood: 2008-2022
CO_2 Captured and Stored	NO	NO	
For storage at national level	NO	NO	
For storage in other countries	NO	NO	

Abbreviations: RBDR – Right Bank of Dniester River; LBDR – Left Bank of Dniester River; NA – Not Available, NO – Not Occurring. For 2022 statistical information was not published on the webpage of the State Statistical Service: <https://mer.gospmr.org/deyatelnost/gosudarstvennaya-sluzhba-statistiki-gosstat.html>.

3.1.4. Uncertainties and Time Series Consistency

The uncertainty analysis of GHG emissions from Sector 1 'Energy' (including by source category) is described in detail in the sub-chapters 3.2-3.9 of the NIR, as well as in the Annex 2-3.1 of this Report according to the 2006 IPCC Guidelines.

Combined uncertainties as a percentage of total direct GHG emissions from Sector 1 'Energy' were estimated to be circa 3.93%. The uncertainties introduced in trend in sectoral emissions were estimated to be circa 1.01%.

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.1.5. Quality Assurance and Quality Control

Tier 1 and Tier 2 procedures associated with the quality assurance and quality control process in the Sector 1 'Energy' include the following:

- according to the description of each source category, representative information was collected, AD used in the previous inventory cycle were updated and specified;
- the sources of reference for collected data were updated and specified;
- with the full transition to the methodologies available in the 2006 IPCC Guidelines, the default EFs used to estimate GHG emissions from each source category were updated and specified; these are available in spreadsheets as tables and can be imported automatically into calculation sheets;
- standard internal documentation procedures are provided for each source category; separate calculation files were developed, identical to the CRT reporting and calcullation tables (Decision 5/CMA.3);
- the same estimation method was used for the entire period under review at individual source category level; for a better view of the results, charts showing the GHG emission trends at individual source category level are created automatically;
- the procedures for data archiving used to estimate GHG emissions from Sector 1 'Energy' have been updated and improved;
- in order to ensure the completeness of the inventory, including from the territorial point of view, various reference sources for AD regarding fossil fuel consumption on the LBDR were used; data were provided by periodic statistical publications produced by the State Service for Statistical Analysis attached to the Ministry of Economic Development of ATULBD, as well as 'Press Releases regarding housing and utilities';
- mechanical errors related to entering activity data were eliminated; in most cases, the respective errors were associated with line routing;
- for each source category where problems were identified regarding the collection of AD, an additional verification of the AD sources was carried out, and the AD rows were updated, respectively.

3.1.6. Recalculations

Since a series of improvements were adopted within the current inventory cycle, it was necessary to recalculate GHG emissions from all source categories included in Sector 1 'Energy'. The main causes of these recalculations are:

- for each individual source category, the activity data associated with fuel consumption have been updated and clarified; some errors associated with incorrect entry of activity data have been removed;
- the emission factors for LPG and coal in the case of source category 1A2 were specified;
- applying other GWP values for the 100-year horizon, available in the IPCC AR5 (2014), instead of those available in the IPCC AR4 (2007) (for CH_4 – 28 instead of 25, for N_2O – 265 instead of 298);
- performing calculations for international water-borne navigation, the activity data became available, but only for the period 2015-2022;
- updating primary statistical data for the LBDR regarding the contribution of the share of each industrial branch;
- specifying the number of the population for the years 2014-2022, according to the updated editions of the Statistical Yearbooks of the Republic of Moldova and of the ATULBD.

Compared to the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes undertaken in the current inventory cycle have resulted in a slight upward trend in direct GHG emissions from Sector 1 'Energy' between 1990 and 2019, this ranging from a minimum increase of +0.3% in the years 1990-1992, up to a maximum increase of 2.6% in 2017. There was, however, a 0.9% decrease in

direct GHG emissions in 2020, compared to similar emissions reported in the NC5 of the RoM to the UNFCCC (Table 3-15).

Table 3-15: Recalculated GHG emissions for the period 1990-2020, included in the NC5 of the RoM to the UNFCCC (Sector 1 'Energy'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	36,992.93	31,258.69	24,419.84	18,253.96	15,377.49	12,391.35	12,373.96	11,120.62	9,652.00	7,640.28	6,940.88
BTR1	37,087.56	31,348.82	24,501.07	18,321.97	15,453.99	12,467.03	12,462.93	11,181.69	9,708.68	7,704.88	7,018.53
Difference, %	0.3	0.3	0.3	0.4	0.5	0.6	0.7	0.5	0.6	0.8	1.1
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	7,570.06	7,355.70	8,041.88	8,545.94	8,836.49	7,982.09	8,154.68	8,450.92	8,875.33	9,496.42	9,787.59
BTR1	7,647.24	7,437.76	8,130.01	8,637.54	8,935.27	8,070.72	8,247.81	8,544.04	8,955.84	9,574.49	9,875.71
Difference, %	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.9	0.8	0.9
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	9,465.24	9,035.88	9,069.71	9,119.65	9,256.62	8,924.91	9,406.86	9,401.42	9,549.89		
BTR1	9,553.17	9,116.08	9,131.98	9,317.70	9,478.03	9,158.19	9,641.29	9,450.40	9,466.98	10,460.91	9,249.65
Difference, %	0.9	0.9	0.7	2.2	2.4	2.6	2.5	0.5	-0.9		

Abbreviations: BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC; NC5 – Fifth National Communication of the RoM to the UNFCCC.

3.1.7. Assessment of Completeness

Under the current inventory cycle within Sector 1 'Energy', direct GHG emissions originating from 8 source categories were estimated (Table 3-16).

Table 3-16: Assessment of completeness under Sector 1 'Energy'

IPCC Category	Source Category	CO_2	CH_4	N_2O
1.A.1	Energy Industries	X	X	X
1.A.2	Manufacturing Industries and Construction	X	X	X
1.A.3	Transport (Civil Aviation, Road Transportation, Railways, Domestic Navigation, Pipeline Transport)	X	X	X
1.A.4	Other Sectors (Commercial/Institutional, Residential, Agriculture/Forestry/Fishing)	X	X	X
1.A.5	Other (other works and needs)	X	X	X
1.B.1	Fugitive Emissions from Coal Mining and Handling	NO	NO	NO
1.B.2	Fugitive Emissions from Oil and Natural Gas	X	X	X
Memo Items	International Aviation	X	X	X
Memo Items	International Water-borne Navigation	X	X	X
Memo Items	CO_2 Emissions from Biomass	X	X	X

Abbreviations: X – Source Categories Included in GHG Inventory; NO – Not Occurring.

As no coal mining exists in the country, no GHG emissions from category 1B1 'Fugitive Emissions from Coal Mining and Handling' were recorded, respectively.

3.1.8. Planned Improvements

Planned improvements at source category level within Sector 1 'Energy' are described in more detail in sub-chapters 3.2-3.9 of this Report.

3.2. Fuel Combustion

3.2.1. Comparison between the Sectoral Approach and Reference Approach

The IPCC reference approach is a top-down inventory based on production, imports, exports, stock change and international fuel consumption (bunkers).

The 2006 IPCC methodology is used to estimate CO_2 using the reference approach. The estimate is based on the country's apparent fuel consumption.

The apparent consumption of primary fuels was calculated using the following formula:

Apparent consumption = production + imports - exports – change (increase/decrease) in stock – international bunkers

Apparent consumption does not include the consumption of fuels for non-energy purposes. Paraffins, bitumen, lubricants, white alcohol used for non-energy purposes, and jet fuel are excluded.

Production, import, export, inventory variation and international bunkers were taken from the Energy Balance for all primary fuels and petroleum products in TJ units. The Energy Balances have a classification of fuels, which slightly differs from that available in the common reporting tables (CRT), and a correspondence table (Table 3-17) has thereby been prepared.

Table 3-17: Correspondence of fuels in the common reporting tables (CRT) and Energy Balances of the Republic of Moldova

Fuels according to CRT 1A Sector	Fuel according to the national Energy Balance
Crude oil	Crude oil
Gasoline	Gasoline, aviation gasoline
Jet kerosene	Fuel for jet engines
Other kerosene	jet fuel, kerosene
Gas/diesel	Fuel for over, fuel for engines, diesel
Residual fuel oil	Residual fuel oil
Liquefied petroleum gases (LPG)	Liquefied petroleum gases (LPG)
Bitumen	Petroleum bitumen
Lubricants	Oils and greases (lubricants), car oils, diesel oils
Petroleum coke	Petroleum coke
Other oil	White-spirit, paraffin, other petroleum products, processed oils
Anthracite	Anthracite
Other bituminous coal	Bituminous coal
Sub-bituminous coal	Other bituminous coal
Lignite	Lignite
Coke oven/gas coke	Coke
Peat	Peat and peat products
Natural gas (dry)	Natural gas
Solid biomass	Fuelwood, wood waste, agricultural fuel residue, briquettes and pellets, charcoal
Liquid biomass	Bioethanol, Biodiesel
Gas biomass	Biogas

Carbon content coefficients (t C/TJ) in fuels are used by default according to the 2006 IPCC Guidelines (Vol. 2, Ch.1, p.1.21-1.22, Table 1.3), carbon oxidation coefficients are taken equal to 1 for all fuel types.

The statistical data collected for the territory on the LBDR were also considered. The differences between CO_2 emissions calculated using the two methodological approaches are thereby within the permissible limit of 5% (2006 IPCC Guidelines, Vol. 2, Chapter 6.8, p. 6.11) (Table 3-18).

The reasons for the differences are as follows:

1. For a number of categories from the Energy Balance, the initial activity data is missing, and the necessary information was obtained based on inquiries addressed to various institutions. Activity data received in natural units were then transferred to energy units (TJ) using country specific net calorific values (NCV).
2. Average NCV values are used (based on NBS instructions) and the resulting values are used with decimals, while statistical data from the Energy Balances are presented as whole values without decimals.

Table 3-18: Comparison of CO_2 emissions calculated using the reference approach (RA) and the sectoral approach (SA) for the period 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RA	34,484.70	29,721.61	23,180.29	16,975.65	14,476.87	11,428.59	11,350.12	10,288.66	8,836.80	6,892.32	6,180.95
SA	35,383.38	29,883.72	23,299.66	17,332.99	14,491.98	11,471.26	11,374.65	10,257.83	8,874.46	6,903.32	6,188.18
Difference, %	-2.61	-0.55	-0.51	-2.10	-0.10	-0.37	-0.22	0.30	-0.43	-0.16	-0.12
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RA	6,813.13	6,467.66	7,077.78	7,561.71	7,785.98	7,014.80	7,116.62	7,408.16	7,964.62	8,594.79	8,777.41
SA	6,817.59	6,536.60	7,177.44	7,625.53	7,870.60	7,112.32	7,249.08	7,546.38	8,092.21	8,716.70	8,924.86
Difference, %	-0.07	-1.07	-1.41	-0.84	-1.09	-1.39	-1.86	-1.87	-1.60	-1.42	-1.68

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
RA	8,435.62	8,044.43	8,000.17	8,432.35	8,486.51	8,044.90	8,332.05	8,343.30	8,580.46	9,624.41	8,903.24
SA	8,612.61	8,223.26	8,189.06	8,389.57	8,483.26	8,068.33	8,480.96	8,558.64	8,840.57	9,815.46	8,703.60
Difference, %	-2.10	-2.22	-2.36	0.51	0.04	-0.29	-1.79	-2.58	-3.03	-1.99	2.24

3.2.2. International Bunkers Fuels

This sector includes two categories:

- 1A3ai International Aviation
- 1A3di International Water-Borne Navigation

3.2.2.1. 1A3ai International Aviation

3.2.2.1.1. Source Category Description

Within source category 1A3ai 'International Aviation', GHG emissions from the burning of fuels for the operation of international air transport are monitored (for aircraft performing operating flights, emissions are allocated to the country where the aircraft refuelled). In the Republic of Moldova, international air transport is carried out with jet-propelled aircraft that use kerosene as fuel.

In the years 2021-2022, international flights were operated by the following aircrafts: (1) produced in CIS countries: Mi-8, Ka-2; (2) produced in other countries: large commercial jet aircrafts: A-319 (320, 321); Boeing-737, 747, EMB-190; small aircraft – Cessna (for domestic flights only).

In previous years, flights were also made with other types of aircrafts: (a) large commercial jet aircraft: A-319 (320, 321); Boeing-707 (737, 739, 747,757), EMB-190 (120, 135, 145, 170), Fokker 70 and Fokker 100, MD-81 (82, 83) RJ-85, RJ-100, CRJ, Rombac-561 Rc; A-300-600; (b) short and medium range turboprop aircraft: Saab-340 (SF-340), Saab-2000 (SF-2000), L410, DHC8, ATR-42; (c) light turboprop aircraft – X-32 Becas; (d) small jet aircrafts: Falcon-2000EX, Learjet-35; (e) aircraft produced in CIS countries are represented by a group of aircraft such as TU-134, TU-154, AN-2 (12, 24, 26, 28, 32, 72, 74), IL-18, IL-76, YAK-18 (40, 42); (k) Mi-8 (2, 17, 26), Ka-26 and Ka-32, Robinson 44 helicopters (domestic flights partly).

The total number of flights with aircraft produced in other countries in the period 1995-2022, recorded an increasing trend, whereas flights with aircraft produced in the CIS countries – a decreasing trend (Figure 3-8).

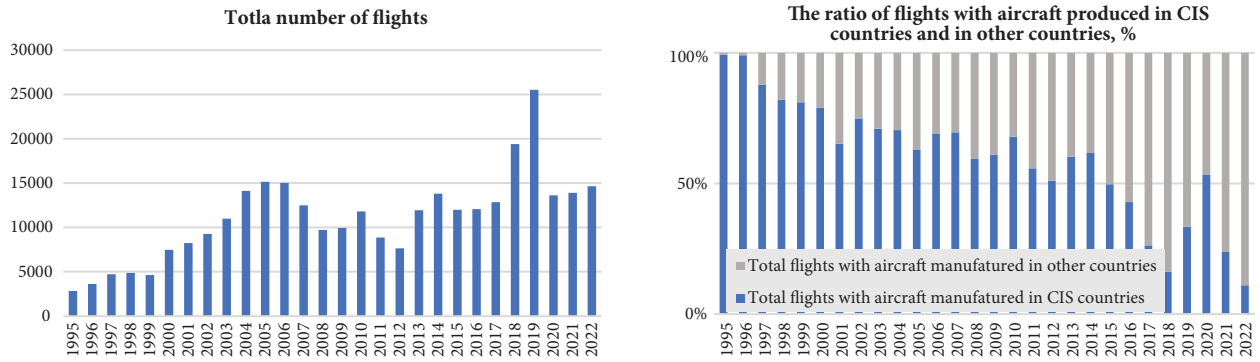


Figure 3-8: Total number of flights in the Republic of Moldova between 1995 and 2022.

The gas with the largest share in total emissions from international air transport is CO_2 (about 70%), slightly less than 30% of the total emissions are water vapor, and only circa 1% – other polluting gases (NO_x, CO, SO_x, NMVOC). Emissions of methane and nitrous oxide are insignificant (according to the 2006 IPCC Guidelines, modern aircraft are considered to emit practically no CH_4, especially during cruise flight).

Aircraft flight is divided into two cycles: (i) the landing/ take-off (LTO) cycle, produced at altitudes below 914 meters and (ii) the cruise flight cycle (c), produced at altitudes greater than 914 meters.

It is considered that only about 10% of emissions recorded during the flight come from the LTO cycle, the remaining 90% from the cruise flight cycle. The exception is CO and NMVOC emissions: 30% are emissions registered during the LTO cycle, the remaining 70% come from the cruise flight cycle.

The evolution of GHG emissions from source category 'International Aviation' recorded a 26% reduction and is shown in Table 3-19.

Table 3-19: Evolution of greenhouse gas emissions from source category 1A3ai 'International Aviation' between 1990 and 2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1.A.3.a.i 'International Aviation', kt CO_2 equivalent	193.68	147.55	108.66	55.30	30.88	35.05	57.31	66.85	54.15	63.68	63.73
%, compared to 1990	100	76.2	56.1	28.6	15.9	18.1	29.6	34.5	28.0	32.9	32.9
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1.A.3.a.i 'International Aviation', kt CO_2 equivalent	51.03	60.57	35.17	35.20	38.36	38.38	44.67	44.60	44.60	41.49	41.43
%, compared to 1990	26.3	31.3	18.2	18.2	19.8	19.8	23.1	23.0	23.0	21.4	21.4
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1.A.3.a.i 'International Aviation', kt CO_2 equivalent	47.79	41.55	54.25	57.45	102.02	149.71	172.13	153.02	35.52	153.02	143.37
%, compared to 1990	24.7	21.5	28.0	29.7	52.7	77.3	88.9	79.0	18.3	79.0	74.0

Table 3-20 shows the evolution of direct and indirect greenhouse gas emissions from 'International Aviation' between 1990 and 2022.

Table 3-20: Evolution of direct and indirect GHG emissions from source 1A3ai 'International Aviation' between 1990 and 2022.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2, kt	191.63	145.99	107.51	54.71	30.55	34.67	56.73	66.19	53.59	63.04	63.08
CH_4, kt	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_2O, kt	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO_x, kt	0.76	0.58	0.42	0.22	0.12	0.13	0.22	0.26	0.21	0.25	0.26
CO, kt	0.57	0.44	0.32	0.16	0.09	0.11	0.15	0.17	0.14	0.16	0.17
NMVOC, kt	0.21	0.16	0.12	0.06	0.03	0.05	0.07	0.08	0.07	0.08	0.07
SO_2, kt	0.06	0.05	0.03	0.02	0.01	0.01	0.02	0.02	0.02	0.02	0.02
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO_2, kt	50.49	59.95	34.77	34.79	37.93	37.92	44.21	44.17	44.17	41.06	41.01
CH_4, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
N_2O, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NO_x, kt	0.19	0.24	0.13	0.13	0.14	0.14	0.18	0.19	0.19	0.17	0.16
CO, kt	0.15	0.16	0.12	0.13	0.14	0.14	0.13	0.11	0.11	0.12	0.12
NMVOC, kt	0.06	0.06	0.04	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.05
SO_2, kt	0.02	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CO_2, kt	47.31	41.07	53.69	56.81	100.97	148.28	170.41	151.50	35.25	151.50	142.05
CH_4, kt	0.00	0.00	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.00
N_2O, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.01	0.00
NO_x, kt	0.18	0.16	0.21	0.23	0.41	0.58	0.65	0.62	0.12	0.62	0.59
CO, kt	0.13	0.16	0.16	0.18	0.27	0.35	0.51	0.42	0.05	0.42	0.33
NMVOC, kt	0.06	0.06	0.06	0.08	0.11	0.14	0.15	0.12	0.02	0.12	0.09
SO_2, kt	0.02	0.01	0.02	0.02	0.03	0.05	0.05	0.05	0.02	0.05	0.05

For the period 1990-1994, the results were restored using the partial overlap method, and for the period 1995-2022, GHG emissions were calculated using the Tier 2b estimation method.

With reference to the evolution of direct GHG emissions from source category 1A3ai 'International Aviation', the volume of these emissions recorded a decreasing trend from about 193.68 kt CO_2 equivalent in 1990, to about 143.37 kt CO_2 equivalent in 2022 (Table 3-21).

Table 3-21: Evolution of direct greenhouse gas emissions from source category 'International Aviation' in the Republic of Moldova between 1990 and 2022

	Direct GHG emissions, kt CO_2 equivalent				%, compared to 1990				Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	191.63	0.38	1.67	193.68	100.0	100.0	100.0	100.0	98.9	0.2	0.9
1991	145.99	0.29	1.27	147.55	76.2	76.2	76.2	76.2	98.9	0.2	0.9
1992	107.51	0.21	0.94	108.66	56.1	56.1	56.1	56.1	98.9	0.2	0.9
1993	54.71	0.11	0.48	55.30	28.6	28.6	28.6	28.6	98.9	0.2	0.9
1994	30.55	0.06	0.27	30.88	15.9	15.9	15.9	15.9	98.9	0.2	0.9
1995	34.67	0.08	0.30	35.05	18.1	21.4	17.8	18.1	98.9	0.2	0.8
1996	56.73	0.10	0.48	57.31	29.6	26.2	29.1	29.6	99.0	0.2	0.8
1997	66.19	0.09	0.57	66.85	34.5	24.7	33.9	34.5	99.0	0.1	0.8
1998	53.59	0.10	0.46	54.15	28.0	25.9	27.5	28.0	99.0	0.2	0.8
1999	63.04	0.10	0.54	63.68	32.9	27.4	32.2	32.9	99.0	0.2	0.8
2000	63.08	0.11	0.54	63.73	32.9	29.8	32.6	32.9	99.0	0.2	0.9
2001	50.49	0.10	0.44	51.03	26.3	26.7	26.2	26.3	98.9	0.2	0.9
2002	59.95	0.10	0.52	60.57	31.3	25.4	31.2	31.3	99.0	0.2	0.9
2003	34.77	0.10	0.31	35.17	18.1	25.2	18.6	18.2	98.8	0.3	0.9
2004	34.79	0.09	0.32	35.20	18.2	24.4	18.9	18.2	98.8	0.3	0.9
2005	37.93	0.09	0.34	38.36	19.8	24.5	20.5	19.8	98.9	0.2	0.9
2006	37.92	0.11	0.34	38.38	19.8	28.7	20.6	19.8	98.8	0.3	0.9
2007	44.21	0.08	0.39	44.67	23.1	20.0	23.5	23.1	99.0	0.2	0.9
2008	44.17	0.05	0.38	44.60	23.0	12.0	23.0	23.0	99.0	0.1	0.9
2009	44.17	0.05	0.38	44.60	23.1	12.6	23.0	23.0	99.0	0.1	0.9
2010	41.06	0.07	0.36	41.49	21.4	19.0	21.7	21.4	99.0	0.2	0.9
2011	41.01	0.08	0.35	41.43	21.4	20.4	20.9	21.4	99.0	0.2	0.8
2012	47.31	0.08	0.40	47.79	24.7	20.5	24.1	24.7	99.0	0.2	0.8
2013	41.07	0.13	0.35	41.55	21.4	33.7	21.3	21.5	98.8	0.3	0.9
2014	53.69	0.10	0.47	54.25	28.0	25.0	28.2	28.0	99.0	0.2	0.9
2015	56.81	0.16	0.49	57.45	29.6	40.9	29.1	29.7	98.9	0.3	0.8
2016	100.97	0.17	0.87	102.02	52.7	45.1	52.4	52.7	99.0	0.2	0.9
2017	148.28	0.16	1.27	149.71	77.4	42.6	76.3	77.3	99.0	0.1	0.9
2018	170.41	0.20	1.53	172.13	88.9	52.3	91.5	88.9	99.0	0.1	0.9
2019	151.50	0.15	1.36	153.02	79.1	40.1	81.8	79.0	99.0	0.1	0.9
2020	35.25	0.01	0.26	35.52	18.4	1.8	15.7	18.3	99.2	0.0	0.7
2021	151.50	0.15	1.36	153.02	79.1	40.1	81.8	79.0	99.0	0.1	0.9
2022	142.05	0.08	1.24	143.37	74.1	21.0	74.3	74.0	99.1	0.1	0.9

3.2.2.1.2. Methodologies, emission factors and activity data

The estimation of GHG emissions from source category 1A3ai 'International Aviation' was carried out using the Tier 2 estimation methodology. Unlike the Tier 1 estimation methodology, the application of which only requires activity data on the fuel consumption and emission factors used by default, the use of the Tier 2 methodology is possible if activity data are available on the number of flights operated by each type of aircraft used in international air transport, as well as the amount of fuel consumed for each flight cycle: lading/take-off (LTO) and (c).

The basic equations used in the estimation process are described below:

$$Emissions_{total} = Emissions_{LTO\ cycle} + Emissions_{c\ cycle}$$

Where:

$$Emissions_{LTO\ cycle} = Number_{LTO} \bullet EF_{LTO\ cycle}$$

$$Fuel\ Consumption_{LTO\ cycle} = Number_{LTO} \bullet Fuel\ Consumption_{LTO\ cycle}$$

$$Emissions_{c\ cycle} = (Total\ Fuel\ Consumption - Fuel\ Consumption_{LTO\ cycle}) \bullet EF_{c\ cycle}$$

In the estimation of GHG emissions, both emission factors available in the Revised 1996 IPCC Guidelines (IPCC, 1997) and emission factors available in the 2006 IPCC Guidelines (Table 3-22) were used.

Table 3-22: Emission factors used by default available in the Revised 1996 IPCC Guidelines, used in the estimation of GHG emissions from international air transport

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
New aircraft: LTO cycle, kg per LTO	7,900	1.5	0.2	41	50	15	2.5
Old aircraft: LTO cycle, kg per LTO	7,560	7	0.2	23.6	101	66	2.4
All types of aircraft: c cycle, kg/t	3,150	0	0.1	17	5	2.7	1.0

Source: Revised 1996 IPCC Guidelines, Vol. 3, Table 1-52, 1.98.

Thus, for the cruise flight cycle emission factors available in the Revised 1996 IPCC Guidelines (IPCC, 1997) were used, with the exception of NO_x emission factors, for which values are available in the 2006 IPCC Guidelines, while for the landing/take-off cycle, emission factors from the 2006 IPCC Guidelines were used. For a number of aircraft, emission factors are available in the 2006 IPCC Guidelines (Vol. 2, Chapter 3, Tables 3.6.9, 3.70-3.71). In the selection process of emission factors, the information regarding the correspondence of different types of aircraft to representative classes is useful (2006 IPCC Guidelines, Vol. 2, Chapter 3, Tables 3.6.3, 3.63). If the values of the emission factors are missing for a certain type of aircraft, characteristic emission factors of the representative classes are used. For the types of aircraft that operate international flights, a table of their correspondence with the representative classes was drafted, with a brief description of the technical specifications (Table 3-23).

Table 3-23: Correspondence between the representative aircraft and the types of aircraft operating international flights from the Republic of Moldova

Generic name of aircraft	Aircraft class	Types of aircraft operating international flights from the RM	Brief technical specifications of aircraft
Large capacity jet commercial aircraft			
Airbus A319 Airbus A320 Airbus A321	Large capacity jet commercial aircraft	A319, A320, A321	A320: length – 37.6 m; weight –73.5 tonnes; top speed – 890 km/h; number of passengers – 320; flight range – 5500 km.
Boeing 707	Large capacity jet commercial aircraft	B707	B707: length – 37.6 m; weight –151.3 tonnes; top speed – 890 km/h; number of passengers – 189 (economy); flight range – 6000 km; engines: P&WJT.
Boeing 737	Large capacity jet commercial aircraft	B737 (emission factors similar to B737-300/400/500)	B737: length – 31 m, weight – 60 tonnes, top speed – 910 km/h, number of passengers – 132, flight range – 3400 km.
Boeing 747	Large capacity jet commercial aircraft	B747 (emission factors similar to B-747/400 and 281F)	
Boeing 757	Large capacity jet commercial aircraft	B757 (emission factors similar to B757/4300)	
Fokker 70 and Fokker 100	Regional jet aircraft	Fokker 70 and Fokker 100	Fokker 100: length – 35 m, weight – 45 tonnes, number of passengers – 109, flight range – 2390 km.
McDonnell Douglas MD-80	Medium range aircraft	MD-81, MD-82, MD-83 (emission factors similar to MD-80)	MD-82: length – 45 m, weight – 67 tonnes, top speed – 925 km/h, number of passengers – 135/155/172, flight range – 3100 km, engines: 2 x 9455 kgf.
Avro RJ-85	Medium range jet aircraft (similar to RJ-70, RJ-80, RJ-100, BAE 146-200)	RJ-85, RJ-100 (emission factors similar to RJ-85)	RJ-85: length – 26 m, weight – 44 tonnes, top speed – 831 km/h, number of passengers – 85 or 100, flight range – 2963 km, engines: 4 jet engines with turboprop.
Embraer 190	E-Jet aircraft – 4 types (E170, E175, E190, E195)	E190	E190: length – 36 m, weight – 50.3 tonnes, top speed – 890 km/h, number of passengers – 98/106, flight range – 2963 km, engines: 2 jet engines with turboprop.
Embraer 170	Regional aircraft, the smallest representative of the E-Jet class, full name – E175	E170	E170: length 29.9 m, weight – 21.1 tonnes, top speed – 890 km/h, number of passengers – 70/110, flight range – 2963 km, engines: 2 jet engines with turboprop.
BAC-111	Large capacity jet commercial aircraft four regional routes	Rombac-561 Rc	BAC-111: length 21 m, weight – 47.4 tonnes, top speed – 850 km/h, number of passengers – 119, flight range – 2780 km.
Bombardier CRJ-100/200	Jet aircraft for regional routes	CRJ	CRJ-100/200: length – 26.8 m, weight – 21 tonnes, top speed – 860 km/h, number of passengers – 50, flight range – 1800/2500/3150 km, engines: 2 x 4180 kgf.
A-300-600	High-capacity jet aircraft for medium and long-range flights	A-300-600	A-300-600 French aircraft: length – 54.08 m, cu 2 Pratt & Whitney JT9D-7R4H1 engines or General Electric2 (turbojet propulsion 249-273,6 kgf, Pratt & Whitney JT9D-7R4H1, PW 4156, General Electric CF6-80-C2A1 or CF6-80-C2A5), number of passengers – 361, flight range – 7000 km, top speed – 890 km/h, cruise speed – 875 km/h. By 2005, the world's airlines had operated 407 Airbus A300 aircraft of all models. In 2015, they were phased out by the world's and Europe's largest airlines and replaced by a newer Airbus A330 model.
Medium capacity turboprop aircraft			
Saab-340	Aircraft for short-haul regional routes	Saab-340 (SF-340, SF-34) (emission factors similar to DHC8-100)	Saab-340 (SF-340, SF-34): length – 19 m, weight – 13 tonnes, top speed – 525 km/h, number of passengers – 37, flight range – 1500 km, engines: 2 x 1870 HP.

Generic name of aircraft	Aircraft class	Types of aircraft operating international flights from the RM	Brief technical specifications of aircraft
Saab-2000	Turboprop aircraft for regional routes	Saab-2000 (SF-2000) (emission factors similar to ATR-42)	Saab-2000 (SF-2000): length – 27 m, weight – 23 tonnes, top speed – 560 km/h, number of passengers – 50, flight range – 2300 km, engines: 2 x 4155 HP.
ATR-42 (ATR-42-320, ATR-42-500)	Turboprop aircraft for regional routes	L410 – turboprop aircraft for 20 passengers (emission factors similar to ATR-42)	ATR-42: length – 22 m, weight –16,700 tonnes, top speed – 860 km/h, number of passengers – 50, flight range – 1950 km, engines: 2 x 2400 HP.
DHC8-100	Canadian-made turboprop aircraft with Pratt & Whitney engines	SA-227 (emission factors similar to DHC8)	DHC8-100: length – 33 m, top speed – 650 km/h, number of passengers – 80, flight range – 2430 km, engines: 2 x 1115 HP.
Beech King Air	Light turboprop aircraft for private and corporate flights	X-32 Becas (emission factors similar to Beech King Air)	Beech King Air: length – 12 m, weight – 6800 kg, top speed – 580 km/h, number of passengers – 7, flight range – 2430 km, engines: 2 x 1050 HP. X-32 Becas: length – 6.5 m, weight – 450 kg, top speed – 168 km/h, number of passengers – 1, flight range – 300-400 km, engines: 1 x 100 HP.
Small capacity turboprop aircraft			
Cessna 525/560	Small-capacity turboprop jet aircraft	Falcon-2000EX turboprop jet aircraft for 10-19 passengers (2 x TRDD Pratt & Whitney Canada engines) (emission factors similar to Cessna 525/560); Learjet-35 aircraft for 8 passengers (engines – General Electric CJ610-8) (emission factors similar to Cessna 525/560)	Cessna 525/560: length –13.26 m, weight – 5.3 tonnes, top speed – 650 km/h, number of passengers – 5, flight range – 300-400 km, engines: 2 x 9.77 kN.

Notes: Conversion factors for engine power: 1kW=1.36 HP; 1 HP = 735 W (HP metric); 1 kgf = 0.0098 kN; 1 HP = 75 kgf (www.covert-me.com). Since small and medium capacity aircraft have very varied specifications, specific emission factors are not available for them in the 2006 IPCC Guidelines; in this case, representative emission factors are selected for these types of aircraft (ATR-42; DHC8-100; Beech Cyprus Air). For low-capacity turboprop aircraft, in the absence of emission factors – EFs characteristic of Cessna 525/560 aircraft are applied.

Default emission factors used by default available in the 2006 IPCC Guidelines, used in the estimation of GHG emissions from international aviation are shown in Tables 3-24 and 3-25.

Table 3-24: Default emission factors available in the 2006 IPCC Guidelines, used in the estimation of GHG emissions from international aviation

Generic name of aircraft	Representative aircraft (according to information available in the 2006 IPCC Guidelines, Vol. 2, Ch. 3, Tab. 3.6.3 and 3.6.9)	Fuel consumption per LTO cycle, t	Emission Factor							
			CO_2		CH_4		N_2O		NO_x	
			kg / LTO cycle	kg / c cycle	kg / LTO cycle	kg / c cycle	kg / LTO cycle	kg / c cycle	kg / LTO cycle	kg / c cycle
TU-154	TU-154B	2.23	7,030	3,150	11.9	0	0.2	0.1	14.33	9.1
TU-134	TU-134	0.93	2,930	3,150	1.8	0	0.1	0.1	8.68	8.5
YAK-40	YAK-42M	0.91	2,880	3,150	0.25	0	0.1	0.1	10.66	15.6
YAK-42	YAK-42M	0.91	2,880	3,150	0.25	0	0.1	0.1	10.66	15.6
IL-18		2.31	7,300	3,150	7.4	0	0.2	0.1	31.64	15.7
IL-76		2.31	7,300	3,150	7.4	0	0.2	0.1	31.64	15.7
AN-12 - AN-74	YAK-42M	0.91	2,880	3,150	0.25	0	0.1	0.1	10.66	15.6
A319	A319	0.73	2,310	3,150	0.06	0	0.1	0.1	8.73	11.6
A320	A320	0.77	2,440	3,150	0.06	0	0.1	0.1	9.01	12.9
A321	A321	0.96	3,020	3,150	0.14	0	0.1	0.1	16.72	16.1
B707	B707	1.86	5,890	3,150	9.75	0	0.2	0.1	10.96	5.9
B737	B737/300/400/500	0.78	2,480	3,150	0.08	0	0.1	0.1	7.19	11
B739	B737/800/900	0.8	2,780	3,150	0.07	0	0.1	0.1	12.3	14
B747	B747/400 and 281F	3.24	10,240	3,150	0.22	0	0.3	0.1	42.88	12.4
B747	B747/200	3.6	11,370	3,150	1.82	0	0.4	0.1	49.52	12.8
B757	B-757/300	1.46	4,630	3,150	0.01	0	0.1	0.1	17.85	9.8
L-410	DHC-8-400	0.2	640	3,150	0	0	0.02	0.1	1.51	12.8
MD-83, MD-81, MD-82	MD-80	1.01	3,180	3,150	0.19	0	0.1	0.1	11.97	12.4
RJ-85, RJ-70, RJ-100	RJ-RJ85	0.6	1,910	3,150	0.13	0	0.1	0.1	4.34	15.6
BAE-146	BAE-146	0.57	1,800	3,150	0.14	0	0.1	0.1	4.07	8.4
E-120ER	ERJ-145	0.31	990	3,150	0.06	0	0.03	0.1	2.69	7.9
E145, E135	E145	0.31	990	3,150	0.06	0	0.03	0.1	2.69	7.9
Fokker-70	Fokker 100/70/28	0.76	2,390	3,150	0.14	0	0.1	0.1	5.75	8.4
Fokker-100	Fokker 100/70/28	0.76	2,390	3,150	0.14	0	0.1	0.1	5.75	8.4
CRJ-2	CRJ-100ER	0.33	1,060	3,150	0.06	0	0.03	0.1	2.27	8
ATR-42	ATR-42	0.2	620	3,150	0.03	0	0.02	0.1	1.82	14.2
SF-340B, SF-34	DHC8-100	0.2	640	3,150	0	0	0.02	0.1	1.51	12.8
SF-2000	ATR-42	0.2	620	3,150	0.03	0	0.02	0.1	1.82	14.2

Generic name of aircraft	Representative aircraft (according to information available in the 2006 IPCC Guidelines, Vol. 2, Ch. 3, Tab. 3.6.3 and 3.6.9)	Fuel consumption per LTO cycle, t	Emission Factor							
			CO_2		CH_4		N_2O		NO_x	
			kg / LTO cycle	kg / c cycle	kg / LTO cycle	kg / c cycle	kg / LTO cycle	kg / c cycle	kg / LTO cycle	kg / c cycle
DHC-8	DHC-8-400	0.2	640	3,150	0	0	0.02	0.1	1.51	12.8
E190	E145	0.31	990	3,150	0.06	0	0.03	0.1	2.69	7.9
HS-25	Cessna-525/500	0.34	1,070	3,150	0.33	0	0.03	0.1	0.74	7.2
Learjet-35	Cessna 525/500	0.34	1,070	3,150	0.33	0	0.03	0.1	0.74	7.2
Rom Bac 561R	BAC111	0.8	2,520	3,150	0.15	0	0.10	0.1	7.40	12
SA-227	DHC-8-400	0.2	640	3,150	0.00	0	0.02	0.1	1.51	12.8
Falcon 2000EX	Cessna 525/500	0.34	1,070	3,150	0.33	0	0.03	0.1	0.74	7.2
X32-912 Becas	Beech King Air	0.07	230	3,150	0.06	0	0.01	0.1	0.3	8.5
CRJ	CRJ-100ER	0.33	1,060	3,150	0.06	0	0.03	0.1	2.27	8
A-300-600	A-300	1.72	5,450	3,150	0.12	0	0.2	0.1	25.86	14.8

Table 3-25: Default emission factors available in the 2006 IPCC Guidelines, used in the estimation of GHG emissions from international aviation

Generic name of aircraft	Representative aircraft (according to the 2006 IPCC Guidelines Vol. 2, Ch. 3, Tab. 3.6.3 and 3.6.9)	Fuel consumption per LTO cycle, t	Emission Factor					
			CO		NMVOC		SO_x	
			kg / LTO cycle	kg / c cycle	kg / LTO cycle	kg / c cycle	kg / LTO cycle	kg / c cycle
TU-154	TY-154B	2.23	143.05	5	107.13	2.7	2.22	1
TU-134	TY-134	0.93	27.98	5	16.19	2.7	0.93	1
YAK-40	YAK-42M	0.91	10.22	5	2.27	2.7	0.91	1
YAK-42	YAK-42M	0.91	10.22	5	2.27	2.7	0.91	1
IL-18		2.31	103.33	5	66.56	2.7	2.31	1
IL-76		2.31	103.33	5	66.56	2.7	2.31	1
AN-12 - AN-74	YAK-42M	0.91	10.22	5	2.27	2.7	0.91	1
A319	A-319	0.73	6.35	5	0.54	2.7	0.73	1
A320	A-320	0.77	6.19	5	0.51	2.7	0.77	1
A321	A-321	0.96	7.55	5	1.27	2.7	0.96	1
B707	B-707	1.86	92.37	5	87.81	2.7	1.86	1
B737	B737/300/400/500	0.78	13.03	5	0.75	2.7	0.78	1
B739	B737/800/900	0.8	7.07	5	0.65	2.7	0.88	1
B747	B747/400 and 281F	3.24	26.72	5	2.02	2.7	3.24	1
B747	B747/200	3.6	79.78	5	16.41	2.7	3.6	1
B757	B757/300	1.46	11.62	5	0.1	2.7	1.46	1
L-410	DHC-8-400	0.2	2.24	5	0	2.7	0.2	1
MD-83, MD-81, MD-82	MD-80	1.01	6.46	5	1.69	2.7	1.01	1
RJ-85, RJ-70, RJ-100	RJ-RJ85	0.6	11.21	5	1.21	2.7	0.6	1
BAE-146	BAE-146	0.57	11.18	5	1.27	2.7	0.57	1
E120ER	E145	0.31	6.18	5	0.5	2.7	0.31	1
E145, E135	E145	0.31	6.18	5	0.5	2.7	0.31	1
Fokker-70	Fokker100/70/28	0.76	13.84	5	1.29	2.7	0.76	1
Fokker-100	Fokker100/70/28	0.76	13.84	5	1.29	2.7	0.76	1
CRJ-2	CRJ-100ER	0.33	6.7	5	0.56	2.7	0.33	1
ATR-42	ATR-42	0.2	2.33	5	0.26	2.7	0.2	1
SF-340B, SF34	DHC8-100	0.2	2.24	5	0	2.7	0.2	1
SF-2000	ATR-42	0.2	2.33	5	0.26	2.7	0.2	1
DHC-8	DHC-8-400	0.2	2.24	5	0	2.7	0.2	1
E190	E145	0.31	6.18	5	0.5	2.7	0.31	1
HS-25	Cessna-525/500	0.34	34.07	5	3.01	2.7	0.34	1
Learjet-35	Cessna 525/500	0.34	34.07	5	3.01	2.7	0.34	1
Rom Bac 561R	BAC111	0.8	13.07	5	1.36	2.7	0.8	1
SA-227	DHC-8-400	0.2	2.24	5	0	2.7	0.2	1
Falcon 2000EX	Cessna 525/500	0.34	34.07	5	3.01	2.7	0.34	1
X32-912 Becas	Beech King Air	0.07	2.97	5	0.58	2.7	0.07	1
CRJ	CRJ-100ER	0.33	6.7	5	0.56	2.7	0.33	1
A300-600	A300	1.72	14.8	5	1.12	2.7	1.72	1

3.2.2.1.3. Activity Data

In the Republic of Moldova, high-capacity jet commercial aircraft manufactured in CIS countries were exploited less between 2005 and 2022, compared 1995-2004. Foreign-made aircraft, on the contrary, when operating international flights from the Republic of Moldova, were exploited much more intensively in the period 2005-2022 (Tables 3-26, 3-27, 3-28).

It should also be mentioned that during the period under review, the fleet of aircraft used in the Republic of Moldova for international air transport essentially changed its structure.

Table 3-26: Number of *international flights* operated from the RoM between 1995 and 2005

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
AN-2											1
AN-12			23	9	13	15	7	25	27	197	111
AN-24	729	929	950	1,037	755	976	749	562	124	3,241	2,811
AN-26	3			12	7	570	182	1	6	243	861
AN-28					1	6	6		3	2	3
AN-32				55	95	964	968	850	250	1,131	1,038
AN-72	23	15	19	17	21	49	53	24	28	27	87
AN-74	31	7	5	11	7	4	1	2	1	2	1
Il-18	15	23	23	45	71	62	18			10	98
Il-76	22	23		20	28	20		7	8	2	5
Mi-8						688	1,300	3,294	5,375	3,906	3,375
Mi-26											4
TU134	1,001	1,395	1,261	1,299	1,325	1,268	1,329	1,024	887	403	15
TU154	287	114	189	53	23	26	25	16	5	12	14
YAK-40	169	561	779	662	770	655	283	289	304	230	94
YAK-42	371	342	527	642	531	499	367	668	638	283	518
Others	158	176	366	137	104	102	91	178	142	255	475
Total flights with aircrafts from CIS countries	**2,809**	**3,585**	**4,142**	**3,999**	**3,751**	**5,904**	**5,379**	**6,940**	**7,798**	**9,944**	**9,511**
A320					15				142	924	1,256
ATR-42			58	131	141	141	151	145	159	198	199
BAE-146										115	253
B-MD-83										16	10
B707	9	7									1
B737		27	84	128	110	16	35	102	201	341	311
B747								2			
B757				7				2	2	5	1
CRJ-2							96	103	218	350	356
CRJ					36	100					
DHC-8			45								
E120							667	627	495	842	821
E145							323	208	1	2	2
Fokker-70					23						7
HS-25			9								
L410	11			56	45	19		7	7	37	3
Learjet-35			8								
RJ-70						7	10	22	5	2	
RJ-85											36
RJ-100					2	25	118	51	19	10	
RomBac-561RC								39			
SAAB-340			372	550	505	1,259	1,467	1,024	1,671	369	132
SAAB-2000									269	970	2,238
Total flights with aircrafts from other countries	**20**	**34**	**576**	**872**	**877**	**1,567**	**2,867**	**2,332**	**3,189**	**4,181**	**5,626**
Total flights operated	**2,829**	**3,619**	**4,718**	**4,871**	**4,628**	**7,471**	**8,246**	**9,272**	**10,987**	**14,125**	**15,137**

Table 3-27: Number of *international flights* operated from the RoM between 2006 and 2016

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
AN-2	144	126	145	227	202						
AN-12	194	149	1								
AN-24	2,782	1,573	5								
AN-26	3,085	1,690	264	1,175	863	463	652	689	302	765	383
AN-32	672	379	47								
AN-72	68	198									
Il-18	155	12	1	31	78	247	128	6	0		
Il-76							52	377	216	577	622
Ka-32	42	283	126	126	139	300	284	309	268	171	193
Mi-2						1,297	1,022			1,249	796
Mi-8	3,088	3,974	5,032	4,321	6,720	2,315	1,264	3,462	4,133	2,661	3,021
Mi-17						320	493	1,129	969	376	153
Mi-26	3	64	84	84							
TU134	65	236	52	1							
YAK-18		2	16	88	5						
YAK-40	52	3	1								
YAK-42								3	3	161	
Sub-total	**10,350**	**8,689**	**5,774**	**6,053**	**8,007**	**4,942**	**3,895**	**5,975**	**5,891**	**5,960**	**5,168**
A319										445	965
A320	1,679	1,340	1,517	1,935	1,779	1,524	1,399	1,041.5	1,239	1,955	2,701
A321	2									640	473
B-MD-81		9	134								
B-MD-82		196	182		11	20	35	3.50	157.5		
B-MD-83		28	54	31		6					
B707							58				
B737		61	1				6	22	6	104	40
B739									1		
B747										361	614
DHC-8		11									
EMB-120	525	600	614	622	555	604	767	779	828	131	
EMB-135								0	16	306	
EMB-190					458	711	744	1,500.5	1,559	1,654	1,839
Fokker-70	455	85	10	12	13	3.5	3				
Fokker-100	58			5	4	26	25	8	2		
L410	1	2				117	258	144.5			
Learjet-35						415	399	425	215	149	
SAAB-340	21	2				12					
SAAB-2000	1,934	1,469	1,442	1,269	969	486	48				
SA-227								95			
Falcon 2000EX								350	298		
X32-912 BECAS										228	
F28F Enstrom										21	
A-300-600											251
Sub-total	**2,994**	**2,402**	**2,436**	**1,939**	**2,010**	**2,400**	**2,337**	**2,955**	**4,016**	**5,930**	**6,890**
Total	**1,3175**	**10,946**	**8,035**	**7,657**	**9,768**	**5,521**	**5,198**	**9,322**	**10,195**	**10,882**	**11,449**

Source: State Civil Aviation Agency of the RM by Letters to No. 3978 of 02.10.2006, to No. 1328 of 13.09.2011; Civil Aviation Authority of the RM by Letters No. to No. 474 of 13.02.2014, to No. 366 of 02.03.2015, to No. 1156 pf 27.05.2016, to No. 4040 of 28.12.2017, No. 1871 of 18.07.2020, No. 2535 of 10.08.2021

Table 3-28: Number of *international flights* operated from the RoM between 2017 and 2022

	2017	2018	2019	2020	2021	2022
AN-26	216	166	285			
Il-76	567	86				
Ka-32	144	287	303	244	170	313
Mi-2		675	923			
Mi-8	2,413	1,921	7,007	6,806	3,135	1,253
Mi-17	34					47
Sub-total	**2,705**	**2,374**	**7,595**	**7,050**	**3305**	**1,613**

	2017	2018	2019	2020	2021	2022
A319	1,620	3,850	4,023	1,002.5	2672	2,225
A320	3,574	1,615	3,913	984	1,601.5	5,246
A321	63	34	1,300	661	552	1,343
B-MD-82		36	22			8
B737						210
B-737-800/900	92	24	15		34	
B-737-300/400/500	53	847	762		3	
B739						246
B747						2,539
B747-400	1,447		299	2,320	4593	
B747-200	80	2,783	1461	430	748	676
BAE-146	2					
EMB-190	2,483	4,023	1,667	373	2	
SAAB-340? SF34						548
A-300-600	5	38	229			
Sub-total	**9,419**	**16,250**	**13,691**	**5,770.5**	**10,205.5**	**13,040**
Total	**12,691**	**18,710**	**21,286**	**13,611.5**	**13,510.5**	**14,653**

Activity data associated with the consumption of *kerosene* for the provision of international air transport were taken from the Energy Balances.

Table 3-29: Kerosene consumption for the operation of international air transport in the RoM between 1990 and 2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Kerosene, kt	69.00	N/A	N/A	19.70	11.00	11.00	18.00	21.00	17.00	20.00	20.00
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Kerosene, kt	16.00	19.00	11.00	11.00	12.00	12.00	14.00	14.00	14.00	13.00	13.00
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Kerosene, kt	15.00	13.00	17.00	18.00	32.00	47.00	54.00	48.00	12.00	40.00	45.00

Source: Energy Balances of the Republic of Moldova for the years 1990 and 1993-2022.

3.2.2.1.4. Uncertainty Assessment and Time Series Consistency

The primary factors affecting uncertainties relate to the estimation methodology, emission factors used to calculate GHG emissions from source category 1A3ai 'International Aviation' and the quality of available activity data.

Thus, uncertainties associated with the emission factors for CO_2 emissions are estimated to be circa 5%, those associated with the emission factors used for the estimation of CH_4 emissions reach ±10%, those associated with the emission factors used for the estimation of N_2O emissions – up to ±100%. Uncertainties of activity data associated with fuel consumption in the international aviation sector are ±5%. Combined uncertainties directly derived from source category 'International Aviation' were estimated to be circa 7.1%.

In view of ensuring time series consistencies of the results obtained, the same methodology was used for the entire period under review in accordance with the sustainable practices applied to the inventory of GHG emissions.

3.2.2.1.5. Quality Assurance and Quality Control

For source category 1A3ai 'International Aviation' a standard check form and quality control was completed for individual source categories, according to the Tier 1 estimation methodology.

Activity data and methods used to assess greenhouse gas emissions from the respective category are documented and archived both on paper and in electronic format.

In order to identify errors related to data entry and those related to the GHG emissions estimation process, quality assurance and quality control procedures were carried out for the data used and the emission factors applied.

In accordance with sustainable practices, activity data and national emission factors from official reference sources were used in the estimation of GHG emissions.

3.2.2.1.6. Recalculations

In the current inventory cycle, the recalculations made for the period 1990-2020 were carried out as a result of other GWP values used for the 100-year horizon, available in IPCC AR5 (2014), instead of those available in IPCC AR4 (2007): for CH_4 – 28 (instead of 25), for N_2O – 265 (instead of 298) (Table 3-30).

Additionally, emissions from the use of the TU-154 model were also recalculated, for which the emission factors characteristic of the TU-154M model were used, instead of that characteristic to the TU-154B model.

Table 3-30: Recalculations of direct GHG emissions for the period 1990-2020, included in NC5 of the RoM to the UNFCCC ('International Aviation'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	195.73	149.12	109.81	55.88	31.20	42.52	57.39	66.96	54.21	63.74	63.80
BTR1	193.68	147.55	108.66	55.30	30.88	35.05	57.31	66.85	54.15	63.68	63.73
Difference, %	-1.0	-1.0	-1.0	-1.0	-1.0	-17.6	-0.1	-0.2	-0.1	-0.1	-0.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	51.08	60.63	35.20	35.23	38.40	38.41	44.71	44.64	44.65	41.53	41.47
BTR1	51.03	60.57	35.17	35.20	38.36	38.38	44.67	44.60	44.60	41.49	41.43
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	47.84	41.59	54.30	57.49	102.11	149.86	172.30	153.17	35.55		
BTR1	47.79	41.55	54.25	57.45	102.02	149.71	172.13	153.02	35.52	153.02	143.37
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1		

Abbreviations: BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC; NC5 – Fifth National Communication of the RoM to the UNFCCC.

3.2.2.1.7. Planned Improvements

Potential improvements under source category 'International Aviation' could be achieved with the transition to the Tier 3 estimation methodology, available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2023), which considers the actual emission values for each type of aircraft depending on flight distance.

3.2.2.2. 1A3di International Water-borne Navigation (International Bunkers)

3.2.2.2.1. Source Category Description

The aggregate emissions of direct greenhouse gases from source category 'International Water-borne Navigation', between 2015 and 2022, varied between 1.4 - 8.6 kt CO_2 equivalent (Table 3-31).

Table 3-31: Direct GHG emissions from source category 1A3di 'International Water-borne Navigation' between 2015 and 2022 and their share compared to 2015

	2015	2016	2017	2018	2019	2020	2021	2022
1A3d.i, kt CO_2 equivalent	1.41	1.96	3.00	1.60	1.69	6.21	8.60	3.59
%, compared to 2015	100.0	139.3	213.3	113.5	120.3	441.9	611.2	255.5

Direct and indirect greenhouse gas emissions from source category 'International Water-borne Navigation' are shown in Table 3-32.

Table 3-32: Direct and indirect greenhouse gas emissions from category 'International Water-borne Navigation' between 1990 and 2022, kt

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
2015	1.393	0.0001	0.00004	0.000032	0.000002	0.000001	0.000001
2016	1.940	0.0002	0.00005	0.000044	0.000002	0.000001	0.000001
2017	2.970	0.0003	0.00008	0.000068	0.000004	0.000002	0.000002
2018	1.581	0.0001	0.00004	0.000036	0.000002	0.000001	0.000001

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
2019	1.675	0.0002	0.00005	0.000038	0.000002	0.000001	0.000001
2020	6.154	0.0006	0.00017	0.000141	0.000007	0.000003	0.000004
2021	8.512	0.0008	0.00023	0.000195	0.000010	0.000005	0.000005
2022	3.558	0.0003	0.00010	0.000081	0.000004	0.000002	0.000002

Direct greenhouse gas emissions from category 'International Water-borne Navigation' and the contribution of each gas for the period 2015-2022 are presented in Table 3-33.

Table 3-33: Direct GHG emissions from source category 'International Water-borne Navigation' and their share in the total structure at the source category level

	1A3e, kt CO_2 equivalent				Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
2015	1.393	0.004	0.010	1.406	99.0	0.3	0.7
2016	1.940	0.005	0.014	1.959	99.0	0.3	0.7
2017	2.970	0.008	0.021	2.999	99.0	0.3	0.7
2018	1.581	0.004	0.011	1.597	99.0	0.3	0.7
2019	1.675	0.004	0.012	1.691	99.0	0.3	0.7
2020	6.154	0.016	0.044	6.214	99.0	0.3	0.7
2021	8.512	0.023	0.061	8.595	99.0	0.3	0.7
2022	3.558	0.009	0.025	3.593	99.0	0.3	0.7

3.2.2.2.2. Methodologies and Emission Factors

When calculating emissions, the Tier 1 estimation methodology was applied. The EFs for gases with direct effect are those available in the 2006 IPCC Guidelines for the inventory of national greenhouse gas emissions (IPCC, 2006), whereas for gases with indirect greenhouse effect – those available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2023) (Table 3-34).

Table 3-34: Emission factors for direct and indirect greenhouse gases from source category 1A3di 'International Water-borne Navigation'

	kg/ TJ			kg/t			
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
Diesel	74,100	7	2	72.2	3.84	1.75	1.82
References	2006 IPCC Guidelines, for CO_2, CH_4, N_2O, Chapter 'Mobile Combustion', Chapter 3.5.2-3, p. 3.50			EMEP/EEA Guidebook (2023) for NO_x, CO, NMVOC, SO_x Source Category 1A3d 'International Water-borne Navigation', Table 3-2, p.17			

3.2.2.2.3. Activity Data

In the current inventory cycle, activity data necessary for the calculation of GHG emissions from source category 1A3di 'International Water-borne Navigation' could only be collected for the period 2015-2022, given that Giurgiulesti International Free Port was put into operation on October 26, 2006, in 2007 the oil terminal became active, and in 2009 the first grain shipments left the port's terminal (Table 3-35).

Table 3-35: Statistics related to Giurgiulesti International Free Port for 2009-2020

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Ships docked/serviced, units						435	331	408		589	569	600
Transhipped freight, kt	78.0	409.2	428.5	282.2	733.2	729.1	867.8	886.4	950.8	1070.3	1090.6	934.7
Cereals export, kt	39.0	207.8	165.0	78.5	245.7	354.5	287.9	388.4	392.3	355.1	395.3	233.0
Freight export, kt					25.8	54.1	77.9	108.8		90.5	116.9	23.9
Petroleum import, kt	38.6	59.8	67.6	86.2	139.5	156.8	266.6	247.0	288.5	218.2	162.5	
Freight import, kt				56.6	53.0	77.2	108.7	85.6		295.8	307.3	346.6

Source: 'DANUBE LOGISTICS' Ltd., Giurgiulesti International Free Port administrator.

Diesel consumption for domestic naval transport and international navigation is presented in Table 3-36, according to the information presented by 'DANUBE LOGISTICS' Ltd., Giurgiulesti International Free Port administrator, with reference to the annual diesel consumption for domestic navigation, and for international navigation respectively, through Giurgiulesti International Free Port, between 2015 and 2022.

Table 3-36: Fuel consumption for source category 1A3di 'International Water-borne Navigation' between 2015 and 2022, tonnes

Year	Diesel consumption for domestic water-borne navigation, t	Diesel consumption for domestic water-borne navigation on the territory of the RoM, t – 30% of total	Diesel consumption for domestic water-borne navigation outside of the territory of the RoM, t – 70% of total	Diesel consumption for international water-borne navigation, t
2015	14.314	4.294	10.020	431.772
2016	13.486	4.045	9.440	606.079
2017	16.588	4.976	11.612	930.683
2018	16.196	4.858	11.337	490.235
2019	17.517	5.255	12.261	519.000
2020	19.703	5.911	13.792	1,938.482
2021	13.000	3.900	9.100	2,691.221
2022	22,602	6,780	15,821	1,112.950

Note: 'DANUBE LOGISTICS' SRL, Letter No. 08.135.2023 of 19.04.2023.

Total diesel consumption for international water-borne transportation is shown in Table 3-37.

Table 3-37: Diesel consumption for source category 1A3di 'International Water-borne Navigation' between 2015 and 2022, tone and TJ

	2015	2016	2017	2018	2019	2020	2021	2022
Diesel consumption, TJ	18.79	26.18	40.09	21.34	22.60	83.05	114.87	48.02
Diesel consumption, kt	0.44	0.62	0.94	0.50	0.53	1.95	2.70	1.13

3.2.2.2.4. Uncertainty Assessment and Time Series Consistency

The primary factors affecting uncertainties relate to the estimation methodology, emission factors used to calculate the GHG emissions from source category 1A3di 'International Water-borne Navigation' and the quality of the available activity data.

Thus, uncertainties associated with the emission factors for CO_2 emissions are estimated to be circa ±1.5% for diesel, those associated with the emission factors used for the estimation of CH_4 emissions reach ±50%, those associated with the emission factors used for the estimation of N_2O emissions in the range (+140% - [-40%]). Uncertainties of activity data associated with fuel consumption in the international water-borne navigation are ±5%. Combined uncertainties directly derived from source category 1A3di 'International Water-borne Navigation (International Bunkers)' were estimated to be circa 7.1%.

In order to ensure time series consistency of the results obtained, the same methodology was used for the entire period under review in accordance with the sustainable practices applied to the inventory of GHG emissions.

3.2.2.2.5. Quality Assurance and Quality Control

For source category 1A3di 'International Water-borne Navigation (International Bunkers)' a standard form for verification and quality control of individual source categories was completed, according to the Tier 1 estimation methodology.

Activity data and the methods used to estimate greenhouse gas emissions from the respective category are documented and archived both on paper and in electronic format.

In order to identify errors related to data entry and those related to the process of estimating GHG emissions, quality control and quality assurance procedures were carried out to verify the quality of the data used and the emission factors applied. In accordance with sustainable practices, activity data and national emission factors from official reference sources were used in the estimation of GHG emissions.

3.2.2.2.6. Recalculations

In the current inventory cycle, GHG emissions from source category 1A3di 'International Water-borne Navigation' have been estimated for the first time.

3.2.2.1.7. Planned Improvements

Planned improvements at source category level for 1A3di 'International Water-borne Navigation' could relate to obtaining activity data associated with diesel fuel consumption for international water-borne transportation and for previous years (2009-2014).

3.2.3. Feedstocks and non-energy use of fuels

GHG emissions from non-energy fuel consumption are not included in Sector 1 'Energy'.

The following types of fuels can be used for non-energy purposes:

- Liquid fuels (crude oil, additives and oxygenated compounds, gasoline, kerosene, diesel, liquefied petroleum gas (LPG), white spirit, oils, paraffins, petroleum bitumen, other petroleum products, naphtha, residual fuel oil);
- Solid fuels (various types of coal);
- Gaseous fuels (natural gas), Table 3-38.

The use of these types of fuels takes place mainly in industry, respectively within source category 2D 'Non-energy Products from Fuels and Solvent Use' (2D1 'Lubricant Use', 2D2 'Paraffin Wax Use', 2D3 'Solvent Use').

Table 3-38: Fuel use for non-energy purposes, TJ

Fuels	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002
Liquid	65	29	29	NO	NO	NO	NO	NO	NO	NO
Solid	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Gaseous	NO	NO	NO	NO	NO	NO	29	29	59	59
Total	**65**	**29**	**29**	**NO**	**NO**	**NO**	**29**	**29**	**59**	**59**
Fuels	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Liquid	585	732	943	1,116	1,580	1,611	1,391	1,617	1,904	2,395
Solid	NO	4	4	1	NO	NO	NO	1	1	NO
Gaseous	59	191	155	93	94	139	13	NO	3	NO
Total	**644**	**927**	**1,102**	**1,210**	**1,674**	**1,750**	**1,404**	**1,618**	**1,908**	**2,395**
Fuels	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Liquid	2,679	2,789	1,550	1,535	1,588	2,728	2,386	3,052	2,568	2,146
Solid	NO	NO	1	5	18	2	NO	NO	1	NO
Gaseous	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total	**2,679**	**2,789**	**1,551**	**1,540**	**1,606**	**2,730**	**2,386**	**3,052**	**2,569**	**2,146**

Note: Energy Balances of the RoM for years 1993-2022.

3.3. Energy Industries (Source Category 1A1)

3.3.1. Source Category Description and GHG Emission Trends

The emission sources monitored under source category 1A1 'Energy Industries' in the Republic of Moldova are as following:

- 1A1a Main Activity Electricity and Heat Production
  - 1A1ai Electricity Generation
  - 1A1aii Combined Heat and Power Generation
  - 1A1aiii Heat Plants
- 1A1b Petroleum Refining
- 1A1c Manufacture of Solid Fuels

Table 3-39: Description of sources within category 1A1 'Energy Industries'

1A1	Source	Description
1A1a	Main Activity Electricity and Heat Production	Combustion of fossil fuels to produce electricity and heat. The share of natural gas is the highest.
1A1b	Petroleum Refining	The quantities of fuel used for energy purposes, including for own consumption, in the process of processing petroleum products.
1A1c	Manufacture of Solid Fuels	Charcoal production

Between 1990 and 2022, GHG emissions from source category 1A1 'Energy Industries' recorded a downward trend. In 2022, the GHG emissions from this category dropped to only 15.7% of the base year level (Figure 3-9, Table 3-40).

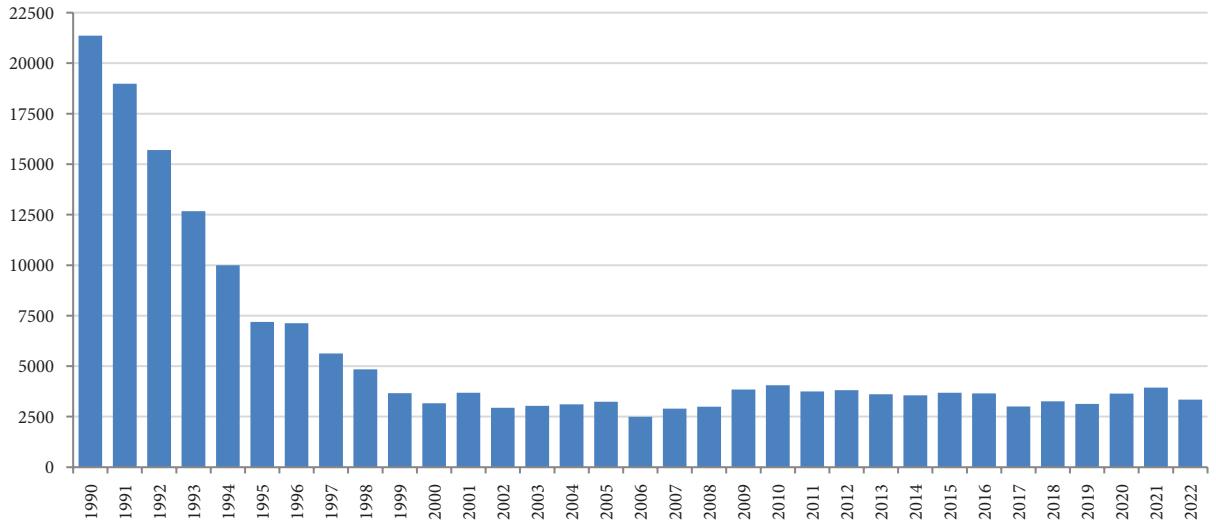


Figure 3-9: Evolution of GHG emissions from source category 1A1 'Energy Industries' between 1990-2022.

Total direct GHG emissions from source category 1A1 'Energy Industries' decreased from circa 21,360 kt CO_2 equivalent in 1990 to circa 3,346 kt CO_2 equivalent in 2022. CO_2 has the largest share in the structure of total direct GHG emissions.

Table 3-40: GHG emissions from source category 1A1 'Energy Industries' between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A1, kt CO_2 equivalent	21,359.99	18,980.28	15,703.31	12,676.53	9,990.25	7,191.16	7,123.27	5,625.19	4,844.34	3,664.61	3,159.28
%, compared to 1990	100.0	88.9	73.5	59.3	46.8	33.7	33.3	26.3	22.7	17.2	14.8
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A1, kt CO_2 equivalent	3,681.88	2,936.75	3,040.33	3,110.75	3,233.22	2,495.89	2,893.79	2,994.57	3,840.36	4,053.06	3,750.68
%, compared to 1990	17.2	13.7	14.2	14.6	15.1	11.7	13.5	14.0	18.0	19.0	17.6
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A1, kt CO_2 equivalent	3,808.15	3,605.95	3,560.48	3,688.43	3,648.99	2,999.89	3,258.96	3,127.91	3,638.38	3,936.22	3,345.93
%, compared to 1990	17.8	16.9	16.7	17.3	17.1	14.0	15.3	14.6	17.0	18.4	15.7

Fuel consumption in source category 1A1 'Energy Industries' decreased from 296,617.75 TJ in 1990 to 58,703.36 TJ in 2022 (Table 3-41).

Table 3-41: Direct GHG emissions from category 1A1 'Energy Industries' between 1990-2022

	Fuel	1A1, kt CO_2 equivalent				Share of total, %			%, compared to 1990			
	TJ	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	296,617.75	21,300.29	13.76	45.95	21,359.99	99.72	0.06	0.22	100.0	100.0	100.0	100.0
1991	263,165.93	18,927.03	11.84	41.41	18,980.28	99.72	0.06	0.22	88.9	86.1	90.1	88.9
1992	221,193.43	15,660.99	10.02	32.30	15,703.31	99.73	0.06	0.21	73.5	72.9	70.3	73.5
1993	175,082.01	12,640.60	7.91	28.03	12,676.53	99.72	0.06	0.22	59.3	57.5	61.0	59.3
1994	139,005.29	9,961.85	5.29	23.11	9,990.25	99.72	0.05	0.23	46.8	38.4	50.3	46.8
1995	106,937.93	7,174.03	3.84	13.30	7,191.16	99.76	0.05	0.18	33.7	27.9	28.9	33.7
1996	107,542.55	7,107.05	3.79	12.43	7,123.27	99.77	0.05	0.17	33.4	27.5	27.0	33.3
1997	91,612.26	5,615.61	3.10	6.48	5,625.19	99.83	0.06	0.12	26.4	22.5	14.1	26.3
1998	79,862.67	4,836.61	2.69	5.04	4,844.34	99.84	0.06	0.10	22.7	19.6	11.0	22.7
1999	63,604.62	3,660.25	2.03	2.33	3,664.61	99.88	0.06	0.06	17.2	14.8	5.1	17.2
2000	55,528.89	3,155.75	1.71	1.82	3,159.28	99.89	0.05	0.06	14.8	12.4	4.0	14.8
2001	65,010.91	3,677.72	2.03	2.13	3,681.88	99.89	0.06	0.06	17.3	14.8	4.6	17.2
2002	51,972.25	2,933.21	1.72	1.82	2,936.75	99.88	0.06	0.06	13.8	12.5	4.0	13.7
2003	53,932.59	3,036.74	1.75	1.84	3,040.33	99.88	0.06	0.06	14.3	12.7	4.0	14.2
2004	55,234.33	3,107.08	1.79	1.87	3,110.75	99.88	0.06	0.06	14.6	13.0	4.1	14.6
2005	57,447.31	3,229.45	1.85	1.92	3,233.22	99.88	0.06	0.06	15.2	13.4	4.2	15.1
2006	44,382.85	2,492.93	1.45	1.51	2,495.89	99.88	0.06	0.06	11.7	10.5	3.3	11.7
2007	51,597.80	2,890.45	1.66	1.68	2,893.79	99.88	0.06	0.06	13.6	12.0	3.7	13.5
2008	53,446.07	2,990.84	1.83	1.90	2,994.57	99.88	0.06	0.06	14.0	13.3	4.1	14.0
2009	68,324.44	3,835.58	2.33	2.45	3,840.36	99.88	0.06	0.06	18.0	16.9	5.3	18.0

	Fuel	1A1, kt CO_2 equivalent				Share of total, %			%, compared to 1990			
	TJ	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
2010	72,256.61	4,047.95	2.50	2.61	4,053.06	99.87	0.06	0.06	19.0	18.1	5.7	19.0
2011	66,864.17	3,746.14	2.24	2.30	3,750.68	99.88	0.06	0.06	17.6	16.3	5.0	17.6
2012	67,501.54	3,803.41	2.48	2.27	3,808.15	99.88	0.07	0.06	17.9	18.0	4.9	17.8
2013	58,473.25	3,598.61	2.34	5.00	3,605.95	99.80	0.06	0.14	16.9	17.0	10.9	16.9
2014	63,548.08	3,555.98	2.32	2.18	3,560.48	99.87	0.07	0.06	16.7	16.9	4.7	16.7
2015	65,628.56	3,684.45	2.21	1.77	3,688.43	99.89	0.06	0.05	17.3	16.0	3.9	17.3
2016	64,827.83	3,644.88	2.29	1.83	3,648.99	99.89	0.06	0.05	17.1	16.6	4.0	17.1
2017	53,501.10	2,996.52	1.91	1.46	2,999.89	99.89	0.06	0.05	14.1	13.9	3.2	14.0
2018	58,183.50	3,255.38	2.00	1.59	3,258.96	99.89	0.06	0.05	15.3	14.5	3.5	15.3
2019	55,818.04	3,124.41	1.99	1.50	3,127.91	99.89	0.06	0.05	14.7	14.5	3.3	14.6
2020	64,944.59	3,634.38	2.25	1.74	3,638.38	99.89	0.06	0.05	17.1	16.4	3.8	17.0
2021	68,525.02	3,931.09	2.41	2.72	3,936.22	99.87	0.06	0.07	18.5	17.5	5.9	18.4
2022	58,703.36	3,341.56	2.43	1.94	3,345.93	99.87	0.07	0.06	15.7	17.7	4.2	15.7

Table 3-42 shows the evolution of GHG emissions from category 1A1 'Energy Industries' by source (1A1a, 1A1b, 1A1c). The contribution of GHG emissions from 1A1b and 1A1c in the structure of total GHG emissions from category 1A1 is insignificant.

Table 3-42: Direct GHG emissions from category 1A1 'Energy Industries' by source between 1990-2022, kt CO_2 equivalent

	1A1ai	1A1aii	1A1aiii	1A1b	1A1c	1A1	1A1a	1A1b	1A1c	1A1
1990	11,776.38	1,966.19	7,617.43	NO	NO	21,359.99	21,359.99	NO	NO	21,359.99
1991	10,509.25	2,184.22	6,286.81	NO	NO	18,980.28	18,980.28	NO	NO	18,980.28
1992	8,862.42	1,854.66	4,986.23	NO	NO	15,703.31	15,703.31	NO	NO	15,703.31
1993	7,470.30	1,590.76	3,615.47	NO	NO	12,676.53	12,676.53	NO	NO	12,676.53
1994	6,747.35	342.97	2,899.93	NO	NO	9,990.25	9,990.25	NO	NO	9,990.25
1995	4,304.32	313.41	2,573.44	NO	NO	7,191.16	7,191.16	NO	NO	7,191.16
1996	4,365.08	444.74	2,313.45	NO	NO	7,123.27	7,123.27	NO	NO	7,123.27
1997	2,817.13	516.07	2,291.99	NO	NO	5,625.19	5,625.19	NO	NO	5,625.19
1998	2,153.74	358.21	2,332.39	NO	NO	4,844.34	4,844.34	NO	NO	4,844.34
1999	1,599.45	361.23	1,703.93	NO	NO	3,664.61	3,664.61	NO	NO	3,664.61
2000	1,461.03	385.93	1,312.33	NO	NO	3,159.28	3,159.28	NO	NO	3,159.28
2001	1,782.36	583.86	1,315.66	NO	NO	3,681.88	3,681.88	NO	NO	3,681.88
2002	1,367.67	492.85	1,076.23	NO	NO	2,936.75	2,936.75	NO	NO	2,936.75
2003	1,437.83	451.24	1,151.26	NO	NO	3,040.33	3,040.33	NO	NO	3,040.33
2004	1,594.70	474.50	1,041.55	NO	NO	3,110.75	3,110.75	NO	NO	3,110.75
2005	1,531.38	544.20	1,157.63	NO	NO	3,233.22	3,233.22	NO	NO	3,233.22
2006	816.46	525.04	1,154.39	NO	NO	2,495.89	2,495.89	NO	NO	2,495.89
2007	1,367.10	512.82	1,013.87	NO	NO	2,893.79	2,893.79	NO	NO	2,893.79
2008	1,456.85	461.39	1,076.33	NO	NO	2,994.57	2,994.57	NO	NO	2,994.57
2009	2,409.44	447.95	982.97	NO	NO	3,840.36	3,840.36	NO	NO	3,840.36
2010	2,549.46	422.82	1,080.77	NO	NO	4,053.06	4,053.06	NO	NO	4,053.06
2011	2,321.67	399.04	1,029.97	NO	NO	3,750.68	3,750.68	NO	NO	3,750.68
2012	2,428.75	381.43	997.61	NO	0.36	3,808.15	3,807.79	NO	0.36	3,808.15
2013	2,197.07	360.40	1,048.03	NO	0.45	3,605.95	3,605.50	NO	0.45	3,605.95
2014	2,224.45	356.55	979.25	NO	0.22	3,560.48	3,560.26	NO	0.22	3,560.48
2015	2,572.62	633.76	477.72	3.96	0.36	3,688.43	3,684.10	3.96	0.36	3,688.43
2016	2,519.30	633.52	491.68	4.04	0.45	3,648.99	3,644.51	4.04	0.45	3,648.99
2017	1,902.94	611.13	481.57	3.87	0.39	2,999.89	2,995.63	3.87	0.39	2,999.89
2018	2,117.74	670.99	466.82	3.07	0.34	3,258.96	3,255.55	3.07	0.34	3,258.96
2019	2,086.51	587.49	452.16	1.33	0.42	3,127.91	3,126.16	1.33	0.42	3,127.91
2020	2,593.73	601.75	440.91	1.57	0.42	3,638.38	3,636.39	1.57	0.42	3,638.38
2021	2,787.54	676.03	471.40	0.80	0.45	3,936.22	3,934.97	0.80	0.45	3,936.22
2022	2,315.65	625.65	403.22	0.80	0.62	3,345.93	3,344.52	0.80	0.62	3,345.93

Table 3-43 shows the evolution of direct and indirect GHG emissions from category 1A1 'Energy Industries'.

Table 3-43: Direct and indirect GHG emissions from category 1A1 'Energy Industries' between 1990-2022

	1A1, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	21,300.29	0.49	0.17	39.47	7.21	0.63	102.36	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	18,927.03	0.42	0.16	35.07	6.41	0.55	90.52	88.9	86.1	90.1	88.9	88.9	87.6	88.4
1992	15,660.99	0.36	0.12	28.75	5.58	0.48	71.24	73.5	72.9	70.3	72.9	77.3	75.6	69.6
1993	12,640.60	0.28	0.11	23.64	4.24	0.37	62.27	59.3	57.5	61.0	59.9	58.7	58.6	60.8
1994	9,961.85	0.19	0.09	18.81	3.56	0.28	47.12	46.8	38.4	50.3	47.7	49.3	45.2	46.0
1995	7,174.03	0.14	0.05	12.99	3.15	0.24	25.59	33.7	27.9	28.9	32.9	43.7	37.6	25.0
1996	7,107.05	0.14	0.05	12.75	3.26	0.24	23.44	33.4	27.5	27.0	32.3	45.2	38.5	22.9
1997	5,615.61	0.11	0.02	9.52	3.14	0.22	10.53	26.4	22.5	14.1	24.1	43.5	35.5	10.3
1998	4,836.61	0.10	0.02	8.11	2.78	0.20	7.93	22.7	19.6	11.0	20.5	38.5	31.3	7.7
1999	3,660.25	0.07	0.01	5.89	2.38	0.16	2.13	17.2	14.8	5.1	14.9	33.0	26.0	2.1
2000	3,155.75	0.06	0.01	5.04	2.12	0.14	0.97	14.8	12.4	4.0	12.8	29.4	22.8	1.0
2001	3,677.72	0.07	0.01	5.88	2.50	0.17	0.88	17.3	14.8	4.6	14.9	34.7	26.8	0.9
2002	2,933.21	0.06	0.01	4.70	2.01	0.14	0.69	13.8	12.5	4.0	11.9	27.8	21.5	0.7
2003	3,036.74	0.06	0.01	4.85	2.09	0.14	0.52	14.3	12.7	4.0	12.3	29.0	22.3	0.5
2004	3,107.08	0.06	0.01	4.96	2.14	0.14	0.48	14.6	13.0	4.1	12.6	29.7	22.9	0.5
2005	3,229.45	0.07	0.01	5.16	2.23	0.15	0.44	15.2	13.4	4.2	13.1	31.0	23.8	0.4
2006	2,492.93	0.05	0.01	3.98	1.73	0.12	0.33	11.7	10.5	3.3	10.1	23.9	18.4	0.3
2007	2,890.45	0.06	0.01	4.61	2.02	0.14	0.21	13.6	12.0	3.7	11.7	27.9	21.4	0.2
2008	2,990.84	0.07	0.01	4.79	2.09	0.14	0.30	14.0	13.3	4.1	12.1	29.0	22.3	0.3
2009	3,835.58	0.08	0.01	6.14	2.66	0.18	0.61	18.0	16.9	5.3	15.6	36.9	28.4	0.6
2010	4,047.95	0.09	0.01	6.48	2.82	0.19	0.53	19.0	18.1	5.7	16.4	39.1	30.1	0.5
2011	3,746.14	0.08	0.01	5.99	2.61	0.18	0.40	17.6	16.3	5.0	15.2	36.2	27.8	0.4
2012	3,803.41	0.09	0.01	6.09	2.71	0.20	0.66	17.9	18.0	4.9	15.4	37.5	31.4	0.6
2013	3,598.61	0.08	0.02	6.23	2.14	0.17	7.14	16.9	17.0	10.9	15.8	29.7	26.5	7.0
2014	3,555.98	0.08	0.01	5.71	2.55	0.18	0.41	16.7	16.9	4.7	14.5	35.3	28.7	0.4
2015	3,684.45	0.08	0.01	5.85	2.65	0.19	0.11	17.3	16.0	3.9	14.8	36.7	30.6	0.1
2016	3,644.88	0.08	0.01	5.80	2.63	0.20	0.23	17.1	16.6	4.0	14.7	36.5	31.0	0.2
2017	2,996.52	0.07	0.01	4.77	2.19	0.16	0.05	14.1	13.9	3.2	12.1	30.4	26.0	0.0
2018	3,255.38	0.07	0.01	5.20	2.37	0.17	0.06	15.3	14.5	3.5	13.2	32.9	27.4	0.1
2019	3,124.41	0.07	0.01	4.98	2.29	0.17	0.05	14.7	14.5	3.3	12.6	31.8	27.2	0.0
2020	3,634.38	0.08	0.01	5.80	2.65	0.20	0.04	17.1	16.4	3.8	14.7	36.8	31.0	0.0
2021	3,931.09	0.09	0.01	6.40	2.72	0.20	2.08	18.5	17.5	5.9	16.2	37.7	32.2	2.0
2022	3,341.56	0.09	0.01	5.38	2.39	0.19	1.38	15.7	17.7	4.2	13.6	33.2	30.2	1.3

By 2022, the level of direct and indirect GHG emissions in the RoM from source category 1A1 'Energy Industries' reached, for CO_2 – circa 15.7% of the base year level, for CH_4 – 17.7%, N_2O – 4.2%, NO_x – 13.6%, CO – 33.2%, NMVOC – 30.2% and SO_2 – 1.3%.

3.3.1.1. 'Main Activity Electricity and Heat Production' (1A1a)

1A1a 'Main Activity Electricity and Heat Production' is disaggregated into three other emission sources: 1A1ai 'Electricity Generation', 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants'. Between 1990 and 2022, total direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' decreased from circa 21,359.99 kt CO_2 equivalent to circa 3,344.52 kt CO_2 equivalent (Table 3-44).

Table 3-44: Evolution of direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' in the Republic of Moldova between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A1a, kt CO_2 equivalent	21,359.99	18,980.28	15,703.31	12,676.53	9,990.25	7,191.16	7,123.27	5,625.19	4,844.34	3,664.61	3,159.28
%, compared to 1990	100.0	88.9	73.5	59.3	46.8	33.7	33.3	26.3	22.7	17.2	14.8
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A1a, kt CO_2 equivalent	3,681.88	2,936.75	3,040.33	3,110.75	3,233.22	2,495.89	2,893.79	2,994.57	3,840.36	4,053.06	3,750.68
%, compared to 1990	17.2	13.7	14.2	14.6	15.1	11.7	13.5	14.0	18.0	19.0	17.6
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A1a, kt CO_2 equivalent	3,807.79	3,605.50	3,560.26	3,684.10	3,644.51	2,995.63	3,255.55	3,126.16	3,636.39	3,934.97	3,344.52
%, compared to 1990	17.8	16.9	16.7	17.2	17.1	14.0	15.2	14.6	17.0	18.4	15.7

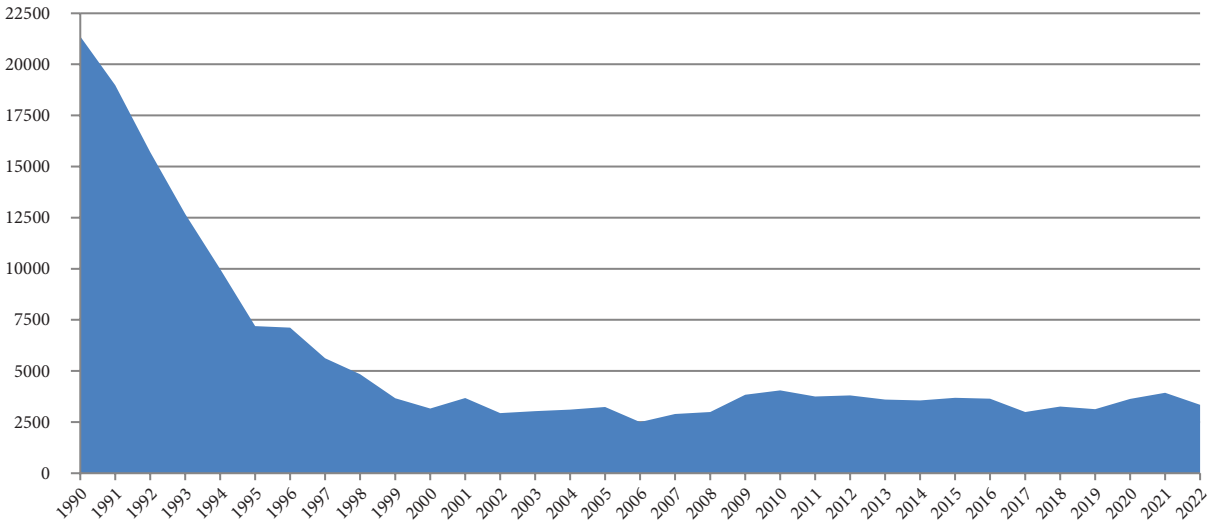


Figure 3-10. Direct GHG emissions from source 1A1a 'Main Activity Electricity and Heat Production' between 1990-2022.

CO_2 emissions had the largest share in the structure of total direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' between 1990 and 2022 (Table 3-45).

Table 3-45: Direct GHG emissions from source 1A1a between 1990-2022 and the share of each gas in the structure of total GHG emissions

	1A1a, kt CO_2 equivalent				% of total			%, compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O	Total
1990	21,300.29	13.76	45.95	21,359.99	99.7	0.1	0.2	100.0	100.0	100.0	100.0
1991	18,927.03	11.84	41.41	18,980.28	99.7	0.1	0.2	88.9	86.1	90.1	88.9
1992	15,660.99	10.02	32.30	15,703.31	99.7	0.1	0.2	73.5	72.9	70.3	73.5
1993	12,640.60	7.91	28.03	12,676.53	99.7	0.1	0.2	59.3	57.5	61.0	59.3
1994	9,961.85	5.29	23.11	9,990.25	99.7	0.1	0.2	46.8	38.4	50.3	46.8
1995	7,174.03	3.84	13.30	7,191.16	99.8	0.1	0.2	33.7	27.9	28.9	33.7
1996	7,107.05	3.79	12.43	7,123.27	99.8	0.1	0.2	33.4	27.5	27.0	33.3
1997	5,615.61	3.10	6.48	5,625.19	99.8	0.1	0.1	26.4	22.5	14.1	26.3
1998	4,836.61	2.69	5.04	4,844.34	99.8	0.1	0.1	22.7	19.6	11.0	22.7
1999	3,660.25	2.03	2.33	3,664.61	99.9	0.1	0.1	17.2	14.8	5.1	17.2
2000	3,155.75	1.71	1.82	3,159.28	99.9	0.1	0.1	14.8	12.4	4.0	14.8
2001	3,677.72	2.03	2.13	3,681.88	99.9	0.1	0.1	17.3	14.8	4.6	17.2
2002	2,933.21	1.72	1.82	2,936.75	99.9	0.1	0.1	13.8	12.5	4.0	13.7
2003	3,036.74	1.75	1.84	3,040.33	99.9	0.1	0.1	14.3	12.7	4.0	14.2
2004	3,107.08	1.79	1.87	3,110.75	99.9	0.1	0.1	14.6	13.0	4.1	14.6
2005	3,229.45	1.85	1.92	3,233.22	99.9	0.1	0.1	15.2	13.4	4.2	15.1
2006	2,492.93	1.45	1.51	2,495.89	99.9	0.1	0.1	11.7	10.5	3.3	11.7
2007	2,890.45	1.66	1.68	2,893.79	99.9	0.1	0.1	13.6	12.0	3.7	13.5
2008	2,990.84	1.83	1.90	2,994.57	99.9	0.1	0.1	14.0	13.3	4.1	14.0
2009	3,835.58	2.33	2.45	3,840.36	99.9	0.1	0.1	18.0	16.9	5.3	18.0
2010	4,047.95	2.50	2.61	4,053.06	99.9	0.1	0.1	19.0	18.1	5.7	19.0
2011	3,746.14	2.24	2.30	3,750.68	99.9	0.1	0.1	17.6	16.3	5.0	17.6
2012	3,803.41	2.11	2.27	3,807.79	99.9	0.1	0.1	17.9	15.4	4.9	17.8
2013	3,598.61	1.90	5.00	3,605.50	99.8	0.1	0.1	16.9	13.8	10.9	16.9
2014	3,555.98	2.10	2.18	3,560.26	99.9	0.1	0.1	16.7	15.3	4.7	16.7
2015	3,680.50	1.84	1.76	3,684.10	99.9	0.0	0.0	17.3	13.4	3.8	17.2
2016	3,640.85	1.84	1.82	3,644.51	99.9	0.1	0.0	17.1	13.3	4.0	17.1
2017	2,992.67	1.52	1.45	2,995.63	99.9	0.1	0.0	14.0	11.0	3.1	14.0
2018	3,252.31	1.66	1.58	3,255.55	99.9	0.1	0.0	15.3	12.0	3.4	15.2
2019	3,123.09	1.57	1.50	3,126.16	99.9	0.1	0.0	14.7	11.4	3.3	14.6
2020	3,632.82	1.83	1.74	3,636.39	99.9	0.1	0.0	17.1	13.3	3.8	17.0
2021	3,930.30	1.96	2.72	3,934.97	99.9	0.0	0.1	18.5	14.2	5.9	18.4
2022	3,340.76	1.81	1.94	3,344.52	99.9	0.1	0.1	15.7	13.2	4.2	15.7

Table 3-46 shows the evolution of direct GHG emissions from 1A1a 'Main Activity Electricity and Heat Production' by sub-category between 1990 and 2022.

Table 3-46: Direct GHG emissions from source 1A1a 'Main Activity Electricity and Heat Production' by sub-category between 1990-2022, kt CO_2 equivalent

	1A1a, kt CO_2 equivalent				% of total		
	1A1ai	1A1aii	1A1aiii	1A1a	1A1ai	1A1aii	1A1aiii
1990	11,776.38	1,966.19	7,617.43	21,359.99	55.1	9.2	35.7
1991	10,509.25	2,184.22	6,286.81	18,980.28	55.4	11.5	33.1
1992	8,862.42	1,854.66	4,986.23	15,703.31	56.4	11.8	31.8
1993	7,470.30	1,590.76	3,615.47	12,676.53	58.9	12.5	28.5
1994	6,747.35	342.97	2,899.93	9,990.25	67.5	3.4	29.0
1995	4,304.32	313.41	2,573.44	7,191.16	59.9	4.4	35.8
1996	4,365.08	444.74	2,313.45	7,123.27	61.3	6.2	32.5
1997	2,817.13	516.07	2,291.99	5,625.19	50.1	9.2	40.7
1998	2,153.74	358.21	2,332.39	4,844.34	44.5	7.4	48.1
1999	1,599.45	361.23	1,703.93	3,664.61	43.6	9.9	46.5
2000	1,461.03	385.93	1,312.33	3,159.28	46.2	12.2	41.5
2001	1,782.36	583.86	1,315.66	3,681.88	48.4	15.9	35.7
2002	1,367.67	492.85	1,076.23	2,936.75	46.6	16.8	36.6
2003	1,437.83	451.24	1,151.26	3,040.33	47.3	14.8	37.9
2004	1,594.70	474.50	1,041.55	3,110.75	51.3	15.3	33.5
2005	1,531.38	544.20	1,157.63	3,233.22	47.4	16.8	35.8
2006	816.46	525.04	1,154.39	2,495.89	32.7	21.0	46.3
2007	1,367.10	512.82	1,013.87	2,893.79	47.2	17.7	35.0
2008	1,456.85	461.39	1,076.33	2,994.57	48.6	15.4	35.9
2009	2,409.44	447.95	982.97	3,840.36	62.7	11.7	25.6
2010	2,549.46	422.82	1,080.77	4,053.06	62.9	10.4	26.7
2011	2,321.67	399.04	1,029.97	3,750.68	61.9	10.6	27.5
2012	2,428.75	381.43	997.61	3,807.79	63.8	10.0	26.2
2013	2,197.07	360.40	1,048.03	3,605.50	60.9	10.0	29.1
2014	2,224.45	356.55	979.25	3,560.26	62.5	10.0	27.5
2015	2,572.62	633.76	477.72	3,684.10	69.8	17.2	13.0
2016	2,519.30	633.52	491.68	3,644.51	69.1	17.4	13.5
2017	1,902.94	611.13	481.57	2,995.63	63.5	20.4	16.1
2018	2,117.74	670.99	466.82	3,255.55	65.1	20.6	14.3
2019	2,086.51	587.49	452.16	3,126.16	66.7	18.8	14.5
2020	2,593.73	601.75	440.91	3,636.39	71.3	16.5	12.1
2021	2,787.54	676.03	471.40	3,934.97	70.8	17.2	12.0
2022	2,315.65	625.65	403.22	3,344.52	69.2	18.7	12.1

1A1ai 'Electricity Generation'

The evolution of direct GHG emissions from source 1A1ai 'Electricity Generation' in the Republic of Moldova between 1990 and 2022 is shown in Figure 3-11.

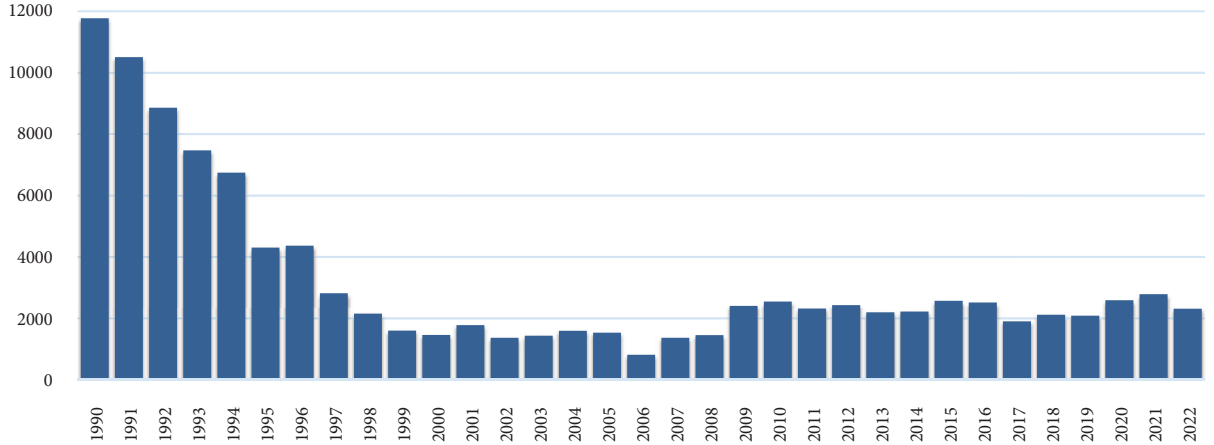


Figure 3-11: Direct GHG emissions from 1A1ai 'Electricity Generation' between 1990 and 2022.

In this period, GHG emissions from this source dropped significantly, constituting only circa 19.7% of the base year level in 2022 (Table 3-47).

Table 3-47: Direct GHG emissions from 1A1ai 'Electricity Generation' between 1990 and 2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A1ai, kt CO_2 equivalent	11,776.38	10,509.25	8,862.42	7,470.30	6,747.35	4,304.32	4,365.08	2,817.13	2,153.74	1,599.45	1,461.03
%, compared to 1990	100.0	89.2	75.3	63.4	57.3	36.6	37.1	23.9	18.3	13.6	12.4
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A1ai, kt CO_2 equivalent	1,782.36	1,367.67	1,437.83	1,594.70	1,531.38	816.46	1,367.10	1,456.85	2,409.44	2,549.46	2,321.67
%, compared to 1990	15.1	11.6	12.2	13.5	13.0	6.9	11.6	12.4	20.5	21.6	19.7
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A1ai, kt CO_2 equivalent	2,428.75	2,197.07	2,224.45	2,572.62	2,519.30	1,902.94	2,117.74	2,086.51	2,593.73	2,787.54	2,315.65
%, compared to 1990	20.6	18.7	18.9	21.8	21.4	16.2	18.0	17.7	22.0	23.7	19.7

CO_2 emissions constituted the largest share in the structure of total direct GHG emissions from source 1A1ai 'Electricity Generation' between 1990 and 2022 (Table 3-48).

Table 3-48: Direct GHG emissions from 1A1ai 'Electricity Generation' between 1990 and 2022 and the share of each gas in the structure of total emissions at source level

	1A1ai, kt CO_2 equivalent				% of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	11,736.20	6.57	33.62	11,776.38	99.7	0.1	0.3
1991	10,473.43	5.43	30.39	10,509.25	99.7	0.1	0.3
1992	8,834.23	4.81	23.38	8,862.42	99.7	0.1	0.3
1993	7,444.99	4.02	21.29	7,470.30	99.7	0.1	0.3
1994	6,724.96	2.95	19.44	6,747.35	99.7	0.0	0.3
1995	4,292.48	1.76	10.08	4,304.32	99.7	0.0	0.2
1996	4,353.84	1.82	9.41	4,365.08	99.7	0.0	0.2
1997	2,811.97	1.28	3.89	2,817.13	99.8	0.0	0.1
1998	2,149.92	1.03	2.79	2,153.74	99.8	0.0	0.1
1999	1,597.90	0.80	0.75	1,599.45	99.9	0.0	0.0
2000	1,459.61	0.73	0.69	1,461.03	99.9	0.0	0.0
2001	1,780.63	0.89	0.84	1,782.36	99.9	0.0	0.0
2002	1,366.34	0.68	0.65	1,367.67	99.9	0.0	0.0
2003	1,436.44	0.72	0.68	1,437.83	99.9	0.0	0.0
2004	1,593.15	0.80	0.75	1,594.70	99.9	0.0	0.0
2005	1,529.89	0.76	0.72	1,531.38	99.9	0.0	0.0
2006	815.67	0.41	0.39	816.46	99.9	0.0	0.0
2007	1,365.77	0.68	0.65	1,367.10	99.9	0.0	0.0
2008	1,455.43	0.73	0.69	1,456.85	99.9	0.0	0.0
2009	2,407.10	1.20	1.14	2,409.44	99.9	0.0	0.0
2010	2,546.99	1.27	1.21	2,549.46	99.9	0.0	0.0
2011	2,319.42	1.16	1.10	2,321.67	99.9	0.0	0.0
2012	2,426.26	1.21	1.28	2,428.75	99.9	0.0	0.1
2013	2,192.28	0.95	3.85	2,197.07	99.8	0.0	0.2
2014	2,222.26	1.11	1.08	2,224.45	99.9	0.0	0.0
2015	2,570.10	1.28	1.24	2,572.62	99.9	0.0	0.0
2016	2,516.78	1.26	1.27	2,519.30	99.9	0.0	0.1
2017	1,901.08	0.95	0.90	1,902.94	99.9	0.1	0.0
2018	2,115.67	1.06	1.01	2,117.74	99.9	0.1	0.0
2019	2,084.47	1.04	1.00	2,086.51	99.9	0.1	0.0
2020	2,591.20	1.30	1.23	2,593.73	99.9	0.1	0.0
2021	2,784.08	1.35	2.10	2,787.54	99.9	0.0	0.1
2022	2,313.39	1.16	1.10	2,315.65	99.9	0.1	0.0

Table 3-49 shows the evolution of direct and indirect GHG emissions from source 1A1ai 'Electricity Generation' in the Republic of Moldova between 1990 and 2022.

Table 3-49: Direct and indirect GHG emissions from 1A1ai 'Electricity Generation' between 1990 and 2022

	1A1ai, kt							% compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	11,736.20	0.23	0.13	23.25	2.81	0.27	74.31	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	10,473.43	0.19	0.11	20.83	2.59	0.24	65.56	89.2	82.7	90.4	89.6	92.3	88.2	88.2
1992	8,834.23	0.17	0.09	17.19	2.51	0.22	50.51	75.3	73.3	69.5	73.9	89.4	82.3	68.0
1993	7,444.99	0.14	0.08	14.75	1.84	0.17	46.45	63.4	61.2	63.3	63.4	65.6	63.7	62.5
1994	6,724.96	0.11	0.07	13.37	1.87	0.15	39.73	57.3	44.9	57.8	57.5	66.7	57.3	53.5
1995	4,292.48	0.06	0.04	8.15	1.66	0.12	18.95	36.6	26.8	30.0	35.1	59.2	45.1	25.5
1996	4,353.84	0.07	0.04	8.13	1.82	0.13	17.30	37.1	27.7	28.0	35.0	64.9	48.6	23.3
1997	2,811.97	0.05	0.01	4.89	1.54	0.11	6.01	24.0	19.4	11.6	21.0	54.8	39.2	8.1
1998	2,149.92	0.04	0.01	3.70	1.19	0.08	4.35	18.3	15.7	8.3	15.9	42.3	30.6	5.9
1999	1,597.90	0.03	0.00	2.53	1.11	0.07	0.01	13.6	12.1	2.2	10.9	39.6	27.4	0.0
2000	1,459.61	0.03	0.00	2.32	1.01	0.07	0.01	12.4	11.1	2.1	10.0	36.2	25.1	0.0
2001	1,780.63	0.03	0.00	2.82	1.24	0.08	0.01	15.2	13.5	2.5	12.1	44.1	30.6	0.0
2002	1,366.34	0.02	0.00	2.17	0.95	0.06	0.01	11.6	10.4	1.9	9.3	33.9	23.5	0.0
2003	1,436.44	0.03	0.00	2.28	1.00	0.07	0.01	12.2	10.9	2.0	9.8	35.6	24.7	0.0
2004	1,593.15	0.03	0.00	2.53	1.11	0.07	0.01	13.6	12.1	2.2	10.9	39.5	27.4	0.0
2005	1,529.89	0.03	0.00	2.43	1.06	0.07	0.01	13.0	11.6	2.1	10.4	37.9	26.3	0.0
2006	815.67	0.01	0.00	1.29	0.57	0.04	0.00	6.9	6.2	1.1	5.6	20.2	14.0	0.0
2007	1,365.77	0.02	0.00	2.17	0.95	0.06	0.01	11.6	10.4	1.9	9.3	33.8	23.5	0.0
2008	1,455.43	0.03	0.00	2.31	1.01	0.07	0.01	12.4	11.1	2.0	9.9	36.1	25.0	0.0
2009	2,407.10	0.04	0.00	3.82	1.67	0.11	0.01	20.5	18.3	3.4	16.4	59.7	41.4	0.0
2010	2,546.99	0.05	0.00	4.04	1.77	0.12	0.01	21.7	19.4	3.6	17.4	63.1	43.7	0.0
2011	2,319.42	0.04	0.00	3.68	1.61	0.11	0.01	19.8	17.6	3.3	15.8	57.5	39.8	0.0
2012	2,426.26	0.04	0.00	3.87	1.66	0.11	0.34	20.7	18.4	3.8	16.6	59.3	41.2	0.5
2013	2,192.28	0.03	0.01	3.95	1.07	0.07	6.56	18.7	14.4	11.4	17.0	38.1	27.7	8.8
2014	2,222.26	0.04	0.00	3.53	1.54	0.10	0.09	18.9	16.9	3.2	15.2	54.9	38.1	0.1
2015	2,570.10	0.05	0.00	4.08	1.78	0.12	0.08	21.9	19.6	3.7	17.6	63.6	44.1	0.1
2016	2,516.78	0.04	0.00	4.01	1.74	0.12	0.20	21.4	19.1	3.8	17.2	61.9	43.0	0.3
2017	1,901.08	0.03	0.00	3.03	1.33	0.09	0.02	16.2	14.5	2.7	13.0	47.5	32.9	0.0
2018	2,115.67	0.04	0.00	3.39	1.49	0.10	0.04	18.0	16.2	3.0	14.6	53.2	36.9	0.1
2019	2,084.47	0.04	0.00	3.33	1.47	0.10	0.03	17.8	15.9	3.0	14.3	52.3	36.2	0.0
2020	2,591.20	0.05	0.00	4.14	1.82	0.12	0.03	22.1	19.8	3.7	17.8	65.0	45.1	0.0
2021	2,784.08	0.05	0.01	4.57	1.83	0.12	1.84	23.7	20.6	6.3	19.7	65.2	45.5	2.5
2022	2,313.39	0.04	0.00	3.70	1.63	0.11	0.01	19.7	17.7	3.3	15.9	58.1	40.3	0.0

1A1aii 'Combined Heat and Power Generation'

The evolution of direct GHG emissions from source 1A1aii 'Combined Heat and Power Generation' between 1990 and 2022 is shown below (Table 3-50, Figure 3-12).

Table 3-50: Direct GHG emissions from 1A1aii 'Combined Heat and Power Generation' between 1990 and 2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A1aii, kt CO_2 equivalent	1966.19	2184.22	1854.66	1590.76	342.97	313.41	444.74	516.07	358.21	361.23	385.93
%, compared to 1990	100.0	111.1	94.3	80.9	17.4	15.9	22.6	26.2	18.2	18.4	19.6
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1A1aii, kt CO_2 equivalent	583.86	492.85	451.24	474.50	544.20	525.04	512.82	461.39	447.95	422.82	399.04
%, compared to 1990	29.7	25.1	22.9	24.1	27.7	26.7	26.1	23.5	22.8	21.5	20.3
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
1A1aii, kt CO_2 equivalent	381.43	360.40	356.55	633.76	633.52	611.13	670.99	587.49	601.75	676.03	625.65
%, compared to 1990	19.4	18.3	18.1	32.2	32.2	31.1	34.1	29.9	30.6	34.4	31.8

In this period, GHG emissions from this source dropped significantly, constituting in 2022 only circa 31.8% of the 1990-year level.

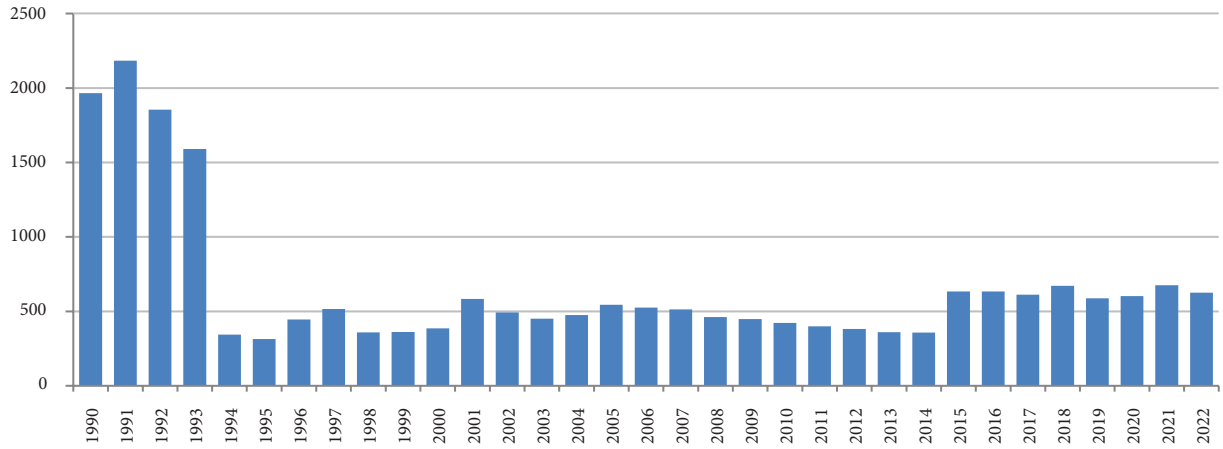


Figure 3-12: Direct GHG emissions from source 1A1aii 'Combined Heat and Power Generation' between 1990 and 2022.

Table 3-51 shows the evolution of direct GHG emissions from source 1A1aii 'Combined Heat and Power Generation' in the Republic of Moldova between 1990 and 2022, the share of each gas in the structure of total emissions at source level, and the evolution of direct GHG emissions, respectively, express in % compared to the base year level.

Table 3-51: Direct GHG emissions from 1A1aii 'Combined Heat and Power Generation' between 1990 and 2022

	1A1aii, kt CO_2 equivalent				Share of total, %			%, compared to 1990		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1990	1,963.40	1.22	1.57	1,966.19	99.9	0.1	0.1	100.0	100.0	100.0
1991	2,180.41	1.55	2.26	2,184.22	99.8	0.1	0.1	111.1	127.0	144.0
1992	1,851.22	1.37	2.07	1,854.66	99.8	0.1	0.1	94.3	112.3	131.8
1993	1,588.13	1.07	1.55	1,590.76	99.8	0.1	0.1	80.9	87.9	99.0
1994	342.45	0.22	0.29	342.97	99.8	0.1	0.1	17.4	18.1	18.8
1995	312.91	0.21	0.29	313.41	99.8	0.1	0.1	15.9	17.2	18.6
1996	444.08	0.28	0.38	444.74	99.9	0.1	0.1	22.6	23.3	24.1
1997	515.37	0.31	0.39	516.07	99.9	0.1	0.1	26.2	25.5	24.6
1998	357.72	0.22	0.28	358.21	99.9	0.1	0.1	18.2	17.9	17.6
1999	360.81	0.20	0.22	361.23	99.9	0.1	0.1	18.4	16.3	14.1
2000	385.53	0.20	0.20	385.93	99.9	0.1	0.1	19.6	16.5	13.0
2001	583.25	0.30	0.31	583.86	99.9	0.1	0.1	29.7	24.9	19.6
2002	492.36	0.25	0.24	492.85	99.9	0.1	0.0	25.1	20.5	15.5
2003	450.79	0.23	0.22	451.24	99.9	0.1	0.0	23.0	18.8	14.2
2004	474.03	0.24	0.23	474.50	99.9	0.1	0.0	24.1	19.7	14.8
2005	543.65	0.28	0.27	544.20	99.9	0.1	0.1	27.7	22.8	17.4
2006	524.52	0.26	0.25	525.04	99.9	0.1	0.0	26.7	21.7	16.2
2007	512.31	0.26	0.25	512.82	99.9	0.1	0.0	26.1	21.1	15.6
2008	460.94	0.23	0.22	461.39	99.9	0.1	0.0	23.5	19.1	14.3
2009	447.46	0.24	0.25	447.95	99.9	0.1	0.1	22.8	19.5	16.0
2010	422.39	0.22	0.21	422.82	99.9	0.1	0.1	21.5	17.8	13.7
2011	398.63	0.20	0.20	399.04	99.9	0.1	0.1	20.3	16.8	12.9
2012	381.04	0.19	0.19	381.43	99.9	0.1	0.0	19.4	15.9	12.0
2013	360.04	0.18	0.18	360.40	99.9	0.1	0.0	18.3	15.0	11.3
2014	356.19	0.18	0.18	356.55	99.9	0.1	0.0	18.1	14.9	11.3
2015	633.14	0.32	0.30	633.76	99.9	0.0	0.0	32.2	25.9	19.0
2016	632.91	0.32	0.30	633.52	99.9	0.0	0.0	32.2	25.9	19.1
2017	610.54	0.30	0.29	611.13	99.9	0.0	0.0	31.1	25.0	18.4
2018	670.34	0.33	0.32	670.99	99.9	0.0	0.0	34.1	27.5	20.2
2019	586.92	0.29	0.28	587.49	99.9	0.0	0.0	29.9	24.0	17.6
2020	601.17	0.30	0.28	601.75	99.9	0.0	0.0	30.6	24.6	18.1
2021	675.29	0.36	0.38	676.03	99.9	0.1	0.1	34.4	29.4	23.9
2022	624.58	0.44	0.63	625.65	99.8	0.1	0.1	31.8	35.8	40.2

The evolution of direct and indirect GHG emissions from source 1A1aii 'Combined Heat and Power Generation' between 1990 and 2022 is shown in Table 3-52.

Table 3-52: Direct and indirect GHG emissions from 1A1aii 'Combined Heat and Power Generation' in the Republic of Moldova between 1990 and 2022

	1A1aii, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	1,963.40	0.04	0.01	3.21	1.16	0.08	2.59	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	2,180.41	0.06	0.01	3.50	1.13	0.09	4.02	111.1	127.0	144.0	108.9	97.6	101.3	155.4
1992	1,851.22	0.05	0.01	3.03	0.91	0.07	4.26	94.3	112.3	131.8	94.4	78.6	85.0	164.6
1993	1,588.13	0.04	0.01	2.64	0.86	0.07	3.17	80.9	87.9	99.0	82.3	73.7	77.4	122.6
1994	342.45	0.01	0.00	0.56	0.20	0.01	0.54	17.4	18.1	18.8	17.6	16.9	17.2	20.8
1995	312.91	0.01	0.00	0.52	0.17	0.01	0.57	15.9	17.2	18.6	16.1	14.8	15.4	22.0
1996	444.08	0.01	0.00	0.73	0.26	0.02	0.67	22.6	23.3	24.1	22.7	22.0	22.3	25.9
1997	515.37	0.01	0.00	0.84	0.31	0.02	0.57	26.2	25.5	24.6	26.1	26.9	26.5	22.0
1998	357.72	0.01	0.00	0.58	0.21	0.02	0.42	18.2	17.9	17.6	18.1	18.5	18.3	16.4
1999	360.81	0.01	0.00	0.58	0.24	0.02	0.18	18.4	16.3	14.1	17.9	20.2	19.1	6.9
2000	385.53	0.01	0.00	0.61	0.26	0.02	0.08	19.6	16.5	13.0	19.1	22.5	20.9	2.9
2001	583.25	0.01	0.00	0.93	0.40	0.03	0.12	29.7	24.9	19.6	28.9	34.0	31.7	4.6
2002	492.36	0.01	0.00	0.78	0.34	0.02	0.05	25.1	20.5	15.5	24.4	29.2	27.0	1.8
2003	450.79	0.01	0.00	0.72	0.31	0.02	0.05	23.0	18.8	14.2	22.3	26.7	24.7	1.8
2004	474.03	0.01	0.00	0.75	0.33	0.02	0.03	24.1	19.7	14.8	23.4	28.1	26.0	1.3
2005	543.65	0.01	0.00	0.86	0.37	0.02	0.06	27.7	22.8	17.4	26.9	32.1	29.7	2.3
2006	524.52	0.01	0.00	0.83	0.36	0.02	0.02	26.7	21.7	16.2	25.9	31.2	28.8	0.8
2007	512.31	0.01	0.00	0.81	0.36	0.02	0.01	26.1	21.1	15.6	25.3	30.6	28.1	0.4
2008	460.94	0.01	0.00	0.73	0.32	0.02	0.02	23.5	19.1	14.3	22.8	27.4	25.3	0.9
2009	447.46	0.01	0.00	0.71	0.30	0.02	0.16	22.8	19.5	16.0	22.3	25.7	24.1	6.0
2010	422.39	0.01	0.00	0.67	0.29	0.02	0.05	21.5	17.8	13.7	20.9	24.9	23.0	2.1
2011	398.63	0.01	0.00	0.63	0.27	0.02	0.05	20.3	16.8	12.9	19.7	23.5	21.7	1.9
2012	381.04	0.01	0.00	0.61	0.26	0.02	0.03	19.4	15.9	12.0	18.8	22.6	20.9	1.2
2013	360.04	0.01	0.00	0.57	0.25	0.02	0.03	18.3	15.0	11.3	17.8	21.3	19.7	1.2
2014	356.19	0.01	0.00	0.57	0.24	0.02	0.03	18.1	14.9	11.3	17.6	21.1	19.5	1.3
2015	633.14	0.01	0.00	1.00	0.44	0.03	0.00	32.2	25.9	19.0	31.3	37.9	34.9	0.1
2016	632.91	0.01	0.00	1.00	0.44	0.03	0.01	32.2	25.9	19.1	31.3	37.9	34.8	0.3
2017	610.54	0.01	0.00	0.97	0.42	0.03	0.00	31.1	25.0	18.4	30.1	36.5	33.6	0.1
2018	670.34	0.01	0.00	1.06	0.47	0.03	0.00	34.1	27.5	20.2	33.1	40.1	36.9	0.1
2019	586.92	0.01	0.00	0.93	0.41	0.03	0.00	29.9	24.0	17.6	29.0	35.1	32.3	0.1
2020	601.17	0.01	0.00	0.95	0.42	0.03	0.00	30.6	24.6	18.1	29.7	36.0	33.1	0.1
2021	675.29	0.01	0.00	1.08	0.45	0.03	0.23	34.4	29.4	23.9	33.6	38.9	36.5	9.0
2022	624.58	0.02	0.00	1.04	0.33	0.03	1.36	31.8	35.8	40.2	32.5	28.2	30.2	52.6

In this period, GHG emissions from this source dropped significantly, constituting in 2022, for CO_2 emissions, only circa 31.8% of the 1990-year level, whereas for CH_4 – 35.8%, N_2O – 40.2%, NO_x – 32.5%, CO – 28.2%, NMVOC – 30.2% and SO_2 – 52.6%.

1A1aiii 'Heat Plants'

The evolution of direct GHG emissions from source 1A1aiii 'Heat Plants' in the Republic of Moldova between 1990 and 2022 is shown in Figure 3-13.

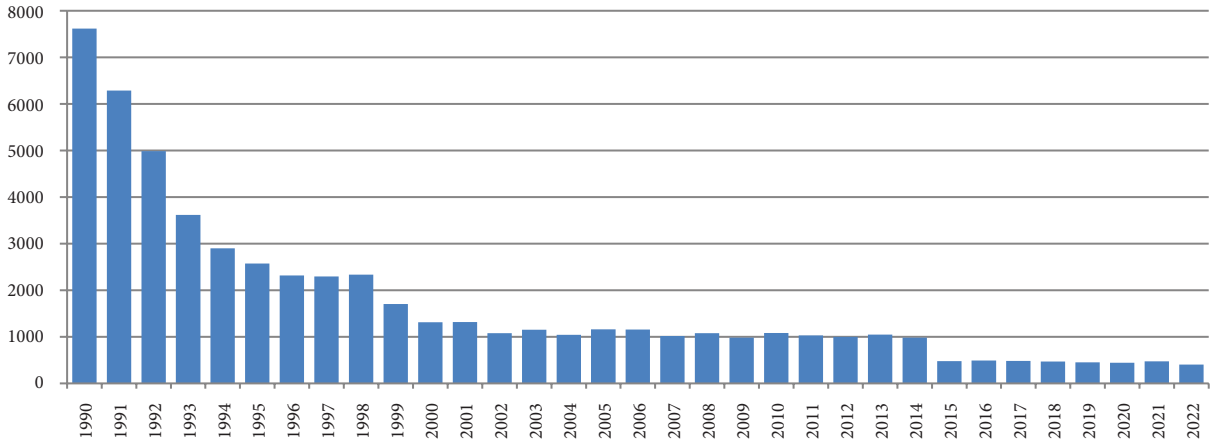


Figure 3-13: Direct GHG emissions from 1A1aiii 'Heat Plants' between 1990 and 2022.

In this period, GHG emissions from this source dropped significantly, constituting in 2022 only circa 5.3% of the 1990-year level (Table 3-53).

Table 3-53: Direct GHG emissions from 1A1aiii 'Heat Plants' between 1990 and 2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A1aiii, kt CO_2 equivalent	7,617.43	6,286.81	4,986.23	3,615.47	2,899.93	2,573.44	2,313.45	2,291.99	2,332.39	1,703.93	1,312.33
%, compared to 1990	100.0	82.5	65.5	47.5	38.1	33.8	30.4	30.1	30.6	22.4	17.2
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A1aiii, kt CO_2 equivalent	1,315.66	1,076.23	1,151.26	1,041.55	1,157.63	1,154.39	1,013.87	1,076.33	982.97	1,080.77	1,029.97
%, compared to 1990	17.3	14.1	15.1	13.7	15.2	15.2	13.3	14.1	12.9	14.2	13.5
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A1aiii, kt CO_2 equivalent	997.61	1,048.03	979.25	477.72	491.68	481.57	466.82	452.16	440.91	471.40	403.22
%, compared to 1990	13.1	13.8	12.9	6.3	6.5	6.3	6.1	5.9	5.8	6.2	5.3

Table 3-54 shows the evolution of direct GHG emissions from source 1A1aiii 'Heat Plants' between 1990 and 2022, the share of each gas in the structure of total emissions at source level, and the evolution of direct GHG emissions, respectively, expressed in % compared to the base year level.

Table 3-54: Direct GHG emissions from 1A1aiii 'Heat Plants' between 1990 and 2022

	1A1aiii, kt CO_2 equivalent				Share of total, %			%, compared to 1990		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1990	7,600.70	5.97	10.76	7,617.43	99.8	0.1	0.1	100.0	100.0	100.0
1991	6,273.19	4.87	8.75	6,286.81	99.8	0.1	0.1	82.5	81.5	81.3
1992	4,975.54	3.84	6.85	4,986.23	99.8	0.1	0.1	65.5	64.3	63.7
1993	3,607.47	2.81	5.18	3,615.47	99.8	0.1	0.1	47.5	47.2	48.2
1994	2,894.44	2.12	3.38	2,899.93	99.8	0.1	0.1	38.1	35.5	31.4
1995	2,568.64	1.87	2.93	2,573.44	99.8	0.1	0.1	33.8	31.3	27.2
1996	2,309.13	1.68	2.64	2,313.45	99.8	0.1	0.1	30.4	28.2	24.5
1997	2,288.27	1.51	2.20	2,291.99	99.8	0.1	0.1	30.1	25.4	20.5
1998	2,328.98	1.44	1.97	2,332.39	99.9	0.1	0.1	30.6	24.2	18.3
1999	1,701.54	1.04	1.35	1,703.93	99.9	0.1	0.1	22.4	17.4	12.5
2000	1,310.61	0.78	0.93	1,312.33	99.9	0.1	0.1	17.2	13.0	8.7
2001	1,313.84	0.84	0.98	1,315.66	99.9	0.1	0.1	17.3	14.1	9.1
2002	1,074.51	0.79	0.94	1,076.23	99.8	0.1	0.1	14.1	13.2	8.7
2003	1,149.52	0.81	0.94	1,151.26	99.8	0.1	0.1	15.1	13.5	8.7
2004	1,039.90	0.76	0.89	1,041.55	99.8	0.1	0.1	13.7	12.7	8.3
2005	1,155.90	0.81	0.92	1,157.63	99.9	0.1	0.1	15.2	13.5	8.6
2006	1,152.75	0.78	0.87	1,154.39	99.9	0.1	0.1	15.2	13.0	8.1
2007	1,012.36	0.72	0.79	1,013.87	99.9	0.1	0.1	13.3	12.0	7.4
2008	1,074.47	0.87	0.99	1,076.33	99.8	0.1	0.1	14.1	14.5	9.2
2009	981.02	0.89	1.06	982.97	99.8	0.1	0.1	12.9	14.9	9.8
2010	1,078.58	1.01	1.19	1,080.77	99.8	0.1	0.1	14.2	16.9	11.0
2011	1,028.09	0.87	1.00	1,029.97	99.8	0.1	0.1	13.5	14.6	9.3
2012	996.10	0.71	0.80	997.61	99.8	0.1	0.1	13.1	11.9	7.4
2013	1,046.29	0.77	0.97	1,048.03	99.8	0.1	0.1	13.8	12.8	9.0
2014	977.53	0.81	0.92	979.25	99.8	0.1	0.1	12.9	13.5	8.6
2015	477.26	0.24	0.23	477.72	99.9	0.0	0.0	6.3	4.0	2.1
2016	491.16	0.26	0.26	491.68	99.9	0.1	0.1	6.5	4.4	2.4
2017	481.05	0.26	0.25	481.57	99.9	0.1	0.1	6.3	4.3	2.4
2018	466.31	0.26	0.26	466.82	99.9	0.1	0.1	6.1	4.3	2.4
2019	451.70	0.23	0.22	452.16	99.9	0.1	0.0	5.9	3.9	2.1
2020	440.45	0.23	0.22	440.91	99.9	0.1	0.1	5.8	3.9	2.1
2021	470.92	0.25	0.24	471.40	99.9	0.1	0.1	6.2	4.1	2.2
2022	402.79	0.22	0.21	403.22	99.9	0.1	0.1	5.3	3.6	2.0

The evolution of direct and indirect GHG emissions from source 1A1aiii 'Heat Plants' between 1990 and 2022 is shown in Table 3-55.

Table 3-55: Direct and indirect GHG emissions from 1A1aiii 'Heat Plants' between 1990 and 2022

	1A1aiii, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	7,600.70	0.21	0.04	13.00	3.24	0.28	25.46	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	6,273.19	0.17	0.03	10.74	2.69	0.23	20.93	82.5	81.5	81.3	82.6	82.9	82.8	82.2
1992	4,975.54	0.14	0.03	8.53	2.15	0.18	16.47	65.5	64.3	63.7	65.6	66.4	66.2	64.7
1993	3,607.47	0.10	0.02	6.25	1.54	0.13	12.64	47.5	47.2	48.2	48.1	47.5	47.8	49.7
1994	2,894.44	0.08	0.01	4.87	1.49	0.12	6.85	38.1	35.5	31.4	37.5	45.9	41.9	26.9
1995	2,568.64	0.07	0.01	4.32	1.31	0.10	6.08	33.8	31.3	27.2	33.2	40.5	37.1	23.9
1996	2,309.13	0.06	0.01	3.88	1.18	0.09	5.47	30.4	28.2	24.5	29.9	36.5	33.5	21.5
1997	2,288.27	0.05	0.01	3.79	1.29	0.10	3.95	30.1	25.4	20.5	29.2	39.7	34.5	15.5
1998	2,328.98	0.05	0.01	3.82	1.38	0.10	3.15	30.6	24.2	18.3	29.4	42.4	36.0	12.4
1999	1,701.54	0.04	0.01	2.78	1.03	0.07	1.94	22.4	17.4	12.5	21.4	31.8	26.7	7.6
2000	1,310.61	0.03	0.00	2.12	0.84	0.06	0.89	17.2	13.0	8.7	16.3	26.0	21.2	3.5
2001	1,313.84	0.03	0.00	2.12	0.87	0.06	0.75	17.3	14.1	9.1	16.3	26.7	21.7	2.9
2002	1,074.51	0.03	0.00	1.75	0.72	0.05	0.63	14.1	13.2	8.7	13.4	22.1	18.0	2.5
2003	1,149.52	0.03	0.00	1.86	0.78	0.05	0.47	15.1	13.5	8.7	14.3	24.1	19.3	1.9
2004	1,039.90	0.03	0.00	1.68	0.71	0.05	0.44	13.7	12.7	8.3	13.0	21.9	17.6	1.7
2005	1,155.90	0.03	0.00	1.87	0.80	0.05	0.37	15.2	13.5	8.6	14.4	24.5	19.6	1.5
2006	1,152.75	0.03	0.00	1.86	0.80	0.05	0.31	15.2	13.0	8.1	14.3	24.6	19.6	1.2
2007	1,012.36	0.03	0.00	1.63	0.71	0.05	0.19	13.3	12.0	7.4	12.6	21.9	17.4	0.8
2008	1,074.47	0.03	0.00	1.75	0.76	0.05	0.27	14.1	14.5	9.2	13.4	23.4	18.7	1.1
2009	981.02	0.03	0.00	1.61	0.69	0.05	0.45	12.9	14.9	9.8	12.4	21.2	17.1	1.8
2010	1,078.58	0.04	0.00	1.77	0.76	0.05	0.46	14.2	16.9	11.0	13.6	23.5	19.0	1.8
2011	1,028.09	0.03	0.00	1.68	0.72	0.05	0.34	13.5	14.6	9.3	12.9	22.4	18.0	1.3
2012	996.10	0.03	0.00	1.61	0.69	0.05	0.30	13.1	11.9	7.4	12.4	21.3	17.0	1.2
2013	1,046.29	0.03	0.00	1.71	0.71	0.05	0.56	13.8	12.8	9.0	13.2	21.9	17.6	2.2
2014	977.53	0.03	0.00	1.61	0.71	0.05	0.28	12.9	13.5	8.6	12.4	21.8	17.4	1.1
2015	477.26	0.01	0.00	0.76	0.33	0.02	0.00	6.3	4.0	2.1	5.8	10.2	8.0	0.0
2016	491.16	0.01	0.00	0.78	0.34	0.02	0.00	6.5	4.4	2.4	6.0	10.6	8.3	0.0
2017	481.05	0.01	0.00	0.77	0.34	0.02	0.01	6.3	4.3	2.4	5.9	10.4	8.1	0.0
2018	466.31	0.01	0.00	0.74	0.33	0.02	0.00	6.1	4.3	2.4	5.7	10.1	7.9	0.0
2019	451.70	0.01	0.00	0.72	0.31	0.02	0.00	5.9	3.9	2.1	5.5	9.7	7.6	0.0
2020	440.45	0.01	0.00	0.70	0.31	0.02	0.00	5.8	3.9	2.1	5.4	9.5	7.4	0.0
2021	470.92	0.01	0.00	0.75	0.33	0.02	0.00	6.2	4.1	2.2	5.8	10.1	7.9	0.0
2022	402.79	0.01	0.00	0.64	0.28	0.02	0.00	5.3	3.6	2.0	4.9	8.7	6.8	0.0

In this period, GHG emissions from this source dropped significantly, constituting in 2022, for CO_2 emissions, only circa 5.3% of the 1990-year level, whereas for CH_4 – 3.6%, N_2O – 2.0%, NO_x – 4.9%, CO – 8.7%, NMVOC – 6.8% and SO_2 – 0.01%.

3.3.1.2. 1A1b 'Petroleum Refining'

The evolution of direct GHG emissions from source 1A1b 'Petroleum Refining' between 2015 and 2022 is shown in Table 3-56.

Table 3-56: Direct GHG emissions from 1A1b 'Petroleum Refining' between 2015 and 2022

	2015	2016	2017	2018	2019	2020	2021	2022
1A1b, kt CO_2 equivalent	3.96	4.04	3.87	3.07	1.33	1.57	0.80	0.80

The evolution of direct GHG emissions from 1A1b 'Petroleum Refining' between 2015 and 2022 and the share of each gas in the structure of total emissions at source level is shown in Table 3-57.

Table 3-57: Direct GHG emissions from 1A1b 'Petroleum Refining' between 2015 and 2022

	GHG emissions, kt CO_2 equivalent				Share of GHG in the structure of total emissions, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
2015	3.9505	0.0044	0.0084	3.9634	99.7	0.1	0.2
2016	4.0252	0.0046	0.0086	4.0384	99.7	0.1	0.2
2017	3.8528	0.0044	0.0083	3.8656	99.7	0.1	0.2
2018	3.0630	0.0035	0.0066	3.0731	99.7	0.1	0.2

	GHG emissions, kt CO_2 equivalent				Share of GHG in the structure of total emissions, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
2019	1.3290	0.0015	0.0029	1.3333	99.7	0.1	0.2
2020	1.5608	0.0018	0.0035	1.5661	99.7	0.1	0.2
2021	0.7959	0.0009	0.0017	0.7986	99.7	0.1	0.2
2022	0.7962	0.0009	0.0018	0.7989	99.7	0.1	0.2

Table 3-58 shows the evolution of direct and indirect GHG emissions from 1A1b 'Petroleum Refining' between 2015 and 2022.

Table 3-58: Direct and indirect GHG emissions from 1A1b 'Petroleum Refining' between 2015 and 2022, kt

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2015	3.9505	0.0002	0.0000	0.0065	0.0005	0.0001	0.0197
2016	4.0252	0.0002	0.0000	0.0059	0.0006	0.0001	0.0161
2017	3.8528	0.0002	0.0000	0.0053	0.0006	0.0001	0.0135
2018	3.0630	0.0001	0.0000	0.0043	0.0005	0.0001	0.0112
2019	1.3290	0.0001	0.0000	0.0024	0.0001	0.0000	0.0079
2020	1.5608	0.0001	0.0000	0.0015	0.0003	0.0000	0.0021
2021	0.7959	0.0000	0.0000	0.0008	0.0002	0.0000	0.0012
2022	0.7962	0.0000	0.0000	0.0009	0.0002	0.0000	0.0014

3.3.1.3. 1A1c 'Manufacture of Solid Fuels'

The evolution of direct GHG emissions from source 1A1c 'Manufacture of Solid Fuels' between 2012 and 2022 is shown in Table 3-59.

Table 3-59: Direct GHG emissions from 1A1c 'Manufacture of Solid Fuels' between 2012 and 2022

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A1c, kt CO_2 equivalent	0.36	0.45	0.22	0.36	0.45	0.39	0.34	0.42	0.42	0.45	0.62

The evolution of direct GHG emissions from source 1A1c 'Manufacture of Solid Fuels' and the share of each gas in the structure of total emissions at source level is shown in Table 3-60.

Table 3-60: Direct GHG emissions from 1A1c 'Manufacture of Solid Fuels' between 2012 and 2022

	GHG emissions, kt CO_2 equivalent				Share of GHG in the structure of total emissions, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
2012	IE	0.36	NA	0.36	IE	100.0	NA
2013	IE	0.45	NA	0.45	IE	100.0	NA
2014	IE	0.22	NA	0.22	IE	100.0	NA
2015	IE	0.36	NA	0.36	IE	100.0	NA
2016	IE	0.45	NA	0.45	IE	100.0	NA
2017	IE	0.39	NA	0.39	IE	100.0	NA
2018	IE	0.34	NA	0.34	IE	100.0	NA
2019	IE	0.42	NA	0.42	IE	100.0	NA
2020	IE	0.42	NA	0.42	IE	100.0	NA
2021	IE	0.45	NA	0.45	IE	100.0	NA
2022	IE	0.62	NA	0.62	IE	100.0	NA

Note: CO_2 emissions are reported in source category 'CO_2 emissions from Biomass'.

Table 3-61 shows the evolution of direct and indirect greenhouse gas emissions from source 1A1c 'Manufacture of Solid Fuels' between 2012-2022.

Table 3-61: Direct and indirect GHG emissions from 1A1c 'Manufacture of Solid Fuels' between 2012-2022

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2012	IE	0.0130	NA	0.0001	0.0910	0.0221	NA
2013	IE	0.0160	NA	0.0002	0.1120	0.0272	NA
2014	IE	0.0080	NA	0.0001	0.0560	0.0136	NA
2015	IE	0.0130	NA	0.0001	0.0910	0.0221	NA
2016	IE	0.0160	NA	0.0002	0.1120	0.0272	NA

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
2017	IE	0.0140	NA	0.0001	0.0980	0.0238	NA
2018	IE	0.0120	NA	0.0001	0.0840	0.0204	NA
2019	IE	0.0150	NA	0.0002	0.1050	0.0255	NA
2020	IE	0.0150	NA	0.0002	0.1050	0.0255	NA
2021	IE	0.0160	NA	0.0002	0.1120	0.0272	NA
2022	IE	0.0220	NA	0.0002	0.1540	0.0374	NA

Note: CO_2 emissions are reported in source category 'CO_2 emissions from Biomass'.

3.3.2. Methodologies and Emission Factors

GHG emissions originating from category 1A1 'Energy Industries' were estimated following a Tier 1 methodology (Table 3-62), using default emission factors according to the 2006 IPCC Guidelines and Revised 1996 IPCC Guidelines. To ensure conversion from natural units to energy units, country-specific net calorific values were used.

Table 3-62: Estimation methods and coefficients utilised in the estimation of direct GHG emissions from source category 1A1 'Energy Industries'

Category	CO_2			CH_4		N_2O	
	Method	Net Calorific Value, TJ/kt	EF, t C/TJ	Method	EF, kg/TJ	Method	EF, kg/TJ
1A1 'Energy Industries'	T1	CS	D	T1	D	T1	D

Abbreviations: T1 – Tier 1; EF – Emission Factor; D – Default; CS – Country Specific. Specific).

Default EFs available in the 2023 EMEP/EEA Guidebook were used for the estimation of non-CO_2 emissions (Table 3-63).

Table 3-63: Emission factors used to estimate GHG emissions from source category 1A1a 'Main Activity Electricity and Heat Production', kg/TJ

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Anthracite	98,300	1	1.5	209	8.7	1	820
Brown Coal (lignite)	101,000	1	1.5	247	8.7	1.4	1,680
Other types of bituminous coal	94,600	1	1.5	209	8.7	1	820
Diesel	74,100	3	0.6	65	16.2	0.8	46.5
Gasoline	69,300	3	0.6	65	16.2	0.8	46.5
Fuel for oven	71,900	3	0.6	65	16.2	0.8	46.5
Residual Fuel Oil	77,400	3	0.6	142	15.1	2.3	495
Other Petroleum Products	73,300	3	0.6	65	16.2	0.8	46.5
Natural Gas	56,100	1	0.1	89	39	2.6	0.244
Liquefied Petroleum Gases	63,100	1	0.1	89	39	2.6	0.244
Fuelwood	112,000	30	4	81	90	7.31	10.8
Agricultural Residue	100,000	30	4	81	90	7.31	10.8
Charcoal	112,000	200	4	81	90	7.31	10.8
Pellets and Briquettes*	100,000	30	4	81	90	7.31	10.8
Biogas	54,600	1	0.1	198	156	10	10.8
References:	IPCC 2006, Vol. 2, Chapter 2, Tables 2.2, p. 2.16-2.17.			2023 EMEP/EEA Guidebook, Category 1A1 Energy Industries			

Emission factor values for direct greenhouse gases used in the estimation of GHG emissions from source category 1A1b 'Petroleum Refining' were taken from the 2006 IPCC Guidelines 2006, whereas for indirect greenhouse gases – from the 2023 EMEP/EEA Guidebook (Table 3-64).

Table 3-64: Emission factors for source category 1A1b 'Petroleum Refining', kg/TJ

Fuels	Emission factors						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Petroleum	73,300	3	0.6	142	6	2.3	485
Gasoline	69,300	3	0.6	65	16.2	0.65	46.1
Diesel	74,100	3	0.6	65	16.2	0.65	46.1
Residual fuel oil	77,400	3	0.6	142	6	2.3	485
Other petroleum products	73,300	3	0.6	65	16.2	0.65	46.1

Fuels	Emission factors						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Other hydrocarbons	73,300	3	0.6	65	16.2	0.65	46.1
Fuel for oven	74,100	3	0.6	65	16.2	0.65	46.1
Fuel for engines	74,100	3	0.6	65	16.2	0.65	46.1
References:	2006 IPCC Guidelines			2023 EMEP/EEA Guidebook			

Emission factor values for direct greenhouse gases used in the estimation of GHG emissions from source category 1A1c 'Manufacture of Solid Fuels' were taken from the Revised 1996 IPPC Guidelines (Table 3-65).

Table 3-65: Emission factor for source category 1A1c 'Manufacture of Solid Fuels'

Fuels	Emission factors kg/TJ						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Charcoal (output)	-	1,000	NA	10	7,000	1,700	NA

Source: Revised 1996 IPCC Guidelines, Table I-14.

This methodology of estimating emissions from category 1A1c, namely from the production of wood charcoal, was applied by other UNFCCC Annex I countries, e.g. by Switzerland[52].

Activity Data

Fuel consumption within category 1A1a 'Main Activity Electricity and Heat Production'

Fuel consumption by source within 1A1a 'Main Activity Electricity and Heat Production', as well as the share of each source in the structure of total emissions is shown in Table 3-66.

Table 3-66: Fuel consumption (TJ) by source within category 1A1a and the share of each source (%) in the structure of total consumption between 1990 and 2022

	Fuel consumption by source, TJ				Share, % of total		
	1A1ai	1A1aii	1A1aiii	1A1a	1A1ai	1A1aii	1A1aiii
1990	148,508.50	33,004.58	115,104.67	296,617.75	50.1	11.1	38.8
1991	132,885.27	35,177.74	95,102.92	263,165.93	50.5	13.4	36.1
1992	116,169.55	29,368.46	75,655.42	221,193.43	52.5	13.3	34.2
1993	94,682.32	25,858.15	54,541.54	175,082.01	54.1	14.8	31.2
1994	86,948.50	5,692.00	46,364.79	139,005.29	62.6	4.1	33.4
1995	60,702.02	5,134.00	41,101.91	106,937.93	56.8	4.8	38.4
1996	63,170.71	7,394.00	36,977.84	107,542.55	58.7	6.9	34.4
1997	45,110.60	8,743.00	37,758.67	91,612.26	49.2	9.5	41.2
1998	34,727.31	6,044.00	39,091.36	79,862.67	43.5	7.6	48.9
1999	28,483.03	6,279.00	28,842.59	63,604.62	44.8	9.9	45.3
2000	26,018.02	6,807.00	22,703.86	55,528.89	46.9	12.3	40.9
2001	31,740.36	10,298.00	22,972.54	65,010.91	48.8	15.8	35.3
2002	24,355.50	8,743.00	18,873.75	51,972.25	46.9	16.8	36.3
2003	25,604.93	8,002.00	20,325.66	53,932.59	47.5	14.8	37.7
2004	28,398.38	8,423.00	18,412.95	55,234.33	51.4	15.2	33.3
2005	27,270.84	9,640.00	20,536.46	57,447.31	47.5	16.8	35.7
2006	14,539.48	9,331.00	20,512.36	44,382.85	32.8	21.0	46.2
2007	24,345.34	9,123.00	18,129.46	51,597.80	47.2	17.7	35.1
2008	25,943.53	8,196.00	19,306.54	53,446.07	48.5	15.3	36.1
2009	42,907.39	7,853.00	17,564.05	68,324.44	62.8	11.5	25.7
2010	45,394.08	7,483.00	19,379.53	72,256.61	62.8	10.4	26.8
2011	41,338.20	7,064.00	18,461.97	66,864.17	61.8	10.6	27.6
2012	42,976.58	6,767.00	17,744.97	67,488.54	63.7	10.0	26.3
2013	33,606.43	6,393.00	18,457.83	58,457.25	57.5	10.9	31.6
2014	39,559.01	6,322.00	17,659.07	63,540.08	62.3	9.9	27.8
2015	45,769.50	11,286.00	8,507.26	65,562.76	69.8	17.2	13.0
2016	44,702.47	11,278.00	8,777.12	64,757.59	69.0	17.4	13.6
2017	33,957.54	10,883.00	8,594.16	53,434.70	63.5	20.4	16.1
2018	37,839.22	11,949.00	8,341.84	58,130.06	65.1	20.6	14.4
2019	37,261.38	10,462.00	8,061.65	55,785.04	66.8	18.8	14.5

[52] <https://unfccc.int/documents/627731>

	Fuel consumption by source, TJ				Share, % of total		
	1A1ai	1A1aii	1A1aiii	1A1a	1A1ai	1A1aii	1A1aiii
2020	46,327.45	10,716.00	7,864.22	64,907.67	71.4	16.5	12.1
2021	48,230.74	11,860.00	8,407.32	68,498.06	70.4	17.3	12.3
2022	41,381.32	10,090.00	7,198.93	58,670.24	70.5	17.2	12.3

The evolution of fuel consumption by source within source 1A1a 'Main Activity Electricity and Heat Production' between 1990 and 2022 is shown in Figure 3-14. In this period, the share of liquid fuels (petroleum products) decreased from 32.5% to circa 4.7%; the share of gaseous fuels increased from 44.6% to 95.0%; and the share of biofuels increased from 0.02% to 0.28% of the total (consumption of biofuels recorded a significant upward trend, especially between 2000 and 2014, from circa 59 TJ to 472 TJ).

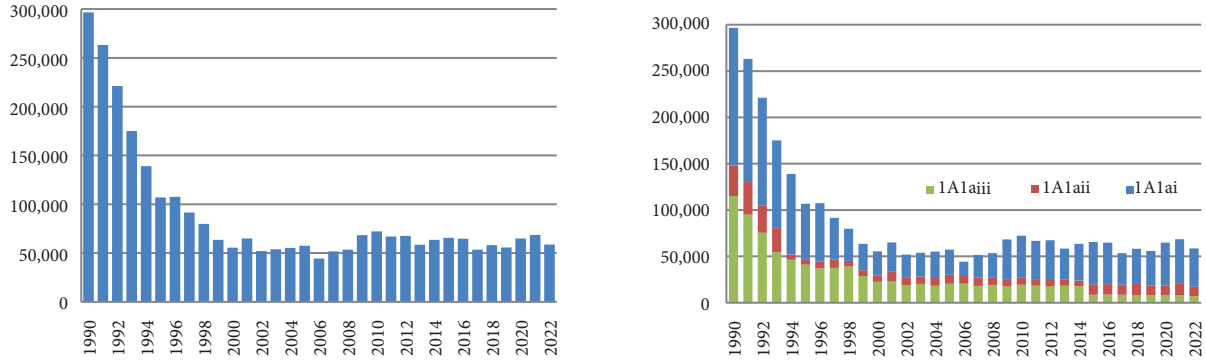


Figure 3-14: Fuel consumption by source and fuel category within 1A1a 'Main Activity Electricity and Heat Production' between 1990 and 2022, TJ.

Overall, fuel consumption within 1A1a 'Main Activity Electricity and Heat Production' constituted in 2022 only circa 19.8% of the base year level (1990), Table 3-67.

Table 3-67: Fuel consumption by category within 1A1a 'Main Activity Electricity and Heat Production' between 1990 and 2022

	Fuel consumption, TJ					Share, % of total				% compared to 1990				
	Coal	Petroleum products	Natural gas	Biofuels	Total	Coal	Petroleum products	Natural gas	Biofuels	Coal	Petroleum products	Natural gas	Biofuels	Total
1990	68,062.04	96,331.34	132,156.37	68.00	296,617.75	22.9	32.5	44.6	0.02	100.0	100.0	100.0	100.0	100.0
1991	64,271.69	79,904.28	118,989.96	0.00	263,165.93	24.4	30.4	45.2	0.0	94.4	82.9	90.0	0.0	88.7
1992	46,855.07	68,343.55	105,994.81	0.00	221,193.43	21.2	30.9	47.9	0.0	68.8	70.9	80.2	0.0	74.6
1993	44,021.68	52,807.81	78,196.52	56.00	175,082.01	25.1	30.2	44.7	0.0	64.7	54.8	59.2	82.4	59.0
1994	43,817.10	22,779.60	72,261.59	147.00	139,005.29	31.5	16.4	52.0	0.1	64.4	23.6	54.7	216.2	46.9
1995	23,047.98	13,753.22	70,048.73	88.00	106,937.93	21.6	12.9	65.5	0.1	33.9	14.3	53.0	129.4	36.1
1996	21,070.24	12,595.72	73,788.59	88.00	107,542.55	19.6	11.7	68.6	0.1	31.0	13.1	55.8	129.4	36.3
1997	7,639.85	8,722.41	75,191.00	59.00	91,612.26	8.3	9.5	82.1	0.1	11.2	9.1	56.9	86.8	30.9
1998	5,021.69	7,743.14	67,068.83	29.00	79,862.67	6.3	9.7	84.0	0.0	7.4	8.0	50.7	42.6	26.9
1999	176.00	4,108.00	59,291.62	29.00	63,604.62	0.3	6.5	93.2	0.0	0.3	4.3	44.9	42.6	21.4
2000	117.00	1,878.00	53,474.89	59.00	55,528.89	0.2	3.4	96.3	0.1	0.2	1.9	40.5	86.8	18.7
2001	88.00	1,672.00	63,103.91	147.00	65,010.91	0.1	2.6	97.1	0.2	0.1	1.7	47.7	216.2	21.9
2002	88.00	1,291.00	50,358.25	235.00	51,972.25	0.2	2.5	96.9	0.5	0.1	1.3	38.1	345.6	17.5
2003	117.00	938.00	52,643.59	234.00	53,932.59	0.2	1.7	97.6	0.4	0.2	1.0	39.8	344.1	18.2
2004	137.00	799.00	54,053.33	245.00	55,234.33	0.2	1.4	97.9	0.4	0.2	0.8	40.9	360.3	18.6
2005	123.00	733.00	56,346.31	245.00	57,447.31	0.2	1.3	98.1	0.4	0.2	0.8	42.6	360.3	19.4
2006	100.00	533.00	43,532.85	217.00	44,382.85	0.2	1.2	98.1	0.5	0.1	0.6	32.9	319.1	15.0
2007	65.00	315.00	50,977.80	240.00	51,597.80	0.1	0.6	98.8	0.5	0.1	0.3	38.6	352.9	17.4
2008	99.00	450.00	52,522.07	375.00	53,446.07	0.2	0.8	98.3	0.7	0.1	0.5	39.7	551.5	18.0
2009	122.00	1,041.00	66,723.44	438.00	68,324.44	0.2	1.5	97.7	0.6	0.2	1.1	50.5	644.1	23.0
2010	96.00	921.00	70,721.61	518.00	72,256.61	0.1	1.3	97.9	0.7	0.1	1.0	53.5	761.8	24.4
2011	69.00	695.00	65,700.17	400.00	66,864.17	0.1	1.0	98.3	0.6	0.1	0.7	49.7	588.2	22.5
2012	409.08	676.10	66,173.35	230.00	67,488.54	0.6	1.0	98.1	0.3	0.6	0.7	50.1	338.2	22.8
2013	8,290.01	711.82	49,169.42	286.00	58,457.25	14.2	1.2	84.1	0.5	12.2	0.7	37.2	420.6	19.7
2014	147.14	569.24	62,351.70	472.00	63,540.08	0.2	0.9	98.1	0.7	0.2	0.6	47.2	694.1	21.4
2015	50.32	60.90	65,437.54	14.00	65,562.76	0.1	0.1	99.8	0.0	0.1	0.1	49.5	20.6	22.1

	Fuel consumption, TJ					Share, % of total				% compared to 1990				
	Coal	Petroleum products	Natural gas	Biofuels	Total	Coal	Petroleum products	Natural gas	Biofuels	Coal	Petroleum products	Natural gas	Biofuels	Total
2016	192.71	88.45	64,452.44	24.00	64,757.59	0.3	0.1	99.5	0.0	0.3	0.1	48.8	35.3	21.8
2017	5.00	38.09	53,284.61	107.00	53,434.70	0.0	0.1	99.7	0.2	0.0	0.0	40.3	157.4	18.0
2018	14.30	41.91	57,891.84	182.00	58,130.06	0.0	0.1	99.6	0.3	0.0	0.0	43.8	267.6	19.6
2019	18.56	22.85	55,607.62	136.00	55,785.04	0.0	0.0	99.7	0.2	0.0	0.0	42.1	200.0	18.8
2020	4.62	31.08	64,705.97	166.00	64,907.67	0.0	0.0	99.7	0.3	0.0	0.0	49.0	244.1	21.9
2021	2,207.18	517.28	65,623.60	150.00	68,498.06	3.2	0.8	95.8	0.2	3.2	0.5	49.7	220.6	23.1
2022	0.00	2,756.00	55,748.24	166.00	58,670.24	0.0	4.7	95.0	0.3	0.0	2.9	42.2	244.1	19.8

Fuel consumption within category 1A1ai 'Electricity Generation'

In the Republic of Moldova, electricity generation capacity includes: the Moldovan Thermal Power Plant (MTPP) in Dnestrovsk (on the left bank of the Dniester River), and other Power Plants, including renewable sources. In recent years, renewable energy sources of small power capacity are under development. Their total capacity in 2022 represented circa 143.8 MW[53]. Out of the total energy produced from renewable sources, the largest share (72.5%) is electric power generated from wind power (circa 142 mil. kWh).

The MTPP in Dnestrovsk has an installed capacity of 2,520 MW, can combust coal, residual fuel oil and natural gas. Currently, the main type of fuel is natural gas, whose volume varied between 1,206.6 mil. m^3 (1990) and 1,217.5 mil. m^3 (2022).

It should be noted that official statistical data on residual fuel oil and coal consumption within the MTTP are available only for 1990-1998 and 2012-2021. AD is available in natural values; in order to convert it into energy values, the following conversion factors were used: for coal – 25.44 TJ/kt, for residual fuel oil – 40.20 TJ/kt, for natural gas – 33.86 TJ/mln.m^3.

Table 3-68 presents the information regarding fuel consumption (TJ) by category for the generation of electricity within source 1A1ai 'Electricity Generation', and the share (%) in the structure of total fuel consumption, respectively. For 2022, natural gas consumption constituted 99.6% of the total quantity of fuels combusted.

Table-68: Fuel consumption by category for the generation of electricity within source 1A1ai 'Electricity Generation', and the share in the structure of total fuel consumption

	1A1ai, TJ					1A1ai, % of total			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
1990	64,643	43,010	40,855	NO	148,508	43.5	29.0	27.5	NO
1991	61,539	30,484	40,862	NO	132,885	46.3	22.9	30.8	NO
1992	44,774	27,855	43,541	NO	116,170	38.5	24.0	37.5	NO
1993	41,900	24,422	28,361	NO	94,682	44.3	25.8	30.0	NO
1994	42,907	9,166	34,876	NO	86,949	49.3	10.5	40.1	NO
1995	22,461	1,049	37,192	NO	60,702	37.0	1.7	61.3	NO
1996	20,513	949	41,709	NO	63,171	32.5	1.5	66.0	NO
1997	7,171	243	37,696	NO	45,111	15.9	0.5	83.6	NO
1998	4,641	1,082	29,004	NO	34,727	13.4	3.1	83.5	NO
1999	NO	NO	28,483	NO	28,483	NO	NO	100.0	NO
2000	NO	NO	26,018	NO	26,018	NO	NO	100.0	NO
2001	NO	NO	31,740	NO	31,740	NO	NO	100.0	NO
2002	NO	NO	24,355	NO	24,355	NO	NO	100.0	NO
2003	NO	NO	25,605	NO	25,605	NO	NO	100.0	NO
2004	NO	NO	28,398	NO	28,398	NO	NO	100.0	NO
2005	NO	NO	27,271	NO	27,271	NO	NO	100.0	NO
2006	NO	NO	14,539	NO	14,539	NO	NO	100.0	NO
2007	NO	NO	24,345	NO	24,345	NO	NO	100.0	NO
2008	NO	NO	25,944	NO	25,944	NO	NO	100.0	NO

[53] Annual Activity Report, National Agency for Energy Regulation 2022, P. 25

	1A1ai, TJ					1A1ai, % of total			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
2009	NO	NO	42,907	NO	42,907	NO	NO	100.0	NO
2010	NO	21	45,373	NO	45,394	NO	0.0	100.0	NO
2011	NO	19	41,319	NO	41,338	NO	0.0	100.0	NO
2012	335	113	42,528	NO	42,977	0.8	0.3	99.0	NO
2013	7,942	84	25,571	10	33,606	23.6	0.2	76.1	0.0
2014	67	68	39,406	18	39,559	0.2	0.2	99.6	0.0
2015	50	61	45,644	14	45,770	0.1	0.1	99.7	0.0
2016	188	88	44,424	2	44,702	0.4	0.2	99.4	0.0
2017	*NO*	38	33,835	84	33,958	NO	0.1	99.6	0.2
2018	11	42	37,636	150	37,839	0.0	0.1	99.5	0.4
2019	19	23	37,094	126	37,261	0.0	0.1	99.6	0.3
2020	5	31	46,139	153	46,327	0.0	0.1	99.6	0.3
2021	2,207	50	45,836	137	48,231	4.6	0.1	95.0	0.3
2022	NO	8	41,226	147	41,381	NO	0.0	99.6	0.4

Source: Energy Balances of the RoM 1990-2022; for MTPP: information regarding natural gas consumption – JSC 'Moldovagaz'; residual fuel oil – for the period 1990-1998: from MTTP Dnestrovsk, for the period 2012-2021: Press Releases of the MTTP in Dnestrovsk (<www.moldgres.com>), for 2022 – JSC 'Tiraspoltransgaz' and Analytical Reports of the Ministry of Energy of the RoM.

Fuel consumption within category 1A1aii 'Combined Heat and Power Generation'

On the RBDR there are three Combined Heat and Power (CHP) Plants CHP-1 (34 MW) and CHP-2 (258 MW) in Chisinau municipality, and CHP-North (37 MW) in Balti municipality, respectively. More detailed information on fuel consumption and the generation of electricity and heat, collected directly from the three CHP plants (CHP-1, CHP-2, and CHP-North), is presented in Table 3-69.

Table 3-69: Consumption of fuel and electricity and heat generation in CHP plants in the Republic of Moldova between 1990 and 2022

		1990	1995	2000	2005	2010	2015	2020	2021	2022
CHP-1	Residual Fuel Oil, kt	13.4	4.7	1.2	0.9	0.0	0.0	0.0	0.0	0.0
	Natural Gas, million m^3	271.2	137.6	65.2	84.8	51.2	25.6	20.3	17.2	24.14
	Electricity, million kWh	207.5	106.4	100.8	154.9	94.9	47.2	27.8	22.5	32.4
	Heat, thousands Gcal	2,249.2	1,035.1	387.4	375.6	245.4	195.3	155.2	141.8	186.4
CHP-2	Residual Fuel Oil, kt	76.4	57.3	3.7	2.9	0.0	0.0	14.6	11.6	68.7
	Natural Gas, million m^3	486.1	270.7	267.4	326.8	304.2	274.7	261.7	278.2	149.9
	Electricity, million kWh	1,150.0	670.9	658.1	854.4	782.4	731.6	693.6	781.2	588.5
	Heat, thousands Gcal	2,544.7	1,518.2	947.0	1,198.1	1,193.4	1,095.8	1,058.3	1,240.1	966.1
CHP-North	Residual Fuel Oil, kt	40.0	8.1	0.9	0.0	0.0	0.0	0.0	0.0	0.0
	Natural Gas, million m^3	15.7	86.9	25.0	44.3	41.5	36.0	41.1	43.4	35.8
	Electricity, million kWh	121.0	81.0	27.3	67.8	70.0	66.6	113.5	115.0	93.9
	Heat, thousands Gcal	1,360.0	596.0	125.7	232.6	227.5	275.5	175.9	193.7	166.4

Source: SOE 'Termoelectrica' and SOE 'CHP-North'.

At the same time, activity data (including in energy units) regarding fuel consumption for combined heat and power generation on the territory on the RBDR are available in the Energy Balances of the Republic of Moldova (see 'CHP plants – energy producers for public purposes').

Fuel consumption by category at CHP plants in the Republic of Moldova is presented in Table 3-70.

Table 3-70: Fuel consumption by category for combined heat and power generation between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Liquid fuels	5,257	10,045	9,759	6,201	1,086	1,173	1,379	1,173	880	411	176
Gaseous fuels	27,747	25,133	19,610	19,528	4,606	3,961	6,015	7,570	5,164	5,868	6,631
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Liquid fuels	264	88	88	72	137	52	26	56	327	125	113
Gaseous fuels	10,034	8,655	7,914	8,351	9,503	9,279	9,097	8,140	7,526	7,358	6,951
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Liquid fuels	68	67	73	NO	NO	NO	NO	NO	NO	467	2,748
Gaseous fuels	6,699	6,326	6,249	11,286	11,273	10,883	11,949	10,462	10,716	11,393	7,342

Fuel consumption within category 1A1aiii 'Heat Plants'

Heat plants (HPs) in the Republic of Moldova mainly combust natural gases and residual fuel oil, rather than coal and biomass. Information regarding the amount of fuel consumption is available in the Energy Balances of the Republic of Moldova.

Between 1990 and 2016, AD on natural gas consumption for heat generation on the LBDR were provided by JSC 'Moldovagaz'. The AD are available in natural units (mil. m^3), converted into energy units (TJ) by applying the conversion factor (33.86 TJ/mil.m^3). For 2017-2022, information on the consumption of natural gas were taken from Analytical Reports of the Ministry of Energy.

AD (including in energy units) regarding fuel consumption for heat generation on the RBDR is available in the Energy Balances (see rubric 'Heat Plants' – energy producers for public purposes').

Fuel consumption by category in heat production between 1990 and 2022 is presented in Table 3-71.

Table 3-71: Fuel consumption by category in heat production between 1990 and 2022

	Fuel consumption by type, TJ					%, compared to 1990				
	Coal	Petroleum products	Natural gas	Biofuels	Total	Coal	Petroleum products	Natural gas	Biofuels	Total
1990	3,419.00	48,064.00	63,553.67	68.00	115,104.67	100.0	100.0	100.0	100.0	100.0
1991	2,732.33	39,375.67	52,994.92	NO	95,102.92	79.9	81.9	83.4	NO	82.6
1992	2,080.67	30,730.33	42,844.42	NO	75,655.42	60.9	63.9	67.4	NO	65.7
1993	1,993.00	22,185.00	30,307.54	56.00	54,541.54	58.3	46.2	47.7	82.4	47.4
1994	910.00	12,528.00	32,779.79	147.00	46,364.79	26.6	26.1	51.6	216.2	40.3
1995	587.00	11,531.00	28,895.91	88.00	41,101.91	17.2	24.0	45.5	129.4	35.7
1996	557.00	10,268.00	26,064.84	88.00	36,977.84	16.3	21.4	41.0	129.4	32.1
1997	469.00	7,306.00	29,924.67	59.00	37,758.67	13.7	15.2	47.1	86.8	32.8
1998	381.00	5,781.00	32,900.36	29.00	39,091.36	11.1	12.0	51.8	42.6	34.0
1999	176.00	3,697.00	24,940.59	29.00	28,842.59	5.1	7.7	39.2	42.6	25.1
2000	117.00	1,702.00	20,825.86	59.00	22,703.86	3.4	3.5	32.8	86.8	19.7
2001	88.00	1,408.00	21,329.54	147.00	22,972.54	2.6	2.9	33.6	216.2	20.0
2002	88.00	1,203.00	17,347.75	235.00	18,873.75	2.6	2.5	27.3	345.6	16.4
2003	117.00	850.00	19,124.66	234.00	20,325.66	3.4	1.8	30.1	344.1	17.7
2004	137.00	727.00	17,303.95	245.00	18,412.95	4.0	1.5	27.2	360.3	16.0
2005	123.00	596.00	19,572.46	245.00	20,536.46	3.6	1.2	30.8	360.3	17.8
2006	100.00	481.00	19,714.36	217.00	20,512.36	2.9	1.0	31.0	319.1	17.8
2007	65.00	289.00	17,535.46	240.00	18,129.46	1.9	0.6	27.6	352.9	15.8
2008	99.00	394.00	18,438.54	375.00	19,306.54	2.9	0.8	29.0	551.5	16.8
2009	122.00	714.00	16,290.05	438.00	17,563.05	3.6	1.5	25.6	644.1	15.3
2010	96.00	775.00	17,990.53	518.00	19,377.53	2.8	1.6	28.3	761.8	16.8
2011	69.00	563.00	17,429.97	401.00	18,462.97	2.0	1.2	27.4	589.7	16.0
2012	74.00	495.00	16,945.97	230.00	17,744.97	2.2	1.0	26.7	338.2	15.4
2013	328.00	561.00	17,272.83	276.00	18,438.83	9.6	1.2	27.2	405.9	16.0
2014	80.00	428.00	16,697.07	454.00	17,659.07	2.3	0.9	26.3	667.6	15.3
2015	NO	NO	8,507.26	NO	8,507.26	NO	NO	13.4	NO	7.4
2016	NO	NO	8,755.12	22.00	8,777.12	NO	NO	13.8	32.4	7.6
2017	5.00	NO	8,566.16	23.00	8,594.16	0.1	NO	13.5	33.8	7.5
2018	3.00	NO	8,306.84	32.00	8,341.84	0.1	NO	13.1	47.1	7.2
2019	NO	NO	8,051.65	10.00	8,061.65	NO	NO	12.7	14.7	7.0
2020	NO	NO	7,851.22	13.00	7,864.22	NO	NO	12.4	19.1	6.8
2021	NO	NO	8,394.32	13.00	8,407.32	NO	NO	13.2	19.1	7.3
2022	NO	NO	7,179.93	19.00	7,198.93	NO	NO	11.3	27.9	6.25

Fuel consumption within category 1A1b 'Petroleum refining'

Activity data on the amount of fuel consumption in crude oil refineries for energy purposes for the period 2015-2022 are available in the Energy Balances of the Republic of Moldova, Table 3-72.

Table 3-72: AD from source category 1A1b 'Petroleum refining', TJ

Production		2015	2016	2017	2018	2019	2020	2021	2022
Source category 1A1b 'Petroleum refining'	Additives and compounds	NO	NO	NO	NO	NO	2.32	0.16	0.08
	Crude oil	22.32	22.88	16.24	17.12	14.08	2.40	1.36	2.08
	Gasoline	NO	0.16	9.52	0.96	NO	12.72	3.20	5.44
	Diesel	13.44	21.12	16.32	15.6	1.28	4.00	6.00	3.52
	Residual fuel oil	16.96	8.08	8.96	4.08	2.08	0.40	0.16	NO
	Other petroleum products	0.08	1.92	0.56	3.36	0.56	NO	NO	NO
	Other hydrocarbons	NO	0.08	0.56	0.16	NO	NO	NO	NO
	Fuel for engines	NO	NO	0.24	0.16	NO	0.08	NO	NO
	Kerosene	NO	NO	NO	NO	NO	NO	0.08	NO

For the period of 2015-2022, activity data, corresponding to category 1A1b 'Petroleum refining', includes the following types of fuels: crude oil, gasoline, diesel fuel, residual fuel oil, other petroleum products, other hydrocarbons. The necessary information can be found in the Energy Balances of the Republic of Moldova for the years 2015-2022, in the following chapter: 'Transformation', categories 'Oil Installations', and 'Oil Refineries'.

Fuel consumption within category 1A1c 'Manufacture of solid fuels'

In the Republic of Moldova, no solid fuel production activities are carried out, except for the production of charcoal. The necessary information can be found in the Energy Balances of the Republic of Moldova for the years 2012-2022 in the following chapter: 'Transformation', category 'Units producing charcoal', Table 3-73.

Table 3-73: Activity data for source 1A1c 'Manufacture of solid fuels'

Production	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Firewood (input), TJ	26	31	34	72	59	61	51	73	63	66	49
Charcoal (output), TJ	13	16	8	13	16	14	12	15	15	16	22

3.3.3. Uncertainties and Time Series Consistency

The primary factors that affect inventory uncertainties are largely dependent on the methodology, and emission factors used to estimate the GHG emissions from category 1A1 'Energy Industries' and they also depend on the quality of available AD.

Uncertainties associated with EFs utilised to estimate CO_2 emissions are estimated to be circa 5%; those associated to EFs utilised to estimate CH_4 and N_2O emissions reach up to ±50%, respectively. Uncertainties associated with AD regarding fuel consumption within energy industries are estimated to be circa 5% for CO_2 and CH_4 emissions, and ±3% for N_2O emissions, respectively. The combined uncertainties presented as a percentage of the total direct GHG emissions originating from sector 1A1 'Energy Industries' were estimated to be circa 7.1% (Annex 2-3.1).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.3.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for 1A1 'Energy Industries', following a Tier 1 approach.

It should be noted that AD and methods used for estimating GHG emissions from the respective category are documented and archived both in hard copies and electronically.

In order to identify errors related to data entry and those related to the GHG estimation process, procedures have been carried out to check and control the quality of the data used and the emission factors applied.

The quality control and verification procedures applied in the calculation process for category 1A1 'Energy Industries' included:

- verification of AD collecting and manipulation procedures, including: verifying whether disaggregation of AD collected for each source category included in 1A1 'Energy Industries' complies with the requirements set out in the description of each source category in the 2006 IPCC Guidelines; verifying the correctness of EFs used for each source category; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for subcategories included in category 1A1 are verified randomly;
- implementation of error minimization procedures for manual entry of AD, with all the spreadsheets provided with the initial sources of activity data in tabular format;
- in the calculation files, the import of the respective values into calculation formulas is ensured by automatic connections;
- the consistency of calculations is also ensured by verifying the correctness of applying conversion factors of natural units into energy units for all source categories and the entire range of years covered by the inventory;
- verification whether the same method is used for the entire range of years;
- verifying whether GHG emissions estimations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RoM and other relevant reference sources;
- verifying to what extent the full geographical coverage of the national GHG inventory of the RoM is ensured;
- verifying the inter-annual evolution trends of emissions by creating representative charts, and unusual fluctuations are explained;
- regarding recalculations, their need is explained, including by drawing attention to the recommendations made by national and international experts stemming from checks and QA/QC activities carried out in previous inventory cycles;
- verifying maintenance and completion of the national inventory archive.

Following the recommendations included in the 2006 IPCC Guidelines, GHG emissions were estimated using AD and EFs from official sources of information.

3.3.5. Recalculations

The recalculation of GHG emissions from category 1A1 'Energy Industries' carried out in the current inventory cycle was caused by changes in the 100-year GWP values available in the IPCC AR5 (2014), to the detriment of those available in the IPCC AR4 (2007) (for CH_4 – 28 instead of 25; for N_2O – 265 instead of 298). For category 1A1b, activity data for the years 2017-2020 has been updated. For the first time, GHG emissions from category 1A1c were calculated.

Compared to the results recorded in NC5 of the RoM to UNFCCC (2023), the changes undertaken in the current inventory cycle resulted in an insignificant downward trend in direct GHG emissions for the entire period under review (Table 3-74).

Table 3-74: Recalculations of GHG emissions for the period 1990-2020, included in the NC5 of the RoM to the UNFCCC (category 1A1 'Energy Industries'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	21,364.24	18,984.17	15,706.26	12,679.18	9,992.56	7,192.41	7,124.41	5,625.67	4,844.68	3,664.69	3,159.33
BTR1	21,359.99	18,980.28	15,703.31	12,676.53	9,990.25	7,191.16	7,123.27	5,625.19	4,844.34	3,664.61	3,159.28
Difference, %	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.02	-0.01	-0.01	0.00	0.00
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	3,681.93	2,936.80	3,040.38	3,110.79	3,233.26	2,495.92	2,893.82	2,994.61	3,840.34	4,052.97	3,750.73
BTR1	3,681.88	2,936.75	3,040.33	3,110.75	3,233.22	2,495.89	2,893.79	2,994.57	3,840.36	4,053.06	3,750.68
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	3,807.85	3,604.02	3,560.30	3,688.09	3,648.58	2,999.50	3,258.64	3,127.51	3,637.97		
BTR1	3,808.15	3,605.95	3,560.48	3,688.43	3,648.99	2,999.89	3,258.96	3,127.91	3,638.38	3,936.22	3,345.93
Difference, %	0.01	0.05	0.00	0.01	0.01	0.01	0.01	0.01	0.01		

Abbreviations: BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC; NC5 – Fifth National Communication of the RoM to the UNFCCC.

For the years 2021-2022, direct GHG emissions from source category 1A1 'Energy Industries' were estimated for the first time in the current inventory cycle.

3.3.6. Planned Improvements

Potential improvements within source category 1A1 'Energy Industries' could be made with reference to the availability of new activity data on fuel consumption for the production of electricity and heat on the left bank of the Dniester River (filling existing gaps for some years). Likewise, there could be potential improvements should additional data sources be identified or should activity data be updated in official statistical publications. Accordingly, the possibility of switching from Tier 1 estimation methodologies to higher ranking estimation methodologies (Tier 2 or 3) shall be analysed.

3.4. Manufacturing Industries and Construction (source category 1A2)

3.4.1. Source category description and GHG emissions trends

GHG emissions from source category 1A2 'Manufacturing Industries and Construction' are a result of fuel combustion within the manufacturing industries of the Republic of Moldova (except for emissions from technological processes, which are monitored under Sector 2 'IPPU').

Direct GHG emissions from 1A2 'Manufacturing Industries and Construction' are monitored within the following sub-categories (which correspond to the ISIC Rev. 3.1[54]):

In the current cycle, the classification of sub-categories changes according to the structure of the common reporting tables (CRT) with the results of the national GHG inventory for the period 1990-2022, with the inclusion of the new coding and presentation by fuel groups:

1A2a 'Iron and Steel';

1A2b 'Non-Ferrous Metals';

1A2c 'Chemicals';

1A2d 'Pulp, Paper and Print';

1A2e 'Food Processing, Beverages and Tobacco';

1A2f 'Non-Metallic Minerals' (glass, ceramic, cement);

Following external recommendations from previous inventory cycles, 6 categories, insignificant in terms of energy resource consumption, were combined into one: 1A2g 'Other Industrial Activities':

1A2gi 'Transport Equipment';

1A2gii 'Machinery';

1A2giii 'Mining (excluding fuels) and Quarrying';

1A2giv 'Wood and Wood Products';

1A2gv 'Construction';

1A2gvi 'Textile and Leather';

1A2gvii 'Other Industrial Activity'.

Between 1990-2022, there had been a downward trend in the evolution of GHG emissions from source category 1A2 'Manufacturing Industries and Construction', decreasing by circa 64.7% (Table 3-75, Figure 3-14).

Table 3-75: Direct GHG emissions from 1A2 'Manufacturing Industries and Construction' between 1990 and 2022, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A2 RBDR	1,904.84	1,273.22	924.48	612.12	216.07	245.85	222.94	259.96	245.42	215.79	246.66
1A2 LBDR	IE	IE	IE	IE	523.07	136.37	99.08	288.06	278.55	258.78	273.61
1A2 RoM	**1,904.84**	**1,273.22**	**924.48**	**612.12**	**739.14**	**382.22**	**322.02**	**548.02**	**523.97**	**474.57**	**520.27**
1A2 RBDR, %	100	100	100	100	29.2	64.3	69.2	47.4	46.8	45.5	47.4
1A2 LBDR, %	IE	IE	IE	IE	70.8	35.7	30.8	52.6	53.2	54.5	52.6

[54] ISIC Rev.3.1 (International Standard Industrial Classification of All Economic Activities, Rev.3.1) (<https://unstats.un.org/unsd/cr/registry/regcst.asp?Cl=17>)

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A2 RBDR	269.54	271.76	289.21	307.87	380.29	380.84	359.43	408.46	269.47	299.92	341.86
1A2 LBDR	331.79	139.18	150.21	136.71	194.89	254.60	442.26	478.63	233.92	217.08	235.27
1A2 RoM	**601.33**	**410.94**	**439.42**	**444.58**	**575.18**	**635.44**	**801.69**	**887.09**	**503.39**	**517.00**	**577.13**
1A2 RBDR, %	44.8	66.1	65.8	69.2	66.1	59.9	44.8	46.0	53.5	58.0	59.2
1A2 LBDR, %	55.2	33.9	34.2	30.8	33.9	40.1	55.2	54.0	46.5	42.0	40.8
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
1A2 RBDR	281.99	363.00	316.05	447.41	414.04	468.97	545.16	504.96	469.75	520.91	424.12
1A2 LBDR	257.61	212.00	248.03	206.72	229.54	192.10	206.15	213.42	225.15	236.88	248.18
1A2 RoM	**539.60**	**575.00**	**564.08**	**654.13**	**643.57**	**661.07**	**751.30**	**718.39**	**694.91**	**757.79**	**672.30**
1A2 RBDR, %	52.3	63.1	56.0	68.4	64.3	70.9	72.6	70.3	67.6	68.7	63.1
1A2 LBDR, %	47.7	36.9	44.0	31.6	35.7	29.1	27.4	29.7	32.4	31.3	36.9

Abbreviations: RBDR – Right Bank of the Dniester River; LBDR – Left Bank of the Dniester River; RoM – aggregated for the Republic of Moldova; IE – included elsewhere.

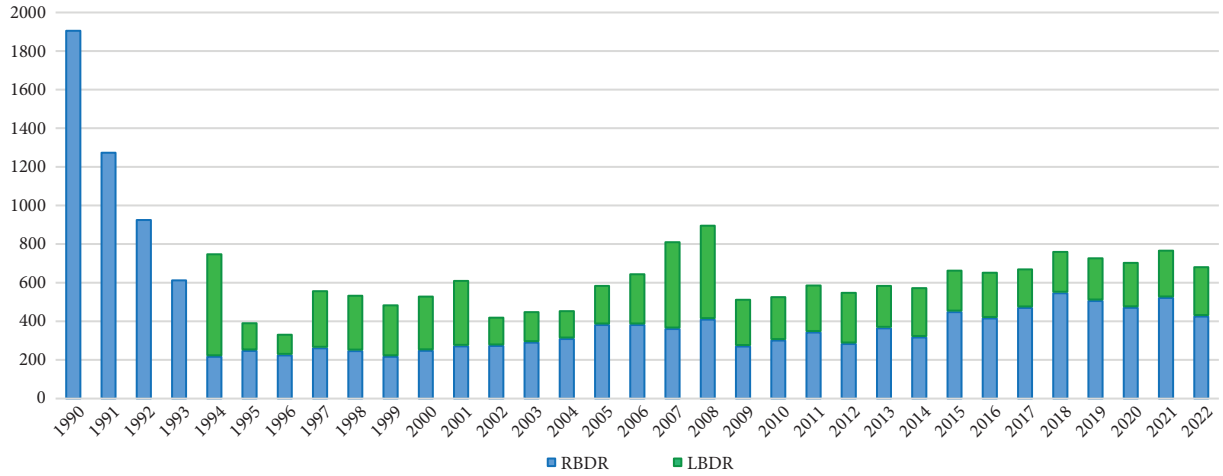


Figure 3-15: Direct GHG emissions from 1A2 'Manufacturing Industries and Construction' between 1990 and 2022, kt CO_2 equivalent.

GHG emissions trends from source category 1A2 'Manufacturing Industries and Construction' between 1990 and 2022 for each industry are presented in Table 3-76.

Table 3-76: Direct GHG emissions from 1A2 'Manufacturing Industries and Construction' between 1990 and 2022, by industry, kt CO_2 equivalent

	1.A.2.a	1.A.2.c	1.A.2.d	1.A.2.e	1.A.2.f	1.A2.g.ii	1.A.2.g.i	1.A.2.g.iii	1.A.2.g.iv	1.A.2.g.v	1.A.2.g.vi	1.A.2.g.viii
1990	140.65	19.55	NO	205.14	1413.57	NO	77.24	5.55	9.10	13.39	20.40	NO
1991	NO	NO	NO	167.38	1024.79	NO	63.69	NO	7.64	9.52	NO	NO
1992	NO	NO	NO	129.63	729.37	NO	50.15	NO	6.18	8.99	NO	NO
1993	0.97	NO	NO	92.68	433.95	NO	37.02	NO	4.72	9.88	0.59	32.31
1994	143.32	0.52	14.12	164.18	141.66	NO	79.19	NO	7.38	36.02	77.41	75.32
1995	37.36	0.14	3.68	94.05	160.08	NO	31.20	NO	1.91	13.98	20.18	19.64
1996	27.94	0.10	1.98	97.66	127.19	NO	17.57	NO	0.89	13.42	19.82	15.46
1997	101.69	0.29	5.19	118.24	173.35	NO	41.43	NO	1.44	22.58	45.80	38.02
1998	91.64	5.57	4.18	110.39	161.53	NO	28.06	NO	1.39	19.30	63.23	38.72
1999	94.71	4.92	3.11	86.28	153.32	NO	21.76	NO	1.04	16.30	57.71	35.45
2000	97.68	5.20	4.92	80.69	185.07	NO	25.75	NO	1.64	9.63	80.72	29.00
2001	117.79	4.31	7.96	85.99	201.26	NO	29.86	NO	3.65	11.18	98.54	40.81
2002	27.28	1.67	0.56	60.53	219.22	NO	11.23	NO	1.81	8.50	41.48	38.69
2003	47.02	1.80	2.29	87.37	216.88	NO	13.65	NO	1.80	5.83	26.44	36.35
2004	45.98	2.47	2.54	68.46	241.79	NO	13.64	NO	1.56	9.37	25.73	33.04
2005	67.19	3.37	3.16	76.30	311.49	NO	18.83	0.22	2.11	7.96	38.70	45.84
2006	76.26	4.75	4.00	90.62	309.30	0.51	25.92	NO	1.95	16.71	59.84	45.59
2007	206.19	4.88	3.73	86.20	304.36	NO	32.83	0.11	1.27	46.35	60.24	55.52
2008	215.29	5.54	4.24	98.18	338.75	NO	31.78	0.06	0.78	58.08	59.28	75.11
2009	74.85	3.77	2.84	54.59	228.07	NO	13.60	NO	0.23	9.37	38.86	77.19
2010	40.92	3.91	3.01	69.09	241.50	NO	17.76	NO	0.65	16.98	48.84	74.33
2011	53.54	5.86	5.62	73.48	277.40	NO	19.52	NO	0.64	16.16	48.44	76.47
2012	65.17	5.88	3.52	80.90	217.59	NO	18.86	NO	1.26	18.87	46.91	80.63

	1.A.2.a	1.A.2.c	1.A.2.d	1.A.2.e	1.A.2.f	1.A2.g.ii	1.A.2.g.i	1.A.2.g.iii	1.A.2.g.iv	1.A.2.g.v	1.A.2.g.vi	1.A.2.g.viii
2013	31.80	7.46	0.64	82.49	304.31	NO	17.75	NO	4.64	14.89	51.67	59.36
2014	67.46	6.59	3.81	92.37	242.03	NO	10.91	NO	2.40	23.78	34.86	79.87
2015	49.82	4.52	4.12	81.61	240.53	0.00	9.40	NO	0.23	13.61	27.02	223.28
2016	41.78	6.18	3.44	94.03	180.69	0.62	11.33	NO	0.24	15.72	33.66	255.89
2017	60.51	4.90	1.00	91.83	231.41	0.11	10.12	NO	0.26	14.33	25.05	221.55
2018	65.76	6.29	3.08	103.68	293.00	0.39	11.39	0.06	0.28	16.07	27.34	223.96
2019	54.55	7.06	3.17	92.39	282.45	0.79	14.28	0.28	0.28	16.97	35.10	211.08
2020	62.94	10.52	3.24	83.66	261.49	0.79	11.70	0.22	0.08	13.71	32.02	214.53
2021	71.85	9.51	3.10	90.54	281.77	0.45	13.72	0.34	0.21	13.55	35.02	237.74
2022	75.28	7.97	3.19	77.28	227.79	0.56	13.10	0.28	0.21	12.88	36.32	217.43

Note: 1A2b 'Non-Ferrous Metals' in Moldova – NO.

The shares in the structure of total GHG emissions are the following (2022): CO_2 – 35.3%, CH_4 – 50.3%, whereas N_2O – 39.9%, total – 35.3% of the level in the base year (1990) (Table 3-77).

Table 3-77: Direct GHG emissions from 1A2 'Manufacturing Industries and Construction' between 1990 and 2022

	1A2 'Manufacturing Industries and Construction', kt CO_2 equivalent				%, compared to 1990			
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total
1990	1,898.61	2.39	3.84	1,904.84	100.0	100.0	100.0	100.0
1991	1,269.19	1.52	2.52	1,273.22	66.8	63.5	65.5	66.8
1992	921.55	1.11	1.82	924.48	48.5	46.5	47.4	48.5
1993	610.17	0.75	1.20	612.12	32.1	31.3	31.3	32.1
1994	738.06	0.50	0.58	739.14	38.9	21.0	15.1	38.8
1995	381.51	0.32	0.39	382.22	20.1	13.4	10.2	20.1
1996	321.29	0.32	0.42	322.02	16.9	13.4	10.9	16.9
1997	546.90	0.51	0.61	548.02	28.8	21.2	15.8	28.8
1998	523.10	0.40	0.47	523.97	27.6	16.8	12.3	27.5
1999	473.83	0.35	0.40	474.57	25.0	14.6	10.3	24.9
2000	519.59	0.32	0.36	520.27	27.4	13.5	9.3	27.3
2001	600.55	0.37	0.41	601.33	31.6	15.5	10.6	31.6
2002	410.40	0.26	0.28	410.94	21.6	10.8	7.4	21.6
2003	438.86	0.27	0.29	439.42	23.1	11.2	7.5	23.1
2004	443.90	0.32	0.36	444.58	23.4	13.4	9.4	23.3
2005	574.40	0.37	0.40	575.18	30.3	15.5	10.5	30.2
2006	634.67	0.37	0.39	635.44	33.4	15.6	10.3	33.4
2007	800.81	0.44	0.44	801.69	42.2	18.2	11.4	42.1
2008	884.97	0.94	1.18	887.09	46.6	39.3	30.7	46.6
2009	501.95	0.63	0.81	503.39	26.4	26.1	21.1	26.4
2010	515.62	0.60	0.77	517.00	27.2	25.3	20.1	27.1
2011	575.45	0.73	0.94	577.13	30.3	30.6	24.6	30.3
2012	538.21	0.62	0.77	539.60	28.3	25.8	20.1	28.3
2013	573.06	0.84	1.10	575.00	30.2	35.0	28.7	30.2
2014	562.39	0.74	0.95	564.08	29.6	30.7	24.9	29.6
2015	651.53	1.14	1.46	654.13	34.3	47.8	38.1	34.3
2016	641.34	0.98	1.26	643.57	33.8	40.8	32.8	33.8
2017	658.71	1.02	1.34	661.07	34.7	42.6	34.9	34.7
2018	748.59	1.18	1.54	751.30	39.4	49.2	40.0	39.4
2019	715.94	1.07	1.38	718.39	37.7	44.6	35.9	37.7
2020	692.66	0.99	1.25	694.91	36.5	41.4	32.6	36.5
2021	755.19	1.14	1.46	757.79	39.8	47.8	38.0	39.8
2022	669.56	1.20	1.53	672.30	35.3	50.3	39.9	35.3

Compared to 1990, the level of GHG emissions from 1A2 'Manufacturing Industries and Construction' constituted in 2022, in terms of direct GHG emissions: CO_2 – 35.3%; CH_4 – 50.3%; N_2O – 39.9% of the base year level; whereas in terms of indirect GHG emissions: NO_x – 17.7%, CO – 35.6%; NMVOC – 61.4%; and SO_x – 17.3%. (Table 3-78).

Table 3-78: Direct and indirect GHG emissions from 1A2 'Manufacturing Industries and Construction' between 1990 and 2022

	1A2 'Manufacturing Industries and Construction', kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	1,898.61	0.09	0.01	8.86	3.45	0.87	2.67	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	1,269.19	0.05	0.01	6.48	1.74	0.55	1.22	66.8	63.5	65.5	73.2	50.4	62.6	45.7
1992	921.55	0.04	0.01	4.56	1.32	0.41	0.93	48.5	46.5	47.4	51.5	38.2	46.6	34.8
1993	610.17	0.03	0.00	2.86	0.95	0.28	0.67	32.1	31.3	31.3	32.3	27.4	32.0	25.3
1994	738.06	0.02	0.00	1.25	0.72	0.32	0.36	38.9	21.0	15.1	14.2	20.9	37.1	13.3
1995	381.51	0.01	0.00	0.69	0.56	0.18	0.37	20.1	13.4	10.2	7.8	16.2	20.6	13.7
1996	321.29	0.01	0.00	0.65	0.63	0.16	0.47	16.9	13.4	10.9	7.3	18.3	18.4	17.8
1997	546.90	0.02	0.00	0.92	0.74	0.28	0.40	28.8	21.2	15.8	10.4	21.3	32.6	14.8
1998	523.10	0.01	0.00	0.88	0.60	0.24	0.32	27.6	16.8	12.3	9.9	17.3	28.0	11.8
1999	473.83	0.01	0.00	0.73	0.49	0.22	0.23	25.0	14.6	10.3	8.3	14.2	25.4	8.5
2000	519.59	0.01	0.00	0.79	0.48	0.22	0.23	27.4	13.5	9.3	8.9	13.9	25.5	8.5
2001	600.55	0.01	0.00	0.90	0.55	0.25	0.26	31.6	15.5	10.6	10.2	15.8	29.3	9.6
2002	410.40	0.01	0.00	0.60	0.40	0.18	0.20	21.6	10.8	7.4	6.8	11.6	20.3	7.6
2003	438.86	0.01	0.00	0.66	0.39	0.19	0.17	23.1	11.2	7.5	7.4	11.2	21.4	6.4
2004	443.90	0.01	0.00	0.70	0.45	0.20	0.20	23.4	13.4	9.4	7.9	12.9	23.5	7.6
2005	574.40	0.01	0.00	0.85	0.49	0.25	0.19	30.3	15.5	10.5	9.7	14.3	29.2	7.1
2006	634.67	0.01	0.00	0.94	0.49	0.27	0.17	33.4	15.6	10.3	10.6	14.1	30.9	6.3
2007	800.81	0.02	0.00	1.12	0.50	0.33	0.10	42.2	18.2	11.4	12.7	14.6	38.5	3.7
2008	884.97	0.03	0.00	1.35	2.27	0.47	1.85	46.6	39.3	30.7	15.2	65.6	53.8	69.2
2009	501.95	0.02	0.00	0.77	1.66	0.29	1.44	26.4	26.1	21.1	8.7	48.2	32.8	53.8
2010	515.62	0.02	0.00	0.79	1.50	0.29	1.25	27.2	25.3	20.1	8.9	43.5	32.9	47.0
2011	575.45	0.03	0.00	0.88	1.86	0.33	1.58	30.3	30.6	24.6	9.9	53.9	38.3	59.1
2012	538.21	0.02	0.00	0.80	1.45	0.30	1.17	28.3	25.8	20.1	9.0	41.9	34.5	43.8
2013	573.06	0.03	0.00	0.87	2.30	0.35	2.03	30.2	35.0	28.7	9.8	66.6	40.7	76.2
2014	562.39	0.03	0.00	0.86	1.93	0.33	1.67	29.6	30.7	24.9	9.7	56.0	37.8	62.4
2015	651.53	0.04	0.01	1.15	2.18	0.50	1.63	34.3	47.8	38.1	13.0	63.2	57.1	60.9
2016	641.34	0.03	0.00	1.22	1.68	0.45	1.15	33.8	40.8	32.8	13.8	48.8	51.9	43.2
2017	658.71	0.04	0.01	1.38	1.79	0.46	1.27	34.7	42.6	34.9	15.6	51.8	52.3	47.5
2018	748.59	0.04	0.01	1.66	1.73	0.53	1.08	39.4	49.2	40.0	18.8	50.2	60.3	40.4
2019	715.94	0.04	0.01	1.56	1.53	0.48	0.92	37.7	44.6	35.9	17.6	44.2	55.5	34.5
2020	692.66	0.04	0.00	1.38	1.37	0.46	0.78	36.5	41.4	32.6	15.6	39.6	53.2	29.0
2021	755.19	0.04	0.01	1.48	1.84	0.55	1.14	39.8	47.8	38.0	16.7	53.2	63.3	42.8
2022	669.56	0.04	0.01	1.57	1.23	0.53	0.46	35.3	50.3	39.9	17.7	35.6	61.4	17.3

3.3.2. Methodologies, Emission Factors and Activity Data

GHG emissions originating from source category 1A2 'Manufacturing Industries and Construction' were estimated following a Tier 1 methodology (Table 3-79).

Table 3-79: Methods and coefficients used for the estimation of direct GHG emissions originating from source category 1A2 'Manufacturing Industries and Construction'

Category	CO_2				CH_4		N_2O	
	Method	Net Calorific Value, TJ/kt	Carbon Oxidation Fraction	EF, tC/TJ	Method	EF, kg/TJ	Method	EF, kg/TJ
1A2 'Manufacturing Industries and Construction'	T1	CS	1	D	T1	D	T1	D

Abbreviations: T1 – Tier 1; EF – Emission Factor; D - Default; CS – Country Specific.

Default EFs were used from the 2006 IPCC Guidelines for the National Inventory of Greenhouse Gas Emissions (for the estimation of direct GHG emissions) and the 2023 EMEP/EEA Air Pollutant Emission Inventory Guidebook (for the estimation of indirect GHG emissions).

To ensure the natural conversion from natural measurement units to energy units, country specific net calorific values were used. The value used for the carbon oxidation fraction is recommended by the 2006 IPCC Guidelines. Default EFs available in the 2023 EMEP/EEA Guidebook were used for the estimation of non-CO_2 emissions (Table 3-81).

Table 3-80: EFs used for the estimation of GHG emissions from source category 1A2 'Manufacturing Industries and Construction', kg/TJ

Fuel Categories	Fuels	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Biofuels	Fuelwood and wood waste	112,000	30	4	91	570	300	11
	Other types of solid biomass	100,000	30	4	91	570	300	11
	Charcoal	112,000	200	4	91	570	300	11
	Biogas from organic waste	54,600	1	0.1	74	29	23	0.67
Liquid fuels	Residual fuel oil	77,400	3	0.6	513	66	25	47
	Other Kerosene	71,900	3	0.6	513	66	25	47
	Other petroleum products	73,300	3	0.6	513	66	25	47
	Petroleum coke	97,500	3	0,6	513	66	25	47
Gaseous fuels	Natural gas	56,100	1	0.1	74	29	23	0.67
	Liquefied petroleum gases	63,100	1	0.1	74	29	23	0.67
Solid fuels	Anthracite	98,300	10	1.5	173	931	88.8	900
	Other bituminous coal	94,600	10	1.5	173	931	88.8	900
	Lignite	101,000	10	1.5	173	931	88.8	900
	Brown coal briquettes	97,500	10	1.5	173	931	88.8	900
	Oven coke and lignite coke	107,000	10	1.5	173	931	88.8	900

Source: CO_2, CH_4, N_2O – 2006 IPCC Guidelines, Chapter 'Stationary Combustion', Table 2.3; NO_x, CO, NMVOC, SO_x - EMEP/EEA Air Pollutant Emission Inventory (2023), Category 1.A.2, Tables 3-2, 3-3, 3-4 and 3-5.

Activity Data

AD associated with fuel consumption for energy purposes within source category 1A2 'Manufacturing Industries and Construction' were collected from the Energy Balances for the years 1990, 1993-2022, as well as from statistical publications of ATULBD (Table 3-81).

Table 3-81: Fuel consumption for energy purposes within source category 1A2 'Manufacturing Industries and Construction' on the LBDR between 1994-2022

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Natural gas, million m^3	275.10	71.72	52.11	151.50	146.50	136.10	143.90	174.50	73.20	79.00
	2004	2005	2006	2007	2008	2009	2010	2011*	2012	2013
Natural gas, million m^3	71.90	102.50	133.90	232.60	250.50	121.90	113.50	123.00	134.90	110.80
Residual fuel oil, kt	NO	NO	NO	NO	0.87	0.57	0.32	0.31	0.26	0.37
Bituminous coal, kt	NO	NO	NO	NO	0.07	0.15	0.11	0.11	0.08	0.03
LPG, kt	NO	NO	NO	NO	NO	NO	NO	0.06	0.03	0.03
	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Natural gas, million m^3	129.70	108.00	120.00	100.00	108.00	112.00	118.00	124.00	130.50	NE
Residual fuel oil, kt	0.37	0.37	0.37	0.36	0.29	0.13	0.13	0.13	NO	NE
Bituminous coal, kt	0.07	0.06	0.06	0.34	0.02	0.02	0.01	0.01	NO	NE
LPG, kt	0.02	0.02	0.02	0.01	0.01	0.01	0.01	0.01	NO	NE

Source: JSC 'Moldovagaz' Letter to No. 06-1253 of 27.09.2006 and No. 02/1476 of 23.02.2011; 2011-2012 – JSC 'Moldovagaz' 'Press Releases on Housing and Communal Services for 2011-2021'; 'Socio-economic development of ATULBD for 2009-2021'. 4. Material and energy resources. P. 23.

Information regarding fuel consumption for each industry for the RBDR is shown in Tables 3-82 to 3-86.

Table 3-82: Fuel consumption for energy purposes within source category 1A2a 'Iron and Steel' between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Coke	158	NO	NO	9	NO	NO	NO	NO	NO	NO	NO
Natural gas	2,201	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Liquefied petroleum gases	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Coke	NO	NO	NO	3	5	6	5	3	NO	3	5
Natural gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Liquefied petroleum gases	NO	NO	NO	NO	NO	NO	NO	1	NO	NO	1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Coke	NO	2	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	NO	NO	NO	NO	NO	NO	NO	2	2	NO	NO
Liquefied petroleum gases	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Table 3-83: Fuel consumption for energy purposes within source category 1A2c 'Chemicals' between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Residual fuel oil	80	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other petroleum products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	237	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Liquefied petroleum gases	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuelwood	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Residual fuel oil	NO	NO	NO	1	1	NO	NO	NO	NO	NO	18
Other petroleum products	NO	NO	NO	NO	8	12	NO	NO	NO	NO	NO
Natural gas	NO	NO	NO	11	3	10	7	39	34	4	4
Liquefied petroleum gases	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO
Fuelwood	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Residual fuel oil	NO	18	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other petroleum products	NO	NO	NO	6	1	NO	NO	NO	NO	NO	NO
Natural gas	13	2	29	21	27	29	30	42	95	93	62
Liquefied petroleum gases	NO	NO	NO	NO	NO	NO	1	NO	NO	NO	NO
Fuelwood	NO	7	NO	NO	NO	NO	NO	NO	NO	1	NO
Agricultural residues	NO	NO	NO	4	NO	2	3	2	1	1	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	100

Table 3-84: Fuel consumption for energy purposes within source category 1A2d 'Pulp, Paper and Print' between 2000-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Wood waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	NO	NO	30	33	39	44	35	50	34	33	75
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	NO
Wood waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Anthracite	NO	NO	NO	NO	NO	NO	NO	1	1	1	NO
Natural gas	49	NO	59	55	49	11	51	47	48	47	49
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Wood waste	NO	NO	NO	NO	NO	NO	4	NO	NO	NO	NO

Table 3-85: Fuel consumption for energy purposes within source category 1A2e 'Food Processing, Beverages and Tobacco' between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Anthracite	80	56	33	9	NO	NO	NO	NO	29	NO	29
Lignite	NO	NO	NO	3	NO	NO	NO	NO	NO	NO	NO
Other bituminous coal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	634	549	463	378	323	352	381	323	264	205	176
Fuel for oven	468	329	189	50	59	29	88	117	59	117	117
Residual fuel oil	563	499	434	370	235	264	264	147	205	88	88
Jet Kerosene	647	494	341	188	29	NO	NO	NO	29	NO	NO
Other petroleum products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	68	70	73	76	29	117	235	323	352	293	323
LPG	NO	NO	NO	6	NO	NO	NO	NO	NO	NO	NO
Pellets and briquettes from vegetable waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuelwood	126	106	85	65	NO	29	29	29	NO	NO	NO
Wood waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Agricultural residue	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	117	59	59	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Anthracite	29	28	29	133	167	156	77	78	53	70	78
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other bituminous coal	NO	NO	NO	NO	1	NO	NO	NO	NO	NO	NO
Coke	235	185	147	51	1	NO	NO	2	NO	NO	NO
Fuel for oven	117	86	29	25	16	8	4	15	NO	6	4
Residual fuel oil	117	NO	117	140	121	122	54	90	NO	6	9
Jet Kerosene	NO	NO	NO	5	10	NO	NO	NO	NO	NO	NO
Other petroleum products	NO	NO	NO	4	NO	NO	NO	NO	NO	NO	NO
Natural gas	293	305	645	386	507	527	526	562	474	565	644
LPG	NO	NO	29	5	7	18	5	5	NO	48	2
Pellets and briquettes from vegetable waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuelwood	NO	NO	NO	7	10	5	3	2	2	2	3
Wood waste	NO	NO	NO	33	20	NO	3	3	NO	2	2
Agricultural residue	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Anthracite	94	78	117	56	63	49	60	38	28	41	40
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other bituminous coal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuel for oven	2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil	6	NO	35	17	67	29	17	5	NO	NO	4
Jet Kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other petroleum products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	710	676	705	869	909	1021	1186	974	894	987	726
LPG	11	5	71	7	8	7	17	17	15	13	9
Pellets and briquettes from vegetable waste	NO	NO	NO	27	18	20	29	3	2	1	2
Fuelwood	6	7	12	15	10	8	16	9	6	6	3
Wood waste	1	NO	NO	1	NO	NO	NO	NO	NO	NO	NO
Agricultural residue	1	8	NO	NO	NO	5	4	3	2	2	2
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	102	NO

Table 3-86: Fuel consumption for energy purposes within source category 1A2f 'Non-Metallic Minerals' between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Anthracite	828	NO	NO	NO	NO	NO	29	29	29	29	NO
Lignite	12	16	20	25	29	NO	NO	NO	NO	NO	NO
Other bituminous coal	NO	NO	NO	NO	NO	NO	59	30	NO	NO	29
Coke	79.23	NO	NO	NO	NO	29	29	29	NO	NO	NO
Hard coal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuel for oven	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil	13,266	9,993	6,721	3,448	176	59	59	59	59	NO	NO
Petroleum coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	5,146	4,403	3,659	2,915	2,171	2,699	1,966	2,817	2,729	2,670	3,227
LPG	46.06	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and briquettes from vegetable waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuelwood	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Wood waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Anthracite	NO	NO	NO	NO	NO	NO	NO	148	93	199	1,655
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other bituminous coal	NO	NO	NO	14	14	NO	NO	1,795	1,375	985	NO
Coke	NO	NO	NO	NO	NO	1	2	NO	63	121	NO
Hard coal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuel for oven	NO	NO	NO	1	5	3	3	1	NO	3	NO
Residual fuel oil	NO	NO	30	22	25	27	30	19	40.2	38	28
Petroleum coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Natural gas	2,934	3,939	3,810	4,242	5,474	5,450	5,346	2,695	1,388.26	1,989	1,983
LPG	557	NO	NO	3	1	1	1	3	NO	1	1
Pellets and briquettes from vegetable waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuelwood	NO	NO	NO	NO	NO	NO	NO	2	NO	NO	NO
Wood waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Anthracite	60	2,166	416	2	1	NO	3	NO	NO	NO	155
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other bituminous coal	1,103	5	1,256	1,646	915	877	825	866	760	975	209
Coke	28	2	52	NO	141	NO	NO	NO	NO	NO	NO
Hard coal	NO	NO	NO	NO	NO	284	101	27	NO	179	NO
Fuel for oven	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil	7	NO	NO	13	8	7	NO	8	NO	12	5
Petroleum coke	NO	NO	NO	NO	NO	473	1,071	1,135	906	651	957
Natural gas	1,832	1,589	1,346	1,469	1,382	1,318	1,777	1,528	1,790	1,910	1,756
LPG	2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and briquettes from vegetable waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuelwood	NO	NO	NO	NO	NO	NO	NO	1	1	NO	1
Wood waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	1	1	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

Aggregated fuel consumption data within source categories 1A2g 'Other Industrial Activities' is shown in Table 3-87.

Table 3-87: Aggregated fuel consumption for energy purposes from source category within 1A2g 'Other Industrial Activities' for the period 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Anthracite	214	NO	NO	9	NO	NO	NO	NO	NO	NO	NO
Other bituminous coal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	158	124	90	56	NO	NO	NO	NO	NO	NO	NO
Fuel for oven	NO	NO	NO	12	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil	46	NO	NO	6	NO	NO	NO	NO	NO	NO	NO
Jet kerosene	NO	NO	NO	3	NO	NO	NO	NO	NO	NO	NO
Other petroleum products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	1,219	838	491	176	88	264	146	146	117	117	88
LPG	46	NO	NO	6	NO	NO	NO	NO	NO	NO	NO
Fuel wood	9	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Wood waste	176	120	94	67	29	NO	NO	NO	NO	NO	NO
Agricultural residue	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Pellets and briquettes from vegetable waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Anthracite	NO	NO	NO	2	2	1	3	NO	NO	NO	NO
Other bituminous coal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	4	2	4	4	4	NO	2	2
Fuel for oven	NO	NO	NO	3	4	4	NO	NO	NO	17	NO
Residual fuel oil	29	40	NO	40	17	48	55	37	14	24	23
Jet kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other petroleum products	NO	NO	NO	NO	1	NO	NO	NO	NO	NO	NO
Natural gas	88	68	58	86	102	111	98	198	72	102	126
LPG	NO	NO	NO	9	12	11	15	31	9	66	61
Fuel wood	NO	NO	NO	2	1	2	3	3	2	9	14
Wood waste	NO	NO	NO	6	6	1	2	11	2	14	23
Agricultural residue	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4
Pellets and briquettes from vegetable waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Anthracite	1	NO	NO	59	58	64	56	5	4	5	7
Other bituminous coal	NO	NO	NO	11	12	6	13	NO	NO	NO	1
Coke	2	NO	NO	1	2	1	1	NO	1	1	NO
Fuel for oven	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil	30	2	30	285	521	455	326	154	44	249	498
Jet kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other petroleum products	NO	NO	NO	NO	NO	3	1	1	8	NO	NO
Natural gas	83	178	136	2,058	2,084	2,246	2,462	2,547	2,493	2,636	1,827
LPG	48	12	11	8	10	15	15	13	10	18	12
Fuel wood	11	6	1	18	23	6	5	6	11	17	13
Wood waste	35	5	16	10	2	7	26	2	9	8	16
Agricultural residue	1	2	NO	341	290	234	385	362	404	387	656
Pellets and briquettes from vegetable waste	NO	NO	NO	35	65	125	115	135	64	105	151
Biogas	NO	NO	NO	387	359	198	163	166	140	142	147

Also, fuel consumption is transferred from source categories 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants' – energy producers for own consumption on the RBDR between 2015 and 2022, as well as fuel consumption on the LBDR – to source category 1A2g 'Other Industrial Activities'. The analysis of the total quantities indicates an increase in fuel consumption in this aggregated category, particularly with reference to the consumption of natural gas and agricultural fuel residues, and that residual fuel oil consumption is decreasing.

Data associated with fuel consumption on the LBDR are only partial. Coal and residual fuel oil consumption data are used according to statistical publications (Socio-Economic Development of ATULBD for the years 2009-2021). Coal and residual fuel oil consumption data for 2022 are not available (Socio-Economic Development of ATULBD for 2022 has not been published yet).

Activity data associated with LPG consumption are used according to the Press Releases on 'Housing and Communal Services of ATULBD' for the years 2011-2021 (section 'Gasification, LPG', line 'Other consumers').

Activity data regarding natural gas consumption are available from two sources – provided by JSC 'Moldovagaz' (for the period 1994-2021) and according to the Press Releases on 'Housing and Communal Services of ATULBD' for the years 2011-2021 (section 'Gasification, Natural gas', line 'Other consumers').

Statistical data received from JSC 'Moldovagaz' (1994-2021) were used for the estimation of GHG emissions, and, for 2022, due to the lack of information, the data were taken for the year 2021.

Activity data regarding natural gas consumption available in the Press Releases on 'Housing and Communal Services of the for the years 2011-2021 were used for information and comparison with the data provided by JSC 'Moldovagaz'. The respective information was not used in this category, since there is no certainty that it refers only to the industrial sector, there being a well-founded suspicion that it could also include other categories of consumers, as compared to the values received from JSC 'Moldovagaz', there is a significant difference (Table 3-88).

Table 3-88: Fuel consumption for energy purposes within source category 1A2 'Manufacturing Industries and Construction' on the territory of the LBDR between 1990 and 2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
LPG	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	NO	NO	NO	NO	9,315	2,428	1,764	5,130	4,960	4,608	4,872
Residual fuel oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other bituminous coal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
LPG	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3
Natural gas	5,909	2,479	2,675	2,435	3,471	4,534	7,876	8,472	4,128	3,843	4,165
Residual fuel oil	NO	NO	NO	NO	NO	NO	NO	35	23	13	12
Other bituminous coal	NO	NO	NO	NO	NO	NO	NO	2	4	3	3

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
LPG	2	1	1	1	1	1	1	1	1	1	NO
Natural gas	4,568	3,752	4,392	3,657	4,063	3,386	3,657	3,792	4,001	4,210	4,420
Residual fuel oil	10	15	15	15	15	13	1	5	5	5	NO
Other bituminous coal	2	1	2	2	2	9	7	0	0	0	NO

The Statistical Yearbooks of ATULBD contain data on the share of each industry, which allows to restore the distribution of available fuels by industry in the territory on the LBDR using an indirect method. The contribution of industries on the LBDR, in % of the total volume of production, is reflected in Table 3-89.

Table 3-89: Contribution of industries on the LBDR, percentage of total production between 1990 and 2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A2 a 'Iron and Steel'	N/A	N/A	N/A	N/A	N/A	27.4	28.2	35.3	32.9	36.6	35.7
1A2 c 'Chemicals'	N/A	N/A	N/A	N/A	N/A	0.1	0.1	0.1	2	1.9	1.9
1A2 d 'Pulp, Paper, and Print'	N/A	N/A	N/A	N/A	N/A	2.7	2	1.8	1.5	1.2	1.8
1A2 e 'Food Processing, Beverages and Tobacco'	N/A	N/A	N/A	N/A	N/A	19.7	16.5	15.6	13.2	12.4	9.2
1A2 f 'Non-Metallic Minerals (glass, ceramic, cement)'	N/A	N/A	N/A	N/A	N/A	0.6	0.6	0.6	0.3	0.2	0.4
1A2 g i 'Transport Equipment'	N/A	N/A	N/A	N/A	N/A	13.2	11.1	12.1	8.3	6.5	8.2
1A2 g iv 'Wood and Wood Products'	N/A	N/A	N/A	N/A	N/A	1.4	0.9	0.5	0.5	0.4	0.6
1A2 g v 'Construction'	N/A	N/A	N/A	N/A	N/A	5.7	5	4.9	4.7	4.8	2.1
1A2 g vi 'Textile and Leather'	N/A	N/A	N/A	N/A	N/A	14.8	20	15.9	22.7	22.3	29.5
1A2 g viii 'Other Industrial Activities'	N/A	N/A	N/A	N/A	N/A	14.4	15.6	13.2	13.9	13.7	10.6
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A2 a 'Iron and Steel'	35.5	19.6	31.3	33.4	34.2	29.7	46.5	44.9	32	18.7	22.5
1A2 c 'Chemicals'	1.3	1.2	1.2	1.3	1.3	1.3	1	0.7	0.8	1.7	1.8
1A2 d 'Pulp, Paper, and Print'	2.4	0.4	0.4	0.5	0.5	0.6	0.4	0.3	0.4	0.5	0
1A2 e 'Food Processing, Beverages and Tobacco'	7.1	10.3	12.9	10.5	9.9	13.5	10	10.5	9.7	12.2	12.1
1A2 f 'Non-Metallic Minerals (glass, ceramic, cement)'	0.4	0.4	0.4	0.2	0.2	0.3	0.3	0	0	0	0
1A2 g i 'Transport Equipment'	8	6.7	8	8.1	8.4	9.3	6.8	6.1	5	7.3	7
1A2 g iv 'Wood and Wood Products'	1.1	1.3	1.2	1	0.8	0.6	0.2	0.1	0.1	0.1	0.1
1A2 g v 'Construction'	2.2	2.5	2.8	2.8	2.1	3.5	8.9	11.1	3.2	3.6	4.2
1A2 g vi 'Textile and Leather'	29.7	29.8	17.6	18.2	19.4	23.4	13.5	12.2	15.8	21.8	19.3
1A2 g viii 'Other Industrial Activities'	12.3	27.8	24.2	24	23.2	17.8	12.4	14.1	33	34.1	32.4
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022*
1A2 a 'Iron and Steel'	25.3	14.9	27.2	24.1	18.2	31.5	31.9	25.5	27.9	30.3	30.3
1A2 c 'Chemicals'	2	2.8	2	1.4	2	1.7	2.2	2.3	2.3	1.8	1.8
1A2 d 'Pulp, Paper, and Print'	0.3	0.3	0.2	0.5	0.3	0.2	0.1	0.2	0.2	0.2	0.2
1A2 e 'Food Processing, Beverages and Tobacco'	11.8	17.2	13.7	12.3	13.5	14.0	13.9	14.5	13.2	12.8	12.8
1A2 f 'Non-Metallic Minerals (glass, ceramic, cement)'	0	0	0	0	0	0	0	0	0	0	0
1A2 g i 'Transport Equipment'	6.8	7.5	4.4	4.3	4.4	4.8	4.7	6.1	4.8	4.9	4.9
1A2 g iv 'Wood and Wood Products'	0.2	0.4	0.3	0.1	0.1	0.1	0.1	0.1	0	0.1	0.1
1A2 g v 'Construction'	4.7	5.4	6.6	4.8	6	5.4	5.5	5.4	4.4	3.9	3.9
1A2 g vi 'Textile and Leather'	17.8	23.5	13.4	12.2	14.1	12.6	11.9	15.0	12.8	13.2	13.2
1A2 g viii 'Other Industrial Activities'	31.1	28	32.2	40.3	41.4	29.7	29.7	30.3	34.4	32.9	32.9

Note: *In the absence of data for 2022, the values of 2021 were used for that year.

The primary data associated with the consumption of aviation gasoline and jet fuel, previously allocated to category 1A2 'Manufacturing Industries and Construction', have been transferred to category 1A3aii 'Civil Aviation' (further description in category 1A3aii). The primary data on the consumption of diesel and gasoline for automobiles, initially allocated to category 1A2, have been transferred to category 1A3b 'Road Transportation' (Table 3-90).

Table 3-90: Consumption of gasoline and diesel, reallocated from category 1A2 'Manufacturing Industries and Construction' to category 1A3b 'Road Transportation' between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline	568	390	211	33	29	29	29	29	NO	NO	NO
Diesel	3,446	2,566	1,687	807	754	765	623	557	353	205	205

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Gasoline	NO	NO	NO	16	23	18	21	20	13	12	16
Diesel	205	205	205	287	322	366	328	324	217	271	270
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Gasoline	9	NO	11	14	16	12	13	8	7	11	0
Diesel	291	313	264	207	213	201	407	376	527	535	393

AD associated with total fuel consumption within category 1A2 'Manufacturing Industries and Construction' (1A2g.viii) for the RBDR and data reallocated from categories 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants', are available in Table 3-91.

Table 3-91: Fuel consumption reallocated from 1A1aii 'Combined Heat and Power Generation' and 1A1aiii 'Heat Plants' to 1A2 'Manufacturing Industries and Construction' for 2015-2022, TJ

	2015	2016	2017	2018	2019	2020	2021	2022
Combined Heat and Power Plants – *Producers of energy for own consumption – 1A1aii*								
Anthracite	NO	NO	NO	NO	NO	NO	NO	NO
Other bituminous coal	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	587	487	628	743	663	587	594	162
Residual fuel oil	262	476	412	273	97	NO	225	470
Biogas from organic waste	387	359	198	163	166	140	142	147
Total	**1,236**	**1,322**	**1,238**	**1,179**	**926**	**727**	**961**	**779**
Heat Plants – *Producers of energy for own consumption – 1A1aiii*								
Anthracite	59	57	63	56	5	4	5	7
Other bituminous coal	11	12	6	13	NO	NO	NO	NO
Natural gas	1,395	1,465	1,514	1,564	1,718	1,774	1,865	1,528
Residual fuel oil	8	33	22	26	21	17	4	5
Other petroleum products	1	1	NO	1	NO	4	NO	NO
Wood pellets and briquettes	33	63	122	107	134	63	100	145
Fuelwood	8	15	2	4	2	1	10	7
Wood waste	7	2	7	26	2	8	6	16
Vegetable waste	341	290	234	385	362	404	387	656
Total	**1,863**	**1,938**	**1,970**	**2,182**	**2,244**	**2,275**	**2,377**	**2,364**

Table 3-92: Aggregated consumption for energy purposes within category 1A2 'Manufacturing Industries and Construction' on the RBDR between 1990 and 2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Anthracite	1,121	56	33	18	NO	NO	29	29	58	29	29
Lignite	12	16	20	28	29	NO	NO	NO	NO	NO	NO
Other bituminous coal	NO	NO	NO	NO	NO	NO	59	30	NO	NO	29
Coke	1,030	673	553	443	323	381	410	352	264	205	176
Hard coal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil	14,070	10,752	7,514	4,670	558	382	411	294	323	117	117
Fuel for oven	468	329	189	62	59	29	88	117	59	117	117
Jet kerosene	647	494	341	191	29	NO	NO	NO	29	NO	NO
Petroleum coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other petroleum products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	8,871	5,311	4,223	3,167	2,288	3,080	2,347	3,286	3,198	3,080	3,638
LPG	92	NO	NO	12	NO	NO	NO	NO	NO	NO	NO
Pellets and briquettes from vegetable waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuelwood	135	112	88	65	NO	29	29	29	NO	NO	NO
Wood waste	176	140	103	67	29	NO	NO	NO	NO	NO	NO
Agricultural waste	NO	NO	NO	NO	NO	NO	NO	117	59	59	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Anthracite	29	28	29	135	169	157	80	226	146	269	1733
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other bituminous coal	NO	NO	NO	14	15	NO	NO	1,795	1,375	985	NO
Coke	235	185	147	58	8	11	11	9	63	126	7
Hard coal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil	146	40	147	203	164	197	139	146	54	68	78

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Fuel for oven	117	86	29	29	25	15	7	16	NO	26	4
Jet kerosene	NO	NO	NO	5	10	NO	NO	NO	NO	1	NO
Petroleum coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other petroleum products	NO	NO	NO	4	9	12	NO	NO	NO	NO	NO
Natural gas	3,315	4,266	4,543	4,758	6,125	6,142	6,012	3,544	2,002	2,693	2,832
LPG	557	NO	29	17	20	30	22	40	9	115	65
Pellets and briquettes from vegetable waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuelwood	NO	NO	NO	9	11	7	6	7	4	11	17
Wood waste	NO	NO	NO	39	26	1	5	14	2	16	25
Agricultural waste	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Anthracite	155	2,244	533	117	122	113	119	44	33	47	162
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other bituminous coal	1,103	5	1,256	1,657	927	883	838	866	760	975	210
Coke	30	4	52	1	143	1	1	NO	1	1	NO
Hard coal	NO	NO	NO	NO	NO	284	101	27	NO	179	NO
Residual fuel oil	43	20	65	315	596	491	343	167	44	261	507
Fuel for oven	2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Jet kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Petroleum coke	NO	NO	NO	NO	NO	473	1,071	1,135	906	651	957
Other petroleum products	NO	NO	NO	6	1	3	1	1	8	NO	NO
Natural gas	2,687	2,445	2,275	4,472	4,451	4,625	5,506	5,140	5,322	5,673	4,420
LPG	61	17	82	15	18	22	33	30	25	31	21
Pellets and briquettes from vegetable waste	NO	NO	NO	62	83	145	144	138	66	106	153
Fuelwood	17	20	13	33	33	14	21	16	18	24	17
Wood waste	36	5	16	11	2	7	30	2	9	8	16
Agricultural waste	2	10	NO	345	290	241	392	367	407	390	658
Charcoal	NO	NO	NO	NO	NO	1	1	NO	NO	NO	NO
Biogas	NO	NO	NO	387	359	198	163	166	140	244	247

Table 3-93: Aggregated consumption of fuel for energy purposes within category 1A2 'Manufacturing Industries and Construction' between 1990 and 2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Solid	2,163	745	606	489	352	381	498	411	322	234	234
Liquid	15,185	11,574	8,044	4,923	646	411	499	411	411	234	234
Gaseous	8,963	5,311	4,223	3,179	11,603	5,508	4,111	8,416	8,158	7,688	8,510
Biofuel	311	251	192	132	29	29	29	146	59	59	NO
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Solid	264	213	176	207	192	168	91	2,032	1,588	1,383	1,743
Liquid	263	126	176	241	208	224	146	197	77	108	94
Gaseous	9,781	6,745	7,247	7,210	9,616	10,706	13,910	12,056	6,138	6,651	7,064
Biofuel	NO	NO	NO	48	37	8	11	21	6	27	47
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Solid	1,290	2,254	1,843	1,777	1,194	1,290	1,066	937	794	1,202	372
Liquid	55	35	80	336	612	980	1,416	1,308	963	917	1,464
Gaseous	7,317	6,215	6,750	8,145	8,533	8,034	9,196	8,963	9,349	9,915	8,861
Biofuel	55	35	29	838	767	606	751	689	640	772	1,091

3.3.3. Uncertainties and Time Series Consistency

The primary uncertainty-related factors pertain to methodology, emission factors utilised in the estimation of GHG emissions originating from source category 1A2 'Manufacturing Industries and Construction', and the quality of available activity data.

Uncertainties associated with EFs are estimated to be circa 5% for CO_2 emissions, and up to ±50% for CH_4 and N_2O emissions, respectively. Uncertainties associated with activity data regarding fuel consumption within manufacturing industries and construction' are circa 5% for CO_2 and CH_4 emissions,

and circa 3% for N_2O emissions. Combined uncertainties presented as a percentage of the total direct GHG emissions originating from sector 1A2 'Manufacturing Industries and Construction' were estimated to be circa 7.1% (Annex 2-3.1).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.3.4. Quality Assurance and Quality Control

A standard verification and QC form and checklist were filled in for source category 1A2 'Manufacturing Industries and Construction' following the Tier 1 approach.

The AD and methods utilised to estimate GHG emissions originating from the respective category are documented and archived both in hard copies and electronically. To identify the data entry and emission estimation process errors regarding the estimation of GHG emissions, verifications and quality control procedures were carried out on the quality of date used and EFs applied.

The QC and verification procedures applied in the calculation process for category 1A2 'Manufacturing and construction industry' included:

- verifying the correctness of EFs used for each sub-category;
- verifying whether the primary reference sources are correctly indicated;
- the accuracy of calculations for sources included in category 1A2 is verified randomly;
- whether the same calculation method is used for the entire time series covered by the inventory;
- verifying whether GHG emission calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RM and relevant reference sources;
- verifying to what extent the full geographical coverage of the national GHG inventory is ensured;
- verifying the inter-annual evolution trends of emissions by creating representative charts, while unusual fluctuations are explained;
- verifying maintenance and completion of the national inventory of GHG emission archive, etc.

Following the recommendations included in the 2006 IPCC Guidelines, GHG emissions were estimated using AD and CS EFs from official sources of information. In the current cycle, when preparing the activity data series, the following alterations have been made:

- the information regarding primary activity data for the most recent years was collected and specified;
- to confirm the final results obtained, control checks are carried out of the calculation formulas in the work sheets;
- when calculating emissions for each category of the entire time series, the same calculation method has been used, and graphs are presented for analysis in MS Excel files;
- to ensure the coverage of the inventory from a territorial point of view for all source categories, activity data collected for the territory on the LBDR are included; various statistical publications of ATULBD were used, including the Statistical Report 'The State of Housing and Communal Services of ATULBD' for 2011-2021;
- the amount of fuel consumed on LBDR was redistributed in all 12 industries considered in source category 1A2 'Manufacturing Industries and Construction'.

3.3.5. Recalculations

Recalculations in the current inventory cycle for source category 1A2 'Manufacturing Industries and Construction' carried out due to: the update of EF values utilised for methane and nitrous oxide from the consumption of LPG, as well as due to using other values for the 100-year GWP available in the IPCC AR5 (2014), instead of those available in the IPCC AR4 (2007): for CH_4 – 28 (instead of 25), and for N_2O – 265 (instead of 298) (Table 3-94).

Table 3-94: Recalculations of GHG emissions for 1990-2020 included in the NC5 of the RoM to the UNFCCC (1A2 'Manufacturing Industries and Construction'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	1,921.76	1,287.13	935.00	619.48	737.87	387.00	327.03	564.95	540.32	484.70	521.63
BTR1	1,904.84	1,273.22	924.48	612.12	739.14	382.22	322.02	548.02	523.97	474.57	520.27
Difference, %	-0.9	-1.1	-1.1	-1.2	0.2	-1.2	-1.5	-3.0	-3.0	-2.1	-0.3
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	602.80	412.30	440.49	449.04	577.38	635.99	802.37	887.27	503.07	517.25	577.51
BTR1	601.33	410.94	439.42	444.58	575.18	635.44	801.69	887.09	503.39	517.00	577.13
Difference, %	-0.2	-0.3	-0.2	-1.0	-0.4	-0.1	-0.1	0.0	0.1	0.0	-0.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	540.29	579.17	565.23	658.29	646.28	664.32	756.25	719.85	803.55		
BTR1	539.60	575.00	564.08	654.13	643.57	661.07	751.30	718.39	694.91	757.79	672.30
Difference, %	-0.1	-0.7	-0.2	-0.6	-0.4	-0.5	-0.7	-0.2	-13.5		

Abbreviations: BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC; NC5 – Fifth National Communication of the RoM to the UNFCCC.

Additionally, the information on natural gas consumption in 2020 for the LBDR was modified: instead of the previously used consumption value (in the absence of data on natural gas consumption in the industrial sector for 2020), another value was used, which was obtained through the interpolation method, based on the real values recorded in 2019, 2021 and 2022.

3.3.6. Planned Improvements

Potential improvements within source category 1A2 'Manufacturing Industries and Construction' regarding fuel consumption for energy purposes could be possible once the updated AD on fuel consumption for the territory on the LBDR is available, thus filling the gaps for certain years.

3.5. Transport (source category 1A3)

3.5.1. Source Category Description and GHG Emissions Trends

Source category 1A3 'Transport' includes the following sources: 1A3a 'Civil Aviation', 1A3b 'Road Transportation', 1A3c 'Railways', 1A3d 'Water-borne Navigation' and 1A3e 'Other Transportation'.

Total GHG emissions from source category 1A3 'Transport'

There had been a downward trend in total GHG emissions from source category 1A3 'Transport' between 1990 and 2022, from 4,830.86 kt CO_2 equivalent in 1990 to la 2,776.78 kt CO_2 equivalent in 2022, or by 42.5% (Table 3-95).

Table 3-95: Direct GHG emissions from 1A3 'Transport' between 1990-2022, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A3, kt CO_2 equivalent	4,830.86	3,762.74	2,694.66	1,916.56	1,654.26	1,658.41	1,617.58	1,553.23	1,396.45	931.24	1,004.59
%, compared to 1990	100.0	77.9	55.8	39.7	34.2	34.3	33.5	32.2	28.9	19.3	20.8
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A3, kt CO_2 equivalent	1,086.09	1,440.38	1,624.14	1,827.10	1,864.52	1,785.12	1,891.74	1,995.91	1,961.51	2,185.47	2,319.77
%, compared to 1990	22.5	29.8	33.6	37.8	38.6	37.0	39.2	41.3	40.6	45.2	48.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A3, kt CO_2 equivalent	2,034.45	2,143.31	2,180.29	2,305.29	2,478.57	2,500.58	2,579.00	2,662.34	2,508.94	2,775.47	2,776.78
%, compared to 1990	42.1	44.4	45.1	47.7	51.3	51.8	53.4	55.1	51.9	57.5	57.5

In the current inventory cycle, GHG emissions from 1A3 'Transport' were estimated separately for the territory on the RBDR (according to AD from EBs), and for the LBDR, respectively (based on specific fuel consumption per capita) (for the period 1990-1992, the information is presented for the entire territory of the country, while since 1993, separately for the RBDR and LBDR).

The values of direct and indirect GHG emissions from source category 1A3 'Transport' are shown in Table 3-96.

Table 3-96: Direct and indirect GHG emissions from 1A3 'Transport' between 1990-2022.

	1A3, kt						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	4,698.24	1.35	0.36	21.04	70.89	9.04	0.78
1991	3,656.10	1.03	0.29	16.79	53.95	6.92	0.62
1992	2,615.22	0.72	0.22	12.61	37.27	4.84	0.45
1993	1,854.84	0.49	0.18	9.92	24.46	3.29	0.32
1994	1,612.96	0.44	0.11	6.25	22.38	2.83	0.22
1995	1,617.92	0.44	0.11	6.32	23.35	2.93	0.23
1996	1,578.77	0.43	0.10	6.19	22.27	2.79	0.22
1997	1,516.13	0.40	0.10	6.05	24.65	3.07	0.23
1998	1,363.25	0.40	0.08	5.07	21.35	2.64	0.19
1999	910.68	0.25	0.05	3.44	12.53	1.55	0.14
2000	982.33	0.25	0.06	3.78	12.43	1.55	0.16
2001	1,061.82	0.27	0.06	4.02	13.29	1.66	0.14
2002	1,405.71	0.34	0.09	5.68	17.26	2.19	0.18
2003	1,588.76	0.40	0.09	6.15	20.61	2.58	0.21
2004	1,786.89	0.43	0.11	7.11	22.06	2.78	0.25
2005	1,821.73	0.44	0.12	7.56	22.79	2.89	0.06
2006	1,742.01	0.41	0.12	7.45	20.89	2.69	0.07
2007	1,846.56	0.43	0.13	7.88	21.55	2.78	0.07
2008	1,949.57	0.45	0.13	8.22	22.47	2.91	0.07
2009	1,919.24	0.46	0.11	7.44	22.29	2.83	0.02
2010	2,139.84	0.47	0.12	8.66	21.91	2.83	0.02
2011	2,272.70	0.47	0.13	9.01	22.52	2.90	0.02
2012	1,992.59	0.40	0.12	8.11	18.90	2.47	0.02
2013	2,101.30	0.41	0.12	8.25	18.35	2.40	0.01
2014	2,140.57	0.41	0.11	8.04	18.55	2.39	0.01
2015	2,261.58	0.43	0.12	8.81	19.05	2.48	0.01
2016	2,428.36	0.50	0.14	9.85	19.62	2.57	0.02
2017	2,451.25	0.48	0.14	9.82	19.04	2.50	0.01
2018	2,529.58	0.50	0.13	9.81	19.87	2.58	0.01
2019	2,611.55	0.50	0.14	10.17	20.57	2.68	0.01
2020	2,462.27	0.44	0.13	9.75	18.40	2.41	0.01
2021	2,721.37	0.58	0.14	10.93	21.79	2.81	0.01
2022	2,724.89	0.49	0.14	10.82	20.28	2.65	0.01

The evolution of GHG emissions from source category 1A3 'Transport' between 1990-2022 is further presented by emission source.

Source 1A3b 'Road Transportation' has the largest share in the structure of total direct GHG emissions from category 1A3 'Transport' between 1990-2022, followed by 1A3c 'Railways' and 1A3e 'Other Transportation' (pipeline transport), while the share of sources 1A3a 'Civil Aviation' and 1A3d 'Water-borne Navigation' is insignificant (Table 3-97, Figure 3-16).

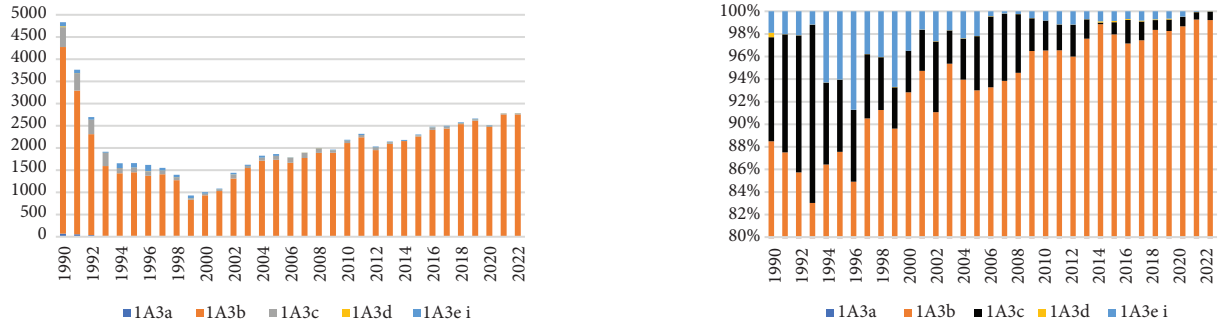


Figure 3-16: Direct GHG emissions from 1A3 'Transport', disaggregated by source, between 1990-2022, in kt CO_2 equivalent; and their share in the structure of total direct GHG emissions within the respective category, % of the total.

In 2022, GHG emissions from source 1A3a 'Civil Aviation' had a share of less than 0.003% of the total within the category, whereas those originating from 1A3b 'Road Transportation' – 99.2%, 1A3c 'Railways' – 0.8%, 1A3d 'Water-borne Navigation' – 0.01%, 1A3e 'Other Transportation' (pipeline transport) – 0.01% of the total.

Table 3-97: Direct GHG emissions, disaggregated by source within category 1A3 'Transport' between 1990-2022

	1A3, kt CO_2 equivalent						% of total				
	1A3a	1A3b	1A3c	1A3d	1A3e i	1A3	1A3a	1A3b	1A3c	1A3d	1A3e i
1990	72.89	4,202.23	445.37	19.10	91.27	4,830.86	1.5	87.0	9.2	0.4	1.9
1991	55.17	3,237.56	393.66	0.29	76.06	3,762.74	1.5	86.0	10.5	0.0	2.0
1992	37.45	2,272.88	327.04	0.25	57.04	2,694.66	1.4	84.3	12.1	0.0	2.1
1993	19.73	1,571.60	302.53	0.28	22.40	1,916.56	1.0	82.0	15.8	0.0	1.2
1994	19.92	1,409.82	120.17	0.22	104.13	1,654.26	1.2	85.2	7.3	0.0	6.3
1995	20.07	1,432.02	105.92	0.22	100.17	1,658.41	1.2	86.3	6.4	0.0	6.0
1996	20.19	1,353.26	102.77	0.23	141.11	1,617.58	1.2	83.7	6.4	0.0	8.7
1997	20.29	1,385.74	88.32	0.25	58.63	1,553.23	1.3	89.2	5.7	0.0	3.8
1998	20.67	1,253.72	65.34	0.16	56.56	1,396.45	1.5	89.8	4.7	0.0	4.1
1999	2.05	832.54	34.04	0.26	62.35	931.24	0.2	89.4	3.7	0.0	6.7
2000	2.05	930.59	36.81	0.12	35.02	1,004.59	0.2	92.6	3.7	0.0	3.5
2001	0.10	1,028.75	39.57	0.21	17.46	1,086.09	0.0	94.7	3.6	0.0	1.6
2002	0.09	1,311.63	90.11	0.49	38.07	1,440.38	0.0	91.1	6.3	0.0	2.6
2003	0.66	1,548.11	47.87	0.44	27.06	1,624.14	0.0	95.3	2.9	0.0	1.7
2004	0.35	1,716.44	66.20	0.44	43.67	1,827.10	0.0	93.9	3.6	0.0	2.4
2005	1.69	1,732.41	89.43	0.26	40.73	1,864.52	0.1	92.9	4.8	0.0	2.2
2006	0.20	1,665.00	111.79	0.52	7.61	1,785.12	0.0	93.3	6.3	0.0	0.4
2007	1.06	1,774.32	112.50	0.34	3.52	1,891.74	0.1	93.8	5.9	0.0	0.2
2008	0.15	1,887.29	103.42	0.34	4.69	1,995.91	0.0	94.6	5.2	0.0	0.2
2009	0.08	1,892.75	56.65	0.34	11.69	1,961.51	0.0	96.5	2.9	0.0	0.6
2010	0.35	2,109.47	57.66	0.26	17.73	2,185.47	0.0	96.5	2.6	0.0	0.8
2011	0.07	2,239.62	53.20	0.26	26.62	2,319.77	0.0	96.5	2.3	0.0	1.1
2012	0.14	1,952.86	57.33	0.26	23.85	2,034.45	0.0	96.0	2.8	0.0	1.2
2013	0.20	2,091.28	36.75	0.26	14.82	2,143.31	0.0	97.6	1.7	0.0	0.7
2014	0.14	2,155.35	3.08	2.37	19.35	2,180.29	0.0	98.9	0.1	0.1	0.9
2015	0.31	2,258.11	24.82	2.44	19.61	2,305.29	0.0	98.0	1.1	0.1	0.9
2016	0.23	2,407.89	51.78	1.83	16.84	2,478.57	0.0	97.1	2.1	0.1	0.7
2017	0.59	2,435.84	41.80	1.75	20.61	2,500.58	0.0	97.4	1.7	0.1	0.8
2018	0.15	2,536.51	22.62	1.58	18.14	2,579.00	0.0	98.4	0.9	0.1	0.7
2019	0.29	2,615.94	27.07	1.84	17.20	2,662.34	0.0	98.3	1.0	0.1	0.6
2020	0.07	2,475.68	21.02	0.62	11.56	2,508.94	0.0	98.7	0.8	0.0	0.5
2021	0.07	2,755.24	18.09	0.35	1.72	2,775.47	0.0	99.3	0.7	0.0	0.1
2022	0.07	2,755.25	20.88	0.18	0.40	2,776.78	0.0	99.2	0.8	0.0	0.0

3.5.2. Methodologies, Emission Factors and Activity Data

GHG emissions from source category 1A3 'Transport' were estimated following the Tier 1 methodological approach available in the 2006 IPCC Guidelines, based on activity data on fuel consumption and default emission factors. In order to estimate non-CO_2 emissions, default EFs were used, which are available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2023) (Table 3-98).

Table 3-98: Emission factors utilised in the estimation of GHG emissions from source category 1A3 'Transport', kg/TJ

Category	Fuel type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Sources of reference for: CO_2, CH_4, N_2O	Sources of reference for: NO_x, CO and NMVOC
1A3a	Aviation gasoline	70,000	0.5	2	4	1200	19	1	2006 IPCC Guidelines, Volume 2, Chapter 3, Tables 3.6.4 and 3.6.5	EMEP/EEA Guidebook, 2023, categories 1.A.3.a, 1.A.5.b, Table 3-3
1A3b	Gasoline	69,300	33.0	3.2	8.7	84.7	10.1		2006 IPCC Guidelines, Volume 2, Chapter 3, Tables 3.2.1 and 3.2.2	EMEP/EEA Guidebook, 2023, Updated Oct. 21, categories 1.A.3.b.i, 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv, Tables 3-5 and 3-6
	Diesel	74,100	3.9	3.9	13.0	3.3	0.7			
	Natural gas	56,100	92.0	3.0	13.0	5.7	0.3	0.0		
	LPG	63,100	62.0	0.2	15.2	84.7	13.6	0.0		

Category	Fuel type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Sources of reference for: CO_2, CH_4, N_2O	Sources of reference for: NO_x, CO and NMVOC
1A3c	Diesel	74,100	4.15	28.6	52.4	10.7	4.65		2006 IPCC Guidelines, Volume 2, Chapter 3, Table 3.4.1	EMEP/EEA Guidebook, 2023, category 1.A.3.c, Table 3-1
1A3d	Diesel	74,100	7	2	72.2	3.84	1.75	1.82	2006 IPCC Guidelines, Volume 2, Chapter 3, Tables 3.5.2 and 3.5.3	EMEP/EEA Guidebook, 2023, categories 1.A.3.d.i, 1.A.3.d.ii, 1.A.4.c.iii, Table 3-1
1A3e	Natural gas	56,100	1	0.1	175	45	1.6	NE	2006 IPCC Guidelines, Volume 2, Chapter 3, Table 2.2	EMEP/EEA Guidebook, 2023, categories 1.A.3.e.i, 1 Table 3-1

The calculation of SO_2 emissions from 1A3b 'Road Transportation' and 1A3c 'Railways' was carried out in accordance with the estimation methods available in the 2023 EMEP/EEA Air Pollutant Emission Inventory.

For the LBDR, there are incomplete AD on diesel and gasoline consumption by transport units in the agriculture sector, and incomplete data on natural gas consumption by transport units in the region, respectively.

The information received from JSC 'Moldovagaz', as well as from the statistical publications of 'The State of Housing and Communal Services of ATULBD' (generated and published between 2011 and 2021) serve as reference sources. All missing data, including for 2022, have been restored and the methods applied are described below.

For the RBDR, the main reference sources regarding fuel consumption for the transport sector between 1993 and 2022 is the information provided by the Energy Balances of the Republic of Moldova, both in natural units (kt and/or million m^3), and in energy units (TJ).

In the Energy Balances for the year 1990, AD are available in natural units, as well as in kilotonnes of conventional fuel (in the years 1991 and 1992, the Energy Balances were not published). For the year 1990, available data in natural units was converted into energy units (TJ) by using country specific NCVs. For the period 1991-1992, data was reconstructed by the interpolation method based on the values available for the years 1990 and 1993.

Additionally, for water-borne navigation and civil aviation, AD was used provided through official letters by the Ministry of Economy and Infrastructure, SOE 'Moldova Railways', SOE 'Ungheni River Port', SOE 'Molovata Ferry', and the Civil Aeronautical Authority, respectively.

The main types of fuels within source category 1A3 'Transport' are aviation gasoline, gasoline, natural gases, liquefied petroleum gases, kerosene and other petroleum products.

It was accepted that part of the diesel consumption in the agriculture sector is made on roads of national importance, and the largest share in agricultural fields (the ratio for 1990-1993 being 30% and 70%; whereas for the period 1994-2022 – 10% and 90%). Fuel consumption on roads of national importance was considered in the estimation of GHG emissions from source category 1A3 'Transport', and fuel consumed by transport units in agricultural fields was considered in the estimation of GHG emissions from source category 1A4c 'Agriculture/forestry/fishing'.

Consumption of lubricants and greases, in accordance with the estimation methodologies available in the 2006 IPCC Guidelines, is included in Sector 2 'IPPU'.

1A3a Civil Aviation

The civil aviation sector is represented by light aircraft and helicopters.

GHG emissions trends in source category 1A3a 'Civil Aviation'

Compared to 1990-year level, GHG emissions from this category decreased by circa 99.7% by 2022 (Table 3-99).

Table 3-99: GHG emissions from source category 1A3a 'Civil Aviation' and their share compared to the 1990 year level

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A3a, kt CO_2 equivalent	72.89	55.17	37.45	19.73	19.92	20.07	20.19	20.29	20.67	2.05	2.05
%, compared to 1990	100	75.7	51.4	27.1	27.3	27.5	27.7	27.8	28.4	2.8	2.8
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A3a, kt CO_2 equivalent	0.10	0.09	0.66	0.35	1.69	0.20	1.06	0.15	0.08	0.35	0.07
%, compared to 1990	0.1	0.1	0.9	0.5	2.3	0.3	1.5	0.2	0.1	0.5	0.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A3a, kt CO_2 equivalent	0.14	0.20	0.14	0.31	0.23	0.59	0.15	0.29	0.07	0.07	0.07
%, compared to 1990	0.2	0.3	0.7	1.5	1.1	2.9	0.7	1.4	0.3	0.3	0.3

Direct and indirect GHG emissions from source category 1A3a 'Civil Aviation' between 1990 and 2022 are shown in Table 3-100.

Table 3-100: Direct and indirect GHG emissions from source category 1A3a 'Civil Aviation' between 1990 and 2022 compared to 1990-year level

	1A3a, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	72.33	0.00	0.00	0.00	0.03	0.00	0.00	100	100	100	100	100	100	100
1991	54.75	0.00	0.00	0.00	0.02	0.00	0.00	75.7	75.7	75.7	75.7	75.7	75.7	75.7
1992	37.16	0.00	0.00	0.00	0.01	0.00	0.00	51.4	51.4	51.4	51.4	51.4	51.4	51.4
1993	19.58	0.00	0.00	0.00	0.01	0.00	0.00	27.1	27.1	27.1	27.1	27.1	27.1	27.1
1994	19.77	0.00	0.00	0.00	0.01	0.00	0.00	27.3	27.3	27.3	27.3	27.3	27.3	27.3
1995	19.92	0.00	0.00	0.00	0.01	0.00	0.00	27.5	27.5	27.5	27.5	27.5	27.5	27.5
1996	20.03	0.00	0.00	0.00	0.01	0.00	0.00	27.7	27.7	27.7	27.7	27.7	27.7	27.7
1997	20.13	0.00	0.00	0.00	0.01	0.00	0.00	27.8	27.8	27.8	27.8	27.8	27.8	27.8
1998	20.51	0.00	0.00	0.00	0.01	0.00	0.00	28.4	28.4	28.4	28.4	28.4	28.4	28.4
1999	2.03	0.00	0.00	0.00	0.00	0.00	0.00	2.8	2.8	2.8	2.8	2.8	2.8	2.8
2000	2.03	0.00	0.00	0.00	0.00	0.00	0.00	2.8	2.8	2.8	2.8	2.8	2.8	2.8
2001	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2002	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2003	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.9	0.9	0.9	0.9	0.9	0.9	0.9
2004	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.5	0.5	0.5	0.5	0.5	0.5	0.5
2005	1.68	0.00	0.00	0.00	0.00	0.00	0.00	2.3	2.3	2.3	2.3	2.3	2.3	2.3
2006	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.3	0.3	0.3	0.3	0.3	0.3	0.3
2007	1.05	0.00	0.00	0.00	0.00	0.00	0.00	1.5	1.5	1.5	1.5	1.5	1.5	1.5
2008	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2009	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2010	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.5	0.5	0.5	0.5	0.5	0.5	0.5
2011	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2012	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2013	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.3	0.3	0.3	0.3	0.3	0.3	0.3
2014	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2015	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2016	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.3	0.3	0.3	0.3	0.3	0.3	0.3
2017	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.8	0.8	0.8	0.8	0.8	0.8	0.8
2018	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.2	0.2	0.2	0.2	0.2	0.2	0.2
2019	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.4	0.4	0.4	0.4	0.4	0.4	0.4
2020	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2021	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.1	0.1	0.1	0.1	0.1	0.1	0.1
2022	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.1	0.1	0.1	0.1	0.1	0.1	0.1

Direct and indirect GHG emissions and the contribution of each gas in the share of total emissions from the respective source between 1990 and 2022 are shown Table 3-101.

Table 3-101: Direct and GHG emissions from source category 1A3a 'Civil Aviation' and the share of each greenhouse gas of the total at source category level

	1A3a, kt CO_2 equivalent				Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	72.3324	0.0145	0.5477	72.8945	99.2	0.0	0.8
1991	54.7486	0.0109	0.4145	55.1741	99.2	0.0	0.8
1992	37.1649	0.0074	0.2814	37.4537	99.2	0.0	0.8
1993	19.5811	0.0039	0.1483	19.7333	99.2	0.0	0.8
1994	19.7669	0.0040	0.1497	19.9205	99.2	0.0	0.8
1995	19.9155	0.0040	0.1508	20.0703	99.2	0.0	0.8
1996	20.0344	0.0040	0.1517	20.1901	99.2	0.0	0.8
1997	20.1295	0.0040	0.1524	20.2860	99.2	0.0	0.8
1998	20.5100	0.0041	0.1553	20.6694	99.2	0.0	0.8
1999	2.0300	0.0004	0.0154	2.0458	99.2	0.0	0.8
2000	2.0300	0.0004	0.0154	2.0458	99.2	0.0	0.8
2001	0.0982	0.0000	0.0007	0.0989	99.2	0.0	0.8
2002	0.0849	0.0000	0.0006	0.0856	99.2	0.0	0.8
2003	0.6558	0.0001	0.0050	0.6609	99.2	0.0	0.8
2004	0.3500	0.0001	0.0027	0.3527	99.2	0.0	0.8
2005	1.6800	0.0003	0.0127	1.6931	99.2	0.0	0.8
2006	0.1972	0.0000	0.0015	0.1987	99.2	0.0	0.8
2007	1.0500	0.0002	0.0080	1.0582	99.2	0.0	0.8
2008	0.1515	0.0000	0.0011	0.1527	99.2	0.0	0.8
2009	0.0760	0.0000	0.0006	0.0766	99.2	0.0	0.8
2010	0.3500	0.0001	0.0027	0.3527	99.2	0.0	0.8
2011	0.0700	0.0000	0.0005	0.0705	99.2	0.0	0.8
2012	0.1400	0.0000	0.0011	0.1411	99.2	0.0	0.8
2013	0.1965	0.0000	0.0015	0.1980	99.2	0.0	0.8
2014	0.1400	0.0000	0.0011	0.1411	99.2	0.0	0.8
2015	0.3113	0.0001	0.0024	0.3137	99.2	0.0	0.8
2016	0.2301	0.0000	0.0017	0.2319	99.2	0.0	0.8
2017	0.5868	0.0001	0.0044	0.5914	99.2	0.0	0.8
2018	0.1535	0.0000	0.0012	0.1547	99.2	0.0	0.8
2019	0.2835	0.0001	0.0021	0.2857	99.2	0.0	0.8
2020	0.0700	0.0000	0.0005	0.0705	99.2	0.0	0.8
2021	0.0700	0.0000	0.0005	0.0705	99.2	0.0	0.8
2022	0.0700	0.0000	0.0005	0.0705	99.2	0.0	0.8

Methodologies and Emission Factors

Direct GHG emissions were estimated following the Tier 1 methodology. EFs are available in the 2006 IPCC Guidelines, whereas in order to estimate non-CO_2 emissions, default EFs were used, available in the EMEP/EEA Air Pollutant Emission Inventory (2023) (Table 3-102).

Table 3-102: EFs utilised in the estimation of GHG emissions from 1A3a 'Civil Aviation

Type of fuel	Emission Factors						
	kg/TJ			kg/t fuel			
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
Aviation gasoline	70,000	0.5	2	4	1,200	19	1
References:	2006 IPCC Guidelines, Chapter 'Mobile Combustion'			2023 EMEP/EEA Guidebook, Category 1.A.3.a.1.A.5.b. Aviation, P.20			

Activity Data

Compared to the previous inventory cycle, the data series in the current one was completed with the same approaches: aviation fuels which are found in the EBs of the RoM in source categories 1A2 and 1A3b have been reallocated to source category 1A3a; activity data for three time series 1991-1992, 1994-1997 and 1999-2000 were restored by the interpolation method, since values for aviation gasoline are available in the EBs of the RoM only for years 1990, 1993, 1998 and 2001-2002. Under these

circumstances, in the previous inventory cycles, activity data were collected through official letters to the CAA; however, the collection of such data was possible only for the period 2001-2022.

The following approaches have been applied in order to restore the time series for this category:

- Recommendations were received from the international expert responsible for peer reviewing Sector 1 'Energy' of the National Inventory Report: 1990-2016, regarding the reallocation of fuels which could be used in domestic aviation from source category 1A2 to source category 1A3a – the recommendation has been implemented.
- In accordance with the EBs of the RoM published between 1990 and 1999, aviation gasoline consumption was registered only in 1990, 1993 and 1998 year; based on these values, the activity data for the years 1991-1992 and 1994-1997 was restored by interpolation;
- For the years 2001-2022, the activity data is available from the official letters provided by the Civil Aeronautical Authority of the RoM;
- For the period 2001-2022, in EBs of the RoM, in category 1A2, aviation fuel consumption was detected for the years 2004-2005, 2010, and 2014, which was reallocated to source category 1A3a;
- Similarly, fuels such as kerosene (1999, 2000, 2005, 2007, 2010, 2011) and 'Other Petroleum Products' (2010 and 2012), previously allocated to category 1A3b 'Road Transportation', were reallocated to source category 1A3a 'Civil Aviation' (Table 3-103).

Table 3-103: Activity data associated with the consumption of aviation fuel, available in the EBs reallocated to source category 1A3a 'Civil Aviation' from 1A2 and 1A3b, TJ

	Activity data regarding fuel consumption reallocated to category 1A3a 'Civil Aviation'								
	From source category 1A2 'Manufacturing Industries and Construction'					From source category 1A3b 'Road Transportation' and 1A3e 'Other Transportation'			
	Aviation gasoline	Fuel for jet engines	Kerosene	Fuel for engines	Total, TJ	1A3b Kerosene	1A3b Other petroleum products	1A3eii Kerosene	Total, TJ
1990	NO	299	647	NO	946	NO	NO	NO	NO
1991	NO	121	494	NO	615	NO	NO	NO	NO
1992	NO	73	341	NO	414	NO	NO	NO	NO
1993	12	27	191	NO	230	15	NO	26	41
1994	NO	NO	29	NO	29	NO	NO	NO	NO
1998	NO	NO	29	264	293	NO	NO	NO	NO
1999	NO	NO	NO	NO	NO	NO	NO	29	29
2000	NO	NO	NO	NO	NO	NO	NO	29	29
2004	NO	NO	5	NO	5	NO	NO	NO	NO
2005	NO	NO	10	NO	10	14	NO	NO	14
2007	NO	NO	NO	NO	NO	3	NO	12	15
2010	NO	NO	1	NO	1	3	1	NO	4
2011	NO	NO	NO	NO	NO	1	NO	NO	1
2012	NO	NO	NO	NO	NO	NO	2	NO	2
2014	NO	NO	NO	2	2	NO	NO	NO	NO

Based on the above-mentioned, fuel consumption has been restored for source category 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation') (Table 3-104).

Table 3-104: Fuel consumption for source category 1A3a 'Civil Aviation' between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Aviation Gasoline	87	61	35	9	NO	NO	NO	NO	NO	NO	NO
Reallocated data from category 1A2	946	615	414	230	29	NO	NO	NO	293	NO	NO
Reallocated data from category 1A3b	NO	NO	NO	41	NO	NO	NO	NO	NO	29	29
Total	**1,033**	**782**	**531**	**280**	**282**	**285**	**286**	**288**	**293**	**29**	**29**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Aviation Gasoline	1	1	9	6	2	3	2	2	1	2	2
Reallocated data from category 1A2	NO	NO	NO	5	10	NO	NO	NO	NO	1	NO
Reallocated data from category 1A3b	NO	NO	NO	NO	14	NO	15	NO	NO	4	1
Total	**1**	**1**	**9**	**11**	**26**	**3**	**17**	**2**	**1**	**7**	**3**

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Aviation Gasoline	3	3	2	4	3	8	2	4	1	1	1
Reallocated data from category 1A2	NO	NO	2	NO	NO	NO	NO	NO	NO	NO	NO
Reallocated data from category 1A3b	2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total	**5**	**3**	**4**	**4**	**3**	**8**	**2**	**4**	**1**	**1**	**1**

The data collected through official letters from the Civil Aeronautical Authority (CAA) for 1A3a 'Civil Aviation' (1A3aii 'Domestic Aviation') for the period 2001-2022 is presented in Table 3-105.

Table 3-105: Data collected through official letters from the CAA through official letters, associated with aviation gasoline for the period 2001-2022

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A3a, kt	0.0321	0.0278	0.2146	0.1352	0.0369	0.0645	0.0411	0.0496	0.0249	0.0383	0.0395
1A3a, TJ	1.4022	1.2133	9.3684	5.9030	1.6105	2.8173	1.7957	2.1643	1.0854	1.6704	1.7246
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
1A3a, kt	0.0676	0.0643	0.0390	0.1019	0.0753	0.1900	0.0502	0.0927	0.0230	0.01855	0.0405
1A3a, TJ	2.9514	2.8073	1.7027	4.4468	3.2876	8.1947	2.1930	4.0490	1.0000	0.8099	1.7682

Source: Civil Aeronautical Authority, for 2021 – Letter No. 2082 of 12.07.2022, for 2022 – Letter No. 1179 of 28.04.2023.

Recalculations

Recalculations of GHG emissions from 1A3a 'Civil Aviation' (Table 3-106) were carried out as a result of utilising GWP values for the 100-year horizon, available in the IPCC AR5 (2014), instead of those available in the AR4 (2007), for CH_4 – 28 (instead of 25), for N_2O – 265 (instead of 298).

Table 3-106: Recalculations of GHG emissions for 1990-2020, included in the NC5 of the RoM to the UNFCCC (1A3a 'Civil Aviation'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	72.96	55.22	37.49	19.75	19.94	20.09	20.21	20.30	20.69	2.05	2.05
BTR1	72.89	55.17	37.45	19.73	19.92	20.07	20.19	20.29	20.67	2.05	2.05
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	0.10	0.09	0.66	0.35	1.69	0.20	1.06	0.15	0.08	0.35	0.07
BTR1	0.10	0.09	0.66	0.35	1.69	0.20	1.06	0.15	0.08	0.35	0.07
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	0.14	0.20	0.14	0.31	0.23	0.59	0.15	0.29	0.07		
BTR1	0.14	0.20	0.14	0.31	0.23	0.59	0.15	0.29	0.07	0.07	0.07
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1		

Abbreviations: BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC; NC5 – Fifth National Communication of the RoM to the UNFCCC.

Planned Improvements

Primary data from two sources are used for the calculations, which creates an inconsistency which is currently difficult to eliminate. It is difficult to eliminate and could be corrected only if the NBS manages to restore the historical data on fuel consumption for domestic aviation and publish this activity data in the updated versions of the Energy Balances of the RoM.

1A3b 'Road Transportation'

The categories of vehicles considered under source 1A3b 'Road Transportation' include the following means of transportation:

1A3bi Cars (M1):

1A3b.i.1 – Passenger cars with catalysts

1A3b.i.2 – Passenger cars without catalysts

1A3bii Light duty trucks (N1):

1A3b.ii.1 – Light duty trucks with catalysts

1A3b.ii.2 – Light duty trucks without catalysts

1A3b.iii Heavy duty trucks (N2-N3) and buses (M2-M3)

1A3b.iv Motorcycles (L1-L7) weighing less than 680 kg

GHG emission trends in source category 1A3b 'Road Transportation'

Aggregated direct GHG emissions from source category 1A3b 'Road Transportation' had decreased between 1990 and 2022 by circa 34.4% (Table 3-107).

Table 3-107: Direct GHG emissions from source category 1A3b 'Road Transportation' between 1990-2022 and their share compared to the base year (1990)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A3b, kt CO_2 equivalent	4,202.23	3,237.56	2,272.88	1,571.60	1,409.82	1,432.02	1,353.26	1,385.74	1,253.73	832.54	930.59
%, compared 1990	100.0	77.0	54.1	37.4	33.5	34.1	32.2	33.0	29.8	19.8	22.1
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1A3b, kt CO_2 equivalent	1,028.75	1,311.63	1,548.11	1,716.44	1,732.41	1,665.00	1,774.32	1,887.29	1,892.75	2,109.48	2,239.62
%, compared 1990	24.5	31.2	36.8	40.8	41.2	39.6	42.2	44.9	45.0	50.2	53.3
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
1A3b, kt CO_2 equivalent	1,952.86	2,091.28	2,155.35	2,258.11	2,407.89	2,435.84	2,536.51	2,615.94	2,475.68	2,755.24	2,755.25
%, compared 1990	46.5	49.8	51.3	53.7	57.3	58.0	60.4	62.3	58.9	65.6	65.6

Direct and indirect GHG emissions originating from source category 1A3b 'Road Transportation' had decreased significantly between 1990 and 2022 (Table 3-108).

Table 3-108: Direct and indirect GHG emissions originating from source category 1A3b 'Road Transportation' compared to the 1990-year level

	1A3b, kt						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	4,112.35	1.32	0.20	14.05	69.42	8.44	0.68
1991	3,168.46	1.01	0.15	10.82	52.69	6.41	0.53
1992	2,224.56	0.70	0.11	7.67	36.23	4.42	0.37
1993	1,538.52	0.48	0.07	5.29	23.51	2.88	0.25
1994	1,380.09	0.43	0.07	4.11	21.91	2.66	0.19
1995	1,401.75	0.44	0.07	4.42	22.93	2.78	0.21
1996	1,324.42	0.42	0.06	4.20	21.83	2.65	0.19
1997	1,357.16	0.40	0.07	4.54	24.32	2.95	0.21
1998	1,226.88	0.40	0.06	3.91	21.09	2.55	0.18
1999	815.26	0.24	0.04	2.74	12.37	1.51	0.13
2000	911.85	0.25	0.04	3.11	12.29	1.50	0.15
2001	1,008.22	0.26	0.05	3.37	13.15	1.61	0.13
2002	1,285.48	0.34	0.06	4.20	16.96	2.07	0.16
2003	1,517.27	0.40	0.07	5.34	20.44	2.52	0.20
2004	1,682.50	0.43	0.08	5.98	21.82	2.69	0.23
2005	1,698.08	0.43	0.08	6.09	22.48	2.77	0.04
2006	1,632.42	0.40	0.08	5.74	20.54	2.54	0.04
2007	1,739.74	0.42	0.09	6.17	21.20	2.63	0.04
2008	1,850.70	0.45	0.09	6.65	22.15	2.77	0.05
2009	1,855.83	0.45	0.09	6.55	22.11	2.76	0.00
2010	2,069.29	0.47	0.10	7.74	21.72	2.75	0.00
2011	2,197.59	0.47	0.11	8.12	22.33	2.83	0.01
2012	1,916.42	0.40	0.10	7.17	18.70	2.39	0.00
2013	2,052.75	0.41	0.10	7.65	18.23	2.35	0.00
2014	2,115.96	0.40	0.11	7.93	18.53	2.39	0.00
2015	2,216.77	0.43	0.11	8.38	18.96	2.44	0.00
2016	2,362.59	0.49	0.12	9.02	19.45	2.50	0.01
2017	2,390.48	0.48	0.12	9.13	18.90	2.44	0.01
2018	2,489.25	0.50	0.13	9.41	19.79	2.55	0.01
2019	2,567.74	0.50	0.13	9.69	20.47	2.64	0.01
2020	2,431.00	0.43	0.12	9.41	18.33	2.39	0.01
2021	2,702.84	0.58	0.14	10.62	21.72	2.79	0.01
2022	2,705.33	0.49	0.14	10.51	20.22	2.62	0.01

Between 1990 and 2022, CO_2 emissions in the structure of GHG emissions at source category level (1A3b) varied between 97.9 and 98.1% of the total, whereas emissions of CH_4 – between 0.9% and 0.5% of the total, N_2O –1.3% din total (Table 3-109).

Table 3-109: Direct GHG emissions from source category 1A3b 'Road Transportation' and their share in the total structure at source category level

	1A3b, kt CO_2 equivalent				Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	4,112.35	36.97	52.92	4,202.23	97.9	0.9	1.3
1991	3,168.46	28.35	40.75	3,237.56	97.9	0.9	1.3
1992	2,224.56	19.74	28.59	2,272.88	97.9	0.9	1.3
1993	1,538.52	13.35	19.73	1,571.60	97.9	0.9	1.3
1994	1,380.09	12.02	17.71	1,409.82	97.9	0.9	1.3
1995	1,401.75	12.25	18.02	1,432.02	97.9	0.9	1.3
1996	1,324.42	11.85	16.99	1,353.26	97.9	0.9	1.3
1997	1,357.16	11.07	17.51	1,385.74	97.9	0.8	1.3
1998	1,226.88	11.17	15.67	1,253.72	97.9	0.9	1.3
1999	815.26	6.85	10.43	832.54	97.9	0.8	1.3
2000	911.85	6.98	11.76	930.59	98.0	0.8	1.3
2001	1,008.22	7.4	13.12	1,028.75	98.0	0.7	1.3
2002	1,285.48	9.42	16.73	1,311.63	98.0	0.7	1.3
2003	1,517.27	11.13	19.72	1,548.11	98.0	0.7	1.3
2004	1,682.50	11.96	21.98	1,716.44	98.0	0.7	1.3
2005	1,698.08	12.16	22.16	1,732.41	98.0	0.7	1.3
2006	1,632.42	11.2	21.38	1,665.00	98.0	0.7	1.3
2007	1,739.74	11.8	22.78	1,774.32	98.1	0.7	1.3
2008	1,850.70	12.47	24.12	1,887.29	98.1	0.7	1.3
2009	1,855.83	12.71	24.21	1,892.75	98.1	0.7	1.3
2010	2,069.29	13.07	27.12	2,109.47	98.1	0.6	1.3
2011	2,197.59	13.03	28.99	2,239.62	98.1	0.6	1.3
2012	1,916.42	11.24	25.2	1,952.86	98.1	0.6	1.3
2013	2,052.75	11.38	27.15	2,091.28	98.2	0.5	1.3
2014	2,115.96	11.34	28.05	2,155.35	98.2	0.5	1.3
2015	2,216.77	11.95	29.39	2,258.11	98.2	0.5	1.3
2016	2,362.59	13.82	31.49	2,407.89	98.1	0.6	1.3
2017	2,390.48	13.47	31.89	2,435.84	98.1	0.6	1.3
2018	2,489.25	14.02	33.24	2,536.51	98.1	0.6	1.3
2019	2,567.74	13.9	34.3	2,615.94	98.2	0.5	1.3
2020	2,431.00	12.15	32.53	2,475.68	98.2	0.5	1.3
2021	2,702.84	16.24	36.15	2,755.24	98.1	0.6	1.3
2022	2,705.33	13.75	36.17	2,755.25	98.2	0.5	1.3

Methodologies and Emission Factors

GHG emissions from fuel consumption (gasoline, diesel, natural gas and liquefied petroleum gases) under category 1A3b 'Road Transportation' were estimated following the Tier 1 methodological approach (Equation 3.2.1, p. 3.12, 2006 IPCC Guidelines, Volume 1 'Mobile Combustion'):

$$Emissions = \Sigma\,[Fuel_a \bullet EF_a]$$

where:

Emissions – GHG emissions (kt);

Fuel $_a$ – fuel sold (TJ);

EF_a – emission factor (kg/TJ);

a – type of fuel (gasoline, diesel, natural gas, LPG, etc.).

Emission factors for direct GHGs were taken from the 2006 IPCC Guidelines, and for indirect GHGs from the EMEP/EEA Air Pollutant Emission Inventory (2023) (Table 3-110).

Table 3-110: EFs for direct and indirect GHG from source category 1A3b 'Road Transportation'

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
	kg/TJ			kg/t			kg/TJ
Gasoline	69,300	33.0	3.2	8.7	84.7	10.1	formula
Diesel	74,100	3.9	3.9	13.0	3.3	0.7	formula
Natural gas	56,100	92.0	3.0	13.0	5.7	0.3	
LPG	63,100	62.0	0.2	15.2	84.7	13.6	
References:	2006 IPCC Guidelines, Chapter 'Mobile Combustion'			2023 EMEP/EEA Guidebook, Chapter 1.A.3.b.i, 1.A.3.b.ii, 1.A.3.b.iii, 1.A.3.b.iv			

Activity Data

The main sources of data for source category 1A3b 'Road Transportation' for the territory on the RBDR are the EBs of the RoM for the years 1990 and 1993-2022. Additionally, information received from JSC 'Moldovagaz' based on official letters from the Ministry of Environment and/or to the Environment Agency is used. For the territory on the LBDR, statistical data associated with fuel consumption are somewhat fragmentary. There is information associated with natural gas and liquefied gas consumption, according to the publications in ATULBD's Communal Services Press Releases (available only for 2011-2021). Unfortunately, the information associated with the consumption of gasoline and diesel for source category 1A3b 'Road Transportation' for the LBDR is missing. In the previous inventory cycle, fuel consumption for the territory on the LBDR was restored by taking into account the specific fuel consumption per capita on the RBDR. The same approach was applied in the current inventory cycle, but the availability of updated information regarding the population of the RoM because of the recent recalculation of the population census results conducted in 2014 was taken into account, as well as information updates in statistical editions for the years 2021-2022, for the LBDR and RBDS (Tables 3-111 to 3-117).

Table 3-111: Population of the RoM within the period 1990-2022, thousand people

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
LBDR	730.7	730.3	729.6	702.5	701.7	691.6	679.1	670.8	665.7	660.0	651.8
RBDR	3,628.68	3,633.78	3,627.28	3,643.08	3,648.79	3,654.09	3,652.77	3,646.71	3,655.6	3,649.9	3,644.1
RoM - total	4,359.38	4,364.08	4,356.88	4,345.58	4,350.49	4,345.69	4,331.87	4,317.51	4,321.3	4,309.9	4,295.9
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
LBDR	642.5	633.6	623.8	554.4	547.5	540.6	533.5	527.5	522.5	518.0	513.4
RBDR	3,635.1	3,627.8	3,618.3	3,607.4	3,600.4	3,589.9	3,581.1	3,572.7	3,567.5	3,563.7	3,560.4
RoM - total	4,277.6	4,261.4	4,242.1	4,161.8	4,147.9	4,130.5	4,114.6	4,100.2	4,090.0	4,081.7	4,073.8
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
LBDR	509.4	505.2	500.7	474.5	470.6	469.0	465.1	465.2	465.8	463.6	459.80
RBDR	3,559.5	3,559.5	2,869.2	2,846.3	2,825.6	2,780.7	2,729.6	2,684.8	2,643.7	2,626.6	2,603.8
RoM - total	4,068.9	4,064.7	3,369.9	3,320.8	3,296.2	3,249.7	3,194.7	3,150.0	3,109.5	3,090.2	3,063.6

Table 3-112: Diesel consumption in the RoM within source category 1A3b 'Road Transportation', presented separately for the RBDR and LBDR

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM: diesel, TJ*	22,419	17,555	12,691	9,337	8,092	7,887	7,337	8,552	6,430	5,067	6,409
Specific consumption, MJ/per capita	5	4	3	2	2	2	2	2	1.5	1.2	1.5
RBDR: diesel, TJ	18,661	14, 17	10,566	7,828	6,787	6, 632	6,187	7,223	5,440	4,291	5,437
LBDR: diesel, TJ	3,758	2,938	2,125	1,509	1,305	1,255	1,150	1,329	991	776	972
RoM: diesel, TJ	**22,419**	**17,555**	**12,691**	**9,337**	**8, 092**	**7, 887**	**7, 337**	**8,552**	**6,430**	**5,067**	**6,409**
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Specific consumption, MJ/per capita	1.7	2.2	2.6	2.9	3.0	3.0	3.3	3.5	3.5	4.3	4.6
RBDR: diesel, TJ	6,190	7,907	9,297	10,579	10,766	10,751	11,705	12,632	12,607	15,282	16,535
LBDR: diesel, TJ	1,094	1,381	1,603	1,626	1,637	1, 619	1,744	1,865	1,846	2,221	2,384
RoM: diesel, TJ	**7,284**	**9,288**	**10,900**	**12,205**	**12,403**	**12,370**	**13,449**	**14,497**	**14,454**	**17,503**	**18,920**
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Specific consumption, MJ/per capita	4.1	4.6	6.0	6.4	6.9	7.2	7.6	8.0	7.9	8.4	8.9
RBDR: diesel, TJ	14,735	16,478	17,252	18,125	19,474	20,047	20,760	21,510	20,877	22,113	23,148
LBDR: diesel, TJ	2,109	2,339	3,011	3,022	3,243	3,381	3,537	3,727	3,678	3,903	4,088
RoM: diesel, TJ	**16,843**	**18,816**	**20,262**	**21,146**	**22,718**	**23,429**	**24,297**	**25,237**	**24,556**	**26, 016**	**27,235**

Note: for years 1990-1992, the information is aggregated for the entire country.

Table 3-113: Gasoline consumption in the RoM within source category 1A3b 'Road Transportation', presented separately for the RBDR and LBDR

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM: gasoline, TJ*	34,320	26,047	17,774	11,333	10,775	11,409	10,786	10,033	10,475	5,994	5,913
Specific consumption, MJ/per capita	8	6	4	3	2	3	2	2	2.4	1.4	1.4
RBDR: gasoline, TJ	28,567	21,688	14,798	9,501	9,037	9,593	9,095	8,474	8,861	5,076	5,016
LBDR: gasoline, TJ	5,753	4,359	2,976	1,832	1,738	1,816	1,691	1,559	1,614	918	897
RoM: gasoline, TJ	**34,320**	**26,047**	**17,774**	**11,333**	**10,775**	**11,409**	**10,786**	**10,033**	**10,475**	**5,994**	**5,913**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Specific consumption, MJ/per capita	1.5	1.9	2.3	2.5	2.6	2.4	2.5	2.5	2.5	2.4	2.5
RBDR: gasoline, TJ	5,487	7,012	8,353	9,106	9,363	8,584	8,778	8,992	8,990	8,557	8,993
LBDR: gasoline, TJ	970	1,225	1,440	1,399	1,424	1,293	1,308	1,328	1,317	1,244	1,297
RoM: gasoline, TJ	**6,457**	**8,237**	**9,793**	**10,505**	**10,787**	**9,877**	**10,086**	**10,320**	**10,307**	**9,801**	**10,290**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Specific consumption, MJ/per capita	2.0	2.0	2.4	2.5	2.6	2.5	2.7	2.8	2.6	3.1	2.9
RBDR: gasoline, TJ	7,280	6,982	6,889	7,112	7,238	6,966	7,373	7,637	6,777	8,142	7,547
LBDR: gasoline, TJ	1,042	991	1,202	1,186	1,205	1,175	1,256	1,323	1,194	1,437	1,333
RoM: gasoline, TJ	**8,322**	**7,973**	**8,091**	**8,298**	**8,443**	**8,141**	**8,629**	**8,960**	**7,971**	**9,579**	**8,880**

Note: for years 1990-1992, the information is aggregated for the entire country.

Table 3-114: Natural gas consumption in the RoM within source category 1A3b 'Road Transportation', presented separately for the RBDR and LBDR

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM, mln.m^3	**13.0**	**9.5**	**8.9**	**13.6**	**8.5**	**7.6**	**10.5**	**11.1**	**11.5**	**11.3**	**12.8**
LBDR	3.9	3.1	2.3	1.8	1.2	0.8	1.1	0.6	0.6	0.5	0.5
RBDR	9.1	6.4	6.6	11.8	7.3	6.8	9.4	10.5	10.9	10.8	12.3
RoM, TJ	**779**	**625**	**471**	**378**	**244**	**175**	**243**	**139**	**138**	**104**	**104**
LBDR	131	105	79	61	39	28	38	22	21	16	16
RBDR	648	520	392	317	205	147	205	117	117	88	88
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RoM, mln.m^3	**13.2**	**14.2**	**13.4**	**12.4**	**12.4**	**2.3**	**3.5**	**7.5**	**13.0**	**8.9**	**3.8**
LBDR	0.5	0.5	0.4	0.4	0.4	0.3	0.5	0.4	4.1	6.9	1.8
RBDR	12.7	13.7	13.0	12.0	12.0	2.0	3.0	7.1	8.9	2.0	2.0
RoM, TJ	**103**	**120**	**103**	**100**	**114**	**82**	**124**	**106**	**207**	**282**	**139**
LBDR	16	18	15	13	15	11	16	14	139	234	61
RBDR	88	102	88	87	99	71	108	92	68	48	78
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RoM, mln.m^3	**4.2**	**5.2**	**6.8**	**17.0**	**29.0**	**26.0**	**28.0**	**22.0**	**14.0**	**42.0**	**23.0**
LBDR	2.2	3.2	4.8	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
RBDR	2.0	2.0	2.0	12.0	24.0	21.0	23.0	17.0	9.0	37.0	18.0
RoM, TJ	**152**	**173**	**222**	**293**	**979**	**907**	**931**	**738**	**462**	**1 424**	**772**
LBDR	74	108	163	169	169	169	169	169	169	169	169
RBDR	78	65	59	124	810	738	762	569	293	1 255	603

Table 3-115: LPG consumption in the RoM within source category 1A3b 'Road Transportation', presented separately for the RBDR and LBDR

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM, kt	**13.00**	**9.47**	**8.93**	**10.02**	**7.10**	**4.72**	**4.83**	**5.94**	**3.47**	**3.30**	**2.48**
LBDR	1.68	1.58	1.50	1.62	1.10	0.72	0.83	0.94	0.81	0.92	1.03
RBDR	11.32	7.88	7.44	8.40	6.00	4.00	4.00	5.00	2.66	2.38	1.45
RoM, TJ	**460.60**	**436.07**	**411.53**	**461.63**	**314.77**	**209.31**	**243.11**	**278.23**	**242.33**	**277.49**	**311.22**
LBDR	77.20	72.97	68.92	74.63	50.77	33.31	38.11	43.23	37.33	42.49	47.22
RBDR	383.40	363.09	342.62	387.00	264.00	176.00	205.00	235.00	205.00	235.00	264.00
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RoM, kt	**1.50**	**2.16**	**7.10**	**5.79**	**5.82**	**5.73**	**6.96**	**11.53**	**11.47**	**14.89**	**10.96**
LBDR	0.68	0.87	1.10	0.79	0.82	0.73	0.96	1.53	1.47	1.89	0.96
RBDR	0.82	1.29	6.00	5.00	5.00	5.00	6.00	10.00	10.00	13.00	10.00
RoM, TJ	**207**	**270**	**344**	**272**	**287**	**255**	**340**	**546**	**529**	**685**	**499**
LBDR	31	40	51	36	38	33	44	70	68	87	44
RBDR	176	230	293	236	249	222	296	476	461	598	455

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
RoM, kt	**13.79**	**13.71**	**13.56**	**14.54**	**13.66**	**13.37**	**12.40**	**12.41**	**11.53**	**10.48**	**9.48**
LBDR	0.79	0.71	0.56	0.54	0.66	0.37	0.40	0.41	0.53	0.48	0.48
RBDR	13.00	13.00	13.00	14.00	13.00	13.00	12.00	12.00	11.00	10.00	9.00
RoM, TJ	**632**	**623**	**613**	**654**	**575**	**604**	**566**	**554**	**524**	**518**	**625**
LBDR	37	33	26	25	30	17	18	19	24	22	22
RBDR	595	590	587	629	545	587	548	535	500	496	603

Aggregated fuel consumption within source category 1A3b 'Road Transportation' between 1990 and 2022 is presented in energy units in Table 3-116.

Table 3-116: Aggregated fuel consumption within source category 1A3b 'Road Transportation' between 1990-2022, TJ

	RBDR				LBDR				Republic of Moldova				
	Gasoline	Diesel	Natural gas	LPG	Gasoline	Diesel	Natural gas	LPG	Gasoline	Diesel	Natural gas	LPG	Total
1990	28,568	18,661	648	383	5,752	3,757	130	77	34,320	22,419	779	461	57,978
1991	21,688	14,617	520	363	4,359	2,938	105	73	26,047	17,555	625	436	44,663
1992	14,796	10,565	392	343	2,978	2,126	79	69	17,774	12,691	471	412	31,348
1993	9,501	7,828	317	387	1,916	1,578	62	75	11,417	9,406	379	462	21,664
1994	9,037	6,787	205	264	1,739	1,306	39	51	10,776	8,093	244	315	19,429
1995	9,593	6,632	147	176	1,846	1,276	28	33	11,439	7,908	175	209	19,732
1996	9,095	6,187	205	205	1,727	1,175	38	38	10,822	7,362	243	243	18,670
1997	8,474	7,223	117	235	1,581	1347	22	43	10,055	8,570	139	278	19,042
1998	8,861	5,440	117	205	1,626	998	21	37	10,487	6,438	138	242	17,306
1999	5,076	4,291	88	235	926	783	16	43	6,002	5,074	104	278	11,457
2000	5,016	5,437	88	264	909	985	16	47	5,925	6,421	104	311	12,761
2001	5,487	6,190	88	176	984	1,110	16	31	6,471	7,300	103	207	14,081
2002	7,012	7,907	102	230	1,242	1,401	18	40	8,254	9,308	120	270	17,952
2003	8,353	9,297	88	293	1,463	1,628	15	51	9,816	10,925	103	344	21,188
2004	9,106	10,579	87	236	1,575	1,830	13	36	10,681	12,409	100	272	23,463
2005	9,363	10,766	99	249	1,469	1,689	15	39	10,832	12,455	114	288	23,689
2006	8,584	10,751	71	222	1,359	1,701	11	35	9,943	12,452	82	257	22,733
2007	8,778	11,705	108	296	1,402	1,869	17	47	10,180	13,575	125	343	24,222
2008	8,992	12,632	92	476	1,449	2,035	15	76	10,441	14,666	107	552	25,765
2009	8,990	12,607	68	461	1,465	2,054	139	74	10,455	14,661	207	535	25,858
2010	8,557	15,282	48	598	1,413	2,523	234	98	9,970	17,805	282	696	28,752
2011	8,993	16,535	78	455	1,507	2,771	61	44	10,500	19,307	139	499	30,445
2012	7,280	14,735	78	595	1,239	2,508	74	37	8,519	17,242	152	632	26,545
2013	6,982	16,478	65	590	1,209	2,852	176	33	8,191	19,330	241	623	28,384
2014	6,889	17,252	59	587	1,213	3,037	163	26	8,102	20,289	222	613	29,225
2015	7,112	18,125	124	629	1,252	3,190	169	25	8364	21,315	293	654	30,626
2016	7,238	19,474	810	545	1,216	3,272	169	30	8,454	22,746	979	575	32,755
2017	6,966	20,047	738	587	1,179	3,394	169	17	8,145	23,441	907	604	33,098
2018	7,373	20,760	762	548	1,266	3,566	169	18	8,639	24,326	931	566	34,463
2019	7,637	21,510	569	535	1,325	3,731	169	19	8,962	25,241	738	554	35,494
2020	6,777	20,877	293	500	1,194	3,678	169	24	7,971	24,556	462	524	33,513
2021	8,122	22,113	1,255	496	1,437	3,903	169	22	9,559	26,016	1,424	518	37,518
2022	7,547	23,148	408	603	1,333	4,088	169	22	8,880	27,235	577	625	37,317

Aggregated fuel consumption within source category 1A3b 'Road Transportation' between 1990 and 2022 is presented in natural units in Table 3-117.

Gasoline and diesel consumption allocated in the Energy Balances to category 1A2 'Manufacturing Industries and Construction' has been reallocated to source category 1A3b 'Road Transportation' as they are consumed on national roads for transportation purposes (Table 3-118).

Table 3-117: Total fuel consumption within source category 1A3b 'Road Transportation' between 1990 and 2022, kt/million m^3 (for natural gas)

	RBDR				LBDR				Republic of Moldova			
	Gasoline	Diesel	Natural gas	LPG	Gasoline	Diesel	Natural gas	LPG	Gasoline	Diesel	Natural gas	LPG
1990	653	439	9.1	11.3	132	88	3.9	1.7	785	527	13.0	13.0
1991	496	344	6.4	7.9	100	69	3.1	1.6	596	413	9.5	9.5
1992	338	248	6.6	7.4	68	50	2.3	1.5	407	298	8.9	8.9
1993	217	173	11.8	8.4	42	35	1.8	1.6	258	209	13.6	10.0
1994	206	104	7.3	6.0	40	31	1.2	1.1	246	135	8.5	7.1
1995	218	123	6.8	4.0	42	30	0.8	0.7	260	153	7.6	4.7
1996	208	115	9.4	4.0	39	27	1.1	0.8	247	142	10.5	4.8
1997	239	116	10.5	2.6	36	31	0.6	0.9	275	147	11.1	3.6
1998	203	101	10.9	2.7	37	23	0.6	0.8	240	124	11.5	3.5
1999	117	85	10.8	2.4	21	18	0.5	0.9	138	103	11.3	3.3
2000	116	110	12.3	1.5	21	23	0.5	1.0	137	133	12.8	2.5
2001	125	120	12.7	0.8	22	26	0.5	0.7	147	146	13.2	1.5
2002	162	147	13.7	1.3	28	32	0.5	0.9	190	180	14.2	2.2
2003	191	202	13.0	6.0	33	38	0.4	1.1	224	239	13.4	7.1
2004	208	242	12.0	5.0	32	38	0.4	0.8	240	280	12.4	5.8
2005	215	245	12.0	5.0	33	38	0.4	0.8	248	284	12.4	5.8
2006	196	244	2.0	5.0	30	38	0.3	0.7	226	282	2.3	5.7
2007	201	268	3.0	6.0	30	41	0.5	1.0	231	309	3.5	7.0
2008	206	289	7.1	10.0	30	44	0.4	1.5	236	333	7.5	11.5
2009	206	277	8.9	10.0	30	43	4.1	1.5	236	320	13.0	11.5
2010	196	367	2.0	13.0	28	52	6.9	1.9	224	419	8.9	14.9
2011	205	396	2.0	10.0	30	56	1.8	1.0	235	452	3.8	11.0
2012	167	355	2.0	13.0	24	50	2.2	0.8	191	404	4.2	13.8
2013	161	390	2.0	13.0	23	55	3.2	0.7	184	445	5.2	13.7
2014	159	393	2.0	13.0	27	71	4.8	0.6	186	464	6.8	13.6
2015	162	414	12.0	14.0	27	71	5.0	0.5	189	485	17.0	14.5
2016	166	444	24.0	13.0	28	76	5.0	0.7	194	520	29.0	13.7
2017	160	457	21.0	13.0	27	79	5.0	0.4	187	536	26.0	13.4
2018	169	467	23.0	12.0	29	83	5.0	0.4	198	550	28.0	12.4
2019	175	485	17.0	12.0	30	88	5.0	0.4	205	573	22.0	12.4
2020	154	490	9.0	11.0	27	86	5.0	0.5	181	576	14.0	11.5
2021	186	526.2	37	10	33	92	5.0	0,5	219	618	42.0	10.5
2022	172	543.9	18	9	30	96	5.0	0,5	202	640	23.0	9.5

Table 3-118: Gasoline and Diesel consumption realloacted from 1A2 'Manufacturing Industries and Construction' to 1A3b 'Road Transportation'

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline, TJ	568	390	211	33	29	29	29	29	NO	NO	NO
Diesel, TJ	3,446	2,566	1,687	807	754	765	623	557	353	205	205
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Gasoline, TJ				16	23	18	21	20	13	12	16
Diesel, TJ	205	205	205	287	322	366	328	324	217	271	270
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Gasoline, TJ	9	NO	11	14	16	12	13	8	7	11	9
Diesel, TJ	291	313	264	207	213	201	407	376	527	535	393

Consumption of kerosene and other petroleum products has been reallocated from source category 1A3b 'Road Transportation' to source category 1A3a 'Civil Aviation' (Table 3-119)

Table 3-119: Consumption of kerosene and other petroleum products reallocated from source category 1A3b 'Road Transportation' to source category 1A3a 'Civil Aviation'

	1993	1999	2000	2005	2007	2010	2011	2012
Kerosene, TJ	41	29	29	14	15	3	1	NO
Other petroleum products, TJ	NO	NO	NO	NO	NO	1	NO	2

The weight distribution of fuel types by vehicle categories 1A3bi Cars (M1), 1A3bii Light duty trucks (N1), 1A3biii Heavy duty trucks (N2-N3) and Buses (M2-M3), 1A3biv Motorcycles (L1-L7) is presented in Table 3-120.

Table 3-120: Furl distribution by category: 1A3b.i, 1A3b.ii, 1A3b.iii, 1A3b.iv, %

	1.A.3.b.i.				1.A.3.b.ii.				1.A.3.b.iii.				1.A.3.b.iv.		
	Gasoline	Diesel	LPG	Gas	Gasoline	Diesel	LPG	Gas	Gasoline	Diesel	LPG	Gas	Gaso-line	Diesel	Gas
1990	78.6	43.4	91.1	74.1	4.8	10.8	4.3	1.0	10.3	45.5	4.6	24.9	6.3	0.3	0.0
1991	78.8	43.8	90.6	74.7	5.1	11.4	5.1	1.2	10.0	44.5	4.4	24.1	6.1	0.3	0.0
1992	79.0	44.1	90.0	75.2	5.3	12.0	5.8	1.4	9.7	43.5	4.2	23.4	6.0	0.3	0.0
1993	79.2	44.5	89.4	75.7	5.6	12.6	6.6	1.6	9.4	42.5	4.0	22.7	5.8	0.3	0.0
1994	79.4	44.9	88.9	76.3	5.9	13.3	7.4	1.8	9.1	41.6	3.7	22.0	5.7	0.3	0.0
1995	79.5	45.2	88.3	76.8	6.1	13.9	8.1	2.0	8.8	40.6	3.5	21.2	5.5	0.3	0.0
1996	79.2	44.8	87.2	76.9	6.8	15.1	9.4	2.3	8.6	39.8	3.4	20.8	5.4	0.3	0.0
1997	78.9	44.5	86.1	77.0	7.4	16.3	10.6	2.6	8.4	38.9	3.3	20.3	5.2	0.3	0.0
1998	78.7	44.1	84.9	77.1	8.1	17.6	11.9	3.0	8.2	38.1	3.2	19.9	5.1	0.3	0.0
1999	78.4	43.7	83.8	77.2	8.7	18.8	13.2	3.3	8.0	37.3	3.0	19.5	5.0	0.2	0.0
2000	78.1	43.3	82.7	77.2	9.3	20.0	14.4	3.7	7.8	36.5	2.9	19.0	4.8	0.2	0.0
2001	77.7	43.0	81.6	77.4	10.0	21.2	15.6	4.1	7.5	35.5	2.8	18.4	4.7	0.2	0.0
2002	77.4	42.8	80.5	77.7	10.7	22.5	16.9	4.5	7.2	34.5	2.6	17.8	4.7	0.2	0.0
2003	77.1	42.6	79.4	77.9	11.4	23.7	18.1	4.9	6.9	33.5	2.5	17.2	4.6	0.2	0.0
2004	76.8	42.3	78.4	78.1	12.1	24.9	19.3	5.3	6.6	32.6	2.3	16.6	4.5	0.2	0.0
2005	77.7	43.6	79.1	79.1	11.7	24.4	18.7	5.1	6.2	31.9	2.2	15.7	4.4	0.2	0.0
2006	78.4	44.7	79.8	79.9	11.3	23.8	18.1	5.0	6.0	31.3	2.1	15.1	4.3	0.2	0.0
2007	82.5	45.7	80.4	80.5	11.4	23.2	17.5	4.9	6.0	31.1	2.0	14.7	0.0	0.0	0.0
2008	83.0	46.5	81.0	81.0	11.1	22.7	17.0	4.7	5.9	30.8	2.0	14.3	0.0	0.0	0.0
2009	83.2	46.9	81.2	81.2	11.0	22.5	16.8	4.7	5.8	30.6	2.0	14.1	0.0	0.0	0.0
2010	79.0	47.0	81.4	81.4	10.3	22.3	16.7	4.6	5.4	30.5	1.9	13.9	5.3	0.2	0.0
2011	78.9	47.2	81.6	81.5	10.2	22.0	16.5	4.6	5.4	30.6	1.9	13.9	5.5	0.2	0.0
2012	78.8	47.3	81.7	81.6	10.1	21.9	16.4	4.6	5.3	30.6	1.9	13.8	5.7	0.2	0.0
2013	78.7	47.4	81.8	81.7	10.0	21.7	16.3	4.5	5.3	30.7	1.9	13.7	6.0	0.2	0.0
2014	85.7	40.0	95.4	75.1	3.1	30.8	2.1	4.8	5.3	28.8	2.5	20.0	5.9	0.4	0.0
2015	85.6	40.9	95.3	79.0	3.1	30.5	2.3	4.5	5.2	28.1	2.4	16.5	6.1	0.5	0.0
2016	73.7	33.1	81.7	68.8	3.3	29.6	2.3	4.3	18.7	35.8	16.0	26.8	4.3	1.5	0.1
2017	86.5	48.5	96.1	85.6	2.8	31.0	2.1	4.2	3.9	20.0	1.8	10.1	6.8	0.5	0.1
2018	82.8	43.1	94.7	79.5	3.3	19.6	1.3	2.2	8.0	37.2	4.1	18.3	5.9	0.2	0.0
2019	82.6	44.0	94.5	80.3	3.3	19.2	1.2	2.2	8.0	36.6	4.2	17.5	6.0	0.2	0.0
2020	82.6	44.0	94.5	80.3	3.3	19.2	1.2	2.2	8.0	36.6	4.2	17.5	6.0	0.2	0.0
2021	83.1	50.4	96.1	87.6	5.9	34.0	3.7	11.3	1.0	15.0	0.1	1.1	10.0	0.7	0.0
2022	82.6	44.0	94.5	80.3	3.3	19.2	1.2	2.2	8.0	36.6	4.2	17.5	6.0	0.2	0.0

Source: Calculations were made based on the information presented by the Public Services Agency (PSA), in response to requests from the Environment Agency.

Recalculations

In the current inventory cycle, insignificant recalculations of GHG emissions from source category 1A3b 'Road Transportation' are associated with correcting activity data related to the updated population of the RoM and utilising GWP values for the 100-year horizon, available in the IPCC AR5 (2014), instead of those available in the IPCC AR4 (2007): for CH_4 – 28 (instead of 25), for N_2O – 265 (instead of 298) (Table 3-121).

Table 3-121: Recalculations of GHG emissions for 1990-2020, included in the NC5 of the RoM to the UNFCCC (1A3b 'Road Transportation'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	4,204.86	3,239.60	2,274.32	1,572.63	1,410.74	1,432.96	1,354.11	1,386.73	1,254.48	833.10	931.31
BTR1	4,202.23	3,237.56	2,272.88	1,571.60	1,409.82	1,432.02	1,353.26	1,385.74	1,253.72	832.54	930.59
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	1,029.59	1,312.70	1,549.37	1,717.89	1,733.86	1,666.46	1,775.89	1,888.96	1,894.40	2,111.45	2,241.84
BTR1	1,028.75	1,311.63	1,548.11	1,716.44	1,732.41	1,665.00	1,774.32	1,887.29	1,892.75	2,109.47	2,239.62
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	1,954.80	2,093.44	2,157.63	2,260.49	2,410.33	2,438.36	2,539.14	2,618.72	2,478.43		
BTR1	1,952.86	2,091.28	2,155.35	2,258.11	2,407.89	2,435.84	2,536.51	2,615.94	2,475.68	2,755.24	2,755.25
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1		

Abbreviations: BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC; NC5 – Fifth National Communication of the RoM to the UNFCCC.

Category 1A3c 'Railways'

GHG emission trends from source category 1A3c 'Railways'

Aggregated direct GHG emissions from source category 1A3c 'Railways' had decreased between 1990 and 2022 by circa 95.3% (Table 3-122).

Table 3-122: Direct GHG emissions from source category 1A3c 'Railways' between 1990-2022 and their share compared to 1990-year level

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A3c, kt CO_2 equivalent	445.37	393.66	327.04	302.53	120.17	105.92	102.77	88.32	65.34	34.04	36.81
%, compared to 1990	100.0	88.4	73.4	67.9	27.0	23.8	23.1	19.8	14.7	7.6	8.3
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A3c, kt CO_2 equivalent	39.57	90.11	47.87	66.20	89.43	111.79	112.50	103.42	56.65	57.66	53.20
%, compared to 1990	8.9	20.2	10.7	14.9	20.1	25.1	25.3	23.2	12.7	12.9	11.9
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A3c, kt CO_2 equivalent	57.33	36.75	3.08	24.82	51.78	41.80	22.62	27.07	21.02	18.09	20.88
%, compared to 1990	12.9	8.3	0.7	5.6	11.6	9.4	5.1	6.1	4.7	4.1	4.7

Direct and indirect GHG emissions between 1990-2022 from source category 1A3c 'Railways' compared to the level in the base year (1990) are shown in Table 3-123.

Table 3-123: Direct and indirect GHG emissions from source category 1A3c 'Railways' and their share compared to the 1990-year level

	1A3c, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	403.47	0.02	0.16	6.71	1.37	0.60	0.10	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	356.63	0.02	0.14	5.74	1.17	0.51	0.09	88.4	88.4	88.4	85.5	85.5	85.5	85.5
1992	296.27	0.02	0.11	4.76	0.97	0.42	0.07	73.4	73.4	73.4	71.0	71.0	71.0	71.0
1993	274.07	0.02	0.11	4.56	0.93	0.40	0.07	67.9	67.9	67.9	67.9	67.9	67.9	67.9
1994	108.86	0.01	0.04	1.81	0.37	0.16	0.03	27.0	27.0	27.0	27.0	27.0	27.0	27.0
1995	95.96	0.01	0.04	1.60	0.33	0.14	0.02	23.8	23.8	23.8	23.8	23.8	23.8	23.8
1996	93.11	0.01	0.04	1.55	0.32	0.14	0.02	23.1	23.1	23.1	23.1	23.1	23.1	23.1
1997	80.01	0.00	0.03	1.33	0.27	0.12	0.02	19.8	19.8	19.8	19.8	19.8	19.8	19.8
1998	59.20	0.00	0.02	0.98	0.20	0.09	0.02	14.7	14.7	14.7	14.7	14.7	14.7	14.7
1999	30.84	0.00	0.01	0.51	0.10	0.05	0.01	7.6	7.6	7.6	7.6	7.6	7.6	7.6
2000	33.35	0.00	0.01	0.55	0.11	0.05	0.01	8.3	8.3	8.3	8.3	8.3	8.3	8.3
2001	35.85	0.00	0.01	0.60	0.12	0.05	0.01	8.9	8.9	8.9	8.9	8.9	8.9	8.9
2002	81.63	0.00	0.03	1.36	0.28	0.12	0.02	20.2	20.2	20.2	20.2	20.2	20.2	20.2
2003	43.36	0.00	0.02	0.72	0.15	0.06	0.01	10.7	10.7	10.7	10.7	10.7	10.7	10.7
2004	59.97	0.00	0.02	1.00	0.20	0.09	0.02	14.9	14.9	14.9	14.9	14.9	14.9	14.9
2005	81.01	0.00	0.03	1.35	0.28	0.12	0.02	20.1	20.1	20.1	20.1	20.1	20.1	20.1
2006	101.28	0.01	0.04	1.68	0.34	0.15	0.03	25.1	25.1	25.1	25.1	25.1	25.1	25.1
2007	101.92	0.01	0.04	1.69	0.35	0.15	0.03	25.3	25.3	25.3	25.3	25.3	25.3	25.3
2008	93.69	0.01	0.04	1.56	0.32	0.14	0.02	23.2	23.2	23.2	23.2	23.2	23.2	23.2
2009	51.32	0.00	0.02	0.85	0.17	0.08	0.01	12.7	12.7	12.7	12.7	12.7	12.7	12.7
2010	52.23	0.00	0.02	0.87	0.18	0.08	0.01	12.9	12.9	12.9	12.9	12.9	12.9	12.9
2011	48.19	0.00	0.02	0.80	0.16	0.07	0.01	11.9	11.9	11.9	11.9	11.9	11.9	11.9
2012	51.94	0.00	0.02	0.86	0.18	0.08	0.01	12.9	12.9	12.9	12.9	12.9	12.9	12.9
2013	33.29	0.00	0.01	0.55	0.11	0.05	0.01	8.3	8.3	8.3	8.3	8.3	8.3	8.3
2014	2.79	0.00	0.00	0.05	0.01	0.00	0.00	0.7	0.7	0.7	0.7	0.7	0.7	0.7
2015	22.48	0.00	0.01	0.37	0.08	0.03	0.01	5.6	5.6	5.6	5.6	5.6	5.6	5.6
2016	46.91	0.00	0.02	0.78	0.16	0.07	0.01	11.6	11.6	11.6	11.6	11.6	11.6	11.6
2017	37.86	0.00	0.01	0.63	0.13	0.06	0.01	9.4	9.4	9.4	9.4	9.4	9.4	9.4

	1A3c, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
2018	20.49	0.00	0.01	0.34	0.07	0.03	0.01	5.1	5.1	5.1	5.1	5.1	5.1	5.1
2019	24.53	0.00	0.01	0.43	0.09	0.04	0.01	6.1	6.1	6.1	6.4	6.4	6.4	6.4
2020	19.04	0.00	0.01	0.30	0.06	0.03	0.00	4.7	4.7	4.7	4.5	4.5	4.5	4.5
2021	16.39	0.00	0.01	0.30	0.06	0.03	0.00	4.1	4.1	4.1	4.5	4.5	4.5	4.5
2022	18.92	0.00	0.01	0.31	0.06	0.03	0.00	4.7	4.7	4.7	4.6	4.6	4.6	4.6

Direct GHG emission trend from source category 1A3c 'Railways' for the period 1990-2022 and the contribution of each direct GHG is shown in Table 3-124.

Table 3-124: Direct GHG emissions from 1A3c 'Railways' between 1990-2022 and the contribution of each GHG in the structure of emissions at source category level

	1A3c, kt CO_2 equivalent				Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	403.47	0.63	41.27	445.37	90.6	0.1	9.3
1991	356.63	0.56	36.48	393.66	90.6	0.1	9.3
1992	296.27	0.46	30.30	327.04	90.6	0.1	9.3
1993	274.07	0.43	28.03	302.53	90.6	0.1	9.3
1994	108.86	0.17	11.13	120.17	90.6	0.1	9.3
1995	95.96	0.15	9.81	105.92	90.6	0.1	9.3
1996	93.11	0.15	9.52	102.77	90.6	0.1	9.3
1997	80.01	0.13	8.18	88.32	90.6	0.1	9.3
1998	59.20	0.09	6.05	65.34	90.6	0.1	9.3
1999	30.84	0.05	3.15	34.04	90.6	0.1	9.3
2000	33.35	0.05	3.41	36.81	90.6	0.1	9.3
2001	35.85	0.06	3.67	39.57	90.6	0.1	9.3
2002	81.63	0.13	8.35	90.11	90.6	0.1	9.3
2003	43.36	0.07	4.44	47.87	90.6	0.1	9.3
2004	59.97	0.09	6.13	66.20	90.6	0.1	9.3
2005	81.01	0.13	8.29	89.43	90.6	0.1	9.3
2006	101.28	0.16	10.36	111.79	90.6	0.1	9.3
2007	101.92	0.16	10.42	112.50	90.6	0.1	9.3
2008	93.69	0.15	9.58	103.42	90.6	0.1	9.3
2009	51.32	0.08	5.25	56.65	90.6	0.1	9.3
2010	52.23	0.08	5.34	57.66	90.6	0.1	9.3
2011	48.19	0.08	4.93	53.20	90.6	0.1	9.3
2012	51.94	0.08	5.31	57.33	90.6	0.1	9.3
2013	33.29	0.05	3.41	36.75	90.6	0.1	9.3
2014	2.79	0.00	0.29	3.08	90.6	0.1	9.3
2015	22.48	0.04	2.30	24.82	90.6	0.1	9.3
2016	46.91	0.07	4.80	51.78	90.6	0.1	9.3
2017	37.86	0.06	3.87	41.80	90.6	0.1	9.3
2018	20.49	0.03	2.10	22.62	90.6	0.1	9.3
2019	24.53	0.04	2.51	27.07	90.6	0.1	9.3
2020	19.04	0.03	1.95	21.02	90.6	0.1	9.3
2021	16.39	0.03	1.68	18.09	90.6	0.1	9.3
2022	18.92	0.03	1.94	20.88	90.6	0.1	9.3

Methodologies and Emission Factors

GHG emissions originating from source category 1A3c 'Railways' were estimated following the Tier 1 methodology available in the 2006 IPCC Guidelines, based on default EFs, whereas for non-CO_2 emissions, default EFs available in the EMEP/EEA Guidebook (2023) (Table 3-125).

Table 3-125: Default EFs utilised in the estimation of GHG emissions from 1A3c 'Railways'

Type of fuel	kg/TJ			kg/t			
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
Diesel	74,100	4.15	28.6	52.4	10.7	4.65	formula
References	2006 IPCC Guidelines, Chapter 1A Mobile Combustion – CO_2, CH_4, Table 3.4.1, p. 3.43			2023 EMEP/EEA Guidebook, Chapter 1.A.3.c 'Railways', Table 3-1, p. 8			

Activity Data

Compared to the previous inventory cycle, the following changes occurred in the current cycle: the series of activity data was extended by another two years (2021-2022), and the data regarding the population on both banks of the Dniester River has been updated.

For category 1A3c 'Railways', fuel consumption for the territory on the RBDR is available in the EBs of the RoM. For the territory on the LBDR, fuel consumption was restored based on specific consumption per capita on the RBDR (Table 3-126).

Table 3-126: Diesel consumption from source category 1A3c 'Railways' between 1990-2022, aggregated for the entire country and separately, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RBDR	4,349	3,877	3,220	3,078	1,232	1,086	1,056	910	675	352	381
LBDR	1,096	936	778	621	237	209	200	170	124	64	69
RoM - total	**5,445**	**4,813**	**3,998**	**3,699**	**1,469**	**1,295**	**1,256**	**1,080**	**799**	**416**	**450**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RBDR	410	936	498	690	945	1,180	1,186	1,089	596	605	557
LBDR	74	166	87	119	148	187	189	175	97	100	93
RoM - total	**484**	**1,102**	**585**	**809**	**1,093**	**1,367**	**1,375**	**1,264**	**693**	**705**	**650**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RBDR	599	383	32	258	542	437	236	282	227	188	217
LBDR	102	66	6	45	91	74	41	49	30	33	38
RoM - total	**701**	**449**	**38**	**303**	**633**	**511**	**277**	**331**	**257**	**221**	**255**

Calculation methodology of SO_2 emissions

SO_2 emissions have been calculated based on the estimation methodology available in the EMEP/EEA Air Pollutant Emission Inventory (2023) applying the following equation:

$$E_{SO2} = 2 \bullet k \bullet AD,$$

Where:

k – sulphur content in type m fuel [g/g fuel] (EMEP/EEA Guidebook 2023, source category 1A3bi, Table 3-13, p. 24), when:

- for the period 1990-1995 and 1996-2000, the value k – 165 / 1,000,000 grams of sulphur / grams of gasoline and k – 400 / 1000000 grams of sulphur / grams of diesel;
- for the period 2001-2005, the value k – 130 / 1,000,000 grams of sulphur / grams of gasoline and k – 300 / 1000000 grams of sulphur / grams of diesel;
- for the period 2006-2009, the value k – 40 / 1,000,000 grams of sulphur / grams of gasoline and k – 40 / 1000000 grams of sulphur / grams of diesel;
- for the period 2010-2019, the value k – 40 / 1,000,000 grams of sulphur / grams of gasoline and k – 8 /1,000,000 grams of sulphur / grams of diesel.

SO_2 emissions from source category 1A3c 'Railways' for the period 1990-2022, are shown on aggregate as well as separately for the RBDR and LBDR in Table 3-127.

Table 3-127: SO_2 emissions from source category 1A3c 'Railways' between 1990-2022, aggregated for the entire coutnry, and separately, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RBDR	0.0852	0.0729	0.0605	0.0579	0.0232	0.0204	0.0199	0.0171	0.0127	0.0066	0.0072
LBDR	0.0172	0.0147	0.0122	0.0117	0.0045	0.0039	0.0038	0.0032	0.0023	0.0012	0.0013
RoM - total	**0.1024**	**0.0876**	**0.0727**	**0.0696**	**0.0276**	**0.0244**	**0.0236**	**0.0203**	**0.0150**	**0.0078**	**0.0085**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RBDR	0.0077	0.0176	0.0094	0.0130	0.0178	0.0222	0.0223	0.0205	0.0112	0.0114	0.0105
LBDR	0.0014	0.0031	0.0016	0.0022	0.0028	0.0035	0.0036	0.0033	0.0018	0.0019	0.0018
RoM - total	**0.0091**	**0.0207**	**0.0110**	**0.0152**	**0.0206**	**0.0257**	**0.0259**	**0.0238**	**0.0130**	**0.0133**	**0.0122**

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
RBDR	0.0113	0.0072	0.0006	0.0049	0.0102	0.0082	0.0044	0.0056	0.0040	0.0040	0.0040
LBDR	0.0019	0.0012	0.0001	0.0009	0.0017	0.0014	0.0008	0.0009	0.0006	0.0006	0.0007
RoM - total	**0.0132**	**0.0084**	**0.0007**	**0.0057**	**0.0119**	**0.0096**	**0.0052**	**0.0065**	**0.0046**	**0.0046**	**0.0047**

Recalculations

In the current inventory cycle, insignificant recalculations of GHG emissions from source category 1A3c 'Railways' are associated with correcting activity data related to the updated population of the RoM and utilising GWP values for the 100-year horizon, available in the IPCC AR5 (2014), instead of those available in the IPCC AR4 (2007), for CH_4 – 28 (instead of 25), for N_2O – 265 (instead of 298) (Table 3-128).

Table 3-128: Recalculation results of GHG emissions for the period 1990-2020, included in the NC5 of the RoM to the UNFCCC (1A3c 'Railways'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	450.45	398.15	330.76	305.98	121.53	107.13	103.94	89.32	66.09	34.43	37.23
BTR1	445.37	393.66	327.04	302.53	120.17	105.92	102.77	88.32	65.34	34.04	36.81
Difference, %	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	40.02	91.14	48.41	66.95	90.44	113.07	113.78	104.60	57.29	58.31	53.80
BTR1	39.57	90.11	47.87	66.20	89.43	111.79	112.50	103.42	56.65	57.66	53.20
Difference, %	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	57.99	37.17	3.11	25.10	52.37	42.27	22.88	27.38	21.26		
BTR1	57.33	36.75	3.08	24.82	51.78	41.80	22.62	27.07	21.02	18.09	20.88
Difference, %	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1	-1.1		

Abbreviations: BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC; NC5 – Fifth National Communication of the RoM to the UNFCCC.

Category 1A3dii "Water-borne Navigation"

GHG emission trends within source category 1A3d 'Water-borne Navigation'

Compared to the base year, emissions from this source category had decreased by circa 99.1% by 2022 (Table 3-129).

Table 3-129: Aggregated GHG emissions from source category 1A3d 'Water-borne Navigation' between 1990-2022 and their share compared to the 1990 year level, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A3d, kt CO_2 equivalent	19.10	0.29	0.25	0.28	0.22	0.22	0.23	0.25	0.16	0.26	0.12
%, compared to 1990	100.0	1.5	1.3	1.5	1.2	1.1	1.2	1.3	0.8	1.4	0.6
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1A3d, kt CO_2 equivalent	0.21	0.49	0.44	0.44	0.26	0.52	0.34	0.34	0.34	0.26	0.26
%, compared to 1990	1.1	2.5	2.3	2.3	1.4	2.7	1.8	1.8	1.8	1.3	1.3
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
1A3d, kt CO_2 equivalent	0.26	0.26	2.37	2.44	1.83	1.75	1.58	1.84	0.62	0,35	0,18
%, compared to 1990	1.3	1.3	12.4	12.8	9.6	9.2	8.3	9.7	3.2	1.8	0.9

Direct and indirect GHG emissions from source category 1A3d 'Water-borne Navigation' for the period 1990-2022 compared to 1990 levels are shown in Table 3-130.

Table 3-130: Direct and indirect GHG emissions originating from source category 1A3d 'Water-borne Navigation' and their share compared to the 1990 year level

	1A3d, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	18.9103	0.0018	0.0005	0.0004	0.0000	0.0000	0.0000	100.00	100.00	100.00	100.00	100.00	100.00	100.00
1991	0.2877	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.52	1.52	1.52	1.52	1.52	1.52	1.52
1992	0.2461	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.30	1.30	1.30	1.30	1.30	1.30	1.30
1993	0.2820	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.49	1.49	1.49	1.49	1.49	1.49	1.49

	1A3d, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1994	0.2217	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.17	1.17	1.17	1.17	1.17	1.17	1.17
1995	0.2137	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.13	1.13	1.13	1.13	1.13	1.13	1.13
1996	0.2318	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.23	1.23	1.23	1.23	1.23	1.23	1.23
1997	0.2500	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.32	1.32	1.32	1.32	1.32	1.32	1.32
1998	0.1565	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.83	0.83	0.83	0.83	0.83	0.83	0.83
1999	0.2606	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.38	1.38	1.38	1.38	1.38	1.38	1.38
2000	0.1152	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.61	0.61	0.61	0.61	0.61	0.61	0.61
2001	0.2077	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.10	1.10	1.10	1.10	1.10	1.10	1.10
2002	0.4814	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.55	2.55	2.55	2.55	2.55	2.55	2.55
2003	0.4361	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.31	2.31	2.31	2.31	2.31	2.31	2.31
2004	0.4364	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.31	2.31	2.31	2.31	2.31	2.31	2.31
2005	0.2561	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.35	1.35	1.35	1.35	1.35	1.35	1.35
2006	0.5116	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	2.71	2.71	2.71	2.71	2.71	2.71	2.71
2007	0.3406	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.80	1.80	1.80	1.80	1.80	1.80	1.80
2008	0.3402	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.80	1.80	1.80	1.80	1.80	1.80	1.80
2009	0.3398	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.80	1.80	1.80	1.80	1.80	1.80	1.80
2010	0.2546	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.35	1.35	1.35	1.35	1.35	1.35	1.35
2011	0.2544	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.35	1.35	1.35	1.35	1.35	1.35	1.35
2012	0.2541	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.34	1.34	1.34	1.34	1.34	1.34	1.34
2013	0.2539	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.34	1.34	1.34	1.34	1.34	1.34	1.34
2014	2.3498	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	12.43	12.43	12.43	12.43	12.43	12.43	12.43
2015	2.4207	0.0002	0.0001	0.0001	0.0000	0.0000	0.0000	12.80	12.80	12.80	12.80	12.80	12.80	12.80
2016	1.8153	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	9.60	9.60	9.60	9.60	9.60	9.60	9.60
2017	1.7320	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	9.16	9.16	9.16	9.16	9.16	9.16	9.16
2018	1.5611	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	8.26	8.26	8.26	8.26	8.26	8.26	8.26
2019	1.8257	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	9.65	9.65	9.65	9.65	9.65	9.65	9.65
2020	0.6101	0.0001	0.0000	0.0000	0.0000	0.0000	0.0000	3.23	3.23	3.23	3.23	3.23	3.23	3.23
2021	0.3487	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	1.84	1.84	1.84	1.84	1.84	1.84	1.84
2022	0.1744	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.92	0.92	0.92	0.92	0.92	0.92	0.92

Direct GHG emissions from source category 1A3d 'Water-borne Navigation' between 1990 and 2022 are shown in Table 3-131.

Table 3-131: Direct GHG emissions from source category 1A3d 'Water-borne Navigation' for the Republic of Moldova, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2	18.9103	0.2877	0.2461	0.2820	0.2217	0.2137	0.2318	0.2500	0.1565	0.2606	0.1152
N_2O	0.0500	0.0008	0.0007	0.0007	0.0006	0.0006	0.0006	0.0007	0.0004	0.0007	0.0003
CH_4	0.1353	0.0021	0.0018	0.0020	0.0016	0.0015	0.0017	0.0018	0.0011	0.0019	0.0008
Total	**19.0956**	**0.2905**	**0.2485**	**0.2848**	**0.2239**	**0.2158**	**0.2340**	**0.2525**	**0.1580**	**0.2631**	**0.1163**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
CO_2	0.2077	0.4814	0.4361	0.4364	0.2561	0.5116	0.3406	0.3402	0.3398	0.2546	0.2544
N_2O	0.0005	0.0013	0.0012	0.0012	0.0007	0.0014	0.0009	0.0009	0.0009	0.0007	0.0007
CH_4	0.0015	0.0034	0.0031	0.0031	0.0018	0.0037	0.0024	0.0024	0.0024	0.0018	0.0018
Total	**0.2098**	**0.4861**	**0.4404**	**0.4407**	**0.2586**	**0.5166**	**0.3439**	**0.3435**	**0.3431**	**0.2571**	**0.2568**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
CO_2	0.2541	0.2539	2.3498	2.4207	1.8153	1.7320	1.5611	1.8257	0.6101	0.3487	0.1744
N_2O	0.0007	0.0007	0.0062	0.0064	0.0048	0.0046	0.0041	0.0048	0.0016	0.0009	0.0005
CH_4	0.0018	0.0018	0.0168	0.0173	0.0130	0.0124	0.0112	0.0131	0.0044	0.0025	0.0012
Total	**0.2566**	**0.2563**	**2.3729**	**2.4444**	**1.8331**	**1.7489**	**1.5764**	**1.8436**	**0.6161**	**0.3521**	**0.1761**

Methodologies and Emission Factors

Direct GHG emissions originating from category 1A3d 'Water-borne Navigation' were estimated following the Tier 1 methodology available in the 2006 IPCC Guidelines, based on AD on default emission factors. In order to estimate non-CO_2 emissions, default emission factors were used, available in the EMEP/EEA Guidebook (2023) (Table 3-132).

Table 3-132: Emission factors for direct and indirect GHG emissions originating from source category 1A3d 'Water-borne Navigation'

	kg/ TJ			kg/to			
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
Diesel	74,100	7	2	72.2	3.84	1.75	1.82
References	2006 IPCC Guidelines, for CO_2, CH_4, N_2O, Chapter 'Mobile Combustion', Chapter 3.5.2-3, p. 3.50			2023 EMEP/EEA Guidebook, Source category 1A3d 'Water-borne Navigation', Tab. 3-2, p. 17			

Activity Data

Compared to the previous inventory cycle, the following changes occurred in the current cycle:

- For the territory on the RBDR, two reference sources were used for the years 1990 and 2005-2022 – the activity data available in the EBs was applied, and for the years 1991-2004 – the activity data obtained through official letters at the requests of the MoEnv was applied;
- For the territory on the LBDR, the consumption of diesel for water-borne navigation for the period 1993-2020 was restored though indirect methods (based on the specific consumption per capita for the territory on the RBDR);
- Data regarding the population of the RBDR and LBDR territory has been updated;
- NO_x, CO, NMVOC, SO_x emission factors have been updated in accordance with the 2023 EMEP/EEA Guidebook, instead of those available in the 2019 EMEP/EEA Guidebook.

Table 3-133: Fuel consumption for source category 1A3d 'Water-borne Navigation' in 1990-2022

	TJ			kt			%	
	RBDR	LBDR	RoM – total	RBDR	LBDR	RoM – total	RBDR	LBDR
1990	212.40	42.80	255.20	4.99	1.01	6.00	83.2	16.8
1991	3.20	0.60	3.90	0.08	0.02	0.09	83.3	16.7
1992	2.80	0.60	3.30	0.07	0.01	0.08	83.3	16.8
1993	3.20	0.60	3.80	0.08	0.02	0.09	83.2	16.8
1994	2.50	0.50	3.00	0.06	0.01	0.07	83.9	16.1
1995	2.40	0.50	2.90	0.06	0.01	0.07	83.9	16.1
1996	2.60	0.50	3.10	0.06	0.01	0.07	84.0	16.0
1997	2.90	0.50	3.40	0.07	0.01	0.08	84.3	15.7
1998	1.80	0.30	2.10	0.04	0.01	0.05	84.5	15.5
1999	3.00	0.50	3.50	0.07	0.01	0.08	84.6	15.4
2000	1.30	0.20	1.60	0.03	0.01	0.04	84.7	15.3
2001	2.40	0.40	2.80	0.06	0.01	0.07	84.8	15.2
2002	5.50	1.00	6.50	0.13	0.02	0.15	85.0	15.1
2003	5.00	0.90	5.90	0.12	0.02	0.14	85.1	14.9
2004	5.10	0.90	6.00	0.12	0.02	0.14	85.3	14.7
2005	3.00	0.50	3.50	0.07	0.01	0.08	86.4	13.6
2006	6.00	0.90	6.90	0.14	0.02	0.16	86.3	13.7
2007	4.00	0.60	4.60	0.09	0.02	0.11	86.2	13.8
2008	4.00	0.60	4.60	0.09	0.02	0.11	86.1	13.9
2009	4.00	0.70	4.70	0.09	0.02	0.11	86.0	14.0
2010	3.00	0.50	3.50	0.07	0.01	0.08	85.8	14.2
2011	3.00	0.50	3.50	0.07	0.01	0.08	85.6	14.4
2012	3.00	0.50	3.50	0.07	0.01	0.08	85.5	14.5
2013	3.00	0.50	3.50	0.07	0.01	0.08	85.2	14.8
2014	27.00	4.80	31.80	0.64	0.11	0.75	85.0	15.0
2015	28.00	4.90	32.90	0.66	0.12	0.77	85.0	15.0
2016	21.00	3.50	24.50	0.49	0.08	0.58	85.6	14.4
2017	20.00	3.40	23.40	0.47	0.08	0.55	85.5	14.5
2018	18.00	3.10	21.10	0.42	0.07	0.50	85.3	14.7
2019	21.00	3.60	24.60	0.49	0.09	0.58	85.2	14.8
2020	7.00	1.20	8.20	0.17	0.03	0.19	85.2	14.8
2021	4.00	0.70	4.70	0.09	0.02	0.11	84.9	15.1
2022	2.00	0.35	2.35	0.05	0.01	0.06	85.0	15.0

Recalculations

In the current inventory cycle, insignificant recalculations of GHG emissions from source category 1A3d 'Water-borne Navigation' are associated with correcting activity data related to the updated population of the RoM and utilising GWP values for the 100-year horizon, available in the IPCC AR5 (2014), instead of those available in the IPCC AR4 (2007): for CH_4 – 28 (instead of 25), for N_2O – 265 (instead of 298) (Table 3-134). For the years 2021-2022, direct GHG emissions originating from source category 1A3d 'Water-borne Navigation' were estimated for the first time.

Table 3-134: Recalculations of GHG emissions for 1990-2020, included in the NC5 of the RoM to the UNFCCC (1A3dii 'Water-borne Navigation'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	19.11	0.29	0.25	0.28	0.22	0.22	0.23	0.25	0.16	0.26	0.12
BTR1	19.10	0.29	0.25	0.28	0.22	0.22	0.23	0.25	0.16	0.26	0.12
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.25	0.28	0.22	0.22	0.23	0.25	0.16	0.26	0.12	0.21	0.49
BTR1	0.25	0.28	0.22	0.22	0.23	0.25	0.16	0.26	0.12	0.21	0.49
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.26	0.26	2.37	2.45	1.83	1.75	1.58	1.84	0.62		
BTR1	0.26	0.26	2.37	2.44	1.83	1.75	1.58	1.84	0.62	0.30	0.15
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1		

Abbreviations: BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC; NC5 – Fifth National Communication of the RoM to the UNFCCC.

Source category 1A3e 'Other Transportation' (pipeline transport)

GHG emission trends from source category 1A3e 'Other Transportation' (Pipeline Transport)

Between 1990 and 2022, aggregated GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) had decreased by circa 99.6% (Table 3-135).

Table 3-135: Direct GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) between 1990-2022 and their share compared to the base year (1990)

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A3e, kt CO_2 equivalent	91.27	76.06	57.04	22.40	104.13	100.17	141.11	58.63	56.56	62.35	35.02
%, compared to 1990	100.0	83.3	62.5	24.5	114.1	109.8	154.6	64.2	62.0	68.3	38.4
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A3e, kt CO_2 equivalent	17.46	38.07	27.06	43.67	40.73	7.61	3.52	4.69	11.69	17.73	26.62
%, compared to 1990	19.1	41.7	29.6	47.8	44.6	8.3	3.9	5.1	12.8	19.4	29.2
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A3e, kt CO_2 equivalent	23.85	14.82	19.35	19.61	16.84	20.61	18.14	17.20	11.56	1.72	0.40
%, compared to 1990	26.1	16.2	21.2	21.5	18.4	22.6	19.9	18.8	12.7	1.9	0.4

Direct and indirect GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) had decreased significantly between 1990 and 2022 (Table 3-136).

Table 3-136: Direct and indirect GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) between 1990 and 2022, kt

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	91.1782	0.0016	0.0002	0.2844	0.0731	0.0026	NE
1991	75.9818	0.0014	0.0001	0.2370	0.0609	0.0022	NE
1992	56.9864	0.0010	0.0001	0.1778	0.0457	0.0016	NE
1993	22.3809	0.0004	0.0000	0.0698	0.0180	0.0006	NE
1994	104.0244	0.0019	0.0002	0.3245	0.0834	0.0030	NE
1995	100.0768	0.0018	0.0002	0.3122	0.0803	0.0029	NE
1996	140.9777	0.0025	0.0003	0.4398	0.1131	0.0040	NE
1997	58.5761	0.0010	0.0001	0.1827	0.0470	0.0017	NE
1998	56.5030	0.0010	0.0001	0.1763	0.0453	0.0016	NE
1999	62.2873	0.0011	0.0001	0.1943	0.0500	0.0018	NE

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
2000	34.9864	0.0006	0.0001	0.1091	0.0281	0.0010	NE
2001	17.4466	0.0003	0.0000	0.0544	0.0140	0.0005	NE
2002	38.0374	0.0007	0.0001	0.1187	0.0305	0.0011	NE
2003	27.0294	0.0005	0.0000	0.0843	0.0217	0.0008	NE
2004	43.6271	0.0008	0.0001	0.1361	0.0350	0.0012	NE
2005	40.6943	0.0007	0.0001	0.1269	0.0326	0.0012	NE
2006	7.6025	0.0001	0.0000	0.0237	0.0061	0.0002	NE
2007	3.5131	0.0001	0.0000	0.0110	0.0028	0.0001	NE
2008	4.6899	0.0001	0.0000	0.0146	0.0038	0.0001	NE
2009	11.6778	0.0002	0.0000	0.0364	0.0094	0.0003	NE
2010	17.7135	0.0003	0.0000	0.0553	0.0142	0.0005	NE
2011	26.5942	0.0005	0.0000	0.0830	0.0213	0.0008	NE
2012	23.8300	0.0004	0.0000	0.0743	0.0191	0.0007	NE
2013	14.8075	0.0003	0.0000	0.0462	0.0119	0.0004	NE
2014	19.3312	0.0003	0.0000	0.0603	0.0155	0.0006	NE
2015	19.5926	0.0003	0.0000	0.0611	0.0157	0.0006	NE
2016	16.8189	0.0003	0.0000	0.0525	0.0135	0.0005	NE
2017	20.5865	0.0004	0.0000	0.0642	0.0165	0.0006	NE
2018	18.1219	0.0003	0.0000	0.0565	0.0145	0.0005	NE
2019	17.1792	0.0003	0.0000	0.0536	0.0138	0.0005	NE
2020	11.5473	0.0002	0.0000	0.0360	0.0093	0.0003	NE
2021	1.7173	0.0000	0.0000	0.0054	0.0014	0.0000	NE
2022	0.3960	0.0000	0.0000	0.0012	0.0003	0.0000	NE

Direct GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) and the contribution of each gas between 1990-2022 are shown in Table 3-137.

Table 3-137: Direct GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport) and their share in the total structure at source category level

	1A3e, kt CO_2 equivalent				Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	91.1782	0.0455	0.0431	91.2668	99.9	0.0	0.1
1991	75.9818	0.0379	0.0359	76.0557	99.9	0.0	0.1
1992	56.9864	0.0284	0.0269	57.0417	99.9	0.0	0.1
1993	22.3809	0.0112	0.0106	22.4027	99.9	0.0	0.1
1994	104.0244	0.0519	0.0491	104.1255	99.9	0.0	0.1
1995	100.0768	0.0499	0.0473	100.1740	99.9	0.0	0.1
1996	140.9777	0.0704	0.0666	141.1147	99.9	0.0	0.1
1997	58.5761	0.0292	0.0277	58.6330	99.9	0.0	0.1
1998	56.5030	0.0282	0.0267	56.5579	99.9	0.0	0.1
1999	62.2873	0.0311	0.0294	62.3478	99.9	0.0	0.1
2000	34.9864	0.0175	0.0165	35.0204	99.9	0.0	0.1
2001	17.4466	0.0087	0.0082	17.4636	99.9	0.0	0.1
2002	38.0374	0.0190	0.0180	38.0744	99.9	0.0	0.1
2003	27.0294	0.0135	0.0128	27.0556	99.9	0.0	0.1
2004	43.6271	0.0218	0.0206	43.6695	99.9	0.0	0.1
2005	40.6943	0.0203	0.0192	40.7338	99.9	0.0	0.1
2006	7.6025	0.0038	0.0036	7.6099	99.9	0.0	0.1
2007	3.5131	0.0018	0.0017	3.5165	99.9	0.0	0.1
2008	4.6899	0.0023	0.0022	4.6944	99.9	0.0	0.1
2009	11.6778	0.0058	0.0055	11.6892	99.9	0.0	0.1
2010	17.7135	0.0088	0.0084	17.7307	99.9	0.0	0.1
2011	26.5942	0.0133	0.0126	26.6200	99.9	0.0	0.1
2012	23.8300	0.0119	0.0113	23.8531	99.9	0.0	0.1
2013	14.8075	0.0074	0.0070	14.8219	99.9	0.0	0.1
2014	19.3312	0.0096	0.0091	19.3500	99.9	0.0	0.1
2015	19.5926	0.0098	0.0093	19.6117	99.9	0.0	0.1
2016	16.8189	0.0084	0.0079	16.8353	99.9	0.0	0.1
2017	20.5865	0.0103	0.0097	20.6065	99.9	0.0	0.1

	1A3e, kt CO_2 equivalent				Share, % of total		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
2018	18.1219	0.0090	0.0086	18.1395	99.9	0.0	0.1
2019	17.1792	0.0086	0.0081	17.1959	99.9	0.0	0.1
2020	11.5473	0.0058	0.0055	11.5585	99.9	0.0	0.1
2021	1.7173	0.0009	0.0008	1.7189	99.9	0.0	0.1
2022	0.3960	0.0002	0.0002	0.3964	99.9	0.0	0.1

Methodologies and emission factors

A Tier 1 methodology was used for the estimation of GHG emissions from 1A3e 'Other Transportation' (Pipeline Transport). EFs for direct GHG emissions were taken from the 2006 IPCC Guidelines for the inventory of national direct GHG emissions, whereas the EFs for indirect GHG emissionsere taken from the 2023 EMEP/EEA Air Pollutant Emission Inventory (Table 3-138).

Table 3-138: Emission factors for direct and indirect GHG emissions from source category 1A3e 'Other Transportation' (Pipeline Transport)

	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
	kg/TJ						
Natural gas	56,100	1	0.1	175	45	1.6	NE
References	2006 IPCC Guidebook, Chapter 'Mobile Combustion'			2023 EMEP/EEA Guidebook, Chapter 1.A.3.e.i, Table 3.1.			

Activity Data

The main source of activity data for source category 1A3e 'Other Transportation' (Pipeline Transport) is the EBs of the RoM for the territory on the RBDR. For the territory on the LBDR, the AD was restored based on specific consumption per capita on the RBDR (Table 3-139).

Table 3-139: Fuel consumption within source category 1A3e 'Other Transportation' (Pipeline Transport) between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RBDR	1,353	1,128	846	332	1,555	1,496	2,112	880	851	939	528
LBDR	272	227	170	67	299	288	401	164	156	171	96
RoM – total	**1,625**	**1,354**	**1,016**	**399**	**1,854**	**1,784**	**2,513**	**1,044**	**1,007**	**1,110**	**624**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RBDR	264	576	410	663	627	117	54	72	179	271	406
LBDR	47	102	72	115	98	19	9	12	29	45	68
RoM – total	**311**	**678**	**482**	**778**	**725**	**136**	**63**	**84**	**208**	**316**	**474**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RBDR	363	225	293	297	257	314	276	261	175	26	6
LBDR	62	39	52	52	43	53	47	45	31	5	1
RoM – total	**425**	**264**	**345**	**349**	**300**	**367**	**323**	**306**	**206**	**31**	**7**

Source: for the territory on the Right Bank of the Dniester River – EBs of the RoM for the years 1990, 1993-2022; for the territory on the Left Bank of the Dniester River – activity data was restored using indirect methods (based on the specific consumption per capita on the Right Bank of the Dniester River).

Recalculations

Compared to the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes undertaken in the current inventory cycle resulted in an insignificant decrease in direct GHG emissions for the period 1990-2022 (Table 3-140). For 2021-2022, direct GHG emissions from source category 1A3e 'Other Transportation' were estimated for the first time. Between 1990 and 2022, direct GHG emissions from the respective category had decreased by circa 98.1%.

Table 3-140: Recalculations of GHG emissions between 1990-2020, included in the NC5 of the RoM to the UNFCCC (1A3e 'Other Transportation'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	91.2673	76.0561	57.0420	22.4028	104.1260	100.1746	141.1154	58.6333	56.5582	62.3482	35.0206
BTR1	91.2668	76.0557	57.0417	22.4027	104.1255	100.1740	141.1147	58.6330	56.5579	62.3478	35.0204
Difference, %	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	17.4636	38.0746	27.0558	43.6697	40.7340	7.6100	3.5166	4.6945	11.6892	17.7308	26.6202
BTR1	17.4636	38.0744	27.0556	43.6695	40.7338	7.6099	3.5165	4.6944	11.6892	17.7307	26.6200
Difference, %	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	23.8533	14.8220	19.3501	19.6118	16.8354	20.6066	18.1396	17.1959	11.5585		
BTR1	23.8531	14.8219	19.3500	19.6117	16.8353	20.6065	18.1395	17.1959	11.5585	1.7189	0.3964
Difference, %	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001	-0.001		

Abbreviations: BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC; NC5 – Fifth National Communication of the RoM to the UNFCCC.

3.5.3. Uncertainties and Time Series Consistency

The primary uncertainty-related factors pertain to the estimation methodology, emission factors utilised in the estimation of GHG emissions from source category 1A3 'Transport', and the quality of activity data available.

Uncertainties associated with CO_2 emission factors were estimated to be circa 5%, for CH_4 emissions – circa 40%, and N_2O emissions – circa 50%, respectively. Uncertainties associated with activity data regarding fuel consumption within the Transport Sector of the Republic of Moldova are considered relatively low (±5%). Combined uncertainties presented as a percentage of the total direct GHG emissions from source category 1A3 'Transport' were estimated to be circa 7.1%.

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with sustainable practices applied to GHG inventory (2006 IPCC Guidelines).

3.5.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for category 1A3 'Transport', following the Tier 1 approach. To be noted, that the AD and methods used for estimating GHG emissions under the respective category were documented and archived both in hard copies and electronically. In order to identify the data entry and emission estimation process related errors, verifications and QC procedures were applied in the calculation process for category 1A3 'Transport':

- verification of AD collection and manipulation procedures, including: verifying if disaggregation of AD collected for each source category included in category 1A3 'Transport' complies with the requirements set out in the description of each source category in the 2006 IPCC Guidelines; verifying the correctness of EFs used for each source; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for sources included in category 1A3 is verified randomly;
- implementation of error minimization procedures for manual entry of AD, with all the spreadsheets provided with the initial sources of activity data in tabular format;
- in the calculation files, the import of the EFs values into calculation formulas is ensured by automatic connections;
- the consistency of the calculations is ensured by verifying the correctness of applying conversion factors of natural units to energy units for all sources and the entire range of years covered by the inventory;
- verification if the same method is used for the entire range of years covered by the inventory;
- verifying if GHG emissions calculations have been carried out for all years and for all types of fuels mentioned in the Energy Balances and other relevant reference sources;
- verifying to what extent the full geographical coverage of the national GHG inventory of the RoM is ensured;
- verifying inter-annual evolution trends of emissions by creating representative charts, while unusual fluctuations are explained;

- regarding recalculations, their need is explained, including by drawing attention to the implemented recommendations resulting from the QA/QC activities carried out by national and international experts in the previous inventory cycles;
- verifying maintenance and completion of the national inventory of GHG emissions archive.

3.5.5. Recalculations

Compared to the values of GHG emissions in the NC5 of the RoM to the UNFCCC (2023), emissions from this category had slightly decreased (Table 3-141). Recalculations made in the current cycle are largely associated with the use of GWP values for the 100-year horizon availabla in the IPCC AR5 (2014), instead of those available in the IPCC AR4 (2007): for CH_4 – 28 (instead of 25), for N_2O – 265 (instead of 298).

Table 3-141: Recalculations of GHG emissions for the period 1990-2020, included in the NC5 of the RoM to the UNFCCC (1A3 'Transport'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	4,838.64	3,769.31	2,699.86	1,920.97	1,656.54	1,660.34	1,619.22	1,555.14	1,397.91	932.11	1,005.66
BTR1	4,830.86	3,762.74	2,694.66	1,916.56	1,654.26	1,658.41	1,617.58	1,553.23	1,396.45	931.24	1,004.59
Difference, %	-0.2	-0.2	-0.2	-0.2	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	1,087.35	1,442.41	1,625.88	1,828.60	1,866.99	1,787.95	1,894.81	1,999.17	1,964.24	2,188.80	2,322.56
BTR1	1,086.09	1,440.38	1,624.14	1,827.10	1,864.52	1,785.12	1,891.74	1,995.91	1,961.51	2,185.47	2,319.77
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.2	-0.2	-0.2	-0.1	-0.2	-0.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	2,037.01	2,145.88	2,182.58	2,307.83	2,481.61	2,503.58	2,581.89	2,665.43	2,511.91		
BTR1	2,034.45	2,143.31	2,180.29	2,305.29	2,478.57	2,500.58	2,579.00	2,662.34	2,508.94	2,777.35	2,776.78
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC, BTR1 – First Biennial Transparency Report of the RoM to the UNFCC.

3.5.6. Planned Improvements

Potential improvements in source category 1A3 'Transport' could be made in the case of the availability of activity data regarding actual fuel consumption in the territory on the LBDR for all emission sources considered within this category.

Likewise, in the case of source category 1A3b 'Road Transportation', the transition to a higher-ranking calculation methodology (Tier 3) is anticipated, by using the COPERT model.

3.6. Other Sectors (source category 1A4)

3.6.1. Source category description and GHG emissions trends

Category 1A4 'Other Sectors' includes the following emission sources: 1A4a 'Commercial/ Institutional'; 1A4b 'Residential'; 1A4c 'Agriculture/Forestry/Fishing' ('Stationary and 'Mobile').

Between 1990 and 2022, GHG emissions from source category 1A4 'Other Sectors' tended to decrease by circa 71.8%: from 7,855.70 kt CO_2 equivalent recorded in 1990, to circa 2,217.25 kt CO_2 equivalent in 2022 (Table 3-142).

Table 3-142: Direct GHG emissions from category 1A4 'Other Sectors' between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A4, kt CO_2 equivalent	7,855.70	6,259.50	4,228.10	2,238.79	2,226.08	2,281.29	2,411.51	2,609.85	2,154.67	1,874.96	1,553.40
%, compared to 1990	100.0	79.7	53.8	28.5	28.3	29.0	30.7	33.2	27.4	23.9	19.8
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A4, kt CO_2 equivalent	1,488.25	1,815.02	2,163.57	2,326.51	2,285.56	2,277.37	1,722.83	1,733.67	1,883.51	2,049.60	2,378.26
%, compared to 1990	18.9	23.1	27.5	29.6	29.1	29.0	21.9	22.1	24.0	26.1	30.3
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A4, kt CO_2 equivalent	2,345.27	2,024.94	2,075.21	1,947.77	1,934.72	2,188.91	2,290.05	2,412.41	2,350.07	2,711.79	2,217.25
%, compared to 1990	29.9	25.8	26.4	24.8	24.6	27.9	29.2	30.7	29.9	34.5	28.2

Compared to 1990, GHG emission levels, in 2022, from source category 1A4 'Other Sectors' constituted 26.7% of the base year level in terms of CO_2 emissions; whereas in the case of CH_4 – 60.3%, N_2O – 36.0%, NO_x – 29.8%, CO – 49.0%, NMVOC – 67.1%, SO_x – 5.3% (Table 3-143).

Table 3-143: Evolution of direct and indirect GHG emissions from source category 1A4 'Other Sectors' between 1990-2022

	1A4, kt							%, compared to 1990						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x
1990	7,372.26	11.50	0.61	21.60	188.29	20.55	43.34	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	5,925.02	8.15	0.40	15.96	133.47	14.45	31.04	80.4	70.8	65.9	73.9	70.9	70.3	71.6
1992	4,024.16	4.93	0.25	10.19	80.11	8.74	18.71	54.6	42.9	40.8	47.2	42.5	42.5	43.2
1993	2,133.92	1.79	0.21	7.79	30.61	3.69	8.37	28.9	15.6	33.9	36.1	16.3	17.9	19.3
1994	2,090.75	2.44	0.25	8.60	41.25	4.83	9.08	28.4	21.2	41.5	39.8	21.9	23.5	20.9
1995	2,172.16	1.33	0.27	9.15	30.52	3.29	5.04	29.5	11.6	44.5	42.3	16.2	16.0	11.6
1996	2,285.70	2.39	0.22	7.90	44.68	4.84	7.39	31.0	20.7	36.6	36.6	23.7	23.5	17.1
1997	2,502.53	1.78	0.22	7.89	35.78	3.82	5.02	33.9	15.5	35.5	36.5	19.0	18.6	11.6
1998	2,078.68	1.19	0.16	6.16	23.79	2.69	3.53	28.2	10.3	26.5	28.5	12.6	13.1	8.1
1999	1,809.40	1.22	0.12	4.71	21.22	2.55	2.93	24.5	10.6	19.5	21.8	11.3	12.4	6.8
2000	1,494.12	1.21	0.10	3.82	19.34	2.46	2.54	20.3	10.5	15.8	17.7	10.3	12.0	5.9
2001	1,434.10	1.06	0.09	3.74	16.74	2.19	2.20	19.5	9.2	15.2	17.3	8.9	10.7	5.1
2002	1,747.82	1.36	0.11	4.48	20.74	2.81	3.16	23.7	11.8	18.1	20.7	11.0	13.7	7.3
2003	2,084.65	1.79	0.11	4.73	26.38	3.51	4.90	28.3	15.6	17.8	21.9	14.0	17.1	11.3
2004	2,260.03	1.47	0.10	4.70	21.48	2.99	4.01	30.7	12.8	15.7	21.8	11.4	14.6	9.3
2005	2,219.08	1.56	0.09	4.34	22.73	3.07	3.83	30.1	13.5	14.2	20.1	12.1	14.9	8.8
2006	2,203.66	1.80	0.09	4.29	25.75	3.48	4.01	29.9	15.6	14.5	19.9	13.7	16.9	9.2
2007	1,666.75	1.30	0.07	3.39	18.39	2.52	2.74	22.6	11.3	12.2	15.7	9.8	12.3	6.3
2008	1,677.37	1.33	0.07	3.37	18.27	2.57	2.44	22.8	11.5	11.9	15.6	9.7	12.5	5.6
2009	1,824.94	1.43	0.07	3.50	18.91	2.69	2.71	24.8	12.5	11.4	16.2	10.0	13.1	6.3
2010	1,985.99	1.57	0.07	3.76	21.82	2.94	2.98	26.9	13.6	12.2	17.4	11.6	14.3	6.9
2011	2,310.78	1.69	0.08	4.14	23.36	3.30	2.81	31.3	14.7	12.4	19.2	12.4	16.1	6.5
2012	2,271.47	1.93	0.07	4.03	26.39	3.67	3.18	30.8	16.7	12.3	18.7	14.0	17.9	7.3
2013	1,947.94	1.98	0.08	3.78	27.76	3.74	3.35	26.4	17.3	13.3	17.5	14.7	18.2	7.7
2014	1,927.74	4.09	0.12	4.49	54.58	8.00	2.45	26.1	35.5	20.5	20.8	29.0	38.9	5.7
2015	1,790.21	4.34	0.14	4.56	58.19	8.53	2.43	24.3	37.8	22.3	21.1	30.9	41.5	5.6
2016	1,767.49	4.66	0.14	4.53	62.05	9.22	2.03	24.0	40.5	22.7	21.0	33.0	44.9	4.7
2017	1,960.70	6.38	0.19	5.71	85.07	12.55	2.99	26.6	55.5	30.8	26.4	45.2	61.0	6.9
2018	1,946.25	10.03	0.24	6.35	133.09	19.94	2.40	26.4	87.2	39.0	29.4	70.7	97.0	5.5
2019	2,105.50	8.76	0.23	6.58	117.16	17.31	3.32	28.6	76.2	38.1	30.5	62.2	84.3	7.7
2020	2,050.09	8.53	0.23	6.50	113.77	16.95	2.51	27.8	74.2	37.8	30.1	60.4	82.5	5.8
2021	2,406.24	8.41	0.26	7.73	112.01	16.74	2.66	32.6	73.1	43.5	35.8	59.5	81.4	6.1
2022	1,964.95	6.93	0.22	6.43	92.18	13.78	2.31	26.7	60.3	36.0	29.8	49.0	67.1	5.3

In the structure of total GHG emissions from source category 1A4 'Other Sectors' in 2022, the share of direct GHG emissions varied as follows: CO_2 – 88.6%, CH_4 – 8.8% and N_2O –2.6% (Table 3-144).

Table 3-144: Direct GHG emissions from category 1A4 'Other Sectors' between 1990-2022

	1A4, kt CO_2 equivalent				% of total			%, compared to 1990		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1990	7,372.26	322.01	161.43	7,855.70	93.8	4.1	2.1	100.0	100.0	100.0
1991	5,925.02	228.10	106.37	6,259.50	94.7	3.6	1.7	80.4	70.8	65.9
1992	4,024.16	138.06	65.89	4,228.10	95.2	3.3	1.6	54.6	42.9	40.8
1993	2,133.92	50.16	54.71	2,238.79	95.3	2.2	2.4	28.9	15.6	33.9
1994	2,090.75	68.33	67.01	2,226.08	93.9	3.1	3.0	28.4	21.2	41.5
1995	2,172.16	37.36	71.76	2,281.29	95.2	1.6	3.1	29.5	11.6	44.5
1996	2,285.70	66.78	59.03	2,411.51	94.8	2.8	2.4	31.0	20.7	36.6
1997	2,502.53	49.94	57.39	2,609.85	95.9	1.9	2.2	33.9	15.5	35.5
1998	2,078.68	33.29	42.71	2,154.67	96.5	1.5	2.0	28.2	10.3	26.5

	1A4, kt CO_2 equivalent				% of total			%, compared to 1990		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	CO_2	CH_4	N_2O
1999	1,809.40	34.02	31.54	1,874.96	96.5	1.8	1.7	24.5	10.6	19.5
2000	1,494.12	33.84	25.45	1,553.40	96.2	2.2	1.6	20.3	10.5	15.8
2001	1,434.10	29.55	24.60	1,488.25	96.4	2.0	1.7	19.5	9.2	15.2
2002	1,747.82	37.95	29.24	1,815.02	96.3	2.1	1.6	23.7	11.8	18.1
2003	2,084.65	50.18	28.75	2,163.57	96.4	2.3	1.3	28.3	15.6	17.8
2004	2,260.03	41.14	25.35	2,326.51	97.1	1.8	1.1	30.7	12.8	15.7
2005	2,219.08	43.55	22.94	2,285.56	97.1	1.9	1.0	30.1	13.5	14.2
2006	2,203.66	50.35	23.36	2,277.37	96.8	2.2	1.0	29.9	15.6	14.5
2007	1,666.75	36.43	19.65	1,722.83	96.7	2.1	1.1	22.6	11.3	12.2
2008	1,677.37	37.13	19.17	1,733.67	96.8	2.1	1.1	22.8	11.5	11.9
2009	1,824.94	40.13	18.44	1,883.51	96.9	2.1	1.0	24.8	12.5	11.4
2010	1,985.99	43.83	19.77	2,049.60	96.9	2.1	1.0	26.9	13.6	12.2
2011	2,310.78	47.44	20.03	2,378.26	97.2	2.0	0.8	31.3	14.7	12.4
2012	2,271.47	53.93	19.87	2,345.27	96.9	2.3	0.8	30.8	16.7	12.3
2013	1,947.94	55.56	21.44	2,024.94	96.2	2.7	1.1	26.4	17.3	13.3
2014	1,927.74	114.43	33.05	2,075.21	92.9	5.5	1.6	26.1	35.5	20.5
2015	1,790.21	121.60	35.96	1,947.77	91.9	6.2	1.8	24.3	37.8	22.3
2016	1,767.49	130.55	36.68	1,934.72	91.4	6.7	1.9	24.0	40.5	22.7
2017	1,960.70	178.56	49.65	2,188.91	89.6	8.2	2.3	26.6	55.5	30.8
2018	1,946.25	280.84	62.96	2,290.05	85.0	12.3	2.7	26.4	87.2	39.0
2019	2,105.50	245.34	61.57	2,412.41	87.3	10.2	2.6	28.6	76.2	38.1
2020	2,050.09	238.98	61.00	2,350.07	87.2	10.2	2.6	27.8	74.2	37.8
2021	2,406.24	235.37	70.17	2,711.79	88.7	8.7	2.6	32.6	73.1	43.5
2022	1,964.95	194.13	58.16	2,217.25	88.6	8.8	2.6	26.7	60.3	36.0

The evolution trends of GHG emissions disaggregated by source under category 1A4 'Other Sectors' are presented below (Table 3-145).

Table 3-145: Direct GHG emissions disaggregated by sources under category 1A4 'Other Sectors' between 1990-2022, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A4a 'Commercial/Institutional'	1,426.18	1,010.72	669.25	594.69	390.60	399.13	366.45	310.33	308.65	230.66	207.28
1A4b 'Residential'	4,732.75	4,101.06	2,841.10	1,026.26	1,129.73	1,103.77	1,415.56	1,670.52	1,372.52	1,318.28	1,087.74
1A4ci 'Agriculture/Forestry/Fishing' (Stationary)	166.47	163.02	113.91	79.49	34.26	19.85	28.38	33.11	39.44	18.62	20.86
1A4cii 'Agriculture/Forestry/Fishing' (Mobile)	1,530.31	984.70	603.85	538.34	671.49	758.54	601.13	595.90	434.07	307.40	237.53
1A4 'Other Sectors'	**7,855.70**	**6,259.50**	**4,228.10**	**2,238.79**	**2,226.08**	**2,281.29**	**2,411.51**	**2,609.85**	**2,154.67**	**1,874.96**	**1,553.40**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1A4a 'Commercial/Institutional'	239.18	430.23	588.42	829.41	707.63	649.88	366.30	375.40	484.06	481.79	811.38
1A4b 'Residential'	996.79	1,104.30	1,313.93	1,259.28	1,374.36	1,430.16	1,188.44	1,193.51	1,246.21	1,396.35	1,399.45
1A4ci 'Agriculture/Forestry/Fishing' (Stationary)	22.14	10.98	12.42	17.27	8.10	4.80	1.98	6.34	4.84	6.13	6.03
1A4cii 'Agriculture/Forestry/Fishing' (Mobile)	230.15	269.51	248.80	220.56	195.46	192.54	166.11	158.43	148.40	165.33	161.40
1A4 'Other Sectors'	**1,488.25**	**1,815.02**	**2,163.57**	**2,326.51**	**2,285.56**	**2,277.37**	**1,722.83**	**1,733.67**	**1,883.51**	**2,049.60**	**2,378.26**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
1A4a 'Commercial/Institutional'	783.02	475.58	489.28	344.93	342.66	341.04	349.48	336.74	301.35	347.26	304.12
1A4b 'Residential'	1,398.59	1,367.54	1,367.37	1,361.74	1,359.71	1,531.20	1,624.99	1,716.96	1,691.95	1,895.34	1,516.27
1A4ci 'Agriculture/Forestry/Fishing' (Stationary)	8.81	11.05	6.32	8.52	8.54	10.87	11.80	12.67	13.85	21.88	23.87
1A4cii 'Agriculture/Forestry/Fishing' (Mobile)	154.85	170.77	212.24	232.57	223.81	305.80	303.78	346.03	342.92	447.30	372.98
1A4 'Other Sectors'	**2,345.27**	**2,024.94**	**2,075.21**	**1,947.77**	**1,934.72**	**2,188.91**	**2,290.05**	**2,412.41**	**2,350.07**	**2,711.79**	**2,217.25**

The emission source with the largest share in the structure of total direct GHG emissions originating form source category 1A4 'Other Sectors' in 2022 is category 1A4b 'Residential' – 68.4%, followed by

category 1A4cii 'Agriculture/Forestry/Fishing' (Mobile), with a share of 16.8%; category 1a4a 'Commercial/Institutional', with a share of 13.7% (Figures 3-17, 3-18, Table 3-146).

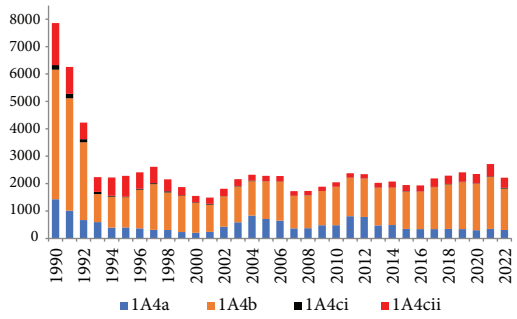


Figure 3-17: Evolution of GHG emissions, disaggregated by emission source under category 1A4 'Other Sectors' between 1990-2022, kt CO_2 equivalent.

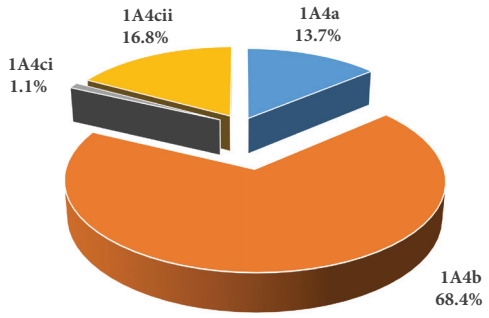


Figure 3-18: The share of different sources in the structure of total direct GHG emissions originating from category 1A4 'Other Sectors' in 2022, %.

Table 3-146: The share of different sources in the structure of total direct GHG emissions originating from category 1A4 'Other Sectors', % of total

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A4a	18.2	16.1	15.8	26.6	17.5	17.5	15.2	11.9	14.3	12.3	13.3
1A4b	60.2	65.5	67.2	45.8	50.7	48.4	58.7	64.0	63.7	70.3	70.0
1A4ci	2.1	2.6	2.7	3.6	1.5	0.9	1.2	1.3	1.8	1.0	1.3
1A4cii	19.5	15.7	14.3	24.0	30.2	33.3	24.9	22.8	20.1	16.4	15.3
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
1A4a	16.1	23.7	27.2	35.7	31.0	28.5	21.3	21.7	25.7	23.5	34.1
1A4b	67.0	60.8	60.7	54.1	60.1	62.8	69.0	68.8	66.2	68.1	58.8
1A4ci	1.5	0.6	0.6	0.7	0.4	0.2	0.1	0.4	0.3	0.3	0.3
1A4cii	15.5	14.8	11.5	9.5	8.6	8.5	9.6	9.1	7.9	8.1	6.8
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
1A4a	33.4	23.5	23.6	17.7	17.7	15.6	15.3	14.0	12.8	12.8	13.7
1A4b	59.6	67.5	65.9	69.9	70.3	70.0	71.0	71.2	72.0	69.9	68.4
1A4ci	0.4	0.5	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.8	1.1
1A4cii	6.6	8.4	10.2	11.9	11.6	14.0	13.3	14.3	14.6	16.5	16.8

3.6.2. Methodologies, emission factors and activity data

Direct GHG emissions originating from source category 1A4 'Other Sectors' were estimated following the Tier 1 methodology available in the 2006 IPCC Guidelines, based on AD on fuel consumption and default emission factors. In order to estimate non-CO_2 emissions, EFs were used, available in the 2023 EMEP/EEA Guidebook (Tables 3-147, 3-148, 3-149, and 3-150).

Table 3-147: Emission factors utilised in the estimation of GHG emissions originating from source category 1A4a 'Commercial/Institutional', kg/TJ

Type of fuel	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Gasoline	69,300	10	0.6	306	93	20	94
Diesel	74,100	10	0.6	306	93	20	94
Residual fuel oil	77,400	10	0.6	306	93	20	94
Kerosene	71,900	10	0.6	306	93	20	94
LPG	63,100	5	0.1	74	29	23	0.67
Other petroleum products	73,300	10	0.6	306	93	20	94
Anthracite	98,300	10	1.5	173	931	88.8	900
Bituminous coal	94,600	10	1.5	173	931	88.8	900
Lignite	101,000	10	1.5	173	931	88.8	900
Brown Coal – briquettes	97,500	10	1.5	173	931	88.8	900
Coke	107,000	10	1.5	173	931	88.8	900
Natural Gas	56,100	5	0.1	74	29	23	0.67
Fuelwood and wood waste	112,000	300	4	91	570	300	11

Type of fuel	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Other Solid Biomass	100,000	300	4	91	570	300	11
Charcoal	112,000	200	1	91	570	300	11

Source: for CO_2,CH_4, N_2O – 2006 IPCC Guidelines, Volume 2, Chapter 2, Table 2.4, 2.20-2.21; for NO_x, CO, NMVOC and SO_2 – EMEP/EEA Air Pollutant Emission Inventory (2023), Table 3.7-3.10, P. 36-39, Category 1.A.4.a.

Table 3-148: Emission factors utilised in the estimation of GHG emissions originating from source category 1A4b 'Residential', kg/TJ

Type of fuel	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Residual fuel oil	77,400	10	0.6	51	57	0.69	70
Kerosene	71,900	10	0.6	51	57	0.69	70
LPG	63,100	5	0.1	51	26	1.9	0.3
Other petroleum products	73,300	10	0.6	51	57	0.69	70
Anthracite	98,300	300	1.5	110	4,600	484	900
Bituminous coal	94,600	300	1.5	110	4,600	484	900
Lignite	101,000	300	1.5	110	4,600	484	900
Coke	107,000	300	1.5	110	4,600	484	900
Peat	106,000	300	1.4	110	4,600	484	900
Natural gas	56,100	5	0.1	51	26	1.9	0.3
Fuelwood and wood waste	112,000	300	4	50	4,000	600	11
Other Solid Biomass	100,000	300	4	50	4,000	600	11
Charcoal	112,000	200	1	50	4,000	600	11

Source: for CO_2,CH_4, N_2O – 2006 IPCC Guidelines, Volume 2, Chapter 2, Table 2.5, 2.22-2.23, for NO_x, CO, NMVOC and SO_2 – EMEP/EEA Air Pollutant Emission Inventory (2023), Table 3.3-3.6, P. 32-35, Category 1.A.4.b.

Table 3-149: Emission factors utilised in the estimation of GHG emissions originating from source category 1A4ci 'Agriculture/Forestry/Fishing' (Stationary), kg/TJ

Fuel type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
Diesel	74,100	10	0.6	306	93	20	94
Residual fuel oil	77,400	10	0.6	306	93	20	94
Kerosene	71,900	10	0.6	306	93	20	94
Other petroleum products	73,300	10	0.6	306	93	20	94
Anthracite	98,300	300	1.5	173	931	88.8	900
Bituminous coal	94,600	300	1.5	173	931	88.8	900
Lignite	101,000	300	1.5	173	931	88.8	900
Natural gas	56,100	5	0.1	74	29	23	0.67
Fuelwood and wood waste	112,000	300	4	91	570	300	11
Other Solid Biomass	100,000	300	4	91	570	300	11

Source: for CO_2, CH_4, N_2O emissions – 2006 IPCC Guidelines, Volume. 2, Chapter. 2, Table 2.5, 2.22-2.23; for NO_x, CO, NMVOC and SO_2 emissions – EMEP/EEA Air Pollutant Emission Inventory (2023), Table 3.7-3.10, P. 36-39.

Table 3-150: Emission factors utilised in the estimation of GHG emissions originating from source category 1A4cii 'Agriculture/Forestry/Fishing' (Mobile),

Fuel type	CO_2	CH_4	N_2O	NO_x	CO	NMVOC
	kg/TJ			kg/kt		
Gasoline	69,300	80	2	7,117	770,368	18,893
Diesel	74,100	4.15	28.6	34,457	11,469	3,542
LPG	63,100	62	0.2	28,571	4,823	6,720

Source: for CO_2 – 2006 IPCC Guidelines, Volume 3, Chapter 3, Table 3.2.1; for CH_4, N_2O (gasoline, diesel) – 2006 IPCC Guidelines, Volume 3, Chapter 3, Table 3.3.1; for CH_4, N_2O (LPG) – 2006 IPCC Guidelines, Volume 3, Chapter 3, Table 3.2.2; for NO_x, CO and NMVOC – EMEP/EEA Air Pollutant Emission Inventory (2023), Category 1.A.4.c.ii, Table 3-1, P. 22-23.

SO_2 emissions were estimated utilising the data associated with the sulphur content in used fuels, applying the following equation:

$$E_{SO_2,m} = 2 \sum k_{S,m}\, b_{j,m}\, 10^{-6}$$

Where:

$E_{SO_2,m}$ – SO_2 emissions by type of fuel m [kt];

$k_{S,m}$ – weight of the sulphur content in type *m* fuel [kg/kg];

$b_{j,m}$ – annual type *m* fuel consumption [kg], by source category *j*;

10^{-6} – conversion coefficient from kg into kt.

Table 3-151: Typical sulphur content of fuels used

Fuel	1990-1999	2000-2004	2005-2008	2009-2022
Gasoline	165 ppm	130 ppm	40 ppm	5 ppm
Diesel	400 ppm	300 ppm	40 ppm	3 ppm

Source: EMEP/EEA Air Pollutant Emission Inventory (2023), Table 3-14, p. 22, Category 1.A.3.b.i-iv.

AD on fuel consumption within source category 1A4 'Other Sectors' are available in the EBs of the RoM and the statistical publications 'Socio-economic development of ATULBD'. A part of the information used was provided by JSC 'Moldovagaz'. It should be noted that the activity data were taken from the EBs of the RoM directly in energy units (TJ), avoiding conversion from natural units to energy units.

For the territory on the RBDR, the information associated with fuel consumption during the years 1990 and 1993-2022 in the EBs of the RoM is available as follows: activity data for the 'Commercial Sector' and 'Institutional Sector' is usually aggregated; whereas for the 'Residential Sector' and the 'Agriculture/Forestry/Fishing Sector' is separate.

AD for source 'Agriculture/Forestry/Fishing' are disaggregated into two subcategories: 1A4ci 'Stationary' (it includes: consumption of coal, residual fuel oil, natural gas and others), and 1A4cii 'Mobile' (it includes: consumption of diesel, gasoline and LPG). AD associated with fuel consumption on the LBDR are available only in natural units, being transferred into energy units (TJ) by using country specific calorific factors.

The activity data available for each source considered under category 1A4 'Other Sectors' is examined below. In the current inventory cycle, LPG has been assigned to gaseous fuels, instead of liquid fuels, as it was in the previous inventory cycle.

1A4a 'Commercial/Institutional'

With reference to source category 1A4a 'Commercial/Institutional', activity data on natural gas consumption for the territory on the LBDR is available for the period 1999-2022, and data on LPG consumption for the period 2011-2022, respectively (Table 3-152).

Table 3-152: Fuel consumption under 1A4a 'Commercial/Institutional' on the territory of the LBDR between 1999-2022

	1999	2000	2001	2002	2003	2004	2005	2006
Natural gas, mil. m^3	6.800	9.300	13.600	81.800	87.400	229.000	181.600	151.900
	2007	2008	2009	2010	2011	2012	2013	2014
Natural gas, mil m^3	14.400	19.800	16.100	37.700	209.200	202.300	99.900	105.100
LPG, kt	NO	NO	NO	NO	0.003	0.002	0.001	0.001
	2015	2016	2017	2018	2019	2020	2021	2022
Natural gas, mil m^3	27.000	19.000	19.000	22.000	18.800	16.400	19.800	20.000
LPG, kt	0.001	0.005	0.002	0.001	0.001	0.002	0.004	0.004

Table 3-153: Fuel consumption under 1A4a 'Commercial/Institutional' on the RBDR between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Gasoline	NO	NO	NO	3	NO	NO	NO	NO	NO	NO	NO
Diesel	468	360	252	144	88	117	88	59	59	88	59
Kerosene	NO	NO	NO	47	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil	844	732	620	508	235	235	205	59	29	29	29
Fuel for oven	733	NO	NO	50	29	NO	NO	NO	29	29	147
Fuel for Engines	43	NO	NO	12	NO	NO	NO	NO	NO	NO	NO
LPG	276	199	121	44	NO	59	59	29	NO	NO	NO
Other petroleum products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	11,616	8,260	4,903	1,546	675	440	440	352	323	323	645
Bituminous coal	NO	NO	NO	2,363	2,200	2,553	2,171	1,966	2,200	1,437	734
Lignite	12	193	375	557	411	352	352	205	176	88	59
Coal-briquettes	36	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	3	NO	NO	NO	NO	NO	NO	NO
Natural gas	1,422	1,327	1,233	1,138	616	557	734	734	616	499	557

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Fuelwood	333	258	184	109	117	117	147	117	117	88	88
Wood waste	NO	NO	NO	6	NO	NO	29	NO	NO	NO	NO
Agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Briquettes and wood pellets	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Gasoline	NO	NO	NO	2	1	3	36	34	6	3	6
Diesel	29	29	59	50	46	29	29	26	35	130	121
Kerosene	NO	NO	NO	2	NO	NO	NO	96	177	NO	NO
Residual fuel oil	59	30	58	47	19	7	6	19	17	30	10
Fuel for oven	205	58	29	70	11	15	19	42	382	59	15
LPG	29	NO	29	32	72	32	41	2	28	291	82
Other petroleum products	NO	NO	NO	NO	NO	NO	NO	801	1,191	7	NO
Anthracite	264	675	1,846	1,788	1,358	1,136	1,016	673	315	828	867
Bituminous coal	1,203	1,174	1,115	745	732	859	570	NO	NO	243	217
Lignite	59	29	29	1	NO	NO	NO	3,105	4,535	NO	NO
Coal-briquettes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	1	268	240	NO	NO
Natural gas	734	1,467	1,993	2,257	2,572	2,799	3,056	15	36	4,722	5,094
Fuelwood	117	147	381	242	210	254	247	28	NO	209	219
Wood waste	NO	NO	146	78	31	26	18	15	36	36	17
Agricultural Residuer	NO	NO	NO	14	5	2	14	28	300	41	31
Other types of fuel	29	NO	NO	NO	NO	NO	3	2	NO	NO	NO
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Briquettes and wood pellets	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Gasoline	NO	NO	NO	NO	5	5	NO	NO	NO	NO	NO
Diesel	15	NO	NO	153	59	44	22	25	23	20	33
Kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil	1	6	NO	5	1	1	NO	NO	NO	NO	NO
Fuel for oven	5	1	4	1	NO	NO	NO	NO	NO	NO	NO
LPG	125	135	193	70	56	46	26	24	18	12	8
Other petroleum products	NO	1	NO	3	3	2	NO	2	1	NO	NO
Anthracite	898	1,032	587	672	655	689	711	655	604	661	591
Bituminous coal	100	67	197	77	106	84	42	23	14	7	15
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal-briquettes	1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	5,061	2,925	3,462	3,545	3,949	3,860	4,001	4,019	3,599	4,219	3,538
Fuelwood	244	185	232	220	237	226	235	216	188	209	204
Wood waste	18	35	26	14	13	16	16	11	12	2	4
Agricultural Residuer	88	68	118	50	58	130	77	60	46	50	49
Other types of fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Charcoal	NO	3	21	16	13	11	32	44	25	32	47
Briquettes and wood pellets	NO	NO	94	83	NO	112	150	127	110	125	131

Source: EBs of the RM for the years 1990 and 1993-2022.

The consumption of certain fuels within source category 1A3c 'Railways', namely residual fuel oil, anthracite, lignite, and bituminous coal, was reallocated to source category 1A4a 'Commercial/ Institutional' (Table 3-154).

Table 3-154: Consumption of fuels reallocated from source category 1A3c 'Railways' to source category 1A4a 'Commercial/Institutional', TJ

	1990	1993	1994	1995	1996	1997	1998	2005	2007	2008	2009	2010
Residual fuel oil	NO	300	88	59	29	29	59	NO	NO	3.5	5.5	8.3
Anthracite	80.1	NO	NO	NO	59	59	NO	1	1	2	NO	2
Bituminous coal	NO	103	29	29	NO	NO	NO	NO	NO	1.6	1.6	0.3
Lignite	46.72	NO	NO	59	29	59	NO	NO	NO	NO	NO	NO

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Residual fuel oil	6.6	9.6	1.7	3.3	1.14	3.1	0.7	NO	0.1	NO	0.1	0.1
Residual fuel oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	1.1	8.2	0.9	0.3	0.1	0.1	0.1	0.8	0.5	0.4	0.1	0.1

Source: EBs of the RM for the years 1990 and 1993-2022.

Table 3-155 and Figure 3-19 below show the consumption of fuel by type of fuel recorded in source category 1A4a 'Commercial/Institutional' between 1990 and 2022.

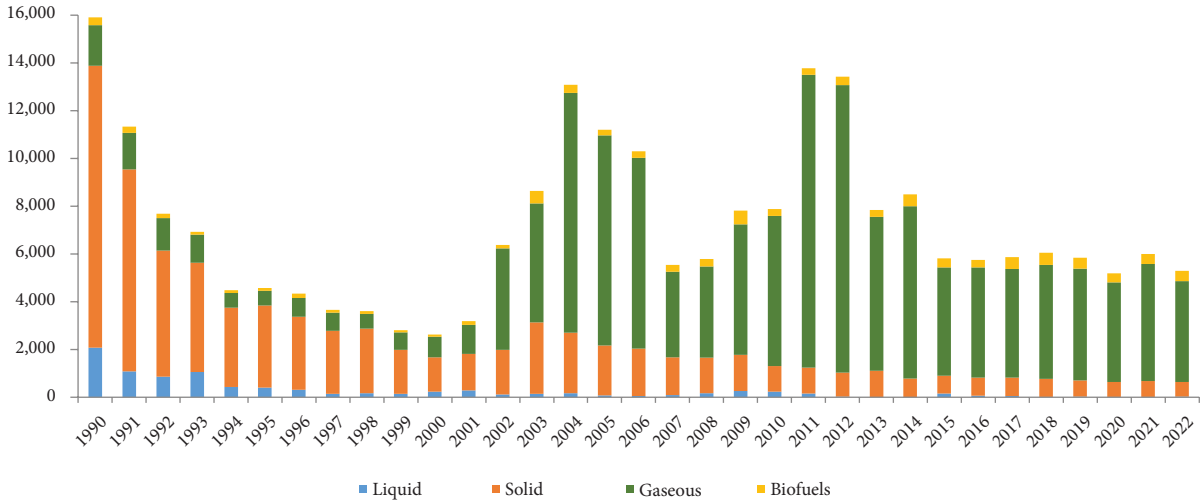


Figure 3-19: Fuel consumption in source category 1A4a 'Commercial/Institutional' between 1990-2022, TJ.

The consumption of liquid fuels had decreased in the respective period by 98.4% (from 2,088 TJ in 1990 to 33 TJ in 2022); the consumption of solid fuels had decreased by 94.9% (from 11,790 TJ in 1990 to 606 TJ in 2022); the consumption of gaseous fuels had increased by circa 2.5 times (from 1,698 TJ in 1990 to 4,225 TJ in 2022; and biofuel consumption had increased by 30.7% (from 333 TJ in 1990 to 435 TJ in 2022).

Table 3-155: Consumption by type of fuel within source category 1A4a 'Commercial/Institutional' between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Liquid fuels	2,088	1,092	872	1,064	440	411	322	147	176	146	235
Solid fuels	11,790	8,453	5,278	4,572	3,315	3,433	3,051	2,641	2,699	1,848	1,438
Gaseous fuels	1,698	1,526	1,354	1,182	616	616	793	763	616	729	872
Biofuels	333	258	184	115	117	117	176	117	117	88	88
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Liquid fuels	293	117	146	171	77	54	90	181	269	237	159
Solid fuels	1,526	1,878	2,990	2,534	2,091	1,995	1,588	1,478	1,508	1,073	1,085
Gaseous fuels	1,223	4,237	4,981	10,043	8,793	7,974	3,585	3,817	5,462	6,290	12,260
Biofuels	146	147	527	334	246	282	282	313	576	286	267
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Liquid fuels	31	10	7	163	71	53	22	27	24	20	33
Solid fuels	1,007	1,100	784	749	761	773	754	679	618	668	606
Gaseous fuels	12,036	6,443	7,214	4,529	4,604	4,549	4,772	4,680	4,172	4,901	4,225
Biofuels	350	291	491	383	321	495	510	458	381	418	435

Table 3-156 shows the total fuel consumption under source category 1A4a 'Commercial/Institutional' in the Republic of Moldova between 1990 and 2022.

Table 3-156: Fuel consumption within source category 1A4a 'Commercial/Institutional' between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A4a, LBDR	NO	NO	NO	NO	NO	NO	NO	NO	NO	230	315
1A4a, RBDR	15,910	11,330	7,688	6,933	4,488	4,577	4,342	3,668	3,608	2,581	2,318
1A4a, RoM	**15,910**	**11,330**	**7,688**	**6,933**	**4,488**	**4,577**	**4,342**	**3,668**	**3,608**	**2,811**	**2,633**

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A4a, LBDR	460	2,770	2,959	7,754	6,149	5,143	488	675	552	1,282	7,087
1A4a, RBDR	2,728	3,609	5,685	5,328	5,058	5,162	5,057	5,113	7,262	6,605	6,684
1A4a, RoM	**3,188**	**6,379**	**8,644**	**13,082**	**11,207**	**10,305**	**5,545**	**5,788**	**7,814**	**7,887**	**13,771**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
1A4a, LBDR	6,852	3,386	3,563	915	602	644	746	637	556	670	679
1A4a, RBDR	6,572	4,458	4,934	4,909	5,155	5,226	5,312	5,206	4,640	5,337	4,620
1A4a, RoM	**13,424**	**7,844**	**8,497**	**5,824**	**5,757**	**5,870**	**6,058**	**5,843**	**5,196**	**6,007**	**5,299**

1A4b 'Residential'

In the case of source category 1A4b 'Residential', activity data associated with natural gas and LPG consumption are available for the territory on the LBDR over the period between 1995-2022, and information regarding fuelwood consumption over the period between 2009-2022 (Table 3-157).

Table 3-157: Fuel consumption under source category 1A4b 'Residential' on the territory of the LBDR between 1995-2022

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
LPG, kt	2.5	2.3	1.4	1.3	0.8	0.4	0.3	0.4	0.5	0.5	0.5	0.5	0.45	0.50
Natural gas, mil. m^3	216.6	163.4	354.8	321.6	293.2	NO	196.4	175.4	176.6	162.8	164.8	161.2	150.8	150.0
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
LPG, kt	0.39	0.58	0.61	0.48	0.38	0.35	0.28	0.23	0.14	0.15	0.12	0.11	0.09	0.12
Natural gas, mil. m^3	156.0	174.3	184.5	184.1	180.6	180.1	175.0	185.7	190.7	199.1	183. 6	180.8	210.0	188.9
Fuelwood, thou.m^3	10.2	10.8	10.0	5.4	4.7	7.7	10.9	6.9	5.4	4.6	8.2	7.2	6.2	6.2

Source: for fuelwood – 'Socio-economic development of ATULBD', over the period 2009-2021, Chapter 'Material and energy resources'; for LPG – Statistical Yearbooks of ATULBD for the years 2000-2021; for natural gas – JSC 'Moldovagaz' through Official Letters No. 07-730 of 06.06.2007; No. 02/1-476 of 23.02.2011; No. 02/1-288 of 22.01.2014; No. 02/1-507 of 10.02.2015; No. 02/1-2183 of 03.06.2016, No. 03/2-74 of 12.01.2018. Press Release 'The State of Housing and Communal Services of ATULBD' for the years 2011-2021, Socio-economic development of ATULBD – 2021, P. 23.

Fuel consumption within source category 1A4b 'Residential' on the territory of the RBDR between 1990 and 2022 is shown in Table 3-158.

Table 3-158: Fuel consumption within source category 1A4b 'Residential' on the territory of the RBDR between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Residual fuel oil	NO	1,065	7,714	NO	29	NO	NO	NO	NO	NO	NO
Kerosene	431	NO	NO	26	NO	NO	NO	NO	NO	NO	NO
Diesel	1,191	8,593	553	15	NO	NO	29	NO	29	29	59
LPG	5,758	4,277	2,797	1,317	557	528	704	910	910	1,144	1,320
Other petroleum products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	32,485	22,481	12,477	2,473	3,491	1,350	1,584	1,936	440	939	1,115
Bituminous coal	25	506	987	1,468	2,847	440	3,199	734	558	323	147
Lignite	1,916	1,348	781	214	29	29	29	29	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	6	NO	NO	29	NO	NO	NO	NO
Natural gas	8,702	8,707	8,712	8,717	7,306	7,834	9,301	11,120	10,152	9,389	7,599
Fuelwood/wood waste	1,052	957	861	766	822	1,526	1,848	1,907	1,966	1,848	1,731
Other solid biomass	234	NO	NO	NO	NO	NO	NO	NO	NO	NO	29
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Residual fuel oil	NO	NO	NO	NO	2	NO	NO	NO	NO	NO	NO
Kerosene	NO	NO	NO	NO	1	NO	NO	NO	NO	NO	NO
Diesel	29	NO	NO	NO	NO	NO	NO	NO	2	NO	11
LPG	1,232	1,936	1,934	2,098	2,079	1,977	2,070	1,982	1,913	1,849	2,486
Other petroleum products	NO	NO	NO	NO	9	1	3	1	1	NO	2
Anthracite	763	1,526	2,286	1,749	2,012	2,345	1,334	1,127	1,409	2,161	1,885
Bituminous coal	21	NO	59	57	92	45	73	42	17	7	70
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Peat	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	7,775	8,186	10,288	10,693	12,096	12,708	10,620	11,240	11,599	12,308	11,597
Fuelwood/wood waste	1,555	1,878	1,964	1,673	1,704	2,123	1,716	1,942	1,767	1,808	2,134
Other solid biomass	NO	NO	17	130	214	245	197	212	NO	66	419
Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Residual fuel oil	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Kerosene	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Diesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
LPG	2,591	2,659	2,664	2,722	2,912	2,642	2,610	2,410	2,296	2,236	2,153
Other petroleum products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	2,446	2,538	1758	1,584	1,271	2,235	1,426	2,615	1,779	1,881	1,135
Bituminous coal	17	10	9	149	10	18	48	19	9	1	443
Lignite	NO	NO	NO	NO	1	NO	NO	1	NO	NO	NO
Peat	NO	NO	NO	8	NO	1	NO	NO	NO	NO	3
Coke	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	12
Natural gas	10,498	9,788	10,012	9,893	9,899	10,476	11,204	12,276	13,645	16,273	11,680
Fuelwood/wood waste	2,543	2,880	10,425	11,439	13,131	17,722	29,650	24,908	25,349	22,609	18,067
Other solid biomass	96	134	181	244	115	155	1,172	539	232	2,306	2,321
Charcoal	17	11	NO	2	4	2	5	9	13	17	22

Source: EBs of the RoM for the year 1990 and 1993-2022.

Table 3-159 and Figure 3-20 below show the fuel consumption by type of fuel under source category 1A4b 'Residential' between 1990 and 2022. We may observe a significant decrease in liquid fuels consumption in the respective period (from 1,622 TJ in 1990 to 13 TJ in 2011, the consumption of the resepctive fuels was not recorded between 2012 and 2022); gaseous fuels consumption increased by 40% (from 14,460 TJ in 1990 to 20,235 TJ in 2022); and biofuels consumption increased by circa 16 times (from 1,287 TJ in 1990 to 20,465 TJ in 2022).

Table 3-159: Consumption by type of fuel under source category 1A4b 'Residential' between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Liquid fuels	1,622	9,658	8,267	41	29	NO	29	NO	29	29	59
Solid fuels	34,941	24,827	14,491	4,161	6,367	1,819	4,841	2,699	998	1,262	1,262
Gaseous fuels	14,460	12,984	11,509	10,034	7,863	15,811	15,644	24,108	22,011	20,498	16,315
Biofuels	1,287	957	861	913	1,027	1,731	2,171	2,200	2,142	2,171	2,259
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Liquid fuels	29	NO	NO	NO	12	1	3	1	3	NO	13
Solid fuels	784	1,526	2,345	1,806	2,104	2,390	1,407	1,169	1,426	2,168	1,955
Gaseous fuels	15,671	16,079	18,225	18,326	19,778	20,166	17,817	18,324	18,812	20,086	20,358
Biofuels	2,142	2,377	2,521	2,123	2,212	2,708	2,184	2,466	2,254	2,208	2,780
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Liquid fuels	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Solid fuels	2,463	2,548	1,767	1,741	1,282	2,254	1,474	2,635	1,788	1,882	1,593
Gaseous fuels	1,9345	18,580	18,790	18,567	19,110	19,581	20,563	20,908	22,068	25,624	20,235
Biofuels	2,977	3,231	10,799	11,835	13,401	17,927	30,868	25,530	25,659	24,987	20,465

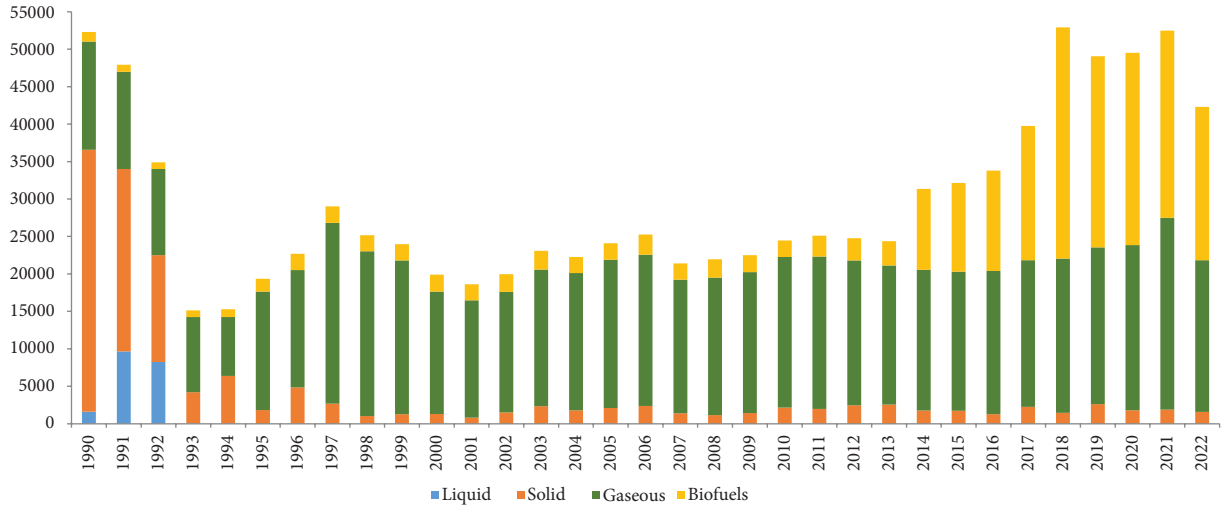


Figure 3-20: Fuel consumption by type of fuel under source category 1A4b 'Residential' between 1990-2022, TJ.

1A4c 'Agriculture/Forestry/Fishing'

Fuel consumption within source category 1A4c 'Agriculture/Forestry/Fishing' has been divided into two separate sources: lA4ci 'Stationary' and 1A4cii 'Mobile'.

1A4ci 'Stationary'

Activity data for fuel consumption in category 1A4ci 'Stationary' on the LBDR is available for natural gas, residual fuel oil, and bituminous coal (Table 3-160).

Table 3-160: Fuel consumption within source category 1A4c 'Agriculture/Forestry/Fishing' – lA4ci 'Stationary' on the territory of the LBDR between 2003-2022

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Natural gas, mil. m³	0.9	0.7	0.4	0.1	NO	0.1	NO	0.1	0,1	0.2
Residual fuel oil, kt	NO	NO	NO	NO	NO	0.003	0.003	0.003	0.003	0.003
Coal, kt	NO	NO	NO	NO	NO	0.015	0.012	0.009	0.031	0.024
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Natural gas, mil. m³	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil, kt	0.003	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal, kt	0.02	0.02	0.02	0.04	0.01	0.01	0.01	0.01	0.01	0.01

Sources: for residual fuel oil – 'Soci-economic development of ATULBD' for years 2009-2021, Section 'Material and energy resources'; for natural gas – JSC 'Moldovagaz' by letters No. 07-730 of 06.06.2007; No. 02/1-476 of 23.02.2011; No. 02/1-288 of 22.01.2014; No. 02/1-507 of 10.02.2015; No. 02/1-2183 of 03.06.2016, and No. 03/2-74 No. 12.01.2018, answer to Letter No. 601/2017-12-03 of 14.12.2017. Press Release 'The State of Housing and Communal Services of ATULBD' for years 2011-2021.

Table 3-161: Fuel consumption within source category lA4ci 'Stationary' on the territory of the RBDR between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Diesel	1,078	1,206	720	235	59	NO	117	88	264	117	NO
Residual fuel oil	241	1,005	683	200	88	NO	NO	29	NO	NO	NO
Kerosene	43	3,429	2,428	246	29	29	NO	NO	NO	NO	147
Other petroleum products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Anthracite	561	405	250	94	59	29	29	29	NO	NO	NO
Bituminous coal	NO	3,910	3,834	120	88	59	59	NO	29	NO	NO
Lignite	NO	NO	NO	18	NO	NO	NO	NO	NO	NO	NO
Natural gas	68	67	67	67	88	147	176	352	293	176	176
Fuelwood/wood waste	36	27	18	12	29	29	29	29	NO	NO	NO
Other solid biomass	NO	NO	NO	29	29	NO	29	117	29	NO	NO
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Diesel	NO	NO	NO	NO	NO	NO	NO	NO	1	NO	2
Residual fuel oil	NO	NO	NO	1	3	2	NO	2	1	NO	1
Kerosene	205	59	29	20	9	2	NO	NO	NO	NO	NO
Other petroleum products	NO	NO	NO	NO	2	NO	NO	NO	1	NO	NO
Anthracite	NO	NO	NO	7	4	3	NO	1	2	2	5
Bituminous coal	NO	NO	NO	3	2	2	2	1	NO	NO	NO
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	117	117	177	259	111	65	29	100	74	96	86
Fuelwood/wood waste	29	NO	29	8	15	18	13	10	19	25	15
Other solid biomass	NO	NO	NO	2	7	12	2	1	2	6	NO
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Diesel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil	NO	3	NO	NO	NO	NO	NO	NO	NO	NO	2
Kerosene	NO	NO	NO	NO	NO	NO	NO	3	3	NO	NO
Other petroleum products	NO	NO	NO	1	2	4	2	NO	NO	NO	NO
Anthracite	NO	11	12	29	28	44	40	45	52	80	88
Bituminous coal	6	9	6	NO	NO	4	NO	NO	NO	NO	6
Lignite	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Natural gas	132	148	70	89	86	88	122	128	133	227	235
Fuelwood/wood waste	31	29	39	27	42	44	41	38	42	39	35
Other solid biomass	2	3	5	2	6	5	6	6	18	16	11

Source: EBs of the RoM for years 1990 and 1993-2022.

Table 3-162 and Figure 3-21 below show the fuel consumption by type of fuel under source category 1A4ci 'Agriculture/Forestry/Fishing' ('Stationary') between 1990 and 2022.

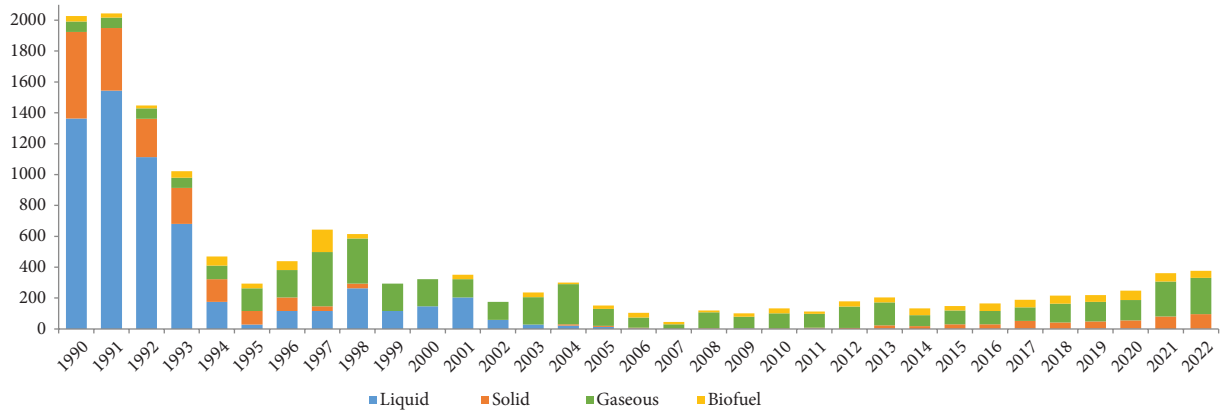


Figure 3-21: Fuel consumption under source category 1A4ci 'Stationary' between 1990-2022, TJ.

Liquid fuels consumption had decreased in the respective period by 99.9% (from 1,363 TJ in 1990 to 2 TJ in 2022); solid fuels consumption had decreased by 83.2% (from 561 TJ in 1990 to 94 TJ in 2022); gaseous fuels consumption had increased by circa 3.5 times (from 68 TJ in 1990 to 235 TJ in 2022); and biofuels consumption had increased by 27.9% (from 36 TJ in 1990 to 46 TJ in 2022).

Table 3-162: Consumption by type of fuel within source category 1A4ci 'Stationary' between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Liquid fuels	1,363	1,544	1,112	681	176	29	117	117	264	117	147
Solid fuels	561	405	250	232	147	88	88	29	29	NO	NO
Gaseous fuels	68	67	67	67	88	147	176	352	293	176	176
Biofuels	36	27	18	41	58	29	58	146	29	NO	NO
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Liquid fuels	205	59	29	21	14	4	NO	2	3	0.1	3
Solid fuels	NO	NO	NO	10	6	5	2	2	2	2	6
Gaseous fuels	117	117	177	259	111	65	29	103	74	99	89
Biofuels	29	NO	29	10	22	30	15	11	21	31	15
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Liquid fuels	0.1	3	NO	1	2	4	2	3	3	NO	2
Solid fuels	7	21	19	30	29	48	40	45	52	80	94
Gaseous fuels	139	148	70	89	86	88	122	128	133	227	235
Biofuels	33	32	44	29	48	49	51	44	60	55	46

1A4cii 'Mobile'

For the territory on the LBDR, activity data on fuel consumption in source category 1A4cii 'Mobile' is available for diesel and gasoline consumption between 1995-2015 (Table 3-163).

Table 3-163: Fuel consumption in source category 1A4cii 'Mobile' on the territory of the LBDR between 1995-2015, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
Diesel	26.8	21.4	28.6	22.1	20.4	14.6	14.4	11.2	7.7	6.9	4.9
Gasoline	9.7	6.1	8.9	5.8	3.1	1.8	1.7	1.2	1.3	0.8	0.6
	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016-2022
Diesel	4.0	2.9	2.7	3.5	7.4	8.4	9.2	10.5	10.2	9.7	NE
Gasoline	0.6	0.4	0.3	0.4	0.6	0.6	0.6	0.8	0.7	0.6	NE

Surse: Statistical Yearbooks of ATULBD for the period 2000-2021.

Activity data for the RBDR is available on the consumption of diesel, gasoline and liquefied petroleum gases (Table 3-164).

Table 3-164: Fuel consumption within source category lA4cii 'Mobile' on the territory of the RBDR between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Diesel	18,403	11,792	7,236	6,518	8,106	7,684	6,021	5,598	4,066	2,720	2,192
Gasoline	306	280	166	59	117	88	205	147	88	59	29
LPG	46	NO	NO	15	NO	NO	NO	NO	NO	NO	NO
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Diesel	2,112	2,773	2,664	2,370	2,147	2,156	1,885	1,805	1,639	1,670	1,578
Gasoline	29	NO	NO	NO	12	3	6	5	6	4	11
LPG	NO	NO	NO	2	2	2	1	3	6	9	8
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Diesel	1,464	1,604	2,112	2,401	2,722	3,721	3,707	4,221	4,180	5,457	4,543
Gasoline	9	NO	15	NO	13	15	5	8	11	9	10
LPG	5	6	7	5	4	6	3	3	4	5	10

Figure 3-22 shows the fuel consumption under source category 1A4c 'Agriculture/Forestry/Fishing' ('Mobile') between 1990 and 2022.

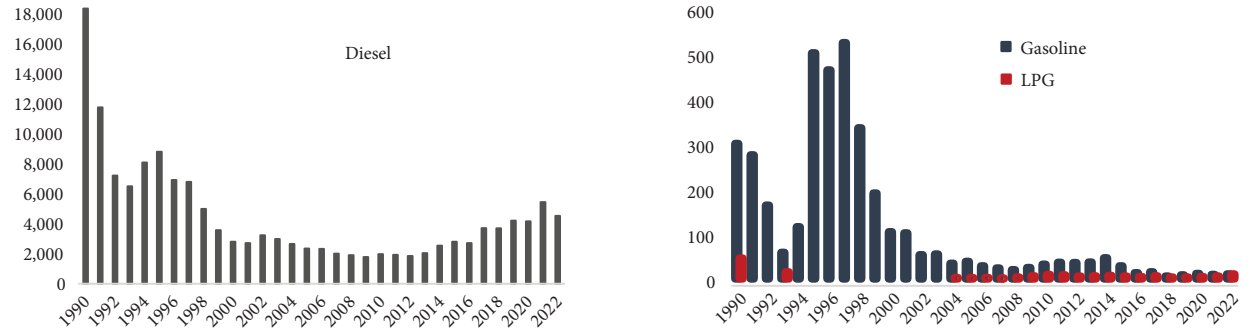


Figure 3-22: Fuel consumption in source category 1A4cii 'Mobile' between 1990-2022, TJ.

Table 3-165 shows the fuel consumption by type of fuel recorded in source category 1A4c 'Agriculture/Forestry/Fishing' ('Mobile') between 1990 and 2022. We may observe that the consumption of gasoline had decreased in the respective period by circa 31 times, LPG consumption – by circa 5 times, and diesel and total consumption – by circa 4 times.

Table 3-165: Total fuel consumption within source category lA4cii 'Mobile' between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Diesel	18,403	11,792	7,236	6,518	8,106	8,823	6,933	6,814	5,006	3,588	2,811
Gasoline	306	280	166	59	117	511	472	534	341	193	106
LPG	46	NO	NO	15	NO	NO	NO	NO	NO	NO	NO
Total	**18,755**	**12,072**	**7,402**	**6,592**	**8,223**	**9,334**	**7,405**	**7,349**	**5,347**	**3,781**	**2,916**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Diesel	2,723	3,248	2,993	2,665	2,354	2,328	2,009	1,917	1,788	1,986	1,935
Gasoline	103	53	55	34	39	28	23	20	24	32	36
LPG	NO	NO	NO	2	2	2	1	3	6	9	8
Total	**2,826**	**3,301**	**3,048**	**2,701**	**2,395**	**2,358**	**2,034**	**1,940**	**1,818**	**2,027**	**1,979**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Diesel	1,858	2,050	2,548	2,815	2,722	3,721	3,707	4,221	4,180	5,457	4,543
Gasoline	36	37	47	28	13	15	5	8	11	9	10
LPG	5	6	7	5	4	6	3	3	4	5	10
Total	**1,898**	**2,093**	**2,602**	**2,848**	**2,739**	**3,742**	**3,715**	**4,232**	**4,195**	**5,471**	**4,563**

3.6.3. Uncertainties and Time Series Consistency

The primary uncertainty-related factors pertain to methodology, emission factors used in the estimation of GHG emissions from source category 1A4 'Other Sectors', and the quality of activity data available. Uncertainties associated with EFs utilised in the estimation of CO_2 emissions are estimated to be circa 5%, whereas for CH_4 and N_2O – up to ±50%. Uncertainties associated with activity data

regarding fuel consumption within source category 1A4 'Other Sectors' constitute circa 5% for CO_2 and CH_4 emissions, and circa 3% for N_2O emissions, respectively.

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.6.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for 1A4 'Other Sectors' category, following the Tier 1 approach. It should be noted that the AD and methods used for the estimation of GHG emissions under the respective category were documented and archived both in hard copies and electronically. In order to identify the data entry and emission estimation process related errors, verifications and quality control procedures have been applied.

The verification and quality control procedures applied in the calculation process for category 1A4 'Other Sectors' included:

- verifying if the same method has been used for the entire range of years;
- verifying if GHG emissions calculations have been made for all years and for all types of fuels included in the Energy Balances and other relevant reference sources;
- verifying to what extent the full geographical coverage of the national GHG inventory of the RoM is ensured;
- verifying the inter-annual evolution trends of emissions by creating representative charts, while unusual fluctuations are explained;
- verifying maintenance and completion of the national inventory of GHG emissions archive.

3.6.5. Recalculations

Recalculations made in the current cycle are associated with the use of GWP values for the 100-year horizon available in the IPCC AR5 (2014), instead of those available in the IPCC AR4 (2007): for CH_4 – 28 (instead of 25), for N_2O – 265 (instead of 298). The direct GHG emissions for years 2021 and 2022 have been estimated for the first time (Table 3-166).

Table 3-166: Recalculations of GHG emissions for the period 1990-2020, included in the NC5 of the RoM to the UNFCCC (1A4 'Other Sectors'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	7,841.31	6,248.30	4,221.52	2,240.23	2,227.11	2,286.22	2,411.71	2,611.65	2,156.43	1,875.25	1,552.95
BTR1	7,855.70	6,259.50	4,228.10	2,238.79	2,226.08	2,281.29	2,411.51	2,609.85	2,154.67	1,874.96	1,553.40
Difference, %	0.2	0.2	0.2	-0.1	0.0	-0.2	0.0	-0.1	-0.1	0.0	0.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	1,488.15	1,814.59	2,161.78	2,325.26	2,283.75	2,274.88	1,721.37	1,732.08	1,881.51	2,047.36	2,375.67
BTR1	1,488.25	1,815.02	2,163.57	2,326.51	2,285.56	2,277.37	1,722.83	1,733.67	1,883.51	2,049.60	2,378.26
Difference, %	0.0	0.0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	2,341.96	2,021.66	2,067.07	1,939.22	1,925.30	2,175.96	2,267.80	2,393.79	2,332.06		
BTR1	2,345.27	2,024.94	2,075.21	1,947.77	1,934.72	2,188.91	2,290.05	2,412.41	2,350.07	2,711.79	2,217.25
Difference, %	0.1	0.2	0.4	0.4	0.5	0.6	1.0	0.8	0.8		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC, BTR1– First Biennial Transparency Report of the RoM to the UNFCCC.

3.6.6. Planned Improvements

Potential improvements within source category 1A4 'Other Sectors' could be possible should there be available AD on fuel consumption on the territory of the LBDR for all emission sources considered within this category.

3.7. Other (source category 1A5)

3.7.1. Source category description

Category 1A5 'Other' includes GHG emissions from fuel combustion for energy purposes and other needs, including military transportation. The respective category includes two emission sources: 1A5a 'Stationary' (all types of fuels, except diesel, gasoline, aviation gasoline and kerosene) and 1A5b 'Mobile', including 1A5bi 'Mobile' ('Aviation component') (aviation gasoline and kerosene), and 1A5biii 'Mobile' (Other) (diesel and gasoline). Between 1990 and 2022, GHG emissions from source category 1A5 'Other' recorded a downward trend, decreasing by circa 97.7%: from circa 115.5 kt CO_2 equivalent in 1990 to circa 2.7 kt CO_2 equivalent in 2022 (Table 3-167).

Table 3-167: Direct GHG emissions from source category 1A5 'Other' between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
1A5, kt CO_2 equivalent	115.46	107.48	78.47	94.26	88.99	126.51	82.76	77.41	73.64	49.77	36.78
%, compared to 1990	100.0	93.1	68.0	81.6	77.1	109.6	71.7	67.1	63.8	43.1	31.9
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
1A5, kt CO_2 equivalent	43.86	40.10	28.79	28.00	26.26	39.46	45.08	44.13	10.59	27.51	19.94
%, compared to 1990	38.0	34.7	24.9	24.2	22.7	34.2	39.0	38.2	9.2	23.8	17.3
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A5, kt CO_2 equivalent	7.00	2.39	2.42	1.83	1.22	1.17	1.19	1.25	1.19	1.60	2.70
%, compared to 1990	6.1	2.1	2.1	1.6	1.1	1.0	1.0	1.1	1.0	1.4	2.3

Carbon dioxide has the largest share in the structure of total direct GHG emissions originated from source category 1A5 'Other', followed by nitrous oxide and methane emissions (Table 3-168).

Table 3-168: Direct GHG emissions from source category 1A5 'Other' between 1990-2022, by gases

	1A5, kt CO_2 equivalent				Share of total, %		
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O
1990	113.97	0.31	1.18	115.46	98.7	0.3	1.0
1991	106.37	0.20	0.91	107.48	99.0	0.2	0.8
1992	77.75	0.13	0.60	78.47	99.1	0.2	0.8
1993	93.45	0.16	0.65	94.26	99.1	0.2	0.7
1994	88.36	0.19	0.43	88.99	99.3	0.2	0.5
1995	125.64	0.29	0.58	126.51	99.3	0.2	0.5
1996	81.84	0.31	0.62	82.76	98.9	0.4	0.7
1997	76.66	0.23	0.53	77.41	99.0	0.3	0.7
1998	72.83	0.25	0.56	73.64	98.9	0.3	0.8
1999	49.16	0.18	0.43	49.77	98.8	0.4	0.9
2000	36.39	0.13	0.27	36.78	98.9	0.3	0.7
2001	43.40	0.14	0.32	43.86	99.0	0.3	0.7
2002	39.45	0.23	0.42	40.10	98.4	0.6	1.0
2003	28.42	0.12	0.25	28.79	98.7	0.4	0.9
2004	27.64	0.09	0.27	28.00	98.7	0.3	1.0
2005	25.94	0.07	0.25	26.26	98.8	0.3	1.0
2006	39.04	0.08	0.34	39.46	98.9	0.2	0.9
2007	44.51	0.11	0.46	45.08	98.7	0.2	1.0
2008	43.63	0.10	0.41	44.13	98.8	0.2	0.9
2009	10.49	0.03	0.07	10.59	99.1	0.3	0.6
2010	27.30	0.06	0.15	27.51	99.2	0.2	0.5
2011	19.79	0.04	0.11	19.94	99.3	0.2	0.6
2012	6.93	0.02	0.05	7.00	99.0	0.2	0.7
2013	2.35	0.01	0.03	2.39	98.4	0.3	1.2
2014	2.38	0.01	0.03	2.42	98.4	0.4	1.2
2015	1.80	0.01	0.02	1.83	98.4	0.4	1.2
2016	1.20	0.01	0.02	1.22	98.2	0.5	1.3
2017	1.15	0.01	0.02	1.17	98.1	0.6	1.3
2018	1.17	0.01	0.02	1.19	98.2	0.5	1.3
2019	1.23	0.01	0.02	1.25	98.1	0.6	1.3
2020	1.16	0.01	0.02	1.19	98.1	0.6	1.3
2021	1.57	0.01	0.02	1.60	98.3	0.4	1.3
2022	2.64	0.04	0.03	2.70	97.5	1.6	1.0

The evolution of direct and indirect GHG emissions from source category 1A5 'Other' is presented below (Table 3-169).

Table 3-169: Direct and indirect GHG emissions from 1A5 'Other' between 1990-2022

	1A5, kt							%, compared to the 1990 year						
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2
1990	113.9722	0.0109	0.0044	0.7597	0.8286	0.1226	0.3256	100.0	100.0	100.0	100.0	100.0	100.0	100.0
1991	106.3685	0.0072	0.0034	0.6579	0.6170	0.0855	0.2949	93.3	66.4	77.2	86.6	74.5	69.8	90.6
1992	77.7474	0.0046	0.0023	0.4776	0.3429	0.0514	0.1691	68.2	42.3	50.6	62.9	41.4	42.0	51.9
1993	93.4518	0.0058	0.0024	0.4591	0.6253	0.0853	0.3659	82.0	53.4	55.0	60.4	75.5	69.6	112.4
1994	88.3648	0.0069	0.0016	0.3325	0.6071	0.0863	0.2749	77.5	63.0	36.4	43.8	73.3	70.4	84.4
1995	125.6438	0.0104	0.0022	0.5138	0.6299	0.1015	0.2763	110.2	95.0	48.8	67.6	76.0	82.8	84.9
1996	81.8376	0.0109	0.0023	0.4423	0.4659	0.0987	0.2121	71.8	100.1	52.3	58.2	56.2	80.6	65.2
1997	76.6587	0.0081	0.0020	0.2875	0.4997	0.0785	0.2175	67.3	74.0	44.9	37.8	60.3	64.1	66.8
1998	72.8283	0.0088	0.0021	0.3919	0.5862	0.1041	0.2211	63.9	81.1	47.4	51.6	70.7	84.9	67.9
1999	49.1563	0.0065	0.0016	0.1458	0.3630	0.0640	0.1731	43.1	59.6	36.4	19.2	43.8	52.3	53.2
2000	36.3881	0.0046	0.0010	0.1311	0.2320	0.0421	0.1628	31.9	42.0	22.8	17.2	28.0	34.4	50.0
2001	43.3961	0.0050	0.0012	0.1565	0.3569	0.0605	0.1131	38.1	46.0	27.2	20.6	43.1	49.4	34.7
2002	39.4529	0.0083	0.0016	0.1411	0.2860	0.0683	0.1648	34.6	76.2	35.4	18.6	34.5	55.7	50.6
2003	28.4228	0.0043	0.0009	0.1427	0.2811	0.0524	0.1155	24.9	39.0	21.0	18.8	33.9	42.8	35.5
2004	27.6373	0.0031	0.0010	0.2161	0.2875	0.0472	0.0418	24.2	28.7	23.0	28.4	34.7	38.5	12.8
2005	25.9403	0.0024	0.0010	0.2301	0.1272	0.0300	0.0446	22.8	21.8	21.4	30.3	15.3	24.5	13.7
2006	39.0397	0.0029	0.0013	0.3325	0.4037	0.0635	0.1297	34.3	26.5	28.7	43.8	48.7	51.8	39.8
2007	44.5097	0.0039	0.0017	0.3855	0.3075	0.0552	0.1051	39.1	35.8	38.7	50.7	37.1	45.1	32.3
2008	43.6263	0.0036	0.0015	0.3223	0.3060	0.0503	0.1248	38.3	33.1	34.5	42.4	36.9	41.0	38.3
2009	10.4909	0.0011	0.0003	0.1018	0.1540	0.0251	0.0193	9.2	10.5	5.8	13.4	18.6	20.5	5.9
2010	27.2976	0.0023	0.0006	0.1245	0.2519	0.0434	0.1060	24.0	21.3	12.4	16.4	30.4	35.4	32.6
2011	19.7870	0.0013	0.0004	0.1531	0.3469	0.0449	0.0941	17.4	11.7	9.6	20.2	41.9	36.7	28.9
2012	6.9340	0.0006	0.0002	0.0536	0.1342	0.0157	0.0050	6.1	5.5	4.2	7.1	16.2	12.8	1.5
2013	2.3493	0.0003	0.0001	0.0403	0.0297	0.0037	0.0003	2.1	2.6	2.5	5.3	3.6	3.0	0.1
2014	2.3839	0.0003	0.0001	0.0102	0.0333	0.0025	0.0002	2.1	3.1	2.5	1.3	4.0	2.0	0.1
2015	1.7977	0.0003	0.0001	0.0092	0.0249	0.0020	0.0002	1.6	2.4	1.9	1.2	3.0	1.6	0.1
2016	1.1989	0.0002	0.0001	0.0080	0.0128	0.0017	0.0000	1.1	2.1	1.4	1.1	1.5	1.4	0.0
2017	1.1523	0.0002	0.0001	0.0089	0.0136	0.0019	0.0000	1.0	2.2	1.3	1.2	1.6	1.5	0.0
2018	1.1691	0.0002	0.0001	0.0093	0.0153	0.0018	0.0000	1.0	2.1	1.3	1.2	1.8	1.5	0.0
2019	1.2306	0.0003	0.0001	0.0090	0.0218	0.0022	0.0000	1.1	2.5	1.4	1.2	2.6	1.8	0.0
2020	1.1638	0.0002	0.0001	0.0088	0.0212	0.0020	0.0000	1.0	2.3	1.3	1.2	2.6	1.6	0.0
2021	1.5705	0.0002	0.0001	0.0137	0.0167	0.0020	0.0000	1.4	2.2	1.8	1.8	2.0	1.6	0.0
2022	2.6360	0.0015	0.0001	0.0210	0.0305	0.0031	0.0000	2.3	13.8	2.2	2.8	3.7	2.5	0.0

In 2022, the level of direct and indirect GHG emissions from source category 1A5 'Other' constituted, in the case of CO_2 emissions – 2.3% of the level recorded in 1990 year; whereas for CH_4 emissions – 13.8%, N_2O – 2.2%, NO_x – 2.8%, CO – 3.7%, NMVOC – 2.5% and SO_2 – 0.0%.

The evolution of GHG emissions originating from source category 1A5 'Other' between 1990 and 2022 by source ('Stationary' and 'Mobile') is presented below (Table 3-170).

Table 3-170: Direct GHG emissions, disaggregated by source, in category 1A5 'Other' between 1990-2022

	1A5a 'Stationary', kt				1A5b 'Mobile', kt				1A5, kt	Share, % of total	
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	Total	1A5a	1A5b
1990	41.96	0.06	0.19	42.21	72.01	0.25	0.98	73.24	115.46	36.6	63.4
1991	51.51	0.03	0.16	51.70	54.86	0.17	0.75	55.78	107.48	48.1	51.9
1992	42.59	0.03	0.11	42.74	35.16	0.09	0.48	35.74	78.47	54.5	45.5
1993	62.13	0.06	0.22	62.41	31.32	0.11	0.43	31.85	94.26	66.2	33.8
1994	71.33	0.07	0.21	71.60	17.04	0.12	0.22	17.38	88.99	80.5	19.5
1995	104.41	0.14	0.30	104.84	21.24	0.15	0.28	21.67	126.51	82.9	17.1
1996	58.79	0.17	0.31	59.27	23.05	0.13	0.31	23.49	82.76	71.6	28.4

	1A5a 'Stationary', kt				1A5b 'Mobile', kt				1A5, kt	Share, % of total	
	CO_2	CH_4	N_2O	Total	CO_2	CH_4	N_2O	Total	Total	1A5a	1A5b
1997	51.79	0.09	0.20	52.08	24.87	0.14	0.33	25.34	77.41	67.3	32.7
1998	50.44	0.13	0.26	50.83	22.39	0.11	0.30	22.80	73.64	69.0	31.0
1999	30.99	0.09	0.18	31.27	18.17	0.09	0.24	18.50	49.77	62.8	37.2
2000	26.59	0.06	0.14	26.78	9.80	0.07	0.13	10.00	36.78	72.8	27.2
2001	28.78	0.06	0.12	28.96	14.62	0.08	0.20	14.89	43.86	66.0	34.0
2002	25.37	0.13	0.23	25.73	14.08	0.10	0.19	14.37	40.10	64.2	35.8
2003	20.41	0.07	0.14	20.63	8.01	0.04	0.11	8.16	28.79	71.6	28.4
2004	11.40	0.03	0.05	11.48	16.24	0.06	0.22	16.52	28.00	41.0	59.0
2005	11.70	0.03	0.06	11.79	14.24	0.04	0.20	14.47	26.26	44.9	55.1
2006	21.48	0.04	0.10	21.61	17.56	0.04	0.24	17.84	39.46	54.8	45.2
2007	17.80	0.04	0.09	17.92	26.71	0.07	0.37	27.15	45.08	39.8	60.2
2008	20.36	0.03	0.09	20.48	23.27	0.07	0.32	23.66	44.13	46.4	53.6
2009	7.47	0.02	0.03	7.52	3.02	0.02	0.04	3.07	10.59	71.0	29.0
2010	23.80	0.05	0.10	23.94	3.50	0.02	0.05	3.57	27.51	87.0	13.0
2011	15.93	0.02	0.06	16.01	3.86	0.02	0.05	3.93	19.94	80.3	19.7
2012	3.59	0.00	0.00	3.59	3.35	0.01	0.04	3.41	7.00	51.3	48.7
2013	0.21	0.00	0.00	0.21	2.14	0.01	0.03	2.18	2.39	8.7	91.3
2014	0.18	0.00	0.00	0.18	2.20	0.01	0.03	2.24	2.42	7.5	92.5
2015	0.15	0.00	0.00	0.16	1.64	0.01	0.02	1.67	1.83	8.5	91.5
2016	NO	NO	NO	NO	1.20	0.01	0.02	1.22	1.22	NO	100.0
2017	NO	NO	NO	NO	1.15	0.01	0.02	1.17	1.17	NO	100.0
2018	NO	NO	NO	NO	1.17	0.01	0.02	1.19	1.19	NO	100.0
2019	NO	NO	NO	NO	1.23	0.01	0.02	1.25	1.25	NO	100.0
2020	NO	NO	NO	NO	1.16	0.01	0.02	1.19	1.19	NO	100.0
2021	NO	NO	NO	NO	1.57	0.01	0.02	1.60	1.60	NO	100.0
2022	NO	NO	NO	NO	2.64	0.04	0.03	2.70	2.70	NO	100.0

3.7.2. Methodologies, Emission Factors and Activity Data

Direct GHG emissions originating from source category 1A5 'Other' were estimated following the Tier 1 methodology, available in the 2006 IPCC Guidelines, based on AD on fuel consumption and default EFs. In order to estimate non-CO_2 emissions, default EFs were used, available in the 2023 EMEP/EEA Air Pollutant Emission Inventory Guidebook (Table 3-171).

Table 3-171: Emission factors utilised for the estimation of GHG emissions from source category 1A5 'Other', kg/TJ – for direct GHGs and kg/t fuel – for indirect GHGs

	Emission factors							Reference sources for:	
	kg/TJ			kg/t fuel					
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2, CH_4,N_2O	NO_x, CO, NMVOC and SO_2
1A5a 'Stationary'									
Anthracite	98,300	1	1.5	173	931	88.8	900	2006 IPCC Guidelines, Volume 2, Table 2.2	EMEP/EEA Guidebook (2023), Categories 1.A.4.a/c. 1.A.5.a
Brown coal, lignite	101,000	1	1.5	173	931	88.8	900		
Other bituminous coal	94,600	1	1.5	173	931	88.8	900		
Coke	107,000	1	1.5	173	931	88.8	900		
Fuel for oven	71,900	3	0.6	306	93	20	94		
Residual fuel oil	77,400	3	0.6	306	93	20	94		
Kerosene	71,900	3	0.6	306	93	20	94		
Other petroleum products	73,300	3	0.6	306	93	20	94		
Natural gas	56.100	1	0.1	74	29	23	0.67		
LPG	63,100	1	0.1	74	29	23	0.67		
Fuelwood	112,000	30	4	91	570	300	11		
Other types of fuel	100,000	30	4	91	570	300	11		
Wood waste	112,000	30	4	91	570	300	11		
Agricultural residues	100,000	30	4	91	570	300	11		
Biogas	54,600	1	0.1	74	29	23	0.67		

	Emission factors							Reference sources for:	
	kg/TJ			kg/t fuel					
	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_2	CO_2, CH_4,N_2O	NO_x, CO, NMVOC and SO_2
1A5bi 'Mobile' (Aviation transport)									
Aviation gasoline	70,000	0.5	2	4	1,200	19	1	2006 IPCC Guidelines, Volume 2, Table 3.6.4 and Table 3.6.5	EMEP/EEA Guidebook (2023), Categories 1.A.3.a. 1.A.5.b. 1.A.3.a.ii.(i)
Kerosene	71,500	0.5	2	4	1,200	19	1		
1A5biii 'Aviation' (Other types of transport)									
Gasoline	69,300	33	3.2	8.73	84.7	10.05	-	2006 IPCC Guidelines, Volume 2, Table 3.2.1 and Table 3.2.2	EMEP/EEA Guidebook (2023), Categories 1.A.3.b.i. 1.A.3.b.ii. 1.A.3.b.iii. 1.A.3.b.iv. SO_2 emissions are calculated for every single year
Diesel	74,100	3.9	3.9	33.37	7.58	1.92	-		

Activity data

The Energy Balances of the RoM (Chapter S.2.1 'Consumed as Fuel or Energy' and columns: 'For Other Works and Needs' and 'Use for other purposes') have been the main source of reference for AD associated with fuel consumption on the territory of the RBDR. Another relevant reference source was the Ministry of Defence of the RoM, which provides information on fuel combustion for military transportation.

The activity data associated with fuel consumption under category 1A5 'Other', by type of fuel are shown in Table 3-172 and Figure 3-23.

Table 3-172: Total consumption by type of fuel under category 1A5 'Other' between 1990-2022

	Consumption by type of fuel, TJ					Share of total, %			
	Solid	Liquid	Gaseous	Biofuels	Total	Solid	Liquid	Gaseous	Biofuels
1990	334.10	1,066.47	46.06	44.97	1,491.60	22.4	71.5	3.1	3.0
1991	284.79	1,020.76	35.37	NO	1,340.92	21.2	76.1	2.6	NO
1992	142.03	827.60	24.69	NO	994.32	14.3	83.2	2.5	NO
1993	370.00	701.32	114.00	25.00	1,210.32	30.6	57.9	9.4	2.1
1994	261.50	619.31	294.00	31.00	1,205.81	21.7	51.4	24.4	2.6
1995	206.00	1,205.04	235.00	60.00	1,706.04	12.1	70.6	13.8	3.5
1996	176.00	817.76	60.00	149.00	1,202.76	14.6	68.0	5.0	12.4
1997	206.00	636.71	161.50	61.00	1,065.21	19.3	59.8	15.2	5.7
1998	206.00	617.05	118.00	117.50	1,058.55	19.5	58.3	11.1	11.1
1999	177.00	368.20	88.00	88.00	721.20	24.5	51.1	12.2	12.2
2000	176.00	167.56	119.00	58.00	520.56	33.8	32.2	22.9	11.1
2001	117.00	261.64	207.00	59.00	644.64	18.1	40.6	32.1	9.2
2002	176.00	238.30	90.00	145.00	649.30	27.1	36.7	13.9	22.3
2003	117.00	192.67	59.00	75.00	443.67	26.4	43.4	13.3	16.9
2004	43.00	229.98	117.00	27.00	416.98	10.3	55.2	28.1	6.5
2005	47.00	199.33	118.00	31.00	395.33	11.9	50.4	29.8	7.8
2006	141.00	247.43	129.00	33.00	550.43	25.6	45.0	23.4	6.0
2007	113.00	371.99	106.00	37.00	627.99	18.0	59.2	16.9	5.9
2008	134.00	335.79	106.00	27.00	602.79	22.2	55.7	17.6	4.5
2009	19.00	62.58	70.00	14.50	166.08	11.4	37.7	42.1	8.7
2010	115.00	68.32	188.00	43.00	414.32	27.8	16.5	45.4	10.4
2011	104.00	55.00	102.00	16.00	277.00	37.5	19.9	36.8	5.8
2012	5.00	49.94	48.00	1.00	103.94	4.8	48.0	46.2	1.0
2013	NO	31.96	NO	NO	31.96	NO	100.0	NO	NO
2014	NO	32.59	NO	NO	32.59	NO	100.0	NO	NO
2015	NO	24.56	NO	NO	24.56	NO	100.0	NO	NO
2016	NO	16.56	NO	NO	16.56	NO	100.0	NO	NO
2017	NO	15.95	NO	NO	15.95	NO	100.0	NO	NO
2018	NO	16.15	NO	NO	16.15	NO	100.0	NO	NO
2019	NO	17.09	NO	NO	17.09	NO	100.0	NO	NO
2020	NO	16.13	NO	NO	16.13	NO	100.0	NO	NO
2021	NO	21.54	NO	NO	21.54	NO	100.0	NO	NO
2022	C	C	C	C	C	C	C	C	C

It should be noted that the Ministry of Defence have not presented fuel consumption for 2022 for undisclosed reasons. However, they have presented emissions calculated based on the calculation file created by the national expert responsible for the estimation of GHG emissions from this category.

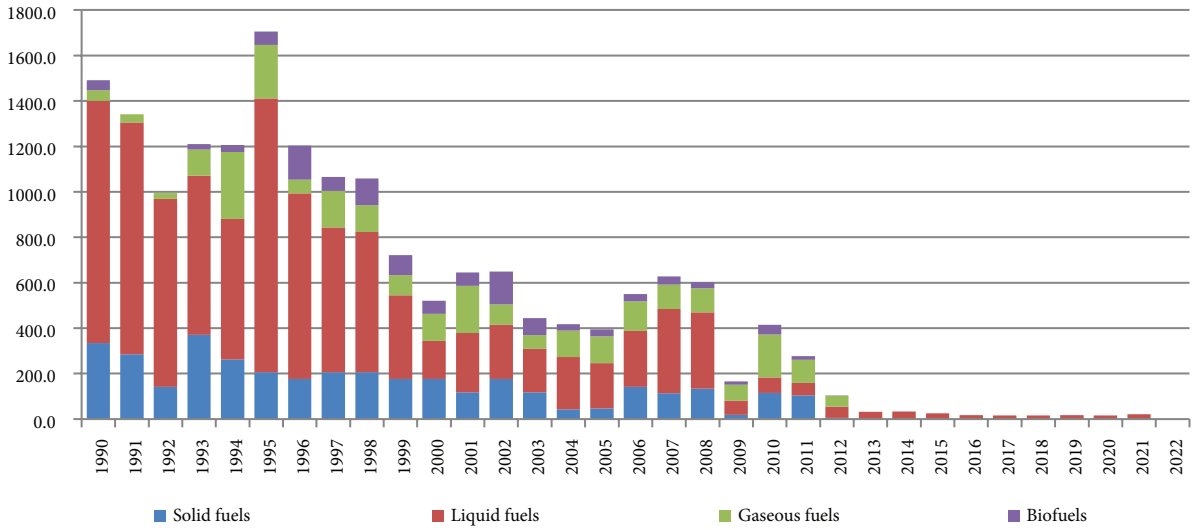


Figure 3-23: Total consumption by type of fuel under category 1A5 'Other' between 1990-2022, TJ.

3.7.3. Uncertainties and Time Series Consistency

The primary factors which affect uncertainties pertain to the estimation methodology, emission factors utilised to calculate GHG emissions from source category 1A5 'Other' and the quality of the available activity data.

Uncertainties associated with activity data on fuel consumption in source category 1A5 'Other' of the Republic of Moldova are estimated to be circa 5% for CO_2 and CH_4 emissions, and circa 3% for N_2O emissions, respectively. Combined uncertainties of total direct GHG emissions from sector 1A5 'Other' were estimated to be circa 7.0%.

In order to ensure the stability over time of the results obtained, the same methodology was used for the entire study period in accordance with sustainable practices applied to the inventory of GHG emissions.

3.7.4. Quality Assurance and Quality Control

Standard verification and QC forms and checklists were filled in for source category 1A5 'Other', following the Tier 1 approach. AD and methods used in the estimation of GHG emissions from category 1A5 'Other' were documented and archived both in hard copies and electronically.

In order to identify the data entry and emission estimation process related errors, verifications and quality control procedures were applied. In accordance with sustainable practices, AD and national EFs from official reference sources were used in the estimation of GHG emissions.

The verification and QC procedures applied in the calculation process for category 1A5 'Other' included:

- verification of AD collecting and manipulation procedures, including: verifying if disaggregation of AD collected for each source category included in category 1A5 'Other' complies with the requirements set out in the description of each source category in the 2006 IPCC Guidelines (for each emission source AD are available in separate files in natural and energy units);
- verifying the correctness of EFs used for each source;
- verifying if the primary reference sources are correctly indicated;
- the accuracy of calculations for sources included in category 1A5 'Other' are verified randomly;
- implementation of error minimization procedures for manual entry of AD, with all the spreadsheets provided with the initial sources of activity data in tabular format;
- in the calculation files, the EFs are specified in tabular formats for each source, the import of the respective values into calculation formulas is ensured by automatic connections;
- the consistency of the calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all sources and the entire range of years covered by the inventory;

- verification if the same method is used for the entire range of years covered by the inventory;
- verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RoM;
- verifying to what extent the full geographical coverage of the national GHG inventory of the RoM is ensured (in the current inventory cycle, GHG emission estimates were made only for the territory on the RBDR;
- verifying the inter-annual evolution trends of emissions by creating representative charts, while unusual fluctuations are explained;
- verifying maintenance and completion of the national inventory of GHG emissions archive.

3.7.5. Recalculations

In the current inventory cycle, recalculations have been made with respect to source category 1A5 'Other' for the period 1990-2020, these being caused by:

- the changes in the global warming potential (GWP) values for the 100-year horizon, available in the IPCC AR5 (2014), instead of those available in the IPCC AR4 (2007);
- the submission by the Ministry of Defence of information on fuel consumption for the operation of military transport for the years 2017-2021, which influenced the increase in emissions from mobile combustion for that period;
- the exclusion of activity data for the territory on the LBDR for the period 2014-2020, which have led to a significant decrease in emissions from stationary combustion for that period; the information source includes 't.c.e.' units of measure and it was not possible to estimate what types of fuel were included.

Direct GHG emissions for 2021 and 2022 have been estimated for the first time. The results obtained show that direct GHG emission from category 1A5 'Other' had decreased in the RM by circa 97.7% between 1990 and 2022 (Table 3-173).

Table 3-173: Recalculations of GHG emissions for the period 1990-2020, included in the NC5 of the RoM to the UNFCCC (1A5 'Other'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	115.57	107.57	78.53	94.33	89.02	126.55	82.80	77.46	73.68	49.80	36.80
BTR1	115.46	107.48	78.47	94.26	88.99	126.51	82.76	77.41	73.64	49.77	36.78
Difference, %	-0.1	-0.1	-0.1	-0.1	0.0	0.0	-0.1	-0.1	-0.1	-0.1	-0.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	43.88	40.13	28.81	28.02	26.28	39.49	45.12	44.17	10.60	27.52	19.95
BTR1	43.86	40.10	28.79	28.00	26.26	39.46	45.08	44.13	10.59	27.51	19.94
Difference, %	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	-0.1	0.0	0.0	-0.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	7.01	2.39	25.16	22.87	22.99	22.74	23.46	22.98	22.49		
BTR1	7.00	2.39	2.42	1.83	1.22	1.17	1.19	1.25	1.19	1.60	2.70
Difference, %	-0.1	-0.1	-938.4	-1,151.9	-1,782.1	-1,835.9	-1,869.8	-1,731.7	-1,796.8		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

3.7.6. Planned Improvements

Potential improvements within source category 1A5 'Other' could be made should new activity data regarding fuel consumption on the LBDR be made available.

3.8. Fugitive Emissions from Oil and Natural Gas (source category 1B2)

3.8.1. Source Category Description

Source category 1B2 'Fugitive Emissions from Oil and Natural Gas' includes GHG emissions originating from oil and natural gas distribution systems, except distribution systems of energy resources which are combusted as fuel.

Distribution systems include the entire infrastructure needed to produce, collect, process, refine and distribute oil products and natural gases to final consumers. The system begins at the well heads and ends at the final sale points to the consumer.

The sources of fugitive emissions from oil and natural gas distribution systems include equipment leaks, evaporation losses, venting, flaring, incineration and accidental releases (e.g., pipeline dig-ins, well blow-outs and spills, etc.).

Between 1990 and 2022, there had been a downward trend in GHG emissions from source category 1B2 'Fugitive Emissions from Oil and Natural Gas', decreasing by circa 77%, from 1,020.7 kt CO_2 equivalent recorded in1990, to la 234.7 kt CO_2 equivalent in 2022 (Table 3-174, Figure 3-24).

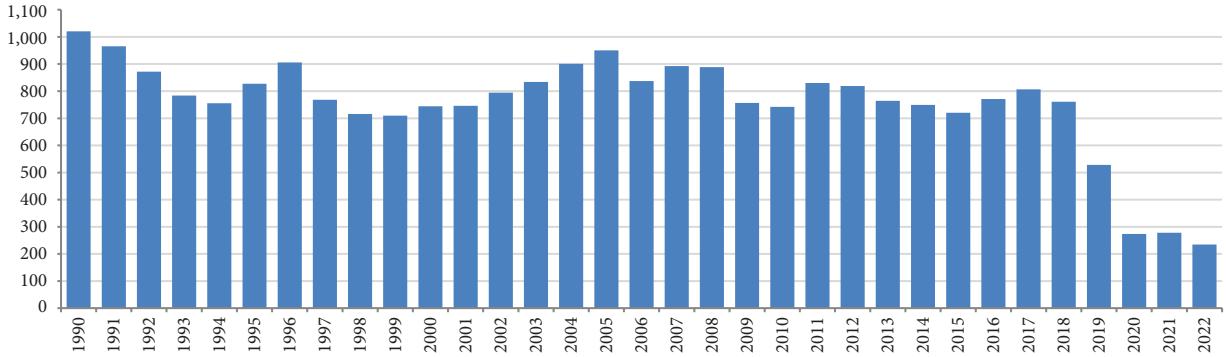


Figure 3-24: GHG emissions from source category 1B2 'Fugitive Emissions from Oil and Natural Gas' between 1990-2022, kt CO_2 equivalent.

Table 3-174: GHG emissions from source category 1B2 'Fugitive Emissions from Oil and Natural Gas' between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2, kt	0.66	0.64	0.54	0.46	0.43	0.44	0.50	0.49	0.45	0.41	0.39
CH_4, kt	36.43	34.46	31.13	27.97	26.96	29.54	32.33	27.41	25.54	25.33	26.56
N_2O, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total, kt CO_2 equivalent	**1,020.70**	**965.59**	**872.04**	**783.70**	**755.27**	**827.44**	**905.78**	**767.99**	**715.61**	**709.73**	**744.21**
NMVOC	0.66	0.62	0.56	0.50	0.49	0.53	0.58	0.49	0.46	0.46	0.48
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
CO_2, kt	0.43	0.41	1.08	1.12	1.14	1.24	1.28	1.29	1.29	1.30	1.33
CH_4, kt	26.62	28.36	29.74	32.12	33.91	29.86	31.84	31.69	26.97	26.45	29.59
N_2O, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total, kt CO_2 equivalent	**745.82**	**794.56**	**833.76**	**900.60**	**950.54**	**837.45**	**892.70**	**888.68**	**756.49**	**741.85**	**829.95**
NMVOC	0.48	0.52	0.58	0.91	0.82	0.71	0.90	1.18	1.17	0.92	1.06
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
CO_2, kt	1.33	1.66	1.69	1.68	1.69	1.68	1.69	1.63	1.58	1.58	1.52
CH_4, kt	29.19	27.24	26.71	25.66	27.47	28.75	27.11	18.80	9.71	9.87	8.33
N_2O, kt	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total, kt CO_2 equivalent	**818.70**	**764.49**	**749.49**	**720.25**	**770.95**	**806.57**	**760.78**	**528.10**	**273.49**	**278.04**	**234.70**
NMVOC	0.97	0.90	0.81	0.75	0.74	0.73	0.69	0.54	0.40	0.36	0.34

3.8.2. Methodologies, Emission Factors and Activity Data

GHG emissions originating from source category 1B2 'Fugitive Emissions from Oil and Natural Gas' were estimated following the Tier 1 methodology (2006 IPCC Guidelines). Fugitive emissions of CH_4, N_2O, CO_2 and NMVOC were monitored.

The basic equations used in the estimation of GHG emissions under this source category are:

$$E_{gas,\ industry\ segment} = A_{industry\ segment} \bullet EF_{gas,\ industry\ segment}$$

$$E_{gas} = \Sigma\, E_{gas,\ industry\ segment}$$

where:

$E_{gas,\ industry\ segment}$ – annual emissions (kt);

$A_{industry\ segment}$ – activity data for the respective industry segment;

$EF_{gas,\ industry\ segment}$ – emission factor (kt/activity unit).

Average default EF values were used in the estimation of GHG emission according to the 2006 IPCC Guidelines (Tables 3-175, 3-176, 3-177, and 3-178).

Table 3-175: EF values from well drilling, testing and servicing

Category	Source	CO_2	CH_4	N_2O	NMVOC
		Ranges and average for EF values used			
Oil and natural gas well drilling, kg/well/yr	1B2a ii, 1B2b ii	100-1,700	33-560	-	0.87-15.0
		900	**296.5**		**7.935**
Oil and natural gas well testing, kg/well/yr	1B2a ii, 1B2b ii	9,000-150,000	51-850	0.068-1.1	12-200
		79,500	**450.5**	**0.584**	**106**
Oil and natural gas well exploitation, kg/well/yr	1B2a ii, 1B2b ii	1.9-32.0	110-1,800	-	17-280
		17	**955**		**148.5**

Table 3-176: EF values from oil extraction, transportation and storage

Category	Source	CO_2	CH_4	N_2O	NMVOC
		Ranges and average for EF values used			
Fugitive emissions from oil production, kg/1000 m^3/yr	1B2a iii 2	0.1-4,300	1,5-60,000	-	1.8-75,000
		2,150	**30,000.8**		**37,500.9**
Ventilation at oil extraction, kg/1000 m^3/yr	1B2a i	95-130	720-990	-	430-590
		112.5	**855**		**510**
Flaring at oil production, kg/1000 m^3/yr	1B2a ii	41,000-56,000	25-34	0.64-0.88	21-29
		48,500	**30**	**0.76**	**25**
Oil transportation in tanks, kg/1000 m^3/yr	1B2a i	**2.30**	**25**	**-**	**250**

Table 3-177: EF values from natural gas extraction, transportation and distribution

Category	Source	CO_2	CH_4	N_2O	NMVOC
		Ranges and average for EF values used			
Fugitive emissions from natural gas production, kg/million m^3/yr	1B2b iii 2	14-180	380-24,000	-	91-1,200
		97	**12,190**		**645.5**
Fugitive emissions from natural gas transportation, kg/million m^3/yr	1B2b iii 4	0.88-2.00	166-1,100	-	7.0-16.0
		1.44	**633**		**11.50**
Fugitive emissions from natural gas distribution, kg/million m^3/yr	1B2b iii 5	51-140	1,100-2,500	-	16-36
		95.5	**1,800**		**26**
Flaring at natural gas production, kg/million m^3/yr	1B2b ii	1,200-1600	0.76-1.00	0.021-0.029	0.62-0.85
		1,400	**0.88**	**0.025**	**0.74**
Ventilation at natural gas transportation, kg/million m^3/yr	1B2b i	3.1-7.3	44-740	-	4.6-11.0
		5.20	**392**		**7.80**

Table 3-178: EF values from LPG transportation

Category	Source	CO_2	CH_4	N_2O	NMVOC
Fugitive emissions from liquefied petroleum gas transportation, kg/1000 m^3/yr	1B2a iii 3	430	-	0.0022	-

Activity Data

Activity data associated with crude oil and natural gas extraction, and those associated with liquefied petroleum gas consumption, respectively, are available in the Energy Balances of the RoM.

In the RoM, crude oil is extracted from the crude oil field in the vicinity of Valeni village, Cahul district. Economically efficient crude oil reserves are estimated at circa 0.5-1.0 Mt. Extraction is carried out at about 15 wells. The amount of crude oil extracted during the mentioned period varied between 1 and 17 kt annually or between 1 and 18 thousand m^3 annually (Table 3-179).

Table 3-179: Crude oil extraction in the RoM between 2003-2022

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Crude oil, kt	1	8	5	4	8	15	17	11	13	11
Crude oil, thousand m^3	1.00	8.50	5.31	4.25	8.50	15.94	18.07	11.69	13.82	11.69
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Crude oil, kt	10	8	7	6	5	5	5	6	5	5
Crude oil, thousand m^3	10.63	8.50	7.44	6.38	5.31	5.31	5.31	6.38	5.31	5.31

Source: Energy Balances of the Republic of Moldova for years 2003-2022.

The density of the crude oil from Valeni field is circa 0.941 t/m^3 (according to the information from the *Inspectorate for Environmental Protection Report 'Norms of limited permissible emissions of pollutants in the atmospheric air'. Exploitation of 'Valeni' Crude Oil Field, 2015*).

Natural gas extraction is currently carried out at about six wells in the natural gas field near Victorovca village (Table 3-180). In 2020, according to NBS data, the volume of natural gas extracted on the territory of the Republic of Moldova was zero. The extracted natural gas is supplied to the population of the neighbouring settlements: Ciobalaccia, Suhata, Baimaclia, Flocoasa and Victorovca.

Table 3-180: Natural gas extraction between 2005-2022

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Natural gas extraction, mil. m^3	0.24	0.15	0.12	0.15	0.24	0.09	0.06	0.12	0.12
	2014	2015	2016	2017	2018	2019	2020	2021	2022
Natural gas extraction, mil. m^3	0.09	0.09	0.12	0.12	0.12	0.09	NO	0.06	0.09

Source: Energy Balances of the Republic of Moldova for years 2005-2022

The natural gas transportation system of the Republic of Moldova includes high, medium and low-pressure networks. The country's natural gas supply is mostly carried out by JSC 'Moldovagaz', which distributes natural gas to consumers in the country. Natural gas transit through the Republic of Moldova is carried out by 'Vestmoldtransgaz' Ltd. Information on natural gas consumption in the Republic of Moldova is available for both banks of the Dniester River. The total consumption of natural gas is shown in Table 3-181 and Figure 3-25.

Table 3-181: Natural gas transited, imported and consumed between 1990-2022

	1990	1995	2000	2005	2010	2015	2020	2021	2022
Natural gas imported, mil. m^3	**3,844**	**3,005**	**2,478**	**2,819**	**3,176**	**2,926**	**2,998**	**3,235**	**2,625**
Net calorific value for natural gas, kcal/m^3	NA	NA	7,978	8,026	8,071	8,246	8,231	8,233	8,228
Net calorific value for natural gas, TJ/mil. m^3	NA	NA	33.40	33.60	33.79	34.52	34.43	34.45	34.43
Natural gas transited, billion m^3	**25**	**21**	**19**	**25**	**17**	**17**	**0.9**	**0.5**	**0.5**
Natural gas used in the RM, million m^3:	**3,814**	**2,791**	**2,320**	**2,716**	**2,971**	**2,782**	**2,998**	**3,249**	**2,723**
on the RBDR	NA	1,558	918	1,315	1,090	928	1,076	1,234	961
on the LBDR	NA	1,233	1,402	1,401	1,881	1,854	1,921	2,016	1,732

Source: JSC 'Moldovagaz' by letters No. 604 of 01.04.1999, answer to Letter No. 02-541 of 28.05.2001; No. 02-156 of 06.02.2004, answer to Letter No. 257-01-07 of 26.01.2004; No. 06-1253 of 27.09.2006, answer to Letter No.01-07/1400 of 25.08.2006; No. 07-730 of 6.6.2007, answer to Letter No. 47/21-103 of 31.05.2007; No. 02/1-476 of 23.02.2011, answer to Letter No. 03-07/175 of 02.02.2011; No. 02/1-288 of 22.01.2014, answer to Letter No. 320/2014-01-01 of 03.01.2014; No. 02/1-507 of 10.02.2015, answer to Letter No. 407/2015-01-09 of 29.01.2015; No. 02/1-2183 of 03.06.2016, answer to Letter No. 512/2016-05-01 of 10.05.2016; No. 03/2-74 of 12.01.2018, answer to Letter No. 601/2017-12-03 of 14.12.2017; No. 03/4-676 of 03.03.2020, answer to Letter No. 08-310/1 of 11.02.2020; No. 03/4-1539 of 24.06.2021, answer to Letter No. 08/136/2021 of 09.06.2021; No. 02/1-1951 of 03.08.2022, answer to Letter No. 08/365/2022 of 07.07.2022, answer to Letter No. 08/365/2022 of 07.07.2022; to No. 02/1-1531 of 02.05.2023, answer to Letter No. 08/150/2023 of 21.04.2023; 'Moldovatrangaz' Ltd. Through Letter to No. 15-1080 of 28.07.23, answer to Letter No. 08/225/2023 of 17.07.2023.

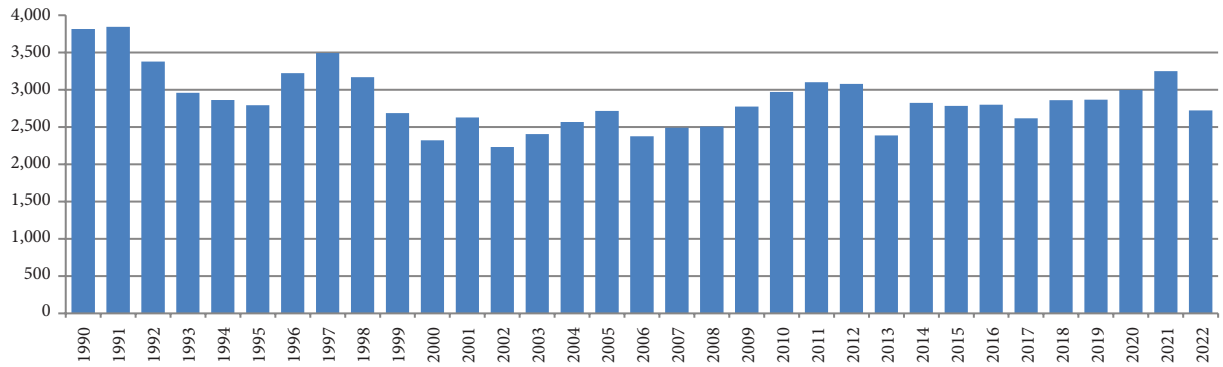


Figure 3-25: Natural gas used in the Republic of Moldova between 1990-2022, mil.m^3.

Information on liquefied petroleum gas (LPG) amounts is available for the territory on the right bank of the Dniester River for the entire reference period, and for the territory on the LBDR only for the period 2011-2021 (Table 3-182). For the year 2022, due to the lack of official statistical data, the data have been extrapolated.

Table 3-182: LPG consumption in the RoM between 1990-2022

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RBDR	kt	146.00	128.00	75.40	39.90	19.00	19.00	22.00	26.00	25.00	31.00	35.00
	thousand m^3	250.00	219.18	129.11	68.32	32.53	32.53	37.67	44.52	42.81	53.08	59.93

		2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
RBDR	kt	47.00	48.00	50.00	52.00	53.00	50.00	53.00	55.00	60.00	64.00	67.00
	thousand m³	80.48	82.19	85.62	89.04	90.75	85.62	90.75	94.18	102.74	109.59	114.73
LBDR	thousand m³	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2.68
Total: RoM	**thousand m³**	**80.48**	**82.19**	**85.62**	**89.04**	**90.75**	**85.62**	**90.75**	**94.18**	**102.74**	**109.59**	**117.41**
		2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RBDR	kt	74.00	74.00	77.00	76.00	78.00	72.00	71.00	66.00	63.00	60.00	57.00
	thousand m³	126.71	126.71	131.85	130.14	133.56	123.29	121.58	113.01	107.88	102.74	97.60
LBDR	thousand m³	2.18	1.87	1.56	1.41	1.52	0.89	0.94	0.92	0.64	0.99	1.08
Total: RoM	**thousand m³**	**128.89**	**128.59**	**133.41**	**131.54**	**135.08**	**124.18**	**122.51**	**113.93**	**108.97**	**103.73**	**98.68**

Sources: Energy Balances of the Republic of Moldova for 1990, 1993, 2022 for the territory on the RBDR; Press Releases on 'Housing and Communal Services for years 2011-2021'

3.8.3. Uncertainties and Time Series Consistency

The primary uncertainty-related factors pertain to methodology, emission factors used in the estimation of GHG emissions from source category 1B2 'Fugitive Emissions from Oil and Natural Gas', and quality of available activity data.

Thus, uncertainties associated with emission factors used in the estimation of direct GHG emissions were estimated to be circa 25%. Uncertainties related to activity data pertaining to fuel consumption in the industrial sector of the Republic of Moldova are considered quite significant, up to circa 25%. Combined uncertainties from sector 1B2 are estimated to be circa 35.4%.

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.8.4. Quality Assurance and Quality Control

Standard verification and QC forms and checklists were filled in for 1B2 'Fugitive Emissions from Oil and Natural Gas' source category, following the Tier 1 approach.

The AD and methods used for estimating GHG emissions from this category were documented and archived both in hard copies and electronically. In order to identify the data entry and emission estimation process related errors verifications and quality control procedures were applied. Following good practices, GHG emissions were estimated based on activity data and country-specific factors from official sources of information.

The specific verifications and QC procedures applied for category 1B2 'Fugitive Emissions from Oil and Natural Gas' included:

- verification of AD collecting and manipulation procedures, including: verifying if disaggregation of AD collected for each source included in source category 1B2 'Fugitive Emissions from Oil and Natural Gas' complies with the requirements set out in the description of each source in the 2006 IPCC Guidelines (1B2a 'Oil', 1B2b 'Natural Gas', 1B2c 'Venting', 1B2d 'Other'); for each source, AD are available in separate files in natural and energy units; verifying the correctness of EFs used for each sub-category separately; verifying if the primary reference sources are correctly indicated; the accuracy of calculations for sub-categories included in category 1B2 is verified randomly;
- implementation of error minimization procedures for manual entry of AD, with all the spreadsheets provided with the initial sources of activity data in tabular format;
- in the calculation files, EFs are specified in tabular formats for each source, the import of the respective values into calculation formulas is ensured by automatic connections;
- the consistency of calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all emission sources and the entire range of years covered by the inventory;
- verification if the same method is used for the entire range of years covered by the inventory;
- verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RoM;

- verifying to what extent the full geographical coverage of the national GHG inventory of the RoM is ensured;
- verifying the inter-annual evolution trends of emissions by creating representative charts, while unusual fluctuations are explained;
- in the case of recalculations, their need is explained, including by drawing attention to the implemented recommendations resulting from the audit carried out by national and international experts in previous inventory cycles;
- verifying maintenance and completion of the national inventory of GHG emission archive.

In accordance with sustainable practices, for the estimation of GHG emissions, activity data and national emission factors were used from official reference sources.

3.8.5. Recalculations

Recalculations made in the current cycle are associated with the changes in GWP values for the 100-year horizon, available in the IPCC AR5 (2014), instead of those available in the IPCC AR4 (2007). For 2020, the value of the amount of natural gas transited has been updated.

Compared to the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made in the current inventory cycle have resulted in an upward trend in direct GHG emissions for the entire period under review (Table 3-183). Direct GHG emissions for years 2021-2022 have been estimated for the first time. Between 1990 and 2022, direct GHG emissions from category 1B2 'Fugitive Emissions from Oil and Natural Gas' in RoM had decreased by circa 77%.

Table 3-183: Recalculations of GHG emissions for the period 1990-2020, included in the NC5 of the RoM to the UNFCCC (1B2 'Fugitive Emissions from Oil and Natural Gas'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	911.41	862.20	778.67	699.78	674.40	738.83	808.79	685.76	638.98	633.73	664.51
BTR1	1,020.70	965.59	872.04	783.70	755.27	827.44	905.78	767.99	715.61	709.73	744.21
Difference, %	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	665.96	709.48	744.54	804.23	848.82	747.86	797.19	793.60	675.57	662.51	741.17
BTR1	745.82	794.56	833.76	900.60	950.54	837.45	892.70	888.68	756.49	741.85	829.95
Difference, %	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	731.12	682.76	669.37	643.26	688.53	720.33	679.45	471.69	241.81		
BTR1	818.70	764.49	749.49	720.25	770.95	806.57	760.78	528.10	273.49	278.04	234.70
Difference, %	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	13.1		

Abbreviations: BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC; NC5 – Fifth National Communication of the RoM to the UNFCCC.

3.8.6. Planned Improvements

Potential improvements within source category 1B2 'Fugitive Emissions from Oil and Natural Gas' could be possible should new data related to crude oil and natural gas distribution networks (from the infrastructure needed to produce, collect, process, refine and distribute oil products and natural gases to final consumers; from evaporation, flaring, etc.) should a higher estimation methodology be used. The possibility of obtaining AD associated to LPG consumption on the LBDR for the entire period under review will also be assessed.

3.9. CO_2 Emissions from Biomass

3.9.1. Source Category Description

Within the respective source category, CO_2 emissions from biomass are monitored. In conformity with recommendations provided in the 2006 IPCC Guidelines, the amount of biomass used is monitored in each source category under the energy sector, and the emissions generated, respectively, with the specification that non-CO_2 emissions are reported within the respective source categories, whereas CO_2 emissions are reported separately for reference, and are not included in the national total.

By 2022, in comparison with the 1990 year level, emissions originating from source category 'CO_2 Emissions from Biomass' increased by circa 10.4 times (Table 3-184).

Table 3-184: CO_2 emissions from biomass in the RM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2 emissions from biomass	232.8	201.2	169.6	143.2	157.5	230.0	294.0	304.2	275.6	272.7	272.4
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO_2 emissions from biomass	282.2	322.1	373.6	307.7	307.4	361.4	304.7	352.5	362.1	341.0	384.6
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CO_2 emissions from biomass	406.3	432.8	1,318.3	1,436.5	1,609.8	2,129.6	3,588.8	2,984.4	2,993.0	2,904.3	2,429.5

3.9.2. Methodologies, Emission Factors and Activity Data

CO_2 emissions from biomass were estimated following the Tier 1 methodological approach, available in the 2006 IPCC Guidelines.

The basic equations used in the estimation of CO_2 emissions from biomass are described below:

$$CO_2 \text{ emissions (kt)} = \text{amount of biomass (TJ)} \bullet CO_2 \text{ emission factor (kg /TJ)} \bullet 10^{(-6)},$$

$$CO_2 \text{ emissions (fuelwood), kt} = \text{fuel consumption (thousand m}^3 \text{ comp.)} \bullet \text{conversion factor in natural units (kt/thousand m}^3 \text{ comp.)} \bullet \text{conversion factor in energy units (TJ/kt)} \bullet CO_2 \text{ emission factor (kg/TJ)} \bullet 10^{(-6)}.$$

AD for the RBDR is taken from the EBs of the RoM in energy units (TJ). For the LBDR, regarding source category 1A4b 'Residential', AD is available in natural units (thousand m^3 comp.), conversion into energy units has thereby been made by applying conversion factors from Table 3-185.

Table 3-185: Conversion factors: from natural units to energy units

Fuels	Calorific values	UM
Fuelwood, thousand m^3 comp.	0.73	kt/thousand m^3 comp.
Fuelwood, kt	12.32	TJ/kt

For the estimation of direct GHG emissions, EFs used by default were applied, available in Tables 2.2-2.5, Chapter 2, Volume 2 of the 2006 IPCC Guidelines (Table 3-186 and 3-187).

Table 3-186: CO_2 emission factors by type of biomass for categories 1A1, 1A2, 1A4a, 1A4b, 1A4c and 1A5

	Fuelwood/ wood waste	Charcoal	Agricultural residue	Briquettes and pellets/other biomass	Biogas
CO_2	112,000	112,000	100,000	100,000	54,600

Sources: 2006 IPCC Guidelines, Volume 2, Chapter 2, Table 2.2-2.5, p. 17, 19, 21 and 23.

Table 3-187: CH_4 and N_2O emission factors by type of biomass for categories 1A1, 1A2, 1A4a, 1A4b, 1A4ci and 1A5

Categories		Fuelwood	Wood waste	Agricultural residue	Charcoal	Briquettes and pellets	Biogas	Other biomass
1A1,1A2,1A5	CH_4	30	30	30	200	30	1	30
	N_2O	4	4	4	4	4	0.1	4
1A4a,1A4b, 1A4c	CH_4	300	300	300	200	300	5	300
	N_2O	4	4	4	1	4	0.1	4

Sources: 2006 IPCC Guidelines, Volume 2, Chapter. 2, Table 2.2-2.5, p. 17, 19, 21 and 23.

Emission factors for non-CO_2 emissions from biomass were taken from the 2023 EMEP/EEA Guidebook (Table 3-188).

Table 3-188: Emission factors used in the estimation of indirect GHG emissions from biomass by source category within Sector 1 'Energy', kg/TJ

Category	Fuels	NO_x	CO	NMVOC	SO_x
1A1	biomass	81	90	7.31	10.8
	biogas	89	39	2.6	0.281
1A2, 1A4a, 1A4ci, 1A5	biomass	91	570	300	11
	biogas	74	29	23	0.67

Category	Fuels	NO_x	CO	NMVOC	SO_x
1A4b	biomass	50	4,000	600	11
	biogas	51	26	1.9	0.3

Sources: for NO_x, CO, NMVOC, SO_x emissions – EMEP/EEA Guidebook (2023), category 1A1 – Table 3-4, 3-7; category 1.A.2 – Table 3-3, 3-5; categories 1.A.4.a.i, 1.A.4.c.i and 1.A.5.a – Table 3-8 and 3-10; category 1.A.4.b.i – Tables 3-4 and 3-6.

In the sectoral statistical publications of ATULBD, information associated with biomass consumption – fuelwood in the residential sector, is available in natural units (thousand m^3 comp.), but only for the period 2009-2022 (Table 3-189).

Table 3-189: Fuelwood consumption on the LBDR within source category 1A4b 'Residential' between 2009-2022

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Fuelwood, thousand m^3 comp.	10.2	10.8	10.0	5.4	4.7	7.7	10.9	6.9	5.4	4.6	8.2	7.2	6.2	6.2
Fuelwood, TJ	92	97	90	48	42	69	98	62	48	41	74	65	55	55

For the territory on the RBDR, with regard to the types of biomass included in the national GHG inventory, in the EBs for the years 1990 and 1993-2002, there is information on the consumption of fuelwood and wood waste; in the EBs for the years 2003-2012 there is information on the consumption of fuelwool, wood waste and agricultural residues, and in the EBs for the years 2003-2022, AD is available on the consumption of biogas, pellets and briquettes (Table 3-190 and 3-191). For a number of years, there are also numerical values for 'Other types of Fuel'.

Table 3-190: Biomass consumption in the Republic of Moldova between 1990-2005, TJ

		1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005
1A1ai	Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A1aii	Biogas	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A1a iii	Fuelwood	9	8	7	6	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3	3
	Wood waste	59	56	53	50	147	88	NO	59	29	29	59	147	NO	29	16	16
	Agricultural residues	NO	NO	NO	NO	NO	NO	88	NO	NO	NO	NO	NO	235	205	226	226
1A2	Fuelwood	135	112	88	65	NO	29	29	29	NO	NO	NO	NO	NO	NO	9	11
	Wood waste/ agricultural residues	176	140	103	67	29	NO	NO	117	59	59	NO	NO	NO	NO	39	26
1A4a	Fuelwood	333	258	184	109	117	117	147	117	117	88	88	117	147	381	242	210
	Wood waste/ agricultural residues	NO	NO	NO	6	NO	NO	29	NO	NO	NO	NO	NO	NO	146	78	36
	Other types of fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29	NO	NO	14	NO
1A4b	Fuelwood	1,052	957	861	766	822	1,526	1,848	1,907	1,966	1,848	1,731	1,555	1,878	1,964	1,673	1,704
	Wood waste	234	205	176	147	205	205	323	293	176	323	499	587	499	440	320	294
	Agricultural residues	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	29	NO	NO	117	130	214
	Other types of fuel	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A4c	Fuelwood	36	27	18	9	29	29	29	29	NO	NO	NO	29	NO	29	8	12
	Wood waste/ agricultural residues	NO	NO	NO	3	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2	10
	Other types of fuel	NO	NO	NO	29	29	NO	29	117	29	NO	NO	NO	NO	NO	NO	NO
1A5	Fuelwood	45	34	24	13	30	30	89	30	88	59	29	30	87	59	24	24
	Wood waste/ agricultural residues	NO	NO	NO	12	1	30	NO	30	NO	29	NO	29	29	NO	3	7
	Other types of fuel	NO	NO	NO	NO	NO	NO	30	1	NO	NO	NO	NO	29	NO	NO	NO
1A	**Total, TJ**	**2,079**	**1,796**	**1,514**	**1,282**	**1,409**	**2,054**	**2,641**	**2,729**	**2,464**	**2,435**	**2,435**	**2,523**	**2,904**	**3,370**	**2,787**	**2,793**

Table 3-191: Biomass consumption in the Republic of Moldova between 2006-2022, TJ

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A1ai	Biogas	NO	NO	NO	NO	NO	NO	NO	10	18	14	2	84	150	126	153	137	147
1A1aii	Biogas	NO	NO	NO	NO	NO	NO	NO	29	79	NO	NO	NO	NO	NO	NO	NO	NO
1A1aiii	Fuelwood	2	NO	1	1	2	1	1	37	29	NO	NO	NO	NO	NO	NO	NO	NO
	Wood waste	1	1	1	2	2	1	3	3	5	NO	NO	NO	NO	NO	NO	NO	NO
	Agricultural residues	214	239	373	435	514	399	226	229	321	NO	NO	NO	NO	NO	3	NO	NO
	Briquettes and pellets	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	22	23	32	10	10	13	19
	Biogas	NO	NO	NO	NO	NO	NO	NO	7	99	387	359	NO	NO	NO	NO	NO	NO

		2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
1A1c	Fuelwood	NO	NO	NO	NO	NO	NO	26	31	34	72	59	61	51	73	63	66	49
1A2	Fuelwood	7	6	7	4	11	17	17	20	13	33	33	14	21	16	18	24	17
	Wood waste	1	5	14	10	16	25	36	5	16	11	2	7	30	2	9	8	16
	Agricultural residues	NO	NO	NO	NO	NO	5	2	10		345	290	241	392	367	407	390	658
	Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	1	NO	NO	NO	NO
	Briquettes and pellets	NO	NO	NO	NO	NO	NO	NO	NO	NO	62	83	145	144	138	66	106	153
	Biogas										387	359	198	163	166	140	244	247
1A4a	Fuelwood	254	247	268	240	209	219	244	185	232	220	237	226	235	216	188	209	204
	Wood waste	26	18	15	36	36	17	18	35	26	14	13	16	16	11	12	2	4
	Agricultural residues	2	14	28	300	41	31	88	68	118	50	58	130	77	60	46	50	49
	Charcoal	NO	NO	NO	NO	NO	NO	NO	3	21	16	13	11	32	44	25	32	47
	Briquettes and pellets	NO	NO	NO	NO	NO	NO	NO	NO	94	83	NO	112	150	127	110	125	131
1A4b	Fuelwood	2,123	1,716	1,942	1,767	1,808	2,134	2,543	2,880	10,425	11,439	13,131	17,474	27,599	23,098	25,130	20,727	16,798
	Wood waste	340	271	312	395	237	137	273	164	124	52	89	248	2,051	1,810	219	1,882	1,269
	Agricultural residues	245	197	212	NO	66	419	96	134	105	135	53	46	1,030	370	52	2,068	1,950
	Charcoal	NO	NO	NO	NO	NO	NO	17	11	NO	2	4	2	5	9	13	17	22
	Briquettes and pellets	NO	NO	NO	NO	NO	NO	NO	NO	76	109	62	109	142	169	180	238	371
	Fuelwood, TJ	NO	NO	NO	92	97	90	48	42	69	98	62	48	41	74	65	55	55
1A4c	Fuelwood	18	12	10	17	25	15	31	28	37	27	42	44	41	38	42	39	39
	Wood waste	NO	1	NO	2	NO	NO	NO	1	2	NO	NO	NO	NO	NO	NO	NO	NO
	Agricultural residues	12	2	1	2	6	NO	2	3	5	1	2	NO	3	2	3	4	2
	Charcoal	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4	NO	NO	NO	NO
	Briquettes and pellets	NO	NO	NO	NO	NO	NO	NO	NO	NO	1	4	5	4	4	15	12	9
1A5	Fuelwood	27	26	23	9	28	12	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Wood waste	4	10	3	NO	8	2	1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	Agricultural residues	2	1	1	NO	7	2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
1A	**Total, TJ**	**3,278**	**2,769**	**3,213**	**3,312**	**3,113**	**3,526**	**3,672**	**3,935**	**11,948**	**13,171**	**14,620**	**19,245**	**32,414**	**26,930**	**26,969**	**26,448**	**22,252**

3.9.3. Uncertainties and Time Series Consistency

The primary uncertainty-related factors pertain to methodology, emission factors used in the estimation of CO_2 emissions from biomass, and quality of available activity data.

Uncertainties associated with emission factors are estimated to be circa 80%, whereas those associated with activity data – circa 20%.

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

3.9.4. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for source category 'CO_2 emissions from biomass', following the Tier 1 approach.

The specific quality assurance and control procedures applied in the calculation process for category 'CO_2 Emissions from Biomass' included:

- verification of activity data collection procedures;
- implementation of error minimization procedures for manual entry of AD, with all the spreadsheets provided with the initial sources of activity data in tabular format;
- in the calculation files, the EFs are specified in tabular formats for each category, the import of the respective values into calculation formulas is ensured by automatic connections;

- the consistency of calculations is also ensured by verifying the correctness of applying conversion factors of natural units to energy units for all categories and the entire range of years covered by the inventory;
- verification if the same method is used for the entire range of years covered by the inventory;
- verifying if GHG emissions calculations have been made for all years and for all types of fuels mentioned in the Energy Balances of the RoM;
- with respect to recalculations, their need is explained;
- verifying maintenance and completion of the national inventory archive.

GHG emissions were estimated based on AD and EFs from official sources of reference.

3.9.5. Recalculations

In the current inventory cycle, recalculations were made for CO_2 emissions from biomass, as a result of considering the consumption of wood waste/agricultural residues in the years 1997-1999 in source category 1A2 'Manufacturing Industries and Construction', and as a result of considering a new emission source – 1A1c 'Manufacture of Solid Fuels' (charcoal) in the period 2012-2020 for the first time in the national inventory.

Compared to the results recorded in NC5 of the RoM to the UNFCCC, the changes undertaken in the current inventory cycle have resulted in an upward trend in the respective emissions. CO_2 emissions for the years 2021-2022 have been estimated for the first time. The obtained results show that between 1990-2022, CO_2 emissions from biomass had increased by about 10 times (Table 3-192).

Table 3-192: Recalculations of CO_2 emissions from biomass for the period 1990-2020, included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	232.81	201.20	169.59	143.24	157.46	230.05	294.03	291.13	269.01	266.11	272.37
BTR1	232.81	201.20	169.59	143.24	157.46	230.05	294.03	304.23	275.62	272.72	272.37
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.5	2.5	2.5	0.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	282.23	322.08	373.58	307.68	307.39	361.44	304.66	352.45	362.10	341.05	384.64
BTR1	282.23	322.08	373.58	307.68	307.39	361.44	304.66	352.45	362.10	341.05	384.64
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	403.38	429.28	1,314.49	1,428.44	1,603.19	2,122.72	3,583.06	2,976.22	2,985.92		
BTR1	406.30	432.75	1,318.30	1,436.50	1,609.80	2,129.55	3,588.77	2,984.40	2,992.97	2,904.28	2,429.50
Difference, %	0.7	0.8	0.3	0.6	0.4	0.3	0.2	0.3	0.2		

Abbreviations: BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC; NC5 – Fifth National Communication of the RoM to the UNFCCC.

3.9.6. Planned Improvements

Potential improvements in source category 'CO_2 Emissions from Biomass' could be made with respect to the availability of new activity data on biomass consumption in the territory on the LBDR.

CHAPTER 4. SECTOR 2 'INDUSTRIAL PROCESSES AND PRODUCT USE'

4.1. Overview

Sector 2 'Industrial Processes and Product Use' (IPPU) includes greenhouse gas emissions generated directly from non-energy industrial activities, inventoried using the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 2006) and EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019).

In the Republic of Moldova, the source categories covered by this sector are: 2A 'Mineral Industry' (*2A1 'Cement Production', 2A2 'Lime Production', 2A3 'Glass Production', 2A4 'Other Process Uses of Carbonates'*, 2B 'Chemical Industry' (*2B10 'Other'*), 2C 'Metal Production' (*2C1 'Iron and Steel Production'*), 2D 'Non-energy Products from Fuels and Solvent Use' (*2D1 'Lubricant Use', 2D2 'Paraffin Wax Use', 2D3 'Solvent Use', 2D4 'Other'*), 2F 'Product uses as substitutes for ODS' (*2F1 'Refrigeration and Air Conditioning', 2F2 'Foam Blowing Agents', 2F3 'Fire Protection', 2F4 'Aerosols'*), 2G 'Other Products Manufacture and Use' (*2G1 'Electrical Equipment', 2G3 'N_2O from Product Uses' (medical applications), 2G4 'Other')* and 2H 'Other' (*2H2 'Food and Beverages Industry'*).

A brief overview, methodological issues, uncertainty assessment and times-series consistency, quality assurance and quality control procedures, recalculations made and planned improvements are described for each source category in this sector.

4.1.1. Emission Trends

Between 1990 and 2022, there had been a downward trend in the evolution of total GHG emissions from Sector 2 'IPPU', decreasing by circa 43.9%: from 1.6 Mt CO_2 equivalent recorded in 1990 to 0.9 Mt CO_2 equivalent in 2022.

Regarding the contribution of ATULBD in the structure of GHG emissions at sectoral level, it varied between a minimum of 19.9% in 2005 to a maximum of 68.0% in 1994 in the period under review (Table 4-1).

Table 4-1: Total direct GHG emissions from Sector 2 'IPPU' in the Republic of Moldova, disaggregated by region, between 1990-2022, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RBDR	978.58	742.79	320.39	300.37	178.11	201.59	164.45	179.50	148.76	116.46	174.71
LBDR	626.66	668.49	502.08	437.51	378.49	254.98	252.32	275.10	229.61	225.42	140.60
RoM: total	**1,605.24**	**1,411.29**	**822.47**	**737.88**	**556.60**	**456.56**	**416.77**	**454.60**	**378.37**	**341.88**	**315.31**
RBDR, %	61.0	52.6	39.0	40.7	32.0	44.2	39.5	39.5	39.3	34.1	55.4
LBDR, %	39.0	47.4	61.0	59.3	68.0	55.8	60.5	60.5	60.7	65.9	44.6
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RBDR	168.31	251.07	256.84	321.41	457.07	539.53	546.63	520.90	365.08	407.67	448.06
LBDR	150.89	118.39	140.52	149.16	113.67	136.23	386.24	499.11	158.87	146.02	206.91
RoM: total	**319.20**	**369.46**	**397.36**	**470.56**	**570.74**	**675.77**	**932.87**	**1,020.01**	**523.95**	**553.69**	**654.97**
RBDR, %	52.7	68.0	64.6	68.3	80.1	79.8	58.6	51.1	69.7	73.6	68.4
LBDR, %	47.3	32.0	35.4	31.7	19.9	20.2	41.4	48.9	30.3	26.4	31.6
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RBDR	435.54	534.36	497.78	551.20	472.68	545.27	657.24	678.36	732.90	742.55	654.96
LBDR	235.10	185.54	247.57	198.59	258.67	205.61	274.40	274.07	237.64	254.21	245.04
RoM: total	**670.64**	**719.91**	**745.35**	**749.79**	**731.35**	**750.89**	**931.64**	**952.43**	**970.54**	**996.76**	**900.00**
RBDR, %	64.9	74.2	66.8	73.5	64.6	72.6	70.5	71.2	75.5	74.5	72.8
LBDR, %	35.1	25.8	33.2	26.5	35.4	27.4	29.5	28.8	24.5	25.5	27.2

The downward trend in total GHG emissions originating from Sector 2 'IPPU' recorded between 1990 and 2022 is due to the reduced industrial output, especially mineral products (cement production de-

creased by 57.6%; clinker production – by 56.9%; lime production – by 89.4%; glass production – by 7.2%; brick production – by 80.0%; soda ash use – by 41.1% steel production – by 57.2%, laminates – by 57.4% and lubricants use – by 80.0%, etc.).

In 2022, Sector 2 'IPPU' accounted for circa 6.7% in net national GHG emissions (with LULUCF). This sector has been a relevant source of national CO_2 emissions (circa 7.1% of the national total), and an exclusive source of F-gas emissions, respectively. In 1990, only CO_2 and N_2O emissions were recorded within this sector (Table 4-2), whereas in 2022, the share in direct GHG emissions covered by Sector 2 'IPPU' constituted: CO_2 – 73.7%, HFC – 26.1%, PFC – 0.004% and SF_6 – 0.183%.

Table 4-2: Direct GHG emissions from Sector 2 'IPPU' between 1990-2022, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2 emissions	1,605.22	1,411.27	822.46	737.86	556.59	455.63	415.26	452.49	375.52	338.23	310.64
N_2O emissions	0.02	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.01
HFC emissions	NO	NO	NO	NO	NO	0.94	1.51	2.10	2.85	3.64	4.66
PFC emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
SF_6 emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total	**1,605.24**	**1,411.29**	**822.47**	**737.88**	**556.60**	**456.56**	**416.77**	**454.60**	**378.37**	**341.88**	**315.31**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
CO_2 emissions	312.94	361.15	386.39	456.15	550.48	645.49	892.11	967.70	462.34	482.43	573.63
N_2O emissions	0.01	0.01	0.01	0.01	0.02	0.02	NO	NO	NO	NO	NO
HFC emissions	6.25	8.30	10.95	14.40	20.20	29.92	40.32	51.77	61.02	70.54	80.58
PFC emissions	NO	NO	NO	NO	NO	0.02	0.02	0.03	0.03	0.04	0.04
SF_6 emissions	NO	NO	0.01	0.01	0.04	0.32	0.42	0.51	0.56	0.68	0.73
Total	**319.20**	**369.46**	**397.36**	**470.56**	**570.74**	**675.77**	**932.87**	**1,020.01**	**523.95**	**553.69**	**654.97**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
CO_2 emissions	581.67	623.12	636.28	610.79	583.41	587.60	755.82	754.51	762.25	781.81	663.47
N_2O emissions	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC emissions	88.14	95.76	107.94	137.88	146.79	162.10	174.41	196.40	206.62	213.27	234.84
PFC emissions	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
SF_6 emissions	0.79	0.99	1.09	1.09	1.12	1.15	1.38	1.48	1.63	1.64	1.65
Total	**670.64**	**719.91**	**745.35**	**749.79**	**731.35**	**750.89**	**931.64**	**952.43**	**970.54**	**996.76**	**900.00**

Abbreviations: NO – Not Occurring.

It may be observed that categories 2A 'Mineral Industry', 2D 'Non-Energy Products from Fuels and Solvent Use', and 2F 'Product Uses as Substitutes for Ozone Depleting Substances' (Tables 4-3 and 4-4) are major sources of direct GHG emissions in Sector 2 'IPPU', with shares varying from a minimum of 54.6% (2022) and a maximum of 84.3% (1991); between a minimum of 6.5% (2008) and a maximum of 21.0% (2020); and, between a minimum of 0.2% (1995) and a maximum of 26.1% (2022) of the total, respectively.

Table 4-3: Total direct GHG emissions from Sector 2 'IPPU', by category between 1990-2022, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2A 'Mineral industry'	1,338.96	1,190.16	641.79	587.58	445.34	351.66	316.36	377.06	308.48	271.71	240.78
2C 'Metal industry'	28.50	24.73	23.99	24.42	25.33	26.24	26.73	32.38	28.68	31.79	36.27
2D 'Non-energy products from fuel and solvent use'	234.36	193.32	154.26	123.88	84.47	76.56	71.07	42.05	37.61	34.08	32.64
2F 'Product uses as substitutes for ODS'	NO	NO	NO	NO	NO	0.94	1.51	2.10	2.85	3.64	4.66
2G 'Other products manufacture and use'	3.42	3.08	2.43	2.00	1.46	1.17	1.11	1.00	0.75	0.65	0.97
2. IPPU	**1,605.24**	**1,411.29**	**822.47**	**737.88**	**556.60**	**456.56**	**416.77**	**454.60**	**378.37**	**341.88**	**315.31**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
2A 'Mineral industry'	237.07	301.49	309.07	350.46	439.19	535.42	767.69	864.47	386.85	405.39	488.20
2C 'Metal industry'	38.63	20.50	35.43	40.51	41.94	27.02	38.61	35.41	17.06	9.70	12.86
2D 'Non-energy products from fuel and solvent use'	36.42	38.37	40.93	64.13	68.19	81.98	84.75	66.72	57.63	66.32	71.34
2F 'Product uses as substitutes for ODS'	6.25	8.30	10.95	14.40	20.20	29.92	40.32	51.77	61.02	70.54	80.58
2G 'Other products manufacture and use'	0.83	0.80	0.98	1.07	1.22	1.42	1.51	1.64	1.39	1.74	1.99
2. IPPU	**319.20**	**369.46**	**397.36**	**470.56**	**570.74**	**675.77**	**932.87**	**1,020.01**	**523.95**	**553.69**	**654.97**

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2A 'Mineral industry'	493.16	544.87	533.99	507.99	492.25	470.20	583.18	593.82	538.63	582.07	491.38
2C 'Metal industry'	12.70	7.66	13.85	17.28	5.22	18.88	20.21	15.79	18.70	22.26	12.20
2D 'Non-energy products from fuel and solvent use'	74.66	69.49	87.24	84.58	84.87	97.34	151.37	143.77	203.98	176.31	159.11
2F 'Product uses as substitutes for ODS'	88.14	95.76	107.94	137.88	146.79	162.10	174.41	196.40	206.62	213.27	234.84
2G 'Other products manufacture and use'	1.98	2.13	2.33	2.06	2.22	2.36	2.47	2.65	2.61	2.84	2.47
2. IPPU	**670.64**	**719.91**	**745.35**	**749.79**	**731.35**	**750.89**	**931.64**	**952.43**	**970.54**	**996.76**	**900.0**

Abbreviations: NO – Not Occurring.

Table 4-4: The share of different categories in total direct GHG emissions originating from Sector 2 'IPPU' between 1990-2022, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2A 'Mineral industry'	83.4	84.3	78.0	79.6	80.0	77.0	75.9	82.9	81.5	79.5	76.4
2C 'Metal industry'	1.8	1.8	2.9	3.3	4.6	5.7	6.4	7.1	7.6	9.3	11.5
2D 'Non-energy products from fuel and solvent use'	14.6	13.7	18.8	16.8	15.2	16.8	17.1	9.3	9.9	10.0	10.4
2F 'Product uses as substitutes for ODS'	NO	NO	NO	NO	NO	0.2	0.4	0.5	0.8	1.1	1.5
2G 'Other products manufacture and use'	0.2	0.2	0.3	0.3	0.3	0.3	0.3	0.2	0.2	0.2	0.3
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
2A 'Mineral industry'	74.3	81.6	77.8	74.5	77.0	79.2	82.3	84.8	73.8	73.2	74.5
2C 'Metal industry'	12.1	5.5	8.9	8.6	7.3	4.0	4.1	3.5	3.3	1.8	2.0
2D 'Non-energy products from fuel and solvent use'	11.4	10.4	10.3	13.6	11.9	12.1	9.1	6.5	11.0	12.0	10.9
2F 'Product uses as substitutes for ODS'	2.0	2.2	2.8	3.1	3.5	4.4	4.3	5.1	11.6	12.7	12.3
2G 'Other products manufacture and use'	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
2A 'Mineral industry'	73.5	75.7	71.6	67.8	67.3	62.6	62.6	62.3	55.5	58.4	54.6
2C 'Metal industry'	1.9	1.1	1.9	2.3	0.7	2.5	2.2	1.7	1.9	2.2	1.4
2D 'Non-energy products from fuel and solvent use'	11.1	9.7	11.7	11.3	11.6	13.0	16.2	15.1	21.0	17.7	17.7
2F 'Product uses as substitutes for ODS'	13.1	13.3	14.5	18.4	20.1	21.6	18.7	20.6	21.3	21.4	26.1
2G 'Other products manufacture and use'	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3

Abbreviations: NO – Not Occurring.

It should be mentioned that there has been a significant upward trend in the share of category 2F 'Product uses as substitutes for ODS' in total direct GHG emissions originating from Sector 2 'IPPU' (Figure 4-1).

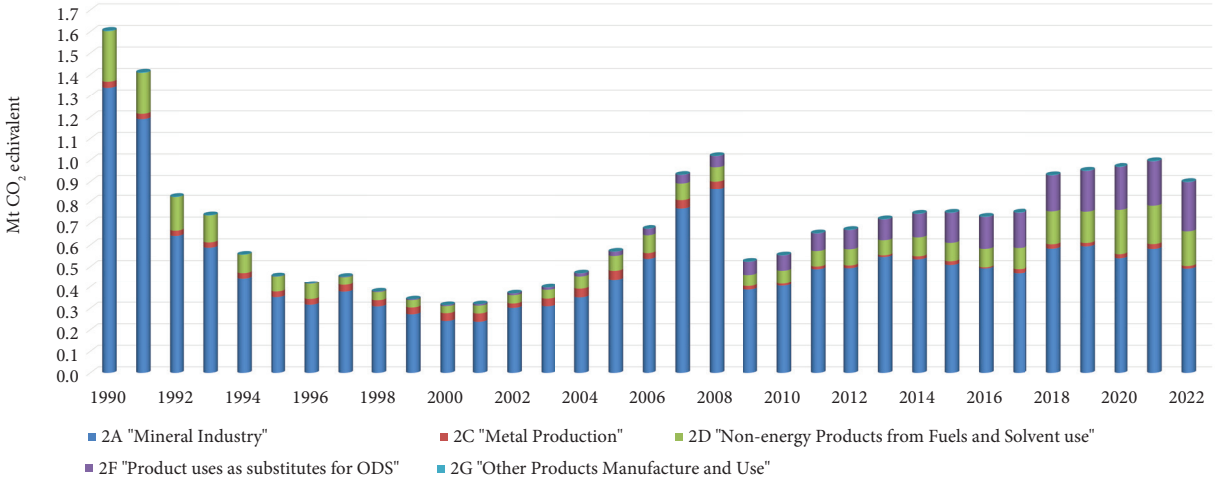


Figure 4-1: Total direct GHG emissions from Sector 2 'IPPU' in the RoM between 1990-2022, Mt CO_2 equivalent.

4.1.2. Key Categories

The results of key category analysis, carried out following the Tier 1 approach, are provided in Chapter 1.5 of this Report, as well as in Annex 1-2. Table 4-5 provides information on identified key categories by level (L) and trend (T) under Sector 2 'IPPU'.

Table 4-5: Key categories identified under Sector 2 'IPPU'

IPCC Categories	GHG	Source category	without LULUCF				with LULUCF			
			T1		T2		T1		T2	
			L	T	L	T	L	T	L	T
2A1	CO_2	Cement production	X	X			X	X		
2A2	CO_2	Lime production								
2A3	CO_2	Glass production								
2A4	CO_2	Other process uses of carbonates								
2C1	CO_2	Iron and steel production								
2D1	CO_2	Lubricants Use								
2D2	CO_2	Paraffin wax use								
2D3	CO_2	Solvent use	X	X	X	X	X	X	X	X
2D4	CO_2	Other (urea-based catalysts)								
2F1	HFC	Refrigeration and Air Conditioning Equipment	X	X	X	X	X	X	X	X
2F2	HFC	Foam blowing		X		X				X
2F4	HFC	Aerosols								
2G1	PFC	Electrical equipment								
2G1	SF_6	Electrical equipment								
2G3	N_2O	N_2O from Product Uses (Medical Applications)								
2G4	CO_2	Other								

Abbreviations: L – Level Assessment; T – Trend Assessment; T1 – Tier 1; T2 – Tier 2.

4.1.3. Methodologies

Emissions from source categories 2A 'Mineral Industry', 2C 'Metal Industry', 2D 'Non-Energy Products from Fuels and Solvent Use', 2F 'Product Uses as Substitutes for ODS', 2G 'Other Products Manufacture and Use', and 2H 'Other' were estimated using both the Tier 1 methodological approach and default EFs, as well as the Tier 2 methodological approach and country-specific emission factors. The methods used in the estimation of emissions by source category is briefly described in Table 4-6, whereas a more detailed description is available in subchapters 4.2-4.8 of this report.

Table 4-6: Summary of methods and EFs utilised in the estimation of GHG emissions from Sector 2 'IPPU'

Category	Source category	CO_2		N_2O		HFC		PFC		SF_6	
		Method	EF	Method	EF	Method	EF	Method	EF	Method	EF
2A	Mineral Industry	T2, T1	CS, D	NA	NA	NA	NA	NA	NA	NA	NA
2B	Chemical Industry	NO	NO	NO	NO	NA	NA	NA	NA	NA	NA
2C	Metal Industry	T2	CS, D	NA	NA	NA	NA	NA	NA	NO	NO
2D	Non-Energy Products from Fuels and Solvent Use	T2, T1	D	NO	NO	NA	NA	NA	NA	NA	NA
2E	Electronics Industry	NA	NA	NA	NA	NA	NA	NO	NO	NO	NO
2F	Product Uses as Substitutes for ODS	NA	NA	NA	NA	T2, T1	CS, D	NO	NO	NO	NO
2G	Other Product Manufacture and Use	T2, T1	D	T1	D	NA	NA	T1	D	T1	D
2H	Other	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Abbreviations: T1 – Tier 1; T2 – Tier 2; CS – Country Specific; D – Default; NA – Not Applicable; NO – Not Occurring.

4.1.4. Uncertainties and Time Series Consistency

The uncertainty analysis of GHG emissions from Sector 2 'IPPU' (including at source category level) is described in detail in subchapters 4.2-4.8, as well as in Annex 2 of this report. Combined uncertainties as a percentage of total direct GHG emissions originating from the respective sector were estimated to be circa 12.2%. Uncertainties introduced in the trend of total direct GHG emissions from this sector were estimated to be circa 6.8%. In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.1.5. Quality Assurance and Quality Control

Standard verification and quality control checklists were filled in for each source category, following the Tier 1 approach. AD and methods used for the estimation of GHG emissions originating from Sector 2 'IPPU' were documented and archived both in hard copies and electronically. In order to

identify the data entry and emission estimation process related errors, verifications and quality control procedures are constantly applied. Following good practices, GHG emissions were estimated using AD and national EFs from official sources of reference.

4.1.6. Recalculations

GHG emissions from Sector 2 'IPPU' were recalculated as a result of using an updated set of AD available in the Statistical Yearbooks of the Republic of Moldova and ATULBD, as well as in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022', and as a result of updated EFs, coefficients, and CS parameters, and as a result of the application of GWP values from the IPCC AR5, instead of the GWP values from the IPCC AR4, when converting N_2O and F-gas emissions from kt to kt CO_2 equivalent.

In comparison with the results included in the NC5 of the RoM to the UNFCCC (2023), the recalculations made in the current inventory cycle resulted in an insignificant decrease in GHG emissions for 1995-2020 (Table 4-7).

Table 4-7: Recalculations of GHG emissions included in the NC5 of the RoM to the UNFCCC (Sector 2 'Industrial Processes and Product Use'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	1,605.24	1,411.29	822.48	737.88	556.60	456.66	416.92	454.81	378.66	342.24	315.78
BTR1	1,605.24	1,411.29	822.47	737.88	556.60	456.56	416.77	454.60	378.37	341.88	315.31
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	-0.1	-0.1	-0.1
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	319.82	370.29	398.57	472.17	573.05	679.09	937.33	1,025.57	530.35	561.21	664.86
BTR1	319.20	369.46	397.36	470.56	570.74	675.77	932.87	1,020.01	523.95	553.69	654.97
Difference, %	-0.2	-0.2	-0.3	-0.3	-0.4	-0.5	-0.5	-0.5	-1.2	-1.3	-1.5
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	682.95	733.20	760.24	765.13	746.94	779.74	964.66	991.22	998.84		
BTR1	670.64	719.91	745.35	749.79	731.35	750.89	931.64	952.43	970.54	996.76	900.00
Difference, %	-1.8	-1.8	-2.0	-2.0	-2.1	-3.7	-3.4	-3.9	-2.8		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

4.1.7. Assessment of Completeness

The current inventory covers GHG emissions from 7 source categories of the 8 which are monitored within Sector 2 'IPPU' (Table 4-8).

Table 4-8: Assessment of completeness under Sector 2 'IPPU'

IPCC code	Source category	CO_2	N_2O	HFC	PFC	SF_6	NF_3
2A	Mineral Industry	X	NO	NA	NA	NA	NA
2B	Chemical Industry	NO	NO	NA	NA	NA	NA
2C	Metal Industry	X	NO	NA	NA	NO	NA
2D	Non-Energy Products from Fuels and Solvent Use	X	NO	NA	NA	NA	NA
2E	Electronics Industry	NA	NA	NA	NO	NO	NO
2F	Product Uses as Substitutes for ODS	NA	NA	X	NA	NA	NA
2G	Other Product Manufacture and Use	X	X	NA	X	X	NA
2H	Other	NO	NO	NA	NA	NA	NA

Abbreviations: X – categories not included in the inventory; NO – Not Occurring; NA – Not Applicable.

4.1.8. Planned Improvements

Planned improvements at source category level are described more in-depth in subchapters 4.2-4.8 of this Report.

4.2. Mineral Industry (Source Category 2A)

4.2.1. Source Category Description

Category 2A 'Mineral Industry' includes GHG emissions from the following sources: 2A1 'Cement Production', 2A2 'Lime Production', 2A3 'Glass Production', 2A4 'Other Process Uses of Carbonates'

(brick, expanded clay and ceramic production). Between 1990 and 2022, direct GHG emissions originating from category 2A 'Mineral Industry' decreased by circa 63.3% (Table 4-9). The significant decrease in emissions recorded in 2008 and 2009 can be explained by the effects of the global economic crisis in 2009, which affected the national economy, the industrial sector suffering a heavy hit, particularly due to a sharp decrease in customer purchasing power of traditional industrial products on traditional Moldovan markets.

Table 4-9: Total direct GHG emissions from category 2A 'Mineral Industry' by source category between 1990-2022, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2A1 Cement production	971.70	900.79	474.31	405.72	328.44	248.53	193.12	270.13	215.06	210.81	172.76
2A2 Lime production	264.31	192.23	116.16	112.79	83.84	78.02	97.77	81.30	68.59	37.89	31.40
2A3 Glass production	27.49	27.19	13.53	12.20	4.33	5.53	8.21	5.46	5.86	3.94	18.03
2A4 Other process uses of carbonates	75.46	69.96	37.79	56.88	28.74	19.58	17.26	20.18	18.97	19.07	18.59
2A Mineral Industry	**1,338.96**	**1,190.16**	**641.79**	**587.58**	**445.34**	**351.66**	**316.36**	**377.06**	**308.48**	**271.71**	**240.78**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
2A1 Cement production	173.88	219.19	245.63	282.58	365.08	457.08	702.67	789.92	340.57	349.83	427.26
2A2 Lime production	28.45	38.25	20.52	20.58	27.84	30.10	21.94	29.14	8.46	15.36	16.62
2A3 Glass production	16.32	22.01	20.32	21.07	24.23	24.95	21.57	24.18	18.07	21.27	25.95
2A4 Other process uses of carbonates	18.42	22.03	22.61	26.23	22.04	23.29	21.51	21.24	19.74	18.92	18.37
2A Mineral Industry	**237.07**	**301.49**	**309.07**	**350.46**	**439.19**	**535.42**	**767.69**	**864.47**	**386.85**	**405.39**	**488.20**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
2A1 Cement production	442.16	476.91	464.61	443.24	433.90	404.93	511.12	523.88	467.52	509.57	408.47
2A2 Lime production	15.53	20.77	23.82	15.74	13.65	28.80	27.79	27.59	21.06	20.82	28.00
2A3 Glass production	20.86	27.72	26.38	31.25	28.09	21.39	28.60	25.93	34.64	33.58	37.34
2A4 Other process uses of carbonates	14.61	19.47	19.19	17.76	16.61	15.07	15.66	16.43	15.41	18.11	17.57
2A Mineral Industry	**493.16**	**544.87**	**533.99**	**507.99**	**492.25**	**470.20**	**583.18**	**593.82**	**538.63**	**582.07**	**491.38**

The subsequent economic recovery of the industrial sector had slow growth rates. Between 2021 and 2022, there was a 15.6% decrease in GHG emissions from category 2A 'Mineral Industry', mainly due to the decrease in clinker and brick production (Figure 4-2).

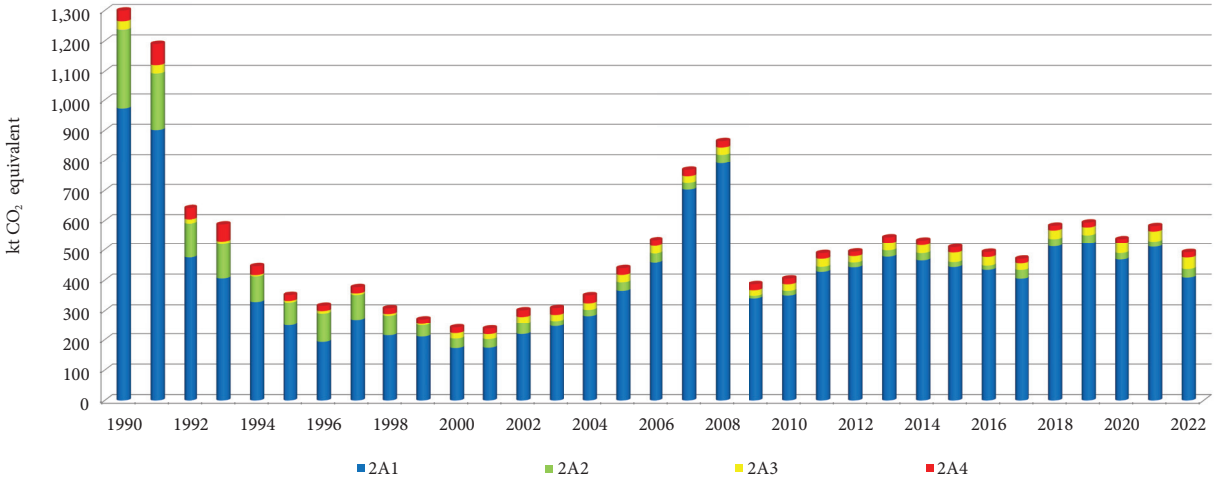


Figure 4-2: Direct GHG emissions from category 2A 'Mineral Industry' by emission source between 1990-2022.

The same trends were recorded in indirect GHG emissions (NO_x, CO, NMVOC) and SO_2 from the respective category (Table 4-10).

Table 4-10: Indirect GHG emissions and SO_2 originating from category 2A 'Mineral Industry' between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NO_x emissions	3.60	3.30	1.73	1.64	1.28	1.09	0.93	1.13	1.00	0.85	1.00
CO emissions	3.44	3.04	1.65	1.49	1.15	0.90	0.80	0.97	0.79	0.70	0.58
NMVOC emissions	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
SO_2 emissions	1.32	1.24	0.63	0.62	0.49	0.44	0.37	0.45	0.42	0.35	0.48

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NO_x emissions	0.94	1.16	1.15	1.28	1.56	1.73	2.23	2.43	1.21	1.31	1.59
CO emissions	0.57	0.73	0.75	0.86	1.10	1.36	2.00	2.28	0.99	1.02	1.25
NMVOC emissions	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.01	0.01	0.02
SO_2 emissions	0.45	0.55	0.53	0.58	0.69	0.73	0.86	0.90	0.50	0.55	0.67
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NO_x emissions	1.50	1.69	1.63	1.61	1.53	1.46	1.82	1.79	1.80	1.88	1.73
CO emissions	1.28	1.39	1.36	1.28	1.24	1.20	1.49	1.53	1.35	1.47	1.21
NMVOC emissions	0.02	0.02	0.02	0.02	0.02	0.01	0.02	0.02	0.02	0.02	0.02
SO_2 emissions	0.60	0.69	0.66	0.67	0.63	0.60	0.75	0.71	0.77	0.79	0.77

2A1. Cement Production

CO_2 is generated in the process of clinker production, an intermediary product used to produce cement. $CaCO_3$ from limestone and other calcium rich materials, as well as $MgCO_3$ from dolomite, are heated at high temperatures in a kiln, thus forming the lime (CaO) and/or dolomitic lime (CaO • MgO) and carbon dioxide (CO_2) in a process called 'calcination'.

$$CaCO_3 \text{ (limestone)} + \text{heat} \rightarrow CaO \text{ (lime)} + CO_2$$

$$CaMg(CO_3)_2 \text{ (dolomite)} + \text{heat} \rightarrow CaO \bullet MgO \text{ (dolomitic lime)} + 2CO_2$$

Lime and/or dolomitic lime is then combined with silicon containing materials (SiO_2), aluminium (Al_2O_3) and iron oxide (Fe_2O_3) to produce clinker (greyish-black pellets 12 mm in diameter). The clinker is then removed from the kiln, cooled and pulverised, and gypsum is added to obtain 'Portland Cement', which is currently all cement produced in the Republic of Moldova, in which, according to ORTECH Corporation (1994), CaO content varies between 60-67%, and MgO content is circa 2%.

It should be noted that two cement producing plants are currently operating in the RM: JSC Lafarge Cement (Moldova) in Rezina and Cement and Slate Combined Works in Rabnita (ATULBD). CO_2 emissions from cement production are directly proportionate to the CaO fraction in the clinker used in its production. GHG emissions resulting from the combustion of fossil fuel used to produce heat, which induces reaction in the kiln, are covered by the Energy Sector and are not discussed in this sector.

2A2. Lime Production

Lime (CaO) is formed by heating limestone to decompose the carbonates. This reaction takes place at high temperatures, usually in a rotating kiln, and CO_2 is emitted in the process of calcination. Primary limestone (calcite) is processed from the rock mined in quarries to produce caustic lime (quicklime) using the above-mentioned reaction (see the *'Cement Production'* section). Dolomitic limestone can also be heated at high temperatures to obtain dolomitic lime, consequently, producing CO_2 emissions as a result of the chemical reaction described above.

2A3. Glass Production

This source category includes GHG emissions from glass production divided into several main categories: flat glass for windows, containers, glassware and tableware, and specialty glass. The glass is obtained from a mixture of raw materials consisting of silica (SiO_2), sodium (Na_2O), lime (CaO) or other carbonates ($CaCO_3$, $CaMg(CO_3)_2$, Na_2CO_3, $BaCO_3$, K_2CO_3, $SrCO_3$, etc.), with small amounts of alumina (Al_2O_3), and other alkaline substances, plus some minor ingredients. A certain amount of recycled scrap glass can also be used in the production process (its share may vary between 10-80% of the total raw material used). The process of glass melting for different purposes is similar. The process of glass production consists of the following steps: selection and preparation of raw material, melting, moulding, hardening, tempering and finishing. During this process, the main pollutants emitted are CO_2, as well as NO_x, CO and SO_x. CO_2 emissions result from the calcination of lime and other carbonates at high temperatures. The main mechanisms for NO_x formation are those related to fuel combustion and emission of NO_x, as well as those resulting from the use of nitrates within the raw materials for some types of glass. The SO_x emitted in the process of glass production is determined particularly by the sulphur content of the molten dose and the sulphur absorption capacity, the excess air and the combustion temperature.

2A4. Other Uses of Carbonates

a. Ceramics

Ceramics production includes mining, processing and refining raw materials (clay) using additives such as kaolin or limestone, forming, cutting, drying and burning the final product in the kiln. The main pollutants resulting from the calcination of carbonates at high temperatures in the process of ceramic production are CO_2 and SO_x.

b. Other Uses of Soda Ash

Besides glass production, soda ash or sodium carbonate (Na_2CO_3) is used as raw material in a number of industries, such as: soap and detergent production, paper production, as well as in wastewater treatment. CO_2 emissions are produced from the use of sodium carbonate and during the production process, depending on its type (it should be noted that no sodium carbonate is produced in the RoM).

4.2.2. Methodologies, Emission Factors and Activity Data

2A1. Cement Production

GHG emissions from cement production were estimated using the Tier 2 methodology (2006 IPCC Guidelines), based on activity data on clinker production. Data obtained directly from the producer on CaO and MgO ratio in clinker and cement were used for calculating the CO_2 emission factors.

$$EF_{clinker} = CaO\ Content \bullet mass\ ratio\ CO_2/CaO + MgO\ Content \bullet mass\ ratio\ CO_2/MgO$$

$$CO_2\ emissions = clinker\ production \bullet EF_{clinker} \bullet CKD\ correction\ factor$$

This approach involves that all the CaO and MgO from the clinker comes from $CaCO_3$ (limestone) and $CaMg(CO_3)_2$ (dolomite). Since no data on other non-carbonate sources were available, it was no need to adjust (reduce) the emission factor value.

The value of the CKD correction factor was also considered. Cement Kiln Dust (CKD) is a mixture of raw materials, the state of which varies from uncalcined to completely calcined. Generally, all cement kilns produce CKD, its quantity depending on the technologies used by the respective plant. It should be noted that cement kiln dust may be recovered via electrostatic precipitation or filtration from the exhaust stacks; the recovered CKD may be recycled in the kiln as a raw material. Any CKD not recycled in the kiln is lost to the system in terms of CO_2 emissions. The default CKD correction factor is 1.02, and in the Republic of Moldova its value varied between 1990 and 2022 from a maximum of 1.013 to a minimum of 1.0002.

CO_2 emission factor national values were estimated based on information obtained directly from producers on the CaO and MgO fraction in clinker production, CO_2/CaO and CO_2/MgO mass ratio, and CKD correction factor (Table 4-11).

Table 4-11: Country-specific emission factors used in the estimation of CO_2 emissions from clinker production in the Republic of Moldova, 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CaO fraction	0.6576	0.6576	0.6576	0.6566	0.6566	0.6577	0.6577	0.6577	0.6577	0.6577	0.6569
CO_2/CaO mass ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
MgO fraction	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160	0.0160
CO_2/MgO mass ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
CKD fraction	1.0110	1.0130	1.0110	1.0120	1.0130	1.0130	1.0130	1.0120	1.0130	1.0120	1.0120
$EF_{clinker}$, t CO_2/ t clinker	**0.5394**	**0.5405**	**0.5394**	**0.5392**	**0.5397**	**0.5406**	**0.5406**	**0.5400**	**0.5406**	**0.5400**	**0.5394**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
CaO fraction	0.6599	0.6602	0.6621	0.6586	0.6591	0.6605	0.6570	0.6570	0.6510	0.6550	0.6529
CO_2/CaO mass ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
MgO fraction	0.0160	0.0160	0.0181	0.0160	0.0160	0.0140	0.0190	0.0120	0.0170	0.0160	0.0166
CO_2/MgO mass ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
CKD fraction	1.0090	1.0060	1.0060	1.0060	1.0060	1.0070	1.0060	1.0050	1.0030	1.0040	1.0008
$EF_{clinker}$, t CO_2/ t clinker	**0.5402**	**0.5388**	**0.5426**	**0.5376**	**0.5379**	**0.5374**	**0.5396**	**0.5314**	**0.5311**	**0.5336**	**0.5310**

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CaO fraction	0.6521	0.6551	0.6569	0.6565	0.6602	0.6565	0.6565	0.6565	0.6565	0.6565	0.6599
CO_2/CaO mass ratio	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
MgO fraction	0.0168	0.0156	0.0158	0.0166	0.0166	0.0166	0.0166	0.0166	0.0166	0.0166	0.0166
CO_2/MgO mass ratio	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
CKD fraction	1.0015	1.0003	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002	1.0002
$EF_{clinker}$, t CO_2/ t clinker	**0.5309**	**0.5313**	**0.5329**	**0.5335**	**0.5363**	**0.5334**	**0.5334**	**0.5334**	**0.5334**	**0.5334**	**0.5361**

Table 4-12 shows the default EFs utilised to calculate indirect GHG emissions (NO_x, CO, NMVOC) and SO_2 from cement production.

Table 4-12: Default EFs used in the estimation of indirect GHG and SO_2 emissions from source category 2A1 'Cement Production'

Category	Process description	NO_x	CO	NMVOC	SO_x
		g/t clinker			
Mineral Industry	Cement production	1241	1455	18	374

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2023), SNAP Code 030311 Cement, Category 1.A.2.f.i, Table 3-24.

Information on clinker production at JSC 'Lafarge Cement (Moldova)' plant in Rezina was obtained directly from the manufacturer.

As for the Cement and Slate Combined Works in Rabnita, activity data on clinker production are available in the statistical publications of ATULBD only since 2009[55] (for the period 2007-2021). For the period between 1990 and 2006, following the recommendations in the 2006 IPCC Guidelines, activity data on clinker production at the Cement and Slate Combined Works in Rabnita were inferred from statistical data on cement production, by using the equation below:

$$Clinker\ Production = Cement\ Production \bullet Clinker\ Fraction\ in\ Cement$$

In accordance with the technological documentation for Portland type cement production, in order to produce one tonne of cement, cement plants in the Republic of Moldova use 786.9 kg of clinker (Annex 3-2).

The information provided by JSC Lafarge Cement (Moldova) in Rezina by Official Letter No. 74 of 02.03.2011 and No. 67 of 06.02.2014 was qualified as '*trade secret with commercial value*', in accordance with the stipulations of Articles 1, 2 and 5, paragraph (1) of Law on 'Commercial Secrets' No. 171-XII dated 06.07.1994, the respective information cannot be divulged. In these circumstances, the activity data used to calculate GHG emissions from source category 2A1 'Cement Production' is presented below only on aggregate at national level (Table 4-13).

Table 4-13: AD on cement and clinker production in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cement production, kt	2,288.0	1,800.0	1,088.2	960.3	769.1	518.8	494.4	611.8	493.0	462.0	431.9
Clinker production, kt	1,801.3	1,666.6	879.3	752.5	608.6	459.7	357.3	500.2	397.8	390.4	320.3
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cement production, kt	402.1	477.0	484.4	667.6	772.8	1,051.1	1,531.0	1,775.9	869.4	861.4	1,018.0
Clinker production, kt	321.9	406.8	452.7	525.7	678.7	850.6	1,302.2	1,486.6	641.3	655.6	804.7
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Cement production, kt	1,051.4	1,095.3	1,086.2	1,122.8	900.2	1,045.9	1,174.9	1,220.2	1,164.1	1,170.6	969.3
Clinker production, kt	832.8	897.6	871.9	830.9	809.0	759.1	958.2	982.1	876.4	955.2	761.9

Source: 'Lafarge Cement (Moldova)' JSC in Rezina through Letter dated 02.05.2023, as a response to the interpellation of the Environment Agency to No. 08/145/2023 of 20.04.2023; Letter No. 189 of 13.07.2022, as a response to the interpellation of the Environment Agency to No. 08/368/2022 of 07.07.2022; Letter No. 245 dated 01.07.2021, as a response to the Environment Agency No. 08/136/2021 dated 09.06.2021; Letter No. 114 dated 02.03.2020, as a response to the request of the Environment Agency No. 08-310/1 dated 11.02.2020; Letter No. 780 dated 22.12.2017, as a response to the request of the Climate Change Office of the Ministry of Environment No. 601/2017-12-03 dated 14.12.2017; Letter No. 395 dated 24.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 82 dated 18.02.2015, as a response to the request of the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 67 dated 06.02.2014, as a response to the request of the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 74 dated 02.03.2011, as a response to the request of the Climate Change Office of the Ministry of Environment No. 03-07/175 dated 02.02.2011; and Letter No. 186 dated 18.04.2007, as a response to the request of the Institute of Ecology and Geography No. 84 dated 26.03.2007; Statistical Yearbooks of ATULBD for 1998 (page 176), 2000 (page 99), 2002 (page 103), 2005 (page 94), 2007 (page 92), 2009 (page 92), 2011 (page 94), 2013 (page 99), 2015 (page 88), 2017 (page 101), 2019 (page 99), 2021 (page 100). Express information, Key performance indicators of the republic's industry (excluding small businesses) for 2009-2021.

2A2. Lime Production

[55] Express Information, Key Performance Indicators for the Industry Sector in the Republic for 2009-2021 (other than the small industries). State Statistical Service of the Transnistrian Moldovan Republic – Tiraspol.

The amount of CO_2 generated per unit of lime manufactured is estimated taking into account the molecular weight and the lime content in the obtained product (ORTECH, 1991). In the calcination reaction, one mole of carbon dioxide is formed for each mole of quicklime produced from burning calcium carbonate, and two moles of CO_2 is formed for each mole of dolomitic quicklime. This principle was used to calculate emission factors according to the equations below:

$$EF_{quicklime} = Mass\ Ratio\ (CO_2/CaO) \bullet CaO\ Content$$

$$EF_{dolomitic\ lime} = Mass\ Ratio\ (CO_2/CaO \bullet MgO) \bullet (CaO \bullet MgO)\ Content$$

It should be noted that there are three types of lime: high-calcium lime (CaO + impurities); dolomitic lime (CaO • MgO + impurities); hydraulic lime (CaO + calcium silicates), which is a substance between lime and cement (the first two types have different mass ratios, and the third has a reduced CaO content). Considering these types of lime, it allows improved emission estimates.

As there is no statistic information on lime production by type in the Republic of Moldova, following the set of good practices, the total lime production was disaggregated for the breakdown of lime types according to the default values for high-calcium/dolomitic lime (85% – high calcium lime, and 15% – dolomitic lime), the proportion of hydraulic lime considered to be zero. The basic parameters used for estimating CO_2 emission factors from lime production are shown in Table 4-14.

Table 4-14: Basic parameters for estimating EFs for category 2A2 'Lime Production'

Type of lime	Mass ratio (1)	Range of CaO content (%)	Range of MgO content (%)	Default values for CaO/CaO·MgO content (2)	Default EFs, t CO_2/t lime (1) · (2)
High-calcium lime	0.7848	93-98	0.3-2.5	0.95	0.7456
Dolomitic lime	0.9132	55-57	38-41	0.85	0.7763
Hydraulic lime	0.7848	65-92		0.75	0.5886

Source: 2006 IPCC Guidelines, Chapter 2.3 'Lime Production', Table 2.4, page. 2.22.

Emission factors for indirect GHG emissions and SO_2 originating from source category 2A2 'Lime Production' are available in Table 4-15 below.

Table 4-15: Default EFs used in the estimation of indirect GHG and SO_x emissions from source category 2A2 'Lime Production'

Category	Process description	NO_x	CO	SO_2
		g/t lime		
Mineral Industry	Lime production	1369	1940	316

Source: 2006 IPCC Guidelines 2023, Chapter 2.3 'Lime Production', SNAP Code 030312 Lime, Category 1.A.2.f.i, Table 3-23.

Statistical Yearbooks of the RoM contain aggregated AD at national level on lime production for the period until 1992. From 1993, AD on commercial lime production are available separately for the right and left banks of the Dniester River, in the Statistical Yearbooks of the RoM and ATULBD (Table 4-16).

Table 4-16: AD on lime production in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM: LBDR	90.00	78.60	55.00	48.00	45.00	28.00	34.00	39.00	26.00	19.00	12.00
RoM: RBDR	114.30	100.00	32.80	30.00	15.90	10.80	19.90	9.70	12.70	5.20	3.10
RoM: total	**204.30**	**178.60**	**87.80**	**78.00**	**60.90**	**38.80**	**53.90**	**48.70**	**38.70**	**24.20**	**15.10**
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
RoM: LBDR	2.00	8.00	0.00	1.00	7.00	8.00	14.00	14.00	4.28	3.18	7.44
RoM: RBDR	3.30	3.30	2.90	2.10	2.08	2.15	1.14	0.34	0.33	0.19	0.18
RoM: total	**5.30**	**11.30**	**2.90**	**3.10**	**9.08**	**10.15**	**15.14**	**14.34**	**4.61**	**3.37**	**7.61**
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
RoM: LBDR	6.84	5.49	8.33	8.01	4.02	22.26	24.73	27.90	22.22	19.84	30.00
RoM: RBDR	0.13	0.08	0.05	0.17	0.05	0.13	0.09	0.04	0.00	0.00	0.00
RoM: total	**6.97**	**5.57**	**8.38**	**8.18**	**4.07**	**22.38**	**24.81**	**27.94**	**22.22**	**19.84**	**30.00**

Source: National Bureau of Statistics of the Republic of Moldova through the Statistical Yearbooks of the RM for years 1994 (page 286), 1999 (page 302), 2003 (page 392), 2006 (page 312); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type for the years 2005-2022'; Statistical Yearbooks of ATULBD for the years 1998 (page 176), 2000 (page 99), 2002 (page 103), 2005 (page 94), 2006 (page 93), 2007 (page 92), 2009 (page 92), 2011 (page 94), 2012 (page 98), 2013 (page 99), 2014 (page 88), 2015 (page 88), 2016 (page 98), 2017 (page 101), 2019 (page 99), 2020 (page 102), 2021 (page 100). Express information, Key performance indicators of the republic's industry (excluding small businesses) for 2009-2021.

As revealed in Table 4-16, commercial lime production has plunged drastically in the RoM in recent years (RBDR). In this context, the amount of commercial lime needed for domestic consumption is substituted with imported amounts. Table 4-17 provides statistical data on lime imports between 1995 and 2022. According to this data, lime imports increased by circa 113 times over this period.

Table 4-17: Commercial lime imports in the RoM (RBDR) between 1995 and 2022, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Lime imports, kt	0.06	0.23	0.34	0.51	0.40	0.60	1.78	2.11	3.24	3.66	3.95	5.12	6.42	7.54
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Lime imports, kt	3.80	4.83	4.70	5.05	4.26	5.26	4.66	5.33	6.53	6.80	7.39	9.32	7.76	7.15

Source: Customs Service of the RM, Official Letter No. 28/07-1893 dated 23.02.2011, as a response to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Letter No. 15-03-05 dated 24.01.2014, as a response to Letter No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office of the Ministry of Environment; Letter No. 28/07-2231 dated 26.02.2015, answer to Letter No. 407/2015-01-09 dated 29.01. 2015, from the Climate Change Office of the Ministry of Environment; Letter No. 28/07-8785 dated 26.05.2016, as a response to Letter No. 512/2016-05-01 dated 10.05.2016, from the Climate Change Office of the Ministry of Environment; Letter No. 28/07-612 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 dated 14.12.2017, from the Climate Change Office of the MARDE; Letter No. 28/07-3025 dated 28.02.2020, as a response to Letter No. 08-310/1 dated 11.02.2020, from the Environment Agency; Letter dated 19 February 2021, as a response to Letter No. 13-07/519 dated 09.02.2021, from the MARDE; Letter dated 20.02.2023, as a response to the interpellation of the Environment Agency to No. 08/34/2023 din 28.01.2023.

According to the 2006 IPCC Guidelines (Volume 3, Chapter 2.5, Table 2-7), emissions from lime production at sugar factories should be reported under 2category A2 'Lime production'.

As the amount of lime produced and utilised by self-producers is not accounted for by the statistical system, this information was requested from sugar-producing enterprises in the RoM (in the current inventory cycle, the information was submitted by two enterprises: Sudzucker-Moldova Ltd. and Moldova Sugar Ltd., the market share of these two enterprises varied in the period 2013-2022 between 93% and 100% of the total amount of sugar produced in the RoM).

Table 4-18: AD on lime production at sugar factories in the RoM between 1990 and 2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Granulated sugar from sugar beet, kt[1]	435.80	236.90	208.00	230.20	166.70	218.70	264.50	213.30	194.50	100.50	105.40
Specific consumption of quicklime, kg/t produced sugar	348.36	339.34	330.32	321.29	312.27	303.25	294.23	285.21	276.19	267.17	258.14
Amount of lime used in sugar production, kt[2]	151.81	80.39	68.71	73.96	52.06	66.32	77.82	60.83	53.72	26.85	27.21
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Granulated sugar from sugar beet, kt[1]	132.60	167.60	107.10	110.90	133.47	149.05	73.96	133.97	38.37	103.21	88.44
Specific consumption of quicklime, kg/t produced sugar	249.12	240.10	231.08	222.06	213.04	204.02	194.99	185.97	176.95	167.93	169.82
Amount of lime used in sugar production, kt[2]	33.03	40.24	24.75	24.63	28.43	30.41	14.42	24.91	6.79	17.33	14.78
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Granulated sugar from sugar beet, kt[1]	83.44	140.30	177.69	84.52	100.00	128.98	73.91	86.93	54.37	101.20	67.80
Specific consumption of quicklime, kg/t produced sugar	175.04	167.28	148.31	155.43	153.38	129.20	199.20	112.09	136.49	107.93	116.39
Amount of lime used in sugar production, kt[2]	13.95	22.41	23.72	13.03	14.31	16.43	12.63	9.23	6.16	8.21	7.73

Source: [1]Statistical Yearbooks of the Republic of Moldova for the years 1994 (page 289), 1999 (page 304), 2003 (page 393), 2006 (page 310), Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the RM, by product type, for the years 2005-2022'; Statistical Yearbooks of ATULBD for years 1998 (page 177), 2000 (page 100), 2002 (page 104), 2005 (page 94); [2]Sudzucker-Moldova Ltd., through Letter No. 03-1-191 dated 19.04.2011, as a response to the interpellation of the Letter of the Ministry of Agriculture, and Food Industry to No. 19/348 dated 15.04.2011; Letter from February 28, 2020, as a response to the interpellation of the Environment Agency No. 08-310/1 dated 11.02.2020; Letter from August 25, 2021, as a response to the interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021; Letter dated 23.07.2022, as a response to the interpellation of the Environment Agency to No. 08/367/2022 of 07.07.2022; Letter dated 17.05.2023, as a response to the interpellation of the Environment Agency to No. 08/145/2023 of 20.04.2023; Moldova Sugar Ltd., through Letter dated 14 August 2020, as a response to the interpellation of the Environment Agency to No. 08-310/1 of 11.02.2020; Letter dated 2 August 2021, as a response to the interpellation of the Environment Agency to No. 08/136/2021 of 09.06.2021; Letter dated 17.07.2022, as a response to the interpellation of the Environment Agency to No. 08/367/2022 of 07.07.2022; Letter dated 15.05.2023, as a response to the interpellation of the Environment Agency to No. 08/145/2023 of 20.04.2023.

The total amount of lime produced in the country between 1990 and 2022 (commercial lime and the lime produced by self-producers, particularly at sugar factories) is presented below (Table 4-19). As the produced amount of hydrated lime (by means of slaking, lime is disaggregated into hydrated lime, i.e. $Ca(OH)_2$ or $Ca(OH)_2{\cdot}Mg(OH)_2$) is unknown in the country. Following good practices, this value was inferred from AD on total amount of lime produced in the RM, by multiplying it by a correction factor (the default value being 0.97).

Table 4-19: AD on hydrated lime production in the RoM for 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Commercial lime produced	204.30	178.60	87.80	78.00	60.90	38.80	53.90	48.70	38.70	24.20	15.10
Lime produced by self-manufacturers	151.81	80.39	68.71	73.96	52.06	66.32	77.82	60.83	53.72	26.85	27.21
Total lime produced in the RM	**356.11**	**258.99**	**156.51**	**151.96**	**112.96**	**105.12**	**131.72**	**109.53**	**92.42**	**51.05**	**42.31**
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Commercial lime produced	5.30	11.30	2.90	3.10	9.08	10.15	15.14	14.34	4.61	3.37	7.61
Lime produced by self-manufacturers	33.03	40.24	24.75	24.63	28.43	30.41	14.42	24.91	6.79	17.33	14.78
Total lime produced in the RM	**38.33**	**51.54**	**27.65**	**27.73**	**37.51**	**40.56**	**29.56**	**39.26**	**11.40**	**20.70**	**22.40**

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Commercial lime produced	6.97	5.57	8.38	8.18	4.07	22.38	24.81	27.94	22.22	19.84	30.00
Lime produced by self-manufacturers	13.95	22.41	23.72	13.03	14.31	16.43	12.63	9.23	6.16	8.21	7.73
Total lime produced in the RM	**20.92**	**27.98**	**32.10**	**21.21**	**18.39**	**38.81**	**37.45**	**37.17**	**28.38**	**28.05**	**37.73**

At the same time, the amount of high-calcium lime and dolomitic lime was inferred from AD on the amount of hydrated lime by using the default value for high calcium/dolomitic lime 85/15 (Table 4-20).

Table 4-20: AD on hydrated lime production in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
High-calcium lime	302.70	220.14	133.03	129.17	96.01	89.35	111.97	93.10	78.56	43.39	35.96
Dolomitic lime	53.42	38.85	23.48	22.79	16.94	15.77	19.76	16.43	13.86	7.66	6.35
Total hydrated lime produced	**356.11**	**258.99**	**156.51**	**151.96**	**112.96**	**105.12**	**131.72**	**109.53**	**92.42**	**51.05**	**42.31**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
High-calcium lime	32.58	43.81	23.50	23.57	31.88	34.48	25.12	33.37	9.69	17.60	19.04
Dolomitic lime	5.75	7.73	4.15	4.16	5.63	6.08	4.43	5.89	1.71	3.11	3.36
Total hydrated lime produced	**38.33**	**51.54**	**27.65**	**27.73**	**37.51**	**40.56**	**29.56**	**39.26**	**11.40**	**20.70**	**22.40**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
High-calcium lime	17.79	23.79	27.28	18.03	15.63	32.99	31.83	31.59	24.12	23.84	32.07
Dolomitic lime	3.14	4.20	4.81	3.18	2.76	5.82	5.62	5.57	4.26	4.21	5.66
Total hydrated lime produced	**20.92**	**27.98**	**32.10**	**21.21**	**18.39**	**38.81**	**37.45**	**37.17**	**28.38**	**28.05**	**37.73**

CO_2 emissions were estimated following the Tier 2 methodological approach available in the 2006 IPCC Guidelines, by multiplying the above-mentioned emission factors by annual activity data on hydrated lime production, considering the type of lime produced, the correction factor or the amount of lime kiln dust, LKD representing a mixture of raw materials varying from an uncalcined state to a completely calcined state. Virtually, all types of kilns which are utilised to produce lime generate such dust, but the amount depends on the technology applied within the respective factory. It should be noted that the lime kiln dust can be retained by electrostatic precipitation or filtration, and it is possible to return it to the kiln as raw material. Related to CO_2 emissions, any amount of dust that is not returned to the kiln is considered to be a system loss.

$$Total_{\,l} = P_{\,i} \bullet EF_{\,lime,\,i} \bullet correction\ factor\ (LKD)$$

Where:

Total $_l$ – CO_2 emissions from type *i* lime production (Kt/yr);

$EF_{\,lime,\,i}$ – emission factor for type *i* lime (0.7456 t CO_2/t high-calcium lime and 0.7763 t CO_2/t dolomitic lime);

$P_{\,i}$ – type *i* lime production (kt/yr);

LKD – correction factor, the default value used is 1.02, the country-specific value is unknown.

2A3. Glass Production

Methodological issues concerning the estimation of direct and indirect GHG emissions originating from glass production are approached in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, as well as in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019).

CO_2 emissions were estimated following the Tier 2 methodological approach available in the 2006 IPCC Guidelines.

$$Total\ CO_2\ emissions = \Sigma\ [M_{\,g,i} \bullet FE_{\,g,\,i} \bullet (1 - CR_i)]$$

Where:

Total – CO_2 emissions from glass production (kt/yr);

$M_{\,g,\,i}$ – mass of melted type *i* glass (kt/yr);

$EF_{\,i}$ – emission factor for type *i* glass (t CO_2/t melted glass);

$CR_{\,i}$ – cullet ratio for manufacturing of type *i* glass, fraction.

Default EFs used in the estimation of CO_2, respectively the cullet ratio for manufacturing different types of glass are provided in Table 4-21.

Table 4-21: Default EFs used in the estimation of CO_2 emissions from glass production

Type of glass	Default Ef, t CO_2/t glass	CR or the typical margin of the share of recyclable glass in the production	The average value of CR or the share of recyclable glass in the production process
Flat glass production for windows	0.21	10%-25%	17.5%
Glass for flint type containers	0.21	30%-60%process	45.0%
Glass for green or amber containers	0.21	30%-80%	55.0%
Fiberglass (type E-glass)	0.19	0%-15%	7.5%
Fiberglass for insulation	0.25	10%-50%	30.0%
Specialty glass (TV panels)	0.18	20%-75%	47.5%
Specialty glass (TV funnels)	0.13	20%-70%	45.0%
Glass for glassware and tableware	0.10	20%-60%	35.0%
Lab/Pharma Glass	0.03	30%-75%	52.5%
Glass for lighting	0.20	40%-70%	55.0%

Source: 2006 IPCC Guidelines for National Greenhouse Gas Inventories, Volume 3, Chapter 2.4, Table 2.6, Page 2.30.

The following glass factories operated in the RoM: SOE 'Chisinau Glass Factory', JSC 'Vetropack Chisinau' (M.E. 'Glass Container Company' and M.E. 'Glass Container Prim') in Chisinau (since 2002); 'Cristal-Flor' Glass Factory in Floresti and the Glass Factory in Tiraspol (ATULBD), but the last two plants ceased their activity.

Activity data on glass production are available in the Statistical Yearbooks of the RM and of ATULBD, as well as in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type' (Table 4-22). It should be noted that the information regarding the production of glass jars, expressed in millions of pieces is available in the Statistical Yearbooks of the Republic of Moldova only for 1990-2011; at the same time, information regarding the production of glass jars, expressed in kt, is available for 2004-2013 in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type'. For 2014-2022, the information is missing due to confidential reasons (C).

Table 4-22: AD on glass production in the RoM for 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Flat glass for windows, thousand m^2	226.00	287.00	184.00	NO	NO	NO	NO	NO	NO	NO	NO
Glass jars, mil. conventional units	657.60	693.70	187.40	248.90	152.70	87.40	39.60	86.40	84.20	104.60	156.20
Glass containers and bottles, mil. units	165.50	153.00	138.80	138.20	133.40	184.00	165.20	172.20	189.10	125.20	260.50
Fiberglass products, tonnes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other products not included elsewhere, tonnes	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Flat glass for windows, thousand m^2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Glass jars, mil. conventional units	148.80	137.40	107.40	98.90	103.10	121.30	98.70	80.70	92.20	99.80	48.20
Glass containers and bottles, mil. units	228.30	296.10	281.40	308.00	354.64	321.45	302.72	284.71	201.30	246.21	326.27
Fiberglass products, tonnes	NO	NO	NO	NO	0.06	0.01	40.64	32.61	14.79	18.15	26.37
Other products not included elsewhere, tonnes	NO	NO	NO	NO	141.18	291.12	77.99	87.91	61.68	35.99	51.11
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Flat glass for windows, thousand m^2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Glass jars, mil. conventional units	111.05	139.77	170.40	218.53	147.04	99.43	248.14	165.70	181.87	166.51	163.47
Glass containers and bottles, mil. units	223.11	272.53	243.72	228.94	218.55	205.97	235.07	215.03	306.84	298.20	336.16
Fiberglass products, tonnes	392.82	1,711.14	1,917.71	2,124.28	2,330.85	2,537.41	2,743.98	2,755.53	2,636.41	4,064.34	4,104.75
Other products not included elsewhere, tonnes	63.13	89.83	147.44	182.21	150.75	69.39	6.88	21.75	26.20	1,520.34	858.26

Source: Statistical Yearbooks of the RoM for the years 1988 (page 228), 1994 (page 287), 1999 (page 303), 2003 (page 393), 2004 (page 443), 2005 (pages 321-322), 2006 (page 312), 2010 (page 305), 2012 (page 309); Statistical Yearbooks of ATULBD for the years 1998 (page 180), 2000 (page 100), 2002 (page 104), 2005 (page 94), 2007 (page 93), 2010 (page 93). Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type, for 2005-2022'.

With reference to the CS values of the share of recyclable glass in the production process of glass jars, containers and glass bottles, the information was received through questionnaires from the SOE 'Chisinau Glass Factory', and from the JSC 'Vetropack Chisinau' (M.E. 'Glass Container Company' and M.E. 'Glass Container Prim'), respectively. The share of these enterprises in the total glass production at national level was taken into account, thus determining the weighted average value of the CR coefficient. The default EF for glass used to produce jars, glass containers and bottles is 210 kg CO_2 per ton of glass produced. Country-specific emission factors were calculated considering the annual country-specific CR values (Table 4-23).

Table 4-23: CS EFs used in the estimation of CO_2 emissions from glass production (glass jars, glass containers and bottles) in the RoM, 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Weighted average value of recyclable glass in the production process of glass jars, glass containers and bottles, %	49.7	51.0	47.8	57.5	81.1	77.8	59.4	76.8	76.8	79.7	51.2
CS EF, kg CO_2/t glass used for the production of glass jars, glass containers and bottles	105.6	102.9	109.6	89.3	39.7	46.7	85.4	48.7	48.7	42.7	102.4
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Weighted average value of recyclable glass in the production process of glass jars, glass containers and bottles, %	50.6	44.7	44.5	46.0	45.4	39.8	43.0	30.7	31.4	32.6	31.5
CS EF, kg CO_2/t glass used for the production of glass jars, glass containers and bottles	103.7	116	116.6	113.4	114.7	126.4	119.7	145.6	144	141.6	143.8
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Weighted average value of recyclable glass in the production process of glass jars, glass containers and bottles, %	29.6	24.4	22.9	16.4	18.0	33.0	28.3	26.5	25.3	25.1	26.0
CS EF, kg CO_2/t glass used for the production of glass jars, glass containers and bottles	147.8	158.7	161.9	175.5	172.2	140.7	150.6	154.4	157.0	157.3	155.4

Source: SOE 'Chisinau Glass Factory', Official Letter No. 31 dated 21.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 9/01-01 dated 16.01.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 16 dated 12.02.2015 as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter No. 86 dated 19.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter from 20.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter from 28.02.2020, as a response to request No. 08-310/1 dated 11.02.2020; Letter No. 244 dated 24.06.2021, as a response to the interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021; Letter dated 10.05.2023, as a response to request to the interpellation of the Environment Agency No. 08/149/2023 of 20.04.2023. Glass Container Company Chisinau and Glass Container Prim, Letter from 28.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 01-1C-78 dated 19.02.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 01-3C-63 dated 30.03.2015, as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter from 23.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter from 23.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter from 02.06.2020, as a response to request No. 08-310/1 dated 11.02.2020. Letter from 29.06.2021, as a response to the interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021; JSC 'Vetropack Chiainau', Letter dated 17.05.2023, as a response to the interpellation of the Environment Agency No. 08/149/2023 of 20.04.2023.

As for other types of glass produced in the Republic of Moldova, default EF values available in the 2006 IPCC Guidelines were used (Volume 3, Chapter 2.4, Table 2.6, Page 2.30).

In order to convert AD in metric mass units (kilotons), a series of conversion coefficients were used: the specific density of flat glass for windows used in the construction sector [56] – 2.5 g/cm^3; the average thickness of flat glass for windows used in the construction sector – 3.5 mm; the average thickness of multi-layer insulating glass used in construction – 6.75 mm [57]; the average weight of a conventional glass container – 0.52 kg and the average weight of a glass jar – 0.26 kg (with reference to the last two conversion coefficients, they were determined after requesting information from SOE 'Glass Factory in Chisinau', and two glass factories belonging to JSC 'Vetropack Chisinau', respectively (M.E. 'Glass Container Company' and JSC 'Glass Container Prim').

It should be noted that flat glass is no longer produced in the Republic of Moldova since 1993, glass bottles for the wine industry are produced only on the right bank of the Dniester River, whereas the production of glass jars for the canning industry on the left bank of the Dniester River was ceased in 2009. AD on glass production in the Republic of Moldova, is available below (Table 4-24).

Table 4-24: AD on glass production in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Flat glass for windows	1.98	2.51	1.61	NO	NO	NO	NO	NO	NO	NO	NO
Glass jars	170.98	180.36	48.72	64.71	39.70	22.72	10.30	22.46	21.89	27.20	40.61
Glass containers and bottles	86.06	79.56	72.18	71.86	69.37	95.68	85.90	89.54	98.33	65.10	135.46
Fiberglass products	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Other products not included elsewhere	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total glass produced in the RoM	**259.01**	**262.43**	**122.51**	**136.58**	**109.07**	**118.40**	**96.20**	**112.01**	**120.22**	**92.30**	**176.07**

[56] National Report of the Russian Federation on the Inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol for 1990-2014, developed and in accordance with the obligations of the Russian Federation under the United Nations Framework Convention on Climate Change and the Kyoto Protocol to the United Nations Framework Convention on Climate Change. Moscow, 2016. 476 p.
[57] Airapetov G.A., Bezrodnii O.C., Jolobov A.L. (2005), Building materials: teaching handbook. – Rostov-on-Don, Phoenix, 2005.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Flat glass for windows	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Glass jars	38.69	35.72	27.92	25.71	26.69	30.07	22.72	17.94	20.76	22.15	10.71
Glass containers and bottles	118.72	153.97	146.33	160.16	184.41	167.15	157.41	148.05	104.68	128.03	169.66
Fiberglass products	NO	NO	NO	NO	0.00	0.00	0.04	0.03	0.01	0.02	0.03
Other products not included elsewhere	NO	NO	NO	NO	0.14	0.29	0.08	0.09	0.06	0.04	0.05
Total glass produced in the RoM	**157.40**	**189.70**	**174.25**	**185.87**	**211.24**	**197.52**	**180.25**	**166.10**	**125.51**	**150.23**	**180.44**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Flat glass for windows	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Glass jars	24.65	31.03	34.08	56.82	47.05	41.76	64.52	53.02	58.20	53.28	57.21
Glass containers and bottles	116.02	141.72	126.74	119.05	113.64	107.11	122.23	111.81	159.55	155.07	178.16
Fiberglass products	0.39	1.71	1.92	2.12	2.33	2.54	2.74	2.76	2.64	4.06	4.10
Other products not included elsewhere	0.06	0.09	0.15	0.18	0.15	0.07	0.01	0.02	0.03	1.52	0.86
Total glass produced in the RoM	**141.13**	**174.55**	**162.88**	**178.18**	**163.18**	**151.47**	**189.50**	**167.62**	**220.41**	**213.93**	**240.34**

For comparison, the table below presents AD on glass production at two glass factories in Chisinau municipality (Table 4-25). The share of glass produced at the respective factories varies in time between 70 and 100% of the total glass production in the Republic of Moldova.

Table 4-25: Activity data on glass production at glass factories in Chisinau between 2002-2022, kt

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SOE Glass Factory in Chisinau	81.84	88.12	80.58	69.96	60.24	48.03	47.27	47.14	34.93	47.04
JSC 'Vetropack Chisinau'	56.36	50.26	61.12	59.03	62.74	61.17	59.27	60.11	97.12	84.38
Total	**138.20**	**138.38**	**141.70**	**128.98**	**122.98**	**109.20**	**106.53**	**107.25**	**132.05**	**131.42**
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
SOE Glass Factory in Chisinau	61.57	59.79	57.41	35.66	28.19	60.16	60.88	56.42	59.41	61.46
JSC 'Vetropack Chisinau'	59.11	57.87	117.30	123.70	119.40	123.30	104.70	145.90	147.10	171.30
Total	**120.67**	**117.66**	**174.71**	**159.36**	**147.59**	**183.46**	**165.58**	**202.32**	**206.51**	**232.76**

Source: SOE Glass Factory, Chisinau, Letter No. 31 dated 21.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 9/01-01 dated 16.01.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 16 dated 12.02.2015, as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter No. 86 dated 19.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter from 20.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter dated 28.02.2020, as a response to request No. 08-310/1 dated 11.02.2020; Letter No. 244 dated 24.06.2021, as a response to request of Environment Agency No. 08/136/2021 dated 09.06.2021; Letter dated 10.05.2023, as a response to the interpellation of the Environment Agency No. 08/149/2023 dated 20.04.2023; JSC Glass Container Company Chisinau and Glass Container Prim, Letter from 28.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 01-1C-78 dated 19.02.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 01-3C-63 dated 30.03.2015, as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter from 23.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter from 23.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter from 02.06.2020, as a response to request No. 08-310/1 dated 11.02.2020. Letter dated 29.06.2021 as a response to interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021; JSC 'Vetropack Chisinau', Letter dated 17.05.2023, as a response to the interpellation of the Environment Agency No. 08/149/2023 dated 20.04.2023.

Default EF values used for NO_x, NMVOC and SO_2 are shown in Table 4-26.

Table 4-26: Default EFs used in the estimation of indirect GHG emissions from glass production

Category	Process description	NO_x	NMVOC	SO_2
		g / t		
Mineral Industry	Glass Production (flat glass for windows, glass containers, specialty glass, glass for glassware and tableware, fiberglass, etc.)	2930	6.13	1960

Source: : EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 030314-030317 Glass, Category 1.A.2.f.i, Table 3-26.

2A4. Other Process Uses of Carbonates

2A4a. Ceramics

Methodological issues regarding the estimation of CO_2 emissions resulting from the production of bricks, expanded clay and ceramics are addressed in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (Volume 3, Chapter 2.5, Pages 2.32-2.40, and by considering the data available in Volume 3, Chapter 2.1, Table 2.1, Page 2.7, respectively).

In the process of ceramics production, CO_2 emissions result from the calcination of the raw material used. Similar to the cement and lime production processes, carbonates are heated to high temperatures in a kiln, producing CO_2 emissions, which can be estimated by multiplying the annual data on the amount of carbonates used by a specific emission factor that takes into account the CaO and MgO content.

$$CO_2\ emissions = M_c \bullet EF_{c,}$$

Where:

M_c – mass of carbonate consumed for bricks and ceramics production (tonnes);

EF_c – emission factor for carbonate calcination (t CO_2/t).

In the calcination of the carbonates in the clay, each mole of CaO and MgO, respectively, forms one mole of CO_2. This principle was used for the development of the emission factor.

$$EF = Mass\ Ratio\ (CO_2/CaO) \bullet CaO\ Content\ in\ clay + Mass\ Ratio\ (CO_2/MgO) \bullet MgO\ Content\ in\ clay$$

It should be noted that the content of CaO in clay varies between 6-9%, whereas the content of MgO – between 2.4%[58], respectively. Based on the information received (Annex 3-2) from the main brick producer in the RoM (the share of bricks production from JSC 'MACON' between 1998 and 2022 varied between a minimum of 45.5% and a maximum of 83.7% of the national total), the annual values of the country-specific EF used in the estimation of CO_2 emissions from brick and ceramic production in the RoM were calculated (Table 4-27), according to which, the annual values of the emission factor varied between 1990 and 2022 between a minimum of 72.9 kg of CO_2 per tonne of clay consumed (in 2007) and a maximum of 103.9 kg of CO_2 per tonne of clay consumed (in 2022).

Table 4-27: CS EFs used in the estimation of CO_2 emissions from brick, expanded clay and ceramic production between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Content of CaO in clay used	0.0844	0.0844	0.0844	0.0844	0.0844	0.0844	0.0844	0.0822	0.0822	0.0822	0.0822
Mass Ratio CO_2/CaO	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
EF, t CO_2/t clay used (only CaO)	0.0662	0.0662	0.0662	0.0662	0.0662	0.0662	0.0662	0.0645	0.0645	0.0645	0.0645
Content of MgO in clay used	0.0303	0.0303	0.0303	0.0303	0.0303	0.0303	0.0303	0.0357	0.0357	0.0357	0.0357
Mass Ratio CO_2/MgO	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
EF, t CO_2/t clay used (only MgO)	0.0331	0.0331	0.0331	0.0331	0.0331	0.0331	0.0331	0.0390	0.0390	0.0390	0.0390
EF, t CO_2/t clay used (total)	**0.0993**	**0.0993**	**0.0993**	**0.0993**	**0.0993**	**0.0993**	**0.0993**	**0.1035**	**0.1035**	**0.1035**	**0.1035**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Content of CaO in clay used	0.0800	0.0787	0.0753	0.0710	0.0534	0.0606	0.0509	0.0529	0.0757	0.0773	0.0733
Mass Ratio CO_2/CaO	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
EF, t CO_2/t clay used (only CaO)	0.0628	0.0618	0.0591	0.0557	0.0419	0.0476	0.0399	0.0415	0.0594	0.0607	0.0575
Content of MgO in clay used	0.0355	0.0354	0.0351	0.0321	0.0302	0.0304	0.0302	0.0305	0.0319	0.0326	0.0314
Mass Ratio CO_2/MgO	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
EF, t CO_2/t clay used (only MgO)	0.0388	0.0387	0.0383	0.0351	0.0330	0.0332	0.0330	0.0334	0.0349	0.0356	0.0343
EF, t CO_2/t clay used (total)	**0.1015**	**0.1005**	**0.0974**	**0.0908**	**0.0749**	**0.0808**	**0.0729**	**0.0748**	**0.0943**	**0.0963**	**0.0918**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Content of CaO in clay used	0.0669	0.0889	0.0898	0.0909	0.0922	0.0874	0.0885	0.0814	0.0828	0.0890	0.0922
Mass Ratio CO_2/CaO	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848	0.7848
EF, t CO_2/t clay used (only CaO)	0.0525	0.0698	0.0705	0.0713	0.0723	0.0686	0.0695	0.0638	0.0650	0.0698	0.0724
Content of MgO in clay used	0.0283	0.0285	0.0286	0.0288	0.0289	0.0289	0.0299	0.0291	0.0295	0.0290	0.0288
Mass Ratio CO_2/MgO	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919	1.0919
EF, t CO_2/t clay used (only MgO)	0.0310	0.0311	0.0312	0.0315	0.0315	0.0316	0.0327	0.0318	0.0322	0.0316	0.0315
EF, t CO_2/t clay used (total)	**0.0834**	**0.1009**	**0.1017**	**0.1028**	**0.1038**	**0.1002**	**0.1022**	**0.0957**	**0.0972**	**0.1014**	**0.1039**

Source: JSC 'MACON', through Letter No. 01/01-R dated 17.01.2014, as a response to the Climate Change Office's interpellation No. 320/2014-01-01 dated 03.01.2014; Letter No. 17/01-G dated 09.02.2015, as a response to the Climate Change Office's interpellation No.407/2015-01-09 dated 29.01.2015; Letter No. 28/01-V dated 28.06.2016, as a response to the Climate Change Office's interpellation No. 512/2016-05-01 dated 10.05.2016; Letter dated 07.08.2020, as a response to the Environment Agency's interpellation No. 08-310/1 dated 11.02.2020. Letter dated 22.06.2021, as a response to the Environment Agency's interpellation No. 08/136/2021 dated 09.06.2021; Letter dated 15.05.2023, as a response to the Environment Agency's interpellation No. 08/149/2023 dated 20.04.2023.

According to the information available in the 2006 IPCC Guidelines (Volume 3, Chapter 2.5, page 2.34), the value of the default emission factor utilised is 100 kg of CO_2 per tonne of clay consumed or 10% of the mass of carbonates used as raw material.

Activity data on brick production are available in the Statistical Yearbooks of the Republic of Moldova and those of ATULBD (Table 4-28). Activity data expressed in million conventional units are available in the Statistical yearbooks of the RoM for the period 1990-2009, and for the period 2004-2022,

[58] In conformity with the information provided by 'MACON' JSC, the average content of CaO in clay extracted in Purcel quarry is circa 8.44%, in Pruncul quarry – 8.22%, in Micauti – 6.70%, in Haruza Mica – 6.66%; while the average content of MgO in clay extracted in Purcel quarry is 3.03%, in Pruncul – 3.57%, in Micautil – 2.93%, and in Haruza Mica – 2.60%.

activity data expressed in thousand m^3 are available in Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type'. The conversion coefficient applied is 0.484 thousand conventional bricks/m^3.

Table 4-28: Activity data on Brick Production between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM: RBDR, mil. conventional units	190.50	177.50	83.20	149.70	64.30	39.20	37.20	47.70	48.70	44.80	39.90
RoM: RBDR, thousand m^3	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
RoM: LBDR, mil. conventional units	45.00	40.00	35.00	30.00	25.00	20.00	16.00	12.00	7.00	12.00	13.00
RoM: total, mil. conventional units	**235.50**	**217.50**	**118.20**	**179.70**	**89.30**	**59.20**	**53.20**	**59.70**	**55.70**	**56.80**	**52.90**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RoM: RBDR, mil. conventional units	38.10	45.80	52.20	54.90	55.70	52.80	55.90	53.00	38.10	37.37	41.00
RoM: RBDR, thousand m^3	NA	NA	NA	NA	114.20	108.59	117.51	108.01	79.73	77.27	84.76
RoM: LBDR, mil. conventional units	15.00	17.00	16.00	21.00	18.00	18.00	19.00	20.70	13.52	11.58	13.01
RoM: total, mil. conventional units	**53.10**	**62.80**	**68.20**	**75.90**	**73.70**	**70.80**	**74.90**	**73.70**	**51.62**	**48.95**	**54.01**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RoM: RBDR, mil. conventional units	28.32	35.77	35.90	37.78	34.57	30.60	33.01	36.54	33.56	41.42	40.31
RoM: RBDR, thousand m^3	58.57	73.95	74.22	78.11	71.48	63.27	68.25	75.56	69.39	85.64	83.35
RoM: LBDR, mil. conventional units	14.66	14.62	14.67	9.06	9.31	8.52	5.53	6.75	9.10	6.90	6.69
RoM: total, mil. conventional units	**42.98**	**50.38**	**50.56**	**46.84**	**43.88**	**39.12**	**38.54**	**43.29**	**42.66**	**48.31**	**47.00**

Source: Statistical Yearbooks of the RoM for the years 1988 (page 228), 1994 (page 287), 1999 (page 303), 2005 (page 322), 20010 (page 305); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type, for 2005-2022'. Statistical Yearbooks of ATULBD for the years 1998 (page 177), 2000 (page 99), 2002 (page 103), 2005 (page 94), 2007 (page 92), 2009 (page 92), 2011 (page 94), 2013 (page 99), 2015 (page 88), 2017 (page 101), 2019 (page 99), 2021 (page 10); Express information, Key performance indicators of the republic's industry (excluding small businesses) for 2009-2021.

To convert the AD in metric mass units (kilotons), conversion coefficients were used based on the data available on the web pages of domestic and foreign construction companies[59]. According to them, the standard size of a conventional brick is: 250 x 120 x 65 mm, with a specific density variation between 1500 and 1900 kg/m^3 (in the RoM – between 1020 and 1869 kg/m^3). Under such circumstances, the volume of a conventional brick is – 0.25 • 0.12 • 0.065 = 0.00195 m^3; the minimum weight – 1020 • 0.00195/1 = 1.989 kg; the maximum weight – 1869 • 0.00195/1 = 3.644 kg; the average weight – 1444.5 • 0.00195/1 = 2.817 kg; this particular value was used in order to calculate the weight in tonnes in the national production of bricks. At the same time, in order to estimate the mass of carbonates used for brick production, the method recommended by the 2006 IPCC Guidelines was utilised; the mass of clay used for brick production is determined by multiplying total brick production (in kilotons) by the default factor – 1.1 (Volume 3, Chapter 2.5, Page 2.36) (Table 4-29).

Table 4-29: AD on the amount of clay used in brick production in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total brick production, kt	663.35	612.65	332.94	506.17	251.54	166.75	149.85	168.16	156.89	159.99	149.01
Clay used in brick production, kt	729.69	673.91	366.24	556.79	276.69	183.43	164.84	184.98	172.58	175.99	163.91
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Total brick production, kt	149.57	176.89	192.10	213.79	207.60	199.43	210.98	207.59	145.41	137.89	152.12
Clay used in brick production, kt	164.53	194.58	211.31	235.17	228.36	219.37	232.07	228.35	159.95	151.68	167.33
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Total brick production, kt	121.07	141.92	142.43	131.93	123.59	110.20	108.55	121.95	120.17	136.09	132.39
Clay used in brick production, kt	133.18	156.11	156.67	145.13	135.95	121.21	119.40	134.14	132.18	149.70	145.63

AD regarding expanded clay production between 2001 and 2022 (*expressed in thousand m^3*) was provided directly by JSC 'MACON', the only expanded clay producer in the RoM (Table 4-30).

Table 4-30: AD on the amount of clay used in expanded clay production between 2001-2022

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Expanded clay production, thousand m^3	3.60	17.17	12.75	55.05	63.40	72.20	80.56	64.96	61.20	61.42	30.36
Specific weight, kg/m^3	390.1	388.9	387.3	371.1	392.9	399.7	385.4	376.2	399.4	353.3	324.8
Expanded clay production, kt	1.40	6.68	4.94	20.43	24.91	28.86	31.04	24.44	24.44	21.70	9.86
Clay used, t/m^3 expanded clay	0.715	0.711	0.717	0.731	0.710	0.711	0.550	0.624	0.629	0.572	0.617
Clay used in expanded clay production, kt	**2.57**	**12.21**	**9.14**	**40.24**	**45.01**	**51.33**	**44.31**	**40.54**	**38.49**	**35.13**	**18.73**

[59] <http://aquagroup.ru/articles/ves-kirpicha.html>, <http://www.lucceram.ro/index.php/products>.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Expanded clay production, thousand m^3	38.15	42.01	34.57	22.98	19.58	26.70	30.42	34.13	14.34	18.80	9.45
Specific weight, kg/m^3	403.5	376.9	375.7	389.8	368.1	377.5	375.9	374.3	376.5	379.2	384.3
Expanded clay production, kt	15.39	15.83	12.99	8.96	7.21	10.08	11.43	12.78	5.40	7.13	3.63
Clay used, t/m^3 expanded clay	0.717	0.639	0.639	0.680	0.703	0.673	0.658	0.642	0.703	0.703	0.703
Clay used in expanded clay production, kt	**27.35**	**26.85**	**22.09**	**15.63**	**13.77**	**17.97**	**20.00**	**21.91**	**10.08**	**13.22**	**6.64**

Source: JSC 'MACON', through Letter No. 01/01-R dated 17.01.2014, as a response to the Climate Change Office's interpellation No. 320/2014-01-01 dated 03.01.2014; Letter No. 17/01-G dated 09.02.2015, as a response to the Climate Change Office's interpellation No. 407/2015-01-09 dated 29.01.2015; Letter No. 28/01-V dated 28.06.2016, as a response to the Climate Change Office's interpellation No. 512/2016-05-01 dated 10.05.2016; Letter dated 07.08.2020, as a response to the Environment Agency's interpellation No. 08-310/1 dated 11.02.2020. Letter dated 22.06.2021, as a response to the Environment Agency's interpellation No. 08/136/2021 dated 09.06.2021; Letter dated 15.05.2023, as a response to the Environment Agency's interpellation No. 08/149/2023 dated 20.04.2023.

Activity data on ceramics production between 2005-2018 (activity data on ceramics productions was not recorded between 2019 and 2022) was provided by the National Bureau of Statistics, the information being available in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type' in Table 4-31.

Table 4-31: AD regarding the amount of clay utilised in ceramics production for 2005-2018

	2005	2006	2007	2008	2009	2010	2011
Roof tiles, pieces	243.51	182.98	288.25	223.36	86.67	7.21	66.87
Non-refractory ceramics for construction, tonnes	303.80	260.80	201.30	150.50	138.80	68.90	55.40
Table and ornamental ware (household ceramics), tonnes	579.72	478.96	838.19	276.80	188.72	169.09	136.85
Wall and paving tiles, thousand m^2	625.20	734.00	1,248.50	808.70	9.80	1.90	1.60
Total ceramics produced, kt	1.89	1.51	2.26	1.36	0.67	0.27	0.46
Total clay used to produce ceramics, kt	**2.08**	**1.66**	**2.48**	**1.50**	**0.74**	**0.29**	**0.51**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**
Roof tiles, pieces	4.55	1.89	NO	NO	NO	NO	NO
Non-refractory ceramics for construction, tonnes	12.70	24.40	NO	NO	NO	NO	NO
Table and ornamental ware (household ceramics), tonnes	118.37	89.63	105.97	89.87	92.23	57.24	38.25
Wall and paving tiles, thousand m^2	0.70	0.50	0.60	1.50	248.20	NO	NO
Total ceramics produced, kt	0.15	0.12	0.11	0.09	0.11	0.06	0.04
Total clay used to produce ceramics, kt	**0.16**	**0.13**	**0.12**	**0.10**	**0.12**	**0.06**	**0.04**

Source: Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic, by product type for 2005-2019'.

As shown in the table, activity data on the production of ceramic roof tiles are available in pieces. In order to transform this data into tonnes, the following conversion factor was used: one piece of roof tile has an average weight of circa 4 kg. The value of the conversion factor is determined by the National Standard of the Russian Federation GOST R 56688-2015[60], according to which, the mass of 1 m^2 of roof tile varies between 54 and 74 kg, while 1 m^2 of light roof tile contains circa 14.8-16.6 pieces with an average weight of circa 3.4 kg, and 1 m^2 of heavy roof tile contains circa 15-17 pieces with an average weight of circa 4.6 kg. As a comparison, web pages of companies importing roof tiles in the RoM and Romania were consulted[61], and similar values of the conversion factors were found.

AD regarding the production of wall and paving tiles is available in thousand m^2. In order to transform this data, the following conversion factor was used: 18.9 kg for 1 m^2 of wall and paving tiles (Table 4-32), determined after consulting the web pages of those companies that sell these products[62]. For comparison, similar conversion factors used in the Russian Federation are: 19 kg for 1 m^2 of paving tiles and 14 kg for 1 m^2 of wall tiles[63].

Table 4-32: Data used to determine the average value of the conversion factor used to transform AD from thousand m^2 into kilotons for wall and paving tiles

Size of one paving tile, cm	Weight, kg per 1 m^2	Size of a wall tile, cm	Weight, kg per 1 m^2
14.7 x 44.5	20.7	10 x 10	13.5
15.0 x 44.5	19.9	20 x 30	12.1
30 x 30	15.9	25 x 40	13.6
33 x 33	17.0		
33.3 x 33.3	16.3	20.2 x 40.2	11.7

[60] Federal Agency for Technical Regulation and Metrology, National Standard of the Russian Federation, GOST R 56688—2015, Ceramic tiles. Specifications. <http://allgosts.ru/91/100/gost_r_56688-2015>.
[61] <http://www.acoperisuldetigla.ro/tigla-ceramica-tondach/>, <https://acoperisuldetigla.wordpress.com/tigla-ceramica-siceram/>.
[62] <http://www.acoperisuldetigla.ro/tigla-ceramica-tondach/>, <https://acoperisuldetigla.wordpress.com/tigla-ceramica-siceram/>.
[63] National Report of the Russian Federation on the Inventory of anthropogenic emissions by sources and removals by sinks of greenhouse gases not controlled by the Montreal Protocol for 1990-2014, developed and in accordance with the obligations of the Russian Federation under the United Nations Framework Convention on Climate Change and the Kyoto Protocol to the United Nations Framework Convention on Climate Change. Moscow, 2016. 476 p.

Size of one paving tile, cm	Weight, kg per 1 m²	Size of a wall tile, cm	Weight, kg per 1 m²
33.5 x 33.5	16.1		
30 x 60	22.7	25.2 x 40.2	13.8
42 x 42	20.4		
45 x 45	20.7	25.0 x 50.3	17.2
Average	**18.9**	**Average**	**13.6**

In order to estimate the mass of carbonates used in the production of ceramics, the methodological approach recommended by the 2006 IPCC Guidelines was utilised; the mass of clay used for ceramics production is determined by multiplying total production (kt) by the default factor – 1.1 (Volume 3, Chapter 2.5, Page 2.36).

The methodology issues in the estimation of indirect GHG emissions from brick and ceramics production is available in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019) (Table 4-33).

Table 4-33: EFs used in the estimation of indirect GHG emissions from brick and ceramic production

Category	Process description	NO_x	CO	SO_2
		g / t		
Mineral Industry	Brick and Ceramics Production	184	189	39.6

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 030319 Brick and Ceramics, Category 1.A.2.f.i, Table 3-28.

2A4b. Other Uses of Soda Ash

Methodological issues regarding the estimation of CO_2 emissions from soda ash production and use are addressed in the 2006 IPCC Guidelines (Volume 3, Chapter 2.1, Table 2.1, Page 2.7; and in Chapter 2.5, Pages 2.32-2.40, respectively). Soda ash is used as raw material in a variety of industries, including glass production, soaps and detergents, pulp and paper, as well as in wastewater treatment. According to the 2006 IPCC Guidelines, CO_2 emissions from other uses of soda ash should be reported in the respective end use sector where it is used. In these circumstances, in order to avoid double counting, the amount of soda ash used in the glass production industry was excluded from the calculation of CO_2 emissions within source category 2A4b 'Other Uses of Soda Ash'.

Activity data on soda ash imports in the RoM between 1990 and 2022 is available in Table 4-34, and were provided by the Customs Service (no exports were recorded during the respective time period). There is no information regarding the years 1990-1994 and, in order to fill this gap, data was reconstructed based on the evolution of glass production in the RM during the respective period. The amount of imported soda ash is not fully used in the same calendar year, some of which is stored for use in the following years. The imported quantities do not thereby correspond to the annual consumption of soda ash.

Table 4-34: AD on soda ash imports in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Soda ash import, kt	67.87	69.06	30.90	34.76	27.30	28.85	19.69	25.27	20.30	16.15	33.75
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Soda ash import, kt	34.65	34.23	30.44	38.42	43.76	38.70	34.12	33.70	24.25	29.03	37.05
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Soda ash import, kt	22.52	37.40	33.81	26.34	25.75	26.19	31.44	31.83	36.31	32.74	40.71

Source: Customs Service of the RoM, through Letter dated 20.02.2023, as a response to the interpellation of the Environment Agency No. 08/34/2023 din 28.01.2023; Letter dated 19.02.2021, as a response to the interpellation of the Ministry of Agriculture, Regional Development and Environment No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the Environment Agency's interpellation No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to request of the Climate Change Office of the MARDE No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to request of the Climate Change Office of the Ministry of Environment No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to request of the Climate Change Office of the Ministry of Environment No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to request of the Climate Change Office of the Ministry of Environment No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to request of the Ministry of Environment No. 03-07/175 dated 02.02.2011.

By enquiring glass producing companies in the Republic of Moldova (SOE 'Chisinau Glass Factory'; M.E. 'Glass Container Company' and JSC 'Glass Container Prim', belonging to SOE 'Vetropack Chisinau'), it was established that during the reference period, circa 90% of the imported soda ash was used in glass production. The average specific consumption of soda ash in the production of one tonne of glass during the period under review ranged from circa 250 kg of soda ash per ton of glass produced between 1990 and 1995 (world average consumption of soda ash in the glass industry[64]) to 200 kg of soda ash per tonne of glass produced between 1996 and 2001; between a maximum of 196 kg and a

[64] Russian Center for Foreign Trade. Conjuncture, goods and markets. Soda ash on the international market. <http://www.rusimpex.ru/Content/Economics/Conjuncture/99_11002.htm>

minimum of 124 kg of soda ash per tonne of glass produced between 2002 and 2021, respectively. These values were used to reconstruct the activity data regarding the consumption of soda ash in glass production in the Republic of Moldova between 1990 and 2021 (Table 4-35).

Table 4-35: AD on soda ash consumption in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Average soda ash consumption, kt	71.95	72.90	34.03	37.94	30.30	32.89	21.38	24.89	26.72	20.51	39.13
Soda ash used in the glass industry, kt	64.75	65.61	30.63	34.14	27.27	29.60	19.24	22.40	24.04	18.46	35.21
Soda ash used in other industries	**7.19**	**7.29**	**3.40**	**3.79**	**3.03**	**3.29**	**2.14**	**2.49**	**2.67**	**2.05**	**3.91**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Average soda ash consumption, kt	34.98	30.29	27.09	29.71	33.66	30.78	28.43	24.09	23.37	21.88	29.63
Soda ash used in the glass industry, kt	31.48	27.26	24.38	26.74	30.29	27.70	25.59	21.68	21.03	19.70	26.67
Soda ash used in other industries	**3.50**	**3.03**	**2.71**	**2.97**	**3.37**	**3.08**	**2.84**	**2.41**	**2.34**	**2.19**	**2.96**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Average soda ash consumption, kt	28.94	24.23	24.17	29.63	25.37	27.11	34.19	36.51	38.32	38.38	42.40
Soda ash used in the glass industry, kt	26.05	21.81	21.76	26.67	22.83	24.39	30.77	32.86	34.49	34.54	38.16
Soda ash used in other industries	**2.89**	**2.42**	**2.42**	**2.96**	**2.54**	**2.71**	**3.42**	**3.65**	**3.83**	**3.84**	**4.24**

Source: SOE 'Chisinau Glass Factory', Letter No. 31 dated 21.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 9/01-01 dated 16.01.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 16 dated 12.02.2015, as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter No. 86 dated 19.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter dated 20.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter from 28.02.2020, as a response to request No. 08-310/1 dated 11.02.2020; Letter No. 244 dated 24.06.2021, answer to request of the Environment Agency No. 08/136/2021 dated 09.06.2021; Letter dated 10.05.2023, as a response to the Environment Agency's interpellation No. 08/149/2023 dated 20.04.2023; M.E. 'Glass Container Company' and 'Glass Container Prim', Letter dated 28.02.2011, as a response to request No. 03-07/175 dated 02.02.2011; Letter No. 01-1C-78 dated 19.02.2014, as a response to request No. 320/2014-01-01 dated 03.01.2014; Letter No. 01-3C-63 dated 30.03.2015, as a response to request No. 407/2015-01-09 dated 29.01.2015; Letter dated 23.05.2016, as a response to request No. 512/2016-05-01 dated 10.05.2016; Letter No. dated 23.02.2018, as a response to request No. 601/2017-12-03 dated 14.12.2017; Letter from 02.06.2020, as a response to request No. 08-310/1 dated 11.02.2020; Letter dated 29.06.2021, as a response to the interpellation of the Environment Agency No. 08/136/2021 dated 09.06.2021; SOE 'Vetropack Chisinau', Letter dated 17.05.2023, as a response to the Environment Agency's interpellation No. 08/149/2023 dated 20.04.2023.

The emission factor used in the estimation of CO_2 emissions from soda ash use is estimated using the stoichiometry of the chemical process according to the following equation:

$$EF_{sa} = 44.0099\ g/mole\ CO_2 / 106.0685\ g/mole\ Na_2CO_3 = 0.41492\ t\ CO_2 / t\ Na_2CO_3$$

CO_2 emissions from soda ash use are estimated using the following equation:

$$Total_{sa} = A_{sa} \bullet EF_{sa}$$

Where:

$Total_{sa}$ – CO_2 emissions from soda ash use (kt);

A_{sa} – soda ash consumption in the respective sector or application (kt);

EF_{sa} – default emission factor used (0.41492 t CO_2/t of soda ash).

4.2.3. Uncertainties and Time Series Consistency

2A1. Cement Production

Cumulative uncertainties associated with the EFs are considered to be circa 3%. Uncertainties associated with activity data are also estimated to be low (±2%), in the case of AD provided by JSC Lafarge Cement (Moldova), uncertainties account for circa 1% and are provided directly by the producer, while in the case of Cement and Slake Integrated Works in Rabnita, uncertainties reach up to circa 3% and are collected from statistical publications. Combined uncertainties associated with activity data and emission factors for source category 2A1 'Cement Production' are thereby considered to be circa 3.6% (Annex 2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2A2. Lime Production

Uncertainties associated with the EFs are considered to be circa 2%. Uncertainties associated with activity data are estimated to be circa 10%, including as a result of indirect generation of activity data on lime production by self-producers (sugar factories) as well as due to the correction factor used for hydrated lime. Combined uncertainties associated with activity data and emission factors for source category 2A2 'Lime Production' thereby account for circa 10.2% (Annex 2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2A3. Glass Production

Uncertainties associated with the EFs used having applied the Tier 2 method account for circa 10% (2006 IPCC Guidelines). Uncertainties associated with activity data regarding glass production are estimated to be circa 15%, including due to the conversion into other units (from thousand m^2 and million conventional units to kilotons, and due to the use of an average value for glass containers within the conversion process from a specific unit to another one, respectively). Combined uncertainties associated with activity data and emission factors for source category 2A3 'Glass Production' thereby account for circa 18.0% (Annex 2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2A4. Other Process Uses of Carbonates

Uncertainties associated with the EFs used having applied the Tier 2 method account for circa 5% (2006 IPCC Guidelines). Uncertainties associated with activity data regarding 'Other process Uses of Carbonates' (ceramic, expanded clay, and other uses of soda ash production) are estimated to be circa 20%, including due to the conversion to other units (from thousand m^3 thousand m^2 and units into kilotons, and due to the indirect estimation of carbonate consumption in the production processes, respectively, by using default factors, 1.1 tonnes of clay to 1.0 tonne of production). Combined uncertainties associated with activity data and emission factors for source category 2A4 'Other Process Uses of Carbonates' thereby account for circa 20.6% (Annex 2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.2.4. Description of Applied Flexibilities

In the current inventory cycle, there was no need to apply the flexibility clause.

4.2.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective source category, following the Tier 1 approach. Likewise, verification was focused on ensuring correct use of the emission factors, including default EFs, available in the 2006 IPCC Guidelines; verification was also focused on correct use of AD obtained from different reference sources, including official sources, and the correctness of their application, especially for the conversion of AD into mass units compatible with the GHG emission estimation process; comparing the results obtained by using different estimation methodologies and explaining the identified discrepancies. It should be noted that AD and methods used for the estimation of GHG emissions from category 2A 'Mineral Industry' were documented and archived both in hard copies and electronically.

4.2.6. Recalculations

2A1. Cement Production

Compared to the results included in the NC5 of the RoM to the UNFCCC (2023), GHG emissions from clinker production were not recalculated in the current inventory cycle. For 2021-2022, the respective emissions were estimated for the first time. Between 1990 and 2022, CO_2 emissions from cement production decreased by circa 58% (Table 4-36).

Table 4-36: GHG emissions from 2A1 'Cement Production', between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2 emissions	971.70	900.79	474.31	405.72	328.44	248.53	193.12	270.13	215.06	210.81	172.76
NO_x emissions	2.24	2.07	1.09	0.93	0.76	0.57	0.44	0.62	0.49	0.48	0.40
CO emissions	2.62	2.42	1.28	1.09	0.89	0.67	0.52	0.73	0.58	0.57	0.47
NMVOC emissions	0.03	0.03	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
SO_2 emissions	0.67	0.62	0.33	0.28	0.23	0.17	0.13	0.19	0.15	0.15	0.12

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO_2 emissions	173.88	219.19	245.63	282.58	365.08	457.08	702.67	789.92	340.57	349.83	427.26
NO_x emissions	0.40	0.50	0.56	0.65	0.84	1.06	1.62	1.84	0.80	0.81	1.00
CO emissions	0.47	0.59	0.66	0.76	0.99	1.24	1.89	2.16	0.93	0.95	1.17
NMVOC emissions	0.01	0.01	0.01	0.01	0.01	0.02	0.02	0.03	0.01	0.01	0.01
SO_2 emissions	0.12	0.15	0.17	0.20	0.25	0.32	0.49	0.56	0.24	0.25	0.30
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CO_2 emissions	442.16	476.91	464.61	443.24	433.90	404.93	511.12	523.88	467.52	509.57	408.47
NO_x emissions	1.03	1.11	1.08	1.03	1.00	0.94	1.19	1.22	1.09	1.19	0.95
CO emissions	1.21	1.31	1.27	1.21	1.18	1.10	1.39	1.43	1.28	1.39	1.11
NMVOC emissions	0.01	0.02	0.02	0.01	0.01	0.01	0.02	0.02	0.02	0.02	0.01
SO_2 emissions	0.31	0.34	0.33	0.31	0.30	0.28	0.36	0.37	0.33	0.36	0.28

2A2. Lime Production

CO_2 emissions from lime production were not recalculated in the current inventory cycle. For 2021-2022, the respective emissions were estimated for the first time. Between 1990 and 2022, CO_2 emissions from lime production decreased by circa 89% (Table 4-37).

Table 4-37: GHG emissions from source category 2A2 'Lime Production' between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2 emissions	264.31	192.23	116.16	112.79	83.84	78.02	97.77	81.30	68.59	37.89	31.40
NO_x emissions	0.49	0.35	0.21	0.21	0.15	0.14	0.18	0.15	0.13	0.07	0.06
CO emissions	0.69	0.50	0.30	0.29	0.22	0.20	0.26	0.21	0.18	0.10	0.08
SO_2 emissions	0.11	0.08	0.05	0.05	0.04	0.03	0.04	0.03	0.03	0.02	0.01
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO_2 emissions	28.45	38.25	20.52	20.58	27.84	30.10	21.94	29.14	8.46	15.36	16.62
NO_x emissions	0.05	0.07	0.04	0.04	0.05	0.06	0.04	0.05	0.02	0.03	0.03
CO emissions	0.07	0.10	0.05	0.05	0.07	0.08	0.06	0.08	0.02	0.04	0.04
SO_2 emissions	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CO_2 emissions	15.53	20.77	23.82	15.74	13.65	28.80	27.79	27.59	21.06	20.82	28.00
NO_x emissions	0.03	0.04	0.04	0.03	0.03	0.05	0.05	0.05	0.04	0.04	0.05
CO emissions	0.04	0.05	0.06	0.04	0.04	0.08	0.07	0.07	0.06	0.05	0.07
SO_2 emissions	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01

2A3. Glass Production

CO_2 emissions from glass production were recalculated for the period 1990-2020 as a result of updated activity data regarding the amount of glass produced based on the information collected through surveys from SOE 'Chisinau Glass Factory', as well as from JSC 'Vetropack Chisinau' glass factories (ME 'Glass Container Company' and 'Glass Container Prim'), and as a result of updating conversion factors associated with the average weight of a conventional glass container (the average weight of a conventional glass container and the average weight of a glass jar).

Compared to the values recorded in the NC5 of the RoM to the UNFCCC, the alterations undertaken resulted in an upward trend in CO_2 emissions for 2014-2016 and 2019-2020, varying from a minimum increase of 0.5% in 2014 to a maximum increase of 17.7% in 2016, and a downward trend in CO_2 emissions for 2017-2018, respectively, varying between a minimum decrease of 19.8% in 2017 to a maximum decrease of 23.2% in 2018. CO_2 emissions from glass production for 2021-2022 were calculated in the RoM for the first time. Between 1990 and 2022, CO_2 emissions from glass production increased by circa 35.8% (Table 4-38), mainly due to the decrease in the share of glass bits per batch by 47.7%: from 49.7% in 1990 to 26.0% in 2022, and the increase of the CS EF value by circa 47.1% respectively, from 105.6 kg CO_2/t of glass in 1990 to 155.4 kg CO_2/t of glass in 2022.

Table 4-38: Recalculations of CO_2 emissions inventory from glass production, included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	27.49	27.19	13.53	12.20	4.33	5.53	8.21	5.46	5.86	3.94	18.03
BTR1	27.49	27.19	13.53	12.20	4.33	5.53	8.21	5.46	5.86	3.94	18.03
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	16.32	22.01	20.32	21.07	24.23	24.95	21.57	24.18	18.07	21.27	25.95
BTR1	16.32	22.01	20.32	21.07	24.23	24.95	21.57	24.18	18.07	21.27	25.95
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	20.86	27.72	26.25	27.46	23.86	26.69	37.22	25.87	32.84		
BTR1	20.86	27.72	26.38	31.25	28.09	21.39	28.60	25.93	34.64	33.58	37.34
Difference, %	0.0	0.0	0.5	13.8	17.7	-19.8	-23.2	0.2	5.5		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

Indirect GHG emissions from glass production between 1990 and 2022 are presented below (Table 4-39). Between 1990 and 2022, indirect GHG emissions from glass production decreased by circa 7.2% due to the decreased production in the RoM.

Table 4-39: Indirect GHG emissions from source category 2A3 'Glass Production' in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NO_x emissions	0.76	0.77	0.36	0.40	0.32	0.35	0.28	0.33	0.35	0.27	0.52
NMVOC emissions	0.002	0.002	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
SO_2 emissions	0.51	0.51	0.24	0.27	0.21	0.23	0.19	0.22	0.24	0.18	0.35
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NO_x emissions	0.46	0.56	0.51	0.54	0.62	0.58	0.53	0.49	0.37	0.44	0.53
NMVOC emissions	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
SO_2 emissions	0.31	0.37	0.34	0.36	0.41	0.39	0.35	0.33	0.25	0.29	0.35
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NO_x emissions	0.41	0.51	0.48	0.52	0.48	0.44	0.56	0.49	0.65	0.63	0.70
NMVOC emissions	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001
SO_2 emissions	0.28	0.34	0.32	0.35	0.32	0.30	0.37	0.33	0.43	0.42	0.47

2A4. Other Process Uses of Carbonates

Brick Production

Compared to the results included in the NC5 of RoM to the UNFCCC (2023), GHG emissions from brick production were not recalculated in the current inventory cycle. For 2021-2022, the respective emissions were estimated for the first time. Between 1990 and 2022, CO_2 emissions from brick production decreased by circa 78% (Table 4-40).

Table 4-40: GHG emissions from source category 2A4 'Other Process Uses of Carbonates' (brick production) in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2 emissions	72.47	66.94	36.38	55.30	27.48	18.22	16.37	19.14	17.86	18.21	16.96
NO_x emissions	0.12	0.11	0.06	0.09	0.05	0.03	0.03	0.03	0.03	0.03	0.03
CO emissions	0.13	0.12	0.06	0.10	0.05	0.03	0.03	0.03	0.03	0.03	0.03
SO_2 emissions	0.03	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO_2 emissions	16.96	20.77	21.48	25.00	20.64	22.01	20.33	20.24	18.77	18.02	17.14
NO_x emissions	0.03	0.03	0.04	0.04	0.04	0.04	0.04	0.04	0.03	0.03	0.03
CO emissions	0.03	0.03	0.04	0.04	0.04	0.04	0.05	0.04	0.03	0.03	0.03
SO_2 emissions	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CO_2 emissions	13.41	18.47	18.18	16.53	15.56	13.95	14.25	14.91	13.82	16.51	15.81
NO_x emissions	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.02	0.02	0.03	0.03
CO emissions	0.03	0.03	0.03	0.03	0.02	0.02	0.02	0.03	0.02	0.03	0.03
SO_2 emissions	0.01	0.01	0.01	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.01

Expanded Clay Production

GHG emissions from expanded clay production were not recalculated for the period 2001-2020. For 2021-2022, the respective emissions were estimated in the Republic of Moldova for the first time (Table 4-41). Between 2001 and 2022, CO_2 emissions from expanded clay production increased by circa 2.6 times, due to the increased production in the RoM.

Table 4-41: GHG emissions from expanded clay production in the RoM between 2001-2022, kt

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO_2 emissions	0.2610	1.2265	0.8911	3.6525	3.3737	4.1485	3.2299	3.0339	3.6282	3.3828	1.7206
NO_x emissions	0.0003	0.0012	0.0009	0.0038	0.0046	0.0053	0.0057	0.0045	0.0045	0.0040	0.0018
CO emissions	0.0003	0.0013	0.0009	0.0039	0.0047	0.0055	0.0059	0.0046	0.0046	0.0041	0.0019
SO_2 emissions	0.0001	0.0003	0.0002	0.0008	0.0010	0.0011	0.0012	0.0010	0.0010	0.0009	0.0004
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CO_2 emissions	2.2825	2.7079	2.2456	1.6062	1.4294	1.8001	2.0432	2.0962	0.9796	1.3408	0.6905
NO_x emissions	0.0028	0.0029	0.0024	0.0016	0.0013	0.0019	0.0021	0.0024	0.0010	0.0013	0.0007
CO emissions	0.0029	0.0030	0.0025	0.0017	0.0014	0.0019	0.0022	0.0024	0.0010	0.0013	0.0007
SO_2 emissions	0.0006	0.0006	0.0005	0.0004	0.0003	0.0004	0.0005	0.0005	0.0002	0.0003	0.0001

Ceramics Production

GHG emissions from ceramics production were recalculated for the period 2005-2018. Since 2019, in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type', information regarding ceramics productions in the RoM cannot be found.

Table 4-42: GHG emissions from ceramics production in the RoM between 2005-2018, kt

	2005	2006	2007	2008	2009	2010	2011
CO_2 emissions	0.15587	0.13427	0.18112	0.11225	0.06995	0.02827	0.04645
NO_x emissions	0.00035	0.00028	0.00042	0.00025	0.00012	0.00005	0.00008
CO emissions	0.00036	0.00029	0.00043	0.00026	0.00013	0.00005	0.00009
SO_2 emissions	0.00007	0.00006	0.00009	0.00005	0.00003	0.00001	0.00002
	2012	2013	2014	2015	2016	2017	2018
CO_2 emissions	0.01370	0.01349	0.01185	0.01017	0.01204	0.00631	0.00430
NO_x emissions	0.00003	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001
CO emissions	0.00003	0.00002	0.00002	0.00002	0.00002	0.00001	0.00001
SO_2 emissions	0.00001	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000

Other Uses of Soda Ash

CO_2 emissions from the other uses of soda ash were recalculated for the period 2017-2020 due to the updated information on glass production in the RoM, and annual consumption of soda ash in glass industry, respectively (considering that soda ash use in glass production were estimated by direct enquiring of operating glass factories in the RoM). Compared to the values recorded in the NC5 of the RoM to the UNFCCC (2023), changes made in the current inventory cycle resulted in a downward trend in CO_2 emissions from other uses of soda ash between 2017-2018 and 2020, varying from a minimum decrease by circa 3.4% in 2020 to a maximum decrease by circa 9.2% in 2017-2018, except for 2019 when there was an 8.1% increase in CO_2 emissions. For 2021-2022, the respective emissions were estimated in the RoM for the first time. Between 1990 and 2022 CO_2 emissions from other uses of soda ash decreased by circa 41% as a result of the decrease in other uses of soda ash consumption, other that glass production (Table 4-43).

Table 4-43: Recalculations of CO_2 emissions from other uses of soda ash included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	2.99	3.02	1.41	1.57	1.26	1.36	0.89	1.03	1.11	0.85	1.62
BTR1	2.99	3.02	1.41	1.57	1.26	1.36	0.89	1.03	1.11	0.85	1.62
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	1.45	1.26	1.12	1.23	1.40	1.28	1.18	1.00	0.97	0.91	1.23
BTR1	1.45	1.26	1.12	1.23	1.40	1.28	1.18	1.00	0.97	0.91	1.23
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	1.20	1.01	1.00	1.23	1.05	1.24	1.56	1.40	1.65		
BTR1	1.20	1.01	1.00	1.23	1.05	1.12	1.42	1.51	1.59	1.59	1.76
Difference, %	0.0	0.0	0.0	0.0	0.0	-9.2	-9.2	8.1	-3.4		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

4.2.7. Planned Improvements

Possible improvements may include activities aimed at specifying the activity data used in the estimation of GHG emissions originating from category 2A 'Mineral Industry' for the reporting period in the previous inventory cycles.

4.3. Chemical Industry (Source Category 2B)

4.3.1. Source Category Description

Category 2B 'Chemical Industry' comprises the following emission sources: 2B1 'Ammonia Production', 2B2 'Nitric Acid Production', 2B3 'Adipic Acid Production', 2B4 'Caprolactam, Glyoxal and Glyoxylic Acid Production', 2B5 'Carbide Production', 2B6 'Titanium Dioxide Production', 2B7 'Soda Ash Production', 2B8 'Petrochemical and Carbon Black Production', 2B9 'Fluorochemical Production' and 2B10 'Other'. Between 1990 and 2022, no emissions were recorded from categories 2B1-2B9 (NO) in the RoM. Under category 2B10 'Other', NMVOC emissions in the RoM were estimated from the following sources: polyethylene, acrylonitrile butadiene styrene (ABS) resins and polystyrene production. Between 1990 and 2022, NMVOC emissions from 2B 'Chemical Industry' had decreased by circa 71.4% (Table 4-44).

Table 4-44: NMVOC emissions from 2B10 'Other' between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Polyethylene production	0.0125	0.0106	0.0063	0.0055	0.0028	0.0017	0.0044	0.0030	0.0030	0.0016	0.0041
ABS resins production	0.0525	0.0438	0.0175	0.0144	0.0045	0.0043	0.0040	0.0038	0.0036	0.0034	0.0032
Polystyrene production	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2B10 'Other'	**0.0650**	**0.0544**	**0.0238**	**0.0199**	**0.0074**	**0.0060**	**0.0085**	**0.0068**	**0.0066**	**0.0050**	**0.0073**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Polyethylene production	0.0050	0.0080	0.0102	0.0102	0.0111	0.0094	0.0096	0.0088	0.0070	0.0092	0.0101
ABS resins production	0.0029	0.0023	0.0021	0.0027	0.0031	0.0025	0.0031	0.0029	0.0023	0.0045	0.0050
Polystyrene production	NO	NO	NO	NO	0.0007	0.0012	0.0012	0.0006	0.0007	0.0005	0.0006
2B10 'Other'	**0.0080**	**0.0104**	**0.0123**	**0.0129**	**0.0149**	**0.0130**	**0.0139**	**0.0122**	**0.0100**	**0.0143**	**0.0157**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Polyethylene production	0.0090	0.0098	0.0109	0.0086	0.0085	0.0080	0.0088	0.0093	0.0109	0.0111	0.0116
ABS resins production	0.0053	0.0055	0.0052	0.0028	0.0044	0.0040	0.0064	0.0074	0.0066	0.0066	0.0067
Polystyrene production	0.0007	0.0005	0.0005	0.0005	0.0003	0.0003	0.0003	0.0002	0.0003	0.0003	0.0002
2B10 'Other'	**0.0150**	**0.0159**	**0.0166**	**0.0119**	**0.0131**	**0.0123**	**0.0155**	**0.0170**	**0.0177**	**0.0179**	**0.0186**

2B10. Other

a) *Polyethylene Production*

There are three types of polyethylene: low density polyethylene (LDPE), linear low-density polyethylene (LLDPE) and high-density polyethylene (HDPE). Polyethylene is a polymer of ethylene and has the general empirical formula $(-CH_2CH_2-)_n$. The manufacturing process used depends on the type of polymer produced. LDPE is a tough waxy polymer, with approximately 2% branching between polymer chains and has a density of about 0.92 t/m^3. LDPE is generally produced by high pressure and high temperature catalytic polymerization of ethylene in a tubular or autoclave reactor. LLDPE is a crystalline polymer with no chain branching and a density comparable to that of LDPE. A low-pressure method is generally used in which ethylene and a co-monomer such as butane or hexane is catalytically polymerized. HDPE is a crystalline polymer with no chain branching and a density of about 0.96t/m^3. HDPE is produced by low pressure polymerization of ethylene in a reactor containing a liquid hydrocarbon diluent and in the presence of Ziegler catalysts. The polymer produces slurry as it forms and is filtered from the solvent. NMVOC emissions are produced primarily through leakages, and depend on the duration of the production process. Control techniques mainly consist of the replacement of leaking valves etc., and regular maintenance.

b) *Acrylonitrile Butadiene Styrene Resins (ABS) Production*

Acrylonitrile Butadiene Styrene (ABS) is a combination of a graft copolymer (polymer with a 'core shell' of one monomer with 'branches' of copolymers of two other monomers) and a polymer mixture. ABS resins can be produced in three ways: (1) emulsion polymerization: it is a two-step process; in the first step a rubber latex is made, usually in a furnace; in the second step, which can be operated continuously in the furnace, styrene and acrylonitrile are polymerized in the rubber latex solution to form an ABS latex; the ABS polymer is recovered through coagulation of the ABS latex by adding a destabilising agent; the resulting slurry is filtered or centrifuged to recover the ABS resin; the ABS resin is then dried; (2) mass polymerization: two or more continuous flow reactors are used in this process; rubber is dissolved in the monomers: styrene and acrylonitrile; during the reaction, the dissolved rubber is replaced by the Styrene Acrylonitrile Copolymer (SAN) and forms rubber particles; part of the SAN is grafted onto the rubber particles; the reaction mixture contains several additives, needed in the polymerization process; the product is devolatilized to remove the unreacted monomer; (3) mass suspension: this batch process starts with a mass polymerization which is stopped at a monomer conversion of 15-30%; after that, a suspension reaction completes the polymerization; for this reaction, the mixture of polymer and monomer is suspended in water using a suspending agent and then the polymerization process is continued; unreacted monomers are then separated, then the product is centrifuged and dried. NMVOC emissions at plants which produce acrylonitrile butadiene styrene resins can be subdivided as follows: leakage losses from use, pumps, and other leakage. The losses due to leakage can be limited by use of certain types of seals, including pumps.

c) *Polystyrene Production*

Polystyrene is a rigid plastic material, transparent or opaque, which has a high refractive index (1.59) and a specific low weight (1.054). It is a polymer in which the high molecular weight hydrocarbon $(C_8H_8)n$ is predominant, with the value of n between 500 and 2000. The polymer also contains small amounts of styrene, ethyl-benzene, traces of catalysts and low molecular weight polymers, in shares that vary according to the polymerization process used. The styrene homopolymer, the copolymers and their components are thermoplastic materials with a predominantly amorphous structure. The molecular weight distribution influences polystyrene properties and in particular the tensile strength, shock resistance, viscosity and the so important flow during moulding through injection or extrusion. The low molecular weight component of the polymer also influences the flow, light stability, electrical properties, chemical stability, etc. Low molecular weight components can be: unpolymerized styrene, saturated or non-polymerizable substances such as aldehydes, ethyl-benzene and di-, tri-, tetramers, etc. Styrene polymerization at industrial scale is carried out on the basis of the radical mechanism. The conjugated double vinyl bond and benzene nucleus give the styrene a particular reactivity as a monomer in the radical polymerization and, at the same time, a low activity of the respective radical. The initiation of radical styrene polymerization can be done thermally, photochemically, radiochemically or with initiators. Thermal polymerization is a consequence of the high reactivity of this monomer. Styrene polymerization can also be initiated by a large number of substances capable of decomposing into radicals under the action of heat. Peroxides, hydroperoxides or nitrocombinations are commonly used. Styrene polymerization can be carried out in bulk, solution, emulsion and suspension. Bulk polymerization is more widespread and can be conducted in the presence of initiators or under the influence of temperature. The use of initiators can lead to an uncontrolled process or to oxidation reactions, which lead to the yellowing of the polymer. For this reason, on an industrial scale, thermal initiation is applied at 150-260°C. Such high temperatures are due to the fact that, at 100°C, the reaction rate is low (conversions of 2% per hour), and at the end (at conversions higher than 90%) the polymerization rate drops greatly and only when temperature reaches 220-260°C, it can lead to a polymer with a monomer content of less than 1%. On industrial scale, bulk polymerization can take place in discontinuous or continuous installations, the latter being the most used. The main difficulty in this process is to increase the viscosity of the environment, making it difficult to remove reaction heat. Discontinuous mass polymerization consists in introducing previously purified styrene in glass forms, which, under heat, in the presence or absence of initiators, in the air or inert gas environment is transformed into a hard mass taking the container's shape. The continuous mass polymerization allows the production

of a polymer free of monomer traces, characterised by a high molecular mass. This is carried out in polymerization towers or vacuum drying chambers. In order to overcome certain drawbacks, different types of reactors were used, with the following bulk polymerization installations being known: with a tubular displacement reactor, with shaking tubular reactors, rolling mill and horizontal reactors.

4.3.2. Methodologies, Emission Factors and Activity Data

2B10. Other

a) *Polyethylene Production*

Methodological issues in the estimation of NMVOC emissions from polyethylene production are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019).

The methodology used relied on the use of an emission factor for the type of polyethylene produced in the RoM – linear low-density polyethylene (LLDPE) (Table 4-45), combined with activity data from the Statistical Yearbooks of the Republic of Moldova and those of ATULBD (Table 4-46).

Table 4-45: Default EFs used in the estimation of NMVOC emissions from polyethylene production

Source	SNAP Code	Description	NMVOC emissions, kg/t
Other chemical products	040506 040507	LDPE Production HDPE Production	2.4 2.3

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 040506 LDPE Production, Category 2.B.5.a, Table 3.39. SNAP Code 040507 HDPE Production, Category 2.B.5.a, Table 3.40.

Table 4-46: AD on polyethylene production in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM: RBDR	3.52	3.10	1.72	1.60	0.88	0.72	1.55	1.17	1.17	0.68	1.69
RoM: LBDR	1.68	1.30	0.90	0.70	0.30	0.01	0.30	0.09	0.07	0.00	0.03
RoM: total	**5.20**	**4.40**	**2.62**	**2.30**	**1.18**	**0.73**	**1.85**	**1.25**	**1.24**	**0.68**	**1.72**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RoM: RBDR	2.05	3.32	4.23	4.24	4.25	3.51	3.64	3.42	2.80	3.63	4.11
RoM: LBDR	0.04	0.02	0.01	0.00	0.36	0.38	0.35	0.23	0.13	0.20	0.12
RoM: total	**2.09**	**3.35**	**4.24**	**4.24**	**4.62**	**3.90**	**3.99**	**3.65**	**2.93**	**3.83**	**4.22**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RoM: RBDR	3.64	3.99	4.20	3.29	3.24	2.94	3.25	3.36	4.02	4.07	4.34
RoM: LBDR	0.13	0.11	0.34	0.29	0.28	0.41	0.43	0.54	0.51	0.54	0.52
RoM: total	**3.76**	**4.10**	**4.53**	**3.58**	**3.53**	**3.35**	**3.67**	**3.89**	**4.53**	**4.61**	**4.85**

Source: National Bureau of Statistics through the Statistical Yearbooks of the RoM for 1994 (page 284), 1999 (page 302), 2005 (page 391), 2011 (page 305); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022'; Statistical Yearbooks of ATULBD for 1998 (page 176), 2002 (page 103), 2005 (page 94), 2007 (page 92), 2010 (page 95), 2012 (page 100), 2014 (page 90), 2017 (page 103), 2019 (page 101), 2020 (page 104), 2021 (page 102).

b)*Acrylonitrile Butadiene Styrene Resins (ABS) Production*

Methodological issues for estimating NMVOC emissions from synthetic resin (ABS) production are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019).

The methodology used relied on the use of a default emission factor (Table 4-47) multiplied by activity data from the national statistics (Table 4-48).

Table 4-47: Default EF used to estimate NMVOC emissions from acrylonitrile butadiene styrene resin (ABS) production

Source	SNAP Code	Description	NMVOC Emissions kg/t
Other Chemical Products	040515	Production of ABS Resins	3.0

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 040515 Production of ABS resins, Category 2.B.5.a, Table 3.51.

Table 4-48: AD on acrylonitrile butadiene styrene resin (ABS) production in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Production of ABS resins	17.50	14.60	5.84	4.79	1.51	1.42	1.35	1.28	1.20	1.13	1.05
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Production of ABS resins	0.98	0.78	0.71	0.91	1.05	0.83	1.03	0.96	0.78	1.52	1.66
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Production of ABS resins	1.77	1.84	1.74	0.93	1.45	1.35	2.13	2.47	2.19	2.21	2.25

Source: Statistical Yearbooks of the RoM for 1994 (page 284); Statistical Yearbooks of ATULBD for 1998 (page 176), 2002 (page 103), 2005 (page 94), 2007 (page 92), 2010 (page 95), 2012 (page 100), 2014 (page 90), 2017 (page 101), 2019 (page 99), 2020 (page 102), 2021 (page 100).

c) *Polystyrene Production*

Methodological issues in the estimation of NMVOC emissions from polystyrene production are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019).

The methodology used relied on the use of a default emission factor (Table 4-49), multiplied by activity data from the national statistics (Table 4-50).

Table 4-49: Default EF used to estimate NMVOC emissions from polystyrene production

Source	SNAP Code	Description	NMVOC Emissions, kg/t
Other Chemical Products	040511	Production of general-purpose polystyrene (GPPS) Production of high impact polystyrene (HIPS) Production of expandable polystyrene (EPS)	0.12 0.12 3.20

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 040511 Polystyrene Production, Category 2.B.5.a, Tables 3.45-3.47, page 42.

Table 4-50: AD on polystyrene production between 2005-2022, kt

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Polystyrene plates, sheets and alveolar strips, kt	0.25	0.71	0.80	0.56	1.58	1.88	2.17	2.01	2.12
Polystyrenes, copolymers and other styrene polymers in primary forms, kt	0.21	0.42	0.44	0.24	0.26	0.10	0.09	0.14	0.08
Total polystyrene production, kt	**0.46**	**1.13**	**1.24**	**0.79**	**1.84**	**1.97**	**2.26**	**2.16**	**2.19**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Polystyrene plates, sheets and alveolar strips, kt	2.47	2.81	2.47	2.05	2.04	1.92	2.30	2.08	1.74
Polystyrenes, copolymers and other styrene polymers in primary forms, kt	0.06	0.04	NO	NO	NO	NO	NO	NO	NO
Total polystyrene production, kt	**2.53**	**2.84**	**2.47**	**2.05**	**2.04**	**1.92**	**2.30**	**2.08**	**1.74**

Source: Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the RM, by product type, for 2005-2022'.

4.3.3. Uncertainties and Time Series Consistency

The primary uncertainty-related factors pertain to methodology, emission factors used in the estimation of NMVOC emissions from category 2B 'Chemical Industry', as well as the quality of activity data available. Uncertainties associated with default emission factors were considered to be circa 100%, whereas those associated with activity data – circa 5%, respectively. In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.3.4. Description of Applied Flexibilities

In the current inventory cycle, there was no need to apply the flexibility clause.

4.3.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category, following the Tier 1 approach. Likewise, verification was focused on ensuring correct use of the emission factors, including default EFs, available in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019); verification was also focused on correct use of AD obtained from different reference sources, including official sources, and their correct application, etc. It should be noted that AD and methods used for the estimation of GHG emissions from category 2B 'Chemical Industry' are documented and archived both in hard copies and electronically.

4.3.6. Recalculations

NMVOC emissions from source category 2B10 'Other' (polyethylene, acrylonitrile butadiene styrene (ABS) resins and polystyrene production) were not recalculated in the current inventory cycle. For 2021-2022, the respective emissions were estimated for the first time in the RoM. Between 1990 and 2022, NMVOC emissions from the respective category decreased by circa 71.4% as a result of the decrease in polyethylene, ABS resin, and polystyrene production.

4.3.7. Planned Improvements

Possible improvements may include specifying activity data utilised in the estimation of NMVOC emissions from category 2B 'Chemical Industry' for the reporting period in the previous inventory cycles.

4.4. Metal Industry (Source Category 2C)

4.4.1. Source Category Description

Category 2C 'Metal Industry' covers GHG emissions from the following emission sources: 2C1 'Iron and Steel Production', 2C2 'Ferroalloy Production', 2C3 'Aluminium Production', 2C4 'Magnesium Production', 2C5 'Lead Production', 2C6 'Zinc Production' and 2C7 'Other'. Currently, 2C1 'Iron and Steel Production' is the only source category relevant for the Republic of Moldova in terms of GHG emissions originating from category 2C 'Metal Industry'.

Iron and steel production can occur at primary integrated facilities, by reducing the iron ore with metallurgical coke; and at secondary facilities, particularly by melting the recycled steel scrap using electrical energy imparted to the charge through carbon electrodes.

Primary facilities are: open hearth furnaces (OHFs) accounting for circa 4% of the world iron and steel production, and basic oxygen steelmaking furnaces (BOFs), accounting for circa 63% of the world iron and steel production. The metallurgical coke used in furnaces and ovens is oxidized to CO_2 and then emitted into the atmosphere (a certain amount of carbon is retained in iron).

Secondary steelmaking most often occurs in electric arc furnaces (EAFs) accounting for circa 33% of the world iron and steel production. It should be noted that the technology used in the Republic of Moldova to produce steel is, exclusively, in electric arc furnaces (EAFs) of different capacities.

Electric arc furnaces are equipped with carbon electrodes (usually made from graphite with a carbon content of circa 97%[65]), when a high voltage is applied between the electrodes. The resulting electric arc leads to the melting of iron pieces at temperatures up to 1700°C.

Limestone, or lime with high calcium and dolomite content, coke, cast iron and other metals (chromium, magnesium, molybdenum, or vanadium compounds) are added in the molten metal, depending on the desired quality of the steel. CO_2 emissions from steel production in electric arc furnaces are determined by carbon losses in electrodes, as well as from the use of carbonates.

When electrodes are placed above the electric arc furnace, the electric arc oxidises the carbon to CO or CO_2. Also, electrodes are immersed in the molten metal to increase carbon concentration in steel, thus contributing to additional CO_2 emissions.

Between 1990 and 2022, CO_2 emissions from category 2C 'Metal Industry' decreased in the Republic of Moldova by circa 57% (Table 4-51).

Table 4-51: CO_2 emissions from category 2C 'Metal Industry' between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM: LBDR	28.29	24.56	23.86	24.33	25.27	26.22	26.71	32.37	28.68	31.79	36.26
RoM: RBDR	0.21	0.17	0.13	0.10	0.06	0.02	0.01	0.02	0.01	0.00	0.01
RoM: total	**28.50**	**24.73**	**23.99**	**24.42**	**25.33**	**26.24**	**26.73**	**32.38**	**28.68**	**31.79**	**36.27**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RoM: LBDR	38.62	20.49	35.38	40.46	41.85	26.96	38.54	35.34	17.01	9.64	12.80
RoM: RBDR	0.01	0.02	0.04	0.05	0.08	0.06	0.07	0.07	0.05	0.05	0.05
RoM: total	**38.63**	**20.50**	**35.43**	**40.51**	**41.94**	**27.02**	**38.61**	**35.41**	**17.06**	**9.70**	**12.86**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RoM: LBDR	12.65	7.59	13.76	17.17	5.09	18.75	20.08	15.66	18.57	22.13	12.07
RoM: RBDR	0.05	0.07	0.08	0.11	0.13	0.14	0.13	0.13	0.13	0.13	0.13
RoM: total	**12.70**	**7.66**	**13.85**	**17.28**	**5.22**	**18.88**	**20.21**	**15.79**	**18.70**	**22.26**	**12.20**

Non-CO_2 emissions from category 2C 'Metal Industry' between 1990-2022 are presented below (Table 4-52). In the period under review, the respective emissions recorded an evolution trend similar to CO_2 emissions.

[65] <http://ukrgrafit.zp.ua/elektrody>, <http://tdvial.ru/ge.htm>, <http://www.ruscastings.ru/work/168/441/449/4785>

Table 4-52: Non-CO_2 emissions from category 2C 'Metal Industry' between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NO_x emissions	0.09	0.08	0.08	0.08	0.08	0.09	0.09	0.11	0.09	0.10	0.12
CO emissions	1.21	1.05	1.02	1.04	1.08	1.12	1.14	1.38	1.22	1.35	1.54
NMVOC emissions	0.04	0.03	0.03	0.03	0.03	0.03	0.03	0.04	0.04	0.04	0.05
SO_2 emissions	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.05	0.04	0.05	0.05
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NO_x emissions	0.13	0.07	0.12	0.13	0.14	0.09	0.13	0.12	0.06	0.03	0.04
CO emissions	1.64	0.87	1.51	1.72	1.78	1.15	1.64	1.51	0.73	0.41	0.55
NMVOC emissions	0.05	0.03	0.05	0.05	0.05	0.04	0.05	0.05	0.02	0.01	0.02
SO_2 emissions	0.06	0.03	0.05	0.06	0.06	0.04	0.06	0.05	0.03	0.01	0.02
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NO_x emissions	0.04	0.02	0.04	0.06	0.02	0.06	0.07	0.05	0.06	0.07	0.04
CO emissions	0.54	0.32	0.59	0.73	0.22	0.80	0.86	0.67	0.79	0.95	0.52
NMVOC emissions	0.02	0.01	0.02	0.02	0.01	0.02	0.03	0.02	0.02	0.03	0.02
SO_2 emissions	0.02	0.01	0.02	0.03	0.01	0.03	0.03	0.02	0.03	0.03	0.02

4.4.2. Methodologies, Emission Factors and Activity Data

CO_2 emissions from source category 2C1 'Iron and Steel Production' were estimated using the Tier 2 methodology available in the 2006 IPCC Guidelines, based on carbon track throughout the production process.

Total CO_2 emissions from category 2C1 'Iron and Steel Production' were estimated using equation 4.9 in the 2006 IPCC Guidelines (Volume 3, Chapter 4.2, page 4.22). The simplified version of this equation is presented below, adapted to national circumstances.

$$E_{CO2} = [\, L \bullet C_L + D \bullet C_D + CE \bullet C_{CE} - S \bullet C_S \,] \bullet 44/12$$

Where:

E_{CO2} – total CO_2 emissions from steel production, tonnes;

L – quantity of limestone consumed in steel production, tonnes;

C_L – carbon content in limestone consumed in steel production, tC/t limestone;

D – quantity of dolomite consumed in steel production, tonnes;

C_D – carbon content in dolomite consumed in steel production, tC/t dolomite;

CE – quantity of carbon electrodes consumed in EAFs, tonnes;

C_{CE} – carbon content in electrodes consumed in EAFs, tC/t electrodes;

S – quantity of steel produced, tonnes;

C_S – carbon content in steel produced, tC/t steel;

44/12 – mass ratio CO_2/C.

In the RoM, the carbon content in steel is circa 0.25% (according to the information provided by the producer, the carbon content in steel varies between 0.17 and 0.33%)[66]. According to the 2006 IPCC Guidelines, depending on the type and quality of steel, the carbon content in steel varies between 0.5 and 2%, the default value used is 1% (Volume 3, Chapter 4.2, Table 4.3, page 4.27).

Other relevant factors used in the estimation of CO_2 emissions from steel production are presented below (Table 4-53).

Table 4-53: Carbon content of various materials used in steel production

Raw Material	Carbon content, default values, t C / t	Raw Material	Carbon content values used at national level, t C / t
Limestone	0.12	Lime with high calcium content	0.2142
Dolomite	0.13	Dolomitic lime	0.2492
Carbon electrodes from petroleum coke for EAF	0.82		
Carbon electrodes from coal coke for EAF	0.83	Graphite electrodes for EAF	0.97
Scrap metal	0.04		
Steel	0.01	Steel	0.0025

[66] Metal Integrated Works in Rabnita, <http://www.aommz.com/pls/webus/webus.main.show>.

In order to estimate CO_2 emissions from steel production, the specific consumption of raw materials and graphite electrodes for producing 1 ton of steel was also considered, this information being identified in the literature in the field and on the web pages of metallurgical companies. Thus, for example, the consumption of graphite electrodes in electric arc furnaces with a capacity of 30-50 tonnes, specific to enterprises on the RBDR, was agreed to be 7 kg/t of steel produced[67]. The specific consumption of graphite electrodes in electric furnaces with higher capacity (such as that from the Metal Integrated Works in Rabnita with a capacity of 120 tonnes[68]) was agreed to be 1.3 kg/t of steel produced [69]. The specific consumption of lime with high calcium content and/or dolomitic lime is considered to be 55 kg/t of steel produced [70] (of which 45 kg of lime with high calcium content, and 10 kg of dolomitic lime, respectively).

Metal Integrated Works in Rabnita is situated on the LBDR, which is one of the two mini-metallurgical works (the second is located in Jlobino, Belarus) bought by the USSR in the early 1980s of the twentieth century. These plants were, at the time, at the level of Western European plants, well provided with advanced equipment and efficient technologies. Production capacity at the launch in 1985 was about 684 kt of steel and 500 kt of rolling mills. Between 2004 and 2005, steel production reached 1 million tonnes of steel and 800 thousand tonnes of rolling mills. The Metal Integrated Works in Rabnita uses scrap metal collected mainly in the RoM, but also from Ukraine. At the same time, there are several enterprises on the RBDR (such as: JSC 'Incomas', JSC 'Fiting' Plant, JSC 'Protos' Pipe Plant owned by M.E. 'Orvento Metall Trading Co' Ltd., etc.) which use low-capacity electric arc furnaces (less than 50 tonnes). Steel production of these enterprises is insignificant compared to that of the Metal Integrated Works in Rabnita.

AD associated with steel (Table 4-54) and rolling mills production (Table 4-55) is available in the statistical publications of the RoM and those of ATULBD.

Table 4-54: AD on steel production between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM: LBDR	3.50	2.86	2.22	1.58	0.94	0.30	0.20	0.26	0.12	0.07	0.10
RoM: RBDR	708.40	614.90	597.40	609.20	632.80	656.50	668.90	810.40	718.00	796.00	908.00
RoM: total	**711.90**	**617.76**	**599.62**	**610.78**	**633.74**	**656.80**	**669.10**	**810.66**	**718.12**	**796.07**	**908.10**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RoM: LBDR	0.13	0.25	0.73	0.86	1.35	1.01	1.22	1.14	0.85	0.89	0.88
RoM: RBDR	967.00	513.00	886.00	1013.00	1048.00	675.00	965.00	884.96	425.94	241.50	320.57
RoM: total	**967.13**	**513.25**	**886.73**	**1013.86**	**1049.35**	**676.01**	**966.22**	**886.10**	**426.79**	**242.39**	**321.45**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RoM: LBDR	0.83	1.09	1.40	1.78	2.10	2.25	2.15	2.18	2.17	2.18	2.17
RoM: RBDR	316.68	190.09	344.59	429.98	127.55	469.45	502.88	392.14	464.90	554.20	302.21
RoM: total	**317.51**	**191.17**	**345.99**	**431.75**	**129.65**	**471.70**	**505.03**	**394.33**	**467.06**	**556.37**	**304.38**

Source: Statistical Yearbooks of the RoM for 1994 (page 224), 1999 (page 302), 2003 (page 391), 2004 (page 441), 2010 (page 305); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the RM, by product type, for 2005-2022'; Statistical Yearbooks of ATULBD for 1998 (page 178), 2000 (page 99), 2002 (page 103), 2006 (page 93), 2007 (page 92), 2010 (page 93), 2013 (page 99), 2017 (page 101), 2019 (page 99), 2020 (page 102), 2021 (page 100); Express information, Key performance indicators of the industry of ATULBD (excluding small businesses) for 2009-2021.

Methodological issues associated with the estimation of non-CO_2 emissions from steel production in electric arc furnaces are addressed in the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019).

Table 4-55: AD regarding rolling mill production between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Rolling mill production	614.20	561.30	547.60	487.20	438.00	357.00	341.00	407.00	588.00	593.00	636.00
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Rolling mill production	791.00	381.00	693.00	791.00	890.00	633.00	914.00	818.04	437.52	237.71	302.16
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Rolling mill production	360.40	173.15	389.26	318.84	222.49	451.39	497.90	394.59	455.60	557.01	261.95

Source: Statistical Yearbooks of the RM for 1994 (page 224); Statistical Yearbooks of ATULBD for 1998 (page 178), 2000 (page 99), 2002 (page 103), 2006 (page 93), 2007 (page 92), 2010 (page 93), 2013 (page 99), 2017 (page 101), 2019 (page 99), 2020 (page 102), 2021 (page 100); Express information, Key performance indicators of the industry of ATULBD (excluding small businesses) for 2009-2021.

[67] <http://metal-archive.ru/tyazhelye-metally/1468-vyplavka-stali-v-dugovyh-pechah.html>
[68] <http://www.aommz.com/pls/web/web.main.show?main_id=10&m_id=11>
[69] <http://elar.urfu.ru/bitstream/10995/40661/1/978-5-7996-1725-7_2016.pdf>
[70] <https://rep.bntu.by/bitstream/handle/data/6984/%D0%A1.%20128-130.pdf?sequence=1>.

The estimation method used is based on default emission factors (Table 4-56), multiplied by activity data available in the national statistical publications (Table 4-54 AND 4-55).

Table 4-56: Default EFs used in the estimation of non-CO_2 emissions from steel production in EAFs

Source	Description	NO_x	CO	NMVOC	SO_2
		g / t			
Steel Production in EAFs	Steel production[1]	130	1700	46	60
	Rolling mill production[2]			7	

Source: : EMEP/EEA Atmospheric Emissions Inventory Guidebook, 2019, [1]2.C.1 Steel Production, 040207 – Steel Production in Electric Arc Furnaces, Table 3.19, page 44; [2] 2.C.1 Steel Production, 040208 – Production of Rolling Mills, Table 3.22, page 47.

4.4.3. Uncertainties and Time Series Consistency

Uncertainties associated with EFs used in the estimation of CO_2 emissions from this category were estimated using the Tier 2 method and are considered to be circa 10% (2006 IPCC Guidelines).

Uncertainties associated with activity data on steel and rolling mill production in the RM are low (circa 1-2%), but, considering that in the estimation process, AD regarding the consumption of electrodes, lime and dolomite is also used, which are estimated according to the specific consumption per specific sector, total uncertainties associated with AD could increase to circa 5%. Thus, combined uncertainties of total sectoral emissions are considered to be circa 11.2% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.4.4. Description of Applied Flexibilities

In the current inventory cycle, there was no need to apply the flexibility clause.

4.4.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category, following the Tier 1 approach.

Verification was focused on ensuring correct use of the emission factors, including default EFs, available in the 2006 IPCC Guidelines and the EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019); verification was also focused on correct use of AD obtained from different reference sources, including official sources (NBS through Statistical Yearbooks of the RoM and the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the RoM, by product type', Statistical Yearbooks of ATULBD, as well as web pages of national and foreign enterprises in the field) as well as the correct application of these, etc.

It should be noted that AD and methods used for the estimation of GHG emissions under source category 2C1 'Iron and Steel Production' were documented and archived both in hard copies and electronically.

4.4.6. Recalculations

CO_2 emissions from source category 2C1 'Iron and Steel Production' were not recalculated for the years 1990-2020. For 2021-2022, the CO_2 emissions from steel production were estimated for the first time. The obtained results show that the respective emissions have decreased in the RoM by circa 57% between 1990 and 2022 as a result of the decrease in production.

4.4.7. Planned Improvements

Possible improvements under category 2C 'Metal Industry' might include specifying activity data on raw material consumption per ton of production, as well as the specific electrode consumption per ton of steel produced by enterprises in the RoM.

Should new country-specific data be available, uncertainties associated with GHG emissions from category 2C1 'Iron and Steel Production' could be reduced in the following inventory cycles.

4.5. Non-Energy Products from Fuels and Solvent Use (Source Category 2D)

4.5.1. Source Category Description

Category 2D 'Non-Energy Products from Fuels and Solvent Use' covers GHG emissions generated from the following emission sources: 2D1 'Lubricant Use', 2D2 'Paraffin Wax Use', 2D3 'Solvent Use', 2D4 'Other'.

2D1. Lubricant Use

Lubricants are mostly used in the industrial and transportation sectors. The use of lubricants in internal combustion engines is primarily for their lubricating properties and CO_2 emissions from these substances are thereby considered as non-combustion emissions to be reported in Sector 2 'IPPU', not in Sector 1 'Energy'.

2D2. Paraffin Wax Use

Within this category, CO_2 emissions are monitored from the use of products, such as: petroleum jelly, solid paraffin waxes and other waxes, including ozokerite. Waxes are used in a number of applications. Solid paraffin waxes, for example, are used in the production of candles, corrugated boxes, paper coating, food, wax polishes, surfactants (detergents) and many others.

2D3. Solvent Use

This category includes indirect CO_2 emissions and indirect GHG emissions from domestic solvent use, road paving with asphalt, asphalt roofing manufacture, paint/coating application, chemical degreasing, dry cleaning, chemical products manufacturing, printing and other solvent use (fat, vegetable oil extraction, preservation of wood, vehicle underseal treatment and vehicle dewaxing).

2D4. Other (Use of Urea-Based Catalysts)

This category includes CO_2 emissions from the use of urea-based catalysts.

Between 1990 and 2022, CO_2 emissions from category 2D 'Non-energy Products from Fuels and Solvent Use' decreased by circa 32.1% (Table 4-57).

Table 4-57: CO_2 emissions from category 2D 'Non-energy Products from Fuels and Solvent Use' by source category between 1990 and 2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2D1 Lubricant Use	24.80	20.76	12.11	10.96	10.10	10.13	9.77	9.22	7.01	5.00	3.91
2D2 Paraffin Wax Use	0.11	0.10	0.06	0.05	0.05	0.05	0.04	0.04	0.03	0.02	0.02
2D3 Solvent Use	204.15	167.78	138.52	110.22	72.15	64.28	59.46	31.09	29.19	28.07	27.64
2D4 Other	5.30	4.68	3.57	2.65	2.17	2.10	1.80	1.70	1.38	0.99	1.07
2D Non-energy Products from Fuels and Solvent Use	**234.36**	**193.32**	**154.26**	**123.88**	**84.47**	**76.56**	**71.07**	**42.05**	**37.61**	**34.08**	**32.64**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
2D1 Lubricant Use	4.39	4.32	6.58	6.56	6.47	6.99	5.77	6.15	5.09	5.46	5.78
2D2 Paraffin Wax Use	0.02	0.02	0.03	0.03	0.01	0.06	0.06	0.03	0.07	0.18	0.07
2D3 Solvent Use	30.84	32.61	32.72	55.73	59.90	73.10	76.99	58.51	50.60	58.36	63.03
2D4 Other	1.17	1.43	1.59	1.81	1.81	1.84	1.93	2.03	1.86	2.32	2.47
2D Non-energy Products from Fuels and Solvent Use	**36.42**	**38.37**	**40.93**	**64.13**	**68.19**	**81.98**	**84.75**	**66.72**	**57.63**	**66.32**	**71.34**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
2D1 Lubricant Use	4.94	4.85	4.78	4.82	4.92	4.81	5.01	4.95	5.08	5.43	4.77
2D2 Paraffin Wax Use	0.14	0.08	0.03	0.06	0.04	0.06	0.12	0.25	0.12	0.21	0.16
2D3 Solvent Use	67.37	62.14	79.86	76.94	76.92	89.29	142.99	135.14	195.44	167.01	150.49
2D4 Other	2.21	2.43	2.56	2.76	2.99	3.18	3.25	3.43	3.34	3.66	3.69
2D Non-energy Products from Fuels and Solvent Use	**74.66**	**69.49**	**87.24**	**84.58**	**84.87**	**97.34**	**151.37**	**143.77**	**203.98**	**176.31**	**159.11**

A similar trend was recorded for indirect GHG emissions (NO_x, CO, NMVOC) and SO_2 originating from this category (Table 4-58).

Table 4-58: Indirect GHG emissions from category 2D 'Non-energy Products from Fuels and Solvent Use' between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NO_x emissions	0.043	0.036	0.030	0.024	0.015	0.013	0.012	0.004	0.003	0.003	0.002
CO emissions	0.24	0.20	0.17	0.14	0.08	0.07	0.07	0.02	0.02	0.02	0.01
NMVOC emissions	92.79	76.26	62.97	50.10	32.80	29.22	27.03	14.13	13.27	12.76	12.56
SO_2 emissions	0.022	0.018	0.015	0.012	0.007	0.007	0.006	0.002	0.002	0.002	0.001
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NO_x emissions	0.003	0.003	0.003	0.008	0.008	0.012	0.013	0.007	0.006	0.007	0.008
CO emissions	0.02	0.02	0.01	0.05	0.04	0.07	0.07	0.04	0.03	0.04	0.04
NMVOC emissions	14.02	14.82	14.87	25.33	27.23	33.23	34.99	26.60	23.00	26.53	28.65
SO_2 emissions	0.002	0.001	0.001	0.004	0.004	0.006	0.006	0.004	0.003	0.003	0.004
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NO_x emissions	0.009	0.009	0.013	0.009	0.008	0.010	0.027	0.019	0.032	0.025	0.025
CO emissions	0.05	0.05	0.07	0.05	0.04	0.05	0.15	0.10	0.18	0.14	0.14
NMVOC emissions	30.62	28.24	36.30	34.97	34.96	40.59	64.99	61.43	88.84	75.91	68.41
SO_2 emissions	0.004	0.004	0.006	0.004	0.004	0.005	0.014	0.009	0.016	0.013	0.012

4.5.2. Methodologies, Emission Factors and Activity Data

2D1. Lubricant Use

The methodology used in the estimation of CO_2 emissions from lubricant use is the Tier 1 methodological approach provided by the 2006 IPCC Guidelines, based on AD on lubricant consumption available in the Energy Balances of the RoM and the statistical publication Socio-Economic Development of ATULBD.

CO_2 emissions from lubricant use are calculated according to Equation 5.2 (2006 IPCC Guidelines, Volume 3, Chapter 5.2, page 5.7).

$$CO_2\ Emissions = LC \bullet CC_{Lubricant} \bullet ODU_{Lubricant} \bullet 44/12$$

Where:

CO_2 Emissions – emissions from lubricants, t CO_2;

LC – total lubricant consumption, TJ;

$CC_{Lubricant}$ – carbon content of lubricant, t C/TJ; the default value used is 20 t C/TJ (2006 IPCC Guidelines, Volume 3, Chapter 5.2, page 5.9);

$ODU_{Lubricant}$ – ODU factor (oxidized during use); the default value used is 20% for oils and 5% for grease (2006 IPCC Guidelines, Vol. 3, Chapter 5.2, Table 5.2, P. 5.9);

44/12 – mass ratio of CO_2/C.

In accordance with the recommendations of the 2006 IPCC Guidelines, if statistical data on lubricant consumption is aggregated, without the possibility of delimiting oil and grease consumption, it is recommended to consider that 90% of total lubricants are oils and 10% grease.

AD used in the estimation of CO_2 emissions from source category 2D1 'Lubricant Use' is presented below (Table 4-59).

Table 4-59: AD regarding lubricant use between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total lubricant used, of which:	1,827.91	1,530.35	892.70	807.68	744.63	746.80	719.97	679.26	516.75	368.54	288.31
Oil	1,645.12	1,377.31	803.43	726.91	670.17	672.12	647.98	611.33	465.07	331.68	259.48
Grease	182.79	153.03	89.27	80.77	74.46	74.68	72.00	67.93	51.67	36.85	28.83
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Total lubricant used, of which:	323.38	318.72	485.20	483.70	476.84	514.95	425.15	453.18	375.30	402.81	425.76
Oil	291.05	286.85	436.68	435.33	429.16	463.45	382.63	407.86	337.77	362.53	383.19
Grease	32.34	31.87	48.52	48.37	47.68	51.49	42.51	45.32	37.53	40.28	42.58

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total lubricant used, of which:	364.26	357.21	352.57	355.03	362.48	354.32	369.63	364.53	374.74	400.26	351.25
Oil	327.83	321.49	317.31	319.52	326.24	318.88	332.67	328.07	337.26	360.24	316.13
Grease	36.43	35.72	35.26	35.50	36.25	35.43	36.96	36.45	37.47	40.03	35.13

Source: Energy Balances of the RoM for 1990, 1993-2022; Socio-Economic Development of the ATULBD for 2009-2021.

2D2. Paraffin Wax Use

The methodology used in the estimation of CO_2 emissions from paraffin wax use is the Tier 1 methodological approach provided by the 2006 IPCC Guidelines, based on AD regarding paraffin wax consumption available in the Energy Balances (since 2004; between 1990 and 2003 – paraffin wax consumption was estimated indirectly based on lubricant consumption and its evolution).

In contrast to the previous inventory cycle, paraffin wax use on the LBDR was also estimated indirectly: it was considered that the share of paraffin consumption on the LBDR of the total national consumption is identical to the share of lubricant consumption in the LBRD of the total national.

CO_2 emissions from paraffin wax use are calculated according to Equation 5.4 (2006 IPCC Guidelines, Volume 3, Chapter 5.3, page 5.11).

$$CO_2\ Emissions = PW \bullet CC_{Wax} \bullet ODU_{Wax} \bullet 44/12$$

Where:

CO_2 Emissions – emissions from waxes, t CO_2;

PW – total wax consumption, TJ;

CC_{Wax} – carbon content of paraffin wax (default), t C/TJ; the default value used is 20 t C/TJ (2006 IPCC Guidelines, Volume 3, Chapter 5.3, page 5.12);

ODU_{Wax} – ODU factor for paraffin wax, fraction; the default value used is 20% (2006 IPCC Guidelines, Volume 3, Chapter 5.3, page 5.12);

44/12 – mass ratio of CO_2/C.

AD used in the estimation of CO_2 emissions from source category 2D2 'Paraffin Wax Use' is presented below in Table 4-60.

Table 4-60: AD on Paraffin Wax Use in the RoM between 1990-2022, TJ

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Paraffin wax used	7.76	6.50	3.79	3.43	3.16	3.17	3.06	2.88	2.19	1.56	1.22
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Paraffin wax used	1.37	1.35	2.06	2.05	1.02	4.05	4.06	2.01	5.06	12.24	5.09
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Paraffin wax used	9.21	5.12	2.05	4.09	3.06	4.08	8.17	17.36	8.17	14.30	11.23

2D3. Solvent Use

Between 1990 and 2022, indirect CO_2 emissions from source category 2D3 'Solvent Use' had decreased by circa 26.3% (Table 4-61).

Table 4-61: Indirect CO_2 emissions from 2D3 'Solvent Use' by sources between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2D3a Domestic Solvent Use	11.51	11.53	11.51	11.48	11.49	11.48	11.44	11.40	11.42	11.39	11.36
2D3b Production and Use of Asphalt for Road Paving	80.54	66.98	56.30	44.75	27.06	24.42	22.15	7.51	6.09	5.68	4.59
2D3c Asphalt Roofing	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2D3d Paint Application	22.07	16.19	11.37	7.18	4.04	1.54	1.94	1.25	1.22	1.29	2.84
2D3e Degreasing	2.60	1.48	0.84	0.55	0.41	0.46	0.15	0.22	0.46	0.40	0.40
2D3f Dry Cleaning	1.40	0.80	0.45	0.30	0.22	0.25	0.08	0.12	0.25	0.21	0.21
2D3g Chemical Products Manufacturing and Processing	78.68	65.57	54.35	42.80	25.97	23.32	21.11	7.74	6.37	6.12	5.27
2D3h Printing	0.54	0.36	0.25	0.18	0.13	0.08	0.10	0.07	0.09	0.06	0.08
2D3i Other Solvent Use	6.80	4.87	3.46	2.99	2.82	2.73	2.49	2.78	3.29	2.91	2.88
2D3 Solvent Use	**204.15**	**167.78**	**138.52**	**110.22**	**72.15**	**64.28**	**59.46**	**31.09**	**29.19**	**28.07**	**27.64**

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2D3a Domestic Solvent Use	11.32	11.27	11.22	11.17	10.79	10.58	10.37	10.15	9.94	9.73	9.53
2D3b Production and Use of Asphalt for Road Paving	5.75	5.03	4.77	15.13	14.19	22.96	24.12	13.82	10.36	12.83	14.51
2D3c Asphalt Roofing	NO	NO	0.00	0.00	0.00	0.00	0.00	0.03	0.01	0.01	0.01
2D3d Paint Application	3.61	5.84	6.12	8.14	13.56	9.15	11.32	11.14	10.69	11.71	14.59
2D3e Degreasing	0.41	0.59	0.33	0.44	0.42	0.59	0.54	0.54	0.50	0.61	0.68
2D3f Dry Cleaning	0.22	0.32	0.18	0.24	0.23	0.32	0.29	0.29	0.27	0.33	0.37
2D3g Chemical Products Manufacturing and Processing	6.35	5.90	5.73	15.36	15.03	23.23	24.83	17.24	13.92	17.28	17.97
2D3h Printing	0.11	0.14	0.16	0.21	0.28	0.22	0.25	0.27	0.24	0.30	0.28
2D3i Other Solvent Use	3.08	3.52	4.21	5.04	5.39	6.06	5.27	5.04	4.69	5.55	5.09
2D3 Solvent Use	**30.84**	**32.61**	**32.72**	**55.73**	**59.90**	**73.10**	**76.99**	**58.51**	**50.60**	**58.36**	**63.03**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
2D3a Domestic Solvent Use	9.32	9.11	8.91	8.84	8.71	8.58	8.44	8.32	8.21	8.16	8.10
2D3b Production and Use of Asphalt for Road Paving	16.38	16.39	23.77	16.53	14.15	18.06	50.62	34.55	60.08	47.04	45.68
2D3c Asphalt Roofing	0.01	0.01	0.01	NO	NO	NO	NO	NO	NO	NO	NO
2D3d Paint Application	14.02	10.68	13.84	18.88	22.68	21.38	21.78	21.96	24.00	23.62	15.79
2D3e Degreasing	1.94	1.27	1.10	0.92	0.78	1.05	1.28	1.29	1.15	0.99	1.27
2D3f Dry Cleaning	1.05	0.68	0.59	0.50	0.42	0.57	0.69	0.70	0.62	0.53	0.69
2D3g Chemical Products Manufacturing and Processing	19.76	19.46	26.74	20.58	18.07	21.98	50.82	36.82	60.27	48.65	47.10
2D3h Printing	0.26	0.29	0.31	0.40	0.33	0.34	0.37	0.37	0.42	0.47	0.46
2D3i Other Solvent Use	4.64	4.23	4.60	10.29	11.79	17.33	8.98	31.13	40.70	37.55	31.41
2D3 Solvent Use	**67.37**	**62.14**	**79.86**	**76.94**	**76.92**	**89.29**	**142.99**	**135.14**	**195.44**	**167.01**	**150.49**

Similar trends were recorded for indirect GHG emissions (NO_x, CO, NMVOC) and SO_2 originating from the respective category (Table 4-58).

D3a. Domestic Solvent Use

In the Republic of Moldova there are no recorded statistical data on domestic solvent use. AD for certain applications can be generated indirectly based on the information on production, import and export of domestic products containing solvents.

It should be noted that their production within the country is insignificant. The Customs Service is the primary source of information on import of domestic products by economic agents in the country (Table 4-62). Albeit activity data on the production and imports of certain domestic products is available, the share of solvents in these products is unknown.

Table 4-62: Activity data on the import of domestic products in the RoM between 1995-2022

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Perfumes and eau de toilette, kt	0.09	0.14	0.15	0.01	0.02	0.10	0.16	0.26	0.24	0.21	0.24	0.29	0.47	0.20
Beauty or make-up products and skin care, manicure or pedicure products, kt	0.07	0.07	0.11	0.06	0.05	0.08	0.20	0.33	0.56	0.56	0.73	0.81	0.99	1.03
Hair care products, kt	0.21	0.33	0.38	0.34	0.56	1.07	1.29	1.50	1.88	1.98	2.31	2.41	2.84	2.68
Pre-shave, shave or after-shave products, deodorants, bath products, depilatories, other perfumery or toiletries and other cosmetics, air freshener, kt	0.04	0.04	0.08	0.07	0.05	0.09	0.19	0.41	0.65	0.77	1.21	1.39	1.65	1.90
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Perfumes and eau de toilette, kt	0.13	0.11	0.09	0.14	0.15	0.11	0.10	0.11	0.20	0.14	0.15	0.19	0.16	0.18
Beauty or make-up products and skin care, manicure or pedicure products, kt	0.83	0.89	0.94	0.94	1.01	1.02	0.98	0.14	1.05	1.18	1.33	1.31	1.22	1.54
Hair care products, kt	2.69	2.75	2.87	3.06	2.98	3.12	1.13	1.15	3.07	2.22	3.99	4.04	3.58	4.19
Pre-shave, shave or after-shave products, deodorants, bath products, depilatories, other perfumery or toiletries and other cosmetics, air freshener, kt	1.54	1.60	1.87	2.10	2.28	2.29	1.37	2.06	2.06	2.43	2.82	2.58	2.13	2.14

Source: Customs Service of the RoM, through Letter dated 20.02.2023, as a response to the interpellation of the Environment Agency to No. 08/34/2023 din 28.01.2023; through Letter dated 19.02.2021, as a response to the interpellation of the MARDE to No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011.

The methodology used in the estimation of NMVOC emissions from source category 2D3a 'Domestic Solvent Use' is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), represented by the following equation:

$$E_{pollutant} = (P \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – emissions from domestic solvent use, t/yr;

P – population, thousand inhabitants/yr (Table 4-63);

$EF_{pollutant}$ – Emission Factor for this pollutant gas, kg/person/yr.

Table 4-63: Population of the Republic of Moldova for 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total population (including ATULBD), thousand inhabitants	4,361.6	4,366.3	4,359.1	4,347.8	4,352.7	4,347.9	4,334.4	4,320.0	4,325.8	4,315.0	4,303.5
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total population (including ATULBD), thousand inhabitants	4,286.3	4,269.7	4,251.3	4,230.6	4,087.5	4,006.8	3,926.2	3,845.3	3,765.6	3,686.8	3,608.6
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total population (including ATULBD), thousand inhabitants	3,530.2	3,452.5	3,374.5	3,347.0	3,300.1	3,251.3	3,198.6	3,149.9	3,108.9	3,092.4	3,067.4

Source: Statistical Yearbooks of the RoM for 1991-2022; Statistical Yearbooks of ATULBD for 1998-2022.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default values for the EF used when applying the Tier 1 methodological approach (Table 4-64).

Table 4-64: Tier 1 default EF used in the estimation of NMVOC emissions from category 2D3a 'Domestic Solvent Use'

Source Category	NMVOC Emission Factor Value	Unit
2D3a 'Domestic Solvent Use'	1.2	kg/person/yr

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Category 2.D.3.a 'Domestic Solvent Use' (including fungicides), Chapter 3.1, Table 3.1, page 9.

Indirect CO_2 emissions were estimated based on the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon converts into CO_2 in the atmosphere (it is assumed that all solvents from household products are fossil-based).

CO_2 emissions from domestic solvent use were estimated using the following equation:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 emissions – CO_2 emissions from domestic solvent use, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3b. Road Paving with Asphalt

Methodological issues in the estimation of GHG emissions from road paving with asphalt are available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019). The Tier 1 methodological approach was used in the estimation of GHG emissions.

Default emission factor values are presented in Table 4-65, whereas the annual data related to asphalt production was provided by the Ministry of Transport and Road Infrastructure for the period 1990-2002, the National Bureau of Statistics for 2003-2015 and 2020-2021, and the State Road Administration for 2016-2019 and 2022, respectively (Table 4-66).

Table 4-65: Default EFs used in the estimation of GHG emissions from road paving with asphalt

Description	NO_x	CO	SO_2	NMVOC
	g / t			kg / t
Asphalt Plants[1]	35.6	200	17.7	
Asphalt Use for Road Paving[2]				30

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019). [1]SNAP Code 030313 Asphalt Plants, Category 1.A.2.f.i, Table 3-25, page 32. [2]SNAP Code 040611 Road Paving with Asphalt, Category 2.D.3.b, Table 3.4, page 12.

Table 4-66: AD regarding road paving with asphalt between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Road paving with asphalt, kt	1,220.31	1,014.81	853.00	678.00	410.00	370.00	335.60	113.73	92.33	86.03	69.61
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Road paving with asphalt, kt	87.15	76.25	72.20	229.30	215.07	347.90	365.39	209.35	156.93	194.44	219.81
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Road paving with asphalt, kt	248.19	248.34	360.09	250.42	214.34	273.67	767.01	523.44	910.24	712.74	692.13

Source: Ministry of Transport and Road Infrastructure, through Letter No. 03-5-2/2-32 dated 31.03.1999, as a response to the request of the Ministry of Environment to No. 01-7/172 dated 12.03.1999; Letter No. 04-02-3/101 dated 18.02.2004, as a response to the request of the Ministry of Ecology to No. 257-01-07 dated 26.01.2004; Letter No. 04-01-3/754 dated 2.10.2006, as a response to the request of the Ministry of Ecology and Natural Resources to No. 01-07/1400 dated 25.08.2006; National Bureau of Statistics of the RM, through Letter No. 06-39/08 dated 23.02.2011, as a response to Letter No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2021'; State Road Administration through Letter to No. 09-02/43, as a response to Letter No. 601/2017-12-03 dated 14.12.2017; Letter to No. 09-02/768 dated 27.02.2020, as a response to Letter No. 08-310/1 dated 11.02.2020; Letter to No. 08-05/3907 dated 21.06.2021, as a response to the interpellation of the Environment Agency to No. 08/136/2021 dated 09.06.2021; Letter to No. 08-02/4406 dated 11.7.2022, as a response to the interpellation of the Environment Agency to No. 08/359/2022 dated 07.07.2022; Letter to No. 10-02/2417 dated 02.05.2023, as a response to the interpellation of the Environment Agency to No. 08/133/2023 dated 19.04.2023.

GHG emissions were estimated using the following equation.

$$E_{pollutant} = (A \bullet EF_{pollutant}) / 10^6$$

Where:

$E_{pollutant}$ – NMVOC, CO, NO_x and SO_x emissions, kt/yr;

A – Annual production of asphalt, kt/yr;

$EF_{pollutant}$ – Default Emission Factor, g/t.

Indirect CO_2 emissions were estimated considering the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents from asphalt are fossil-based).

In order to estimate indirect CO_2 emissions from asphalt production, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from road paving with asphalt, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; IPCC 2006 Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3c. Asphalt Roofing

Methodological issues regarding GHG emissions estimation from asphalt roofing are addressed in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019).

The methodology used in the estimation of GHG emissions from asphalt roofing is the Tier 1 methodological approach. Default EF values (for typical or medium production technologies and mitigation measures) are presented below (Table 4-67).

Table 4-67: Default EFs used in the estimation of GHG emissions from asphalt roofing

Process description	CO	NMVOC
	g / t	
Asphalt Roofing	9.5	130

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), SNAP Code 040610 Asphalt Roofing, Category 2.D.3.c, Table 3.1, page 7.

AD regarding asphalt roofing production was provided by the NBS only for the period 2003-2014 (Table 4-68). According to this data, domestic asphalt roofing production was recorded only between 2003 and 2014, after which the products have been imported only.

Table 4-68: Activity data on asphalt roofing production between 2003-2014, kt

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
Production of asphalt or similar materials, exclusively in rolls	8.8	6.7	6.9	10.4	11.2	90.5	17.6	37.3	34.2	39.6	40.9	32.2

Source: National Bureau of Statistics, Letter No. 06-39/08 dated 23.02.2011, as a response to request No. 03-07/175 dated 02.02.2011 from the Ministry of Environment; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2015'.

Total GHG emissions from asphalt roofing production are estimated using the following equation:

$$E_{pollutant} = (A \bullet EF_{pollutant}) / 10^6$$

Where:

$E_{pollutant}$ – GHG emissions from asphalt roofing, kt/yr;

A – Annual production of asphalt roofing, kt/yr;

$EF_{pollutant}$ – Default Emission Factor, g/t.

Indirect CO_2 emissions were estimated considering the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents from asphalt are fossil-based).

In order to estimate indirect CO_2 emissions from asphalt roofing, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from asphalt roofing, kt/yr;

NMVOC – total NMVOC emissions from the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3d. Paint Application

Under this category, emissions are reported from decorative coating application, particularly in construction (SNAP 060103) and domestic paint application (SNAP 060104); industrial coating application, particularly in automobile manufacture (SNAP 060101), car repairing (SNAP 060102), coil coating (SNAP 060105), painting ships and boats (SNAP 060106), wood treatment and painting (SNAP 060107), other industrial application (painting aircraft, carriages, steel bridges, military vehicles, engines, pumps, tanks, office equipment, plastic items, toys, etc.) (SNAP 060108); respectively, other non-industrial paint application (paint or varnish application to protect large metal constructions from corrosion, road marking, etc.) (SNAP 060109). Because the breakdown of activity data on paint and varnish consumption in the RoM by sector was not possible, the respective emissions were aggregated at national level.

It is known from the literature in the field that the share of solvents in different types of paints varies according to the technology applied during their production (Table 4-69).

Table 4-69: Carbon and solvent content in different types of products

Products Containing Solvents	Carbon content, %[1]	Solvent content, %[2]
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	60	40-70
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution		<20

Source: [1]2006 IPCC Guidelines, Volume 3, Chapter 5.4, page 5.17; [2]EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Source Category 2.D.3.d 'Paint Application', (NFR) Table 2-1, page 9.

The methodology used in the estimation of NMVOC emissions from paint application is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – pollutant gas emissions from paint application, kt/yr;

$AR_{product}$ – activity rate for the coating application (consumption of paint), kt/yr;

$EF_{pollutant}$ – the emission factor for the pollutant, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 1 approach (Table 4-70). Mitigation actions for NMVOC emissions from paint producing plants were taken into consideration in order to determine the EF values.

Table 4-70: Default emission factors utilised for source category 2D3d 'Paint Application' applying the Tier 1 methodology approach

Source	NMVOC Emission factor	Unit
Decorative Coating Application	150	g/kg paint applied
Industrial Coating Application	400	g/kg paint applied
Other Coating Application	200	g/kg paint applied

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.d 'Coating Application', Tables 3-1, 3-2 and 3-3, page 17.

The total consumption of varnishes and paints was estimated considering domestic production and statistical data on import and export of such substances in the RoM. The Statistical Yearbooks of the RoM and ATULBD (data on the production of varnishes and paints is available starting from 2012) contain aggregated data on total production of varnishes and paints in the country (Table 4-71). The NBS also provides disaggregated AD on the production of different types of varnishes and paints.

Table 4-71: Activity data on the production of varnishes and paints between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	10.10	8.25	5.55	2.71	1.13	0.74	0.66	0.45	0.35	0.67	2.03
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	1.60	0.55	0.45	0.39	0.07	0.06	0.04	0.06	0.02	0.00	0.03
Total varnish and paint production	**11.70**	**8.80**	**6.00**	**3.10**	**1.20**	**0.80**	**0.70**	**0.51**	**0.37**	**0.67**	**2.05**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	2.70	3.38	2.42	3.87	5.09	6.69	8.79	8.77	8.27	9.66	12.91
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	0.17	0.72	1.03	1.26	1.18	1.63	2.26	2.81	3.64	3.35	5.13
Total varnish and paint production	**2.87**	**4.10**	**3.44**	**5.14**	**6.27**	**8.32**	**11.06**	**11.58**	**11.91**	**13.00**	**18.04**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	13.67	9.47	13.54	20.58	25.72	22.39	20.55	22.02	22.98	22.20	13.52
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	4.25	2.87	4.13	6.27	7.12	7.68	9.28	7.50	8.58	9.87	5.64
Total varnish and paint production	**17.92**	**12.34**	**17.67**	**26.84**	**32.84**	**30.07**	**29.84**	**29.52**	**31.55**	**32.07**	**19.16**

Source: NBS through Letter No. 06-39/08 dated 23.02.2011, as a response to Letter No. 03-07/175 dated 02.02.2011, from the Ministry of Environment of the RM; Letter No. 06-39/38 dated 22.09.2011, as a response to Letter No. 101/2011-09-01 dated 02.09.2011, from the Climate Change Office of the Ministry of Environment of the RM; Letter No. 15-03/05 dated 24.01.2014, as a response to Letter No. 320/2014-01-01 dated 03.01.2014, from the Climate Change Office of the Ministry of Environment of the RM; Letter No. 15-03-09 dated 13.02.2015, as a response to Letter No. 407/2015-01-09 dated 29.01.2015, from the Climate Change Office of the Ministry of Environment of the RM; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022'.

The Customs Service is the primary source of information on varnish and paint import-export operations undertaken by economic agents (varnishes and paints based on synthetic polymers or modified, natural polymers, dispersed or dissolved in a non-aqueous solution, code 3208; varnishes and paints based on synthetic polymers or modified, natural polymers, dispersed or dissolved in an aqueous solution, code 3209; other paints and varnishes, prepared water pigments, e.g. used for leather coating, code 3210; prepared desiccants, code 3211; pigment dispersed in a non-aqueous solution as liquid or paste used in paint manufacture, code 3212) (Table 4-72).

AD on the consumption of varnishes and paints in the RoM (Table 4-73) was inferred from information on production (Table 4-71) and import (Table 4-72) of these products (no exports of these products were recorded within the reference period).

Table 4-72: Activity data on the import of varnishes and paints between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	16.52	12.19	9.12	6.70	4.52	1.69	2.46	1.40	1.38	1.06	1.85
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	11.11	7.87	5.15	3.00	1.49	0.25	0.29	0.31	0.43	0.56	1.16
Total varnish and paint import	**27.63**	**20.06**	**14.27**	**9.70**	**6.01**	**1.94**	**2.75**	**1.71**	**1.81**	**1.63**	**3.01**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	1.68	3.72	4.69	7.13	15.64	5.58	6.26	5.20	4.63	5.14	4.89
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	1.89	2.59	2.77	2.25	2.27	2.40	2.85	3.09	2.51	2.73	3.08
Total varnish and paint import	**3.57**	**6.31**	**7.46**	**9.38**	**17.91**	**7.98**	**9.12**	**8.28**	**7.14**	**7.87**	**7.97**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	3.89	3.67	3.90	3.67	4.21	4.35	4.70	4.85	5.58	4.71	4.11
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	3.17	3.03	3.09	3.14	3.37	3.69	4.29	4.78	5.64	5.31	4.88
Total varnish and paint import	**7.06**	**6.70**	**6.99**	**6.81**	**7.59**	**8.04**	**8.99**	**9.63**	**11.22**	**10.03**	**8.99**

Source: Customs Service of the RoM through Letter dated 20.02.2023, response to the interpellation of the Environment Agency to No. 08/34/2023 dated 28.01.2023; through Letter dated 19.02.2021, as a response to the interpellation of the MARDE to No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015 as a response to the request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011.

Table 4-73: Activity data on varnish and paint consumption between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	26.62	20.44	14.67	9.42	5.65	2.43	3.13	1.85	1.73	1.74	3.88
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	12.71	8.42	5.60	3.39	1.55	0.31	0.32	0.37	0.45	0.56	1.19
Total varnish and paint consumption	**39.33**	**28.86**	**20.27**	**12.80**	**7.21**	**2.74**	**3.45**	**2.22**	**2.18**	**2.30**	**5.07**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	4.38	7.10	7.11	11.00	20.73	12.27	15.06	13.96	12.90	14.80	17.80
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	2.06	3.30	3.80	3.52	3.45	4.03	5.12	5.90	6.15	6.07	8.21
Total varnish and paint consumption	**6.44**	**10.40**	**10.91**	**14.52**	**24.18**	**16.30**	**20.18**	**19.87**	**19.05**	**20.87**	**26.01**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Varnishes and paints based on polyesters and polymers dissolved in a non-aqueous solution	17.57	13.14	17.44	24.25	29.93	26.74	25.26	26.87	28.55	26.91	17.63
Varnishes and paints based on polymers dispersed or dissolved in an aqueous solution	7.42	5.90	7.22	9.41	10.49	11.37	13.57	12.28	14.22	15.19	10.52
Total varnish and paint consumption	**24.98**	**19.04**	**24.66**	**33.66**	**40.42**	**38.11**	**38.83**	**39.15**	**42.77**	**42.10**	**28.15**

No statistical data regarding the consumption of varnishes and paints in various applications is available. Under such circumstances, it was considered that the share of paints in decorative coating application constitutes 50% of the total national consumption, the share of varnishes and paints in the industrial sector – 40%, while the share of other coating application – 10% (Table 4-74).

Table 4-74: AD on varnish and paint consumption in various applications between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Decorative coating application	19.67	14.43	10.14	6.40	3.60	1.37	1.72	1.11	1.09	1.15	2.53
Industrial coating application	15.73	11.55	8.11	5.12	2.88	1.10	1.38	0.89	0.87	0.92	2.03
Other coating application	3.93	2.89	2.03	1.28	0.72	0.27	0.34	0.22	0.22	0.23	0.51
Total varnish and paint consumption	**39.33**	**28.86**	**20.27**	**12.80**	**7.21**	**2.74**	**3.45**	**2.22**	**2.18**	**2.30**	**5.07**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Decorative coating application	3.22	5.20	5.45	7.26	12.09	8.15	10.09	9.93	9.53	10.44	13.01
Industrial coating application	2.58	4.16	4.36	5.81	9.67	6.52	8.07	7.95	7.62	8.35	10.41
Other coating application	0.64	1.04	1.09	1.45	2.42	1.63	2.02	1.99	1.91	2.09	2.60
Total varnish and paint consumption	**6.44**	**10.40**	**10.91**	**14.52**	**24.18**	**16.30**	**20.18**	**19.87**	**19.05**	**20.87**	**26.01**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Decorative coating application	12.49	9.52	12.33	16.83	20.21	19.06	19.41	19.57	21.39	21.05	14.07
Industrial coating application	9.99	7.62	9.87	13.46	16.17	15.24	15.53	15.66	17.11	16.84	11.26
Other coating application	2.50	1.90	2.47	3.37	4.04	3.81	3.88	3.91	4.28	4.21	2.81
Total varnish and paint consumption	**24.98**	**19.04**	**24.66**	**33.66**	**40.42**	**38.11**	**38.83**	**39.15**	**42.77**	**42.10**	**28.15**

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents from paint application are fossil-based).

In order to estimate indirect CO_2 emissions from paint application, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from paint application, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3e. Degreasing

GHG emissions from solvent use in industry are monitored within category 2D3e 'Degreasing', especially for metal degreasing – SNAP 060201; manufacturing of electronic components – SNAP 060203, as well as other industrial cleaning – SNAP 060204. Typically, solvents used for degreasing are obtained by distillation of fossil fuels. For example, chlorinated solvents, including trichloroethylene (TRI) (code 2903 22 000), tetrachloroethylene (PER) (code 2903 23 000) and dichloromethane (MC) (code 2903 12 000) are widely used in the industrial sector for cleaning metal items, electronic products and other industrial products (in closed-type cleaning equipment). Previously, 1,1,1-trichloroethane (TCA) (2903 19 100) was particularly used until recently when it was replaced by trichloroethylene (TRI). As for the open-type cleaning equipment, the most commonly used solvents are those obtained from white-spirit (code 2710 11 210) and alcohols, such as propylene glycol 2905 32 000).

The methodology used in the estimation of NMVOC emissions from solvent use for degreasing is provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – emissions from solvent application for degreasing, kt/yr;

$AR_{product}$ – activity rate for the use of solvents for degreasing, kt/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 1 methodological approach (Table 4-75).

Table 4-75: Default EF utilised for the estimation of NMVOC emissions from source category 2D3e 'Degreasing' applying the Tier 1 methodological approach

	NMVOC Emission Factor	Unit
2D3e Degreasing	460	g/kg of degreased products

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.e 'Degreasing', Table 3-1, page 8.

Because no AD breakdown on solvent consumption for degreasing in various industrial applications is available in the Republic of Moldova, an alternative approach was used, represented by the following formula:

$$E_{pollutant} = AR_{product} \bullet EF_{pollutant}$$

Where:

$E_{pollutant}$ – emissions from the use of solvent application for degreasing, kt/yr;

$AR_{product}$ – activity rate for the use of solvents for degreasing (consumption), kt/yr;

$EF_{pollutant}$ – the emission factor for this pollutant technology kg/yr.

According to the available methodology, the content of organic solvents in substances used in chemical degreasing is considered to be 100% (EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), source category 2D3e 'Degreasing', Table 3-5, page 12). It is considered that the total amount of solvents for degreasing evaporates into the atmosphere, NMVOC emissions thus being equal to the quantity of solvents used.

Total consumption of organic solvents for degreasing is estimated using the following equation:

$$Total\ Consumption = Production + Import - Export$$

There is no statistical data for activities involving the use of solvents for degreasing in the RoM. Under such circumstances, the total consumption of solvents used for degreasing was estimated based on information on solvent import (domestic production of solvents is insignificant; likewise, it was assumed that such substances are not re-exported). The Customs Service is the primary source of information on solvent import-export operations by enterprises and economic agents in the RoM.

Table 4-76: AD on solvent consumption used in chemical degreasing and dry cleaning in RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cyclic and Acyclic Hydrocarbons, kt	1.23	0.76	0.49	0.35	0.26	0.29	0.06	0.11	0.12	0.03	0.15
Alcohols, kt	0.60	0.28	0.09	0.03	0.03	0.04	0.05	0.04	0.20	0.25	0.12
Total solvents used, kt	**1.82**	**1.04**	**0.59**	**0.38**	**0.29**	**0.32**	**0.11**	**0.16**	**0.32**	**0.28**	**0.28**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Cyclic and Acyclic Hydrocarbons, kt	0.06	0.17	0.12	0.19	0.11	0.13	0.13	0.11	0.12	0.18	0.20
Alcohols, kt	0.23	0.24	0.11	0.12	0.18	0.28	0.25	0.26	0.23	0.25	0.27
Total solvents used, kt	**0.29**	**0.41**	**0.23**	**0.31**	**0.29**	**0.41**	**0.38**	**0.38**	**0.35**	**0.43**	**0.48**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Cyclic and Acyclic Hydrocarbons, kt	0.93	0.36	0.16	0.19	0.12	0.15	0.36	0.26	0.38	0.37	0.26
Alcohols, kt	0.43	0.52	0.61	0.45	0.43	0.59	0.54	0.64	0.43	0.32	0.63
Total solvents used, kt	**1.36**	**0.89**	**0.77**	**0.64**	**0.54**	**0.74**	**0.89**	**0.90**	**0.81**	**0.69**	**0.89**

Source: Customs Service of the RoM through letter dated 20.02.2023, response to the interpellation of the Environment Agency to No. 08/34/2023 dated 28.01.2023, through Letter dated 19.02.2021, as a response to the interpellation of the MARDE to No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011.

Because the same substances are widely used for both degreasing and dry cleaning, it was accepted that 65% were used for degreasing, and 35% – for dry cleaning out of the total amount consumed.

Table 4-77: Activity data on solvent consumption used in chemical degreasing between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cyclic and Acyclic Hydrocarbons, kt	0.80	0.49	0.32	0.23	0.17	0.19	0.04	0.07	0.08	0.02	0.10
Alcohols, kt	0.39	0.18	0.06	0.02	0.02	0.02	0.03	0.03	0.13	0.16	0.08
Total solvents used, kt	**1.18**	**0.67**	**0.38**	**0.25**	**0.19**	**0.21**	**0.07**	**0.10**	**0.21**	**0.18**	**0.18**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Cyclic and Acyclic Hydrocarbons, kt	0.04	0.11	0.08	0.12	0.07	0.08	0.08	0.07	0.08	0.11	0.13
Alcohols, kt	0.15	0.16	0.07	0.08	0.12	0.18	0.16	0.17	0.15	0.16	0.18
Total solvents used, kt	**0.19**	**0.27**	**0.15**	**0.20**	**0.19**	**0.27**	**0.24**	**0.24**	**0.23**	**0.28**	**0.31**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Cyclic and Acyclic Hydrocarbons, kt	0.61	0.24	0.10	0.13	0.08	0.10	0.23	0.17	0.25	0.24	0.17
Alcohols, kt	0.28	0.34	0.40	0.29	0.28	0.38	0.35	0.42	0.28	0.21	0.41
Total solvents used, kt	**0.88**	**0.58**	**0.50**	**0.42**	**0.35**	**0.48**	**0.58**	**0.59**	**0.52**	**0.45**	**0.58**

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from degreasing, kt/yr;

NMVOC – total NMVOC emissions from the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3f. Dry Cleaning

Within category 2D3f 'Dry Cleaning', GHG emissions from solvent use are monitored in dry cleaning of clothes and textiles from water-insoluble substances such as animal fats, oils, wax, tar, etc. (SNAP 060202).

Tetrachloroethylene (PER) (code 2903 23 000) is the most widely used solvent for dry cleaning. Previously, 1,1,1-trichloroethane (TCA) (2903 19 100) was particularly used until recently when it was replaced by trichloroethylene (TRI).

The methodology used to estimate NMVOC emissions from solvent use for dry cleaning is provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant})/ 10^3$$

Where:

$E_{pollutant}$ – emissions from the use of solvents for dry cleaning, kt/yr;

$AR_{product}$ – activity rate for the use of solvents for dry cleaning, kt/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 1 methodological approach (Table 4-78).

Table 4-78: Default EF utilised for the estimation of NMVOC emissions from source category 2D3f 'Dry Cleaning' applying the Tier 1 methodological approach

Source	NMVOC Emission Factor	Unit
2D3f Dry Cleaning	40	g/kg treated textiles

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.f 'Dry Cleaning', Table 3-1, page 7.

Because there is no AD breakdown on solvent consumption for dry cleaning, an alternative approach was used, represented by the following formula:

$$E_{pollutant} = AR_{product} \bullet EF_{pollutant}$$

Where:

$E_{pollutant}$ – emissions from the use of solvents for dry cleaning, kt/yr;

$AR_{product}$ – activity rate for the use of solvents for dry cleaning (consumption), kt/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology.

According to the available methodology, the content of organic solvents in substances used in dry cleaning is considered to be 100% (EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), source category 2D3f 'Dry Cleaning', page 10).

It is considered that the total amount of solvents for dry cleaning evaporates into the atmosphere, NMVOC emissions thus being equal to the quantity of solvents used. For dry cleaning of clothes and other textiles, it is assumed that the solvents used are emitted directly into the atmosphere or retained in clothes and textiles, with subsequent evaporation into the atmosphere.

Total consumption of organic solvents for dry cleaning is estimated using the following equation:

$$Total\ Consumption = Production + Import - Export$$

It should be noted that for most activities involving use of solvents for dry cleaning there is no statistical data. Under such circumstances, the total consumption of solvents used for dry cleaning was estimated based on information on solvent import in the RM (domestic production of solvents is insignificant; likewise, it was assumed that such substances are not re-exported).

Because the same substances are widely used for both degreasing and dry cleaning, it was accepted that out of the total amount consumed (Table 4-76), 65% were used for degreasing (Table 4-77), and 35% – for dry cleaning (Table 4-79).

Table 4-79: AD on solvent consumption in dry cleaning of textiles between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cyclic and acyclic hydrocarbons, kt	0.43	0.27	0.17	0.12	0.09	0.10	0.02	0.04	0.04	0.01	0.05
Alcohols, kt	0.21	0.10	0.03	0.01	0.01	0.01	0.02	0.02	0.07	0.09	0.04
Total solvents used, kt	**0.64**	**0.36**	**0.21**	**0.13**	**0.10**	**0.11**	**0.04**	**0.05**	**0.11**	**0.10**	**0.10**
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cyclic and acyclic hydrocarbons, kt	0.02	0.06	0.04	0.07	0.04	0.04	0.04	0.04	0.04	0.06	0.07
Alcohols, kt	0.08	0.08	0.04	0.04	0.06	0.10	0.09	0.09	0.08	0.09	0.10
Total solvents used, kt	**0.10**	**0.14**	**0.08**	**0.11**	**0.10**	**0.14**	**0.13**	**0.13**	**0.12**	**0.15**	**0.17**
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Cyclic and acyclic hydrocarbons, kt	0.33	0.13	0.05	0.07	0.04	0.05	0.12	0.09	0.13	0.13	0.09
Alcohols, kt	0.15	0.18	0.21	0.16	0.15	0.21	0.19	0.22	0.15	0.11	0.22
Total solvents used, kt	**0.48**	**0.31**	**0.27**	**0.23**	**0.19**	**0.26**	**0.31**	**0.32**	**0.28**	**0.24**	**0.31**

Indirect CO_2 emissions were estimated taking the carbon content in NMVOC emissions into consideration. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvent consumption in dry cleaning, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3g. Chemical Products

Under source category 2D3g 'Chemical Products', NMVOC emissions are reported from polyester processing (SNAP 060301); polyurethane foam processing (SNAP 060303) and polystyrene foam processing (SNAP 060304); rubber processing (SNAP 060305); pharmaceutical product manufacturing (SNAP 060306); paint manufacture (SNAP 060307); ink manufacture (SNAP 060308); glue manufacturing (SNAP 060309); asphalt blowing (SNAP 060310); adhesive, magnetic tapes, film and photograph manufacturing (SNAP 060311); textile finishing (SNAP 060312); leather tanning (SNAP 060313).

The methodology used in the estimation of NMVOC emissions from chemical products is provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – emissions of the specified pollutant from solvent use in the production and processing of chemical products, kt/yr;

$AR_{product}$ – use of chemical product, kt/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 2 methodological approach (Table 4-80).

Table 4-80: Default emission factors utilised for the estimation of emissions from 2D3g 'Chemical Products' applying the Tier 2 methodological approach

Source Categories	NMVOC Emission Factor	Unit
SNAP 060301, Polystyrene processing	50	g/kg monomer
SNAP 060303, Polyurethane foam processing	120	g/kg foam
SNAP 060304, Polystyrene foam processing	60	g/kg foam
SNAP 060305, Rubber processing	8	g/kg rubber
SNAP 060306, Pharmaceutical products manufacturing	300	g/kg solvent
SNAP 060307, Paints manufacturing	11	g/kg product
SNAP 060308, Inks manufacturing	11	g/kg product
SNAP 060309, Glues manufacturing	11	g/kg product
SNAP 060310, Asphalt blowing	27.2	kg/t asphalt
SNAP 060310, Saturated asphalt blowing	0.66	kg/t asphalt
SNAP 060310, Asphalt (in layers) blowing	1.71	kg/t asphalt
SNAP 060314, Tire production	10	g/kg tire
Adhesive tapes manufacturing	3	g/m^2
Shoe manufacture	0.045	kg/pair of shoes

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.g 'Chemical Products', Tables 3-2 – 3-13, pages 17-23.

Statistical publications of the RoM provide activity data on manufacturing different industrial products, including: polyurethane and polystyrene products, refurbished tires and rubber soles, varnishes and paints, glues, inks, pharmaceutical products, shoes (Table 4-81).

Table 4-81: Activity data on the processing of chemical products between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Polyurethane processing, kt	0.83	0.70	0.59	0.50	0.42	0.35	0.29	0.18	0.12	0.15	0.19
Polystyrene processing, kt	5.92	3.71	2.32	1.46	0.91	0.57	0.23	0.21	0.22	0.19	0.41
Rubber processing, kt	46.90	44.30	20.70	4.20	0.90	1.40	1.51	1.36	1.23	0.85	1.60
Pharmaceutical product processing, kt	1.85	1.65	1.07	0.68	0.33	0.32	0.29	0.31	0.45	0.76	0.51
Paint and varnish production, kt	11.70	8.80	6.00	3.10	1.20	0.80	0.70	0.51	0.37	0.67	2.05
Ink production, kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Adhesive production, kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Asphalt production, kt	1,220.31	1,014.81	853.00	678.00	410.00	370.00	335.60	113.73	92.33	86.03	69.61
Refurbished tires, thousand pieces	75.30	73.10	40.10	1.50	4.50	6.60	8.00	9.80	7.10	10.20	7.00
Refurbished tires, kt	1.44	1.40	0.77	0.03	0.09	0.13	0.15	0.19	0.14	0.20	0.13
Shoes, mil. pairs	23.20	20.80	16.27	13.20	9.47	7.61	6.93	6.19	4.59	3.75	5.91
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Polyurethane processing, kt	0.22	0.44	0.60	0.75	1.54	1.69	2.22	2.55	2.13	2.38	2.22
Polystyrene processing, kt	0.39	0.75	1.29	1.39	2.88	4.14	4.49	4.45	4.89	5.71	5.94
Rubber processing, kt	1.80	3.07	2.42	2.26	0.06	0.30	0.51	0.19	0.04	0.06	0.06
Pharmaceutical product processing, kt	0.65	0.73	0.52	0.63	0.70	0.76	1.26	3.71	3.83	4.99	3.35
Paint and varnish production, kt	2.87	4.10	3.44	5.14	6.27	8.32	11.05	11.56	11.82	12.86	18.01
Ink production, kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01
Adhesive production, kt	NO	NO	0.36	0.66	0.85	1.46	0.77	0.58	0.92	1.37	1.32
Asphalt production, kt	87.15	76.25	72.20	229.30	215.07	347.90	365.39	209.35	156.93	194.44	219.81
Refurbished tires, thousand pieces	9.20	4.60	6.00	4.60	3.20	2.80	2.60	2.25	5.83	6.74	6.85
Refurbished tires, kt	0.18	0.09	0.11	0.09	0.06	0.05	0.05	0.05	0.08	0.16	0.16
Shoes, mil. pairs	4.94	4.93	6.04	6.63	7.45	6.77	6.70	7.08	4.83	6.25	7.69

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Polyurethane processing, kt	1.58	1.59	1.32	1.98	0.95	1.21	1.47	1.42	1.41	1.96	1.24
Polystyrene processing, kt	6.14	6.21	7.02	7.93	7.50	6.97	7.07	7.90	8.33	8.72	7.28
Rubber processing, kt	0.07	0.07	0.07	0.05	0.05	0.04	0.12	0.11	0.03	0.05	0.04
Pharmaceutical product processing, kt	3.74	3.35	4.10	4.06	3.80	4.35	3.52	3.64	3.72	3.78	4.61
Paint and varnish production, kt	17.91	12.34	17.69	26.86	32.84	30.07	29.84	29.52	31.55	32.07	19.16
Ink production, kt	0.02	0.03	NO	NO	NO	NO	NO	NO	NO	NO	NO
Adhesive production, kt	1.08	0.95	1.12	6.00	7.61	12.26	4.94	23.87	32.14	29.09	23.94
Asphalt production, kt	248.19	248.34	360.09	250.42	214.34	273.67	767.01	523.44	910.24	712.74	692.13
Refurbished tires, thousand pieces	18.36	17.30	11.95	6.04	7.27	7.42	8.56	8.12	9.61	6.80	8.52
Refurbished tires, kt	0.25	0.27	0.20	0.14	0.16	0.14	0.17	0.14	0.20	0.13	0.29
Shoes, mil. pairs	7.45	8.33	7.61	5.55	5.16	4.65	4.35	3.78	3.27	3.59	3.05

Source: National Bureau of Statistics of the RM through Statistical Yearbooks for the years 1994 (pages 284, 288, 291), 1995 (pages 253, 257, 260), 1997 (pages 320, 322, 324), 1999 (pages 302, 304, 306), 2003 (pages 391, 393, 395), 2006 (page 311), 2011 (page 305), 2014 (pages 302); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022'; Customs Service of the RM through Letter dated 20.02.2023, response to the Interpellation of the Environment Agency to No. 08/34/2023 dated 28.01.2023; through Letter dated 19.02.2021, as a response to the interpellation of the MARDE to No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011.

The Customs Service is the primary source of information on import-export operations regarding primary polyurethane products (code 3909 50); alveolar polyurethane products (code 3921 13); primary polystyrene products (code 3903 11), and alveolar styrene polymer products (code 3921 11), respectively. In order to convert AD into mass metric units (tonnes), the following conversion factors were used: a car tire weighs circa 7.1 kg; a minibus and small tonnage truck tire – circa 11.1 kg; bus and heavy truck tire – circa 46.0 kg; a tractor tire – circa 69.9 kg).

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in chemical products, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvents used in chemical products, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3h. Printing

The methodology used to estimate NMVOC emissions from printing is provided by the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF) / 10^3$$

Where:

$E_{pollutant}$ – emissions of the specified pollutant from ink consumption for printing, kt/yr;

$AR_{product}$ – activity rate for the use of inks for printing, kt/yr;

EF – default emission factor (Table 4-82), kg/t.

Table 4-82: Default emission factor used for category 2D3h 'Printing' applying the Tier 1 methodological approach

Source	NMVOC Emission Factor	Unit
Printing	500	kg/t ink

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.h 'Printing', Table 3-1, page 11.

No statistical data on solvents and/or printing inks used are available in the RoM. Under such circumstances, the total ink consumption was estimated considering statistical data on production (Table 4-82), import and export (Table 4-83) (according to the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, by product type, for 2005-2022' inks were produced only during 2011-2013; there is no information on the export of inks during the reference period).

Table 4-83: Activity data on ink import in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Inks for printing, writing and drawing, as well as other inks, kt	0.36	0.22	0.14	0.10	0.08	0.04	0.06	0.06	0.06	0.04	0.06
Paints for artistic painting, for educational use, firms painting, amusement and other similar products, kt	0.14	0.11	0.08	0.06	0.04	0.03	0.03	0.00	0.02	0.01	0.02
Total inks, kt	**0.49**	**0.33**	**0.23**	**0.16**	**0.12**	**0.07**	**0.09**	**0.06**	**0.08**	**0.06**	**0.07**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Inks for printing, writing and drawing, as well as other inks, kt	0.08	0.10	0.12	0.16	0.23	0.15	0.19	0.19	0.17	0.22	0.20
Paints for artistic painting, for educational use, firms painting, amusement and other similar products, kt	0.02	0.03	0.03	0.03	0.03	0.05	0.04	0.05	0.04	0.05	0.05
Total inks, kt	**0.10**	**0.13**	**0.15**	**0.19**	**0.26**	**0.20**	**0.23**	**0.24**	**0.22**	**0.27**	**0.25**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Inks for printing, writing and drawing, as well as other inks, kt	0.18	0.20	0.21	0.30	0.22	0.22	0.25	0.24	0.24	0.25	0.26
Paints for artistic painting, for educational use, firms painting, amusement and other similar products, kt	0.05	0.06	0.07	0.07	0.08	0.09	0.09	0.10	0.14	0.17	0.16
Total inks, kt	**0.23**	**0.26**	**0.28**	**0.37**	**0.30**	**0.31**	**0.33**	**0.34**	**0.38**	**0.43**	**0.42**

Source: Customs Service of the RoM, through Letter dated 20.02.2023, as a response to the interpellation of the Environment Agency to No. 08/34/2023 din 28.01.2023; through Letter dated 19.02.2021, as a response to the interpellation of the MARDE to No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to the request of the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to the request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, response to the request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to the request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, response to the request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011.

The Customs Service is the primary source of information on import-export operations by economic agents in the RM (including for printing, writing or drawing and other inks – code 3215 10-90; as well as paints for artistic painting, educational use, firm painting, amusement, and other similar products – code 3213 10-90).

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in ink production, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvents used in ink production, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; IPCC 2006 Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D3i. Other Solvent and Product Use

Seed Oil Extraction

A certain amount of solvents, hexane in particular, is used in the extraction of vegetable oil from seeds (mechanical extraction of oil does not require solvent use). The cleaned and prepared seeds are washed several times in warm hexane solvent until all oil is extracted, while the remaining seed residue is treated with steam to capture the solvent and oil that remains in it. After drying, the remaining seed residue may be used as animal feed (having a content rich in proteins and mineral salts). The obtained oil is separated from the warm hexane solution, as well as from the solvent vapours from the

steam. The solvent (hexane) is recovered and re-used. Recovery efficiency is quite high although it is dictated by some economic aspects specific to enterprises in this branch. The obtained oil is further refined.

The methodology used in the estimation of NMVOC emissions from 2D3i 'Other Solvent and Product Use' (SNAP 060404 'Fat, edible and non-edible oil extraction'), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), is represented by the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – emission of the specified pollutant resulting from the use of solvents in the extraction of vegetable oil, kt/yr;

$AR_{product}$ – activity rate for the use of solvents in seed oil extraction, kt/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides the default EF for the Tier 2 methodological approach (Table 4-84).

Table 4-84: Default emission factor used for the estimation of NMVOC emissions from seed oil extraction applying the Tier 2 methodological approach

Source	NMVOC Emission Factor	Unit
Seed Oil Extraction	1.57	g/kg seeds

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.i 'Other Solvent and Product Use', SNAP 060404, Table 3-4, page 16.

In order to estimate NMVOC emissions, statistical data on the amount of oil extracted at the Moldovan enterprises is used. At national level, there are over 100 enterprises specialised in oil production, the largest being JSC 'Floarea-Soarelui' in Balti municipality. Current technologies used in seed oil extraction in the RM by solvent use involve obtaining circa 450 kg of oil per one tonne of seeds. This particular conversion factor was utilised to estimate the quantity of seeds consumed for oil extraction (Table 4-85).

Table 4-85: AD on the production of vegetable oil and quantity of seeds used for vegetable oil extraction between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total crude vegetable oil non-chemically modified	125.60	117.90	57.32	60.27	50.44	50.70	39.40	35.20	28.70	24.26	31.34
Total refined vegetable oil non-chemically modified	57.52	54.00	26.25	27.60	23.10	23.22	18.05	16.12	13.14	11.11	14.36
Amount of seeds from which refined oils were extracted	**127.83**	**120.00**	**58.34**	**61.34**	**51.34**	**51.60**	**40.10**	**35.83**	**29.21**	**24.70**	**31.90**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Total crude vegetable oil non-chemically modified	43.49	53.63	77.01	96.09	83.39	81.47	84.97	79.31	83.88	80.71	89.79
Total refined vegetable oil non-chemically modified	19.92	24.56	35.27	44.01	38.23	35.57	38.84	34.58	28.45	26.51	20.94
Amount of seeds from which refined oils were extracted	**44.26**	**54.59**	**78.38**	**97.80**	**84.95**	**79.05**	**86.32**	**76.84**	**63.21**	**58.90**	**46.54**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Total crude vegetable oil non-chemically modified	96.83	65.50	113.22	109.53	79.96	86.81	106.31	124.66	154.93	104.66	230.62
Total refined vegetable oil non-chemically modified	20.62	14.42	16.20	16.70	25.72	13.75	13.85	11.25	26.35	21.69	45.37
Amount of seeds from which refined oils were extracted	**45.82**	**32.04**	**35.99**	**37.10**	**57.16**	**30.55**	**30.78**	**25.00**	**58.56**	**48.20**	**100.82**

Source: National Bureau of Statistics of the RoM through Letter No. 06-39/08 dated 23.02.2011, response to letter No. 03-07/175 dated 02.02.2011 of the Ministry of Environment of the RM; Letter No. 06-39/38 dated 22.09.2011, response to Letter No. 101/2011-09-01 dated 02.09.2011 from the Climate Change Office of the Ministry of Environment of the RM; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022'; Statistical Yearbooks of ATULBD for 1998 (page 183), 2000 (page 100), 2002 (page 104), 2003 (page 99), 2006 (page 94), 2006 (page 94), 2009 (page 93), 2011 (page 95), 2013 (page 100), 2017 (page 102), 2020 (page 103). 2021 (page 101).

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents used in seed oil extraction are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use seed oil extraction, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from seed oil extraction, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

Use of Glues and Other Adhesives

The methodology used in the estimation of NMVOC emissions from use of glues and other adhesives (SNAP 060405), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), is represented by the following equation:

$$E_{pollutant} = (AR \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – emission of the specified pollutant from use of glues and other adhesives, t/yr;

AR – activity rate for the use of glues and other adhesives, t/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology, kg/t (Table 4-86).

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 2 methodological approach.

Table 4-86: Default emission factor used for category 2D3i 'Use of Glues and Other Adhesives' when applying the Tier 2 methodological approach

Source	NMVOC Emission Factor	Unit
Use of Glues and Other Adhesives	522	g/kg glue

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.i 'Other Solvent and Product Use', SNAP 060405, Table 3-11, page 20.

For most activities related to other solvent use in the RoM, there are no reliable statistical reference sources. Under such circumstances, the total consumption of glues and other adhesives was estimated based on information on production, import and export.

It should be noted that the production of glues and other adhesives in the RoM was relatively low and is recorded only since 2003 albeit it has increased significantly in recent years (Table 4-87).

Table 4-87: AD on the production, import and consumption of glue and other adhesives between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Glue and other adhesive production, kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Glue and other adhesive import, kt	3.25	1.71	0.92	0.62	0.56	0.50	0.33	0.62	1.09	0.75	0.73
Glue and other adhesive consumption, kt	**3.25**	**1.71**	**0.92**	**0.62**	**0.56**	**0.50**	**0.33**	**0.62**	**1.09**	**0.75**	**0.73**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Glue and other adhesive production, kt	NO	NO	0.36	0.66	0.85	1.46	0.77	0.58	0.92	1.37	1.32
Glue and other adhesive import, kt	0.86	1.22	1.39	1.75	1.95	1.97	1.96	1.97	1.43	1.80	1.52
Glue and other adhesive consumption, kt	**0.86**	**1.22**	**1.75**	**2.41**	**2.80**	**3.43**	**2.73**	**2.55**	**2.36**	**3.17**	**2.85**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Glue and other adhesive production, kt	1.08	0.95	1.12	6.00	7.61	12.26	4.94	23.87	32.14	29.09	23.94
Glue and other adhesive import, kt	1.41	1.25	1.40	1.49	1.16	1.42	1.48	1.87	1.81	2.09	1.78
Glue and other adhesive consumption, kt	**2.49**	**2.21**	**2.52**	**7.48**	**8.77**	**13.68**	**6.41**	**25.74**	**33.95**	**31.18**	**25.72**

Source: Customs Service of the RoM, through Letter dated 20.02.2023, as a response to the interpellation of the Environment Agency to No. 08/34/2023 din 28.01.2023; through Letter dated 19.02.2021, as a response to the interpellation of the MARDE to No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to request of the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, response to request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, response to request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022'.

The Customs Service is the primary source of information on national import operations by economic agents in the country (no data on glue and other adhesives exports from the RoM was recorded during the period under review).

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents in glues and adhesive substances are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in glues and other adhesives, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvent used in glues and other adhesives, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

Preservation of Wood

The methodology used in the estimation of NMVOC emissions from 2D3i 'Other Solvent and Product Use' (SNAP 060406 preservation of wood), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), is represented by the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant}) / 10^3$$

Where:

$E_{pollutant}$ – emission of the specified pollutant from solvent use in preservation of wood, t/yr;

$AR_{product}$ – activity rate for preservation of wood, t/yr;

$EF_{pollutant}$ – emission factor for this pollutant technology, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides the default EF for the Tier 2 methodological approach (Table 4-88).

Table 4-88: Default emission factor used for the estimation of NMVOC emissions from 'Preservation of Wood' applying the Tier 2 methodological approach

Source	NMVOC Emission Factor	Unit
Preservation of Wood	105	g/kg creosote
	945	g/kg preservative based on organic solvents
	5	g/kg preservatives based on aqueous solutions

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2.D.3.i 'Other Solvent and Product Use', SNAP 060406, Tables 3-5, 3-6 and 3-7, pages 17-18.

In order to estimate NMVOC emissions, statistical data on the total amount of timber produced at Moldovan enterprises is used (Table 4-89).

Table 4-89: AD on timber production in the RoM between the period 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total timber production, thousand m³	265.0	215.0	106.0	55.0	32.0	25.1	21.2	17.2	15.2	21.2	14.9
Timber treated with creosote-based preservatives, thousand m³	39.8	32.3	15.9	8.3	4.8	3.8	3.2	2.6	2.3	3.2	2.2
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total timber production, thousand m³	16.2	17.1	17.2	24.1	23.1	27.0	31.8	46.5	34.0	25.6	18.5
Timber treated with creosote-based preservatives, thousand m³	2.4	2.6	2.6	3.6	3.5	4.0	4.8	7.0	5.1	3.8	2.8
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total timber production, thousand m³	19.4	16.8	15.8	16.5	14.3	17.1	18.5	13.4	11.3	20.0	14.2
Timber treated with creosote-based preservatives, thousand m³	2.9	2.5	2.4	2.5	2.1	2.6	2.8	2.0	1.7	3.0	2.1

Source: Statistical Yearbooks of the RoM for 1994 (page 273), 1999 (page 273), 2003 (page 273), 2006 (page 273); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022'; Statistical Yearbooks of ATULBD for 2000 (page 99), 2003 (page 98), 2006 (page 93), 2009 (page 92), 2011 (page 95), 2012 (page 98), 2017 (page 101), 2019 (page 99), 2020 (page 102), 2021 (page 100).

The literature in the field reveals that about 50% of the total timber is used in construction, 15% in the furniture industry and other finished wood products, 15% in the packaging industry and 20% in other uses. Since the share of timber treated with preservatives is unknown, it was inferred that preservatives

in the RoM are creosote-based, and that this corresponds to the share of timber used in the furniture industry and other finished wood products (15% of the total).

Current technologies for preservation of wood by creosote impregnation imply the use of circa 75 kg of creosote in order to treat one cubic metre of wood, while for the same volume of wood, 24 kg of organic solvents can be used (EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), source category 2D3i 'Other Solvent and Product Use', SNAP 060406 'Preservation of Wood', page 16). The respective conversion factor was utilised to estimate the amount of creosote used in timber treatment at Moldovan enterprises (Table 4-90).

Table 4-90: AD on creosote use in the preservation of wood in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Creosote use in preservation of wood, kt	2.98	2.42	1.19	0.62	0.36	0.28	0.24	0.19	0.17	0.24	0.17
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Creosote use in preservation of wood, kt	0.18	0.19	0.19	0.27	0.26	0.30	0.36	0.52	0.38	0.29	0.21
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Creosote use in preservation of wood, kt	0.22	0.19	0.18	0.19	0.16	0.19	0.21	0.15	0.13	0.23	0.16

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidization, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents used in the preservation of wood are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in preservation of wood, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvent used in preservation of wood, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

Underseal Treatment and Conservation of Vehicles

The methodology used in the estimation of NMVOC emissions from 'Underseal Treatment and Conservation of Vehicles' (SNAP 060407), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), is represented by the following equation:

$$E_{pollutant} = (AR \bullet EF) / 10^3$$

Where:

$E_{pollutant}$ – emission of the specified pollutant from underseal treatment and conservation of vehicles, t/yr;

AR – activity rate, population;

EF – emission factor, kg/person.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 2 methodological approach (Table 4-91).

Table 4-91: Default emission factor used for the estimation of NMVOC emissions from 'Underseal Treatment and Conservation of Vehicles' applying the Tier 2 methodological approach

Source	NMVOC Emission Factor	Unit
Underseal Treatment and Conservation of Vehicles	0.2	kg/person
	636	g/kg underseal agent
	950	g/kg organic solvent

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2D3i 'Other Solvent and Product Use', SNAP 060407, Table 3-10, page 19-20.

Since the amount of underseal agent and/or solvent used for underseal treatment and conservation of vehicles is unknown, AD on the number of the population of the RM was used (Table 4-63).

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents used in underseal treatment and conservation of vehicles are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in underseal treatment and conservation of vehicles, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvent use in underseal treatment and conservation of vehicles, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

Vehicles Dewaxing

The methodology used in the estimation of NMVOC emissions from vehicles dewaxing after long storage and long-distance transport (SNAP 060409), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), is represented by the following equation:

$$E_{pollutant} = (AR \bullet EF) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant from vehicles dewaxing, kt/yr;

AR – the activity rate on vehicles import, units;

EF – the emission factor, kg/vehicle.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default EFs for the Tier 2 methodological approach (Table 4-92).

Table 4-92: Default emission factor used for category 2D3i 'Vehicles Dewaxing' when applying the Tier 2 methodological approach

Source	NMVOC Emission Factor	Unit
Vehicle Dewaxing	1.0	kg/vehicle

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Category 2D3i 'Other Solvent and Product Use', SNAP 060409, Table 3-9, page 19.

No vehicles are produced in the RoM. The Customs Service is the primary source of information on new imported vehicles (Table 4-93).

Table 4-93: Activity data on new imported vehicles in the RM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Imported vehicles – total, units	5,803	4,836	4,030	3,358	2,798	2,332	2,334	1,922	1,947	3,281	1,161
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Imported vehicles – total, units	1,841	3,503	8,431	7,768	10,030	7,477	10,523	14,368	7,832	7,923	11,126
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Imported vehicles – total, units	10,604	12,233	22,103	23,844	14,951	17,764	24,780	29,140	50,826	71,989	60,993

Source: Customs Service of the RoM, through Letter dated 20.02.2023, as a response to the interpellation of the Environment Agency to No. 08/34/2023 dated 28.01.2023; through Letter dated 19.02.2021, as a response to the interpellation of the MARDE to No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011.

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere (it is assumed that all solvents used in vehicle dewaxing are fossil-based).

In order to estimate indirect CO_2 emissions from solvent use in vehicles dewaxing, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from solvent use in vehicles dewaxing, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

2D4. Other (Urea-Based Catalysts)

The methodology used in the estimation of CO_2 emissions from use of urea-based catalysts, available in the 2006 IPCC Guidebook (Volume 2, Chapter 3.2, page 3.12), is represented by the following equation:

$$E = A \bullet 12/60 \bullet Purity \bullet 44/12$$

Where:

E – CO_2 emissions from urea-based additive in catalytic converters, kt/yr;

A – Amount of urea-based additive consumed for use in catalytic converters, kt/yr;

12/60 – mass ratio of carbon (C) and urea ($CO(NH_2)_2$;

Purity – Mass fraction of urea in the urea-based additive (the default value used is 32.5%);

44/12 – mass ratio of carbon (C) and carbon dioxide (CO_2).

AD on the amount of urea-based additive used in catalytic converters is determined indirectly from diesel consumption at national level (additives consumed is between 1 and 3% of the diesel consumption).

Activity data on diesel consumption is available in the EBs for 1990 and 1993-2022 (in 1991 and 1992 the EBs were not compiled, but the information for the respective years was provided to the MoEnv by the NBS through Official Letter No. 05-96-08 dated 10.03.1999, as a response to the request of the MoEnv No. 01-7/138 dated 24.02.1999). The statistical information is available for the entire territory of the country only for 1990 and 1991, whereas for the rest of the period, it covers only the RBDR.

The table below shows data on the population number between 1990 and 2022, separately for the two banks of the Dniester River (Table 4-94).

Table 4-94: Population of the RoM between 1990-2022, mil. inhabitants

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM: RBDR	3.631	3.636	3.629	3.618	3.650	3.646	3.643	3.641	3.655	3.649	3.644
RoM: LBDR	0.731	0.731	0.730	0.730	0.703	0.702	0.692	0.679	0.671	0.666	0.660
RoM: total	**4.362**	**4.366**	**4.359**	**4.348**	**4.353**	**4.348**	**4.334**	**4.320**	**4.326**	**4.315**	**4.304**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RoM: RBDR	3.635	3.627	3.618	3.607	3.533	3.459	3.386	3.312	3.238	3.164	3.091
RoM: LBDR	0.652	0.643	0.634	0.624	0.554	0.548	0.541	0.534	0.528	0.523	0.518
RoM: total	**4.286**	**4.270**	**4.251**	**4.231**	**4.087**	**4.007**	**3.926**	**3.845**	**3.766**	**3.687**	**3.609**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RoM: RBDR	3.017	2.943	2.869	2.846	2.826	2.781	2.730	2.685	2.644	2.627	2.604
RoM: LBDR	0.513	0.509	0.505	0.501	0.475	0.471	0.469	0.465	0.465	0.466	0.464
RoM: total	**3.530**	**3.452**	**3.374**	**3.347**	**3.300**	**3.251**	**3.199**	**3.150**	**3.109**	**3.092**	**3.067**

Source: Statistical Yearbooks of the RM for 1991-2022. Statistical Yearbooks of ATULBD for 1998-2022.

In order to generate data on diesel consumption on the LBDR, information on specific diesel consumption per capita on the RBDR was used: the population number in ATULBD was multiplied by

the specific diesel consumption per capita (for 1990 and 1991 the information was representative for the entire country) (Table 4-95).

Table 4-95: Specific diesel consumption as energy and fuel between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Specific diesel consumption, kg/per capita/yr	255.0	225.0	172.0	127.7	104.7	101.5	87.0	82.7	66.8	48.2	52.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Specific diesel consumption, kg/per capita/yr	57.2	70.0	78.5	89.6	92.8	96.3	103.4	110.8	103.8	131.8	143.3
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Specific diesel consumption, kg/per capita/yr	131.3	147.8	159.3	172.9	190.0	205.3	213.2	228.3	225.1	248.6	252.3

Table 4-96 shows the total diesel consumption as energy and fuel in the RoM between 1990 and 2022.

Table 4-96: Total diesel consumption as energy and fuel in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM: RBDR	925.6	817.8	624.0	462.0	382.0	370.0	317.0	301.0	244.0	176.0	190.0
RoM: LBDR	186.4	164.4	125.6	93.2	73.5	71.2	60.2	56.1	44.8	32.1	34.4
RoM: total	**1,112.0**	**982.2**	**749.6**	**555.2**	**455.5**	**441.2**	**377.2**	**357.1**	**288.8**	**208.1**	**224.4**
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
RoM: RBDR	208.0	254.0	284.0	323.0	328.0	333.0	350.0	367.0	336.0	417.0	443.0
RoM: LBDR	37.3	45.0	49.7	55.9	51.5	52.7	55.9	59.1	54.7	68.9	74.3
RoM: total	**245.3**	**299.0**	**333.7**	**378.9**	**379.5**	**385.7**	**405.9**	**426.1**	**390.7**	**485.9**	**517.3**
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
RoM: RBDR	396.0	435.0	457.0	492.0	537.0	571.0	582.0	613.0	595.0	653.0	657.0
RoM: LBDR	67.4	75.3	80.5	86.5	90.2	96.6	100.0	106.2	104.7	115.8	117.0
RoM: total	**463.4**	**510.3**	**537.5**	**578.5**	**627.2**	**667.6**	**682.0**	**719.2**	**699.7**	**768.8**	**774.0**

Source: National Bureau of Statistics, Energy Balances of the RM for the years 1990, 1993-2022.

The amount of urea-based additives in catalytic converters was determined indirectly based on the total diesel consumption as energy and fuel, considering that additive consumption is 2% of the total amount of diesel consumed in the RoM as energy and fuel (Table 4-97).

Table 4-97: Amount of urea-based additives consumed in catalytic converters between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Urea-based additives, kt	22.2	19.6	15.0	11.1	9.1	8.8	7.5	7.1	5.8	4.2	4.5
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Urea-based additive, kt	4.9	6.0	6.7	7.6	7.6	7.7	8.1	8.5	7.8	9.7	10.3
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Urea-based additive, kt	9.3	10.2	10.7	11.6	12.5	13.4	13.6	14.4	14.0	15.4	15.5

4.5.3. Uncertainties and Time Series Consistency

2D1. Lubricant Use

Uncertainties associated with the emission factors used in the estimation of CO_2 emissions from source category 2D1 'Lubricant Use' following the Tier 1 approach reach up to circa 50% (2006 IPCC Guidelines). Uncertainties associated with activity data on lubricant use in the RM are low (circa 5%). Thus, combined uncertainties associated with activity data and emission factors for source category 2D1 'Lubricant Use' are circa 50.25% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with the recommendations included in the 2006 IPCC Guidelines.

2D2. Paraffin Wax Use

Uncertainties associated with the emission factors used in the estimation of CO_2 emissions from source category 2D2 'Paraffin Wax Use' following the Tier 1 approach reach up to circa 100% (2006 IPCC Guidelines). Uncertainties associated with activity data on paraffin wax use in the RoM can be

considered moderate (circa 20%). Thus, combined uncertainties associated activity data and emission factors for source category 2D2 'Paraffin Wax Use' are estimated to be circa 101.98% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2D3. Solvent Use

Uncertainties associated with the emission factors used in the estimation of indirect CO_2 emissions from source category 2D3 'Solvent Use' were estimated to be circa 35% (2006 IPCC Guidelines). Uncertainties associated with activity data on solvent use in the RoM are moderate (circa 20%). Thus, combined uncertainties associated with activity data and emission factors for source category 2D3 'Solvent Use' are circa 40.31% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2D4. Other (Urea-Based Catalysts)

Uncertainties associated with the emission factors used in the estimation of CO_2 emissions from source category 2D4 'Other' (Urea-Based Catalysts) are low (circa 2%). Uncertainties associated with activity data on the use of urea catalysts in the RoM are moderate (circa 20%). Thus, combined uncertainties associated with activity data and emission factors for source category 2D4 'Other' (urea-based catalysts) are circa 20.10% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.5.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

4.5.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective source category, following the Tier 1 methodological approach.

Verification was focused on ensuring correct use of emission factors, including default emission factors, available in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories; verification was also focused on correct use of AD obtained from different reference sources, including official sources, especially for the conversion of AD into mass units compatible with GHG emission estimation methods; comparing the results obtained by using different estimating methodologies and explaining the identified discrepancies.

AD and methods used for estimating GHG emissions from category 2D 'Non-energy Products from Fuels and Solvent Use' were documented and archived both in hard copies and electronically.

4.5.6. Recalculations

2D1. Lubricant Use

CO_2 emissions from source category 2D1 'Lubricant Use' have not been recalculated in the current inventory cycle.

2D2. Paraffin Wax Use

CO_2 emissions from source category 2D2 'Paraffin Wax Use' have not been recalculated in the current inventory cycle.

2D3. Solvent Use

CO_2 emissions from category 2D3 'Solvent use' were recalculated for the period 2006-2020, as a result of the update of the data associated with the country's population by the National Bureau of Statistics; the use of the information regarding the production of bituminous products based on natural asphalt or natural bitumen available in the PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2020', instead of the information received from SOE 'State Administration of Roads'; consideration for the first time of the quantities of varnishes and paints produced in ATULBD between 2012-2020; using the specified information regarding the number of cars imported into the RoM in 2015-2017 and 2020, based on the data provided by the Customs Service. Overall, the impact of recalculations is insignificant, except for the year 2020 (Table 4-98).

Table 4-98: Comparative results of the inventory of CO_2 emissions from category 2D3 'Solvent Use' included in the NC5 and BTR1 of the RoM to UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	204.15	167.78	138.52	110.22	72.15	64.28	59.46	31.09	29.19	28.07	27.64
BTR1	204.15	167.78	138.52	110.22	72.15	64.28	59.46	31.09	29.19	28.07	27.64
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	30.84	32.61	32.72	55.73	59.90	73.10	76.98	58.50	50.55	58.28	63.01
BTR1	30.84	32.61	32.72	55.73	59.90	73.10	76.99	58.51	50.60	58.36	63.03
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	67.37	62.13	79.86	76.93	76.85	88.97	142.80	134.99	186.82		
BTR1	67.37	62.14	79.86	76.94	76.92	89.29	142.99	135.14	195.44	167.01	150.49
Difference, %	0.0	0.0	0.0	0.0	0.1	0.4	0.1	0.1	4.6		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

2D4. Other (Urea-Based Catalysts)

CO_2 emissions from source category 2D4 'Other' have not been recalculated for 1990-2020.

4.5.7. Planned Improvements

There are no planned improvements for category 2D 'Non-Energy Products from Fuels and Solvent Use' in the next inventory cycle.

4.6. Product Uses as Substitutes for ODS (Source Category 2F)

4.6.1. Source Category Description

A large number of hydrofluorocarbons are used to substitute ozone depleting substances (ODS) (Table 4-99).

Globally, wide scale production of halocarbons started in 1991 as alternative substances to chlorofluorocarbons (ozone layer depleting substances). According to the Montreal Protocol, the Parties to this treaty committed to phase out the import and domestic consumption of ODS, with further complete elimination starting with 2008 (because halocarbons do not contain chlorine atoms, they do not have any impact on the ozone layer).

Table 4-99: GWP for 100 years and the atmospheric lifetime of hydrofluorocarbons used to substitute ozone depleting substances[71]

GHG	Chemical formula	Lifetime, according to AR5	SAR	TAR	AR4	AR5
HFC-23	CHF_3	222	11,700	12,000	14,800	12,140
HFC-32	CH_2F_3	5.2	650	550	675	677
HFC-125	C_2HF_5	28.2	2,800	3,400	3,500	3,170
HFC-134a	$C_2H_2F_2$ (CH_2FCF_3)	13.4	1,300	1,300	1,430	1,300

[71] < http://www.epa.gov/climatechange/Downloads/ghgemissions/US-GHG-Inventory-2014-Annex-6-Additional-Information.pdf>.

GHG	Chemical formula	Lifetime, according to AR5	SAR	TAR	AR4	AR5
HFC-143a	$C_2H_3F_3$ (CF_3CH_3)	47.1	3,800	4,300	4,470	4,800
HFC-152a	C_2H4F_2 (CH_3CHF_2)	1.5	140	120	124	138
HFC-227ea	CF_3CHFCF_3	38.9	2,900	3,500	3,220	3,350
HFC-236fa	$CF_3CH_2CF_3$	242	6,300	9,400	9,810	8,060
HFC-245fa	$CHF_2CH_2CF_3$	7.7	NA	950	1,030	858
HFC-365mfc	$CH_3CF_2CH_2CF_3$	8.7	NA	890	794	804
HFC-43-10mee	$CF_3CHFCHFCF_2CF_3$	16.1	1,300	1,500	1,640	1,650

Sources: SAR – Second Assessment Report (IPCC, 1996), TAR – Third Assessment Report (IPCC, 2001), AR4 – Fourth Assessment Report (IPCC, 2007), AR5 – Fifth Assessment Report (IPCC, 2013).

Category 2F 'Product Uses as Substitutes for ODS' includes GHG emissions from the following emission sources: 2F1 'Refrigeration and Air Conditioning', 2F2 'Foam Blowing Agents', 2F3 'Fire Protection', 2F4 'Aerosols', 2F5 'Solvents' and 2F6 'Other Applications'.

In the current inventory cycle, the Republic of Moldova monitored emissions generated from HFC consumption from source categories 2F1, 2F2, 2F3, and 2F4. Emissions from source categories 2F5 and 2F6 were not estimated due to lack of activity data.

It should be noted that the process of collecting activity data on the consumption of alternative substances to ODS is extremely difficult at national level. The primary difficulty is due to the fact that import, export, re-export and circulation of these substances on the market is not regulated at national level (for example, the ODS[72] since 01.01.2013). Import of substitutes for ODS in stock, as well as products and equipment charged with halocarbons do not require a license and/or environmental authorization. Secondly, there are difficulties in monitoring the import of disaggregated HFCs by type of substance, as ODS and their alternatives are aggregated in the Combined Nomenclature of Goods of the RM in several tariff positions (2903 3919-2903 3990; 2903 7900-2903 7919; 3824 7100; 3824 7400, 3824 7800 and 3824 7900).

Under these circumstances, HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' were estimated based on estimation methodologies available in the 2006 IPCC Guidelines, considering data on import and consumption of halocarbons provided by economic agents, including through the Annual Reports submitted by enterprises to the National Montreal Protocol Unit under the Public Institution 'Environmental Projects National Implementation Office' (P.I. 'EPNIO') (it should be noted that between 2003 and 2022, only a limited number of enterprises were licensed to import, export, re-export, transit and place ODS and equipment containing ODS on the market: 'Ecolux' Ltd., 'Frio-Dins' Ltd., 'Frigoind' Ltd., 'Frig industrial' CE, 'York Refrigerent' Ltd., 'Dina Cociug' Ltd).

In addition, the Generalised Reports were also used on the production, consumption, import/export of ozone-depleting substances, regulated by the Montreal Protocol in the RoM between 2001 and 2008 according to the Statistical Report No. 1-Ozone, provided by the NBS (between 2009 and 2016, the responsibility for collecting statistical information in conformity with the Statistical Report No. 1-Ozone lay with the Environmental Protection Inspectorate, but due to the lack of capacities, the respective information was not collected).

It should be noted that the Republic of Moldova does not produce HFCs; and that these substances had a relatively narrow use before 1995, being imported in insignificant amounts.

2F1. Refrigeration and Air Conditioning

Refrigeration equipment (refrigerators, freezers, refrigerated display cases, industrial refrigeration equipment) and air conditioning equipment (stationary and mobile air conditioners) are a primary source of HFC emissions in the Republic of Moldova.

Because since 1995, in accordance with the Montreal Protocol, highly industrialised countries are not supposed to produce CFCs and equipment using CFCs, the Republic of Moldova uses R-22 and

[72] <http://mediu.gov.md/index.php/activitate/autorizatii>.

R-600a refrigerants as transit substances, and R-134a, R-404a, R-407c, R-410a and R-507a as alternative refrigerants to CFCs (Table 4-100).

Table 4-100: Composition of refrigerants preponderantly used in the RoM

Commercial name	Sector	Composition
R-32	Commercial refrigerant, air conditioning	HFC-32 (100%)
R-134a	Transport, commercial, industrial refrigerant	HFC-134a (100%)
R-404a	Commercial, industrial refrigerant	HFC-125 (44%)/HFC-143a (52%)/HFC-134a (4%)
R-406a	Commercial refrigerant	HCFC-22 (55%)/HC-600a (14%)/HCFC-142B (41%)
R-407c	Commercial refrigerant, air conditioning	HFC-32 (23%)/HFC-125 (25%)/HFC-134a (52%)
R-407f	Commercial, industrial refrigerant	HFC-32 (30%)/HFC-125 (40%)/HFC-134a (40%)
R-408a	Commercial refrigerant	HCFC-22 (47%)/HFC-143a (46%)/HFC-125 (7%)
R-410a	Air conditioning	HFC-32 (50%)/HFC-125 (50%)
R-422d	Commercial, industrial refrigerant	HFC-125 (65.1%)/HFC-134a (31.5%)/R-600a (3.4%)
R-507a	Transport, commercial, industrial refrigerant	HFC-125 (50%)/HFC-143a (50%)

Since 2017, relatively large amounts of R-407f (circa 1.8 tonnes) were introduced on the domestic market as an alternative substance to the R-404a refrigerant agent, and R-422d (circa 14.8 tonnes) as an alternative substance to the R-22 refrigerant agent, respectively.

2F2. Foam Blowing Agents

Since 1995, hydrofluorocarbons have been also used to replace CFCs and HCFCs used in foam blowing agents (closed and opened cell foams), used in insulation, cushioning and packaging. The basic components for the production of these foams are: HFC-245f, HFC-365mfc, HFC-134a, HFC-152a, HCFC-22, HCFC-141b, HCFC-142b, Pentane (C,I,N) and CO_2+ethanol.

In the RoM, foams have been produced since 2005. Foams produced as well as imported ones are mostly closed cell foams (the emissions from these last longer, circa 20 years).

2F3. Fire Protection

There are two types of fire extinguishers which use HFCs (mainly HFC-227ea and HFC-236fa) as halon substitutes (halon-1211 or bromoclorodifluoromethane; halon-1301 or bromotrifluoromethane and halon-2402 or dibromotetrafluoroethane): (1) portable fire extinguishing systems and (2) fixed fire extinguishing systems.

According to the information received from the General Inspectorate for Emergency Situations of the Ministry of Internal Affairs, only CO_2 had been used in fixed fire extinguishing systems as an extinguishing agent until 2016 (halon and HFC-based fixed and portable extinguishing systems were not in use) (Table 4-101).

Table 4-101: Import of portable fire extinguishers between 1995-2022, thousand units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2007
Portable fire extinguishers	12.195	11.086	10.078	9.162	8.329	7.572	4.178	9.247	13.806	20.913	18.494	26.666	41.232	12.195
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Portable fire extinguishers	46.428	154.462	43.347	29.374	42.465	51.143	51.942	42.613	42.601	58.547	90.623	87.879	76.092	66.391

Source: Customs Service of the RM, through Letter dated 20.02.2023, response to the interpellation of the Environment Agency to No. 08/34/2023 dated 28.01.2023; through Letter dated 19.02.2021, response to the interpellation of the MARDE to No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to the request from the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to the request of the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to the request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, response to the request from the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to the request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, response to the request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011.

The import of HFC-227ea for use in fire protection systems has been recorded in the Republic of Moldova since 2016 (Table 4-102).

Table 4-102: Import and export of HFC-227ea in the RoM between 2016-2022, tonnes

	2016	2017	2018	2019	2020	2021	2022
HFC-227ea stock at the beginning of year, t	0.00	0.00	0.00	2.90	4.13	6.00	0.00
Import of HFC-227ea, t	0.96	2.00	20.00	22.00	12.00	10.00	14.00
Amount of HFC-227ea sold, t	**0.96**	**2.00**	**17.10**	**20.77**	**10.14**	**16.00**	**13.68**
HFC-227ea stock at the end of the year, t	0.00	0.00	2.90	4.13	6.00	0.00	0.32

Source: 'Micasa International' JSC, through Letter dated 01.02.2023, response to the interpellation of the Environment Agency to No. 08/64/2023 dated 31.01.2023.

2F4. Aerosols (Metered Dose Aerosols)

HFCs are used as propellant in most aerosol products. Emissions from aerosols are usually released shortly after being marketed, on average 1-2 years after sale. When used, the entire amount of propellant is considered to be emitted into the atmosphere. Most frequently, HFC-134a is used as a propellant (less frequently – HFC-227ea and HFC-152a).

In the Republic of Moldova, aerosols containing chemical substances included in Annex A, Group I of the Montreal Protocol cannot be imported, exported, re-exported, transited and put into circulation on the market. The interdiction does not extend on medical care goods: pharmaceutical aerosols in the form of sprays used in the treatment of chronic lung obstructions, cardiac conditions, as well as medication whose active substances can be applied as aerosols only; and goods needed to ensure public order (special products manufactured commissioned and used by the Ministry of Internal Affairs or other organisations entitled to ensure public order, and used in cases stipulated by legislation).

HFC emissions from category 2F 'Product Uses as Substitutes for ODS' had increased in the RoM between 1995 and 2022 by circa 251 times, from 0.94 kt CO_2 equivalent in 1995 to 234.84 kt CO_2 equivalent in 2022 (Table 4-103, Figure 4-3).

Table 4-103: HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' in the RM between 1995-2022, kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
HFC emissions	0.94	1.51	2.10	2.85	3.64	4.66	6.25	8.30	10.95	14.40	20.20	29.92	40.32	51.77
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
HFC emissions	61.02	70.54	80.58	88.14	95.76	107.94	137.88	146.66	162.10	174.41	196.40	206.62	213.27	234.84

Categories 2F1 'Refrigeration and Air Conditioning' and 2F2 'Foam Blowing Agents' had the largest share in the structure of total F-gases emissions from category 2F 'Product Uses as Substitutes for ODS' in the respective period.

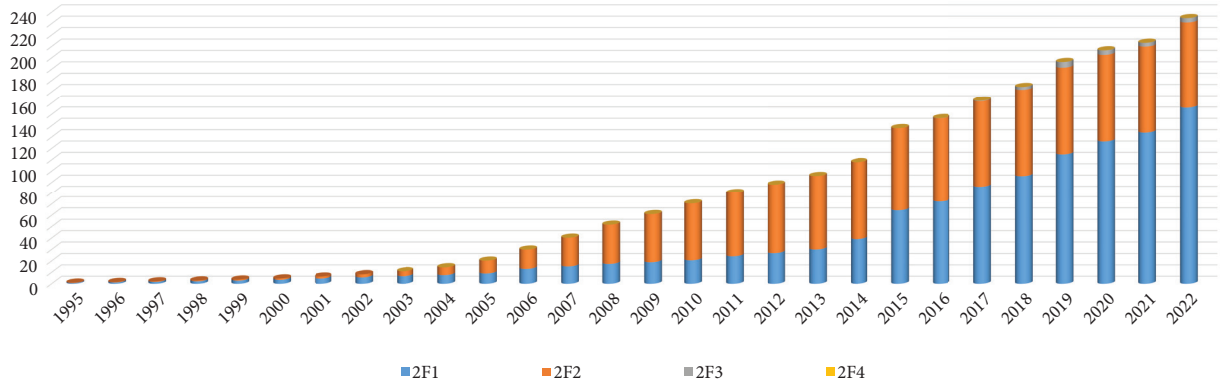


Figure 4-3: Evolution of HFC emissions from category 2F 'Product Uses as Substitutes for ODS', by source, between 1995-2022, kt CO_2 equivalent.

4.6.2. Methodologies, Emission Factors and Activity Data

2F1. Refrigeration and Air Conditioning

Refrigeration equipment (refrigerators, freezers, refrigerated display cases, industrial refrigeration equipment) and air conditioning equipment (stationary and mobile air conditioners) are a primary source of HFC emissions in the Republic of Moldova.

GHG emissions from the consumption of halocarbons in this category were estimated using the Tier 2 approach (2006 IPCC Guidelines, Volume 3, Chapter 7.5, Equation 7.10, page 7.49).

$$E_{total,\,t} = E_{containers,\,t} + E_{Charge,\,t} + E_{lifetime,\,t} + E_{end\text{-}of\text{-}life,\,t}$$

Where:

$E_{containers,\,t}$ – emissions related to the management of refrigerant containers;

$E_{charge,\,t}$ – emissions related to the refrigerant charge: connection and disconnection of the refrigerant container and the new equipment to be charged;

$E_{lifetime,\ t}$ – annual emissions from the banks of refrigerants associated with the six sub-applications during operation (fugitive emissions and ruptures) and servicing;

$E_{end\text{-}of\text{-}life,\ t}$ – emissions at system disposal.

The estimation process involves several steps, using the following equations.

Step 1: Refrigerant management of containers

The emissions related to the refrigerant container comprises all the emissions related to the refrigerant transfer, from bulk containers (typically 40 tonnes) down to small capacities (from 0.5 kg to 1 tonne). Emissions are estimated using Equation 7.11 in the 2006 IPCC Guidelines (Volume 3, Chapter 7.5, page 7.49).

$$E_{containers,\ t} = RM_{t} \bullet (c / 100)$$

Where:

RM_{t} – HFC market for new equipment and servicing of all refrigeration application in year *t*, kg;

c – emission factor of HFC container management of the current refrigerant market, percent (varies between 2% and 10% of the refrigerant market; on average, circa 6%).

Step 2: Refrigerant charge emissions of new equipment

The emissions of refrigerant due to the charging process of new equipment are related to the process of connecting and disconnecting the refrigerant container to and from the equipment when it is initially charged. The respective emissions are estimated using Equation 7.12 in the 2006 IPCC Guidelines (Volume 3, Chapter 7.5, page 7.50).

$$E_{charge,\ t} = M_{t} \bullet (k / 100)$$

Where:

M_{t} – amount of HFC charged into new equipment in year t (including equipment to be exported), kg; it should be noted that systems that are imported pre-charged are not taken into consideration;

k – emission factor of assembly losses of the HFC charged into new equipment (per sub-application),

percent, (varies between 0.1% and 3%).

Step 3: Emissions during lifetime (operation and servicing)

Annual emissions from the refrigerant bank, associated with sub-applications, during lifetime and servicing, represent fugitive emissions and are estimated using Equation 7.13 in the 2006 IPCC Guidelines (Volume 3, Chapter 7.5, page. 7.50).

$$E_{lifetime,\ t} = B_{t} \bullet (x / 100)$$

Where:

B_{t} – amount of HFC banked in existing systems in the respective country in year t (per sub-application), kg;

x – annual emission rate (i.e., annual emissions) of HFC of each sub-application bank during operation, accounting for average annual leakage and average annual emissions during servicing, percent.

Step 4: Emissions at end-of-life

Emissions at system disposal are estimated using Equation 7.14 in the 2006 IPCC Guidelines (Volume 3, Chapter 7.5, page 7.51).

$$E_{end\text{-}of\text{-}life,\ t} = M_{t\text{-}d} \bullet (p / 100) \bullet (1 - \eta_{rec,\ d} / 100)$$

Where:

$M_{t\text{-}d}$ – amount of HFC initially charged into new systems (produced and imported into the respective country) installed in year *t*, kg;

p – residual charge of HFC in equipment being disposed of expressed in percentage of full charge, percent;

$\eta_{rec,\,d}$ – recovery efficiency at disposal, which is the ratio of recovered HFC referred to the HFC contained in the system, percent.

During the estimation process, default emission factors available in the 2006 IPCC Guidelines were used, as well as country-specific EFs provided by the members of the Republican Association of Refrigeration Technicians, and from the reports submitted by companies to the National Ozone Unit under the P.I. 'EPNIO' of the MoEnv, respectively (Table 4-104).

Table 4-104: EFs and parameters used in the estimation of HFC emissions from refrigeration and air conditioning equipment imported into the Republic of Moldova

Equipment Type (sub-application)	Charge, kg (margin and value used)	Lifetime, years (margin and value used)	Emission Factor (% of the initial charge/year)		End-of-life emissions (%)	
			Initial emissions	operational emissions	Recovery efficiency	initial charge remaining
Factors in equations	**(M)**	**(d)**	**(k)**	**(x)**	**($\eta_{rec,\,d}$)**	**(p)**
Domestic refrigeration	0.05 ≤ M ≤ 0.5 **0.10**	12 ≤ d ≤ 20 **16**	0.2 ≤ k ≤ 1 **0.6**	0.1 ≤ x ≤ 0.5 **0.5**	$0 < \eta_{rec,\,d} < 70$ **0**	0 < p < 80 **50**
Chest freezers	0.05 ≤ M ≤ 0.5 **0.20**	12 ≤ d ≤ 20 **16**	0.2 ≤ k ≤ 1 **0.6**	0.1 ≤ x ≤ 0.5 **0.5**	$0 < \eta_{rec,\,d} < 70$ **0**	0 < p < 80 **50**
Cabinet type freezers	0.05 ≤ M ≤ 0.5 **0.18**	12 ≤ d ≤ 20 **16**	0.2 ≤ k ≤ 1 **0.6**	0.1 ≤ x ≤ 0.5 **0.5**	$0 < \eta_{rec,\,d} < 70$ **0**	0 < p < 80 **50**
Showcases, counters, chest freezers, cabinet type freezers and similar furniture for small capacity refrigeration	0.2 ≤ M ≤ 6 **0.4**	10 ≤ d ≤ 15 **12**	0.5 ≤ k ≤ 3 **1.5**	1 ≤ x ≤ 15 **16.8**	$0 < \eta_{rec,\,d} < 70$ **30**	0 < p < 80 **50**
Showcases, counters, chest freezers, cabinet type freezers and similar furniture for medium capacity refrigeration	3 ≤ M ≤ 30 **6**	10 ≤ d ≤ 15 **12**	0.5 ≤ k ≤ 3 **1.5**	1 ≤ x ≤ 15 **16.8**	$0 < \eta_{rec,\,d} < 70$ **30**	0 < p < 80 **50**
Showcases, counters, chest freezers, cabinet type freezers and similar furniture for large capacity refrigeration	100 ≤ M ≤ 200 **150**	10 ≤ d ≤ 15 **12**	0.5 ≤ k ≤ 3 **1.5**	1 ≤ x ≤ 15 **16.8**	$0 < \eta_{rec,\,d} < 70$ **50**	0 < p < 80 **50**
Industrial refrigeration	10 ≤ M ≤ 10000 **150**	15 ≤ d ≤ 30 **20**	0.5 ≤ k ≤ 3 **1.5**	7 ≤ x ≤ 25 **16**	$0 < \eta_{rec,\,d} < 90$ **50**	50 < p < 100 **75**
Stationary air conditioners	0.5 ≤ M ≤ 100 **0.6**	10 ≤ d ≤ 20 **18**	0.2 ≤ k ≤ 1 **0.6**	1 ≤ x ≤ 10 **5**	$0 < \eta_{rec,\,d} < 80$ **0**	0 < p < 80 **50**
Mobile A/C – personal cars	0.4 ≤ M ≤ 0.8 **0.6**	9 ≤ d ≤ 16 **16**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	$0 < \eta_{rec,\,d} < 50$ **0**	0 < p < 50 **50**
Mobile A/C – buses, trains, passenger carriages	10 ≤ M ≤ 20 **12**	9 ≤ d ≤ 16 **16**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	$0 < \eta_{rec,\,d} < 50$ **30**	0 < p < 50 **50**
Mobile A/C – minibuses	0.5 ≤ M ≤ 1.5 **1.2**	9 ≤ d ≤ 16 **16**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	$0 < \eta_{rec,\,d} < 50$ **30**	0 < p < 50 **50**
Mobile A/C – trucks	0.5 ≤ M ≤ 1.5 **1**	9 ≤ d ≤ 16 **16**	0.2 ≤ k ≤ 0.5 **0.5**	10 ≤ x ≤ 20 **15**	$0 < \eta_{rec,\,d} < 50$ **30**	0 < p < 50 **50**
Refrigeration vehicles	3 ≤ M ≤ 8 **7**	6 ≤ d ≤ 9 **9**	0.2 ≤ k ≤ 1 **0.6**	15 ≤ x ≤ 50 **30**	$0 < \eta_{rec,\,d} < 70$ **30**	0 < p < 50 **50**

Source: 2006 IPCC Guidelines, Volume 3, Chapter 7.5, Table 7.9, page 7.52. Republican Association of Refrigeration Technicians of the Republic of Moldova and reports submitted by companies to the National Ozone Unit of the Ministry of Environment.

I) Domestic Refrigeration

The refrigerator plant in Chisinau was founded in November 1964 and had produced, between 1965 and 1998, a series of refrigerator models ('Nistru', 'Iarna', 'Iarna-2', 'Iarna-3', 'Iarna-4', 'Codru') and one freezer model – 'Ghiocel'. The plant production had been popular in the RoM, other union republics of the former USSR as well as in other socialist countries. Once the transition to the market economy began, production could not face the competition from imported items. As a result, in 1997, the company went bankrupt. No domestic refrigerators and freezers have been produced in the RoM since 1998 (Table 4-105). The R-12 refrigerant was used in the manufacture of refrigerators and freezers at the respective enterprise.

Table 4-105: AD on refrigerator and freezer production in the RoM between 1990-1998, thous. units

Refrigeration equipment	1990	1991	1992	1993	1994	1995	1996	1997	1998
Refrigerators	2.6	1.3	1.1	1.0	0.9	0.8	0.2	0.2	0.0
Freezers	131.0	118.0	55.0	58.0	53.0	23.0	0.9	1.5	0.1

AD used in the estimation of HFC emissions from consumption of hydrofluorocarbons charged into domestic refrigeration equipment (refrigerators and freezers) were provided by the Customs Service of the RoM. Between 1995 and 2022, the import of domestic refrigerators increased by circa 4 times, whereas for domestic freezers – by circa 156 times (Table 4-106).

Table 4-106: AD on import of domestic refrigeration equipment between 1995-2022, units

Refrigeration equipment	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refrigerators	18,958	8,376	11,597	15,230	8,498	12,092	19,937	30,689	42,524	52,694	70,412	87,034	112,982	78,880
Chest freezers	36	243	100	148	96	242	428	97	442	457	1,265	1,713	1,549	2,834
Cabinet type freezer	43	337	22	320	200	393	558	995	2,033	1,481	1,965	5,180	9,574	3,169
Refrigeration equipment	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Refrigerators	65,306	72,824	66,900	63,433	55,638	60,963	55,713	51,245	60,255	77,510	93,196	85,944	94,018	73,972
Chest freezers	2,529	2,492	3,395	2,107	2,870	3,151	5,413	6,822	10,142	15,188	25,608	39,267	34,953	7,695
Cabinet type freezer	4,323	8,825	9,239	7,994	6,164	8,242	7,482	5,660	6,115	6,783	11,090	19,289	13,200	4,614

Source: Customs Service of the RoM, through Letter dated 20.02.2023, as a response to the Interpellation of the Environment Agency to No. 08/34/2023 dated 28.01.2023; Letter dated 12.02.2021, as a response to the Interpellation of the MARDE to No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the Interpellation of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the Interpellation of the 'Climate Change' Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as response to the Interpellation of the 'Climate Change' Office of the MARDE to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as response to the Interpellation of the 'Climate Change' Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as response to the Interpellation of the 'Climate Change' Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as response to the Interpellation of the Ministry of Environment to No. 03-07/175 din 02.02.2011.

The share of refrigerants charged into domestic refrigeration equipment in the RoM varied from one year to another (Table 4-107).

Table 4-107: Share of refrigerants charged into domestic refrigeration equipment in the Republic of Moldova between 1995-2022, %

Equipment	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refrigerators	R-134a	0	0	0	0	0	0	0	0	30	40	55	65	70	75
	R-600a	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	R-12	100	100	100	100	100	100	100	100	70	60	45	35	30	25
Freezers	R-134a	0	0	0	0	0	0	0	0	20	30	40	50	50	45
	R-404a	0	0	0	0	0	0	0	0	15	25	35	40	45	50
	R-290	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	R-12	100	100	100	100	100	100	100	100	65	45	25	10	5	5
Equipment	**Refrigerant**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Refrigerators	R-134a	70	65	55	45	30	20	10	0	0	0	0	0	0	0
	R-600a	30	35	45	55	40	80	90	100	100	100	100	100	100	100
	R-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Freezers	R-134a	40	35	35	35	30	25	15	5	0	0	0	0	0	0
	R-404a	60	65	65	65	65	70	80	90	95	95	95	90	90	90
	R-290	0	0	0	0	5	5	5	5	5	5	5	10	10	10
	R-12	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

The information on the composition of refrigerants charged into the refrigeration equipment imported into the country (Table 4-99), the share of refrigerants charged into the refrigeration equipment imported into the country between 1995 and 2022 (Table 4-107), the average charge of equipment with refrigerant (Table 4-104), and statistical data on the import of domestic refrigeration equipment (Table 4-106) was used to estimate the total amount of freon imported into the country in domestic refrigeration equipment (Table 4-108) and the cumulative amount of refrigerant used in domestic refrigeration equipment imported into the Republic of Moldova (Table 4-109).

Table 4-108: AD on import of refrigerants charged into domestic refrigeration equipment between 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-134a	1.37	2.22	4.12	6.29	8.93	6.43	5.08	5.46	4.50	3.51
R-404a	0.07	0.09	0.21	0.51	0.91	0.57	0.77	1.36	1.52	1.21
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
R-134a	2.17	1.75	0.92	0.12	0.00	0.00	0.00	0.00	0.00	0.00
R-404a	1.09	1.48	1.94	2.14	2.97	4.05	6.76	10.19	8.43	2.13

Activity data on the total amount of refrigerants imported into the country were provided through reports submitted by economic agents presented annually to the national Montreal Protocol Unit under the P.I. 'EPNIO'. However, this information is aggregated for the entire country, the share for the servicing of domestic refrigeration equipment being unspecified.

Table 4-109: Cumulative amount of refrigerants charged into domestic refrigeration equipment imported into the RoM between 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-134a	1.37	3.58	7.70	13.99	22.92	29.34	34.43	39.89	44.39	47.90
R-404a	0.07	0.16	0.37	0.88	1.79	2.36	3.13	4.49	6.01	7.22
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
R-134a	50.07	51.82	52.74	52.86	52.86	52.86	51.49	49.28	45.16	38.87
R-404a	8.32	9.80	11.74	13.88	16.86	20.90	27.60	37.70	45.92	47.54

In order to identify this information (Table 4-110), it has been inferred that circa 0.5% of the total amount of refrigerants charged into domestic refrigeration equipment is used for servicing, considering that circa 6% (margin used by default: varies between 2% and 10%) of the total amount of imported refrigerant is lost through fugitive emissions during the management of containers charged with freon.

Table 4-110: AD on imported refrigerants for servicing domestic refrigeration equipment for 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-134a	0.01	0.02	0.04	0.07	0.12	0.16	0.18	0.21	0.24	0.25
R-404a	0.00	0.00	0.00	0.00	0.01	0.01	0.02	0.02	0.03	0.04
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
R-134a	0.27	0.27	0.28	0.28	0.28	0.28	0.27	0.26	0.24	0.21
R-404a	0.04	0.05	0.06	0.07	0.09	0.11	0.15	0.20	0.24	0.25

II) Commercial Refrigeration

AD used in the estimation of HFC emissions from consumption of hydrofluorocarbons charged into commercial refrigeration equipment (refrigerated display cases, chest freezers and cabinet type freezers as well as other similar equipment) was provided by the Customs Service. Between 1995 and 2022, the import of commercial refrigeration equipment increased by circa 139% (Table 4-111).

Table 4-111: AD on import of commercial refrigeration equipment between 1995-2022, units

Equipment	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refrigerated display cases for frozen products	102	583	558	2,286	622	822	977	1,122	1,605	1,260	1,173	1,246	1,436	478
Showcases and industrial refrigerated counters	2,696	1,037	1,411	2,714	913	1,195	1,696	3,153	1,803	2,465	2,830	3,621	8,978	8,692
Industrial refrigerated cabinets	652	775	446	305	669	587	1,796	1,695	1,434	1,213	1,001	1,851	3,808	2,675
Total showcases, counters, chest freezers, cabinet type freezers and other similar furniture for refrigeration	**3,450**	**2,395**	**2,415**	**5,305**	**2,204**	**2,604**	**4,469**	**5,970**	**4,842**	**4,938**	**5,004**	**6,718**	**14,222**	**11,845**
Equipment	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Refrigerated display cases for frozen products	422	403	441	224	343	252	837	675	821	1,121	796	1,329	1,270	662
Showcases and industrial refrigerated counters	4,908	4,296	4,997	4,000	5,333	3,961	3,565	3,079	4,423	6,464	6,365	4,912	11,205	5,131
Industrial refrigerated cabinets	1,054	1,273	1,777	570	566	780	1,038	753	2,215	1,143	1,804	2,003	2,095	16,688
Total showcases, counters, chest freezers, cabinet type freezers and other similar furniture for refrigeration	**6,384**	**5,972**	**7,215**	**4,794**	**6,242**	**4,993**	**5,440**	**4,507**	**7,459**	**8,728**	**8,965**	**8,244**	**14,570**	**22,481**

Source: Customs Service of the RoM, through Letter dated 20.02.2023, response to the interpellation of the Environment Agency to No. 08/34/2023 dated 28.01.2023; Letter dated 19.02.2021, response to the interpellation of the MARDE to No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to the request from the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to the request from the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, response to the request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to the request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011 response to the request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011.

The share of refrigerants charged into domestic refrigeration equipment in the Republic of Moldova varied from one year to another (Table 4-112).

Table 4-112: Share of refrigerants charged into commercial refrigeration equipment imported into the RoM between 1995-2022, %

Equipment	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Showcases, counters, chest freezers, cabinet type freezers and other similar furniture for refrigeration	R-12	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	45.0	35.0	25.0	20.0	12.0	7.0
	R-22	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.0	48.0	54.0	57.0	60.0	60.5
	R-134a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	7.0	10.0	12.0	15.0	18.0
	R-404a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	7.0	8.0	8.0	8.0	8.5
	R-407c	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	2.0	2.0	2.0	3.0	3.0
	R-507a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0	1.0	2.0	3.0
	R-744	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	R-290	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Equipment	**Refrigerant**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Showcases, counters, chest freezers, cabinet type freezers and other similar furniture for refrigeration	R-12	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	R-22	62.5	56.0	49.5	44.5	37.5	33.0	27.0	24.5	20.0	15.5	12.5	9.5	6.5	4.5
	R-134a	21.0	24.0	27.5	29.0	30.5	32.0	32.5	33.0	34.5	35.0	35.0	35.0	34.5	34.5
	R-404a	8.5	11.0	12.5	15.0	17.0	18.0	19.0	20.0	21.0	22.5	24.0	25.5	27.5	28.5
	R-407c	3.0	3.0	3.0	4.0	4.0	4.0	4.3	4.3	4.8	5.3	4.5	4.5	4.0	3.5
	R-507a	5.0	6.0	7.5	7.5	10.8	12.8	17.0	18.0	19.5	21.5	23.0	24.5	26.5	27.5
	R-744	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	0.8	0.8	1.2
	R-290	0.0	0.0	0.0	0.0	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.3

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

The information on the share of refrigerants charged into the refrigeration equipment imported into the country (Table 4-100), the share of refrigerants charged into the commercial refrigeration equipment imported into the country between 1997 and 2022 (Table 4-112), the average charge of equipment with refrigerant (Table 4-104) and statistical data on import of commercial refrigeration equipment (Table 4-111), was used to estimate the total amount of freon imported into the country within the commercial refrigeration equipment (Table 4-113) and the cumulative amount of refrigerants used in the commercial refrigeration equipment imported into the RoM (Table 4-114).

Table 4-113: AD on imported refrigerants charged into commercial refrigeration equipment in the RoM between 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-134a	0.60	1.58	2.35	4.00	11.59	12.31	7.55	8.06	11.23	7.98
R-404a	1.20	1.58	1.88	2.67	6.18	5.81	3.05	3.69	5.10	4.13
R-407c	0.40	0.45	0.47	0.67	2.32	2.05	1.08	1.01	1.22	1.10
R-507a	NO	0.23	0.23	0.33	1.55	2.05	1.80	2.01	3.06	2.06
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
R-134a	10.84	9.13	9.08	7.68	13.85	16.13	17.27	14.71	27.71	45.26
R-404a	6.04	5.14	5.31	4.65	8.43	10.37	11.84	10.72	22.08	37.39
R-407c	1.42	1.14	1.20	1.00	1.93	2.44	2.22	1.89	3.21	4.59
R-507a	3.84	3.65	4.75	4.19	7.83	9.91	11.35	10.30	21.28	36.07

Table 4-114: Cumulative amount of refrigerants charged into commercial refrigeration equipment imported into the RoM between 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-134a	0.60	2.18	4.53	8.53	20.12	32.43	39.98	48.04	59.26	67.24
R-404a	1.20	2.78	4.66	7.33	13.51	19.32	22.38	26.07	31.17	35.30
R-407c	0.40	0.85	1.32	1.99	4.31	6.36	7.44	8.44	9.67	10.77
R-507a	NO	0.23	0.46	0.79	2.34	4.39	6.19	8.20	11.26	13.33
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
R-134a	78.08	87.21	95.70	101.79	113.30	125.43	131.10	133.50	153.66	190.86
R-404a	41.34	46.48	50.59	53.66	60.22	67.92	73.58	78.48	97.51	131.20
R-407c	12.19	13.33	14.13	14.68	16.14	17.92	17.82	17.66	19.79	23.38
R-507a	17.16	20.82	25.57	29.76	37.35	46.93	56.73	64.97	84.46	118.52

Activity data on the total amount of refrigerants imported into the country (Table 4-115) were provided through reports submitted by economic agents presented annually to the National Montreal Protocol Unit under the P.I. 'EPNIO'.

However, this information is aggregated for the entire country, the amount used for servicing commercial refrigeration equipment being unspecified.

In order to identify this information, it is has been inferred that circa 16.8% of the total amount of freon charged into commercial refrigeration equipment (a value identifies by enquiring active economic agents in the field in this sector), taking into account that circa 6% (margin used by default: between 2% and 10%) of the total amount of imported refrigerants for servicing refrigeration equipment is lost through fugitive emissions during the management of containers charged with freon.

Table 4-115: AD on imported refrigerants for servicing commercial refrigeration equipment into the Republic of Moldova between 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-134a	0.11	0.39	0.81	1.52	3.58	5.78	7.12	8.55	10.55	11.97
R-404a	0.21	0.50	0.83	1.30	2.41	3.44	3.99	4.64	5.55	6.29
R-407c	0.07	0.15	0.24	0.35	0.77	1.13	1.32	1.50	1.72	1.92
R-507a	NO	0.04	0.08	0.14	0.42	0.78	1.10	1.46	2.01	2.37
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
R-134a	13.90	15.53	17.04	18.13	20.18	22.34	23.35	23.77	27.36	33.99
R-404a	7.36	8.28	9.01	9.56	10.72	12.10	13.10	13.98	17.36	23.36
R-407c	2.17	2.37	2.52	2.61	2.87	3.19	3.17	3.14	3.52	4.16
R-507a	3.06	3.71	4.55	5.30	6.65	8.36	10.10	11.57	15.04	21.11

III) Industrial Refrigeration

Activity data used in the estimation of emissions from HFCs incorporated in industrial refrigeration equipment (Table 4-116) was identified after enquiring economic agents who operate the industrial refrigeration sector in February-March, 2022, and after consulting the web-page of the former Ministry of Agriculture, Regional Development and Environment, and the web-page of the Agency of Intervention and Payments in Agriculture (AIPA), as well as Analytical Reports for 2012-2022 on the management of financial resources allocated to the National Fund for the Development of Agriculture and Rural Environment.

Table 4-116: AD on the use of industrial refrigeration equipment in the RoM between 1995-2022

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Agro-industrial refrigerated warehouses	205	207	208	209	210	211	212	213	214	215	216	217	221	222
Enterprises in the milk processing industry with industrial refrigeration equipment	23	23	23	23	23	23	23	23	23	23	23	23	23	23
Enterprises in the meat and sausage processing industry with industrial refrigeration equipment	76	76	76	76	76	76	76	76	76	76	76	76	76	76
Enterprises in the wine industry with industrial refrigeration equipment	196	196	196	196	196	196	196	196	196	196	192	188	184	180
Total enterprises that own industrial refrigerators	500	502	503	504	505	506	507	508	509	510	507	504	504	501
Amount of refrigerant charged into industrial refrigeration equipment, t	50.0	50.2	50.3	50.4	50.5	50.6	50.7	50.8	50.9	51.0	50.7	50.4	50.4	50.1
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Agro-industrial refrigerated warehouses	226	227	228	229	278	323	405	525	532	626	755	1,008	1,131	1,238
Enterprises in the milk processing industry with industrial refrigeration equipment	23	23	23	20	20	20	20	20	20	20	20	20	20	20
Enterprises in the meat and sausage processing industry with industrial refrigeration equipment	76	76	76	76	76	76	76	76	76	76	76	76	76	76
Enterprises in the wine industry with industrial refrigeration equipment	176	172	168	164	160	156	152	148	144	140	140	140	140	140
Total enterprises that own industrial refrigerators	501	498	495	489	534	575	653	769	772	862	991	1,244	1,367	1,474
Amount of refrigerant charged into industrial refrigeration equipment, t	50.1	49.8	49.5	48.9	49.1	51.8	58.8	69.2	69.5	77.6	89.2	112.0	123.0	132.7

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova, Ministry of Agriculture and Food Industry.

The share of refrigerants charged into industrial refrigeration equipment in the Republic of Moldova varied from one year to another (Table 4-117). The information on the share of refrigerants charged into refrigeration equipment imported into the country (Table 4-100), the share of refrigerants charged into industrial refrigeration equipment imported into the country between 1995 and 2022 (Table 4-117) and activity data on the charge of refrigerant in industrial equipment with (Table 4-116) were used to estimate the total amount of freon by type of refrigerant used within the industrial refrigeration equipment (Table 4-118) and the cumulative amount of refrigerants used in industrial refrigeration equipment in the Republic of Moldova (Table 4-119).

Table 4-117: Share of refrigerants charged into industrial refrigeration equipment imported into the Republic of Moldova between 1995-2022, %

	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Industrial refrigeration equipment	R-134a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	0.5	0.5	0.5	0.5	0.5
	R-404a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.5	2.5	2.5	3.0	5.0
	R-407c	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.5	1.0	1.0	1.0
	R-410a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	R-507a	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.5	2.0	2.5	3.0	3.5
	R-22	0.0	0.0	0.0	0.0	0.0	5.0	10.0	20.0	37.5	46.5	49.5	53.5	62.5	62.0
	R-422d	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	R-290	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	R-717	100.0	100.0	100.0	100.0	100.0	95.0	90.0	80.0	60.0	50.0	45.0	40.0	30.0	28.0
	Refrigerant	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Industrial refrigeration equipment	R-134a	0.5	0.5	0.5	0.5	0.5	0.5	0.5	1.0	1.0	1.0	1.0	1.0	1.0	1.0
	R-404a	7.0	9.0	11.5	13.0	14.0	15.0	16.0	17.0	18.0	19.0	20.0	21.0	22.5	24.0
	R-407c	1.0	1.5	1.5	2.0	2.5	2.5	3.0	3.0	4.0	5.0	7.0	8.0	9.0	10.0
	R-410a	0.0	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
	R-507a	4.0	4.5	5.0	5.5	6.0	7.0	12.5	17.0	18.0	20.0	22.0	23.5	24.0	24.5
	R-22	60.5	58.0	56.0	53.5	51.5	49.5	45.5	38.0	36.0	31.0	27.0	24.0	20.5	18.0
	R-422d	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.5	2.5	3.5	4.5	5.0	5.5	6.0
	R-290	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	R-717	27.0	26.0	25.0	25.0	25.0	25.0	22.0	22.0	20.0	20.0	18.0	17.0	17.0	16.0

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

Table 4-118: AD on the amount of refrigerants charged into industrial refrigeration equipment in the Republic of Moldova between 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-134a	0.25	0.26	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.24
R-404a	0.51	0.77	1.27	1.26	1.51	2.51	3.51	4.48	5.69	6.36
R-407c	NO	NO	0.25	0.50	0.50	0.50	0.50	0.75	0.74	0.98
R-410a	NO	NO	NO	NO	NO	NO	NO	0.25	0.25	0.24
R-422d	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-507a	0.51	0.77	1.01	1.26	1.51	1.75	2.00	2.24	2.48	2.69
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
R-134a	0.25	0.26	0.29	0.69	0.69	0.78	0.89	1.12	1.23	1.33
R-404a	6.88	7.76	9.40	11.77	12.51	14.74	17.84	23.51	27.68	31.84
R-407c	1.23	1.29	1.76	2.08	2.78	3.88	6.24	8.96	11.07	13.27
R-410a	0.25	0.26	0.29	0.35	0.35	0.39	0.45	0.56	0.62	0.66
R-422d	NO	NO	NO	1.04	1.74	2.72	4.01	5.60	6.77	7.96
R-507a	2.95	3.62	7.35	11.77	12.51	15.52	19.62	26.31	29.53	32.50

Table 4-119: Cumulative amount of refrigerants charged into industrial refrigeration equipment in the Republic of Moldova between 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-134a	0.25	0.51	0.76	1.02	1.27	1.52	1.77	2.02	2.26	2.51
R-404a	0.51	1.27	2.54	3.80	5.31	7.82	11.33	15.81	21.50	27.86
R-407c	NO	NO	0.25	0.76	1.26	1.76	2.26	3.01	3.75	4.73
R-410a	NO	NO	NO	NO	NO	NO	NO	0.25	0.50	0.74
R-422d	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-507a	0.51	1.27	2.29	3.55	5.06	6.81	8.82	11.06	13.53	16.22

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
R-134a	2.75	3.01	3.31	4.00	4.69	5.47	6.36	7.48	8.71	10.04
R-404a	34.73	42.50	51.90	63.67	76.17	90.91	108.75	132.26	159.94	191.78
R-407c	5.96	7.25	9.02	11.09	13.87	17.75	23.99	32.95	44.02	57.29
R-410a	0.99	1.25	1.54	1.89	2.23	2.62	3.07	3.63	4.24	4.90
R-422d	NO	NO	NO	1.04	2.78	5.49	9.50	15.10	21.87	29.83
R-507a	19.17	22.79	30.14	41.91	54.41	69.93	89.55	115.86	145.39	177.89

Activity data on the total amount of freon imported into the country for servicing industrial refrigeration equipment (Table 4-120) were provided through reports submitted by economic agents presented periodically to the National Montreal Protocol Unit under the P.I. 'EPNIO'.

Table 4-120: AD on imported refrigerants for servicing industrial refrigeration equipment into the Republic of Moldova between 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-134a	0.04	0.09	0.13	0.17	0.21	0.26	0.30	0.34	0.38	0.43
R-404a	0.09	0.22	0.43	0.64	0.90	1.33	1.92	2.68	3.65	4.72
R-407c	NO	NO	0.04	0.13	0.21	0.30	0.38	0.51	0.64	0.80
R-410a	NO	NO	0.00	NO	NO	NO	NO	0.04	0.08	0.13
R-422d	NO	NO	0.00	NO	NO	NO	NO	NO	NO	NO
R-507c	0.09	0.22	0.39	0.60	0.86	1.16	1.50	1.88	2.30	2.75
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
R-134a	0.47	0.51	0.56	0.68	0.80	0.93	1.08	1.27	1.48	1.70
R-404a	5.89	7.21	8.80	10.80	12.92	15.42	18.44	22.43	27.13	32.53
R-407c	1.01	1.23	1.53	1.88	2.35	3.01	4.07	5.59	7.47	9.72
R-410a	0.17	0.21	0.26	0.32	0.38	0.44	0.52	0.62	0.72	0.83
R-422d	NO	NO	NO	0.18	0.47	0.93	1.61	2.56	3.71	5.06
R-507c	3.25	3.87	5.11	7.11	9.23	11.86	15.19	19.65	24.66	30.17

However, this information is aggregated for the entire country, the share used for servicing industrial refrigeration equipment being unspecified. In order to identify this information, it has been inferred that, when servicing this equipment, circa 16% of the total amount of refrigerants charged into industrial refrigeration equipment, considering that circa 6% (margin used by default: between 2% and 10%) of the total amount of imported refrigerants is lost through fugitive emissions during the management of containers charged with refrigerants.

IV) Stationary Air Conditioning

AD used in the estimation of HFC emissions from hydrofluorocarbons charged into stationary air conditioning equipment was provided by the Customs Service. Between 1995 and 2022, the imports of this type of equipment increased by circa 27.7 times (Table 4-121).

Table 4-121: AD on imported stationary air conditioning equipment between 1995-2022, units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
AC equipment	2,245	424	1,247	1,177	794	1,654	1,212	2,160	5,767	5,750	7,843	11,284	38,256	36,130
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
AC equipment	8,199	17,429	28,010	25,820	32,545	17,149	12,091	30,889	36,780	44,924	52,702	55,620	58,684	62,094

Source: Customs Service of the RoM, through Letter dated 20.02.2023, response to request of the Environment Agency to No. 08/34/2023 din 28.01.2023; Letter dated 19.02.2021, response to request of the MARDE to No. 13-07/519 din 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, response to request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, response to request of the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, response to request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015 response to request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, response to request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, response to request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011.

The share of refrigerants charged into stationary air conditioning equipment in the Republic of Moldova varied from one year to another (Table 4-122).

Table 4-122: Share of refrigerants charged into stationary air conditioning equipment imported into the Republic of Moldova between 1995-2022, %

	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Air conditioning equipment	R-410a	0	0	0	0	0	0	0	0	30	40	50	60	65	65
	R-22	100	100	100	100	100	100	100	100	70	60	50	40	35	35
	R-32	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	R-290	0	0	0	0	0	0	0	0	0	0	0	0	0	0

	Refrigerant	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Air conditioning equipment	R-410a	70	70	75	75	75	75	70	65	45	35	30	24.5	19.5	14
	R-22	30	30	25	25	25	25	15	0	0	0	0	0	0	0
	R-32	0	0	0	0	0	0	15	35	55	65	70	75	80	85
	R-290	0	0	0	0	0	0	0	0	0	0	0	0.5	0.5	1

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

The information on the share of refrigerants charged into refrigeration equipment imported into the country (Table 4-100), the share of refrigerants charged into stationary air conditioning equipment imported into the country between 1995 and 2022 (Table 4-122), the average charge of equipment with refrigerant (Table 4-104), and based on statistical data on the import of stationary air conditioning equipment (Table 4-121), were used to estimate the total amount of refrigerants imported into the country within the stationary air conditioning equipment (Table 4-123) and the cumulative amount of refrigerants charged into stationary air conditioning equipment imported into the RoM (Table 4-124).

Table 4-123: AD on imported refrigerants charged into stationary air conditioning equipment into the Republic of Moldova between 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-410a	1.73	2.30	3.92	6.77	24.87	23.48	5.74	12.20	21.01	19.37
R-32	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
R-410a	24.41	12.86	8.46	20.08	16.55	15.72	15.81	13.63	11.44	8.69
R-32	NO	NO	1.81	10.81	20.23	29.20	36.89	41.72	46.95	52.78

Table 4-124: Cumulative amount of refrigerants charged into stationary air conditioning equipment imported into the Republic of Moldova between 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-410a	1.73	4.03	7.95	14.72	39.59	63.07	68.81	81.01	102.02	121.39
R-32	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
R-410a	145.79	158.66	167.12	187.20	203.75	219.47	235.28	247.18	254.59	255.33
R-32	NO	NO	1.81	12.62	32.85	62.05	98.95	140.66	187.61	240.39

Activity data on the total amount of refrigerants imported into the country for servicing stationary air conditioning equipment (Table 4-125) was identified through reports submitted by economic agents periodically to the National Montreal Protocol Unit under the P.I. 'EPNIO'.

Table 4-125: AD on imported refrigerants for servicing stationary air conditioning equipment in the RoM between 2003-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-410a	0.09	0.21	0.42	0.78	2.10	3.34	3.65	4.29	5.41	6.43
R-32	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
R-410a	7.73	8.41	8.86	9.92	10.80	11.63	12.47	13.10	13.49	13.53
R-32	NO	NO	0.10	0.67	1.74	3.29	5.24	7.46	9.94	12.74

However, this information is aggregated for the entire country, the amount used for servicing stationary air conditioning equipment being unspecified. In order to identify this information, it has been inferred that, when servicing this equipment, circa 5% of the cumulative amount of freon charged into stationary air conditioning equipment, considering that circa 6% (margin used by default: between 2% and 10%) of the total amount of imported refrigerants is lost through fugitive emissions during management of containers charged with freon.

V) Mobile Air-Conditioning Systems

AD used in the estimation of HFCs emissions from the consumption of hydrofluorocarbons charged into mobile air-conditioning equipment was provided by the NBS (Statistical Yearbooks of the RoM before 2000, and the Bank for Statistical Data after 2000, respectively), as well as by the SOE 'State

Information Resources Centre 'Register' (SOE 'CRIS Register') (for the period 1995-2013), and by the Public Services Agency of the RoM, respectively (for 2014-2022), based on the information included in the State Transport Register.

In order to estimate the amount of HFCs used in mobile air-conditioning equipment, the information on the total number of transportation units registered in the country was considered (Table 4-126 and 4-127), as well as the share of transportation units equipped with air conditioning equipment (Table 4-128).

Table 4-126: Vehicles registered between 1995-2022 (end of calendar year total), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Passenger cars	165,941	173,618	205,973	222,769	232,278	238,380	256,459	268,882	265,841	269,551	292,994	319,311	338,944	366,351
Buses and minibuses	9,181	9,798	11,169	12,917	13,582	12,769	14,703	15,777	15,723	19,741	19,825	21,056	21,095	21,491
Trucks	59,888	57,138	56,924	57,404	52,430	46,351	45,809	46,277	46,905	73,774	81,798	84,087	94,828	115,967
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Passenger cars	386,365	404,290	426,973	456,379	487,418	512,561	529,813	546,781	588,119	616,800	648,780	677,670	716,906	745,970
Buses and minibuses	21,346	21,395	21,349	21,433	21,344	21,359	21,134	20,968	20,944	21,050	21,087	21,014	21,076	21,055
Trucks	120,174	131,243	141,696	151,830	154,163	160,199	164,533	168,618	173,384	179,392	185,669	185,878	190,850	194,523

Source: Statistical Yearbooks of the RM for 1999 (page 390), 2003 (pages 515-516), 2005 (page 407), 2008 (pages 399); Bank for Statistical Data of the RM: <http://statbank.statistica.md/PxWeb/pxweb/ro/40%20Statistica%20economica/40%20Statistica%20economica__19%20TRA__TRA020/TRA020100.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>

Only passenger cars manufactured after 1993 were considered to be equipped with air conditioning equipment (particularly Euro-1, Euro-2, Euro-3, Euro-4, and Euro-5); whereas for trains, it was considered that 100% of these transportation units are equipped with air conditioning equipment.

Table 4-127: Railway transportation vehicles inventoried between 1995-2022 (end of calendar year total), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Diesel locomotives	163	163	162	162	162	162	162	160	159	156	156	154	154	152
Locomotives for manoeuvring	114	100	75	72	50	42	44	48	54	50	56	56	56	53
Diesel trains	29	28	26	26	24	22	22	22	22	18	20	20	20	18
Passengers carriages	463	463	462	462	460	460	440	460	452	452	440	436	416	398
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Diesel locomotives	152	152	150	139	138	138	138	138	134	134	134	146	146	146
Locomotives for manoeuvring	39	39	67	67	67	67	67	67	25	23	30	31	31	31
Diesel trains	15	15	21	21	21	21	21	21	21	21	16	13	13	13
Passengers carriages	423	411	399	399	388	381	381	346	268	263	262	264	212	220

Source: Statistical Yearbooks of the RoM for 1999 (page 390), 2003 (pages 515-516), 2005 (page 407), 2008 (page 399); Bank for Statistical Data of the RoM: <http://statbank.statistica.md/PxWeb/pxweb/ro/40%20Statistica%20economica/40%20Statistica%20economica__19%20TRA__TRA020/TRA020300.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>

Table 4-128: Transportation units equipped with air conditioning equipment in the RoM between 1995-2022 (end of calendar year total), % of total

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Passenger cars	2.9	5.9	8.9	11.9	14.9	17.9	22.1	25.3	27.6	34.7	39.6	43.4	46.2	48.5
Buses and minibuses	2.4	5.4	8.4	11.4	14.4	17.4	20.1	21.8	22.6	28.7	30.8	31.9	33.1	34.0
Trucks	2.9	8.9	14.9	20.9	26.9	32.9	41.8	49.6	56.6	53.4	54.7	55.6	56.4	56.9
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Passenger cars	49.5	50.1	50.9	51.3	51.7	52.1	53.7	55.2	61.6	62.0	62.2	63.9	66.0	67.5
Buses and minibuses	34.2	34.5	34.7	34.9	35.0	35.4	36.1	36.7	38.6	38.9	39.0	39.3	40.2	40.8
Trucks	57.0	57.1	57.2	57.3	57.4	57.4	58.5	59.4	62.8	62.9	63.0	64.2	65.5	66.2

Based on the information on the average freon charge (HFC-134a in proportion of 100%) of air conditioning equipment in mobile sources (Table 4-104) and information on the total number of transportation units equipped with air conditioning systems (Table 4-129) the total amount of HFC-134a charged into mobile air-conditioning equipment in the RoM was estimated (Table 4-130).

Table 4-129: Estimated number of transportation units equipped with air conditioning equipment in the RoM between 1995-2022 (end of year total), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Passenger cars	7,124	15,125	23,768	33,053	42,979	53,547	70,353	85,228	98,502	130,447	161,118	188,223	211,084	231,504
Buses and minibuses	331	777	1,257	1,772	2,322	2,906	3,491	3,922	4,228	5,557	6,139	6,464	6,826	7,112
Trucks	2,077	7,001	12,770	19,383	26,840	35,141	49,535	64,648	80,482	82,163	86,568	89,686	92,632	94,550
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Passenger cars	240,614	246,895	254,433	258,714	263,144	267,042	284,508	301,823	393,086	399,483	403,541	433,031	473,356	503,823
Buses and minibuses	7,177	7,265	7,329	7,402	7,436	7,567	7,637	7,705	8,078	8,186	8,224	8,259	8,463	8,591
Trucks	94,993	95,376	95,788	96,129	96,494	96,603	100,601	104,306	119,620	120,146	120,569	126,346	132,973	136,491

Table 4-130: AD on the cumulative amount of HFC-134a charged into mobile air-conditioning systems registered in the RoM between 1995-2022, t

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
HFC-134a	3.30	5.46	7.85	10.57	13.51	16.74	21.92	27.02	30.34	33.63	38.06	41.72	44.87	47.52
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
HFC-134a	48.64	49.41	50.38	50.92	51.46	79.38	171.94	179.83	219.51	222.13	223.83	237.36	254.90	267.60

In order to estimate the cumulative amount of refrigerants charged into air-conditioning equipment, it was considered that all transportation units are imported and the share of second-hand vehicles is dominant. Under these circumstances, it can be considered that mobile air-conditioning systems were functional (in working condition) in the case of vehicles, and only partially for trucks: between 2003-2014 – 90%, and between 2015-2022 – 95%.

Activity data on the total amount of refrigerants imported into the country for servicing mobile air-conditioning equipment (Table 4-131) was identified through reports submitted annually by economic agents to the National Montreal Protocol Unit under the P.I. 'EPNIO'.

Table 4-131: AD on imported refrigerants for servicing mobile air conditioning systems in the RoM between 1995-2022, t/yr

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
HFC-134a	0.53	0.87	1.25	1.68	2.15	2.66	3.49	4.30	4.82	5.35	6.05	6.63	7.13	7.56
	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
HFC-134a	7.73	7.86	8.01	8.10	8.18	12.62	27.34	28.59	34.90	35.32	35.59	37.74	40.53	42.55

However, this information is aggregated for the entire country, the share used for servicing mobile air-conditioning equipment being unspecified. In order to identify this information, it has been inferred that circa 15% of the cumulative amount of refrigerants charged into mobile air-conditioning equipment is used for servicing this equipment, considering that circa 6% (margin used by default: between 2% and 10%) of the total amount of imported refrigerants used for servicing mobile air-conditioning equipment is lost through fugitive emissions during management of containers charged with refrigerants.

VI) Transport Refrigeration

Equipment used for refrigerated transportation of fresh and frozen food includes: battery-operated aggregates, closed-type aggregates, refrigerators, split-off and monoblock for the transportation of small and medium-sized rooms. The respective equipment and systems use R-404a freon (average charge – 7 kg/unit), specific to refrigerated trucks with a capacity of 20 tonnes and more, and with a capacity of less than 5 tonnes, respectively. AD used in the estimation of HFC emissions from consumption of hydrofluorocarbons charged into transport refrigeration systems was provided by SOE 'State Information Resources Centre 'Register' (SOE 'CRIS Register') (for the period 1995-2013), and by the Public Services Agency of the RoM (for 2014-2022), based on the information included in the State Transport Register.

In order to estimate the amount of R-404a used in transport refrigeration systems, the information on the total number of transportation means used for transport refrigeration of fresh and frozen food was

considered (Table 4-132). According to the information received from the International Association of Car Transporters in the RoM, about 60-65 companies in the country have refrigerators with a capacity of 20 tonnes and more (cooling capacity of about 10 kW per unit), these being predominantly involved in the international transport of goods. Refrigerators with a capacity of up to 5 tonnes (the cooling capacity is circa 5 kw per unit) are used predominantly on the domestic market of transport refrigeration for fresh and frozen food and there is a number of companies such as 'Incomlac', 'Drancor', 'Sandriliona', 'Amir', 'Carmez', 'Basarabia-Nord', 'Rogob', 'Pegas', and others with a truck fleet of circa 10-50 units each.

Table 4-132: Number of refrigerators between 1995-2022 (end of calendar year total), units

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refrigerators ≥ 20 t	897	1,059	1,223	1,386	1,550	1,712	1,886	2,060	2,236	2,410	2,490	2,566	2,686	2,756
Refrigerators 5-20 t	451	454	457	459	462	465	467	469	470	472	473	473	476	476
Refrigerators < 5 t	396	398	399	401	402	404	406	408	409	411	411	415	416	416
Total	**1,744**	**1,911**	**2,079**	**2,246**	**2,414**	**2,581**	**2,759**	**2,937**	**3,115**	**3,293**	**3,374**	**3,454**	**3,578**	**3,648**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Refrigerators ≥ 20 t	2,760	2,791	2,814	2,822	2,828	2,836	2,844	2,798	2,301	2,303	2,303	2,112	1,982	1,925
Refrigerators 5-20 t	476	476	476	476	476	476	480	471	452	452	452	448	443	918
Refrigerators < 5 t	418	418	419	419	419	419	399	411	401	401	401	401	401	2,028
Total	**3,654**	**3,685**	**3,709**	**3,717**	**3,723**	**3,731**	**3,723**	**3,680**	**3,154**	**3,156**	**3,156**	**2,961**	**2,826**	**4,871**

The share of refrigerants used in food transport refrigeration equipment in the RoM varied from one year to another (Table 4-133).

The information on the share of refrigerants used in refrigeration equipment imported into the country (Table 4-100), the share of refrigerants charged into the equipment for refrigerated transport of food for the period 1995-2022 (Table 4-133), the average refrigerant charge of the respective equipment (Table 4-104) and statistical data on the import of refrigerated food transport equipment (Table 4-132) was used to estimate the cumulative amount of R-404a charged into transport refrigeration in the Republic of Moldova (Table 4-134).

Table 4-133: Share of refrigerants charged into food transport refrigeration equipment for the period 1995-2022, %

	Refrigerant	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Refrigerators	R-22	100	100	100	100	100	100	100	100	100	100	100	63.1	60.1	56.7
	R-404a	0	0	0	0	0	0	0	0	0	0	0	36.9	39.9	43.3
	Refrigerant	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Refrigerators	R-22	52.9	49.2	45.5	41.8	38.0	34.2	30.6	26.6	21.9	18.2	11.5	7.1	7.0	4.0
	R-404a	47.1	50.8	54.5	58.2	62.0	65.8	69.4	73.4	78.1	81.8	88.5	92.9	93.0	96.0

Source: Republican Association of Refrigeration Technicians of the Republic of Moldova.

Table 4-134: AD on the cumulative amount of R-404a charged into food transport refrigeration equipment between 1995-2022, t

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-404a	NO	NO	NO	8.91	10.00	11.07	12.05	13.10	14.14	15.15
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
R-404a	16.16	17.18	18.10	18.90	17.25	18.06	19.55	19.25	18.39	32.75

Activity data on the total amount of freon imported into the country for servicing transport refrigeration equipment (Table 4-135) was identified through reports submitted by economic agents annually to the National Montreal Protocol Unit under the P.I. 'EPNIO'.

Table 4-135: AD on freon imported for servicing food transport refrigeration equipment between 1995-2022, t/yr

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
R-404a	NO	NO	NO	1.34	1.50	1.66	1.81	1.96	2.12	2.27
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
R-404a	2.42	2.58	2.71	2.84	2.59	2.71	2.93	2.89	2.76	4.91

However, this information is aggregated for the entire country, the share used for servicing transport refrigeration equipment being unspecified. In order to identify this information, it is admitted that circa 15% of the total amount of freon charged into transport refrigeration equipment is used for servicing this equipment, considering that circa 6% (margin used by default: between 2% and 10%) of the total amount of imported refrigerant is lost through fugitive emissions during the management of containers charged with refrigerants.

VII) Refrigeration and Air Conditioning – Total

Based on the above information regarding the estimates of refrigerants import for servicing refrigeration and air conditioning equipment (domestic, commercial, industrial, transport refrigeration, and stationary and mobile air-conditioning equipment, respectively), the estimated amount of refrigerants imported into the RoM for the period 1995-2022 was calculated (Table 4-136).

Table 4-136: Estimated imported refrigerants for servicing refrigerant and air conditioning equipment between 1995-2022, t

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
R-32	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-134a	0.53	0.87	1.25	1.68	2.15	2.66	3.49	4.30	4.98	5.84	7.03	8.40	11.05	13.74
R-404a	NO	NO	NO	NO	NO	NO	NO	NO	0.30	0.71	1.26	3.37	4.91	6.54
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	0.07	0.15	0.28	0.48	0.98	1.43
R-410a	NO	NO	NO	NO	NO	NO	NO	NO	0.09	0.21	0.42	0.78	2.10	3.34
R-422d	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-507a	NO	NO	NO	NO	NO	NO	NO	NO	0.09	0.26	0.47	0.74	1.27	1.94
TOTAL	**0.53**	**0.87**	**1.25**	**1.68**	**2.15**	**2.66**	**3.49**	**4.30**	**5.53**	**7.18**	**9.46**	**13.77**	**20.32**	**27.00**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
R-32	NO	NO	NO	NO	NO	NO	0.10	0.67	1.74	3.29	5.24	7.46	9.94	12.74
R-134a	15.34	16.96	19.18	20.75	22.82	28.94	45.22	47.68	56.16	58.86	60.29	63.04	69.61	78.44
R-404a	7.84	9.43	11.48	13.46	15.87	18.27	20.75	23.43	26.47	30.50	34.80	39.67	47.66	61.35
R-407c	1.71	2.01	2.36	2.72	3.18	3.60	4.05	4.50	5.23	6.20	7.24	8.73	10.99	13.88
R-410a	3.65	4.34	5.49	6.56	7.89	8.62	9.12	10.24	11.18	12.08	12.99	13.72	14.21	14.36
R-422d	NO	NO	NO	NO	NO	NO	NO	0.18	0.47	0.93	1.61	2.56	3.71	5.06
R-507a	2.60	3.34	4.30	5.12	6.31	7.57	9.67	12.41	15.88	20.22	25.29	31.22	39.70	51.28
TOTAL	**31.13**	**36.08**	**42.81**	**48.61**	**56.07**	**67.00**	**88.90**	**99.10**	**117.13**	**132.07**	**147.47**	**166.40**	**195.82**	**237.11**

Between 2009 and 2022, periodical enquiries were submitted to economic agents with a license for import, export, re-export, transit and circulation of ozone layer depleting substances (ODS) and ODS equipment. The number of these companies was relatively low and varied insignificantly during the period under review. The National Montreal Protocol Unit under the P.I. 'EPNIO' of the MoEnv has information on freon imported into the country between 2003 and 2020, but due to the few responses to these enquiries from economic agents (Coral Ltd. reported information for the period 2004-2005, 'Ecolux' Ltd. – for 2003-2022, 'Frio-Dins' Ltd. – for 2010-2022, 'Frigoinds' Ltd. – for 2003-2022, 'Frig Industrial' Ltd. – for 2019-2022, 'York Refrigerent' Ltd. – for 2011-2022, CS Dina-Cociug Ltd. – for 2013-2022) this information is considered incomplete.

For the past nine years (2013-2022), available information is considered more complete, including the fact that starting with 01.01.2013, the MoEnv established the procedure for granting the import, export and re-export authorizations for chemical ODS and for the equipment and products charged with such substances. The respective companies report annually to the National Montreal Protocol Unit under the P.I. "EPNIO", including information on the following indicators: stock at the beginning of the year, imports during the reporting year, the amount of substances purchased within the country during the reporting year, the amount sold and used during the reporting year and the stock at the end of the year.

Below, for comparison, AD on actual freon imported for refrigeration and air conditioning servicing in the RM is presented for the period 1995-2022 (Table 4-137). As it can be seen from the information presented above, the differences between the total amount of the main types of refrigerants actually imported into the RoM between 2003 and 2022 (as previously explained, as the information was collected through enquiries, there is no certainty that the data is complete) (Table 4-137) and those cal-

culated for the same period following the estimation methodology available in the 2006 IPCC Guidelines (Table 4-136) are relatively insignificant.

Table 4-137: Amount of main types of refrigerants actually imported into the RoM between 1995-2022, t

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
R-32	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-134a	0.11	0.17	0.27	0.41	0.63	0.97	1.49	2.29	3.53	2.66	2.45	2.34	4.38	9.79
R-404a	NO	NO	NO	NO	NO	NO	NO	NO	0.45	1.11	2.29	2.51	2.85	7.19
R-407c	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.29	1.45	0.52	0.45	1.24
R-410a	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	0.00	0.45	0.00	0.45
R-422d	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
R-507a	NO	NO	NO	NO	NO	NO	NO	NO	0.06	3.60	1.60	0.88	0.41	6.11
TOTAL	**0.11**	**0.17**	**0.27**	**0.41**	**0.63**	**0.97**	**1.49**	**2.29**	**4.04**	**7.67**	**7.79**	**6.70**	**8.08**	**24.80**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
R-32	NO	NO	NO	NO	NO	0.09	0.00	0.00	0.59	1.50	3.19	8.51	1.63	26.02
R-134a	3.54	15.36	12.04	9.02	65.59	49.96	36.30	32.01	27.61	125.32	62.36	65.75	77.14	58.22
R-404a	4.36	1.64	15.58	5.78	12.62	21.28	29.65	18.53	18.57	44.84	44.21	30.52	27.75	86.40
R-407c	3.05	0.00	2.03	2.26	1.47	2.15	2.99	3.75	9.27	20.11	8.76	8.14	8.20	3.71
R-410a	2.60	0.57	1.13	1.13	5.42	3.39	4.52	7.51	7.39	41.80	12.61	11.02	12.10	29.05
R-422d	NO	NO	NO	NO	NO	NO	NO	NO	4.80	2.36	5.85	1.23	0.00	0.57
R-507a	2.94	0.00	3.97	2.71	7.67	6.72	18.59	16.78	37.91	38.53	13.38	20.13	11.52	45.99
TOTAL	**16.48**	**17.56**	**34.76**	**20.90**	**92.78**	**83.58**	**92.05**	**78.58**	**106.13**	**274.47**	**150.36**	**145.31**	**138.34**	**249.95**

2F2. Foam Blowing Agents

HFC emissions from expanded foam consumption (particularly closed-cell foams) used in insulation, cushioning and packaging, with blowing agents such as HFC-245fa, HFC-365mfc, HFC-134a and HFC-152a, were estimated using the Tier 2 methodological approach.

The IPCC 2006 Guidelines suggests that HFC emissions from closed-cell foams should be calculated separately from open-cell foams.

Hydrofluorocarbons used in the production of expanded foams with open cells are emitted into the atmosphere instantly, all emissions being generated during their production. Since no open-cell foams are produced in the Republic of Moldova, no emissions are recorded from this category, respectively.

Emissions from closed-cell foam occur at three distinct phases:

1) First year losses from foam manufacture and application, these emissions occur where the product is manufactured and applied;
2) Annual losses (in situ losses from foam use); closed-cells foam will lose a fraction of their initial charge each year until decommissioning;
3) Decommissioning losses: emissions upon decommissioning also occur where the product is used.

Emissions from closed-cell foam were estimated following Equation 7.7 in the 2006 IPCC Guidelines (Volume 3, Chapter 7.4, page 7.38).

$$Emissions_t = M_t \bullet EF_{FYL} + Bank \bullet EF_{AL} + DL_t - RD_t$$

Where:

$Emissions_t$ – emissions from closed-cell foam in year *t*, tonnes;

M_t – total HFC used in manufacturing new closed-cell foam in year *t*, tonnes;

EF_{FYL} – first year loss emission factor, fraction (%);

$Bank_t$ – HFC charge blown into closed-cell foam manufacturing between year *t* and *year t-n*, tonnes;

EF_{AL} – annual loss emission factor, fraction (%);

DL_t – decommissioning losses in year *t* at the end of the period of exploitation of the production from closed-cell expanded foams, tonnes;

RD_t – HFC emissions prevented by recovery and destruction of foams and their blowing agents in year *t*, tonnes;

n – product lifetime of closed-cell foam;

t – Current year;

(t-n) – The total period over which HFCs used in foams could still be present.

This equation is applied to each type of expanded foam product. Total emissions expressed in CO_2 equivalent represent the cumulative sum of emissions from each type of foam blowing product used. Default emission factors are recommended should country-specific data not be available (Table 4-138).

Table 4-138: Default emission factors for source category 2F2 'Foam Blowing Agents'

Emission factor	Default value
Product lifetime of closed-cell foam	n = 20 years
First Year Losses	10% of the original HFC charge/year
Annual Losses	4.5% of the original HFC charge/year

Source: 2006 IPCC Guidelines, Volume 3, Chapter 7.4, Table 7.5, page 7.35.

In the Republic of Moldova, foam blowing production has been recorded since 2005. AD on the production of expanded polystyrene is available in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type' (Table 4-139).

Table 4-139: Production of foam blowing products between 2005-2022, kt

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Polystyrene in primary forms	0.21	0.35	0.34	0.16	0.15	0.10	0.09	0.14	0.07
Alveolar plates, sheets, and blades made of styrene polymers	0.25	0.71	0.80	0.56	1.58	1.88	2.17	2.01	2.12
Polyurethane in primary forms	0.49	0.38	0.15	0.53	0.89	0.83	0.68	0.37	0.28
Alveolar plates, sheets, and blades made of polyurethane	NO	NO	NO	NO	NO	NO	NO	0.002	0.206
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Polystyrene in primary forms	0.06	0.04	NO	NO	NO	NO	NO	NO	NO
Alveolar plates, sheets, and blades made of styrene polymers	2.47	2.81	2.47	2.05	2.04	1.92	2.30	2.08	1.74
Polyurethane in primary forms	NO	NO	NO	NO	NO	NO	NO	NO	NO
Alveolar plates, sheets, and blades made of polyurethane	0.343	NO	NO	NO	NO	NO	NO	NO	NO

Source: Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022.

It is unknown which blowing agents are used in the production of foam blowing products, but since the production is relatively recent, it was considered that expanded polystyrene products are ethanol- and CO_2-based, whereas the expanded polyurethane products are pentane-based (C,I,N).

AD on imported foam blowing products imported were provided by the Customs Service (Table 4-140).

Table 4-140: Import of foam blowing products between 1995-2022, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Polystyrene in primary forms, kt (product code: 3903 11)	0.55	0.22	0.16	0.17	0.17	0.40	0.29	0.50	0.89	0.90	1.82	2.48	2.75	3.02
Alveolar products of polystyrene, kt (product code: 3921 11)	0.02	0.01	0.05	0.05	0.02	0.01	0.10	0.25	0.40	0.49	0.61	0.61	0.60	0.71
Polyurethane in primary forms, kt (product code: 3909 50)	0.22	0.14	0.07	0.03	0.04	0.04	0.02	0.01	0.07	0.18	0.36	0.31	0.54	0.77
Alveolar products of polyurethane, kt (product code: 3921 13)	0.14	0.15	0.11	0.09	0.11	0.15	0.20	0.42	0.53	0.57	0.68	1.01	1.53	1.25
Total foam blowing products, kt	**0.92**	**0.52**	**0.38**	**0.33**	**0.34**	**0.60**	**0.62**	**1.19**	**1.89**	**2.14**	**3.47**	**4.40**	**5.41**	**5.75**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Polystyrene in primary forms, kt (product code: 3903 11)	2.53	3.10	3.14	3.30	3.30	3.64	3.95	3.66	3.59	3.62	4.42	4.18	4.54	4.24
Alveolar products of polystyrene, kt (product code: 3921 11)	0.63	0.64	0.54	0.69	0.72	0.85	1.04	1.29	1.26	1.35	1.55	1.84	2.10	1.30
Polyurethane in primary forms, kt (product code: 3909 50)	0.60	0.68	0.70	0.36	0.16	0.16	1.07	0.13	0.25	0.36	0.36	0.32	0.51	0.49
Alveolar products of polyurethane, kt (product code: 3921 13)	0.65	0.86	0.83	0.85	0.94	0.81	0.91	0.82	0.96	1.11	1.07	1.09	1.45	0.75
Total foam blowing products, kt	**4.40**	**5.28**	**5.22**	**5.20**	**5.12**	**5.47**	**6.97**	**5.90**	**6.06**	**6.44**	**7.39**	**7.44**	**8.60**	**6.78**

Source: Customs Service of the RoM, through Letter dated 20.02.2023, response to the interpellation of the Environment Agency to No. 08/34/2023 dated 28.01.2023; through Letter dated 19.02.2021, as a response to the interpellation of the MARDE to No. 13-07/519 dated 09.02.2021; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011

The most frequently used blowing agents in polyurethane and polystyrene foam manufacturing can be considered HFC-134a, HFC-152a, HFC-245fa, HFC-365mfc, Pentane (C,I,N) and CO_2/ethanol.

Since the share of blowing agents in foam products in total imports is unknown, it has been determined considering expert opinions (Table 4-141 and Table 4-142), especially the European and international experience regarding HFC emissions inventory process within the respective category, as well as the recent trend aimed at reducing the use of HFCs as blowing agents, following the international commitments to phasing out F-gas consumption, especially when there already are competitive alternative technologies on the foam blowing market[73],[74].

Table 4-141: Share of blowing agents used in expanded polyurethane production imported into the RM between 1995-2022, %

	Blowing agent	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Expanded polyurethane	HCFC-22	50	50	50	50	50	50	45	45	45	40	30	25	20	15
	HCFC-141b	45	45	45	40	40	40	40	40	40	40	30	30	25	15
	HFC-134a	5	5	5	10	10	10	15	15	15	20	20	20	25	20
	HFC-365mfc	0	0	0	0	0	0	0	0	0	0	5	5	5	10
	HFC-245fa	0	0	0	0	0	0	0	0	0	0	5	5	5	10
	Pentane (C,I,N)	0	0	0	0	0	0	0	0	0	0	10	15	20	30
	Blowing agent	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Expanded polyurethane	HCFC-22	5	0	0	0	0	0	0	0	0	0	0	0	0	0
	HCFC-141b	5	0	0	0	0	0	0	0	0	0	0	0	0	0
	HFC-134a	20	15	15	10	10	5	5	0	0	0	0	0	0	0
	HFC-365mfc	15	15	15	15	10	10	10	10	10	5	5	0	0	0
	HFC-245fa	15	15	15	15	15	20	25	15	15	10	5	0	0	0
	Pentane (C,I,N)	40	55	55	60	65	65	60	75	75	85	90	100	100	100

The volume of blowing agents in foam products imported into the RoM was identified based on the information available in the literature in the field, with the assumption that for the polyurethane products HCFC-22, HCFC-141b and HFC-134a have a volume of circa 6% of the total mass of the product[75], HFC-365mfc – 9%, HFC-254fa – 10%, and Pentane (C,I,N) – 7.5%; as for the polystyrene products HFC-134a – it has as a volume of circa 13% of the total mass of the product, HFC-152a – 8%, HCFC-22 and HFCF-142b – 12%, and CO_2 + ethanol – 6% of the total mass[76].

Table 4-142: Share of blowing agents used in expanded polystyrene production imported into the RoM between 1995-2022, %

	Blowing agent	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Expanded polystyrene	HCFC-22	50	50	50	45	45	40	35	35	35	30	25	20	15	10
	HCFC-142b	45	45	45	45	45	45	45	45	40	40	35	30	25	20
	HFC-134a	5	5	5	10	10	10	15	15	15	20	20	20	25	25
	HFC-152a	0	0	0	0	0	5	5	5	10	10	10	15	15	20
	CO_2/ethanol	0	0	0	0	0	0	0	0	0	0	10	15	20	25
	Blowing agent	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Expanded polystyrene	HCFC-22	5	0	0	0	0	0	0	0	0	0	0	0	0	0
	HCFC-142b	10	0	0	0	0	0	0	0	0	0	0	0	0	0
	HFC-134a	25	20	15	10	10	5	5	0	0	0	0	0	0	0
	HFC-152a	25	30	30	30	25	25	20	15	10	10	5	5	0	0
	CO_2/ethanol	35	50	55	60	65	70	75	85	90	90	95	95	100	100

Considering the AD provided in Table 4-140 as well as the share of different blowing agents used in expanded polyurethane and polystyrene production imported into the RoM between 1995 and 2022 (Tables 4-141 and 4-142), and considering the volume of blowing agents in foams, respectively, the

[73] Natural Foam Blowing Agents, Sustainable Ozone- and Climate-Friendly Alternatives to HCFCs (2012), PROKLIMA International Programme of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, commissioned by the Federal Ministry for Economic Cooperation and Development (BMZ) Environment and Sustainable Use of Natural Resources Division. Eschborn, September 2012, page 178.

[74] Danish Ministry of the Environment, Environment Protection Agency (2010), Greenhouse Gases HFCs, PFCs and SF6, Danish Consumption and Emissions, 2008, Environmental Project No. 1323 2010, <http://www2.mst.dk/udgiv/publications/2010/978-87-92617-66-8/pdf/978-87-92617-67-5.pdf>.

[75] EMEP/EEA Emission Inventory Guidebook 2009, Category 3.C, Chemical products', 3.3.2.2 'Polyurethane foam processing' and Chapter 3.3.2.3 'Polystyrene processing', page 17.

[76] Natural Foam Blowing Agents, Sustainable Ozone- and Climate-Friendly Alternatives to HCFCs (2012), PROKLIMA International Programme of the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, commissioned by the Federal Ministry for Economic Cooperation and Development (BMZ) Environment and Sustainable Use of Natural Resources Division. Eschborn, September 2012. page 178.

share of blowing agents contained in polyurethane products (Table 4-143) and polystyrene products (Table 4-143) imported into the country was estimated for the period 1995-2022.

Table 4-143: AD on blowing agents charged into polyurethane products imported into the Republic of Moldova between 1995-2022, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
HCFC-22	0.010	0.008	0.005	0.003	0.004	0.005	0.005	0.011	0.014	0.016	0.017	0.018	0.022	0.016
HCFC-141b	0.009	0.007	0.004	0.003	0.003	0.004	0.005	0.009	0.013	0.016	0.017	0.021	0.028	0.016
HFC-134a	0.001	0.001	0.000	0.001	0.001	0.001	0.002	0.004	0.005	0.008	0.011	0.014	0.028	0.022
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.004	0.005	0.008	0.016
HFC-245fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.005	0.006	0.009	0.018
Pentane (C,I,N)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.007	0.013	0.028	0.041
Total	**0.019**	**0.015**	**0.010**	**0.006**	**0.008**	**0.010**	**0.012**	**0.024**	**0.032**	**0.041**	**0.061**	**0.078**	**0.124**	**0.130**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
HCFC-22	0.003	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HCFC-141b	0.003	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	0.013	0.013	0.012	0.007	0.006	0.003	0.005	NO	NO	NO	NO	NO	NO	NO
HFC-365mfc	0.015	0.019	0.019	0.015	0.009	0.008	0.016	0.008	0.010	0.006	0.006	NO	NO	NO
HFC-245fa	0.017	0.021	0.021	0.016	0.015	0.018	0.045	0.013	0.016	0.013	0.006	NO	NO	NO
Pentane (C,I,N)	0.034	0.057	0.057	0.049	0.049	0.043	0.080	0.048	0.061	0.084	0.086	0.095	0.132	0.084
Total	**0.086**	**0.109**	**0.109**	**0.087**	**0.078**	**0.071**	**0.146**	**0.069**	**0.087**	**0.103**	**0.099**	**0.095**	**0.132**	**0.084**

Table 4-144: AD on blowing agents charged into polystyrene products imported into the Republic of Moldova between 1995-2022, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
HCFC-22	0.031	0.012	0.011	0.011	0.009	0.018	0.015	0.028	0.049	0.045	0.065	0.067	0.054	0.040
HCFC-142b	0.028	0.011	0.010	0.011	0.009	0.020	0.019	0.036	0.056	0.060	0.092	0.100	0.090	0.081
HFC-134a	0.003	0.001	0.001	0.003	0.002	0.005	0.007	0.013	0.023	0.032	0.057	0.072	0.098	0.109
HFC-152a	NO	NO	NO	NO	NO	0.001	0.001	0.003	0.009	0.010	0.017	0.033	0.036	0.054
CO_2+ethanol	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.013	0.025	0.036	0.050
Total	**0.062**	**0.025**	**0.022**	**0.024**	**0.020**	**0.044**	**0.042**	**0.081**	**0.136**	**0.147**	**0.244**	**0.297**	**0.315**	**0.334**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
HCFC-22	0.017	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HCFC-142b	0.034	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
HFC-134a	0.092	0.087	0.065	0.047	0.047	0.026	0.029	NO	NO	NO	NO	NO	NO	NO
HFC-152a	0.057	0.081	0.080	0.086	0.072	0.081	0.072	0.053	0.035	0.036	0.021	0.022	NO	NO
CO_2+ethanol	0.060	0.101	0.109	0.129	0.141	0.170	0.202	0.227	0.236	0.242	0.306	0.309	0.359	0.299
Total	**0.260**	**0.269**	**0.253**	**0.262**	**0.260**	**0.277**	**0.303**	**0.281**	**0.271**	**0.277**	**0.328**	**0.331**	**0.359**	**0.299**

Activity data on the cumulative amount of blowing agents charged into foam blowing products imported between 1995 and 2022 is presented below (Tables 4-145 and 4-146).

Table 4-145: AD on the cumulative amount (bank) of blowing agents charged into polyurethane products imported into the RoM between 1995-2022, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
HCFC-22	0.010	0.017	0.022	0.025	0.029	0.034	0.040	0.051	0.065	0.081	0.098	0.116	0.138	0.155
HCFC-141b	0.009	0.016	0.020	0.022	0.026	0.030	0.035	0.044	0.057	0.073	0.090	0.111	0.139	0.156
HFC-134a	0.001	0.002	0.002	0.003	0.004	0.005	0.006	0.010	0.015	0.023	0.034	0.048	0.076	0.098
HFC-365mfc	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.004	0.010	0.018	0.034
HFC-245fa	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.005	0.011	0.020	0.038
Pentane (C,I,N)	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.007	0.020	0.048	0.089
Total	**0.019**	**0.034**	**0.044**	**0.050**	**0.059**	**0.069**	**0.081**	**0.105**	**0.137**	**0.178**	**0.239**	**0.316**	**0.440**	**0.570**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
HCFC-22	0.158	0.158	0.158	0.158	0.158	0.158	0.148	0.141	0.136	0.133	0.129	0.124	0.118	0.107
HCFC-141b	0.159	0.159	0.159	0.159	0.159	0.159	0.150	0.144	0.139	0.137	0.133	0.129	0.124	0.115
HFC-134a	0.112	0.124	0.137	0.143	0.149	0.152	0.156	0.155	0.155	0.154	0.153	0.152	0.151	0.147
HFC-365mfc	0.049	0.068	0.087	0.102	0.110	0.118	0.134	0.142	0.152	0.158	0.164	0.164	0.164	0.164
HFC-245fa	0.055	0.076	0.096	0.113	0.128	0.145	0.190	0.203	0.219	0.232	0.239	0.239	0.239	0.239
Pentane (C,I,N)	0.123	0.180	0.237	0.286	0.335	0.378	0.458	0.506	0.567	0.651	0.738	0.833	0.965	1.049
Total	**0.656**	**0.765**	**0.874**	**0.961**	**1.039**	**1.110**	**1.237**	**1.290**	**1.368**	**1.465**	**1.555**	**1.640**	**1.760**	**1.821**

Table 4-146: AD on the cumulative amount (bank) of blowing agents charged into polystyrene products imported into the RoM between 1995-2022, kt

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
HCFC-22	0.031	0.043	0.054	0.065	0.074	0.092	0.107	0.135	0.184	0.229	0.294	0.361	0.415	0.455
HCFC-142b	0.028	0.039	0.049	0.060	0.069	0.089	0.108	0.144	0.200	0.260	0.351	0.451	0.542	0.622
HFC-134a	0.003	0.005	0.006	0.008	0.011	0.015	0.022	0.035	0.058	0.091	0.147	0.219	0.317	0.426
HFC-152a	NO	NO	NO	NO	NO	0.001	0.003	0.006	0.015	0.025	0.042	0.076	0.112	0.166
CO_2+ethanol	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.013	0.038	0.074	0.125
Total	**0.062**	**0.087**	**0.109**	**0.133**	**0.153**	**0.197**	**0.239**	**0.320**	**0.456**	**0.604**	**0.848**	**1.145**	**1.460**	**1.794**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
HCFC-22	0.472	0.472	0.472	0.472	0.472	0.472	0.441	0.429	0.418	0.407	0.398	0.380	0.366	0.337
HCFC-142b	0.656	0.656	0.656	0.656	0.656	0.656	0.628	0.617	0.607	0.597	0.588	0.568	0.549	0.512
HFC-134a	0.519	0.606	0.671	0.717	0.764	0.791	0.816	0.815	0.814	0.811	0.809	0.804	0.798	0.784
HFC-152a	0.222	0.303	0.382	0.469	0.541	0.622	0.694	0.747	0.782	0.818	0.839	0.861	0.861	0.861
CO_2+ethanol	0.184	0.285	0.394	0.524	0.664	0.834	1.036	1.264	1.499	1.741	2.047	2.356	2.715	3.014
Total	**2.054**	**2.323**	**2.576**	**2.838**	**3.098**	**3.375**	**3.616**	**3.872**	**4.120**	**4.374**	**4.681**	**4.969**	**5.287**	**5.509**

2F3. Fire Protection

HFC emissions from fire protection were calculated using the Tier 1 methodology, based on a default emission factor. The respective emissions were estimated using Equation 7.17 in the 2006 IPCC Guidelines (Volume 3, Chapter 7.6, page 7.61).

$$Emissions_t = Bank_t \bullet EF + RRL_t$$

$$Bank_t = \Sigma_{i\text{-}t0} (Production_t + Import_t - Export_t - Destruction_t - Emissions_t) - RRL_t$$

Where:

Emissions $_t$ – emissions of agent from fire protection equipment in year *t*, tonnes;

Bank $_t$ – bank of agent in fire protection equipment in year *t*, tonnes;

EF – the emission factor or fraction of the extinguishing agent in the fire protection systems emitted each year (excluding emissions from retired equipment or otherwise removed from service), (%) (default value used – 4%, 2006 IPCC Guidelines, Volume 3, Chapter 7.6, pages 7.63-7.64);

RRL $_t$ – Recovery Release or Loss: emissions of agent during recovery, recycling or disposal at the time of removal from use of existing fire protection equipment in year *t*, tonnes;

Production $_t$ – amount of newly supplied agent in fire protection equipment produced in year *t*, tonnes;

Import $_t$ – amount of agent in fire protection equipment imported in year *t*, tonnes;

Export $_t$ – amount of agent in fire protection equipment exported in year *t*, tonnes;

Destruction $_t$ – amount of agent from retired fire protection equipment that is collected and destroyed, tonnes;

t – year for which emissions are being estimated;

t_0 – first year of chemical production and/or use;

i – counter from first year of chemical production and/or use t_0 to current year t.

AD regarding the amount of extinguishing agent imported and re-exported was provided by the Customs Service for the period 2016-2022 (Table 4-147). The year in which the extinguishing agent HFC-227ea was introduced into the RoM is considered the year 2016. Based on the respective information, the cumulative extinguishing agent bank for the period 2016-2022 was calculated.

Table 4-147: Extinguishing agent HFC-227ea used in fire protection systems in the RoM between 2016-2022, t

	2016	2017	2018	2019	2020	2021	2022
Production of HFC-227ea, t	NO	NO	NO	NO	NO	NO	NO
Import of HFC-227ea, t	0.96	2.00	20.00	22.00	12.00	10.00	14.00
Amount of HFC-227ea sold, t	0.96	2.00	17.10	20.77	10.14	16.00	13.68
Cumulative bank of extinguishing agent used in fire protection systems, t	**0.96**	**2.92**	**18.98**	**37.11**	**29.42**	**24.96**	**28.68**

2F4. Aerosols (Metered Dose Aerosols)

HFC emissions from aerosol consumption (particularly metered dose aerosols, in which HFC-134a is used as propellant) were estimated using the Tier 2 methodology. It is considered that, during the use of aerosols, 100% of the chemical is emitted into the atmosphere. The respective emissions occur within 1-2 years after being marketed and are estimated using Equation 7.6 in the 2006 IPCC Guidelines (Volume 3, Chapter 7.3, page 7.28).

$$Emissions_t = S_t \bullet EF + S_{t-1} \bullet (1 - EF)$$

Where:

Emissions $_t$ – emissions in year *t*, tonnes;

S_t – quantity of HFC contained in aerosol products sold in year *t*, tonnes;

EF – emission factor (= fraction of chemical emitted during the first year), fraction (%);

S_{t-1} – quantity of HFC contained in aerosol products sold in year *t*–1, tonnes.

AD on the amount of medical substances imported into the RoM (metered dose inhalers used in the treatment of asthma and chronicle pulmonary diseases, including tuberculosis was provided by the Agency for Medicines and Medical Devices for the period 2003-2022 (Table 4-148).

Table 4-148: Import of metered dose inhalers (MDI) using HFC-134a as propellant in the RoM between 2003-2022, vials

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Salbutamol sulphate – Salbutamol pressurized inhalation suspension, 100 mcg/dose, 200 doses	-	-	-	87,200	60,640	68,960	109,500	100,184	118,779	109,144
Salbutamol sulphate – Ventolin Inhaler 100 mcg/dose, 200 doses	-	4,500	7,923	12,206	5,448	12,800	13,236	19,450	14,500	10,885
Fenoterol hydrobromide – Berotec N pressurized inhalation solution 100 mcg/dose, 200 doses	3,014	6,548	4,320	3,524	4,363	1,558	5,138	4,164	7,984	11,348
Ipratropium bromide/Fenoterol hydrobromide - Berodual N pressurized inhalation solution 0.25 mg/dose, 200 doses	-	-	-	200	500	586	1,300	1,726	4,248	5,096
Fluticasone propionate – Flixotide 50 Evohaler 50 µg/dose, 120 doses	500	1,630	1,690	1,160	1,200	300	1,150	1,896	500	3,116
Fluticasone propionate – Flixotide 125 Evohaler 125 µg/dose, 60 doses	-	-	-	-	612	800	250	-	-	300
Fluticasone propionate – Flixotide 125 Evohaler 125 µg/dose, 120 doses	282	3,170	2,650	1,370	-	1,933	1,400	1,650	282	600
Fluticasone propionate – Flixotide 250 Evohaler 250 µg/dose, 60 doses	250	950	1,330	2,170	-	2,990	620	-	250	300
Fluticasone propionate – Flixotide 250 Evohaler 250 µg/dose, 120 doses	-	-	-	-	850	480	2,750	3,018	-	-
Salmeterol xinafoate/Fluticasone propionate – Seretide Inhaler 25 µg + 50 µg, 120 doses	-	-	-	-	-	250	299	530	-	-
Salmeterol xinafoate – Serevente Inhaler 25 µg, 120 doses	-	-	-	-	-	1,200	1,637	2,100	-	-
Fluticasone propionate – Flixotide 250 Evohaler 250 µg/dose, 60 doses	-	-	-	-	-	200	3,040	620	-	-
Fluticasone propionate – Flixotide 50 Evohaler 50 µg/dose, 120 doses	-	-	-	-	-	850	300	-	-	-
Fluticasone propionate – Flixotide 125 Evohaler 125 µg/dose, 120 doses	-	-	-	-	-	1,413	-	-	-	-
Fluticasone propionate – Flixotide 250 Evohaler 250 µg/dose, 60 doses	-	-	-	-	-	100	2,990	620	-	-
Total Metered Dose Inhalers using HFC-134a as propellant	**3,014**	**12,080**	**17,993**	**108,800**	**75,651**	**88,016**	**137,613**	**134,324**	**152,075**	**140,789**
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Salbutamol sulphate – Salbutamol pressurized inhalation suspension, 100 mcg/dose, 200 doses	85,200	90,840	-	-	900	-	-	-	-	-
Salbutamol sulphate – Ventolin Inhaler 100 mcg/dose, 200 doses	14,741	33,400	132,852	142,000	149,110	158,530	129,971	153,078	59,820	130,682
Fenoterol hydrobromide – Berotec N pressurized inhalation solution 100 mcg/dose, 200 doses	18,576	17,926	-	7,136	12,424	17,382	6,624	7,071	9,833	-
Ipratropium bromide/Fenoterol hydrobromide – Berodual N pressurized inhalation solution 0.25 mg/dose, 200 doses	-	-	14,736	-	-	-	-	-	14,280	-

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Ipratropium bromide / Fenoterol hydrobromide – Berodual N pressurized inhalation solution 20+50mcg/dose 10 ml	6,568	5,712	7,212	7,428	8,209	10,948	12,078	10,920	-	19,382
Fluticasone propionate – Flixotide 50 Evohaler 50 µg / dose, 120 doses	2,400	2,930	3,230	7,973	3,891	4,350	3,596	3,220	2,370	3,300
Fluticasone propionate – Flixotide 125 Evohaler 125 µg / dose, 60 doses	496	820	930	10,598	8,458	8,650	9,703	13,040	6,850	13,350
Fluticasone propionate – Flixotide 125 Evohaler 125 µg / dose, 120 doses	3,108	4,739	5,715	7,375	323	-	-	-	600	-
Fluticasone propionate – Flixotide 250 Evohaler 250 µg / dose, 60 doses	200	400	-	-	-	-	-	-	-	-
Salmeterol xinafoate/Fluticasone propionate – Seretide™/ Diskus ™ Inhaler – pressurized inhalation susp. 50 mcg + 250 mcg/dose, 60 doses	50	50	-	-	-	-	-	-	-	-
Salmeterol xinafoate/Fluticasone propionate - Seretide™/ Diskus ™ Inhaler – pressurized inhalation susp. 50 mcg + 500 mcg/dose, 60 doses	-	100	-	-	-	-	-	-	-	-
Fluticasone propionate – Flixotide 50 Evohaler 50 µg/dose, 120 doses	-	-	4,207	6,049	2,476	2,346	5,042	4,488	3,118	3,934
Fluticasone propionate – Flixotide 125 Evohaler 125 µg/ dose, 120 doses	-	-	7,475	18,870	9,160	6,731	18,858	27,301	28,390	17,898
Fluticasone propionate – Flixotide 250 Evohaler 250 µg/ dose, 60 doses	-	-	2,710	13,480	6,860	6,150	12,631	17,684	14,609	18,738
Combiwave SF 125 pressurized inhalation solution 25+125 mcg/dose, 120 doses (DCI – Salmeterol + Fluticasone)	-	-	-	-	-	5,000	-	-	-	-
Combiwave SF 250 pressurized inhalation solution 25+250 mcg/dose,120 doses N1 (DCI – Salmeterol + Fluticasone)	-	-	-	-	-	12,836	-	-	-	-
Beclomethasone Dipropionate inhaler, pressurized inhalation susp. 50 mcg/dose, 200 doses N1 (DCI – Beclomethasone)	-	-	-	-	600	-	-	-	-	-
Airtec pressurized inhalation susp. 25 + 125 mcg/dose, 120 doses	-	-	-	-	-	-	6,000	9,000	7,515	4,084
Airtec pressurized inhalation susp. 25 + 250 mcg/dose, 120 doses	-	-	-	-	-	-	6,000	1,979	10,440	5,639
Airtec pressurized inhalation susp. 25 + 150 mcg/dose, 120 doses	-	-	-	-	-	-	6,000	-	-	-
Pefsal pressurized inhalation susp. 25 + 125 mcg/dose, 120 doses (DCI – Salmeterol + Fluticasone)	-	-	-	-	-	-	1,527	900	-	-
Pefsal pressurized inhalation susp. 25 + 250 mcg/dose, 120 doses (DCI – Salmeterol + Fluticasone)	-	-	-	-	-	-	903	5,006	-	-
Fluticasone / Flutinex spray nasal susp. 50 mcg/dose 120 doses	-	-	-	-	-	-	-	-	15,600	27,040
Flixonae 50 mcg 120 doses	-	-	-	-	-	-	-	-	950	0
Fluticasone furoate / Avamys 27.5 mcg/dose 120 doses	-	-	-	-	-	-	-	-	6,441	18,348
Salmeterol/Fluticasone / AirFluSal/Forspiro inhalation powder 50+250 mcg/dose 60 doses	-	-	-	-	-	-	-	-	868	4,368
AirFluSal/Forspiro inhalation powder 50+500 mcg/dose 60 doses	-	-	-	-	-	-	-	-	680	3,432
Total Metered Dose Inhalers using HFC-134a as propellant	**131,339**	**156,917**	**179,067**	**220,909**	**202,411**	**232,923**	**218,933**	**253,687**	**182,364**	**270,195**

Sources: Ministry of Health of the RoM: through Letter No. 019/550 dated March 1, 2011, as a response to the request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011; Letter No. 019/2045, dated September 14, 2011, as a response to the request of the Ministry of Environment to No. 05-07/1321 dated 05.08.2011; Letter No. 01-9/220, dated 05.02.2014, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 01-10/315, dated 04.03.2015, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 01-10/483, dated 30.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Agency for Medicines and Medical Devices: Letter No. Rg 02-359, dated 26.01.2018, as a response to the request of the Climate Change Office of the MARDE to No. 612/2018-01-02 dated 10.01.2018; Letter No. Rg 02-002625 dated 15.07.2020, as a response to the request of the MARDE to No. 13-07/3044 dated 13.07.2020; Letter No. RG 02-003639 dated 10.08.2021, as a response to the request of the Environment Agency to No. 08/136/2021 dated 09.06.2021; Letter No. Rg02-000652 dated 14.02.2022, as a response to the request of the Environment Agency to No. 05/07/200 dated 31.01.2022; Letter No. Rg02-000722 dated 14.02.2023, as a response to the request of the Environment Agency to No. 08/29/2023 din 25.01.2023.

It should be noted that MDI are not produced in the RoM and, in the past, these substances were imported mainly from Ukraine, Russia, India and China, and, more recently, they have been imported from Spain, France, Germany, Poland, Turkey, and Great Britain. The amount of HFC-134a contained in MDI was estimated based on activity data presented above (Table 4-149).

Table 4-149: AD on HFC-134a incorporated in MDI imported between 2003-2022, kg

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
HFC-134a	0.06	0.23	0.32	2.14	1.49	1.77	2.82	2.71	3.16	2.92
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
HFC-134a	2.77	3.23	4.13	4.43	4.17	5.02	4.72	5.39	3.67	4.94

4.6.3. Uncertainties and Time-Series Consistency

2F1. Refrigeration and Air Conditioning

Uncertainties associated with the emission factors used in the estimation of HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' reach up to circa 50%. Uncertainties associated with activity data on the use of refrigeration and air conditioning equipment are considered moderate (circa 20%). Thus, combined uncertainties for this source category are estimated to be circa 53.85% (Annex 2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2F2. Foam Blowing Agents

Uncertainties associated with the emission factors used in the estimation of HFC emissions from source category 2F2 'Foam Blowing Agents' were estimated to be circa 30% (2006 IPCC Guidelines). Uncertainties associated with activity data on the use of foams in the RoM are considered relatively high (circa 30%), including due to the fact that the current statistical system does not offer the possibility to disaggregate activity data by type of foams (open-cell or closed-cell), and it is thereby not possible to know all types of agents used. Thus, combined uncertainties for this source category are estimated to be circa 42.43% (Annex 2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2F3. Fire Protection

Uncertainties associated with the emission factors used in the estimation of HFC emissions from source category 2F3 'Fire Protection' were estimated to be circa 5% (2006 IPCC Guidelines). Uncertainties associated with activity data on the use of HFC-227ea in fire protection systems in the RoM are considered moderate (circa 15%). Thus, combined uncertainties for source category 2F3 'Fire Protection' are estimated to be circa 15.81% (Annex 2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

2F4. Aerosols (Metered Dose Aerosols)

Uncertainties associated with the emission factors used in the estimation of HFC emissions from source category 2F4 'Aerosols' were estimated to be circa 5% (2006 IPCC Guidelines). Uncertainties associated with activity data on the use of metered dose aerosols using HFC-134a as propellant in the RoM are considered low (circa 10%). Thus, combined uncertainties for source category 2F4 'Aerosols' are estimated to be circa 7.07% (Annex 2). In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.6.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

4.6.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category following the Tier 1 methodological approach. For source category 2F 'Product Uses as Substitutes for ODS', comparison and verification was focused on ensuring correct use of the default emission factors available in the 2006 IPCC Guidelines; on correct use of AD obtained from different reference sources, including official sources (i.e., NBS, Customs Service, Republican Association of Refrigeration Technicians and reports submitted by economic agents annually to the National Montreal Protocol Unit under the PI 'EPNIO' of the Ministry of Environment) and the correct use of them. It should be noted

that AD and methods used for estimating GHG emissions from source category 2F 'Consumption of halocarbon and SF_6' were documented and archived both in hard copies and electronically.

4.6.6. Recalculations

2F1. Refrigeration and Air Conditioning

HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' were recalculated for the period 1995-2010 as a result of: (a) the updated share of refrigerants charged into refrigeration and air conditioning equipment in the RoM; (b) updated information on the share of transport units equipped with air conditioning equipment, provided by the Public Services Agency, based on the information included in the State Transport Register; (c) change in global warming potential values for the 100-year horizon (GWP_{100}), instead of the values available in IPCC AR4 (2007), the values available in the IPCC AR5 (2014) were used (for HFC-32, the 677 GWP_{100} value was used instead of 675; for HFC-125, the 3170 GWP_{100} value was used instead of 3170; for HFC-134a, the 1300 GWP_{100} value was used instead of 1430; and in the case of HFC-143a: the 4800 GWP_{100} value was used instead of 4470).

In comparison with the results recorded in the NC5 of the RoM to the UNFCCC, the recalculations resulted in a downward trend in HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' for the period 1995-2020, varying from a minimum of 9.1% in the years 1995-2002, to a maximum of 20.7% in 2019 (Table 4-150).

Table 4-150: Recalculations of HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
NC5	0.75	1.25	1.79	2.41	3.08	3.82	5.00	6.17	7.39	8.56	10.22	14.75	17.26	19.68
BTR1	0.69	1.13	1.63	2.19	2.80	3.47	4.55	5.61	6.59	7.60	8.98	13.02	15.17	17.34
Difference, %	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-10.7	-11.2	-12.1	-11.7	-12.1	-11.9
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	21.37	23.52	27.45	30.74	34.52	44.95	74.39	82.69	100.01	110.88	144.65	153.08		
BTR1	18.86	20.55	24.11	26.86	30.03	39.05	64.48	72.27	86.22	95.61	114.76	126.21	133.98	156.03
Difference, %	-11.7	-12.6	-12.2	-12.6	-13.0	-13.1	-13.3	-12.6	-13.8	-13.8	-20.7	-17.5		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

For 2021-2022, HFC emissions from the respective category were estimated for the first time. The obtained results show that between 1995-2022, HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' had increased in the RoM by circa 184 times (Table 4-151).

Table 4-151: HFC emissions from source category 2F1 'Refrigeration and Air Conditioning' in the RoM between 1995-2022

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	2F1a 'Domestic Refrigeration Equipment'"													
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	0.000	0.000	0.001	0.002	0.004	0.006
HFC-134a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.007	0.019	0.041	0.075	0.122	0.157
HFC-143a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.000	0.000	0.001	0.002	0.005	0.007
2F1a, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.011**	**0.028**	**0.061**	**0.115**	**0.196**	**0.252**
	2F1b 'Commercial Refrigeration Equipment'													
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	0.001	0.003	0.004	0.006	0.013	0.019
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	0.008	0.020	0.034	0.054	0.108	0.162
HFC-134a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.011	0.036	0.071	0.130	0.302	0.482
HFC-143a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.008	0.021	0.035	0.056	0.108	0.162
2F1b, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.082**	**0.213**	**0.373**	**0.612**	**1.264**	**1.930**
	2F1c 'Industrial Refrigeration Equipment'													
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.003	0.006	0.008	0.010
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	0.022	0.040	0.069	0.094	0.124	0.172
HFC-134a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.012	0.017	0.028	0.040	0.049	0.059

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
HFC-143a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.023	0.043	0.072	0.095	0.126	0.177
2F1c, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.196**	**0.353**	**0.601**	**0.808**	**1.065**	**1.481**
	2F1d 'Stationary Air Conditioning Equipment'													
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	0.003	0.007	0.014	0.026	0.069	0.110
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	0.003	0.007	0.014	0.026	0.069	0.110
2F1d, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.012**	**0.027**	**0.053**	**0.099**	**0.265**	**0.422**
	2F1e 'Mobile Air Conditioning Equipment'													
HFC-134a, t	0.527	0.872	1.253	1.687	2.155	2.671	3.497	4.312	4.841	5.366	6.072	6.655	7.159	7.582
2F1e, kt CO_2 eq.	**0.685**	**1.133**	**1.629**	**2.193**	**2.801**	**3.472**	**4.547**	**5.605**	**6.293**	**6.976**	**7.893**	**8.652**	**9.306**	**9.856**
	2F1f 'Transport Refrigeration'													
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.711	0.798	0.883
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.711	0.798	0.883
2F1f, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**2.734**	**3.070**	**3.396**
	2F1 'Refrigeration and Air Conditioning'													
2F1, kt CO_2 eq.	**0.685**	**1.133**	**1.629**	**2.193**	**2.801**	**3.472**	**4.547**	**5.605**	**6.593**	**7.597**	**8.981**	**13.021**	**15.167**	**17.338**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
	2F1a 'Domestic Refrigeration Equipment'													
HFC-125, t	0.007	0.011	0.014	0.017	0.019	0.023	0.027	0.032	0.039	0.049	0.080	0.108	0.155	0.225
HFC-134a, t	0.184	0.213	0.237	0.256	0.268	0.278	0.283	0.284	0.285	0.286	0.971	1.397	2.350	3.444
HFC-143a, t	0.009	0.012	0.017	0.020	0.023	0.027	0.032	0.038	0.047	0.058	0.094	0.128	0.183	0.266
2F1a, kt CO_2 eq.	**0.304**	**0.370**	**0.433**	**0.483**	**0.521**	**0.564**	**0.611**	**0.657**	**0.719**	**0.804**	**1.967**	**2.774**	**4.426**	**6.470**
	2F1b 'Commercial Refrigeration Equipment'													
HFC-32, t	0.023	0.026	0.029	0.033	0.037	0.040	0.075	0.081	0.087	0.108	0.241	0.219	0.147	0.152
HFC-125, t	0.195	0.234	0.287	0.329	0.394	0.452	0.730	0.879	1.021	1.291	2.286	2.377	2.069	2.631
HFC-134a, t	0.591	0.706	0.865	0.980	1.137	1.268	1.688	2.131	2.571	3.374	6.459	6.689	5.097	5.805
HFC-143a, t	0.195	0.233	0.288	0.330	0.397	0.457	0.735	0.892	1.042	1.320	2.275	2.385	2.097	2.708
2F1b, kt CO_2 eq.	**2.337**	**2.795**	**3.440**	**3.924**	**4.657**	**5.298**	**8.088**	**9.890**	**11.640**	**14.884**	**26.728**	**27.825**	**23.350**	**28.988**
	2F1c 'Industrial Refrigeration Equipment'													
HFC-32, t	0.011	0.021	0.025	0.032	0.040	0.047	0.059	0.072	0.089	0.113	0.155	0.211	0.269	0.336
HFC-125, t	0.229	0.302	0.382	0.464	0.550	0.658	0.865	1.172	1.418	1.778	2.254	2.927	3.585	4.310
HFC-134a, t	0.070	0.088	0.102	0.121	0.143	0.164	0.198	0.266	0.333	0.428	0.576	0.774	0.979	1.212
HFC-143a, t	0.239	0.309	0.395	0.478	0.566	0.677	0.887	1.170	1.383	1.694	2.090	2.659	3.209	3.810
2F1c, kt CO_2 eq.	**1.973**	**2.572**	**3.256**	**3.943**	**4.672**	**5.580**	**7.296**	**9.724**	**11.627**	**14.400**	**18.032**	**23.189**	**28.223**	**33.754**
	2F1d 'Stationary Air Conditioning Equipment'													
HFC-32, t	0.120	0.141	0.178	0.211	0.254	0.276	0.297	0.370	0.469	0.598	0.754	0.920	1.097	1.283
HFC-125, t	0.120	0.141	0.178	0.211	0.254	0.276	0.291	0.326	0.355	0.382	0.409	0.430	0.444	0.446
2F1d, kt CO_2 eq.	**0.461**	**0.542**	**0.683**	**0.813**	**0.976**	**1.062**	**1.123**	**1.283**	**1.441**	**1.615**	**1.808**	**1.987**	**2.150**	**2.283**
	2F1e 'Mobile Air Conditioning Equipment'													
HFC-134a, t	7.760	7.883	9.194	10.036	10.959	16.365	32.158	34.549	42.694	44.898	46.330	49.640	53.986	57.293
2F1e, kt CO_2 eq.	**10.089**	**10.248**	**11.952**	**13.047**	**14.246**	**21.275**	**41.805**	**44.914**	**55.502**	**58.367**	**60.228**	**64.532**	**70.182**	**74.480**
		2F1f 'Transport Refrigeration'												
HFC-32, t	0.962	1.045	1.128	1.209	1.289	1.371	1.444	1.508	1.376	1.441	1.560	1.535	1.4673	2.6124
HFC-125, t	0.962	1.045	1.128	1.209	1.289	1.371	1.444	1.508	1.376	1.441	1.560	1.535	1.4673	2.6124
2F1f, kt CO_2 eq.	**3.699**	**4.019**	**4.341**	**4.650**	**4.960**	**5.273**	**5.554**	**5.801**	**5.292**	**5.543**	**6.000**	**5.907**	**5.6448**	**10.0500**
	2F1 'Refrigeration and Air Conditioning'													
2F1, kt CO_2 eq.	**18.862**	**20.545**	**24.105**	**26.860**	**30.032**	**39.052**	**64.477**	**72.270**	**86.221**	**95.613**	**114.764**	**126.214**	**133.975**	**156.026**

2F2. Foam Blowing Agents

HFC emissions from source category 2F2 'Foam Blowing Agents' were recalculated for the period 1995-2020 as a result of changing the values of GWP for the 100-year horizon (GWP_{100}). Therefore, the values available in the IPCC AR5 (2014) were used instead of the values available in the IPCC AR4 (2007) (for HFC-134a – the 1300 GWP_{100} was used instead of 1430; for HFC-152a: the 138 GWP_{100} value was used instead of 124; for HFC-245fa: the 858 GWP_{100} value was used instead of 1030; and for HFC-365mfc: the 804 GWP_{100} value was used instead of 794).

In comparison with the emission values recorded in the NC5 of the RoM to the UNFCCC, the recalculations resulted in a downward trend in HFC emissions from source category 2F2 'Foam Blowing Agents' for the period 1995-2020 (Table 4-152), varying from a minimum of 8.5% in 2010, to a maximum of 14.4% of 2020.

Table 4-152: Recalculations of HFC emissions from source category 2F2 'Foam Blowing Agents included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
NC5	0.28	0.41	0.52	0.72	0.92	1.30	1.87	2.96	4.78	7.45	12.29	18.50	27.53	37.67
BTR1	0.25	0.38	0.47	0.66	0.84	1.18	1.70	2.69	4.36	6.80	11.22	16.90	25.15	34.43
Difference, %	-9.1	-9.1	-9.1	-9.1	-9.1	-9.0	-8.9	-8.9	-8.7	-8.7	-8.7	-8.6	-8.6	-8.6
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	46.11	54.63	63.05	69.73	74.56	78.03	82.65	84.02	85.62	87.05	88.58	89.27		
BTR1	42.16	49.99	56.47	61.28	65.73	68.88	73.40	74.38	75.48	76.25	76.66	76.45	75.95	74.97
Difference, %	-8.6	-8.5	-10.4	-12.1	-11.9	-11.7	-11.2	-11.5	-11.8	-12.4	-13.5	-14.4		

Abbreviations: NC5 – Fifth National Communication of the RM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RM to the UNFCCC.

For 2021-2022, HFC emissions from the respective category were estimated for the first time. The results obtained show that HFC emissions from source category 2F2 'Foam Blowing Agents' had increased in the RoM by circa 298 times between 1995 and 2022.

2F3. Fire Protection

HFC-227ea emissions from source category 2F3 'Fire Protection' were recalculated in the current inventory cycle as a result of using updated information on the import and sale of HFC-227ea in the RM, which was provided by 'Micasa International' Ltd., the only importer and distributor of this substance in the RoM (in the previous inventory cycle, the information available and used regarding the import of HFC-227ea was provided only by the Customs Office), and as a result of changing the GWP value for the 100-year horizon: the GWP_{100} 3350 value, available in the IPCC AR5 (2014) was used instead of the GWP_{100} 3220 value, available in the IPCC AR4 (2007).

In comparison with the values of HFC-227ea emissions recorded in the NC5 of the RoM to the UNFCCC, the changes made resulted in an upward trend in HFC-227ea emissions from source category 2F3 'Fire Protection' for the years 2017-2020 (Table 4-153).

Table 4-153: Recalculations of HFC emissions from source category 2F3 'Fire Protection' included in the NC5 of the RoM to the UNFCCC, kt CO_2 eq.

	2016	2017	2018	2019	2020	2021	2022
NC5	NE	0.26	0.95	2.30	2.96		
BTR1	0.13	0.39	2.54	4.97	3.94	3.34	3.84
Difference, %	NE	52.0	167.7	115.9	33.1		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

For 2016, and 2021-2022, HFC-227 emissions from the respective category were estimated for the first time. The results obtained show that HFC emissions from source category 2F3 'Fire Protection' had increased in the RoM by circa 30 times between 2016 and 2022.

2F4. Aerosols

HFC emissions from source category 2F4 'Aerosols' were recalculated for the period 2003-2020 as a result of changing the GWP value for the 100-year horizon. Thus, the GWP_{100} 1300 value, available in the IPCC AR5 (2014) was used instead of the GWP_{100} 1430 value, available in the IPCC AR4 (2007).

In comparison with the HFC-134a emission values recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made have resulted in a downward trend (by circa 9.1%) in HFC-134a emissions from source category 2F4 'Aerosols' in the period 2003-2020 (Table 4-154).

Table 4-154: Recalculations of HFC emissions from source category 2F4 'Aerosols' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
NC5	0.0001	0.0002	0.0004	0.0018	0.0026	0.0023	0.0033	0.0040	0.0042	0.0043
BTR1	0.0001	0.0002	0.0004	0.0016	0.0024	0.0021	0.0030	0.0036	0.0038	0.0043
Difference, %	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	0.0
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	0.0041	0.0043	0.0053	0.0061	0.0061	0.0066	0.0070	0.0072		
BTR1	0.0037	0.0039	0.0048	0.0056	0.0056	0.0060	0.0063	0.0066	0.0059	0.0056
Difference, %	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

For 2021-2022, HFC-134a emissions from the respective category were estimated for the first time. The obtained results show that HFC-134a emissions from source category 2F4 'Aerosols' had increased by circa 95 times between 2003 and 2022.

2F. Product Uses as Substitutes for ODS

HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' were recalculated for the period 1995-2020, as a result of the previously-mentioned reasons.

In comparison with the emission values recorded in the NC5 of the RoM to the UNFCCC (2023), the changes have resulted into an insignificant downward trend in HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' in the years 1995-2000 (Table 4-155), varying from a minimum of 9.0% in 2001-2002, to a maximum of 14.8% in 2019.

For 2021-2022, HFC emissions from the respective category have been estimated for the first time. The obtained results show that HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' had increased by circa 251 times in the RoM between 1995 and 2022.

Table 4-155: Recalculations of HFC emissions from category 2F 'Product Uses as Substitutes for ODS' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
NC5	1.03	1.66	2.31	3.14	4.00	5.12	6.87	9.12	12.16	16.00	22.51	33.25	44.79	57.36
BTR1	0.94	1.51	2.10	2.85	3.64	4.66	6.25	8.30	10.95	14.40	20.20	29.92	40.32	51.77
Difference, %	-9.1	-9.1	-9.1	-9.1	-9.1	-9.1	-9.0	-9.0	-10.0	-10.0	-10.3	-10.0	-10.0	-9.7
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	67.48	78.15	89.12	97.59	106.19	120.03	154.45	163.79	182.68	194.94	230.49	239.46		
BTR1	61.02	70.54	80.58	88.14	95.76	107.94	137.88	146.79	162.10	174.41	196.40	206.62	213.27	234.84
Difference, %	-9.6	-9.7	-9.6	-9.7	-9.8	-10.1	-10.7	-10.4	-11.3	-10.5	-14.8	-13.7		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

Table 4-156 below shows HFC emissions by substance and emission source.

Table 4-156: HFC emissions from source category 2F 'Product Uses as Substitutes for ODS' between 1995-2022

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	2F1 'Refrigeration and Air Conditioning'													
HFC-32, t	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.01	0.02	0.75	0.89	1.02
HFC-125, t	NO	NO	NO	NO	NO	NO	NO	NO	0.03	0.07	0.12	0.89	1.10	1.33
HFC-134a, t	0.53	0.87	1.25	1.69	2.15	2.67	3.50	4.31	4.87	5.44	6.21	6.90	7.63	8.28
HFC-143a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.03	0.06	0.11	0.15	0.24	0.35
2F1, kt CO_2 eq.	**0.69**	**1.13**	**1.63**	**2.19**	**2.80**	**3.47**	**4.55**	**5.61**	**6.59**	**7.60**	**8.98**	**13.02**	**15.17**	**17.34**
	2F2 'Foam Blowing Agents'													
HFC-134a, t	0.19	0.29	0.36	0.51	0.64	0.90	1.29	2.05	3.28	5.11	8.17	12.06	17.72	23.61
HFC-152a, t	NO	NO	NO	NO	NO	0.07	0.13	0.25	0.67	1.12	1.90	3.40	5.03	7.45
HFC-365mfc, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.19	0.43	0.81	1.54
HFC-245fa, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.21	0.48	0.90	1.71
2F2, kt CO_2 eq.	**0.25**	**0.38**	**0.47**	**0.66**	**0.84**	**1.18**	**1.70**	**2.69**	**4.36**	**6.80**	**11.22**	**16.90**	**25.15**	**34.43**
	2F3 'Fire Protection'													
HFC-227ea, t	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
2F4, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
	2F4 'Aerosols'													
HFC-134a, t	NO	NO	NO	NO	NO	NO	NO	NO	0.00	0.00	0.00	0.00	0.00	0.00
2F4, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**
	2F 'Product Uses as Substitutes for ODS'													
2F, kt CO_2 eq.	**0.94**	**1.51**	**2.10**	**2.85**	**3.64**	**4.66**	**6.25**	**8.30**	**10.95**	**14.40**	**20.20**	**29.92**	**40.32**	**51.77**
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
	2F1 'Refrigeration and Air Conditioning'													
HFC-32, t	1.12	1.23	1.36	1.49	1.62	1.73	1.88	2.03	2.02	2.26	2.71	2.88	2.98	4.38
HFC-125, t	1.51	1.73	1.99	2.23	2.51	2.78	3.36	3.92	4.21	4.94	6.59	7.38	7.72	10.23
HFC-134a, t	8.61	8.89	10.40	11.39	12.51	18.08	34.33	37.23	45.88	48.98	54.34	58.50	62.41	67.75
HFC-143a, t	0.44	0.56	0.70	0.83	0.99	1.16	1.65	2.10	2.47	3.07	4.46	5.17	5.49	6.78
2F1, kt CO_2 eq.	**18.86**	**20.55**	**24.11**	**26.86**	**30.03**	**39.05**	**64.48**	**72.27**	**86.22**	**95.61**	**114.76**	**126.21**	**133.98**	**156.03**
	2F2 'Foam Blowing Agents'													
HFC-134a, t	28.37	32.86	36.33	38.72	41.11	42.41	43.77	43.67	43.60	43.45	43.32	43.06	42.67	41.91
HFC-152a, t	10.00	13.63	17.21	21.09	24.34	27.97	31.21	33.62	35.19	36.80	37.76	38.74	38.74	38.74
HFC-365mfc, t	2.22	3.07	3.91	4.57	4.97	5.33	6.05	6.40	6.84	7.10	7.36	7.36	7.36	7.36
HFC-245fa, t	2.47	3.41	4.34	5.08	5.75	6.54	8.54	9.12	9.86	10.45	10.74	10.74	10.74	10.74
2F2, kt CO_2 eq.	**42.16**	**49.99**	**56.47**	**61.28**	**65.73**	**68.88**	**73.40**	**74.38**	**75.48**	**76.25**	**76.66**	**76.45**	**75.95**	**74.97**
	2F3 'Fire Protection'													
HFC-227ea, t	NO	NO	NO	NO	NO	NO	NO	0.04	0.12	0.76	1.48	1.18	1.00	1.15
2F4, kt CO_2 eq.	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**0.13**	**0.39**	**2.54**	**4.97**	**3.94**	**3.34**	**3.84**
	2F4 'Aerosols'													
HFC-134a, t	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00
2F4, kt CO_2 eq.	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**	**0.01**
	2F 'Product Uses as Substitutes for ODS'													
2F, kt CO_2 eq.	**61.02**	**70.54**	**80.58**	**88.14**	**95.76**	**107.94**	**137.88**	**146.79**	**162.10**	**174.41**	**196.40**	**206.62**	**213.27**	**234.84**

4.6.7. Planned Improvements

Potential improvements could include capacity building activities by setting up an on-line information system for collecting AD from companies that import, use, dispose, recover and recycle refrigerants and refrigerant equipment. This information system will provide the Environment Agency, and the Ministry of Environment, respectively, with more accurate AD, which could potentially contribute to reducing uncertainties in the estimation of GHG emissions from ˙category 2F 'Product Uses as Substitutes for ODS' in the Republic of Moldova.

4.7. Other Product Manufacture and Use (Source Category 2G)

4.7.1. Source Category Description

Category 2G 'Other Product Manufacture and Use', covers GHG emissions generated from the following emission sources: 2G1 'Electrical Equipment', 2G3 'N_2O from Product Uses' and 2G4 'Other' ('Tobacco Combustion' and 'Use of Shoes').

2G1. Electrical Equipment

Sulphur hexafluoride (SF_6) and perfluorocarbons (particularly CF_4) are used for insulation in medium and high voltage electrical equipment. SF_6 is also used in gas insulated switchgear and chemical lasers.

In order to determine how sulphur hexafluoride and PFC are used in the RoM, a series of enterprises subordinated to the current Ministry Energy (SOE 'Moldelectrica' and SOE RED-North) and SOE Premier Energy Distribution JSC were surveyed. The survey of the above-mentioned entities has revealed the following: under the Ministry of Energy (SOE 'Moldelectrica' and 'Retelele Electrice de Distributie Nord') and SOE 'Premier Energy Distribution' JSC, by the year 2022 dielectric 652 medium voltage electrical switchgear devices were used, the charge varying between 0.605 kg and 6.276 kg of SF_6, and 224 high voltage electrical switchgear devices, the charge varying between 6 kg and 45 kg of SF_6, respectively. In the RoM, the use of perfluorocarbons (PFCs), especially CF_4, is currently only registered as a dielectric in high-voltage electrical switchgear.

The share of SF_6 and CF_4 emissions in the total GHG emissions generated from source category 2G1 'Electrical Equipment' is insignificant, these emissions being recorded in the RoM only since 2003, and since 2006, respectively.

2G3. N_2O from Product Uses

Under this category, N_2O emissions from medical applications for anaesthetic use are estimated (SNAP 060508 – N_2O for anaesthetic use in medical application).

2G4. Other

Under this category, NO_x, CO, NMVOC, SO_x, and indirect CO_2 emissions from tobacco combustion (SNAP 060602 – tobacco combustion) and use of shoes (SNAP 060603 – use of shoes), and use of fireworks (SNAP 060601) are estimated.

Between 1990 and 2022, direct GHG emissions from category 2G 'Other Product Manufacture and Use' decreased by circa 27.8% (Table 4-157).

Table 4-157: Direct GHG emissions from category 2G 'Other Product Manufacture and Use', by emission source, between 1990-2022, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2G1 Electrical equipment	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G3 N_2O from medical applications	0.02	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.00	0.01	0.01
2G4 Other	3.40	3.06	2.41	1.98	1.44	1.17	1.10	1.00	0.75	0.64	0.96
2G Other product manufacture and use	**3.42**	**3.08**	**2.43**	**2.00**	**1.46**	**1.17**	**1.11**	**1.00**	**0.75**	**0.65**	**0.97**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
2G1 Electrical equipment	NO	NO	0.01	0.01	0.04	0.34	0.44	0.54	0.58	0.72	0.76
2G3 N_2O from medical applications	0.01	0.01	0.01	0.01	0.02	0.02	NO	NO	NO	NO	NO
2G4 Other	0.82	0.78	0.96	1.05	1.16	1.07	1.07	1.10	0.80	1.02	1.23
2G Other product manufacture and use	**0.83**	**0.80**	**0.98**	**1.07**	**1.22**	**1.42**	**1.51**	**1.64**	**1.39**	**1.74**	**1.99**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
2G1 Electrical equipment	0.82	1.03	1.12	1.12	1.15	1.19	1.41	1.52	1.67	1.68	1.69
2G3 N_2O from medical applications	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2G4 Other	1.16	1.10	1.21	0.94	1.06	1.18	1.06	1.13	0.94	1.16	0.78
2G Other product manufacture and use	**1.98**	**2.13**	**2.33**	**2.06**	**2.22**	**2.36**	**2.47**	**2.65**	**2.61**	**2.84**	**2.47**

The table below shows the evolution of indirect GHG emissions (NO_x, CO, NMVOC, SO_x) from the respective category (Table 4-158).

Table 4-158: Indirect GHG emissions from category 2G 'Other Product Manufacture and Use' between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NO_x emissions	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
CO emissions	0.60	0.61	0.57	0.58	0.53	0.47	0.64	0.63	0.50	0.58	0.61
NMVOC emissions	1.55	1.39	1.10	0.90	0.66	0.53	0.50	0.45	0.34	0.29	0.43
SO_x emissions	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NO_x emissions	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
CO emissions	0.62	0.45	0.55	0.58	0.57	0.55	0.61	0.52	0.63	0.72	0.72
NMVOC emissions	0.37	0.36	0.44	0.48	0.53	0.48	0.48	0.50	0.37	0.47	0.56
SO_x emissions	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE	NE
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NO_x emissions	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
CO emissions	0.53	0.41	0.36	0.36	0.32	0.24	0.26	0.24	0.30	0.24	0.16
NMVOC emissions	0.53	0.50	0.55	0.43	0.48	0.53	0.48	0.51	0.43	0.53	0.36
SO_x emissions	NE	0.0003	0.0007	0.0003	0.0003	0.0003	0.0007	0.0008	0.0008	0.0007	0.0006

4.7.2. Methodologies, Emission Factors and Activity Data

2G1. Electrical Equipment

SF_6 and PFC emissions from use of sulphur hexafluoride as gas insulation in medium and high and medium tension electrical switchgear were estimated based on the Tier 1 estimation methodology (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Equation 8.1, page 8.8).

$$Total\ Emissions = M \bullet EF + EI \bullet EF + EU \bullet EF + ED \bullet EF$$

Where:

Total Emissions – emissions from use of SF_6 and PFC as insulation in high and medium tension electrical switchgear, tonnes;

M – manufacturing emissions, tonnes;

EF – the emission factor or the fraction of SF_6 and PFC emitted during the production of electrical switches; emission factors used by default: 7% for medium voltage switchgear (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.2, p. 8.15) and 8.5% for high voltage switchgear (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.16);

EI – installation emissions, tonnes;

EF – emission factor or fraction SF_6 and PFC emitted when installing medium and high voltage electrical switches;

EU – emissions in medium and high voltage equipment, tonnes;

EF – the emission factor or fraction of SF_6 and PFC emitted when using medium and high voltage switchgear; emission factors used by default: 0.2% for medium voltage switchgear (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.2, p. 8.15) and 2.6% for high voltage circuit breakers (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.16);

ED – equipment disposal emissions, tonnes;

EF – the emission factor or the fraction of SF_6 and PFCs that remains in medium and high voltage switchgear at the time of breaking down the equipment (the lifetime of the equipment in European countries is over 35 years; emission factors used by default: 93% of the amount initially charged in medium voltage switchgear (2006 IPCC Guidelines, Volume 3, Chapter 8.1, Table 8.2, p. 8.15) and 95% of the amount initially charged in high voltage switchgear (2006 IPCC Guidelines, Volume 3 , Chapter 8.1, Table 8.3, p. 8.16).

Only since 2003 have Moldovan companies initiated the use of medium-voltage electrical switchgear (10 and 35 kV) and high-voltage electrical switchgear (110 kV, 330 kV and 400 kV), the SF_6 charge in each case varying between 0.605 kg and 45.0 kg. In accordance with the manufacturer's technical log, the first repairs shall take place after 35 years of operation. The installation of medium and high-voltage electrical switchgear, as well as the number of available units in stock at the end of the calendar year are provided in Table 4-159, and in Tables 4-160 and 4-161, respectively.

Table 4-159: The installation of medium and high voltage switchgear using SF_6 and CF_4 for the period 2003-2022, units installed per year

Enterprises	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
SOE Moldelectrica	1	0	5	28	8	2	0	8	1	3
Premier Energy Ltd.	0	0	0	6	6	34	11	5	34	48
SOE 'Red-North'	0	0	0	0	0	0	0	0	0	0
Total	**1**	**0**	**5**	**34**	**14**	**36**	**11**	**13**	**35**	**51**
Enterprises	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
SOE Moldelectrica	4	0	0	0	0	45	20	31	0	0
Premier Energy Ltd.	25	26	5	44	16	23	6	27	54	54
SOE 'Red-North'	0	0	2	6	26	42	5	152	47	16
Total	**29**	**26**	**7**	**50**	**42**	**110**	**31**	**210**	**101**	**70**

Sources: JSC Red Union Fenosa through Letter No. 0201/65392 dated 15.08.2011, as a response to the request of the Ministry of Environment to No. 03-07/1337 dated 08.08.2011; Letter dated 13.01.2014, as a response to the request of the Climate Change Office to No. 320/2014-01-01 dated 03.01.2014; Letter dated 10.05.2016, as a response to the request of the Climate Change Office to No. 512/2016-05-09 dated 10.05.2016; Letter dated 23.01.2018, as a response to the request of the Climate Change Office to No. 601/2017-12-03 dated 14.12.2017; SOE 'Premier Energy Distribution' JSC through Letter dated 19.02.2020, as a response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter dated 14.06.2021, as a response to the request of the Environment Agency to No. 08/136/2021 dated 09.06.2021; Letter dated 02.02.2022, as a response to the request of the Environment Agency to No. 05-07/220 dated 01.02.2022; Letter dated 02.02.2023, as a response to the request of the Environment Agency to No. 08/34/2023 dated 28.01.2023; SOE 'MOLDELECTRICA' through Letter No. 46-47/1795 dated 23.08.2011, as a response to the request of the Ministry of Environment to No. 03-07/1337 dated 08.08.2011; Letter No. 46-47/112 dated 17.01.2014, as a response to the request of the Climate Change Office to No. 320/2014-01-01 dated 03.01.2014; Letter No. 46-74/937 dated 25.05.2016, as a response to the request of the Climate Change Office to No. 512/2016-05-01 dated 10.05.2016; Letter No. 46-74/1 dated 03.01.2018, as a response to the request of the Climate Change Office to No. 601/2017-12-03 dated 14.12.2017; Letter No. 46-74/333 dated 28.02.2020, as a response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 46-47/908 dated 28.06.2021, as a response to the request of the Environment Agency to No. 08/136/2021 dated 09.06.2021; Letter No. 46-57/222 dated 07.02.2022, as a response to the request of the Environment Agency to No. 05-07/220 dated 01.02.2022; Letter No. 46-74/297 dated 15.02.2023, as a response to the request of the Environment Agency to No. 08/34/2023 dated 28.01.2023; JSC 'Red-North' through Letter dated 06.07.2021, as a response to the request of the Environment Agency to No. 08/136/2021 dated 09.06.2021; Letter dated 02.02.2022, as a response to the request of the Environment Agency to No. 05-07/220 dated 01.02.2022; Letter dated 02.02.2023, as a response to the request of the Environment Agency to No. 08/34/2023 dated 28.01.2023.

Table 4-160: Total medium-voltage switchgear available in stock at the end of calendar year for the period 2006-2022, units

	2006	2007	2008	2009	2010	2011	2012	2013	2014
10 kV switchgear, model PT COMPACT 3L1P (Ormazabal), 0.605 kg SF_6	0	0	0	0	0	0	0	1	2
10 kV switchgear, model CGMCOSMOS-L, 0.605 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-S (Ormazabal), 0.770 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model Siemens 8DJH, 0.9 kg SF_6	0	0	0	0	0	0	0	0	0
10 KV switchgear, model THO 24/SO5/E/THO-T1, 0.98 kg SF_6	0	0	0	0	0	28	52	52	59
10 kV switchgear, model Siemens 8DJH, 1.2 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model GAE630, 1.2 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model GLX24, 1.2 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model GSEC1, 1.2 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model PT COMPACT 1P (Ormazabal), 1.25 kg SF_6	0	0	0	0	0	0	0	1	1
10 kV switchgear, model CGMCOSMOS-P (Ormazabal), 1.25 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model PT COMPACT 2L1P, 1.3 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model AUGUSTE 2012 / 1.5 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model AUGUSTE 2012 / 1.5 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model AUGUSTE 50C 24-630-CTE, 1.5 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model PT COMPACT 1P (ZPUE), 1.6 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-LP, 1.855 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model Siemens NXPLUS C, 1.995 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model Siemens NXPLUS C, 2.1 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model GMA-24 / 2.2 kg SF_6	0	0	24	24	24	24	36	36	36
10 kV switchgear, model PT COMPACT 2L1P (ZPUE), 2.25 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model PT COMPACT 2L1P (Ormazabal), 2.46 kg SF_6	0	0	0	0	0	0	3	15	22
10 kV switchgear, model CGMCOSMOS-2LP, 2.460 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-P_L_P, 2.460 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-2L1P, 2.460 kg SF_6	0	0	0	0	0	0	0	0	0
10 KV switchgear, model Siemens NXPLUS C, 2.514 kg SF6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model Siemens NXPLUS C, 2.6 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model PT COMPACT 3L1P (ZPUE), 2.9 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-3L1P, 2.900 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-3LP, 3.065 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-2LP+L, 3.067 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model PT COMPACT 2LP+L, 3.067 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model PT COMPACT 2L2P (ZPUE), 3.2 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model PT COMPACT 2LP+2L, 3.670 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-2LP+2L, 3.670 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-3L+LP, 3.670 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model PT COMPACT 2LP+P, 3.710 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-2LP+P, 3.710 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-3L+2LP, 4.275 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-2L-2P-P, 4.275 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-2LP+LP, 4.315 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model PT COMPACT 2LP+LP, 4.315 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model PT COMPACT 2LP2P_L, 4.315 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model CGMCOSMOS-2LP+2LP, 4.920 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model Siemens NXPLUS C, 5.737 kg SF6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model Siemens NXPLUS C, 5.9 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model Siemens NXPLUS C, 6.0 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model Siemens NXPLUS C, 6.172 kg SF_6	0	0	0	0	0	0	0	0	0
10 kV switchgear, model Siemens NXPLUS C, 6.276 kg SF_6	0	0	0	0	0	0	0	0	0
35 kV switchgear, model THO 36 / 0.98 kg SF_6	0	0	0	0	0	0	0	0	2
35 kV switchgear, model GL-107X (2012) / 2.4 kg SF_6	0	0	0	0	0	0	1	1	1
35 kV switchgear, model GL-107X (2005) / 2.6 kg SF_6	5	5	5	5	5	5	5	4	4
35 kV switchgear, model VOX 36 / 2.9 kg SF_6	0	0	2	7	7	7	12	12	16
Total units installed	**5**	**5**	**31**	**36**	**36**	**64**	**109**	**122**	**143**

	2015	2016	2017	2018	2019	2020	2021	2022	2023
10 kV switchgear, model PT COMPACT 3L1P (Ormazabal), 0.605 kg SF_6	2	2	2	2	2	2	2	2	NA
10 kV switchgear, model CGMCOSMOS-L, 0.605 kg SF_6	0	0	0	0	0	1	2	15	NA
10 kV switchgear, model CGMCOSMOS-S (Ormazabal), 0.770 kg SF_6	0	0	0	0	0	0	0	1	NA
10 kV switchgear, model Siemens 8DJH, 0.9 kg SF_6	0	0	0	0	0	0	4	4	NA
10 KV switchgear, model THO 24/SO5/E/THO-T1, 0.98 kg SF_6	64	65	65	67	67	84	92	92	NA
10 kV switchgear, model Siemens 8DJH, 1.2 kg SF_6	0	0	0	0	0	0	14	14	NA
10 kV switchgear, model GAE630, 1.2 kg SF_6	0	0	15	44	44	78	79	79	NA
10 kV switchgear, model GLX24, 1.2 kg SF_6	0	0	0	0	0	16	32	32	NA
10 kV switchgear, model GSEC1, 1.2 kg SF_6	0	0	0	0	0	12	12	12	NA
10 kV switchgear, model PT COMPACT 1P (Ormazabal), 1.25 kg SF_6	1	1	1	1	1	1	1	1	NA
10 kV switchgear, model CGMCOSMOS-P (Ormazabal), 1.25 kg SF_6	0	0	0	0	0	0	0	6	NA
10 kV switchgear, model PT COMPACT 2L1P, 1.3 kg SF_6	1	2	2	4	9	10	10	10	NA
10 kV switchgear, model AUGUSTE 2012 / 1.5 kg SF_6	0	29	36	44	45	49	49	49	NA
10 kV switchgear, model AUGUSTE 2012 / 1.5 kg SF_6	0	0	0	0	0	75	75	75	NA
10 kV switchgear, model AUGUSTE 50C 24-630-CTE, 1.5 kg SF_6	0	0	0	0	0	0	16	16	NA
10 kV switchgear, model PT COMPACT 1P (ZPUE), 1.6 kg SF_6	0	1	1	3	3	3	3	3	NA
10 kV switchgear, model CGMCOSMOS-LP, 1.855 kg SF_6	0	0	1	2	2	2	3	3	NA
10 kV switchgear, model Siemens NXPLUS C, 1.995 kg SF_6	0	0	0	0	0	0	0	1	NA
10 kV switchgear, model Siemens NXPLUS C, 2.1 kg SF_6	0	0	0	0	0	0	23	49	NA
10 kV switchgear, model GMA-24 / 2.2 kg SF_6	36	36	36	36	36	36	36	36	NA
10 kV switchgear, model PT COMPACT 2L1P (ZPUE), 2.25 kg SF_6	0	7	9	14	16	16	16	16	NA
10 kV switchgear, model PT COMPACT 2L1P (Ormazabal), 2.46 kg SF_6	22	22	22	22	22	22	22	22	NA
10 kV switchgear, model CGMCOSMOS-2LP, 2.460 kg SF_6	0	0	2	2	2	10	12	14	NA
10 kV switchgear, model CGMCOSMOS-P_L_P, 2.460 kg SF_6	0	0	0	0	0	0	1	1	NA
10 kV switchgear, model CGMCOSMOS-2L1P, 2.460 kg SF_6	0	0	0	0	0	0	0	2	NA
10 KV switchgear, model Siemens NXPLUS C, 2.514 kg SF6	0	0	0	0	0	0	0	1	NA
10 kV switchgear, model Siemens NXPLUS C, 2.6 kg SF_6	0	0	0	0	0	0	1	2	NA
10 kV switchgear, model PT COMPACT 3L1P (ZPUE), 2.9 kg SF_6	0	0	2	2	2	2	2	2	NA
10 kV switchgear, model CGMCOSMOS-3L1P, 2.900 kg SF_6	0	0	0	0	0	0	0	4	NA
10 kV switchgear, model CGMCOSMOS-3LP, 3.065 kg SF_6	0	0	0	1	1	1	3	3	NA
10 kV switchgear, model CGMCOSMOS-2LP+L, 3.067 kg SF_6	0	0	1	2	2	4	4	4	NA
10 kV switchgear, model PT COMPACT 2LP+L, 3.067 kg SF_6	0	4	4	4	4	4	4	4	NA
10 kV switchgear, model PT COMPACT 2L2P (ZPUE), 3.2 kg SF_6	0	0	0	2	2	2	2	2	NA
10 kV switchgear, model PT COMPACT 2LP+2L, 3.670 kg SF_6	0	0	2	2	2	2	2	2	NA
10 kV switchgear, model CGMCOSMOS-2LP+2L, 3.670 kg SF_6	0	0	1	3	3	3	5	5	NA
10 kV switchgear, model CGMCOSMOS-3L+LP, 3.670 kg SF_6	0	0	1	1	1	1	1	1	NA
10 kV switchgear, model PT COMPACT 2LP+P, 3.710 kg SF_6	0	0	1	1	1	1	1	2	NA
10 kV switchgear, model CGMCOSMOS-2LP+P, 3.710 kg SF_6	0	0	2	5	5	5	5	5	NA
10 kV switchgear, model CGMCOSMOS-3L+2LP, 4.275 kg SF_6	0	0	0	1	1	1	1	1	NA
10 kV switchgear, model CGMCOSMOS-2L-2P-P, 4.275 kg SF_6	0	0	0	0	0	0	1	1	NA
10 kV switchgear, model CGMCOSMOS-2LP+LP, 4.315 kg SF_6	0	0	0	2	2	4	4	7	NA
10 kV switchgear, model PT COMPACT 2LP+LP, 4.315 kg SF_6	1	2	2	2	2	2	2	3	NA
10 kV switchgear, model PT COMPACT 2LP2P_L, 4.315 kg SF_6	0	0	0	0	0	0	2	2	NA
10 kV switchgear, model CGMCOSMOS-2LP+2LP, 4.920 kg SF_6	0	0	0	0	0	1	3	5	NA
10 kV switchgear, model Siemens NXPLUS C, 5.737 kg SF6	0	0	0	0	0	0	0	1	NA
10 kV switchgear, model Siemens NXPLUS C, 5.9 kg SF_6	0	0	0	0	0	0	1	3	NA
10 kV switchgear, model Siemens NXPLUS C, 6.0 kg SF_6	0	0	0	0	0	0	3	5	NA
10 kV switchgear, model Siemens NXPLUS C, 6.172 kg SF_6	0	0	0	0	0	0	0	1	NA
10 kV switchgear, model Siemens NXPLUS C, 6.276 kg SF_6	0	0	0	0	0	0	0	1	NA
35 kV switchgear, model THO 36 / 0.98 kg SF_6	2	2	2	2	2	8	8	8	NA
35 kV switchgear, model GL-107X (2012) / 2.4 kg SF_6	1	1	1	1	1	1	1	1	NA
35 kV switchgear, model GL-107X (2005) / 2.6 kg SF_6	4	4	4	4	4	4	4	4	NA
35 kV switchgear, model VOX 36 / 2.9 kg SF_6	16	18	18	18	18	18	18	17	NA
Total units installed	**150**	**196**	**233**	**294**	**302**	**481**	**582**	**652**	**NA**

Table 4-161: Total high-voltage switchgear available in stock at the end of calendar year for the period 2003-2022, units

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
110 kV switchgear, model LTB 145D / 1B / 6 kg SF_6	0	0	0	2	2	2	2	2	4	6
110 kV switchgear, model GL-311 F1 / 12 kg SF_6	0	0	0	4	10	18	24	29	33	35
110 kV switchgear, model PASS MO 145 kV / 15 kg SF_6	0	0	0	0	0	0	0	0	0	0
110 kV switchgear, model HYpact / 45 kg SF_6	0	0	0	0	0	0	0	0	0	0
110 kV switchgear, model GL-311 F1 / 12 kg SF_6	1	1	6	21	29	29	29	29	29	29
110 kV switchgear, model GL-311 F1 P / 9.9 kg SF_6	0	0	0	0	0	0	0	3	4	4
110 kV switchgear, model GL-312F1/4031 P / VR / 7.8 kg SF_6	0	0	0	0	0	0	0	1	1	1
110 kV switchgear, model 120-SFM-32B / 6.8 kg SF_6	0	0	0	0	0	0	0	0	0	0
330 kV switchgear, model GL-315 F3 / 26 kg SF_6 and 15 kg CF_4	0	0	0	8	8	10	10	14	14	14
400 kV switchgear, model LTB 420 E2/ 30 kg SF_6	0	0	0	0	0	0	0	0	0	2
Total units installed	**1**	**1**	**6**	**35**	**49**	**59**	**65**	**78**	**85**	**91**
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
110 kV switchgear, model LTB 145D / 1B / 6 kg SF_6	6	8	8	9	11	11	11	11	11	11
110 kV switchgear, model GL-311 F1 / 12 kg SF_6	41	41	41	44	47	48	51	51	51	51
110 kV switchgear, model PASS MO 145 kV / 15 kg SF_6	0	0	0	0	0	3	3	3	3	3
110 kV switchgear, model HYpact / 45 kg SF_6	5	8	8	8	8	8	8	8	8	8
110 kV switchgear, model GL-311 F1 / 12 kg SF_6	29	29	29	29	29	29	29	32	32	32
110 kV switchgear, model GL-311 F1 P / 9.9 kg SF_6	4	4	4	4	4	4	4	4	4	4
110 kV switchgear, model GL-312F1/4031 P / VR / 7.8 kg SF_6	6	6	6	6	6	6	6	7	7	7
110 kV switchgear, model 120-SFM-32B / 6.8 kg SF_6	0	0	0	0	0	45	65	92	92	92
330 kV switchgear, model GL-315 F3 / 26 kg SF_6 and 15 kg CF_4	14	14	14	14	14	14	14	14	14	14
400 kV switchgear, model LTB 420 E2/ 30 kg SF_6	2	2	2	2	2	2	2	2	2	2
Total units installed	**107**	**112**	**112**	**116**	**121**	**170**	**193**	**224**	**224**	**224**

The amount of insulating gas (SF_6) in stock charged into medium-voltage switchgear in the Republic of Moldova is shown in Table 4-162.

Table 4-162: Total amount of insulating gas – SF_6, available in stock, charged into medium-voltage switchgear for the period 2006-2022, kg

	2006	2007	2008	2009	2010	2011	2012	2013	2014
10 kV switchgear, model PT COMPACT 3L1P (Ormazabal), 0.605 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6	1.2
10 kV switchgear, model CGMCOSMOS-L, 0.605 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-S (Ormazabal), 0.770 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model Siemens 8DJH, 0.9 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 KV switchgear, model THO 24/SO5/E/THO-T1, 0.98 kg SF_6	0.0	0.0	0.0	0.0	0.0	27.4	51.0	51.0	57.8
10 kV switchgear, model Siemens 8DJH, 1.2 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model GAE630, 1.2 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model GLX24, 1.2 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model GSEC1, 1.2 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model PT COMPACT 1P (Ormazabal), 1.25 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.3	1.3
10 kV switchgear, model CGMCOSMOS-P (Ormazabal), 1.25 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model PT COMPACT 2L1P, 1.3 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model AUGUSTE 2012 / 1.5 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model AUGUSTE 2012 / 1.5 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model AUGUSTE 50C 24-630-CTE, 1.5 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model PT COMPACT 1P (ZPUE), 1.6 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-LP, 1.855 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model Siemens NXPLUS C, 1.995 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model Siemens NXPLUS C, 2.1 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model GMA-24 / 2.2 kg SF_6	0.0	0.0	52.8	52.8	52.8	52.8	79.2	79.2	79.2
10 kV switchgear, model PT COMPACT 2L1P (ZPUE), 2.25 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model PT COMPACT 2L1P (Ormazabal), 2.46 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	7.4	36.9	54.1
10 kV switchgear, model CGMCOSMOS-2LP, 2.460 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-P_L_P, 2.460 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-2L1P, 2.460 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	2006	2007	2008	2009	2010	2011	2012	2013	2014
10 KV switchgear, model Siemens NXPLUS C, 2.514 kg SF6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model Siemens NXPLUS C, 2.6 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model PT COMPACT 3L1P (ZPUE), 2.9 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-3L1P, 2.900 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-3LP, 3.065 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-2LP+L, 3.067 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model PT COMPACT 2LP+L, 3.067 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model PT COMPACT 2L2P (ZPUE), 3.2 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model PT COMPACT 2LP+2L, 3.670 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-2LP+2L, 3.670 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-3L+LP, 3.670 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model PT COMPACT 2LP+P, 3.710 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-2LP+P, 3.710 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-3L+2LP, 4.275 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-2L-2P-P, 4.275 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-2LP+LP, 4.315 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model PT COMPACT 2LP+LP, 4.315 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model PT COMPACT 2LP2P_L, 4.315 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model CGMCOSMOS-2LP+2LP, 4.920 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model Siemens NXPLUS C, 5.737 kg SF6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model Siemens NXPLUS C, 5.9 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model Siemens NXPLUS C, 6.0 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model Siemens NXPLUS C, 6.172 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
10 kV switchgear, model Siemens NXPLUS C, 6.276 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
35 kV switchgear, model THO 36 / 0.98 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0
35 kV switchgear, model GL-107X (2012) / 2.4 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	2.4	2.4	2.4
35 kV switchgear, model GL-107X (2005) / 2.6 kg SF_6	13.0	13.0	13.0	13.0	13.0	13.0	13.0	10.4	10.4
35 kV switchgear, model VOX 36 / 2.9 kg SF_6	0.0	0.0	5.8	20.3	20.3	20.3	34.8	34.8	46.4
Total	**13.0**	**13.0**	**71.6**	**86.1**	**86.1**	**113.5**	**187.7**	**216.5**	**254.8**
	2015	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
10 kV switchgear, model PT COMPACT 3L1P (Ormazabal), 0.605 kg SF_6	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	NA
10 kV switchgear, model CGMCOSMOS-L, 0.605 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.6	1.2	9.1	NA
10 kV switchgear, model CGMCOSMOS-S (Ormazabal), 0.770 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.8	NA
10 kV switchgear, model Siemens 8DJH, 0.9 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	3.6	3.6	NA
10 KV switchgear, model THO 24/SO5/E/THO-T1, 0.98 kg SF_6	62.7	63.7	63.7	65.7	65.7	82.3	90.2	90.2	NA
10 kV switchgear, model Siemens 8DJH, 1.2 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	16.8	16.8	NA
10 kV switchgear, model GAE630, 1.2 kg SF_6	0.0	0.0	18.0	52.8	52.8	93.6	94.8	94.8	NA
10 kV switchgear, model GLX24, 1.2 kg SF_6	0.0	0.0	0.0	0.0	0.0	19.2	38.4	38.4	NA
10 kV switchgear, model GSEC1, 1.2 kg SF_6	0.0	0.0	0.0	0.0	0.0	14.4	14.4	14.4	NA
10 kV switchgear, model PT COMPACT 1P (Ormazabal), 1.25 kg SF_6	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3	NA
10 kV switchgear, model CGMCOSMOS-P (Ormazabal), 1.25 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.5	NA
10 kV switchgear, model PT COMPACT 2L1P, 1.3 kg SF_6	1.3	2.6	2.6	5.2	11.7	13.0	13.0	13.0	NA
10 kV switchgear, model AUGUSTE 2012 / 1.5 kg SF_6	0.0	43.5	54.0	66.0	67.5	73.5	73.5	73.5	NA
10 kV switchgear, model AUGUSTE 2012 / 1.5 kg SF_6	0.0	0.0	0.0	0.0	0.0	112.5	112.5	112.5	NA
10 kV switchgear, model AUGUSTE 50C 24-630-CTE, 1.5 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	24.0	24.0	NA
10 kV switchgear, model PT COMPACT 1P (ZPUE), 1.6 kg SF_6	0.0	1.6	1.6	4.8	4.8	4.8	4.8	4.8	NA
10 kV switchgear, model CGMCOSMOS-LP, 1.855 kg SF_6	0.0	0.0	1.9	3.7	3.7	3.7	5.6	5.6	NA
10 kV switchgear, model Siemens NXPLUS C, 1.995 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	NA
10 kV switchgear, model Siemens NXPLUS C, 2.1 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	48.3	102.9	NA
10 kV switchgear, model GMA-24 / 2.2 kg SF_6	79.2	79.2	79.2	79.2	79.2	79.2	79.2	79.2	NA
10 kV switchgear, model PT COMPACT 2L1P (ZPUE), 2.25 kg SF_6	0.0	15.8	20.3	31.5	36.0	36.0	36.0	36.0	NA
10 kV switchgear, model PT COMPACT 2L1P (Ormazabal), 2.46 kg SF_6	54.1	54.1	54.1	54.1	54.1	54.1	54.1	54.1	NA
10 kV switchgear, model CGMCOSMOS-2LP, 2.460 kg SF_6	0.0	0.0	4.9	4.9	4.9	24.6	29.5	34.4	NA
10 kV switchgear, model CGMCOSMOS-P_L_P, 2.460 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.5	NA
10 kV switchgear, model CGMCOSMOS-2L1P, 2.460 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.9	NA
10 KV switchgear, model Siemens NXPLUS C, 2.514 kg SF6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	NA
10 kV switchgear, model Siemens NXPLUS C, 2.6 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	2.6	5.2	NA

	2015	2016	2017	2018	2019	2020	2021	2022	2023
10 kV switchgear, model PT COMPACT 3L1P (ZPUE), 2.9 kg SF_6	0.0	0.0	5.8	5.8	5.8	5.8	5.8	5.8	NA
10 kV switchgear, model CGMCOSMOS-3L1P, 2.900 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	NA
10 kV switchgear, model CGMCOSMOS-3LP, 3.065 kg SF_6	0.0	0.0	0.0	3.1	3.1	3.1	9.2	9.2	NA
10 kV switchgear, model CGMCOSMOS-2LP+L, 3.067 kg SF_6	0.0	0.0	3.1	6.1	6.1	12.3	12.3	12.3	NA
10 kV switchgear, model PT COMPACT 2LP+L, 3.067 kg SF_6	0.0	12.3	12.3	12.3	12.3	12.3	12.3	12.3	NA
10 kV switchgear, model PT COMPACT 2L2P (ZPUE), 3.2 kg SF_6	0.0	0.0	0.0	6.4	6.4	6.4	6.4	6.4	NA
10 kV switchgear, model PT COMPACT 2LP+2L, 3.670 kg SF_6	0.0	0.0	7.3	7.3	7.3	7.3	7.3	7.3	NA
10 kV switchgear, model CGMCOSMOS-2LP+2L, 3.670 kg SF_6	0.0	0.0	3.7	11.0	11.0	11.0	18.4	18.4	NA
10 kV switchgear, model CGMCOSMOS-3L+LP, 3.670 kg SF_6	0.0	0.0	3.7	3.7	3.7	3.7	3.7	3.7	NA
10 kV switchgear, model PT COMPACT 2LP+P, 3.710 kg SF_6	0.0	0.0	3.7	3.7	3.7	3.7	3.7	7.4	NA
10 kV switchgear, model CGMCOSMOS-2LP+P, 3.710 kg SF_6	0.0	0.0	7.4	18.6	18.6	18.6	18.6	18.6	NA
10 kV switchgear, model CGMCOSMOS-3L+2LP, 4.275 kg SF_6	0.0	0.0	0.0	4.3	4.3	4.3	4.3	4.3	NA
10 kV switchgear, model CGMCOSMOS-2L-2P-P, 4.275 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	4.3	4.3	NA
10 kV switchgear, model CGMCOSMOS-2LP+LP, 4.315 kg SF_6	0.0	0.0	0.0	8.6	8.6	17.3	17.3	30.2	NA
10 kV switchgear, model PT COMPACT 2LP+LP, 4.315 kg SF_6	4.3	8.6	8.6	8.6	8.6	8.6	8.6	12.9	NA
10 kV switchgear, model PT COMPACT 2LP2P_L, 4.315 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	8.6	8.6	NA
10 kV switchgear, model CGMCOSMOS-2LP+2LP, 4.920 kg SF_6	0.0	0.0	0.0	0.0	0.0	4.9	14.8	24.6	NA
10 kV switchgear, model Siemens NXPLUS C, 5.737 kg SF6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	NA
10 kV switchgear, model Siemens NXPLUS C, 5.9 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	5.9	17.7	NA
10 kV switchgear, model Siemens NXPLUS C, 6.0 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	18.0	30.0	NA
10 kV switchgear, model Siemens NXPLUS C, 6.172 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.2	NA
10 kV switchgear, model Siemens NXPLUS C, 6.276 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.3	NA
35 kV switchgear, model THO 36 / 0.98 kg SF_6	2.0	2.0	2.0	2.0	2.0	7.8	7.8	7.8	NA
35 kV switchgear, model GL-107X (2012) / 2.4 kg SF_6	2.4	2.4	2.4	2.4	2.4	2.4	2.4	2.4	NA
35 kV switchgear, model GL-107X (2005) / 2.6 kg SF_6	10.4	10.4	10.4	10.4	10.4	10.4	10.4	10.4	NA
35 kV switchgear, model VOX 36 / 2.9 kg SF_6	46.4	52.2	52.2	52.2	52.2	52.2	52.2	49.3	NA
Total	**265.3**	**350.8**	**425.2**	**536.8**	**549.3**	**806.0**	**999.5**	**1,168.7**	**NA**

The amount of insulating gas (SF_6 and CF_4) in stock charged into high-voltage switchgear in the Republic of Moldova is shown in Tables 4-163 and 4-164.

Table 4-163: Total amount of insulating gas – SF_6, available in stock, charged into high-tension switchgear for the period 2003-2022, kg

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
110 kV switchgear, model LTB 145D / 1B / 6 kg SF_6	0.0	0.0	0.0	12.0	12.0	12.0	12.0	12.0	24.0	36.0
110 kV switchgear, model GL-311 F1 / 12 kg SF_6	0.0	0.0	0.0	48.0	120.0	216.0	288.0	348.0	396.0	420.0
110 kV switchgear, model PASS MO 145 kV / 15 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
110 kV switchgear, model HYpact / 45 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
110 kV switchgear, model GL-311 F1 / 12 kg SF_6	12.0	12.0	72.0	252.0	348.0	348.0	348.0	348.0	348.0	348.0
110 kV switchgear, model GL-311 F1 P / 9.9 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	29.7	39.6	39.6
110 kV switchgear, model GL-312F1/4031 P / VR / 7.8 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.8	7.8	7.8
110 kV switchgear, model 120-SFM-32B / 6.8 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
330 kV switchgear, model GL-315 F3 / 26 kg SF_6 and 15 kg CF_4	0.0	0.0	0.0	208.0	208.0	260.0	260.0	364.0	364.0	364.0
400 kV switchgear, model LTB 420 E2/ 30 kg SF_6	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	60.0
Total	**12.0**	**12.0**	**72.0**	**520.0**	**688.0**	**836.0**	**908.0**	**1,109.5**	**1,179.4**	**1,275.4**
	2013	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
110 kV switchgear, model LTB 145D / 1B / 6 kg SF_6	36.0	48.0	48.0	54.0	66.0	66.0	66.0	66.0	66.0	66.0
110 kV switchgear, model GL-311 F1 / 12 kg SF_6	492.0	492.0	492.0	528.0	564.0	576.0	612.0	612.0	612.0	612.0
110 kV switchgear, model PASS MO 145 kV / 15 kg SF_6	0.0	0.0	0.0	0.0	0.0	45.0	45.0	45.0	45.0	45.0
110 kV switchgear, model HYpact / 45 kg SF_6	225.0	360.0	360.0	360.0	360.0	360.0	360.0	360.0	360.0	360.0
110 kV switchgear, model GL-311 F1 / 12 kg SF_6	348.0	348.0	348.0	348.0	348.0	348.0	348.0	384.0	384.0	384.0
110 kV switchgear, model GL-311 F1 P / 9.9 kg SF_6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6	39.6
110 kV switchgear, model GL-312F1/4031 P / VR / 7.8 kg SF_6	46.8	46.8	46.8	46.8	46.8	46.8	46.8	54.6	54.6	54.6
110 kV switchgear, model 120-SFM-32B / 6.8 kg SF_6	0.0	0.0	0.0	0.0	0.0	306.0	442.0	625.6	625.6	625.6
330 kV switchgear, model GL-315 F3 / 26 kg SF_6 and 15 kg CF_4	364.0	364.0	364.0	364.0	364.0	364.0	364.0	364.0	364.0	364.0
400 kV switchgear, model LTB 420 E2/ 30 kg SF_6	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0	60.0
Total	**1,611.4**	**1,758.4**	**1,758.4**	**1,800.4**	**1,848.4**	**2,211.4**	**2,383.4**	**2,610.8**	**2,610.8**	**2,610.8**

Table 4-164: Total amount of insulating gas – CF_4 available in stock, charged into medium and high-tension switchgear for the period 2006-2022, kg

	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
330 kV switchgear, model GL-315 F3 / 26 kg SF_6 and 15 kg CF_4	120	120	150	150	210	210	210	210	210	210	210	210	210	210	210	210	210

2G3. N_2O from Product Uses

The methodology used in the estimation of N_2O emissions from source category 2G3 'N_2O from Product Uses' (anaesthesia) is represented by the following formula:

$$E_{pollutant} = (AR_{product} \bullet {}_{pollutant\ technology}) / 10^3$$

Where:

$E_{pollutant}$ – pollutant gas emissions from N_2O use in anaesthesia, t/yr;

$AR_{product}$ – activity rate for N_2O consumption in anaesthesia, t/yr;

$EF_{pollutant\ technology}$ – the emission factor for this pollutant technology, t/t (by default, 100% of the whole amount of N_2O used in anaesthesia is deemed to be emitted into the atmosphere).

AD for estimating nitrous oxide emissions from use of N_2O in anaesthesia was based on activity data provided by the former Ministry of Health, as a response to the Official Letters of the former Ministry of Ecology and Natural Resources (Table 4-165). In accordance with the response to the last Letter, dated March 1st, 2011, N_2O has not been used in anaesthesia anymore in the RoM since 2007.

Table 4-165: Amount of nitrous oxide used in anaesthesia between 1990-2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O consumption in anaesthesia, kg	66	55	50	60	50	1	2	3	5
	1999	2000	2001	2002	2003	2004	2005	2006	2007-2022
N_2O consumption in anaesthesia, kg	43	44	44	44	44	50	61	59	NO

Source: Ministry of Health of the RoM, through Letter No. 01-9/2513 dated 9.11.2007, as a response to Official request No. 01-07/1608 dated 15.10.2007 from the Ministry of Ecology and Natural Resources of the RM and through Letter No. 01-9/550 dated 01.03.2011, as a response to Official request No. 03-07/175 dated 02.02.2011 from the Ministry of Environment of the RM.

2G4. Other

Tobacco Combustion

The methodology used in the estimation of NO_x, CO, and NMVOC emissions from tobacco combustion (SNAP 060602), available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) is represented by the following formula:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant\ technology}) / 10^3$$

Where:

$E_{pollutant}$ – the emission of the specified pollutant from tobacco combustion, t/yr;

$AR_{product}$ – activity rate for burnt tobacco products, t/yr;

$EF_{pollutant\ technology}$ – default emission factor, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default emission factors (Table 4-166) for the Tier 2 methodological approach.

Statistical data regarding cigar and cigarette production is available in the Statistical Yearbooks of the RoM, the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022', as well as in the statistical database which can be accessed on-line on the NBS website of the RM[77]; At the same time, statistical data associated with the import and export of cigars and cigarettes was provided by the Customs Service, from the Automated System for Customs Data ASYCUDA World, which ensures the management and processing of customs forms and documents used in customs procedures, but offered only for the period 2013-2022; other available sources of information were also consulted[78].

[77] National Bureau of Statistics of the RoM, Statistical database: <http://statbank.statistica.md/pxweb/Dialog/varval.asp?ma=IND0301&ti=Productia+ principalelor+produse+industriale%2C+1997-2009&path= ../ Database/RO/14%20IND/IND03/&lang=1>

[78] <https://www.mold-street.com/?go=news&n=6123>, <https://www.mold-street.com/?go=news&n=9744>

Table 4-166: Tier 2 default EFs used for category 2G4 'Other' (Tobacco Combustion)

Source	GHG	Emission Factors	Unit
2G4 'Other' (Tobacco Combustion)	NO_x	1.80	kg/t of tobacco
	CO	55.10	
	NMVOC	4.84	

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Category 2D3i, SNAP 060602, Table 3-15, page 22-23.

According to the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) (source category 2D3i 'Other Solvent and Product Use' Snap 060602, page 21), a cigar contains 5 g of tobacco, whereas a cigarette – only 1 g of tobacco. In order to estimate the amount of tobacco burnt (Table 4-167), it was considered that the market share for cigarettes is 95%, whereas for cigars – 5%.

Table 4-167: Activity data on cigar and cigarette consumption in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cigars and cigarettes imported, billion units	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cigars and cigarettes produced, billion units	9.100	9.200	8.600	8.800	8.000	7.100	9.700	9.500	7.512	8.731	9.262
Cigars and cigarettes exported, billion units	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Cigars and cigarettes consumed, billion units	9.100	9.200	8.600	8.800	8.000	7.100	9.700	9.500	7.512	8.731	9.262
Amount of tobacco in cigars and cigarettes consumed, kt	10.920	11.040	10.320	10.560	9.600	8.520	11.640	11.400	9.014	10.477	11.114
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Cigars and cigarettes imported, billion units	NA	0.600	1.300	1.700	2.500	3.400	4.300	4.200	4.800	4.900	4.800
Cigars and cigarettes produced, billion units	9.421	6.310	7.126	7.050	6.195	5.031	4.975	3.990	4.878	6.261	6.462
Cigars and cigarettes exported, billion units	NA	0.100	0.040	0.040	0.100	0.100	0.100	0.300	0.200	0.200	0.300
Cigars and cigarettes consumed, billion units	9.421	6.810	8.386	8.710	8.595	8.331	9.175	7.890	9.478	10.961	10.962
Amount of tobacco in cigars and cigarettes consumed, kt	11.305	8.172	10.063	10.452	10.314	9.997	11.010	9.468	11.373	13.153	13.154
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Cigars and cigarettes imported, billion units	4.400	3.284	3.567	4.395	4.530	4.999	3.641	3.230	4.305	2.252	2.020
Cigars and cigarettes produced, billion units	4.656	3.472	2.322	1.776	1.839	1.411	0.660	0.650	0.494	1.381	0.530
Cigars and cigarettes exported, billion units	1.000	0.624	0.524	0.793	1.544	2.798	0.413	0.341	0.285	0.036	0.084
Cigars and cigarettes consumed, billion units	8.056	6.132	5.365	5.377	4.825	3.612	3.889	3.539	4.515	3.598	2.465
Amount of tobacco in cigars and cigarettes consumed, kt	9.667	7.359	6.438	6.453	5.790	4.334	4.667	4.247	5.417	4.317	2.958

Source: National Bureau of Statistics of the RoM through Statistical Yearbooks for 1994 (page 290), 1999 (page 305), 2003 (page 395), 2006 (page 311), 2007 (page 310), 2008 (page 306), 2009 (page 303), 2010 (page 303), 2011 (page 304), 2012 (page 307), 2013 (page 305), 2014 (page 301); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2021'; <https://www.mold-street.com/?go=news&n=6123>, <https://www.mold-street.com/?go=news&n=9744>; Customs Service of the Republic of Moldova, through Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; through Letter dated 19.02.2021, as a response to Letter 13-07/519 dated 09.02.2021, from the MARDE; Letter dated 20.02.2023, as a response to the request of the Environment Agency to No. 08/34/2023 dated 28.01.2023.

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (IPCC 2006 Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere.

In order to estimate indirect CO_2 emissions from use of tobacco, the following equation was used:

$$CO_2\ Emissions = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from use of tobacco, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%; 2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17);

44/12 – mass ratio of CO_2/C.

Use of Shoes

The methodology used in the estimation of NMVOC emissions from use of shoes (SNAP 060603), is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant\ technology}) / 10^3$$

Where:

$E_{pollutant}$ – emission of the specified pollutant from use of shoes, t/yr;

$AR_{product}$ – activity rate for use of shoes, million pairs/yr;

$EF_{pollutant\ technology}$ – default emission factor, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides a default emission factor (Table 4-168) for the Tier 2 methodological approach.

Table 4-168: Tier 2 default emission factor for category 2G4 'Other' (Use of Shoes)

Source	GHG	Emission factor	Unit
2G4 'Other' (Use of Shoes)	NMVOC	60	g/pair of shoes

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Category 2D3i, SNAP 060603, Table 3-16, p. 24.

Statistical data regarding shoe production (Table 4-169) is available in the Statistical Yearbooks of ATULBD and the RoM, as well as in the Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022'; at the same time, statistical data associated with the import and export of shoes was provided by the Customs Service.

Table 4-169: Activity data on shoe consumption in the RoM between 1990-2022, million pairs

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Shoe production, million pairs	23.200	20.800	16.268	13.197	9.467	7.606	6.929	6.193	4.591	3.747	5.912
Shoe export, million pairs	13.041	11.692	9.144	7.418	5.321	4.275	3.895	3.481	2.581	2.106	3.323
Shoe import, million pairs	14.725	13.202	10.325	8.376	6.009	4.828	4.398	3.931	2.914	2.378	3.752
Shoe consumption, million pairs	24.884	22.310	17.449	14.155	10.154	8.158	7.432	6.643	4.924	4.019	6.341
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Shoe production, million pairs	4.944	4.925	6.038	6.633	7.450	6.774	6.696	7.083	4.829	6.247	7.692
Shoe export, million pairs	2.779	2.768	3.394	3.728	4.188	3.808	3.764	3.981	2.715	3.511	4.324
Shoe import, million pairs	3.138	3.126	3.832	4.210	4.729	4.299	4.250	4.495	3.065	3.965	4.882
Shoe consumption, million pairs	5.303	5.283	6.476	7.114	7.991	7.266	7.182	7.597	5.180	6.701	8.250
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Shoe production, million pairs	7.448	8.329	7.607	5.547	5.156	4.647	4.352	3.785	3.272	3.593	3.047
Shoe export, million pairs	4.187	3.435	5.158	3.226	2.871	2.603	2.514	2.559	2.299	1.761	1.363
Shoe import, million pairs	4.728	2.819	6.169	4.278	5.316	6.513	5.807	6.991	5.723	6.628	3.996
Shoe consumption, million pairs	7.989	7.713	8.618	6.599	7.601	8.557	7.645	8.217	6.696	8.460	5.681

Source: Statistical Yearbooks of ATULBD for 1998-2021; Express information, Key performance indicators of ATULBD industry (excluding small businesses) for 2009-2021; Statistical Yearbooks of the RM for 1991-2022; Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022'; Customs Service of the RM, through Letter dated 20.02.2023, as a response to the request of the Environment Agency to No. 08/34/2023 dated 28.01.2023; through Letter dated 19.02.2021, as a response to Letter No. 13-07/519 dated 09.02.2021, from the MARDE; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020; Letter No. 28/07-612 dated 12.01.2018, as a response to the request of the Climate Change Office of the MARDE to No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-8785 dated 26.05.2016, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-2231 dated 26.02.2015, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 407/2015-01-09 dated 29.01.2015; Letter No. 15-03-05 dated 24.01.2014, as a response to the request of the Climate Change Office of the Ministry of Environment to No. 320/2014-01-01 dated 03.01.2014; Letter No. 28/07-1893 dated 23.02.2011, as a response to the request of the Ministry of Environment to No. 03-07/175 dated 02.02.2011.

Indirect CO_2 emissions were estimated taking into consideration the carbon content in NMVOC emissions. The default value used is 60% (2006 IPCC Guidelines, Volume 3, Chapter 5.5, page 5.17). By oxidation, this carbon is converted into CO_2 in the atmosphere.

In order to estimate indirect CO_2 emissions from use of shoes, the following equation was used:

$$CO_2\ Emission = NMVOC \bullet CC \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions from use of shoes, kt/yr;

NMVOC – total NMVOC emissions within the respective category, kt/yr;

CC – carbon content in NMVOC, fraction (the default value used is 60%, with a margin of 50-70%;

44/12 – mass ratio of CO_2/C.

Use of Fireworks

The methodology used in the estimation of NO_x, CO, and SO_2 emissions from use of fireworks (SNAP 060601), is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) and uses the following equation:

$$E_{pollutant} = (AR_{product} \bullet EF_{pollutant\ technology}) / 10^3$$

Where:

$E_{pollutant}$ – emission of the specified pollutant from use of fireworks, t/yr;

$AR_{product}$ – activity rate for use of fireworks, t/yr;

$EF_{pollutant\ technology}$ – default emission factor, kg/t.

The EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019) provides default emission factors (Table 4-170) for the Tier 2 methodological approach.

Table 4-170: Tier 2 default emission factors for category 2G4 'Other' (Use of Fireworks)

Source	GHG	Emission factors	Unit
2G4 'Other' (Use of Fireworks)	NO_x	0.260	kg/t of product
	CO	7.150	
	SO_2	3.020	

Source: EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Category 2D3i, SNAP 060601, Table 3-14, p. 22.

Statistical data associated with the import and export of fireworks (code: 3604 10 000 – signalling flares, rain rockets, and other pyrotechnic articles, as well as 3604 90 000 – other fireworks) was provided by the Customs Service, from the Automated System for Customs Data ASYCUDA World, which ensures the management and processing of customs forms and documents used in customs procedures, but offered only for the period 2013-2022 (Table 4-171).

Table 4-171: Activity data on fireworks import into the RoM between 2013-2022

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Fireworks, t	107.52	214.50	72.32	98.58	80.78	195.02	234.75	206.89	178.88	165.61
Signalling flares, rain rockets, t	2.85	29.04	11.19	15.08	31.83	30.01	43.50	57.89	48.57	28.87
Total fireworks and pyrotechnic articles, t	**110.37**	**243.54**	**83.51**	**113.66**	**112.61**	**225.02**	**278.25**	**264.78**	**227.45**	**194.48**

Source: Customs Service of the RoM, through Letter dated 20.02.2023, as a response to the request of the Environment Agency to No. 08/34/2023 dated 28.01.2023; through Letter dated 19.02.2021, as a response to Letter 13-07/519 dated 09.02.2021, from the MARDE; Letter No. 28/07-3025 dated 28.02.2020, as a response to the request of the Environment Agency to No. 08-310/1 dated 11.02.2020.

4.7.3. Uncertainties and Time-Series Consistency

2G1. Electrical Equipment

Uncertainties associated with the emission factors used in the estimation of SF_6 and PFC emissions from source category 2G1 'Electrical Equipment' reach up to circa 20% (2006 IPCC Guidelines). Uncertainties associated with activity data on the use of SF_6 and PFC as a dielectric are considered to be low (circa 5%). Thus, combined uncertainties associated with activity data and emission factors for this source category are estimated to be circa 20.62% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with the recommendations included in the 2006 IPCC Guidelines.

2G3. N_2O from Product Uses

Uncertainties associated with the emission factors used in the estimation of N_2O emissions from source category 2G3 'N_2O from Product Uses' are estimated to be circa 3%. Uncertainties associated with activity data on the use of N_2O in medical applications in the RM are considered to be low (circa 5%). Thus, combined uncertainties associated with activity data and emission factors for this source category are estimated to be circa 5.83% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with the recommendations included in the 2006 IPCC Guidelines.

2G4. Other

Uncertainties associated with the emission factors used in the estimation of GHG emissions from source category 2G4 'Other' (Tobacco Combustion and Use of Shoes) reach up to circa 50%. Uncertainties associated with activity data on use of tobacco and use of shoes are considered moderate (circa 15%). Thus, combined uncertainties associated with activity data and emission factors for source category 2G4 'Other' (Tobacco Combustion and Use of Shoes) are estimated to be circa 52.20% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with the recommendations included in the 2006 IPCC Guidelines.

4.7.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

4.7.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category following the Tier 1 methodological approach. Verification was focused on ensuring correct use of the default emission factors available in the 2006 IPCC Guidelines; on correct use of AD obtained from different reference sources, including official sources (i.e., National Bureau of Statistics, SOE 'Moldelectrica', SOE 'Premier Energy Distribution' JSC, 'Retelele Electrice de Distributie Nord' JSC) and the correct use of these. It should be noted that the AD and methods used for estimating GHG emissions from category 2G 'Other Product Manufacture and Use' were documented and archived both in hard copies and electronically.

4.7.6. Recalculations

2G1. Electrical Equipment

SF_6 and CF_4 emissions from category 2G1 'Electrical Equipment' were recalculated for the period 2003-2020 as a result of changing the GWP value for the 100-year horizon (GWP_{100}). The GWP_{100} value available in the IPCC AR5 (2014) was used instead of the GWP_{100} value available in the IPCC AR4 (2017) (for SF_6, the GWP_{100} value used in the previous inventory cycle was 22.800, whereas in the current inventory cycle – 23.500; and, for CF_4, the GWP_{100} value used in the previous inventory cycle was 7.390, whereas in the current inventory cycle – 6.630).

Compared to the emission values recorded in the NC5 of the RoM to the UNFCCC, the changes made resulted in an upward trend in GHG emissions from source category 2G1 'Electrical Equipment', varying from a minimum of 2.1% in 2006 to maximum of 3.1% in 2003-2005 (Table 4-172).

Table 4-172: Recalculations of SF_6 and CF_4 emissions from source category 2G1 'Electrical Equipment' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
NC5	0.01	0.01	0.04	0.33	0.43	0.53	0.57	0.70	0.74	0.80
BTR1	0.01	0.01	0.04	0.34	0.44	0.54	0.58	0.72	0.76	0.82
Difference, %	3.1	3.1	3.1	2.1	2.4	2.3	2.4	2.3	2.3	2.4
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	1.01	1.09	1.09	1.12	1.16	1.38	1.48	1.62		
BTR1	1.03	1.12	1.12	1.15	1.19	1.41	1.52	1.67	1.68	1.69
Difference, %	2.5	2.6	2.6	2.6	2.6	2.7	2.7	2.7		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

For 2021-2022, SF_6 and CF_4 emissions from the respective category were estimated for the first time. The results obtained show that the respected emissions had increased in the Republic of Moldova by 230 times between 2003 and 2022.

The table below shows SF_6 and CF_4 emissions by substance in metric tonnes and expressed in CO_2 equivalent (Table 4-173).

Table 4-173: SF_6 and CF_4 emissions from source category 2G1 'Electrical Equipment' in the RoM between 2003-2022

	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
	2G1 'Electrical Equipment'									
SF_6, t	0.0003	0.0003	0.0019	0.0135	0.0179	0.0219	0.0238	0.0290	0.0309	0.0335
SF_6, kt CO_2 eq.	**0.0073**	**0.0073**	**0.0440**	**0.3183**	**0.4210**	**0.5142**	**0.5588**	**0.6820**	**0.7259**	**0.7881**
CF_4, t	NO	NO	NO	0.0031	0.0031	0.0039	0.0039	0.0055	0.0055	0.0055
CF_4, kt CO_2 eq.	NO	NO	NO	**0.0207**	**0.0207**	**0.0259**	**0.0259**	**0.0362**	**0.0362**	**0.0362**
	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
	2G1 'Electrical Equipment'									
SF_6, t	0.0423	0.0462	0.0462	0.0475	0.0489	0.0586	0.0631	0.0695	0.0699	0.0702
SF_6, kt CO_2 eq.	**0.9947**	**1.0864**	**1.0869**	**1.1165**	**1.1494**	**1.3764**	**1.4821**	**1.6331**	**1.6422**	**1.6501**
CF_4, t	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055	0.0055
CF_4, kt CO_2 eq.	**0.0362**	**0.0362**	**0.0362**	**0.0362**	**0.0362**	**0.0362**	**0.0362**	**0.0362**	**0.0362**	**0.0362**

2G3. N_2O from Product Uses

N_2O emissions from source category 2G3 'N_2O from Product Uses' were recalculated for the period 1990-2006 (Table 4-174), as a result of changing the GWP value for the 100-year horizon (GWP_{100}).

The 265 GWP_{100} value available in the IPCC AR5 (2014) was used instead of the 298 GWP_{100} value available in the IPCC AR4 (2007). Between 2007-2022, no N_2O emissions were recorded from category 2G3 'N_2O from Product Uses'.

Table 4-174: N_2O emissions from source category 2G3 'N_2O from Product Uses' in the RoM between 1990-2006

	1990	1991	1992	1993	1994	1995	1996	1997	1998
N_2O emissions, tone	0.0001	0.0001	0.0001	0.0001	0.0001	0.0000	0.0000	0.0000	0.0000
N_2O emissions, kt CO_2 equivalent	0.0175	0.0146	0.0133	0.0159	0.0133	0.0003	0.0005	0.0008	0.0013
	1999	2000	2001	2002	2003	2004	2005	2006	%
N_2O emissions, tone	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0001	0.0001	-10.6
N_2O emissions, kt CO_2 equivalent	0.0114	0.0117	0.0117	0.0117	0.0117	0.0133	0.0162	0.0156	-10.6

2G4. Other

Indirect CO_2 emissions from category 2G4 'Other' were not recalculated in the current inventory cycle (for the year 2020, the activity data associated with footwear production on the territory of ATULBD were specified). For the years 2021 and 2022, indirect CO_2 emissions from the respective category have been estimated for the first time. The obtained results show that the respective emissions decreased in the Republic of Moldova by about 77% between 1990-2022 (Tab. 4-175).

Table 4-175: Recalculations of indirect CO_2 emissions from source category 2G4 'Other' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	3.40	3.06	2.41	1.98	1.44	1.17	1.10	1.00	0.75	0.64	0.96
BTR1	3.40	3.06	2.41	1.98	1.44	1.17	1.10	1.00	0.75	0.64	0.96
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.82	0.78	0.96	1.05	1.16	1.07	1.07	1.10	0.80	1.02	1.23
BTR1	0.82	0.78	0.96	1.05	1.16	1.07	1.07	1.10	0.80	1.02	1.23
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	1.16	1.10	1.21	0.94	1.06	1.18	1.06	1.13	0.94		
BTR1	1.16	1.10	1.21	0.94	1.06	1.18	1.06	1.13	0.94	1.16	0.78
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

4.7.7. Planned Improvements

Potential improvements under category 2G 'Other Product Manufacture and Use' could include specifying the activity data used in the estimation of GHG emissions from this category for the period 1990-2022. Likewise, activity data is to be collected for the use of fireworks (code 3604 10 000 – signalling flares, rain rockets, and other pyrotechnic articles, as well as other fireworks – code 3604 90 000), and for the period 1990-2012 (in the previous two inventory cycles, it was possible to collect data only for the period 2013-2022), in order to estimate indirect GHG emissions from the respective emission source (SNAP 060601) under category 2G 'Other Product Manufacture and Use'.

4.8. Other (Source Category 2H)

4.8.1. Source Category Description

Category 2H 'Other', covers GHG emissions generated from the following emission sources: 2H1 'Pulp and Paper Industry' and 2H2 'Food and Beverage Industry'. In the RoM, no pulp and paper is produced, and there are no recorded emissions from category 2H1, respectively, and are reported as Not Occurring (NO).

NMVOC emissions have been reported from source category 2H2 'Food and Beverage Industry'. Between 1990 and 2022, the respective emissions had decreased by circa 68.7% (Table 4-176).

It should be noted that in the base year (1990), circa 91.4% of the total NMVOC emissions were generated from source category 2H2a 'Bread Making and Other Food'. By 2022, the share of this category in the total NMVOC emissions had decreased to circa 64.4% (Figure 4-4).

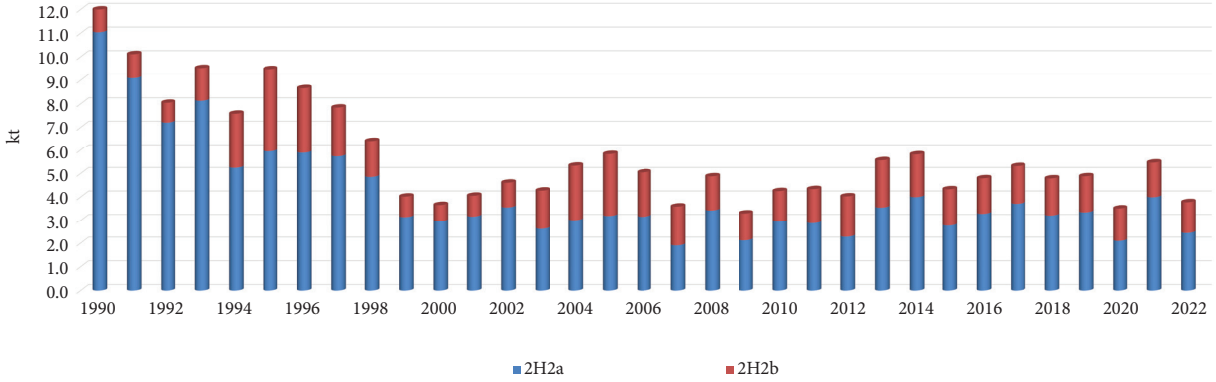


Figure 4-4: NMVOC emissions from category 2H2 'Food and Beverages Industry' in the RoM between 1990-2022.

Table 4-176: NMVOC emissions from source category 2H2 'Food and Beverage Industry' between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
2H2a 'Bread Making and Other Food'	11.04	9.09	7.21	8.14	5.25	5.95	5.89	5.73	4.86	3.15	2.97
2H2b 'Alcoholic Beverages'	1.03	1.02	0.84	1.39	2.33	3.53	2.78	2.11	1.57	0.87	0.69
2H2 'Food and Beverage Industry'	12.08	10.11	8.05	9.52	7.58	9.47	8.67	7.84	6.42	4.02	3.66
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
2H2a 'Bread Making and Other Food'	3.17	3.56	2.61	3.01	3.19	3.16	1.91	3.43	2.12	2.93	2.86
2H2b 'Alcoholic Beverages'	0.89	1.05	1.66	2.32	2.63	1.89	1.69	1.45	1.18	1.33	1.48
2H2 'Food and Beverage Industry'	4.05	4.61	4.27	5.33	5.83	5.05	3.59	4.88	3.30	4.25	4.34
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
2H2a 'Bread Making and Other Food'	2.28	3.55	4.00	2.75	3.29	3.71	3.21	3.35	2.10	3.99	2.44
2H2b 'Alcoholic Beverages'	1.75	2.01	1.82	1.58	1.51	1.60	1.58	1.53	1.42	1.47	1.34
2H2 'Food and Beverage Industry'	4.03	5.56	5.81	4.33	4.80	5.32	4.79	4.88	3.51	5.46	3.78

4.8.2. Methodologies, Emission Factors and Activity Data

a) Bread Making and Other Food

Methodological issues pertaining to the calculation of NMVOC emissions from bread making and other food are addressed in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019). The estimation method used is based on multiplying default EF values (Table 4-177) by activity data on bread making and other food available in the national statistics (Table 4-178).

Table 4-177: Default EFs used in the estimation of NMVOC emissions from Bread Making and Other Food

Source	Bread Making and Other Food	NMVOC, kg/t
Bread Making and Other Food	Meat processing	0.33
	Fish processing	1.0
	Grain drying in elevators	1.3
	Sugar; Margarine and solid cooking fats	10
	Cakes, biscuits and breakfast cereals; Animal Feed	1
	Bread	4.5

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), 2H2 Food and Beverages Industry, SNAP 040605 – Bread Making and Other Food, Tables 3-2, 3-3, 3-4, 3-11, 3-18, 3-19, 3-20, 3-21, 3-22. Pages 10-20.

Table 4-178: Activity data on bread making and other food in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Meat	257.90	218.50	136.00	114.20	85.90	58.40	52.60	50.80	27.30	25.72	13.35
Fish	9.50	5.20	6.50	9.50	2.10	0.00	0.00	0.90	0.80	1.00	1.90
Dried grains in elevators	2,169.79	2,539.63	1,725.93	2,609.94	1,363.89	1,687.86	1,333.59	1,804.73	1,430.51	1,040.44	936.06
Sugar	435.80	236.90	192.20	230.20	166.70	218.70	264.50	213.30	194.50	100.50	105.40
Margarine	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02
Confectionery Products	24.30	23.50	12.10	10.08	5.00	5.17	5.15	5.55	9.20	8.42	8.75
Bread	601.90	528.30	468.60	431.70	325.20	268.40	252.50	221.90	180.20	147.05	138.13
Animal Feed	1037.29	946.19	867.50	440.21	309.79	333.63	350.39	231.89	221.18	108.60	59.79

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Meat	7.30	11.26	14.86	10.18	6.65	10.23	16.12	12.81	16.26	24.70	28.51
Fish	2.30	2.70	2.70	2.70	3.00	2.50	2.30	4.60	3.70	1.30	7.58
Dried grains in elevators	910.74	924.90	617.54	877.31	852.80	692.11	287.30	939.60	693.69	806.73	850.14
Sugar	132.60	167.60	107.10	110.90	133.47	149.05	73.96	133.97	38.37	103.21	88.44
Margarine	1.03	2.62	3.30	3.52	3.39	2.62	2.23	1.94	1.66	1.27	1.12
Confectionery Products	12.83	15.85	18.04	17.88	20.73	21.69	22.28	22.91	23.63	27.72	29.38
Bread	133.28	130.78	144.65	145.83	142.03	144.85	154.77	169.81	161.56	160.41	162.92
Animal Feed	31.44	41.38	28.09	46.06	50.84	64.34	46.42	51.04	60.14	74.41	75.40
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Meat	31.60	35.50	44.07	45.96	45.94	55.93	62.23	62.65	70.50	66.22	74.09
Fish	7.73	8.49	8.77	9.97	8.09	7.79	7.97	7.42	7.57	8.56	8.46
Dried grains in elevators	433.11	955.03	1,031.21	798.57	1,089.61	1,197.28	1,241.26	1,250.21	558.39	1,632.58	725.79
Sugar	83.44	140.30	177.69	84.52	100.00	128.98	73.91	86.93	54.37	101.20	67.80
Margarine	0.48	0.71	C	C	C	C	C	C	C	C	C
Confectionery Products	31.33	34.63	34.88	34.26	35.14	36.49	37.88	40.23	39.41	39.83	38.84
Bread	161.77	165.45	160.26	161.33	157.55	157.97	156.33	158.11	148.85	154.73	141.88
Animal Feed	96.28	97.79	98.47	80.12	101.73	94.03	89.65	74.79	87.16	90.96	103.36

Source: Statistical Yearbooks of the RoM for 1994 (page 289-290), 1999 (page 304-305), 2003 (page 393-394), 2006 (page 309-310), 2010 (page 301-303), 2014 (page 299-301); Statistical Reports PROD-MOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022'; Statistical Yearbooks of ATULBD for 1998 (page 177), 2000 (page 100), 2002 (page 104), 2005 (page 94), 2007 (page 93), 2009 (page 93), 2011 (page 95), 2014 (page 89), 2017 (page 102), 2020 (page 103), 2021 (page 104).

Activity data on the amount of dried grains in elevators was inferred from the information available in the national statistics of the RoM and ATULBD (Table 4-179).

Table 4-179: Selective activity data on agricultural crops in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Wheat (winter and spring), kt	1,129.0	1,056.5	925.8	1,577.8	714.2	1,305.2	784.2	1,344.7	1,104.7	922.4	813.0
Barley (winter and spring), kt	417.9	427.0	405.0	553.4	402.2	337.6	141.0	288.7	271.0	214.8	155.4
Oat, kt	3.8	5.0	6.8	12.4	9.1	10.4	4.3	11.0	10.3	6.2	3.5
Grain maize, kt	885.5	1,501.2	635.6	1,375.0	654.2	948.6	1,006.6	1,788.0	1,272.7	1,151.3	1,050.4
Sunflower, kt	252.2	151.4	176.2	200.6	164.7	208.1	284.0	174.3	196.4	291.6	305.1
Soy, kt	23.8	33.4	7.9	9.3	4.0	3.3	2.5	2.7	6.0	13.7	11.6
Oilseed rape, kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.2	1.1
Total cereals, kt	2,712.2	3,174.5	2,157.4	3,728.5	1,948.4	2,813.1	2,222.7	3,609.5	2,861.0	2,601.1	2,340.2
Share of cereals dried in elevators, % of total	80.0	80.0	80.0	70.0	70.0	60.0	60.0	50.0	50.0	40.0	40.0
Cereals dried in elevators, kt	2,169.8	2,539.6	1,725.9	2,609.9	1,363.9	1,687.9	1,333.6	1,804.7	1,430.5	1,040.4	936.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Wheat (winter and spring), kt	1,326.4	1,254.4	105.2	951.0	1,174.3	721.0	430.5	1,345.8	856.3	898.3	958.1
Barley (winter and spring), kt	270.2	263.0	67.4	306.7	267.2	230.3	120.9	378.5	315.4	259.1	246.0
Oat, kt	7.4	4.9	3.6	10.4	7.9	6.4	1.1	3.9	1.6	3.2	3.7
Grain maize, kt	1,141.9	1,206.3	1,440.2	1,845.1	1,523.4	1,327.6	363.2	1,484.1	1,159.6	1,462.1	1,547.2
Sunflower, kt	278.3	340.9	421.4	354.8	368.7	396.1	158.7	387.2	310.2	440.2	497.4
Soy, kt	10.5	12.6	19.4	40.2	66.4	80.2	40.0	58.8	50.1	113.0	80.6
Oilseed rape, kt	1.0	1.0	1.2	1.1	3.4	6.9	34.9	100.1	81.6	51.0	67.7
Total cereals, kt	3,035.8	3,083.0	2,058.5	3,509.2	3,411.2	2,768.4	1,149.2	3,758.4	2,774.7	3,226.9	3,400.6
Share of cereals dried in elevators, % of total	30.0	30.0	30.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Cereals dried in elevators, kt	910.7	924.9	617.5	877.3	852.8	692.1	287.3	939.6	693.7	806.7	850.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Wheat (winter and spring), kt	604.0	1,264.8	1,361.7	1,185.7	1,664.2	1,549.3	1,469.4	1,447.9	655.2	1,956.5	1,058.6
Barley (winter and spring), kt	143.1	276.2	289.3	236.2	320.0	301.6	206.9	197.3	118.4	307.5	160.2
Oat, kt	2.0	4.0	3.1	1.7	3.1	3.7	1.6	1.6	1.7	2.7	1.8
Grain maize, kt	587.2	1,546.5	1,642.1	1,133.6	1,485.5	1,871.0	2,208.0	2,263.7	821.2	3,008.4	810.3
Sunflower, kt	339.1	602.2	627.1	562.3	789.4	925.1	898.7	915.3	547.3	1,084.0	730.1
Soy, kt	48.9	67.6	111.4	49.2	43.8	48.5	59.7	64.8	33.4	51.4	33.0
Oilseed rape, kt	8.1	58.8	90.2	25.6	52.4	89.9	120.8	110.2	56.3	119.9	109.2
Total cereals, kt	1,732.4	3,820.1	4,124.8	3,194.3	4,358.4	4,789.1	4,965.1	5,000.9	2,233.5	6,530.3	2,903.1
Share of cereals dried in elevators, % of total	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0	25.0
Cereals dried in elevators, kt	433.1	955.0	1,031.2	798.6	1,089.6	1,197.3	1,241.3	1,250.2	558.4	1,632.6	725.8

Source: National Bureau of Statistics, Statistical database, 'Sown area, average yield on agricultural crops, 1990-2022': <http://statbank.statistica.md/pxweb/pxweb/ro/40%20Statistica%20economica/40%20Statistica%20economica__16%20AGR__AGR020/AGR020100.px/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>; Statistical Yearbooks of ATULBD for 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 98), 2014 (page 95), 2017 (page 112), 2020 (page 113), 2021 (page 113).

Only agricultural crops, the production of which is dried in elevators, were considered. The share of cereal production dried in elevators was determined by the opinion of experts, based on national practices during the period under review.

b) Alcoholic Beverages

Methodological issues associated with the estimation of NMVOC emissions from the production of alcoholic beverages are addressed in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019).

The estimation method is based on multiplying default values of emission factors (Table 4-180) by activity data on the production of alcoholic beverages available in national statistics (Table 4-181).

Table 4-180: EFs used in the estimation of NMVOC emissions from alcoholic beverage production

Source	Alcoholic Beverages	NMVOC, kg / hl
Alcoholic Beverages	Red Wine	0.080
	White Wine, Beer	0.035
	Spirits (unspecified)	15.0
	Whisky / Grain Whisky / Vodka	7.5
	Divin (Cognac) / Brandy	3.5

Source: EMEP/EEA Atmospheric Emissions Inventory Guidebook, (2019), 2H2 Food and Beverages Industry SNAP 040606 – Alcoholic Beverages, Tables 3-24, 3-25, 3-26, 3-27, 3-28, 3-30, 3-31. Pages 21-24.

Table 4-181: AD on the production of alcoholic beverages in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Wine, thousand hl	1,630.0	1,430.0	920.0	1,130.0	977.8	996.9	1,458.0	1,941.5	1,239.6	690.1	1,092.2
White wine, thousand hl	764.5	670.7	431.5	530.0	458.6	467.5	683.8	910.6	581.4	323.7	512.3
Red wine, thousand hl	865.5	759.3	488.5	600.0	519.2	529.4	774.2	1,030.9	658.2	366.4	580.0
Wines of Porto, Madeira, Sherry, Tokay and other, thousand hl	0.218	0.189	0.126	0.157	0.135	0.142	0.216	0.291	0.183	0.102	0.163
Sparkling wine, thousand hl	80.4	78.3	85.4	88.8	74.2	94.8	141.9	134.5	51.9	67.5	41.6
Brandy, thousand hl	139.4	140.2	75.0	74.0	79.3	102.7	45.7	58.6	49.7	48.6	71.8
Grain Whisky and Liqueurs, thousand hl	55.9	55.6	67.6	139.4	264.7	412.7	335.8	237.0	174.1	87.0	48.9
Beer, thousand hl	760.0	660.0	430.0	360.0	285.0	302.9	256.0	262.7	300.1	220.9	257.9
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Wine, thousand hl	1,564.2	1,494.0	1,921.8	3,351.4	3,643.5	1,886.8	1,258.1	1,553.0	1,263.1	1,285.5	1,260.6
White wine, thousand hl	733.6	700.7	901.3	1,571.8	1,710.2	983.0	717.9	814.4	600.4	591.7	664.3
Red wine, thousand hl	830.6	793.3	1,020.5	1,779.6	1,933.3	903.8	540.2	738.6	662.7	693.8	596.3
Wines of Porto, Madeira, Sherry, Tokay and other, thousand hl	0.235	0.225	0.290	0.302	0.324	0.134	0.075	0.092	0.069	0.105	0.111
Sparkling wine, thousand hl	58.4	61.3	73.9	93.8	105.1	40.2	54.1	57.3	50.0	55.6	68.6
Brandy, thousand hl	95.6	103.8	136.1	142.8	171.1	79.1	82.4	103.7	69.8	74.6	91.2
Grain Whisky and Liqueurs, thousand hl	59.4	77.9	139.8	212.9	238.8	196.3	172.2	129.1	110.8	127.1	140.2
Beer, thousand hl	336.2	462.4	599.1	695.7	777.8	913.3	1,014.6	866.6	781.7	952.6	1,068.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Wine, thousand hl	1,422.0	1,551.7	1,409.5	1,356.5	1,345.8	1,652.3	1,717.3	1,787.2	1,746.2	1,577.4	1,455.9
White wine, thousand hl	679.2	694.3	765.1	622.5	576.2	775.7	774.9	781.5	801.4	676.3	655.2
Red wine, thousand hl	742.8	857.4	644.3	734.0	768.4	880.8	932.5	979.2	922.5	877.3	778.2
Wines of Porto, Madeira, Sherry, Tokay and other, thousand hl	0.053	0.065	0.035	0.037	0.047	0.043	0.017	0.021	0.020	0.020	0.019
Sparkling wine, thousand hl	65.4	60.0	52.2	50.2	63.3	65.2	67.4	67.9	66.3	96.5	100.0
Brandy, thousand hl	109.4	118.0	93.9	70.2	50.1	84.0	87.7	91.9	73.3	96.1	90.1
Grain Whisky and Liqueurs, thousand hl	165.9	196.1	183.4	162.3	162.8	156.9	151.9	143.0	137.0	134.3	121.3
Beer, thousand hl	1,118.4	1,029.3	984.8	994.5	847.8	866.5	819.5	839.3	832.6	924.6	885.4

Source: Statistical Yearbooks of the RoM for 1994 (pages 289-290), 1999 (pages 304-305), 2003 (pages 393-394), 2006 (pages 309-310), 2010 (pages 301-303), 2014 (pages 299-301);); Statistical Reports PRODMOLD-A 'Total production, as a natural expression, in the Republic of Moldova, by product type, for 2005-2022'; Statistical Yearbooks of ATULBD for 1998 (page 177), 2000 (page 100), 2002 (page 104), 2005 (page 94), 2007 (page 93), 2009 (page 93), 2011 (page 95), 2014 (page 89), 2017 (page 102), 2020 (page 103); 2021 (page 103).

4.8.3. Uncertainties and Time-Series Consistency

The primary uncertainty-related factors pertain to methodology, emission factors utilised in the estimation of GHG emissions originating from source category 2H2 'Food and Beverages Industry', and the quality of activity data available.

Uncertainties associated with the default emission factors utilised in the estimation of NMVOC emissions from this source category may be with a coverage factor of 2. Uncertainties associated with

activity data on bread making and other food and alcoholic beverage production in the Republic of Moldova are low, estimated to be circa 5%.

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

4.8.4. Description of applied flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

4.8.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category, following the Tier 1 methodological approach.

Verification was focused on comparing and verifying the correct use of the emission factors including the default emission factors used according to the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019); verification of activity data obtained from different reference sources, including official sources and their correct application, etc.

It should be noted that the activity data and methods used in the estimation of GHG emissions from source category 2H2 'Food and Beverages Industry' were documented and archived both in hard copies and electronically.

4.8.6. Recalculations

NMVOC emissions from source category 2H2 'Food and Beverages Industry' were recalculated for the period 1993-2020, as a result of considering the activity data associated with the amount of dry grain in elevators on the territory of ATULBD for the first time.

Compared to the emission values recorded in NC5 of the RoM to the UNFCCC, the changes made resulted in an upward trend in NMVOC emissions from category 2H2 'Food and Beverages Industry', varying from a minimum of 0.2% in 2007 up to a maximum of 4.1% in 2019 (Table 4-182).

Table 4-182: Recalculations of NMVOC emissions from source category 2H2 'Food and Beverages Industry' included in the NC5 of the Republic of Moldova to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	12.08	10.11	8.05	9.22	7.42	9.34	8.58	7.70	6.30	3.95	3.61
BTR1	12.08	10.11	8.05	9.52	7.58	9.47	8.67	7.84	6.42	4.02	3.66
Difference, %	0.0	0.0	0.0	3.3	2.1	1.5	1.0	1.9	1.9	1.8	1.3
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	3.99	4.55	4.27	5.30	5.78	5.03	3.59	4.85	3.25	4.20	4.28
BTR1	4.05	4.61	4.27	5.33	5.83	5.05	3.59	4.88	3.30	4.25	4.34
Difference, %	1.6	1.4	0.0	0.7	0.9	0.4	0.2	0.5	1.4	1.3	1.4
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	3.99	5.47	5.72	4.23	4.66	5.21	4.69	4.69	3.51		
BTR1	4.03	5.56	5.81	4.33	4.80	5.32	4.79	4.88	3.51	5.46	3.78
Difference, %	0.9	1.7	1.7	2.3	2.8	2.0	2.2	4.1	0.2		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

For 2021-2022, NMVOC emissions from the respective category have been estimated for the first time. The results obtained show that NMVOC emissions from category 2H2 'Food and Beverages Industry' decreased by circa 68.7% between 1990 and 2022.

4.8.7. Planned Improvements

Possible improvements may include updating of the activity data used in the estimation of NMVOC emissions from source category 2H2 'Food and Beverages Industry' for the reporting period within the previous inventory cycles.

CHAPTER 5. SECTOR 3 'AGRICULTURE'

5.1. Overview

The main sources covered by Sector 3 'Agriculture' include methane emissions from animal breeding, particularly from categories 3A 'Enteric Fermentation' and 3B 'Manure Management'; nitrous oxide emissions from categories 3B 'Manure Management' and 3D 'Agricultural Soils'; as well as carbon dioxide emissions from category 3H 'Urea Application' to agricultural land.

As rice is not cultivated and there are no savannas, no GHG emissions were reported from categories 3C 'Rice Cultivation' and 3E 'Prescribed Burning of Savannas'. Likewise, GHG emissions from source category 3F 'Field Burning of Agricultural Residues' were reported under Sector 4 'Land Use, Land-Use Change and Forestry', source category 4B1 'Cropland Remaining Cropland'.

A brief overview, methodological issues and data sources, key categories, uncertainties and time-series consistency, QA and QC procedures, recalculations made, and planned improvements are described for each source category in this sector.

5.1.1. Summary of Emission Trends

With reference to the inventory of GHG emissions from the agriculture sector, the statistical system of the RoM covered the entire territory of the country during the years 1990-1992, and starting from 1993, the statistical information published by the NBS covered only the territory on the RBDR. For the territory on the LBDR, the statistical information available on the web page[79] of the Ministry of Economic Development of the ATULBD was used. In the structure of GHG emissions at sectoral level, the contribution of ATULBD varied during the period under review between a minimum of 5.4% in 2008 and a maximum of 10.5% in 2019 (Table 5-1).

Table 5-1: Evolution of total direct GHG emissions from Sector 3 'Agriculture' in the RoM, disaggregated by region between 1990-2022, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RBDR	IE	IE	IE	3,534.85	3,242.74	2,892.69	2,639.84	2,372.64	2,293.06	2,096.25	1,970.78
LBDR	IE	IE	IE	302.68	338.69	327.60	281.78	254.23	253.29	239.21	207.70
RoM: total	**5,101.04**	**4,729.89**	**4,360.93**	**3,837.53**	**3,581.43**	**3,220.29**	**2,921.62**	**2,626.87**	**2,546.35**	**2,335.46**	**2,178.48**
RBDR, %	NE	NE	NE	92.1	90.5	89.8	90.4	90.3	90.1	89.8	90.5
LBDR, %	NE	NE	NE	7.9	9.5	10.2	9.6	9.7	9.9	10.2	9.5
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RBDR	2,064.13	2,136.67	1,955.87	1,949.75	1,935.67	1,920.14	1,553.92	1,621.06	1,627.20	1,674.50	1,597.71
LBDR	196.78	191.75	144.44	130.62	135.26	112.95	92.60	91.90	110.87	129.69	137.25
RoM: total	**2,260.91**	**2,328.42**	**2,100.30**	**2,080.37**	**2,070.93**	**2,033.09**	**1,646.52**	**1,712.97**	**1,738.07**	**1,804.19**	**1,734.96**
RBDR, %	91.3	91.8	93.1	93.7	93.5	94.4	94.4	94.6	93.6	92.8	92.1
LBDR, %	8.7	8.2	6.9	6.3	6.5	5.6	5.6	5.4	6.4	7.2	7.9
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RBDR	1,505.42	1,607.36	1,780.02	1,507.80	1,576.07	1,660.83	1,627.04	1,526.44	1,341.86	1,523.28	1,229.18
LBDR	139.02	154.35	160.07	148.16	166.57	173.41	178.12	178.81	137.16	155.74	127.91
RoM: total	**1,644.45**	**1,761.71**	**1,940.10**	**1,655.97**	**1,742.64**	**1,834.24**	**1,805.17**	**1,705.25**	**1,479.01**	**1,679.02**	**1,357.09**
RBDR, %	91.5	91.2	91.7	91.1	90.4	90.5	90.1	89.5	90.7	90.7	90.6
LBDR, %	8.5	8.8	8.3	8.9	9.6	9.5	9.9	10.5	9.3	9.3	9.4

In 2022, Sector 3 'Agriculture' accounted for circa 10.1% of the net direct GHG emissions in the RoM (with LULUCF), being the third major source of GHG emissions after Sector 1 'Energy' and Sector 5 'Waste'.

It should be noted that Sector 3 'Agriculture' was a major source of CH_4 and N_2O emissions, accounting for circa 20.1% and 85.3%, respectively, of the total emissions reported at national level.

Between 1990 and 2022, the total GHG emissions originating from Sector 3 'Agriculture' recorded a downward trend, decreasing by circa 73.4% (Table 5-2), particularly due to the decrease in the number of domestic livestock and poultry, the amount of synthetic and organic nitrogen fertilisers applied

[79] Ministry of Economic Development of the TMR, http://mer.gospmr.org/deyatelnost/gosudarstvennaya-sluzhba-statistiki-gosstat/informacziya.html.

to soils, the quantities of agricultural crop residues returned to soil and carbon losses from land-use change and soil management practices.

Table 5-2: Total direct GHG emissions originating from Sector 3 'Agriculture' between 1990-2022, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2	0.58	0.52	0.39	0.13	0.05	0.06	0.09	1.10	0.27	0.00	0.44
CH_4	3,006.67	2,737.22	2,654.29	2,405.59	2,338.63	2,043.29	1,880.74	1,606.93	1,551.96	1,427.06	1,323.70
N_2O	2,093.79	1,992.14	1,706.25	1,431.81	1,242.75	1,176.94	1,040.79	1,018.84	994.11	908.39	854.34
Total	**5,101.04**	**4,729.89**	**4,360.93**	**3,837.53**	**3,581.43**	**3,220.29**	**2,921.62**	**2,626.87**	**2,546.35**	**2,335.46**	**2,178.48**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
CO_2	0.15	0.05	0.24	0.37	0.17	0.15	0.26	0.85	0.59	1.74	3.68
CH_4	1,343.83	1,373.21	1,256.38	1,174.91	1,138.38	1,118.32	892.08	858.51	891.02	890.65	837.30
N_2O	916.94	955.16	843.68	905.09	932.38	914.63	754.18	853.61	846.46	911.80	893.98
Total	**2,260.91**	**2,328.42**	**2,100.30**	**2,080.37**	**2,070.93**	**2,033.09**	**1,646.52**	**1,712.97**	**1,738.07**	**1,804.19**	**1,734.96**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
CO_2	5.59	4.18	10.21	11.24	12.27	26.39	44.16	39.12	42.50	18.61	22.66
CH_4	792.71	796.80	817.62	771.64	747.03	722.77	645.09	546.79	485.77	476.06	461.17
N_2O	846.15	960.72	1,112.27	873.09	983.33	1,085.09	1,115.92	1,119.34	950.74	1,184.35	873.26
Total	**1,644.45**	**1,761.71**	**1,940.10**	**1,655.97**	**1,742.64**	**1,834.24**	**1,805.17**	**1,705.25**	**1,479.01**	**1,679.02**	**1,357.09**

It should be noted that in 1990, CO_2, CH_4 and N_2O emissions accounted for circa 0.01%, 58.9% and 41.0%, respectively, of the total direct GHG emissions from Sector 3 'Agriculture'. By 2022, the share of CO_2 emissions increased up to 1.7%, N_2O emissions – up to 64.3%, whereas CH_4 emissions decreased to 34.0%.

During the period under review CH_4 and N_2O emissions from the agriculture sector decreased by circa 84.7% and 58.3%, respectively (Figure 5-1, Table 5-3). At the same time, between 1990 and 2022, CO_2 emissions from urea application to cropland increased by circa 39 times.

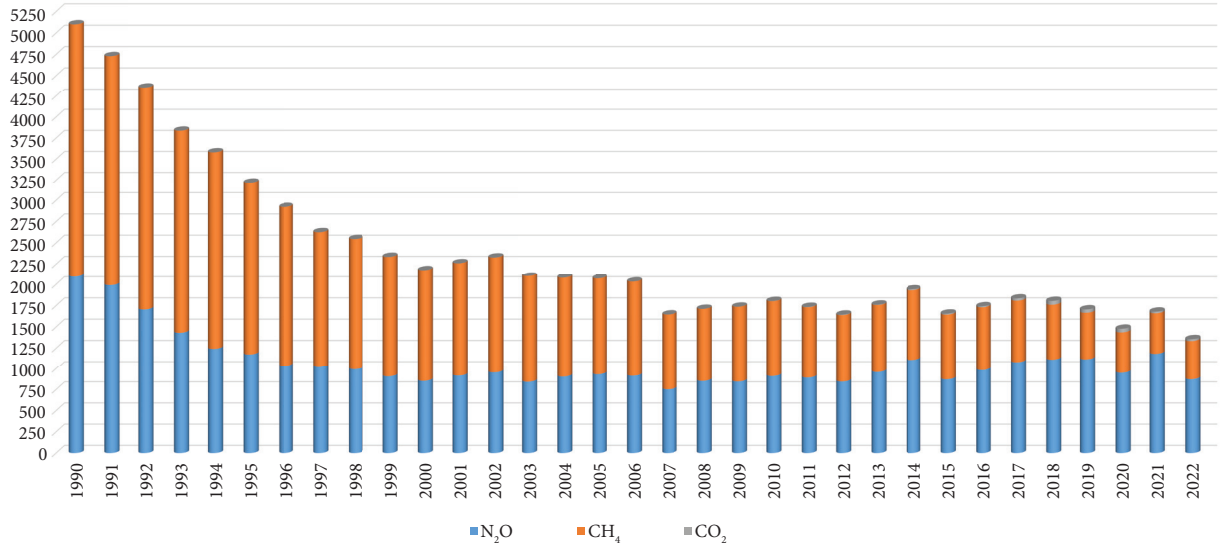


Figure 5-1: Evolution of direct GHG emissions from Sector 3 'Agriculture' of the Republic of Moldova between 1990-2022, kt CO_2 equivalent

Table 5-3: Evolution of total direct GHG emissions, by sub-category, from Sector 3 'Agriculture' between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
3H Urea Application	0.58	0.52	0.39	0.13	0.05	0.06	0.09	1.10	0.27	0.00	0.44
Total CO_2 emissions from Sector 3 'Agriculture'	**0.58**	**0.52**	**0.39**	**0.13**	**0.05**	**0.06**	**0.09**	**1.10**	**0.27**	**0.00**	**0.44**
3A Enteric Fermentation	87.58	81.15	79.87	74.92	72.91	64.72	59.67	51.30	49.81	46.07	43.43
3B Manure Management	19.80	16.60	14.92	11.00	10.61	8.25	7.49	6.09	5.62	4.89	3.84
Total CH_4 emissions from Sector 3 'Agriculture'	**107.38**	**97.76**	**94.80**	**85.91**	**83.52**	**72.97**	**67.17**	**57.39**	**55.43**	**50.97**	**47.28**
3B Manure Management	2.90	2.71	2.41	2.03	1.96	1.73	1.49	1.35	1.33	1.20	1.09
3D Agricultural Soils	5.00	4.80	4.03	3.37	2.73	2.71	2.43	2.50	2.43	2.23	2.13
Total N_2O emissions from Sector 3 'Agriculture'	**7.90**	**7.52**	**6.44**	**5.40**	**4.69**	**4.44**	**3.93**	**3.84**	**3.75**	**3.43**	**3.22**

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
3H Urea Application	0.15	0.05	0.24	0.37	0.17	0.15	0.26	0.85	0.59	1.74	3.68
Total CO_2 emissions from Sector 3 'Agriculture'	**0.15**	**0.05**	**0.24**	**0.37**	**0.17**	**0.15**	**0.26**	**0.85**	**0.59**	**1.74**	**3.68**
3A Enteric Fermentation	44.13	45.02	41.14	38.46	36.96	36.14	29.20	28.08	28.90	28.67	26.93
3B Manure Management	3.86	4.02	3.73	3.50	3.70	3.80	2.66	2.58	2.92	3.14	2.97
Total CH_4 emissions from Sector 3 'Agriculture'	**47.99**	**49.04**	**44.87**	**41.96**	**40.66**	**39.94**	**31.86**	**30.66**	**31.82**	**31.81**	**29.90**
3B Manure Management	1.10	1.11	1.07	1.03	1.10	1.15	0.88	0.88	0.99	1.02	0.93
3D Agricultural Soils	2.36	2.49	2.12	2.39	2.42	2.30	1.96	2.34	2.21	2.42	2.44
Total N_2O emissions from Sector 3 'Agriculture'	**3.46**	**3.60**	**3.18**	**3.42**	**3.52**	**3.45**	**2.85**	**3.22**	**3.19**	**3.44**	**3.37**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
3H Urea Application	5.59	4.18	10.21	11.24	12.27	26.39	44.16	39.12	42.50	18.61	22.66
Total CO_2 emissions from Sector 3 'Agriculture'	**5.59**	**4.18**	**10.21**	**11.24**	**12.27**	**26.39**	**44.16**	**39.12**	**42.50**	**18.61**	**22.66**
3A Enteric Fermentation	25.55	25.76	26.36	24.80	24.14	23.38	20.88	17.48	15.50	15.32	14.82
3B Manure Management	2.76	2.69	2.84	2.76	2.54	2.43	2.16	2.05	1.85	1.68	1.65
Total CH_4 emissions from Sector 3 'Agriculture'	**28.31**	**28.46**	**29.20**	**27.56**	**26.68**	**25.81**	**23.04**	**19.53**	**17.35**	**17.00**	**16.47**
3B Manure Management	0.86	0.81	0.88	0.81	0.82	0.83	0.80	0.63	0.56	0.56	0.51
3D Agricultural Soils	2.33	2.82	3.32	2.48	2.89	3.27	3.41	3.59	3.03	3.91	2.79
Total N_2O emissions from Sector 3 'Agriculture'	**3.19**	**3.63**	**4.20**	**3.29**	**3.71**	**4.09**	**4.21**	**4.22**	**3.59**	**4.47**	**3.30**

Table 5-4 shows that category 3D 'Agricultural Soils' is the largest source of total direct GHG emissions from Sector 3 'Agriculture' (with a share varying between a minimum of 20.1% in 1994 and a maximum of 61.8% in 2021), followed by category 3A 'Enteric Fermentation' (with a share varying between a minimum of 25.6% in 2021 and a maximum of 57.0% in 1994), and category 3B 'Manure Management' (with a share varying between a minimum of 11.6% in 2021 and a maximum of 26.0% in 1990). The share of category 3H 'Urea Application' in agricultural soils was initially insignificant; however, there had been a constant upward trend, reaching 2.9% of the total emissions from the respective sector in 2020.

Table 5-4: Share of total direct GHG emissions from Sector 3 'Agriculture' between 1990-2022, % of total

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
3A Enteric Fermentation	48.1	48.0	51.3	54.7	57.0	56.3	57.2	54.7	54.8	55.2	55.8
3B Manure Management	26.0	25.0	24.2	22.1	22.8	21.4	20.7	20.1	20.0	19.5	18.2
3D Agricultural Soils	26.0	26.9	24.5	23.3	20.2	22.3	22.1	25.2	25.3	25.3	25.9
3H Urea Application	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.04	0.01	0.00	0.02
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
3A Enteric Fermentation	54.7	54.1	54.8	51.8	50.0	49.8	49.7	45.9	46.6	44.5	43.5
3B Manure Management	17.7	17.5	18.4	17.8	19.1	20.3	18.7	17.9	19.8	19.9	19.1
3D Agricultural Soils	27.6	28.4	26.7	30.4	31.0	30.0	31.6	36.2	33.7	35.5	37.3
3H Urea Application	0.01	0.00	0.01	0.02	0.01	0.01	0.02	0.05	0.03	0.10	0.21
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
3A Enteric Fermentation	43.5	40.9	38.0	41.9	38.8	35.7	32.4	28.7	29.3	25.6	30.6
3B Manure Management	18.6	16.4	16.1	17.7	16.5	15.7	15.1	13.2	13.5	11.6	13.4
3D Agricultural Soils	37.6	42.4	45.3	39.7	44.0	47.2	50.1	55.8	54.3	61.8	54.4
3H Urea Application	0.3	0.2	0.5	0.7	0.7	1.4	2.4	2.3	2.9	1.1	1.7

5.1.2. Key Categories

The results of key category analysis (with LULUCF), carried out following the Tier 1 methodological approach, are provided in Chapter 1.5 of this Report, as well as in Annex 1. Table 5-5 provides information on identified key categories under Sector 3 'Agriculture'.

Table 5-5: Key categories in Sector 3 'Agriculture'

IPCC Category	GHG	Source Category	Without LULUCF				With LULUCF			
			T1		T2		T1		T2	
			L	T	L	T	L	T	L	T
3A	CH_4	CH_4 emissions from enteric fermentation	X	X	X	X	X	X	X	X
3B	CH_4	CH_4 emissions from manure management	X	X	X	X	X	X	X	

IPCC Category	GHG	Source Category	Without LULUCF				With LULUCF			
			T1		T2		T1		T2	
			L	T	L	T	L	T	L	T
3B1	N_2O	Direct N_2O emissions from manure management	X		X	X	X		X	X
3B5	N_2O	Indirect N_2O emissions from manure management	X		X	X	X		X	X
3Da	N_2O	Direct N_2O emissions from agricultural soils	X	X	X	X	X	X	X	X
3Db	N_2O	Indirect N_2O emissions from agricultural soils	X	X	X	X	X		X	X
3H	CO_2	CO_2 emissions from urea application								

Abbreviations: L – Level Assessment; T – Trend Assessment; T1 – Tier 1; T2 – Tier 2.

5.1.3. Methodologies

Emissions from categories 3A 'Enteric Fermentation', 3B 'Manure Management', 3D 'Agricultural Soils', and 3H 'Urea Application' were estimated using both the Tier 1 methodological approach and default EF values, as well as the Tier 2 methodological approach and CS EFs, particularly for key categories. A summary description of the methods used in the estimation of emissions by category is provided in Table 5-6, whereas a more detailed description is available in subchapters 5.2-5.5 of this Report.

Tab 5-6: Summary of methods used in the estimation of GHG emissions from Sector 3 'Agriculture'

Category	Source Category	CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
3A	Enteric Fermentation	NA	NA	T2, T1	CS, D	NA	NA
3B	Manure Management	NA	NA	T2, T1	CS, D	T2, T1	CS, D
3D	Agricultural Soils	NA	NA	NA	NA	T2, T1	CS, D
3H	Urea Application	T1	D	NA	NA	NA	NA

Abbreviations: T1 – Tier 1; T2 – Tier 2; CS – country-specific; D – default; EF – emission factor.

5.1.4. Uncertainties and Time-Series Consistency

Results of uncertainty analysis of GHG emissions from Sector 3 'Agriculture' (including at source category level) are closely described in subchapters 5.2-5.5 as well as in the Annex 5-3.4 of this Report.

Combined uncertainties as a percentage of the total direct GHG emissions from Sector 3 'Agriculture' were estimated to be circa 21.48%. Uncertainties in the trend of total direct GHG emissions from this sector were estimated to be circa 5.93%.

In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review in conformity with the recommendations included in the 2006 IPCC Guidelines.

5.1.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for Sector 3 'Agriculture', following the Tier 1 methodological approach. It should be noted that the AD and methods used in the estimation of GHG emissions from this sector were documented and archived both in hard copies and electronically. In order to identify the data entry and emission estimation process related errors, verifications and quality control procedures were carried.

Following the recommendations in the 2006 IPCC Guidelines, GHG emissions were estimated using AD and national factors and parameters from official reference sources.

5.1.6. Recalculations

Recalculations of GHG emissions from sector 3 'Agriculture' were made as a result of the availability of an updated set of activity data (the Statistical Yearbooks of the RoM and those of the ATULBD, other relevant statistical publications in the field of agriculture), as a result of the update of some CS EFs, as well as resulting from the application of the GWP_{100} values available in the IPCC AR5 (2014), instead of the GWP_{100} values available in the IPCC AR4 (2007), when converting CH_4 and N_2O emissions into kt CO_2 equivalent.

Compared to the results recorded in the previous inventory cycle (reported in NC5 of the RoM to the UNFCCC), the changes made in the process of compiling this inventory resulted in an upward trend in direct GHG emissions between 1990-2010, varying from a minimum increase of 0.02% in 2010, up to a maximum increase of 2.8% in 1994; and in a downward trend in direct GHG emissions in the years 1996 and 2011-2020, respectively, varying from a minimum decrease of 0.1% in 2012, up to a maximum decrease of 5.2% in 2019 (Table 5-7).

Table 5-7: Recalculations of GHG emissions between 1990-2020, included in the NC5 of the RoM to the UNFCCC (sector 3 'Agriculture'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	5,076.73	4,695.35	4,292.30	3,754.61	3,483.39	3,173.37	3,013.66	2,624.57	2,519.44	2,306.87	2,136.19
BTR1	5,101.04	4,729.89	4,360.93	3,837.53	3,581.43	3,220.29	2,921.62	2,626.87	2,546.35	2,335.46	2,178.48
Difference, %	0.5	0.7	1.6	2.2	2.8	1.5	-3.1	0.1	1.1	1.2	2.0
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	2,228.20	2,297.46	2,064.22	2,064.10	2,063.22	2,005.40	1,624.11	1,696.59	1,725.24	1,803.75	1,740.24
BTR1	2,260.91	2,328.42	2,100.30	2,080.37	2,070.93	2,033.09	1,646.52	1,712.97	1,738.07	1,804.19	1,734.96
Difference, %	1.5	1.3	1.7	0.8	0.4	1.4	1.4	1.0	0.7	0.02	-0.3
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	1,645.31	1,774.67	1,973.97	1,701.21	1,826.65	1,881.75	1,837.31	1,798.72	1,546.44		
BTR1	1,644.45	1,761.71	1,940.10	1,655.97	1,742.64	1,834.24	1,805.17	1,705.25	1,479.01	1,679.02	1,357.09
Difference, %	-0.1	-0.7	-1.7	-2.7	-4.6	-2.5	-1.7	-5.2	-4.4		

Abbreviations: BTR1 – First Biennial Transparency Report; NC5 – Fifth National Communication.

Recalculation results at category level are presented in subchapters 5.2-5.5 of this Report.

5.1.7. Assessment of Completeness

The current inventory covers GHG emissions from 4 source categories: 3A 'Enteric Fermentation', 3B 'Manure Management', 3D 'Agricultural Soils', and 3H 'Urea Application' (Table 5-8).

Table 5-8: Assessment of completeness of GHG emissions from Sector 3 'Agriculture'

IPCC Category	Source Category	CO_2	CH_4	N_2O
3A	Enteric Fermentation	NA	X	NO
3B	Manure Management	NA	X	X
3C	Rice Cultivation	NA	NO	NA
3D	Agricultural Soils	NA	NA	X
3E	Prescribed Burning of Savannas	NA	NO	NO
3F	Field Burning of Agricultural Residues	NA	IE	IE
3G	Liming	NO	NA	NA
3H	Urea Application	X	NA	NA
3I	Other Carbon-Containing Fertilizers	NO	NA	NA
3J	Other	NO	NO	NO

Abbreviations: X – source categories included in the inventory; NA – Not Applicable; NO – Not Occurring; NE – Not Estimated; IE – Included Elsewhere.

Since rice is not cultivated in the RoM and there are no savannas, no GHG emissions have been recorded from categories 3C 'Rice Cultivation' and 3E 'Prescribed Burning of Savannas'. GHG emissions from source category 3F 'Field Burning of Agricultural Residues' were reported under Sector 4 'LULUCF', namely source category 4B 'Cropland'. CO_2 emissions from categories 3G 'Liming' and 3I 'Other Carbon-Containing Fertilizers' were not estimated as such activities do not occur in the RoM.

5.1.8. Planned Improvements

Planned improvements at source category level under Sector 3 'Agriculture' are closely described in the respective subchapters (5.2-5.5) of this Report.

5.2. Enteric Fermentation (source category 3A)

5.2.1. Source Category Description

Ruminant livestock, due to the symbiosis between the macro-organism and the micro-organisms that inhabit the stomach consisting of four chambers (rumen, reticulum, omasum, abomasum) can be

regarded as a complex biological factory, which converts feedstock into high quality food products, creating daily a protein mass of up to 2.5 kg.

Also, during the process, due to the fermentation of nutrients, significant quantities of gases are generated, containing CH_4 – up to 30-40%, and CO_2 – up to 60-70%[80]. About 5% of ingested feed gross energy is lost through gaseous emissions. The problem of reducing gas emissions within the feed fermentation process is thereby important not only in terms of environmental protection, but also from an economic point of view.

It should be noted that both ruminant (cattle, sheep and goats) and non-ruminant livestock (pigs, horses, asses and mules) are major sources of CH_4 emissions. However, ruminant livestock account for a larger share of the total CH_4 emissions from category 3A 'Enteric fermentation'. The amount of methane that is released depends on a number of factors, such as species, age, weight of the animal, quantity and quality of feed intake, etc.

5.2.2. Methodologies, Emission Factors and Activity Data

In order to estimate methane emissions from category 3A 'Enteric Fermentation', three basic steps were undertaken:

(1) division of the livestock population into subgroups and description of each subgroup (see basic information on domestic breeds of animals bred in the RoM in Annex 3-3);

(2) estimation of emission factors for each subgroup, as well as the average situation for the entire population, by age, kilograms of CH_4/animal/year;

(3) estimation of CH_4 emissions by multiplying the specific emission factors with AD on the number of animals (then summing the emissions from each category of animals, obtaining the total methane emissions from category 3A 'Enteric Fermentation').

It was possible to carry out these steps for different levels of details and complexity, following two methodological approaches: Tier 1 and Tier 2. While following the Tier 1 methodology, CH_4 emissions from category 3A 'Enteric Fermentation' were estimated based on equations 10.19 and 10.20 in the 2006 IPCC Guidelines:

$$Total\ CH_{4\ enteric} = \Sigma_i\ E_i\ [EF_{(T)} \bullet (N_{(T)} / 10^6)]$$

Where:

Total $CH_{4\ enteric}$ – total CH_4 emissions from enteric fermentation, kt CH_4/yr;

E_i – emissions for the *i* livestock categories and subcategories (i);

$EF_{(T)}$ – emission factor for the defined livestock population, kg CH_4/head/yr;

$N_{(T)}$ – number of head of livestock species/category T;

T – species/category of livestock.

The Tier 1 methodology is a simplified approach based on the use the of default emission factors (Table 5-9) multiplied by national activity data on the animal population data (Table 5-10).

Table 5-9: Default EFs for Western Europe (WE) and Eastern Europe (EE) used to estimate CH_4 emissions from category 3A 'Enteric Fermentation'

Animal by category	EF, kg CH_4/head/an		Comments
	Western Europe	Eastern Europe	
Dairy cows	117	99	Average Milk Production: WE – 6000 kg/head/year, EE – 2550 kg/head/year WE: Average live weight – 600 kg. EE: Average live weight – 550 kg.
Other cattle	57	58	Beef cows, including young cattle. WE: Average live weight of other cattle –420 kg, including males – 600 kg, females – 500 kg, young cattle – 230 kg. EE: Average live weight of other cattle – 391 kg, including: males – 600 kg, females – 500 kg, young cattle – 230 kg.
Sheep	8	5	Average live weight: WE – 48.5 kg, EE – 28 kg
Goats	5	5	Average live weight: WE – 38.5 kg, EE – 30 kg
Horses	18	18	Average live weight: WE – 377 kg, EE – 238 kg
Asses	10	10	Average live weight: WE – 130 kg, EE – 130 kg
Swine	1.5	1	Average live weight: WE – 50 kg, breeding – 198 kg. Average live weight: EE – 50 kg, breeding – 180 kg.

[80] 'Technical Guideline for Milk Production', Babcock International Institute for Dairy Research and Development, USA, 1996 (<www.animals-feed.info>).

The Tier 2 assessment methodology presents a more complex approach, which requires country-specific information on livestock (including its distribution by species and subcategories of animals), the maintenance and feeding conditions for typical animals within each species and subcategory (especially for cattle and sheep, which have a greater share in total CH_4 emissions from source category 3A 'Enteric Fermentation').

Distribution of livestock population into subgroups. Following the 2006 IPCC Guidelines, it is good practice to divide the livestock population into subcategories (Table 5-10).

Table 5-10: Livestock and poultry population in the RoM between 1990-2022, thousand heads

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cattle total, including:	1,060.7	1,000.5	970.1	882.6	832.0	729.5	646.3	549.7	532.4	482.4	445.4
...Dairy Cows	395.2	397.1	403.2	401.8	402.6	380.8	355.4	323.7	318.4	306.9	298.5
...Other Cattle	665.5	603.4	566.9	480.7	429.4	348.7	290.9	226.0	214.0	175.5	146.9
Sheep and Goats total, including:	1,281.9	1,288.8	1,357.2	1,437.3	1,501.9	1,423.0	1,372.4	1,235.3	1,147.2	1,055.5	962.1
...Sheep	1,244.8	1,239.3	1,294.3	1,362.4	1,409.8	1,326.6	1,271.1	1,136.3	1,046.4	948.9	846.3
...Goats	37.1	49.5	62.9	74.9	92.2	96.4	101.3	99.0	100.8	106.6	115.8
Horses	47.2	48.4	51.4	54.5	58.2	61.6	63.3	65.4	68.5	72.0	76.0
Asses	1.7	1.8	2.1	2.2	2.9	3.2	3.1	3.0	3.2	3.4	3.8
Swine	1,850.1	1,753.0	1,487.4	1,082.3	1,046.8	1,016.4	950.1	797.5	928.0	751.3	492.7
Poultry total, including:	24,625.0	23,715.0	17,128.0	12,809.2	13,448.3	13,746.4	12,364.9	12,363.9	13,046.0	13,730.1	13,624.9
...Chickens	20,234.5	19,607.1	13,271.0	9,516.6	9,957.4	10,200.6	9,137.4	9,112.0	9,557.0	9,992.5	9,952.9
...Geese	1,335.5	1,321.8	1,300.4	1,378.9	1,457.0	1,487.4	1,357.9	1,372.3	1,470.0	1,581.6	1,550.6
...Ducks	2,165.7	1,914.7	1,736.5	1,198.9	1,284.8	1,293.3	1,166.6	1,169.5	1,264.8	1,349.4	1,325.3
...Turkeys	889.3	871.3	820.2	714.8	749.0	765.2	703.0	710.1	754.2	806.6	796.2
Rabbits	283.0	250.8	298.5	262.4	237.2	209.3	189.8	176.8	185.9	182.6	161.3
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Cattle total, including:	453.8	454.7	409.1	359.5	339.8	326.9	253.7	238.4	243.0	236.4	224.4
...Dairy Cows	300.1	304.8	277.7	249.0	233.1	222.0	181.1	171.9	173.2	165.8	155.8
...Other Cattle	153.7	149.9	131.5	110.5	106.7	104.9	72.6	66.5	69.8	70.5	68.6
Sheep and Goats total, including:	971.8	978.4	958.4	959.8	954.3	962.5	866.4	879.6	929.7	920.6	846.2
...Sheep	851.7	843.7	829.2	832.6	827.0	842.6	759.9	767.7	809.4	793.1	714.2
...Goats	120.2	134.6	129.2	127.2	127.3	119.9	106.5	111.9	120.3	127.5	132.0
Horses	81.6	82.6	81.4	75.8	72.0	69.3	60.5	57.4	56.1	53.6	50.9
Asses	4.3	4.0	4.3	4.0	3.7	3.6	3.1	3.2	2.9	2.8	2.5
Swine	490.8	550.1	476.4	422.3	493.0	568.3	320.8	302.9	403.6	511.7	471.7
Poultry total, including:	14,737.4	15,535.3	16,195.5	17,883.9	22,773.6	23,017.2	17,544.2	18,830.6	22,986.6	23,782.5	19,766.7
...Chickens	10,952.8	11,484.5	12,184.2	13,559.0	17,195.3	17,320.6	14,162.0	15,464.0	18,836.1	19,456.4	16,194.1
...Geese	1,589.9	1,777.4	1,780.2	1,828.0	2,120.3	2,111.5	1,342.2	1,277.2	1,497.4	1,597.3	1,351.6
...Ducks	1,368.2	1,423.3	1,461.9	1,592.6	2,394.1	2,551.0	1,435.5	1,501.7	1,981.8	2,010.8	1,622.1
...Turkeys	826.6	850.1	769.3	904.4	1,063.9	1,034.0	604.5	587.8	671.4	718.1	599.0
Rabbits	191.4	190.7	205.4	239.1	278.9	326.0	263.4	248.5	274.5	277.0	277.4
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Cattle total, including:	210.6	208.0	210.7	204.5	199.9	185.6	162.7	141.2	125.8	120.2	118.3
...Dairy Cows	145.1	141.3	140.6	137.7	132.3	122.1	106.4	90.2	80.3	76.9	75.3
...Other Cattle	65.5	66.7	70.1	66.9	67.7	63.5	56.3	51.0	45.5	43.4	43.0
Sheep and Goats total, including:	836.9	862.0	887.0	880.8	882.0	853.8	781.2	688.8	629.1	585.4	567.5
...Sheep	699.0	717.4	733.5	722.2	714.9	683.6	618.3	535.9	479.3	438.4	423.7
...Goats	137.8	144.6	153.4	158.6	167.0	170.3	162.9	152.9	149.7	147.0	143.9
Horses	47.5	46.0	42.8	40.2	37.4	34.1	30.4	26.4	23.0	19.9	18.0
Asses	2.4	2.1	2.2	2.0	3.1	5.0	3.8	1.4	1.2	1.6	1.6
Swine	438.4	444.8	504.7	484.5	469.8	439.8	431.6	428.5	366.9	371.7	363.4
Poultry total, including:	15,897.8	11,947.9	12,520.0	12,590.6	13,172.6	13,616.4	11,456.5	11,115.7	9,492.0	9,746.0	9,335.9
...Chickens	13,252.8	10,096.2	10,438.5	10,633.3	11,155.0	11,542.6	9,666.9	9,494.4	8,176.6	8,558.1	8,279.5
...Geese	1,028.5	718.7	768.0	746.1	770.6	790.7	683.8	621.3	492.7	450.0	409.1
...Ducks	1,166.9	822.4	986.1	904.1	929.1	956.9	823.6	742.8	599.2	545.0	476.9
...Turkeys	449.6	310.6	327.4	307.1	317.8	326.1	282.2	257.1	223.5	192.8	170.4
Rabbits	267.0	296.2	326.1	350.2	366.7	376.5	351.5	329.7	319.2	385.0	303.1

Source: Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Number of livestock and poultry in all household categories as of January 1 (annual reports for 1990-2022); Statistical Yearbooks of ATULBD for 1998 (page 224), 2002 (page 118), 2006 (page 109), 2010 (page 110), 2014 (page 104), 2017 (page 117), 2019 (page 115), 2020 (page 118), 2021 (page 118).

Average daily feed intake per day. In addition to activity data on livestock, information on average daily feed intake is required. Because data on average daily feed intake is not available in statistical sources, it was necessary to calculate this index indirectly. The following data was collected for each representative animal category: weight of a typical animal in the respective category (kg), average weight gain per day (g), feeding situation (either confined or grazing), average daily milk production (kg), milk fat content (%), percentage of females that give birth in a year (%), average annual wool production per animal (kg), number of offsprings produced per year (heads), and feed digestibility (%).

Weight (W) and Mature Weight (MW) in livestock and poultry. Information on the weight of the most prevalent breeds of livestock and poultry in the RoM is provided by statistical sources (Table 5-11), as well as by the scientific literature.

Table 5-11: Livestock and poultry weight, by species and subcategories for 1990-2022, kg

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Average weight per head at the end of the year, kg:											
Cattle, including	325	320	316	310	295	279	264	307	308	303	294
Dairy cows	476	443	430	415	413	412	411	452	443	439	435
Breeding males	580	562	550	545	540	539	537	551	542	539	533
Swine, including	145	143	132	140	118	109	100	55	51	46	56
Female sows	189	186	181	185	176	169	162	144	141	137	145
Sheep and goats	43	44	43	43	44	39	39	35	35	35	35
Ewes and rams											
Horses, including	376	326	341	344	369	356	340	276	282	279	285
Female horses older than 3 years and stallions	433	381	396	399	414	401	382	308	314	311	317
Poultry of all species and ages	1.74	1.69	1.54	1.49	1.50	1.43	1.28	1.38	1.62	1.65	1.62
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Average weight per head at the end of the year, kg:											
Cattle, including	297	294	290	300	293	297	284	286	289	291	322
Dairy cows	434	434	431	435	429	427	425	405	409	420	421
Breeding males	535	534	532	535	531	529	475	480	478	480	467
Swine, including	49	47	54	51	50	51	51	56	56	55	57
Female sows	139	137	145	141	138	140	137	141	137	141	155
Sheep and goats	33	33	33	33	33	34	33	33	35	35	35
Ewes and rams						38	37	39	39	38	38
Horses, including	283	277	277	282	275	297	297	308	302	307	304
Female horses older than 3 years and stallions	315	309	309	314	307	322	339	342	346	345	343
Poultry of all species and ages	1.57	1.60	1.29	1.35	1.39	1.50	1.36	1.26	1.28	1.28	1.28
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Average weight per head at the end of the year, kg:											
Cattle, including	318	310	344	348	344	391	400	425	383	358	388
Dairy cows	427	430	450	463	457	461	451	438	408	451	446
Breeding males	474	431	591	595	505	456	540	495	480	405	420
Swine, including	59	54	57	54	75	60	102	57	55	49	48
Female sows	167	176	170	172	164	176	170	172	187	146	148
Sheep and goats	36	38	43	41	42	41	41	41	42	41	60
Ewes and rams	40	42	46	36	32	44	44	38	40	44	37
Horses, including	320	326	318	316	315	365	331	347	348	297	307
Female horses older than 3 years and stallions	342	343	338	375	293	360	361	354	350	420	400
Poultry of all species and ages	1.23	1.31	1.16	2.00	1.80	1.40	1.30	1.20	1.10	1.10	1.10

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic indices of livestock development sector in all household categories in the RoM (annual reports for 1990-2022).

As for cattle[81], the information on the weight of the most prevalent breeds of cattle in the RoM (Steppe Red and Spotted Black) (dynamics by age) is presented in Table 5-12. It should be noted that, currently, most animals in the RoM are not purebred, but crossbred (Bucataru, Radionov, 1999). Productivity indices for crossbreeds are average values of the purebred indices. Information on the typical body weight of sheep and goats at different stages of ontogeny (birth, weaning, one year of age and slaughter) is available in the scientific literature (Bucataru, Radionov, Varban, 2003).

[81] Default values used for Eastern European countries: 550 kg for dairy cows, 600 kg for males and 230 kg for young cattle (IPCC 2006 Guidelines, Volume 4, Chapter 10, Table 10A-2, Page 10.73).

Table 5-12: Weight of most widespread breeds of cattle in the RoM

Breed	Sex	Weight in dynamics by months, kg														
		At birth	6	7	8	9	10	12	15	18	24	30	36	48	60	72
Steppe Red	♀	30	150	170	190	205	220	250	295	340	400	425	450	490	520	520
	♂	30	170	195	220	240	260	300	375	445	525	590	650	750	800	800
Spotted Black	♀	35	165	180	200	220	240	270	320	375	430	455	480	520	550	550
	♂	35	180	205	250	255	280	330	405	480	575	640	750	820	880	880

According to the information collected, the weight of sheep and goats at birth is circa 2-4 kg, lambs are weaned at the age of 3-4 months, when they reach the mass of 18-23 kg; whereas kids at the age of 2-3 months when they reach the weight of 13-15 kg; young sheep that are not left for breeding are fed intensely until the age of 6-7 months, when they reach the weight of 30-35 kg, after which they are slaughtered. Other relevant information on the weight of sheep and goats in the RoM is provided in Annex 3-3.

Average daily weight gain per day (WG)[82]*, g/day.* The information on daily actual weight gain reported in the RoM between 1990 and 2022 for cattle and swine is shown in Table 5-13.

Table 5-13: Average daily weight gain for cattle and swine in the RoM between 1990-2022

Index	Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Daily weight gain, g	cattle	515.0	421.0	425.0	376.0	363.0	223.0	203.0	181.0	230.0	192.0	217.0
	swine	304.0	117.0	110.0	89.0	94.0	148.0	171.0	189.0	222.0	117.0	107.0
Index	**Category**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Daily weight gain, g	cattle	260.0	287.0	262.0	275.0	321.0	323.0	297.0	325.0	378.0	345.0	366.0
	swine	134.0	147.0	136.0	166.0	187.0	200.0	218.0	268.0	311.0	317.0	339.0
Index	**Category**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Daily weight gain, g	cattle	379.0	355.0	383.0	342.0	437.0	398.0	456.0	415.0	482.0	520.0	480.0
	swine	398.0	402.0	451.0	448.0	487.0	507.0	622.0	541.0	681.0	610.0	559.0

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the RoM as of January 1 (annual reports for 1990-2022).

Average annual milk production per one cow. In the past 20 years, the average productivity of dairy cows in the RoM varied between a maximum of 3,735 kg of milk per year in 1990 and a minimum of 1,957 kg of milk per year in 1997 (Table 5-14) albeit the potential is much higher (Annex 3-3).

Table 5-14 shows that the average milk productivity typical for the period 1993-2003 is inferior to the one recorded at the beginning of the 1990s, comparable with milk productivity recorded in the 1960s-1970s, when the cattle population in the RoM mainly consisted of the Red Estonian (circa 8%), Simmental (35-37%) and Steppe Red (48-53%) (Bucataru, et al., 2006).

Table 5-14: Average annual milk production per one cow between 1990-2022, kg/head/yr

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total national average annual milk production per one cow	3,735	3,248	2,841	2,398	2,189	2,043	2,021	1,957	2,040	2,030	2,039
Average annual milk production per one cow at agricultural enterprises and farm households	3,975	3,394	3,026	2,413	2,245	2,207	2,051	1,687	2,001	2,036	2,179
Average annual milk production per one cow at individual farms	2,940	2,815	2,421	2,100	2,097	2,125	2,029	2,038	2,048	2,038	2,028
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Total national average annual milk production per one cow	2,072	2,111	2,126	2,480	2,800	2,807	2,871	3,011	3,316	3,435	3,438
Average annual milk production per one cow at agricultural enterprises and farm households	2,447	2,710	2,493	2,561	3,018	2,913	2,710	2,743	3,098	2,993	3,224
Average annual milk production per one cow at individual farms	2,052	2,081	2,110	2,477	2,792	2,803	2,877	3,020	3,323	3,449	3,444
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Total national average annual milk production per one cow	3,425	3,607	3,672	3,666	3,607	3,758	3,815	3,698	3,598	3,351	3,563
Average annual milk production per one cow at agricultural enterprises and farm households	3,380	3,225	3,742	3,468	3,939	4,363	3,626	3,573	3,579	3,812	3,478
Average annual milk production per one cow at individual farms	3,426	3,621	3,669	3,676	3,590	3,728	3,828	3,198	3,778	3,245	3,647

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the RoM as of January 1 (annual reports for 1990-2022).

[82] The default values are: WG – 0 kg per day for dairy cows and adult males (>5 years), and WG – 0.4 kg per day for young cattle (2006, IPCC Guidelines, Volume 4, Chapter 10, Table 10 A.2).

Since 1970, there has been a massive import of Spotted Black cattle in the country. A programme was developed to crossbreed all stock with this breed, considered to be one of the most productive in the world. Consequently, over the following 30 years, absorption crossbreeding was carried out for Simmental, Estonian Red and Steppe Red breeds with Spotted Black breed. The Holstein breed was also intensely used to improve the breed, particularly in the 1980s-1990s. Developing an immense stock of half-breeds of different generations and a good organization of foddering had thereby led to a national average daily milk yield of 10-11 kg per head by 1990 (Table 5-15).

Table 5-15: Average daily milk production per one cow between 1990-2022, kg/head/day

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total national average daily milk production per one cow	10.2	8.9	7.8	6.6	6.0	5.6	5.5	5.4	5.6	5.6	5.6
Average daily milk production per one cow at agricultural enterprises and farm households	10.9	9.3	8.3	6.6	6.2	6.0	5.6	4.6	5.5	5.6	6.0
Average daily milk production per one cow at individual farms	8.1	7.7	6.6	5.8	5.7	5.8	5.5	5.6	5.6	5.6	5.5
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total national average daily milk production per one cow	5.7	5.8	5.8	6.8	7.7	7.7	7.9	8.2	9.1	9.4	9.4
Average daily milk production per one cow at agricultural enterprises and farm households	6.7	7.4	6.8	7.0	8.3	8.0	7.4	7.5	8.5	8.2	8.8
Average daily milk production per one cow at individual farms	5.6	5.7	5.8	6.8	7.6	7.7	7.9	8.3	9.1	9.4	9.4
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total national average daily milk production per one cow	9.4	9.9	10.1	10.0	9.9	10.3	10.5	10.1	9.8	9.2	9.8
Average daily milk production per one cow at agricultural enterprises and farm households	9.2	8.8	10.3	9.5	10.8	12.0	9.9	9.8	9.8	10.4	9.5
Average daily milk production per one cow at individual farms	9.4	9.9	10.1	10.1	9.8	10.2	10.5	8.8	10.3	8.9	10.0

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the RoM as of January 1 (annual reports for 1990-2022).

Subsequently, once the big collective farms collapsed and livestock was concentrated in the private sector (in 2022, according to the NBS, circa 74.5% of the total cattle of the RoM is in the private sector[83]), the average productivity of dairy cows decreased significantly, particularly as a consequence of poor organization of foddering and inappropriate animal feeding and maintenance conditions in the private sector.

It should be noted that milk yield greatly depends on the content of protein in the animal diet. The optimal level of protein is circa 14-18% of the dry matter in the feed intake. At a 20% deficit of protein in the feed intake, the milk yield decreases by 30%, and at a 30% deficit of protein, milk productivity drops down to 50%. For a long time, the protein deficit in the cattle diet exceeded 20% (Bucataru, et al., 2006), being the main reason for poor productivity indices, particularly over the period 1993-2003. Starting with 2004, the average productivity of dairy cows tended to grow.

Average annual milk production per one sheep and goat. Milk yield from sheep and goats in the RoM varies in different breeds (Bucataru, et al., 2002, 2003). For example, the potential average milk yield of a Karakul breed sheep is 60-80 kg of milk per year, with a fat content of 7-8%, and the Tsigae breed reaches a productivity of 75-120 kg of milk per year with a fat content of 6.5-7.0%, whereas for local goats the milking potential is 224-324 kg of milk per year with an average fat content of 4.7% (see Annex 3-3). Table 5-16 provides statistical data on the average milk production per sheep and goats at individual farms in the Republic of Moldova between 1990 and 2022.

Table 5-16: Average milk production per sheep and goats at individual farms between 1990-2022, kg/head/year

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Average annual milk production per one goat	102.0	105.0	108.0	121.0	134.0	117.0	121.0	125.0	110.0	106.0	97.0
Average annual milk production per one sheep	15.9	16.0	16.1	16.2	16.3	16.1	16.3	16.2	18.9	20.0	20.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Average annual milk production per one goat	97.0	99.0	98.0	105.0	112.0	137.0	143.0	139.0	147.0	149.0	136.9
Average annual milk production per one sheep	20.0	24.0	26.0	21.0	32.0	30.0	33.0	35.0	36.0	36.0	34.6
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Average annual milk production per one goat	168.8	201.3	167.0	178.0	179.0	188.0	191.0	171.0	154.0	159.0	182.0
Average annual milk production per one sheep	32.7	37.1	39.0	37.0	40.0	40.0	41.0	38.0	37.0	42.0	48.0

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the RoM as of January 1 (annual reports for 1990-2022).

[83] NBS, on-line database: < http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR03/AGR03.asp>.

Average wool production per sheep. The default value used is 4 kg/year/head (2006 IPCC Guidelines). According to statistical data, the value of this index varied in the RoM over the period 1990-2022 between 1.2 and 2.9 kg of wool collected per year from one sheep (Table 5-17).

Table 5-17: Average wool production from sheep at individual farms between 1990-2022, kg/head/year

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Average annual amount of wool sheared per sheep	2.30	2.30	2.10	1.90	2.00	2.00	1.90	2.00	2.00	1.90	1.80
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Average annual amount of wool sheared per sheep	2.30	2.20	2.00	2.10	2.20	2.00	1.80	1.70	1.80	1.76	1.66
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Average annual amount of wool sheared per sheep	1.25	1.64	1.93	1.51	1.53	1.41	1.74	2.00	2.30	2.25	2.90

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the RoM as of January 1 (annual reports for 1990-2022).

Climate conditions. Feeding conditions for animals are greatly dependent on climate conditions, particularly on the average annual temperature in areas where livestock is bred. In accordance with the 2006 IPCC Guidelines, data on the average annual temperature in areas with animal population are to be used as follows: areas with average annual temperatures lower than 15°C are defined as cold climate areas; areas with average annual temperatures between 15°C and 25°C are defined as temperate climate areas; and areas with average annual temperatures higher than 25°C are defined as warm climate areas. In accordance with data on the average annual temperature in the Celsius scale available in the statistical yearbooks, the RoM is an Eastern European country with cold climate (Table 5-18).

Table 5-18: Average annual temperature in the RoM between 1990-2022, °C

Geographic areas	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
North	9.5	8.0	8.5	7.8	9.5	8.4	7.1	7.7	8.2	9.2	9.7
Centre	11.3	9.4	10.1	9.4	11.3	10.0	9.1	9.4	10.3	11.0	11.2
South	11.4	9.3	10.2	9.3	11.3	10.0	9.1	9.1	10.1	10.9	11.2
Geographic areas	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
North	8.8	9.5	8.6	9.0	8.7	9.7	9.6	8.9	9.1	9.3	9.4
Centre	10.3	10.8	9.8	10.3	10.5	11.3	11.4	10.6	10.5	11.2	11.1
South	10.4	11.0	10.3	10.9	10.8	11.8	11.8	11.2	10.6	11.7	11.5
Geographic areas	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
North	9.7	9.4	9.3	10.5	9.9	9.8	9.8	10.6	10.7	8.9	10.1
Centre	11.3	11.1	10.9	12.0	11.2	11.2	11.2	12.2	12.7	10.6	11.7
South	11.8	11.5	11.3	12.1	11.8	11.5	11.7	12.6	13.1	11.4	12.5

Source: NBS, Statistical Yearbooks of the RM for 1991 (page 207), 1994 (page 31), 1999 (page 13), 2006 (page 15), 2011 (page 15), 2013 (page 15), 2016 (page 18), 2019 (page 16), 2020 (page16).

Percentage of females that give birth in a year (%)[84]. Table 5-19 provides statistical data on live products from 100 females at publicly owned agricultural enterprises in the RoM between 1990-2022.

Table 5-19: Live products from 100 females at publicly owned agricultural enterprises between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Calves from cows	86	80	79	75	72	66	65	58	61	55	58
Pigs from sows	1,466	1,317	1,569	1,223	989	983	1,019	892	1,187	772	434
Lambs from sheep giving birth	91	84	80	79	78	76	75	73	75	68	71
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Calves from cows	65	69	63	60	72	66	63	62	67	63	71
Pigs from sows	869	967	558	689	997	949	782	1,015	1,222	1,040	1,136
Lambs from sheep giving birth	79	81	75	79	84	80	73	81	83	73	82
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Calves from cows	63	56	93	71	71	67	66	73	80	95	90
Pigs from sows	1,106	1,173	1,646	2,378	2,403	1,877	2,539	2,828	2,450	3,038	3,155
Lambs from sheep giving birth	89	89	126	85	64	65	59	70	77	83	88

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the RoM as of January 1 (annual reports for 1990-2022).

It should be noted that the birth rate of some local breeds of sheep and goats is much higher than the one officially reported: circa 115 lambs per 100 Karakul female sheep giving birth; circa 120 lambs per 100 Tsigae female sheep giving birth; and circa 165 kids per 100 local female goats giving birth.

[84] Default values used for Eastern European countries: 80% for dairy cows and 67% for other cattle, see the 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A.1-2, page 10.73.

Digestible Energy (DE)[85]. The situation regarding the quality of animal feed and digestibility of the food consumed, which represents the percentage of energy from food which is not eliminated in the form of fecal excretion (50-60% for crop by-products and range lands, 60-75% for high quality pastures, well preserved forages, and grain supplemented forage-based diets, and 75-85% for grain-based diets fed in feedlots).

In the RoM, DE values varied over the years. In the base year, when the livestock maintenance conditions, foddering and feeding situation were optimal, the DE value was inferred to be 69%; for 1991-1992, DE – 68%; for 1993, DE – 66%; for 1994-1996, DE – 65%; for 1997-2004, DE – 66%; for 2005-2008, DE – 67%; for 2009-2013, DE – 68%; and for 2014-2019, DE – 70%, respectively.

Gross Energy (GE). Animal performance and diet data were collected from Statistical Yearbooks and other relevant specialty publications to estimate daily feed intake, which is the amount of gross energy (MJ/day) an animal needs for maintenance and for activities such as growth, lactation, and pregnancy. The 2006 IPCC Guidelines provides a series of equations (Table 5-20), which were used in the estimation of the average amount of gross energy required for animal maintenance and other relevant vital activities.

Table 5-20: Equations used to estimate daily gross energy intake for cattle, sheep and goats for maintenance and other relevant vital activities

Metabolic function	Equation in the 2006 IPCC Guidelines	
	Cattle	Sheep and goats
Maintenance (NE_m)	10.3	10.3
Activity (NE_a)	10.4	10.5
Growth (NE_g)	10.6	10.7
Lactation (NE_l)	10.8	10.9 and 10.10
Work (NE_w)	10.11	NA
Wool Production (NE_{wool})	NA	10.12
Pregnancy (NE_p)	10.13	10.13
REM {NE_{ma}/DE}	10.14	10.14
REG {NE_{ga}/DE}	10.15	10.15
Gross Energy *(GE)*	10.16	10.16

Net energy for maintenance (NE_m). Net energy required for maintenance represents the amount of energy needed to keep the animal in optimal equilibrium where body energy is neither gained nor lost. NE_m was calculated based on Equation 10.3 in the 2006 IPCC Guidelines.

$$NE_m = Cf_i \bullet (Weight)^{0.75}$$

Where:

NE_m – net energy required by the animal for maintenance, MJ/day;

Cf_i – a coefficient which varies for each animal category[86], the values in the current inventory cycle being used as follows: Cf_i – 0.386 for dairy cows in the dry period (60 days), Cf_i – 0.451 for dairy cows during the lactation period (305 days), Cf_i – 0.370 for work oxen, Cf_i – 0.426 for breeding bulls, Cf_i – 0.322 for other cattle, Cf_i – 0.236 for sheep and goats up to 1 year, Cf_i – 0.247 for breeding males and Cf_i – 0.217 for animals older than 1 year, MJ/kg day;

Weight – live-weight of animal, kg.

Net energy for animal activity (NE_a). NE_a is the net energy for activity, or the energy needed for animals to obtain their food, water and shelter. NE_a for cattle was calculated in accordance with Equation 10.4, whereas for sheep and goats in accordance with Equation 10.5 in the 2006 IPCC Guidelines.

$$NE_a = C_a \bullet NE_m$$

Where:

NE_a – net energy for animal (cattle) activity, MJ/day i;

[85] Default values used, available in the 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.2, Page 10.14.
[86] Default values available in the 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.4, Page 10.16.

C_a – coefficient corresponding to animal's feeding situation[87], default values used in the current inventory cycle are as follows: C_a – 0, cattle is confined to a small area with the result that they expend very little or no energy to acquire feed; C_a – 0.17, cattle is confined in areas with sufficient forage requiring modest energy expense to acquire feed; C_a – 0.36, cattle graze in open range land or hilly terrain and expend significant energy to acquire feed. Taking into account that the grazing period for cattle in the RoM is generally circa 210 days (April-November), and the confinement period is respectively circa 155 days (December-March) (Andries, et al., 2005), the average weighted values for C_a coefficient for conditions of the RoM were estimated as: C_a – 0.098 for 1990-1991, and C_a – 0.207 for 1992-2022, respectively;

NE_m – net energy required by the animal for maintenance, MJ/day.

$$NE_a = C_a \bullet Weight$$

Where:

NE_a – net energy necessary for animal (sheep and goats) maintenance, MJ/day;

C_a – coefficient corresponding to animal's feeding situation[88]), default values used are as follows: C_a – 0.0090, when animals are confined due to pregnancy in final trimester (50 days); C_a – 0.0107, when animals graze in open range land, walk up to one km per day and expend very little energy to acquire feed; C_a – 0.0240, graze in hilly terrain, when animals walk up to 5 km per day and expend significant energy to acquire feed; and C_a – 0.0067, when animals are housed for fattening. Taking into account that the grazing period for sheep and goats in the RoM is generally circa 210 days (April-November) and the confinement period is respectively circa 155 days (December-March) (Andries, et al., 2005), the weighted average values for C_a coefficient for conditions of the RoM is C_a – 0.0170 for sheep and lambs from one year and over, C_a – 0.0167 for mature rams, and C_a – 0.0202 for growing lambs and kids up to 1 year, respectively;

Weight – live-weight of animal, kg.

Net energy for growth (NE_g). (NE_g) is the net energy needed for growth (i.e., weight gain). NE_a for cattle was calculated based on Equation 10.6, and for sheep and goats – Equation 10.7 in the 2006 IPCC Guidelines.

$$NE_g = 22.02 \bullet (BW / C \bullet MW)^{0.75} \bullet WG^{1.097}$$

Where:

NE_g – net energy needed for cattle growth, MJ/day;

BW – the average live body weight (BW) in the cattle population, kg;

C – coefficient with a value of 0.8 for females, 1.0 for castrates and 1.2 for breeding bulls[89];

MW – the mature live body weight of an adult female in moderate body condition, kg;

WG – average daily weight gain of the animals in the population, kg/day.

$$NE_g = \{WG_{lamb} \bullet [a + 0.5b\ (BW_i + BW_f)]\} / (365\ days/yr)$$

Where:

NE_g – net energy needed for growth (sheep and goats), MJ/day;

WG_{lamb} – average weight gain (BW_f-BW_i), kg/yr;

BW_i – average live body weight at weaning, kg;

BW_f – average live bodyweight at one year old or at slaughter (live-weight) if slaughtered prior to 1 year of age, kg;

a, b – constants, a – 2.5 and b – 0.35 for breeding males; a – 4.4 and b – 0.32 for castrates; a – 2.1 and b – 0.45 for females[90].

[87] Default values available in the 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.5, Page 10.17.
[88] Default values available in the 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.5, Page 10.17.
[89] Default values available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Equation 10.6, Page 10.17.
[90] Default values available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Equation 10.6, Page 10.18.

Net energy for lactation (*NE_l*). (NE_l) is the net energy for lactation. For cattle, the net energy for lactation was calculated in conformity with Equation 10.8, based on information on the annual amount of milk produced and its fat content, and for sheep it was calculated in accordance with Equation 10.9 in the 2006 IPCC Guidelines.

$$NE_l = Milk \bullet (1.47+0.40 \bullet Fat)$$

Where:

NE_l – net energy for lactation (cattle), MJ/day;

Milk – amount of milk produced by a dairy cow, kg of milk/day;

Fat – fat content of milk (cattle), % by weight.

For sheep and goats NE_l may be calculated using two possible methods. The first method, used in the current inventory cycle, is used when the amount of milk produced is known (Equation 10.9 in the 2006 IPCC Guidelines), and the second method is used when the amount of milk produced is not known (Equation 10.10 in the 2006 IPCC Guidelines).

$$NE_l = Milk \bullet EV_{milk}$$

Where:

NE_l – net energy for lactation (sheep and goats), MJ/day;

Milk – amount of milk produced, kg of milk/day;

EV_{milk} – the net energy required to produce 1 kg of milk; the default value is 4.6 MJ/kg, which corresponds to a milk fat content of 7% by weight.

Net energy for work (*NE_{work}*). (NE_{work}) is the net energy for work. It is believed that one hour of typical work of draft animals (cattle) requires circa 10% of the net daily energy for maintenance (NE_m). NE_{work} is calculated in conformity with Equation 10.11 in the 2006 IPCC Guidelines.

$$NE_{work} = 0.10 \bullet NE_m \bullet Hours$$

Where:

NE_{work} – net energy for work (cattle), MJ/day;

NE_m – net energy required by the animal for maintenance (from Equation 10.3), MJ/day;

Hours – number of hours of work per day[91]; this inventory cycle used 2 hours of work per day for 1990-1991 and 3 hours of work per day for 1992-2022.

Net energy for wool production (NE_{wool}*)*. (NE_{wool}) is the average daily net energy required for wool production. NE_{wool} was calculated in accordance with Equation 10.12 in the 2006 IPCC Guidelines.

$$NE_{wool} = (EV_{wool} \bullet Production_{wool}) / 365$$

Where:

NE_{wool} – net energy required to produce wool, (sheep and goats), MJ /day;

EV_{wool} – the energy value of each kg of wool produced, MJ/kg, the default value used is 24 MJ/kg;

$Production_{wool}$ – annual wool production per sheep, kg.

Net energy for pregnancy (NE_p*)*. (NE_p) is the energy required for pregnancy[92] and is calculated in accordance with Equation 10.13 in the 2006 IPCC Guidelines. For cattle, the total energy requirement for pregnancy for a 281-day gestation period averaged over an entire year is calculated as 10% of NE_m. For sheep and goats, the NE_p requirement is similarly estimated for the 144-154-day gestation period although the percentage varies depending on the number of lambs born[93].

$$NE_p = C_{pregnancy} \bullet NE_m$$

Where:

NE_p – net energy required for pregnancy, MJ/day;

$C_{pregnancy}$ – pregnancy coefficient;

NE_m – net energy required by the animal for maintenance (Equation 10.3), MJ/day.

[91] Default value available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-2, Page 10.73.
[92] Default value available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.7, Page 10.20.
[93] Cpregnancy default values were estimated taking into account average prolificacy of the local breeds in the RM: Cpregnancy – 0.087 for sheep and goats.

Ratio of net energy available in diet for maintenance to digestible energy consumed (REM). REM was calculated in accordance with Equation 10.14 in the 2006 IPCC Guidelines.

$$REM = [1.123 - (4.092 \bullet 10^{-3} \bullet DE\%) + [1.126 \bullet 10^{-5} \bullet (DE\%)^2] - (25.4/DE\%)]$$

Where:

REM – ratio of net energy available in diet for maintenance to digestible energy consumed;

DE – digestible energy expressed as a percentage of gross energy.

Ratio of net energy available for growth in a diet to digestible energy consumed (REG). REG was calculated in accordance with Equation 10.15 in the 2006 IPCC Guidelines.

$$REG = [1.164 - (5.160 \bullet 10^{-3} \bullet DE\%) + (1.308 \bullet 10^{-5} \bullet (DE\%)^2) - (37.4/DE\%)]$$

Where:

REG – ratio of net energy available for growth in a diet to digestible energy consumed;

DE – digestible energy expressed as a percentage of gross energy.

Gross Energy (GE). Gross energy (GE) was calculated in accordance with Equation 10.16 in the 2006 IPCC Guidelines.

$$GE = \{[(NE_m + NE_a + NE_l + NE_{work} + NE_p) / REM] + [(NE_g) + NE_{wool} / REG]\} / (DE\%/100)$$

Where:

GE – gross energy, MJ/day;

NE_m – net energy required by the animal for maintenance (Equation 10.3), MJ/day;

NE_a – net energy for animal activity (Equations 10.4 and 10.5), MJ/day;

NE_l – net energy for lactation (Equations 10.8, 10.9 and 10.10), MJ/day;

NE_{work} – net energy for work (Equation 10.11), MJ/day;

NE_p – net energy required for pregnancy (Equation 10.13), MJ/day;

REM – ratio of net energy available in diet for maintenance to digestible energy consumed (Equation 10.14);

NE_g – net energy needed for growth (Equations 10.6 and 10.7), MJ/day;

NE_{wool} – net energy required to produce wool (Equation 10.12), MJ/day;

REG – ratio of net energy available for growth in a diet to digestible energy consumed (Equation 10.15);

DE – digestible energy expressed as a percentage of gross energy.

GE values calculated for animal categories relevant in the RoM are provided in Table 5-21.

Table 5-21: Gross energy (GE) values calculated for animal categories in the RoM following the Tier 2 methodology, MJ/head/day

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Dairy cows	245.8	229.0	227.3	219.8	217.8	213.2	211.8	211.4	212.1	212.5	213.5
Other cattle (average)	118.4	116.1	116.8	122.5	125.9	123.4	129.5	124.7	123.3	123.6	128.9
…Calves and heifers up to 1 year	100.2	94.6	95.0	95.4	96.7	78.5	75.4	69.9	77.4	71.6	75.5
…Heifers between 12 and 18 months	131.0	131.0	126.7	127.2	127.4	127.4	125.7	120.8	114.8	114.8	114.8
…Heifers between 18 and 24 months	156.8	152.3	147.2	142.7	146.4	146.4	146.4	142.7	136.1	136.1	136.1
…Heifers between 24 months and more	167.2	165.0	158.8	158.8	160.2	160.2	164.4	158.7	152.0	152.0	152.0
…Breeding males	207.9	204.9	191.9	194.2	190.4	188.3	184.2	178.2	178.2	178.2	178.2
…Work bullocks	182.5	181.8	170.7	185.5	187.0	187.0	187.0	183.0	180.5	177.9	175.3
Sheep and goats (average)	16.9	16.9	16.3	16.2	16.3	15.6	15.6	15.2	15.1	15.2	15.1
…Mature females ≥ 1 year	17.4	17.3	16.7	16.7	17.0	16.0	15.9	15.6	15.6	15.6	15.6
…Breeding males	24.9	24.3	23.9	23.8	23.9	23.1	23.1	22.9	22.4	22.3	22.3
…Growing lambs and kids up to 1 year	13.2	12.9	12.4	12.4	12.7	12.4	12.3	11.4	10.6	11.4	10.6

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Dairy cows	216.2	218.9	219.4	227.1	229.8	228.7	230.1	230.8	232.2	237.6	238.8
Other cattle (average)	124.6	127.4	126.3	131.7	129.4	130.2	127.7	121.7	120.7	121.8	123.7
…Calves and heifers up to 1 year	81.5	85.0	81.7	83.5	86.7	87.0	83.9	87.2	90.5	87.1	89.3
…Heifers between 12 and 18 months	120.8	129.4	129.4	128.3	130.1	132.5	130.1	119.4	114.9	120.5	122.9
…Heifers between 18 and 24 months	142.7	147.9	147.9	151.5	149.2	154.1	152.1	142.1	143.3	144.6	146.6
…Heifers between 24 months and more	160.1	161.5	161.5	166.8	166.3	170.3	166.3	151.9	150.3	153.6	154.6
…Breeding males	178.2	180.3	180.3	182.3	178.5	180.4	180.4	182.4	180.6	180.6	180.6
…Work bullocks	177.9	180.5	183.0	185.5	184.1	184.1	184.1	186.6	185.2	185.2	185.2
Sheep and goats (average)	15.2	15.3	14.9	15.3	15.7	16.6	16.6	17.1	17.2	17.2	16.8
…Mature females ≥ 1 year	15.6	15.8	15.5	15.7	16.4	17.6	17.5	18.0	18.1	18.0	17.7
…Breeding males	21.9	21.9	21.3	22.4	21.4	21.6	21.5	20.7	21.3	21.3	21.2
…Growing lambs and kids up to 1 year	11.1	11.5	10.5	11.8	10.9	11.3	10.9	11.2	11.3	11.6	10.9
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Dairy cows	239.0	242.3	245.9	245.8	243.5	246.9	247.1	241.8	230.5	240.7	241.2
Other cattle (average)	124.3	122.0	118.5	114.8	122.9	116.3	117.9	115.0	120.4	122.5	118.3
…Calves and heifers up to 1 year	90.7	88.1	86.5	82.6	91.4	89.5	93.0	89.4	95.1	98.1	95.0
…Heifers between 12 and 18 months	123.7	121.3	118.0	113.9	122.5	118.0	124.0	122.5	126.2	129.8	125.5
…Heifers between 18 and 24 months	147.6	145.1	140.9	138.0	140.9	140.9	142.7	140.9	142.7	144.6	141.8
…Heifers between 24 months and more	155.1	154.1	149.4	146.6	149.4	149.4	151.3	149.4	151.3	153.2	150.3
…Breeding males	180.6	180.6	177.4	173.6	172.7	177.4	176.5	175.6	175.6	177.4	174.7
…Work bullocks	185.2	185.2	186.9	178.0	176.9	186.9	181.0	179.8	179.8	182.2	179.0
Sheep and goats (average)	16.9	17.9	18.5	15.7	14.8	17.9	18.2	16.4	17.0	18.6	18.0
…Mature females ≥ 1 year	17.9	19.1	19.9	16.9	16.1	19.2	19.4	17.6	18.2	19.9	19.5
…Breeding males	21.1	21.2	20.4	20.7	20.7	20.7	20.8	20.9	21.0	21.0	21.2
…Growing lambs and kids up to 1 year	11.5	12.3	12.5	9.9	8.6	12.6	12.7	10.8	11.5	12.8	11.4

For animal categories 'other cattle'[94] and 'sheep and goats'[95], GE values are weighted averages, taking into account the specific GE values for each subcategory of animals, and the percentage distribution of their population, respectively (Table 5-22).

Table 5-22: Distribution of animal population by subcategories in the Republic of Moldova between 1990-2022, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Other cattle, including:											
…Calves and heifers up to 1 year	62.3	58.2	53.3	40.9	37.4	31.9	22.3	27.0	27.1	24.2	16.8
…Heifers between 12 and 18 months	17.3	19.8	21.0	25.5	27.0	26.8	31.1	18.0	14.2	13.2	13.4
…Heifers between 18 and 24 months	8.7	10.2	12.4	17.3	16.2	18.5	20.1	24.2	26.4	32.3	40.0
…Heifers between 24 months and more	11.4	11.4	12.9	14.8	17.5	20.7	23.5	27.5	28.6	26.0	25.4
…Breeding males	0.2	0.3	0.4	1.1	1.4	1.4	1.9	2.3	2.6	3.1	3.0
…Work bullocks	0.0	0.0	0.1	0.4	0.5	0.7	1.0	0.9	1.1	1.3	1.3
Sheep and goats, including:											
…Mature females ≥ 1 an	79.2	83.0	82.4	80.0	74.0	81.5	82.2	82.5	82.5	81.8	82.0
…Breeding Males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing lambs and kids up to 1 year	17.8	14.0	14.6	17.0	23.0	15.5	14.8	14.5	14.5	15.2	15.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Other cattle, including:											
…Calves and heifers up to 1 year	32.2	34.7	33.7	29.5	34.2	34.2	34.8	37.0	35.9	35.5	34.6
…Heifers between 12 and 18 months	15.9	14.7	16.3	17.9	15.0	20.4	18.3	17.2	19.6	19.1	21.2
…Heifers between 18 and 24 months	26.6	25.8	27.0	27.4	27.0	25.7	26.2	25.9	25.5	26.9	26.4
…Heifers between 24 months and more	21.4	21.0	19.4	21.9	20.7	17.3	18.3	17.6	17.0	16.7	16.3
…Breeding males	2.8	2.7	2.6	2.4	2.2	1.8	1.7	1.6	1.4	1.4	0.4
…Work bullocks	1.1	1.0	0.9	0.8	0.9	0.5	0.7	0.7	0.4	0.3	1.2
Sheep and goats, including:											
…Mature females ≥ 1 an	82.9	81.7	81.5	81.5	81.9	79.6	80.7	82.5	82.1	82.7	83.0
…Breeding Males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing lambs and kids up to 1 year	14.1	15.3	15.5	15.5	15.1	17.4	16.3	14.5	14.9	14.3	14.0

[94] Default values used for 'other cattle' category are: 30% of total – mature females, 22% – mature males, and 48% – young cattle (2006 IPCC Guidelines, Volume 3, Chapter 10, Table 10A-2, Page 10.73).
[95] According to the literature in the field (Bucataru et al., 2003), the reproduction structure at local sheep and goats is: breeding males – circa 3%, mature females – circa 75%, breeding youngsters – circa 22%.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Other cattle, including:											
…Calves and heifers up to 1 year	36.2	35.7	36.9	36.8	32.6	44.0	46.8	47.0	41.5	43.8	48.1
…Heifers between 12 and 18 months	20.2	22.0	21.0	20.6	22.2	18.4	17.6	18.6	25.3	23.1	17.1
…Heifers between 18 and 24 months	25.4	24.5	24.2	25.1	26.0	20.9	20.6	19.6	19.3	18.7	20.0
…Heifers between 24 months and more	15.7	15.2	15.4	15.4	16.9	14.5	13.5	13.3	12.6	12.7	12.9
…Breeding males	0.4	0.5	0.4	0.3	0.4	0.4	0.3	0.2	0.3	0.3	0.2
…Work bullocks	2.1	2.2	2.1	1.9	1.9	1.8	1.3	1.3	1.1	1.4	1.8
Sheep and goats, including:											
…Mature females ≥ 1 an	79.7	79.2	78.0	77.2	77.8	76.3	77.9	77.5	78.8	78.2	78.2
…Breeding Males	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0	3.0
…Growing lambs and kids up to 1 year	17.3	17.8	19.0	19.8	19.2	20.7	19.1	19.5	18.2	18.8	18.8

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector'. Basic Indices of Animal Breeding Sector Development in all Households Categories in the RoM as of January 1 (annual reports for 1990-2022).

Methane Conversion Factor (Y_m). The extent to which feed energy is converted to CH_4 depends on several feeding factors and production practices in the country. As there are no CH_4 CS conversion factors, default values provided in the 2006 IPCC Guidelines were used for cattle[96]: Y_m – 0.03 for feed-lot fed cattle (young animals) and Y_m – 0.065 for dairy cows and other cattle; for sheep and goats[97]: Y_m – 0.045 for lambs and kids and Y_m – 0.065 for mature animals, respectively.

Methane emission factors (EF). Based on the information above, country-specific national factors were developed for source category 3A 'Enteric Fermentation' (for cattle, sheep and goats). The emission factor for each animal category was developed following Equation 10.21 in the 2006 IPCC Guidelines.

$$EF = [GE \bullet (Y_m/100) \bullet 365 / 55.65]$$

Where:

EF – emission factor, kg CH_4/head/yr;

GE – gross energy intake, MJ/head/day;

Y_m – methane conversion factor, % of gross energy in feed converted to methane;

55.65 MJ/kg CH_4 – the energy content of methane.

Table 5-23 shows country-specific emission factors for cattle bred in the RoM, developed using the Tier 2 simplified methodology.

Table 5-23: Country-Specific EFs for enteric fermentation, calculated for cattle population in the RoM following the Tier 2 methodology, kg CH_4/head/year

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Dairy cows	**104.8**	**97.6**	**97.2**	**93.7**	**92.8**	**90.9**	**90.5**	**90.1**	**90.4**	**90.6**	**91.3**
Other cattle (average)	**50.5**	**49.5**	**49.9**	**52.2**	**53.7**	**52.6**	**55.3**	**53.2**	**52.6**	**52.7**	**55.1**
…Calves and heifers up to 1 year	42.7	40.3	40.6	40.7	41.2	33.5	32.2	29.8	33.0	30.5	32.3
…Heifers between 12 and 18 months	55.9	55.8	54.2	54.2	54.3	54.3	53.7	51.5	49.0	49.0	49.1
…Heifers between 18 and 24 months	66.8	64.9	62.9	60.8	62.4	62.4	62.6	60.8	58.0	58.0	58.2
…Heifers between 24 months and more	71.3	70.4	67.9	67.7	68.3	68.3	70.3	67.7	64.8	64.8	65.0
…Breeding males	88.6	87.3	82.0	82.8	81.2	80.3	78.8	76.0	76.0	76.0	76.2
…Work bullocks	77.8	77.5	73.0	79.1	79.7	79.7	79.9	78.0	76.9	75.8	75.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Dairy cows	**92.2**	**93.3**	**93.5**	**97.1**	**98.0**	**97.5**	**98.1**	**98.7**	**99.0**	**101.3**	**101.8**
Other cattle (average)	**53.1**	**54.3**	**53.9**	**56.3**	**55.2**	**55.5**	**54.4**	**52.0**	**51.4**	**51.9**	**52.7**
…Calves and heifers up to 1 year	34.8	36.3	34.8	35.7	37.0	37.1	35.8	37.3	38.6	37.1	38.1
…Heifers between 12 and 18 months	51.5	55.1	55.1	54.9	55.5	56.5	55.5	51.1	49.0	51.4	52.4
…Heifers between 18 and 24 months	60.8	63.0	63.0	64.8	63.6	65.7	64.9	60.8	61.1	61.7	62.5
…Heifers between 24 months and more	68.3	68.8	68.8	71.3	70.9	72.6	70.9	64.9	64.1	65.5	65.9
…Breeding males	76.0	76.9	76.9	77.9	76.1	76.9	76.9	78.0	77.0	77.0	77.0
…Work bullocks	75.8	76.9	78.0	79.3	78.5	78.5	78.5	79.8	79.0	79.0	79.0

[96] Default values used for cattle available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.12, Tables 10A-1 and 10A-2, Pages 10.30, 10.72-10.73.
[97] Default values used for sheep and goats available in 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.13, Page 10.31.

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Dairy cows	**102.2**	**103.3**	**104.8**	**104.8**	**104.1**	**105.3**	**105.3**	**103.1**	**98.3**	**102.6**	**102.9**
Other cattle (average)	**53.1**	**52.0**	**50.5**	**49.0**	**52.5**	**49.6**	**50.3**	**49.0**	**51.3**	**52.2**	**50.4**
…Calves and heifers up to 1 year	38.8	37.6	36.9	35.2	39.1	38.2	39.6	38.1	40.6	41.8	40.5
…Heifers between 12 and 18 months	52.9	51.7	50.3	48.6	52.4	50.3	52.9	52.2	53.8	55.4	53.5
…Heifers between 18 and 24 months	63.1	61.9	60.1	58.9	60.2	60.1	60.8	60.1	60.8	61.6	60.5
…Heifers between 24 months and more	66.3	65.7	63.7	62.5	63.9	63.7	64.5	63.7	64.5	65.3	64.1
…Breeding males	77.2	77.0	75.6	74.0	73.8	75.6	75.2	74.8	74.8	75.6	74.5
…Work bullocks	79.2	79.0	79.7	75.9	75.6	79.7	77.2	76.7	76.7	77.7	76.3

Table 5-24 shows country-specific emission factors calculated for sheep and goats. The obtained results are intermediate to the default values typical of developing countries – with 5 kg CH_4/head/year for sheep and goats, whereas for developed countries – 8 kg CH_4/head/year, respectively (2006 IPCC Guidelines).

Table 5-24: Country-Specific EFs from enteric fermentation, calculated for sheep population following the Tier 2 methodology, kg CH_4/head/year

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Sheep (average)	**6.9**	**6.9**	**6.7**	**6.6**	**6.5**	**6.4**	**6.4**	**6.3**	**6.2**	**6.2**	**6.2**
…Mature ewes and ewe lambs ≥ 1 year	7.4	7.4	7.1	7.1	7.3	6.8	6.8	6.6	6.6	6.7	6.7
…Breeding rams	10.6	10.4	10.2	10.2	10.2	9.9	9.9	9.8	9.5	9.5	9.5
…Growing lambs up to 1 year	3.9	3.8	3.7	3.7	3.7	3.6	3.6	3.4	3.1	3.4	3.1
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Sheep (average)	**6.3**	**6.3**	**6.1**	**6.3**	**6.5**	**6.8**	**6.8**	**7.1**	**7.1**	**7.1**	**7.0**
…Mature ewes and ewe lambs ≥ 1 year	6.7	6.7	6.6	6.7	7.0	7.5	7.5	7.7	7.7	7.7	7.5
…Breeding rams	9.3	9.3	9.1	9.6	9.1	9.2	9.2	8.9	9.1	9.1	9.1
…Growing lambs up to 1 year	3.3	3.4	3.1	3.5	3.2	3.3	3.2	3.3	3.3	3.4	3.2
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Sheep (average)	**6.9**	**7.4**	**7.6**	**6.4**	**6.1**	**7.3**	**7.4**	**6.7**	**7.0**	**7.6**	**7.4**
…Mature ewes and ewe lambs ≥ 1 year	7.6	8.1	8.5	7.2	6.9	8.2	8.3	7.5	7.8	8.5	8.3
…Breeding rams	9.0	9.1	8.7	8.8	8.9	8.8	8.9	8.9	9.0	8.9	9.0
…Growing lambs up to 1 year	3.4	3.6	3.7	2.9	2.5	3.7	3.7	3.2	3.4	3.8	3.4

5.2.3. Uncertainties and Time-Series Consistency

Uncertainties associated with the estimation of methane emissions from enteric fermentation result from uncertainties associated with livestock estimation, and also from the emission factors used. The uncertainties associated with the domestic animal population in the RoM are moderate (circa 10%). Should a Tier 1 method be used, the accuracy of the default EFs is circa 30% (2006 IPCC Guidelines). Because this methodology does not rely on country-specific values and does not consider the country's livestock characteristics, general uncertainty of results obtained by using this approach could reach up to circa 50% (2006 IPCC Guidelines).

Should a Tier 2 method be used, uncertainties will depend particularly only on how accurately the characteristics of basic categories of domestic animals will be applied and the extent to which the calculation methods and coefficients used in the different equations used to calculate the energy used correspond to national circumstances (2006 IPCC Guidelines). The accuracy of country-specific emission factors, calculated using the Tier 2 method, is estimated to be circa 20% (2006 IPCC Guidelines). Thus, combined uncertainties associated with activity data and emission factors for source category 3A 'Enteric Fermentation' are estimated to be circa 22.36% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

5.2.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

5.2.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for category 3A 'Enteric Fermentation', following the Tier 1 methodological approach.

It should be noted that the AD and methods used in the estimation of GHG emissions under category 3A 'Enteric Fermentation' were documented and archived both in hard copies and electronically. In order to identify the data entry and the CH_4 emission estimation process-related errors, verifications and quality control procedures were applied.

Following the recommendations in the 2006 IPCC Guidelines, CH_4 emissions from source category 3A 'Enteric Fermentation' were estimated using AD from official reference sources.

5.2.6. Recalculations

CH_4 emissions from source category 3A 'Enteric fermentation' were recalculated for 2006-2020 as a result of updating the CS EFs used for sheep and goats, as a result of using new activity data associated with the average weight of one head at the end of the calendar year, available starting with 2006 for category 'ewes and rams' in Statistical Annual Report No. 24-agr 'Animal Breeding Sector. Basic Indices of Animal Breeding Sector Development in all Households Categories in the RoM'.

In comparison with the emission values recorded in the NC5 of the RoM to the UNFCCC, the changes made resulted in an upward trend in methane emissions originating from source category 3A 'Enteric Fermentation' for 2006-2014 and 2017-2018, varying from a minimum increase by 1.0% in 2011, to a maximum increase by 1.9% in 2008, and in a downward trend in methane emissions for 2015-2016 and 2019-2020, respectively, varying from a minimum decrease by 0.4% in 2020, to a maximum decrease by cu 3.0% in 2016 (Table 5-25).

Table 5-25: Recalculations of CH_4 emissions from source category 3A 'Enteric Fermentation' included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	87.58	81.15	79.87	74.92	72.91	64.72	59.67	51.30	49.81	46.07	43.43
BTR1	87.58	81.15	79.87	74.92	72.91	64.72	59.67	51.30	49.81	46.07	43.43
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	44.13	45.02	41.14	38.46	36.96	35.75	28.88	27.57	28.54	28.33	26.68
BTR1	44.13	45.02	41.14	38.46	36.96	36.14	29.20	28.08	28.90	28.67	26.93
Difference, %	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.9	1.3	1.2	1.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	25.21	25.39	26.10	25.17	24.88	23.14	20.66	17.64	15.56		
BTR1	25.55	25.76	26.36	24.80	24.14	23.38	20.88	17.48	15.50	15.32	14.82
Difference, %	1.3	1.5	1.0	-1.5	-3.0	1.1	1.1	-0.9	-0.4		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

At the same time, methane emissions from source category 3A 'Enteric Fermentation' have been recalculated for the years 1990-2020 and as a result of the change in the GWP_{100}, the GWP_{100} – 28 value available in the IPCC AR5 (2014) was utilised, instead of the GWP_{100} – 25 value available in the IPCC AR4 (2007)

In comparison with the emission values recorded in NC5 of the RoM to UNFCCC (2023), the changes made resulted in an upward trend in methane emissions originating from source category 3A 'Enteric Fermentation' for 1990-2020 (Table 5-26).

Table 5-26: Recalculations of CH_4 emissions from source category 3A 'Enteric Fermentation' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	2,189.43	2,028.87	1,996.79	1,872.90	1,822.83	1,618.09	1,491.87	1,282.60	1,245.20	1,151.82	1,085.78
BTR1	2,452.16	2,272.33	2,236.40	2,097.65	2,041.57	1,812.26	1,670.90	1,436.51	1,394.62	1,290.04	1,216.08
Difference, %	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	1,103.27	1,125.61	1,028.54	961.42	924.03	893.81	722.10	689.29	713.60	708.18	666.91
BTR1	1,235.66	1,260.68	1,151.96	1,076.79	1,034.91	1,012.00	817.65	786.37	809.31	802.68	754.04
Difference, %	12.0	12.0	12.0	12.0	12.0	13.2	13.2	14.1	13.4	13.3	13.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	630.27	634.86	652.58	629.21	622.00	578.38	516.49	440.95	389.04		
BTR1	715.30	721.38	737.98	694.45	675.89	654.60	584.64	489.47	434.00	429.07	414.83
Difference, %	13.5	13.6	13.1	10.4	8.7	13.2	13.2	11.0	11.6		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

For 2021-2022, CH_4 emissions resulting from category 3A 'Enteric Fermentation' have been estimated for the first time. The obtained results allow us to assert that between 1990 and 2022, methane emissions originating from the respective category had decreased by 83.1%, particularly due to the decrease in the animal population.

Between 1990 and 2022, the share of different livestock categories in the structure of methane emissions from source category 3A 'Enteric Fermentation' had changed. By 2022, the share of categories such as 'other cattle' had decreased compared to the level in 1990, whereas the share of other categories such as 'dairy cows', 'sheep', 'goats', 'horses', 'asses and mules', 'swine', and 'rabbits' recorded an upward trend (Table 5-27).

Table 5-27: Share of different livestock categories in the structure of CH_4 emissions from source category 3A 'Enteric Fermentation' in the RoM between 1990-2022, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Dairy cows	47.3	47.8	49.1	50.3	51.3	53.5	53.9	56.9	57.8	60.3	62.7
Other cattle	38.3	36.8	35.4	33.5	31.6	28.3	27.0	23.4	22.6	20.1	18.6
Sheep	9.8	10.6	10.9	12.0	12.7	13.1	13.7	13.9	13.1	12.9	12.1
Goats	0.2	0.3	0.4	0.5	0.6	0.7	0.8	1.0	1.0	1.2	1.3
Horses	1.0	1.1	1.2	1.3	1.4	1.7	1.9	2.3	2.5	2.8	3.2
Asses and mules	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.1	0.1	0.1
Swine	3.2	3.2	2.8	2.2	2.2	2.4	2.4	2.3	2.8	2.4	1.7
Rabbits	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Dairy cows	62.7	63.2	63.1	62.9	61.8	59.9	60.8	60.4	59.3	58.6	58.9
Other cattle	18.5	18.1	17.2	16.2	15.9	16.1	13.5	12.3	12.4	12.8	13.4
Sheep	12.1	11.8	12.4	13.6	14.5	15.9	17.8	19.4	19.9	19.7	18.5
Goats	1.4	1.5	1.6	1.7	1.7	1.7	1.8	2.0	2.1	2.2	2.5
Horses	3.3	3.3	3.6	3.5	3.5	3.4	3.7	3.7	3.5	3.4	3.4
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	1.7	1.8	1.7	1.6	2.0	2.4	1.6	1.6	2.1	2.7	2.6
Rabbits	0.3	0.2	0.3	0.4	0.4	0.5	0.5	0.5	0.6	0.6	0.6
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Dairy cows	58.0	56.7	55.9	58.2	57.0	55.0	53.7	53.2	50.9	51.1	52.2
Other cattle	13.6	13.5	13.4	13.2	14.7	13.5	13.5	14.3	15.1	14.8	14.6
Sheep	19.0	20.5	21.1	18.7	18.0	21.3	22.0	20.5	21.7	21.8	21.2
Goats	2.7	2.8	2.9	3.2	3.5	3.6	3.9	4.4	4.8	4.8	4.9
Horses	3.3	3.2	2.9	2.9	2.8	2.6	2.6	2.7	2.7	2.3	2.2
Asses and mules	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.1	0.1	0.1	0.1
Swine	2.6	2.6	2.9	2.9	2.9	2.8	3.1	3.7	3.6	3.6	3.7
Rabbits	0.6	0.7	0.7	0.8	0.9	1.0	1.0	1.1	1.2	1.5	1.2

It should also be noted that the impact of using the Tier 2 estimation methodology, instead of the Tier 1 methodology, generally provided lower values of methane emissions from source category 3A 'Enteric Fermentation', this reduction varying between a minimum of 8.5% in 2014 and a maximum of 18.6% in 1999 (Table 5-28).

Table 5-28: Comparative results of CH_4 emissions from category 3A 'Enteric Fermentation', calculated using the Tier 1 and Tier 2 methodologies, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Tier 1	98.12	94.68	93.51	88.47	86.11	78.31	71.55	62.85	61.09	56.60	52.89
Tier 2	87.58	81.15	79.87	74.92	72.91	64.72	59.67	51.30	49.81	46.07	43.43
Difference, %	-10.7	-14.3	-14.6	-15.3	-15.3	-17.4	-16.6	-18.4	-18.5	-18.6	-17.9
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Tier 1	53.65	54.09	49.61	44.91	42.85	41.62	33.70	32.27	33.12	32.33	30.32
Tier 2	44.13	45.02	41.14	38.46	36.96	36.14	29.20	28.08	28.90	28.67	26.93
Difference, %	-17.7	-16.8	-17.1	-14.4	-13.7	-13.2	-13.3	-13.0	-12.7	-11.3	-11.2
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Tier 1	28.68	28.49	28.82	28.16	27.51	25.77	22.86	19.84	17.74	16.87	16.43
Tier 2	25.55	25.76	26.36	24.80	24.14	23.38	20.88	17.48	15.50	15.32	14.82
Difference, %	-10.9	-9.6	-8.5	-11.9	-12.3	-9.3	-8.7	-11.9	-12.6	-9.1	-9.8

5.2.7. Planned Improvements

Planned improvements could include specifying productivity indices used in the estimation of GHG emissions from source category 3A 'Enteric Fermentation' following the Tier 2 methodology, particularly for cattle and sheep.

5.3. Manure Management (Source Category 3B)

Category 3B 'Manure Management' includes both methane and nitrous oxide emissions. Emissions level depends on the amount of manure treated and handled within manure management systems, properties of manure and type of manure management systems. Usually, poorly aerated manure management systems generate larger amounts of CH_4 and smaller amounts of N_2O; whereas well aerated systems generate less CH_4 emissions and more N_2O emissions.

5.3.1. Methane Emissions

5.3.1.1. Source Category Description

When manure decomposes anaerobically (in the absence of oxygen), methanogenic bacteria produce methane. The main factors affecting the production of CH_4 emissions from manure are the amount of manure produced and the share (or percentage) of manure decomposed anaerobically. The first category of these factors depends on the production rate of animal manure during a calendar year, as well as on livestock; and the second group of factors – the way in which animal manure is collected, stored, and used. The share of manure that decomposes anaerobically depends on how the manure is managed. When manure is stored or treated as a liquid (e.g., in lagoons, ponds, etc.), it decomposes anaerobically and can produce a significant quantity of CH_4, and when manure is stored or handled as a solid (e.g., in stacks or piles) or when it is excreted in the grazing process or applied on agricultural soils as organic fertilizer, it tends to decompose under more aerobic conditions and produces insignificant amounts of methane.

In order to estimate methane emissions from manure management, the total animal population was divided into subgroups to better reflect the average amount of waste produced per animal or poultry per year, as well as the way in which manure is managed. Average emission rates were calculated for existent animal and poultry categories, based on typical manure management systems and country-specific emission factors for cattle and swine, as well as based on default emission factors for other livestock and poultry categories.

5.3.1.2. Methodologies, Emission Factors and Activity Data

When using the Tier 1 methodology, emissions may be calculated by multiplying the activity data on livestock (identical to those used in the estimation of CH_4 emissions from 3A 'Enteric Fermentation') by default emission factors in countries with cold climate (average annual temperature being less than 15°C), for each category of animals (see Equation 10.22 in the 2006 IPCC Guidelines).

$$CH_4 \text{ Emissions} = \Sigma_{(T)} [(EF_{(T)} \bullet N_{(T)})/10^6]$$

Where:

CH_4 Emissions – CH_4 from manure management, for a defined population, kt CH_4/yr;

$EF_{(T)}$ – emission factor for the defined livestock population, kg CH_4/head/yr;

$N_{(T)}$ – number of head of livestock species/category *T* in the country;

T – species/category of livestock.

Since source category 3B 'Manure Management' has a significant share in the country's emissions and default values used do not correspond to the specific conditions of animal growth and manure management practices used in the RoM, following the 2006 IPCC Guidelines, in order to estimate CH_4 emissions, the Tier 2 methodology was used (for cattle and swine).

Methane Emission Factors (EFs). In the RoM, country-specific EFs (for cattle and swine) were calculated based on information collected from statistical publications and various scientific research publications. To calculate these coefficients, it was necessary to determine the range in manure volatile solid content per animal (VS, in kg) and the maximum methane producing capacity typical to certain type of manure (B_0 in m^3 per kg of VS). Additionally, methane conversion factors (MCF) which also account for the influence of climate conditions on methane formation were identified for each type of manure management system.

CH_4 emission factors under category 3B 'Manure Management' were calculated by using Equation 10.23 in the 2006 IPCC Guidelines.

$$EF_{(T)} = (VS_{(T)} \bullet 365) \bullet [B_{0(T)} \bullet 0.67 \text{ kg/m}^3 \bullet \Sigma_{(S, k)} (MCF_{(S, k)}/100) \bullet MS_{(T,S, k)}]$$

Where:

$EF_{(T)}$ – annual CH_4 emission factor for livestock category *T*, kg CH_4/animal/yr;

$VS_{(T)}$ – daily volatile solid excreted for livestock category *T*, kg dm/animal/day (Table 5-29);

$B_{0(T)}$ – maximum methane producing capacity for manure produced by livestock category *T*, m^3 CH_4/kg of VS excreted;

0.67 – conversion factor (CF) of m^3 CH_4 to kilograms CH_4;

$MCF_{(S,k)}$ – methane conversion factors for each manure management system *S* by climate region *k*, %;

$MS_{(T,S,k)}$ – fraction of livestock category *T*'s, manure handled using management system *S* in climate region *k*, dimensionless.

Table 5-29: Daily volatile solid excreted (VS) calculated for the period 1990-2022, kg dry matter/day

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Dairy cows	4.15	3.98	3.95	4.03	4.10	4.01	3.98	3.87	3.89	3.89	3.91
Other cattle	1.99	2.00	2.02	2.23	2.36	2.31	2.42	2.27	2.25	2.25	2.35
Market swine	0.54	0.54	0.52	0.53	0.51	0.49	0.47	0.42	0.41	0.40	0.42
Fattening swine	0.34	0.34	0.33	0.34	0.32	0.31	0.29	0.26	0.26	0.25	0.26
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Dairy cows	3.96	4.01	4.02	4.05	4.10	4.08	4.11	4.12	4.03	4.01	4.03
Other cattle	2.27	2.32	2.30	2.34	2.30	2.31	2.27	2.16	2.08	2.04	2.08
Market swine	0.40	0.40	0.42	0.41	0.40	0.40	0.40	0.41	0.40	0.41	0.45
Fattening swine	0.25	0.25	0.26	0.26	0.25	0.25	0.25	0.26	0.25	0.26	0.28
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Dairy cows	4.04	3.97	4.03	4.03	3.99	4.05	4.05	3.97	3.78	3.95	3.96
Other cattle	2.09	1.99	1.93	1.87	2.00	1.90	1.92	1.88	1.96	2.00	1.93
Market swine	0.48	0.51	0.49	0.50	0.47	0.51	0.49	0.50	0.54	0.42	0.43
Fattening swine	0.30	0.32	0.31	0.31	0.30	0.32	0.31	0.31	0.34	0.27	0.27

Volatile Solids Excretion Rate (VS) was calculated following Equation 10.24 in the 2006 IPCC Guidelines.

$$VS = [GE \bullet (1 - DE\%/100) + (UE \bullet GE)] \bullet [(1 - ASH/18.45)]$$

Where:

VS – volatile solid excretion per day on a dry-organic matter basis, kg VS/day[98] (see country-specific values in Table 5-29);

GE – gross energy intake, MJ/day; the same values as those used for Enteric Fermentation;

DE – digestibility of the feed in %; for cattle the same values were used as under 3A 'Enteric Fermentation'; for fattening swine, DE – 85%, while for market swine DE – 75%;

(UE • GE) – urinary energy expressed as fraction of gross energy (GE); typically, this value is 0.04 GE for cattle and 0.02 GE for swine;

ASH – the ash content of manure, expressed in %; values used by Austria in its NIR were used: 11% for dairy cows, 11.5% for other cattle, the default value of 2% was used for swine (2006 IPCC Guidelines);

18.45 – conversion factor (CF) for dietary GE in MJ per kg of dry matter; this value is relatively constant across a wide range of forage and grain-based feeds.

The maximum *methane-producing capacity of the manure* (B_0) varies by species and diet. As it was not possible to identify country-specific values of B_0 expressed in m^3 per kg of VS in the specialty literature, default values typical of EE countries were used (Tables 5-30 and 5-31).

Table 5-30: Coefficients and default EFs used in source category 3B 'Manure Management' for cattle and swine

Categories	Weight, kg	Digestibility, %	Energy, MJ/zi	Daily feed intake, kg	Manure, kg/day (dm)	VS, kg/day	B_0, m^3 CH_4/kg VS	EF, kg CH_4/yr
Dairy cows	550	60	207.2	11.2	4.49	4.5	0.24	11
Other cattle	391	60	134.4	7.3	2.91	2.7	0.17	6
Fattening swine	50	75	38.0	2.1	0.51	0.3	0.45	3
Market swine	180	60	38.0	2.1	0.51	0.5	0.45	4

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.14, page 10.38; Table 10A-4, page 10.77; Table 10A-5, page 10.78; Table 10A-7, page 10.80 and Table 10A-8, page 10.81.

Table 5-31: Coefficients and default emission factors used in category 3B 'Manure Management' (for developed countries)

Categories	Weight, kg	Digestibility, %	Daily feed intake, kg	% Ash, dm	VS per day, kg VS	B_0, m^3/kg VS	CF CH_4, %	EF, kg CH_4/yr
Sheep	48.5	60	1.08	8	0.40	0.19	1	0.19
Goats	38.5	60	0.76	8	0.30	0.18	1	0.13
Horses	377	70	5.96	4	2.13	0.30	1	1.56
Asses and Mules	130	70	3.25	4	0.94	0.33	1	0.76
Rabbits	1.6	-	-	-	0.10	0.32	1	0.08
Chickens	1.8	63	-	5	0.02	0.39	1	0.03
Turkeys	6.8	68	-	3	0.07	0.36	1	0.09
Broilers	0.9	68	-	2	0.01	0.36	1	0.02
Ducks	2.7	66	-	2	0.02	0.36	1	0.02

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.15, page 10.41; Table 10A-9, pages 10.82-10.83.

Methane Conversion Factor (MCF) values vary depending on the manure management systems and annual average temperatures. Because of the unavailability of CS methane conversion factors (MCF), default values provided in the 2006 IPCC Guidelines were used (Table 5-32). MCF represents the extent to which maximum methane producing capacity (B_0) is attained. Thus, the calculation of MCF values should include the following factors: length of storage; manure characteristics; amount of manure left in the storage; temperature distribution between indoor and outdoor storage; daily temperature fluctuation; seasonal temperature variation, etc.

Table 5-32: Default values of MCF for Manure Management Systems, %

Manure Management Systems	MCF, %
Pasture/Range/Paddock: the manure from pasture and range grazing animals is allowed to lie as deposited, and is not managed	1
Daily Spread: animal manure is collected in solid form, being then immediately applied to cropland or pastures with a certain regularity. Manure is not stored or treated, so emissions are considered zero.	0.1

[98] Default values used as follows: for dairy cows – 4.5 kg dm/day, other cattle – 2.7 kg dm/day (2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-4, Page 10.77, and Table 10A-5, Page 10.78); for swine: market swine – 0.5 kg dm/day, fattening swine – 0.3 kg dm/day (2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-8, Page 10.81 and Table 10A-7, Page 10.80).

Manure Management Systems		MCF, %
Solid storage: manure is collected and stored in solid form for a long time (by default – a few months) before use.		2
Dry lot: in countries with dry climates, animals can be kept in confinement areas, the manure formed is allowed to dry, being periodically evacuated in a dry state and used accordingly.		1
Liquid/Slurry: manure is stored in either tanks or earthen ponds for six months or more, later applied to land; in order to facilitate manure management, water is added to it.	with natural crust cover	10
	without natural crust cover	17
Uncovered anaerobic lagoon: systems that use water to transport animal manure to lagoons/ponds, where they are kept for 30 to 200 days; the water can be recycled or then used to irrigate and fertilize agricultural land.		66
Pit storage below animal confinements: solid and liquid animal manure is excreted on the floor, under which there are deep pits, from where manure is discharged after a certain period. Storage varies for this analysis and was divided into two categories.	< 30 days	3
	> 30 days	17
Anaerobic Digester: manure, usually in liquid form, is subjected to anaerobic digestion in digesters to produce methane or energy. Emissions, in this case, come from leaks and vary depending on the type of digester.		0-100
Burned for Fuel: manure is collected, dried and burned for fuel. Methane emissions associated with burned manure are not included in the Agriculture Sector but were considered in the Energy Sector category 'Biomass'.		10
Composting – Intensive windrow: solid and liquid manure is collected and stored in tanks or pits, with forced aeration of manure		0.5
Composting – Passive windrow: solid and liquid animal manure is collected and stored in piles, with regular turning for aeration.		0.5
Poultry manure with bedding: poultry manure is excreted on the floor with bedding; birds tread on the manure.		1.5
Poultry manure without bedding: poultry manure is excreted on the floor without bedding; birds do not tread on the manure.		1.5
Aerobic treatment: animal manure (dung and urine) is collected in a liquid state, subjected to forced aeration, or treated in aerobic lagoons or ponds or in moist soil systems to ensure the nitrification or denitrification process.		0

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.17, pages 10.44-10.47.

The default values of the methane conversion factor for cattle and swine are presented in Table 5-33, whereas the percentage of using different manure management systems in Eastern European countries – in Table 5-34 below.

Table 5-33: MCFs for different animal categories and manure management systems

Manure Management Systems	MCF, %	
	Cattle	Swine
Anaerobic lagoon	66	66
Liquid/slurry	17	17
Solid storage	2	2
Dry lot	1	1
Pasture/range/paddock	1	0
Pit Storage below animal confinements < 1 month	0	3
Pit Storage below animal confinements > 1 month	0	17
Daily spread	0.1	0.1
Anaerobic digester	10	10
Burning for fuel	10	0
Other systems	1	1

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-4 page 10.77, Table 10A-5 page 10.78, Table 10A-7 page 10.80 and Table 10A-8 page 10.88.

Table 5-34: Default manure management systems used in Eastern European countries (MS%)

	Anaerobic lagoon	Liquid/slurry	Solid storage	Pasture	Daily spread	Other
Dairy cows	0	17.5	60	18	2.5	2
Other cattle	0	22.5	44	20	0	13.5
	Anaerobic Lagoon	**Liquid / Slurry**	**Solid Storage**	**Pits < 1 month**	**Pits > 1 month**	**Other**
Fattening swine	3	0	42	24.7	24.7	5.7
Market swine	3	0	42	24.7	24.7	5.7

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10A-4 page 10.77, Table 10A-5 page 10.78, Table 10A-7 page 10.80 and Table 10A-8 page 10.88.

Based on country-specific AD (identical to those used for category 3A 'Enteric Fermentation'), as well as on default EFs and coefficients, country-specific CH_4 EFs for source category 3B 'Manure Management' were calculated (for animal categories such as 'cattle' and 'swine'). Following good practices, the same estimation methodology was used for the entire period under review.

As significant changes occurred in the livestock breeding sector of the RoM in terms of manure management practices (large scale feedlots for cattle and swine were closed down, most animal population being concentrated currently in the private sector; the share of liquid manure management systems, contributing to a greater extent to the generation of CH_4 emissions, has decreased; while the share of solid manure management systems, less responsible for the generation of CH_4 emissions, increased),

as well as a consequence of non-compliance to actual manure management systems in the RoM with the ones described in the 2006 IPCC Guidelines (for Eastern European countries), it was not deemed necessary to use default values in terms of the share of different manure management systems typical of Eastern European countries.

Thus, in order to estimate CH_4 emissions from source category 3B 'Manure Management' (for cattle and swine), country-specific values were used (Table 5-35), available from a study developed in May-June 2015 by specialists from the Scientific-Practical Institute of Biotechnology in Animal Breeding and Veterinary Medicine, as well as from a second study developed in June 2021 from the National Agency for Food Safety, whose results were presented to the Environment Agency through Letter No. 016/1722 dated 30.06.2021, as a response to request to No. 08/136/2021 dated 09.06.2021.

Table 5-35: Share of Manure Management Systems (MS%) in the RoM for the period 1989-2022

Animal Categories (T) and Manure Management Systems (MS)	1989 / 1990	1991 / 1992	1993 / 1994	1995 / 1997	1998 / 1999	2000 / 2001	2002 / 2003	2004 / 2005	2006 / 2007	2008 / 2009
	MS values $_{(T,S)}$									
Dairy cows	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
pasture/range/paddock	6.0	10.0	16.0	20.0	23.0	24.0	24.0	24.5	24.5	24.5
liquid/slurry	24.0	20.0	12.0	7.0	3.0	1.0	1.0	1.5	1.5	1.5
aerobic digestion in digesters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
solid storage	70.0	70.0	72.0	73.0	74.0	75.0	75.0	74.0	74.0	74.0
Other cattle	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
pasture/range/paddock	4.0	8.0	12.0	16.0	20.0	22.0	22.0	22.0	22.0	22.0
liquid/slurry	34.0	26.0	18.0	10.0	4.0	4.0	4.0	6.0	6.0	6.0
solid storage	62.0	66.0	70.0	74.0	76.0	74.0	74.0	72.0	72.0	72.0
Swine	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
liquid systems	73.0	65.0	60.0	55.0	52.0	49.0	47.0	45.0	43.0	41.0
aerobic digestion in digesters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
litter, pit storage <1 month	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
solid storage	27.0	35.0	40.0	45.0	48.0	51.0	53.0	55.0	57.0	59.0
Sheep and Goats	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
pasture/range/paddock	18.0	18.0	20.0	20.0	22.0	22.0	24.0	24.0	24.0	26.0
solid storage	82.0	82.0	80.0	80.0	78.0	78.0	76.0	76.0	76.0	74.0
Horses, Asses and Mules	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
pasture/range/paddock	18.0	18.0	20.0	20.0	22.0	22.0	24.0	24.0	24.0	26.0
solid storage	82.0	82.0	80.0	80.0	78.0	78.0	76.0	76.0	76.0	74.0
Rabbits	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
solid storage	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Poultry	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
pasture/range/paddock	7.0	7.0	7.0	8.0	8.0	8.0	9.0	9.0	9.0	10.0
aerobic digestion in digesters	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
solid storage	93.0	93.0	93.0	92.0	92.0	92.0	91.0	91.0	91.0	90.0
Animal Categories (T) and Manure Management Systems (MS)	**2010 / 2011**	**2012 / 2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
	MS values $_{(T,S)}$									
Dairy cows	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
pasture/range/paddock	24.50	25.00	23.85	23.83	23.80	25.60	25.30	24.92	23.88	22.46
liquid/slurry	1.50	1.50	1.46	1.49	1.53	0.89	1.08	1.32	1.98	2.89
aerobic digestion in digesters	0.00	0.00	0.00	0.00	0.00	0.18	0.22	0.27	0.40	0.58
solid storage	74.00	73.50	74.69	74.68	74.67	73.33	73.40	73.49	73.74	74.07
Other cattle	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
pasture/range/paddock	22.00	21.50	21.92	20.57	19.47	18.82	17.86	16.94	15.52	15.11
liquid/slurry	6.00	6.10	6.16	4.28	5.15	5.66	6.42	7.14	8.26	8.59
solid storage	72.00	72.40	71.92	75.15	75.38	75.52	75.72	75.92	76.22	76.30
Swine	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
liquid systems	39.00	38.00	37.00	30.52	27.12	25.28	23.25	22.28	21.82	21.17
aerobic digestion in digesters	0.00	0.00	0.00	2.98	3.26	4.30	8.25	9.26	10.00	10.18
litter, pit storage <1 month	0.00	0.00	0.00	12.10	18.02	26.32	28.30	29.36	31.69	32.25
solid storage	61.00	62.00	63.00	54.40	51.60	44.10	40.20	39.10	36.49	36.40
Sheep and Goats	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
pasture/range/paddock	26.00	26.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00

Animal Categories (T) and Manure Management Systems (MS)	1989 / 1990	1991 / 1992	1993 / 1994	1995 / 1997	1998 / 1999	2000 / 2001	2002 / 2003	2004 / 2005	2006 / 2007	2008 / 2009
	MS values $_{(T, S)}$									
Dairy cows	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**	**100.0**
solid storage	74.00	74.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00
Horses, Asses and Mules	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
pasture/range/paddock	26.00	26.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00	27.00
solid storage	74.00	74.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00	73.00
Rabbits	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
solid storage	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
Poultry	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
pasture/range/paddock	10.00	10.00	9.99	9.84	9.84	9.84	9.73	9.65	9.34	9.14
aerobic digestion in digesters	0.00	0.00	0.00	1.82	1.82	1.82	1.87	1.93	2.04	2.14
solid storage	90.00	90.00	90.01	88.34	88.34	88.34	88.40	88.42	88.62	88.72

The goal of the study was to determine the share of manure management systems in the RoM in order to enhance the accuracy of GHG inventory results from category 3B 'Manure Management'. In the process of carrying out this study, dairy cow and other cattle farms with a livestock of more than 5 heads were inspected, as well as pig farms with more than 30 heads and the largest poultry farms in the country. In total, manure management systems from 593 farms were inspected: of which 188 dairy cow farms, 17 other cattle farms, 114 pig farms, 188 sheep farms, 6 horse farms, 13 rabbit farms and 67 poultry farms (Table 5-36).

Table 5-36: Share of different manure management systems in agricultural enterprises and individual farms in 2021

Animal Categories (T) and Manure Management Systems (MS)	Farms, units	Share, % of total	Livestock, heads	Share, % of total
Dairy cows	**188**	**100.0**	**12,222**	**100.0**
Solid storage, including:	170	90.4	9,700	79.4
On concrete platforms	37	19.7	2,000	16.4
Directly on the ground	133	70.7	7,700	63.0
Liquid manure management systems, including:	17	9.0	2,522	20.6
Special anaerobic tanks	0	0.0	0	0.0
Ponds and lakes	16	8.5	2,100	17.2
Anaerobic digestion of manure in digesters	1	0.5	422	3.5
Other cattle	**17**	**100.0**	**16,483**	**100.0**
Solid storage, including:	12	70.6	13,100	79.5
On concrete platforms	0	0.0	0	0.0
Directly on the ground	12	70.6	13,100	79.5
Liquid manure management systems, including:	5	29.4	3,383	20.5
Special anaerobic tanks	1	5.9	2,400	14.6
Ponds and lakes	4	23.5	983	6.0
Anaerobic digestion of manure in digesters	0	0.0	0	0.0
Swine	**114**	**100.0**	**236,774**	**100.0**
Solid storage, including:	0	0.0	0	0.0
On concrete platforms	0	0.0	0	0.0
Directly on the ground	0	0.0	0	0.0
Storage in pits below floor of animal confinement area	4	3.5	120,000	50.7
<30 days	4	3.5	120,000	50.7
>30 days	0	0.0	0	0.0
Liquid manure management systems, including:	110	96.5	116,774	49.3
Special anaerobic tanks	20	17.5	35,774	15.1
Ponds and lakes	89	78.1	43,000	18.2
Anaerobic digestion of manure in digesters	1	0.9	38,000	16.0
Sheep and goats	188	100.0	64,822	100.0
Solid storage, including:	188	100.0	64,822	100.0
On concrete platforms	0	0.0	0	0.0
Directly on the ground	188	100.0	64,822	100.0

Animal Categories (T) and Manure Management Systems (MS)	Farms, units	Share, % of total	Livestock, heads	Share, % of total
Horses and Asses	6	100.0	253	100.0
Solid storage, including:	6	100.0	253	100.0
On concrete platforms	0	0.0	0	0.0
Directly on the ground	6	100.0	253	100.0
Rabbits	13	100.0	16,600	100.0
Solid storage, including:	13	100.0	16,600	100.0
On concrete platforms	0	0.0	0	0.0
Directly on the ground	13	100.0	16,600	100.0
Poultry	67	100.0	2,832,475	100.0
Solid storage, including:	67	100.0	2,832,475	100.0
On concrete platforms	0	0.0	0	0.0
Directly on the ground	65	97.0	2,682,475	94.7
Liquid manure management systems, including:	2	3.0	150,000	5.3
Special tanks	0	0.0	0	0.0
Ponds and lakes	0	0.0	0	0.0
Anaerobic digestion of manure in digesters	2	3.0	150,000	5.3

In order to estimate the share of manure management systems (MS%) (Table 5-35) for the period 1990-2022, the information on livestock and poultry population was considered (Table 5-10), and their share in agricultural enterprises and farm households, and individual farms, respectively (Table 5-37).

Table 5-37: Livestock and poultry population between 1990-2022, % of the total livestock and poultry population in all households in the RoM

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Agricultural enterprises and farm households											
Cattle, including:	81.8	77.2	71.3	59.0	50.7	43.8	37.0	26.8	20.9	13.0	9.4
cows	74.9	69.5	62.0	49.9	40.0	33.1	26.7	18.6	14.3	8.4	5.6
other cattle	86.0	82.2	78.0	66.8	61.0	55.8	50.1	39.0	31.2	21.6	17.6
Swine	81.0	77.4	71.1	60.3	54.0	55.1	52.0	40.2	36.9	19.6	9.2
Sheep and goats, including:	35.9	31.3	27.3	20.3	16.5	14.6	11.7	9.4	8.1	5.9	5.0
sheep	37.0	32.6	28.7	21.5	17.6	15.6	12.6	10.2	8.9	6.6	5.7
goats	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Horses	84.7	76.4	66.2	53.6	46.3	41.9	35.8	28.0	21.9	11.9	8.4
Poultry	53.5	51.9	36.4	21.9	20.5	19.4	16.9	14.9	12.9	9.8	9.6
Individual farms											
Cattle, including:	18.1	22.9	28.8	41.1	49.3	56.3	63.0	73.3	79.1	87.0	90.6
cows	25.0	30.5	37.9	50.2	59.9	66.7	73.5	81.5	85.6	91.7	94.4
other cattle	14.0	17.9	22.2	33.3	39.1	44.6	49.7	61.1	68.9	78.4	82.5
Swine	19.0	22.5	29.0	40.0	46.1	44.9	47.9	59.8	63.2	80.4	90.8
Sheep and goats, including:	64.1	68.7	72.6	79.6	83.5	85.4	88.3	90.5	91.9	94.1	95.0
sheep	63.1	67.5	71.3	78.5	82.4	84.4	87.4	89.7	91.1	93.4	94.4
goats	99.7	99.0	100.0	100.0	100.0	100.0	100.0	100.1	100.0	100.0	100.0
Horses	14.8	24.8	35.0	45.9	53.4	57.7	64.8	70.8	78.2	87.8	91.4
Poultry	46.5	48.1	63.6	78.1	79.5	80.6	83.1	85.1	87.1	90.2	90.4
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Agricultural enterprises and farm households											
Cattle, including:	7.9	7.8	6.7	6.0	6.4	6.4	6.6	6.1	6.0	5.4	5.9
cows	4.8	4.3	3.9	3.5	3.7	3.4	3.6	3.2	3.0	2.9	3.0
other cattle	14.3	15.3	12.9	12.0	12.9	13.0	14.8	14.1	13.7	11.5	12.9
Swine	11.1	14.6	9.2	8.5	10.0	12.6	20.6	23.3	25.1	29.1	27.5
Sheep and goats, including:	4.9	5.0	4.5	4.0	3.9	3.8	3.7	3.0	2.6	2.2	2.5
sheep	5.5	5.7	5.1	4.6	4.5	4.3	4.1	3.3	2.9	2.5	2.9
goats	0.0	0.8	0.0	0.0	0.0	0.0	0.3	0.4	0.4	0.3	0.4
Horses	6.5	6.4	5.2	4.1	4.3	3.0	2.9	2.7	2.2	2.1	1.8
Poultry	12.6	10.9	9.5	11.3	11.7	11.3	13.0	17.4	14.9	13.8	14.7

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Individual farms											
Cattle, including:	92.1	92.3	93.3	94.1	93.4	93.6	93.4	93.9	94.0	94.7	94.1
cows	94.9	95.6	96.4	96.6	96.3	96.8	96.5	96.8	97.0	97.1	96.9
other cattle	86.4	85.1	86.6	88.2	86.7	86.5	85.2	85.8	86.2	88.5	87.2
Swine	88.9	85.4	90.8	91.5	90.1	87.4	79.4	76.7	74.9	70.9	72.5
Sheep and goats, including:	95.2	94.7	95.5	95.9	96.0	96.2	96.3	97.0	97.4	97.8	97.5
sheep	94.5	94.2	94.8	95.4	95.4	95.7	95.9	96.7	97.1	97.5	97.1
goats	100.0	97.6	100.1	99.7	99.7	100.1	99.7	99.6	99.7	99.8	99.6
Horses	94.0	94.6	95.6	95.2	96.9	97.4	97.2	97.3	97.8	98.0	98.1
Poultry	87.4	89.1	90.5	88.7	88.3	88.7	87.0	82.6	85.1	86.2	85.3
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Agricultural enterprises and farm households											
Cattle, including:	6.1	6.5	7.2	8.1	10.0	11.4	12.6	14.9	17.1	21.4	25.5
cows	3.5	3.9	4.5	4.6	4.7	4.8	5.2	6.3	7.7	11.6	16.8
other cattle	12.2	12.4	13.0	15.7	20.9	25.1	27.6	31.3	34.9	40.3	41.9
Swine	34.6	37.8	41.6	41.0	43.6	45.4	51.9	57.8	57.9	62.5	63.6
Sheep and goats, including:	2.1	2.3	2.7	3.2	2.9	3.0	2.7	2.8	2.9	3.4	5.0
sheep	2.5	2.6	3.1	3.7	3.3	3.5	3.1	3.3	3.5	3.9	5.6
goats	0.4	0.7	0.8	0.7	0.8	0.9	0.8	1.0	0.8	1.9	3.3
Horses	1.7	1.3	1.2	1.0	1.0	0.8	0.8	0.7	0.8	0.8	0.6
Poultry	22.4	30.3	29.6	33.4	34.4	34.4	32.8	38.1	35.3	39.6	38.4
Individual farms											
Cattle, including:	93.9	93.5	92.8	91.9	90.0	88.6	87.4	85.1	82.8	78.6	74.5
cows	96.5	96.1	95.6	95.4	95.3	95.2	94.8	93.7	92.2	88.4	83.2
other cattle	87.9	87.6	87.0	84.2	79.1	74.9	72.4	68.7	65.1	59.7	58.1
Swine	65.4	62.2	58.4	59.0	56.4	54.6	48.1	42.2	42.1	37.5	36.4
Sheep and goats, including:	97.9	97.7	97.3	96.8	97.1	97.0	97.3	97.2	97.1	96.6	95.0
sheep	97.5	97.4	96.9	96.3	96.6	96.5	96.9	96.7	96.5	96.1	94.4
goats	99.6	99.3	99.2	99.2	99.2	99.1	99.2	99.0	99.2	98.1	96.7
Horses	98.3	98.6	98.7	98.9	99.0	99.2	99.2	99.3	99.2	99.2	99.4
Poultry	77.6	69.7	70.4	66.6	65.6	65.6	67.2	61.9	64.7	60.4	61.6

CS EFs, calculated following the simplified Tier 2 approach (Equation 10.23 in the 2006 IPCC Guidelines) are shown in Table 5-38.

Table 5-38: Country-specific CH_4 emission factors for source category 3B calculated following the Tier 2 methodology for cattle and swine population in the RoM, kg CH_4/head/yr

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Dairy cows	13.5	11.4	11.4	8.6	8.8	6.7	6.7	6.5	5.1	5.1	4.4
Other cattle (average)	5.8	4.9	4.9	4.3	4.5	3.2	3.4	3.2	2.2	2.2	2.3
Swine (average)	5.1	4.6	4.5	4.4	4.2	3.7	3.6	3.2	3.0	2.9	3.0
Market swine	7.8	6.9	6.7	6.5	6.1	5.5	5.3	4.7	4.4	4.3	4.3
Fattening piglets	4.9	4.4	4.2	4.1	3.9	3.5	3.3	2.9	2.8	2.7	2.7
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Dairy cows	4.4	4.5	4.5	4.7	4.8	4.7	4.8	4.8	4.7	4.7	4.7
Other cattle (average)	2.2	2.3	2.3	2.6	2.6	2.6	2.5	2.4	2.3	2.3	2.3
Swine (average)	2.8	2.7	2.8	2.7	2.6	2.6	2.5	2.5	2.4	2.4	2.6
Market swine	4.1	3.9	4.2	3.9	3.8	3.8	3.7	3.6	3.5	3.5	3.9
Fattening piglets	2.6	2.5	2.6	2.5	2.4	2.4	2.3	2.3	2.2	2.2	2.4
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Dairy cows	4.7	4.6	4.7	4.7	4.7	4.7	4.5	4.5	4.4	4.8	5.2
Other cattle (average)	2.3	2.2	2.2	2.1	2.0	2.0	2.1	2.2	2.4	2.6	2.5
Swine (average)	2.7	2.9	2.8	2.8	2.4	2.5	2.3	2.3	2.5	2.0	2.0
Market swine	4.1	4.3	4.2	4.1	3.6	3.6	3.4	3.5	3.8	3.0	3.0
Fattening piglets	2.6	2.7	2.6	2.6	2.3	2.3	2.2	2.2	2.4	1.9	1.9

Regarding other cattle and swine population, the share of animal population by subcategory was considered for the estimation of average CS EFs (see Table 5-22 for 'Other Cattle' and Table 5-39 for 'Swine').

Table 5-39: Distribution of swine population by subcategory in the RoM between 1990-2022, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…market swine	8.4	9.1	9.9	12.3	12.5	12.1	12.8	13.6	14.6	14.5	15.3
…piglets over 4 months	7.4	8.7	9.4	11.5	12.4	12.7	12.9	12.7	16.0	28.6	37.8
...other swine	84.2	82.2	80.7	76.3	75.1	75.1	74.4	73.7	69.4	56.9	46.9
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…market swine	16.6	16.3	14.7	14.9	15.5	14.2	13.2	13.0	12.9	12.1	12.2
…piglets over 4 months	56.3	56.5	65.0	66.4	64.4	65.2	66.3	60.7	65.8	64.9	64.5
...other swine	27.1	27.1	20.3	18.8	20.1	20.6	20.5	26.2	21.3	23.0	23.2
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Swine, total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
…market swine	11.0	10.6	10.8	11.4	12.0	12.3	11.0	10.7	10.8	10.4	10.0
…piglets over 4 months	65.0	57.6	62.1	54.1	54.0	58.5	57.3	59.0	55.6	57.7	56.2
...other swine	23.9	31.8	27.1	34.5	34.0	29.1	31.7	30.3	33.5	31.9	33.8

Source: NBS, Statistical Annual Report No. 24-agr 'Animal Breeding Sector', the Number of Livestock and Poultry in all Households Categories as of January 1 (annually for 1990-2022).

5.3.1.3. Uncertainties and Time-Series Consistency

Uncertainties associated with the estimation of methane emissions from category 3B 'Manure Management' result from uncertainties associated with the estimation of livestock, and also from the default emission factors used. The uncertainties associated with the total animal population in the Republic of Moldova are moderate (circa 10%).

It should be noted that the uncertainty range for the default emission factors calculated using the Tier 1 method is estimated to be circa 30% (2006 IPCC Guidelines). Since this approach is not based on the country-specific data and the characteristics of livestock from the particular country are not taken into account, the general uncertainty related to the use of this methodology can reach circa 50% (2006 IPCC Guidelines).

Should the Tier 2 methodology be used, uncertainties associated with manure management systems will depend on the accuracy of characteristic features of the livestock breeding sector and how information on manure management systems is collected and used in the RoM. Because the RoM lately uses mainly three manure management systems (pasture/range/paddock, solid storage and, to a lesser extent, liquid/slurry), uncertainties associated with manure management systems can be considered relatively low; however, because the share of manure management systems used varied considerably in the period under review, uncertainties may reach circa 30%. Thus, combined uncertainties of AD and EFs for source category 3B 'Manure Management' account for circa 31.62% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

5.3.1.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

5.3.1.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category, following the Tier 1 approach. It should be noted that the AD and methods used in the estimation of CH_4 emissions from category 3B 'Manure Management' were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied.

5.3.1.6. Recalculations

Methane emissions from source category 3B 'Manure Management' were recalculated for the years 2010-2020 as a result updating the shares of manure management systems applied in the RoM for poultry, based on the results of the studies carried out in 2015 and 2021 by the National Food Safety Agency.

Compared to the emission values recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend in methane emissions from source category 3B 'Manure Management' during the years 2010-2013 and 2016-2019, varying from a minimum decrease of 0.01% in 2012, to a maximum decrease of 3.3% in 2017, and in an upward trend in methane emissions between 2014-2015 and 2020, varying from a minimum increase of 0.07% in 2015, to a maximum increase of 4.18% in 2020, respectively (Table 5-40).

Table 5-40: Recalculations of CH_4 emissions from source category 3B 'Manure Management' included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	19.80	16.60	14.92	11.00	10.61	8.25	7.49	6.09	5.62	4.89	3.84
BTR1	19.80	16.60	14.92	11.00	10.61	8.25	7.49	6.09	5.62	4.89	3.84
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	3.86	4.02	3.73	3.50	3.70	3.80	2.66	2.58	2.92	3.17	3.00
BTR1	3.86	4.02	3.73	3.50	3.70	3.80	2.66	2.58	2.92	3.14	2.97
Difference, %	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.84	-0.85
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	2.76	2.72	2.82	2.75	2.56	2.52	2.19	2.06	1.77		
BTR1	2.76	2.69	2.84	2.76	2.54	2.43	2.16	2.05	1.85	1.68	1.65
Difference, %	-0.01	-0.81	0.97	0.07	-0.84	-3.26	-1.57	-0.62	4.18		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

At the same time, methane emissions from source category 3B 'Manure Management' were recalculated for the years 1990-2020 as a result of the change in the GWP_{100}; the value available in the IPCC AR5 (2014) (GWP_{100} – 28) was used instead of value available in IPCC AR4 (2007) (GWP_{100} – 25).

Compared to the emission values recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made resulted in an upward trend in methane emissions from source category 3B 'Manure Management' in the period under review (Table 5-41).

Table 5-41: Recalculations of CH_4 emissions from source category 3B 'Manure Management' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	495.10	415.08	373.12	274.95	265.23	206.28	187.36	152.16	140.48	122.35	96.10
BTR1	554.51	464.89	417.89	307.94	297.06	231.03	209.84	170.42	157.34	137.03	107.63
Difference, %	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	96.57	100.47	93.23	87.61	92.38	94.93	66.45	64.41	72.96	79.20	74.97
BTR1	108.16	112.53	104.42	98.12	103.47	106.32	74.43	72.14	81.71	87.96	83.26
Difference, %	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	12.0	11.1	11.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	69.12	67.89	70.43	68.87	64.06	62.91	54.83	51.50	44.37		
BTR1	77.41	75.42	79.65	77.19	71.14	68.17	60.45	57.32	51.77	46.99	46.34
Difference, %	12.0	11.1	13.1	12.1	11.1	8.4	10.2	11.3	16.7		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

For 2021-2022, CH_4 emissions resulting from category 3B 'Manure Management' were estimated for the first time. The obtained results allow us to assert that, between 1990-2022, methane emissions from the respective category decreased by 91.6%, as a result of the decrease in livestock population, and changes in the share of manure management systems (overall, there had been a significant downward trend in the share of liquid-based systems and a simultaneous increase in the share of solid storage of animal manure).

Between 1990 and 2022, the share of different livestock categories in the overall methane emissions from category 3B 'Manure Management' had changed significantly. By 2022, the share of categories 'Cattle' and 'Swine' had decreased considerably compared to the level in 1990, whereas the share of categories such as 'Sheep', 'Goats', 'Horses', 'Asses and Mules', 'Rabbits', and 'Poultry' recorded an upward trend (Table 5-42).

Table 5-42: Share of different animal categories in the structure of CH_4 emissions from source category 3B 'Manure Management' for the period 1990-2022, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cattle	46.5	45.0	49.2	50.0	51.4	44.5	44.7	46.2	37.2	39.9	43.0
Sheep	1.2	1.4	1.6	2.4	2.5	3.1	3.2	3.5	3.5	3.7	4.2
Goats	0.0	0.0	0.1	0.1	0.1	0.2	0.2	0.2	0.2	0.3	0.4
Horses	0.4	0.5	0.5	0.8	0.9	1.2	1.3	1.7	1.9	2.3	3.1
Asses and Mules	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
Swine	47.9	48.6	44.8	42.9	41.0	45.7	45.2	41.7	49.5	44.7	37.8
Poultry	3.8	4.4	3.6	3.6	4.0	5.2	5.2	6.4	7.3	8.8	11.1
Rabbits	0.1	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3	0.3
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cattle	43.5	42.7	41.6	42.8	37.5	34.8	39.4	38.2	33.4	29.7	29.9
Sheep	4.2	4.0	4.2	4.5	4.3	4.2	5.4	5.7	5.3	4.8	4.6
Goats	0.4	0.4	0.5	0.5	0.4	0.4	0.5	0.6	0.5	0.5	0.6
Horses	3.3	3.2	3.4	3.4	3.0	2.8	3.6	3.5	3.0	2.7	2.7
Asses and Mules	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Swine	36.2	37.2	36.4	32.3	35.1	38.3	30.1	29.1	33.2	38.6	41.3
Poultry	12.0	12.1	13.4	15.9	19.0	18.6	20.1	22.2	23.8	22.9	20.2
Rabbits	0.4	0.4	0.4	0.5	0.6	0.7	0.8	0.8	0.8	0.7	0.7
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Cattle	30.1	29.7	28.4	28.5	29.6	29.0	27.7	25.2	24.8	28.8	30.4
Sheep	4.8	5.1	4.9	5.0	5.3	5.3	5.4	5.0	4.9	5.0	4.9
Goats	0.6	0.7	0.7	0.7	0.9	0.9	1.0	1.0	1.1	1.1	1.1
Horses	2.7	2.7	2.3	2.3	2.3	2.2	2.2	2.0	1.9	1.8	1.7
Asses and Mules	0.1	0.1	0.1	0.1	0.1	0.2	0.1	0.1	0.0	0.1	0.1
Swine	43.5	47.5	49.4	48.7	45.0	44.3	46.2	49.2	50.3	43.8	43.4
Poultry	17.4	13.4	13.3	13.8	15.6	16.9	16.0	16.4	15.5	17.5	17.0
Rabbits	0.8	0.9	0.9	1.0	1.2	1.2	1.3	1.3	1.4	1.8	1.5

It should be mentioned that for animal categories 'dairy cows', 'other cattle' and 'swine', the Tier 2 methodology impact is much greater compared to the Tier 1 methodology.

The use of the Tier 2 method, an approach that reflects country-specific conditions, particularly related to manure management systems (MS%), has contributed to much lower CH_4 emission values for 1993-2022, varying between a minimum of 2.9% in 1993 to a maximum of 40.4% in 2001; except for the years 1990-1992, in which the results obtained using the Tier 2 method show increased values compared to those obtained after using the Tier 1 method (Table 5-43); this is explained by the fact that the productivity indices of livestock and poultry during the soviet period and in the following few years immediately after independence, respectively the application of manure management systems were close to similar indices typical of Western European countries; likewise, during that period, the overwhelming majority of livestock and poultry was under collective management, and large agricultural enterprises, respectively, as opposed to the current state of affairs (Table 5-37), the majority of the livestock and poultry being owned by individual farmers with much more limited opportunities, including financial ones, for the use of modern manure management systems.

Table 5-43: Comparative results of CH_4 emissions from source category 3B 'Manure Management', estimated using Tier 1 and Tier 2 methodologies, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Tier 1, kt	14.99	14.32	13.19	11.33	10.96	10.14	9.26	8.04	8.32	7.44	6.38
Tier 2, kt	19.80	16.60	14.92	11.00	10.61	8.25	7.49	6.09	5.62	4.89	3.84
Difference, %	32.1	16.0	13.1	-2.9	-3.2	-18.6	-19.1	-24.3	-32.4	-34.2	-39.8
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Tier 1, kt	6.48	6.71	6.09	5.54	5.70	5.79	4.20	4.04	4.51	4.78	4.40
Tier 2, kt	3.86	4.02	3.73	3.50	3.70	3.80	2.66	2.58	2.92	3.14	2.97
Difference, %	-40.4	-40.1	-38.8	-36.8	-35.1	-34.5	-36.7	-36.3	-35.3	-34.3	-32.4
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Tier 1, kt	4.03	3.90	4.11	4.00	3.92	3.69	3.37	3.11	2.72	2.68	2.61
Tier 2, kt	2.76	2.69	2.84	2.76	2.54	2.43	2.16	2.05	1.85	1.68	1.65
Difference, %	-31.5	-31.0	-30.8	-31.1	-35.1	-34.1	-35.9	-34.2	-32.0	-37.4	-36.6

5.3.1.7. Planned Improvements

Planned improvements may include activities focused on specifying productivity indices used in the estimation of CH_4 emissions from category 3B 'Manure Management', particularly for 'cattle' and 'swine', which are livestock categories accounting for the largest share in the structure of total CH_4 emissions originating from this source; as well as updating the values for the main coefficients used in the calculation of country-specific emission factors for the respective animal categories following the Tier 2 methodology; likewise, there are planned activities focused on regular updating (every 3 years) the activity data regarding the share of manure management systems in the livestock breeding sector.

5.3.2. Nitrous Oxide Emissions

5.3.2.1. Source Category Description

During the storage and treatment of manure (dung and urine) before it is applied to land, direct N_2O emissions occur via combined nitrification and denitrification of nitrogen contained in the manure. It should be noted that nitrification is the aerobic oxidation of ammonia (NH_4^+) into nitrate (NO_3^-), whereas denitrification consists of the reduction under anaerobic conditions of nitrates into nitrogen oxides or molecular nitrogen: $NO_3^- \rightarrow NO_2^- \rightarrow NO \rightarrow N_2O \rightarrow N_2$.

Direct emission of N_2O vary depending on the nitrogen and carbon content of manure, as well as on the duration of storage and type of treatment within animal waste management systems.

It is considered that the aeration increase in animal waste contributes to direct N_2O emissions. There is general agreement in the scientific literature that the ratio of N_2O/N_2 increases when acidity, nitrate concentration, and reduced moisture increases. Generally, the production and emission of N_2O from managed manures requires the presence of either nitrites or nitrates in an anaerobic environment preceded by aerobic conditions necessary for the formation of these oxidized forms of nitrogen. In addition, it is necessary to have conditions, such as a low pH or limited moisture, which would prevent the reduction of nitrogen oxide (N_2O) to dinitrogen (N_2).

Indirect emissions result from volatile nitrogen losses that occur primarily in the forms of ammonia (NH_3) and (NO_x). The fraction of excreted organic nitrogen that is mineralized to ammonia nitrogen during manure collection and storage depends primarily on the duration of storage, and to a lesser degree on temperature. Simple forms of organic nitrogen such as urea (mammals) and uric acid (poultry) are rapidly mineralized to ammonia nitrogen, which is highly volatile and easily diffused into the surrounding air. Nitrogen losses begin at the point of excretion in agricultural households and continue through on-site management in storage and treatment systems. Nitrogen is also lost through runoff and leaching[99] processes.

Due to significant direct and indirect losses of manure nitrogen in management systems it is important to estimate, both directly and indirectly, the remaining amount of animal manure nitrogen available for application to soils as organic fertilizer or for other purposes.

5.3.2.2. Methodologies, Emission Factors and Activity Data

N_2O emissions from category 3B 'Manure Management' were estimated based on the Tier 2 methodology (2006 IPCC Guidelines). In order to estimate direct N_2O emissions from manure management, it was necessary to collect information on the total livestock population (identical to the one used for 3A 'Enteric Fermentation'), information on the amount of produced manure per head in a year, as well as information on manure management systems in the RoM. The following five steps were used to estimate direct N_2O emissions from category 3B 'Manure Management':

(i) collection of data on the livestock population;

(ii) determining annual average nitrogen excretion rate per head ($N_{ex(T)}$) for each defined livestock species/category *T*;

[99] Leaching – the loss of mineral and organic solutes due to water or other liquids percolation from soil.

(iii) determining the fraction of total annual nitrogen excretion for each livestock species/category *T* that is managed in each manure management system *S* ($MS_{(T, S)}$);

(iv) determining N_2O EFs for each manure management system *S* ($FE_{3\ (S)}$);

(v) calculation of N_2O emissions for each manure management system type S, multiplying the emission factor ($FE_{3(S)}$) by the total amount of nitrogen managed (from all livestock species/categories) in the respective system.

The obtained results for each manure management system were summed, resulting in the total N_2O emissions from the respective source category.

The calculation of direct N_2O emissions is based on Equation 10.25 in the 2006 IPCC Guidelines.

$$N_2O_{D(mm)} = [\ \Sigma_{(S)}\ [\Sigma_{(T)}\ (N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T, S)})] \bullet FE_{3(S)}] \bullet 44/28$$

Where:

$N_2O_{D\ (mm)}$ – direct N_2O emissions from Manure Management (kg N_2O/yr);

$N_{(T)}$ – number of head of livestock in category T;

$N_{ex\ (T)}$ – annual average N excretion per head of species T (kg N/animal/yr);

$MS_{(T, S)}$ – fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S;

$FE_{3\ (S)}$ – emission factor for direct N_2O emissions from manure management system S in the country, (kg N_2O-N/kg N in manure management system S);

S – manure management system;

T – species/category of livestock;

44/28 – conversion of $(N_2O\text{-}N)_{(mm)}$ emissions to $N_2O_{(mm)}$ emissions.

The calculation of the average N excretion rates $N_{ex(T)}$ is based on Equation 10.30 available in the 2006 IPCC Guidelines.

$$Nex_{(T)} = N_{\ rate(T)} \bullet (TAM/1000) \bullet 365$$

Where:

$N_{ex\ (T)}$ – annual N excretion for livestock category T, (kg N/animal/yr);

$N_{rate\ (T)}$ – default N excretion rate, kg N 1000 kg/animal mass/yr;

$TAM_{\ (T)}$ – typical animal mass for livestock category T, kg/animal.

The annual amount of N excreted by each livestock species/category depends on the total annual N intake and total annual nitrogen retention of the animal, respectively.

Annual N intake (the amount of N consumed by the animal annually) depends on the annual amount of feed digested by the animal, and the protein content of that feed.

Total feed intake depends on the production level of the animal (growth rate, milk production, wool production, egg production, etc.).

Annual N retention (the fraction of N intake that is retained by the animal to produce meat, milk, wool, eggs, etc.) is a measure of the animal's efficiency to produce animal protein from feed.

Livestock and poultry default nitrogen retention values are provided in Table 10.20 (2006 IPCC Guidelines, Volume 4, Chapter 10, Page 10.60).

Rates of annual N excretion for each livestock species/category $N_{ex\ (T)}$ were estimated using Equation 10.31 available in the 2006 IPCC Guidelines.

$$Nex_{(T)} = N_{\ intake\ (T)} \bullet (1 - N_{\ retention\ (T)})$$

Where:

$N_{\ intake\ (T)}$ – the annual N intake per head of animal of species/category T, (kg N/animal/yr);

$N_{\ retention\ (T)}$ – fraction of annual N intake that is retained by animal of species/category T, dimensionless).

Based on information on the average weight of livestock and poultry in Eastern European countries and default values of nitrogen excretion rate (kg N/1000 kg of animal mass/yr) typical of the region, country-specific $N_{ex(T)}$ values were calculated (Table 5-44).

The amount of N fed to animals stored in straw bedding together with manure ($N_{bedding\ MS}$) was taken into consideration. It is known from the literature in the field that this amount can reach circa 7 kg N/head/yr for dairy cows; circa 4 kg N/head/yr for other cattle; circa 0.8 kg N/head/yr for market swine; and circa 5.5 kg N/head/yr for fattening swine; at the same time, should a large straw bedding be applied, as it is practised in the RoM, these quantities may be doubled (Webb, 2001; Döhler et al., 2002; quoted in the 2006 IPCC Guidelines).

Table 5-44: Average annual nitrogen excretion by main livestock and poultry categories in Eastern European countries

Livestock Category	$N_{rate\ (T)}$, kg N/1000 kg/zi	TAM, average weight in kg	$N_{ex\ (T)\ ANIMAL}$, kg N/head/yr	$N_{ex(T)\ ANIMAL}$	$N_{retention\ (T)}$, kg N retained / animal/yr	$N_{ex(T)\ ANIMAL\ ADJUSTED}$	$N_{bedding\ MS}$	$N_{ex(T)\ ANIMAL\ FINAL}$
Dairy cows	0.35	550	0.5500	70.3	0.20	56.2	14.0	70.2
Other cattle	0.35	391	0.3910	50.0	0.07	46.5	8.0	54.5
Sheep	0.90	28	0.0280	9.2	0.10	8.3	1.0	9.3
Goats	1.28	30	0.0300	14.0	0.10	12.6	1.0	13.6
Horses	0.30	238	0.2380	26.1	0.07	24.2	14.0	38.2
Asses and mules	0.30	130	0.1300	14.2	0.07	13.2	6.0	19.2
Swine	0.74	70	0.0695	18.8	0.30	13.1	2.0	15.1
Fattening swine	0.55	50	0.0500	10.0	0.30	7.0	2.0	9.0
Market swine	0.46	180	0.1800	30.2	0.30	21.2	2.0	23.2
Rabbits	8.10	1.6	0.0016	4.7	0.10	4.3	2.0	6.3
Chicken	0.82	1.8	0.0018	0.5	0.30	0.4	0.1	0.5
Geese	0.83	3.8	0.0038	1.2	0.30	0.8	0.1	0.9
Ducks	0.83	2.7	0.0027	0.8	0.30	0.6	0.1	0.7
Turkeys	0.74	6.8	0.0068	1.8	0.30	1.3	0.1	1.4

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.19, page 10.59, Table 10A-9, pages 10.82-10.83.

Applying the methodological approach above, the default values used for the nitrogen excretion rate characteristic to Eastern Europe, as well as country-specific data on the typical animal mass (TAM) in the RoM during the period under review (see Table 5-11), country-specific values for $N_{ex(T)}$ were also calculated (Table 5-45).

Table 5-45: Average annual $N_{ex(t)}$ excretion by main livestock and poultry categories in the Republic of Moldova between 1990-2022, kg N/head/year

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Dairy cows	62.6	59.3	58.1	56.4	56.2	56.1	56.1	60.2	59.3	58.9	58.6
Other cattle	46.6	46.0	45.6	44.8	43.0	41.1	39.5	44.5	44.6	44.0	43.0
Sheep	13.7	14.0	13.7	13.7	14.0	12.5	9.6	11.3	11.3	11.3	11.4
Goats	17.0	17.4	17.0	17.0	17.0	15.3	15.3	13.6	13.6	13.6	13.6
Horses	52.3	47.2	48.8	49.0	51.6	50.3	48.7	42.1	42.7	42.4	43.1
Asses and mules	19.3	18.8	18.7	18.8	18.6	18.1	17.6	17.5	17.4	16.6	16.8
Swine	20.5	20.2	18.1	17.7	16.9	16.2	13.8	12.4	11.6	10.7	12.6
Rabbits	6.3	6.2	6.2	6.1	6.2	6.2	6.1	6.2	6.2	6.1	6.1
Chicken	0.5	0.5	0.5	0.5	0.4	0.4	0.4	0.4	0.4	0.4	0.4
Geese	0.9	0.9	0.9	0.9	0.8	0.8	0.8	0.8	0.8	0.8	0.8
Ducks	0.7	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Turkeys	1.4	1.4	1.3	1.3	1.2	1.2	1.2	1.2	1.2	1.2	1.2
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Dairy cows	58.4	58.4	58.0	58.6	57.8	57.6	57.4	55.5	55.8	56.9	57.0
Other cattle	43.3	42.9	42.5	43.7	42.8	43.3	41.7	42.1	42.3	42.6	46.2
Sheep	10.8	10.8	10.8	10.8	10.8	12.2	11.9	12.6	12.5	12.2	12.4
Goats	12.8	12.8	12.8	12.8	12.8	14.9	14.9	15.8	15.7	14.9	14.9
Horses	42.8	42.2	42.2	42.8	42.0	44.2	44.2	45.5	44.8	45.3	45.0
Asses and mules	16.7	16.7	16.9	16.7	17.1	17.3	17.3	17.6	17.3	17.5	17.7
Swine	11.3	10.9	12.2	11.7	11.5	11.6	11.6	12.6	12.6	12.4	12.8
Rabbits	6.2	6.2	6.0	6.2	6.2	6.2	6.0	6.2	6.2	6.3	6.2

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Chicken	0.5	0.4	0.4	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Geese	0.9	0.8	0.8	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Ducks	0.6	0.6	0.6	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
Turkeys	1.2	1.2	1.2	1.2	1.3	1.3	1.3	1.4	1.4	1.4	1.4
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Dairy cows	57.7	57.9	60.0	61.3	60.7	61.1	60.1	58.8	55.8	60.1	59.6
Other cattle	45.8	44.8	48.9	49.3	48.9	54.5	55.5	58.5	53.6	50.5	54.1
Sheep	12.8	13.4	14.6	11.6	10.5	14.0	14.0	12.2	12.9	14.0	11.9
Goats	15.8	17.0	18.2	14.5	13.2	17.4	17.0	14.9	15.8	17.4	14.5
Horses	46.6	47.2	46.4	46.2	46.1	51.2	47.7	49.3	49.5	44.2	45.3
Asses and mules	17.9	18.1	17.7	17.5	17.4	19.2	18.0	18.3	18.5	18.1	18.2
Swine	13.2	12.2	12.8	12.2	16.2	13.3	21.3	12.8	12.4	11.3	11.1
Rabbits	6.0	6.0	6.2	6.2	6.2	6.3	6.2	6.2	6.2	6.3	6.3
Chicken	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Geese	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9
Ducks	0.6	0.6	0.7	0.7	0.6	0.6	0.6	0.6	0.6	0.6	0.6
Turkeys	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.3	1.4

Based on information from the scientific literature, country-specific values on average annual nitrogen excretion ($N_{ex(T)}$) from manure were calculated following an alternative methodological approach (Table 5-46), which does not consider the amount of N retained annually by livestock and poultry. Albeit the average annual N excretion values $N_{ex(T)}$ were calculated by different methods, the obtained results are still comparable.

As values featured in Table 5-45 are not available for all animal categories, country-specific values related to N retained were not identified, respectively (the fraction of N intake retained for the production of meat, milk, wool, eggs, etc.); $N_{ex(T)}$ values set forth in Table 5-45 were used to calculate the direct N_2O emissions from manure management.

Table 5-46: Average annual nitrogen excretion for a typical animal $N_{ex(T)}$ calculated based on country-specific information

Livestock Category	Solid Manure, kg/head/day	Liquid Manure, kg/ head/day	Straw Bedding, kg/head/day	Total Manure with/ without bedding, kg/ head/day	N content with/ without bedding, kg/t	$N_{ex(T)}$ with/ without bedding kg N/ head/day
Cattle	25.0	12.0	5.0	42.0 / 37.0	5.6 / 4.6	85.8 / 62.1
Sheep	2.5	1.0	0.8	4.3 / 3.5	9.5 / 9.2	14.9 / 11.8
Horses	18.0	5.0	4.0	27.0 / 23.0	6.0 / 5.0	59.1 / 42.0
Swine	2.0	3.5	1.5	7.0 / 5.5	8.2 / 5.7	21.0 / 11.4
Poultry	0.1	0.0	0.1	0.2 / 0.1	16.3 / 22.3	1.2 / 0.8

Source: Ungureanu, Cerbari et al., 2006; Bucataru, Cosman, Holban, 2006; Raileanu, Jolondcovschi et al., 2006; Andries, Rusu et al., 2005; Bucataru, Maciuc, 2005; Toncea, 2004.

Activity data on manure management systems usage is identical to that previously used in subchapter 5.3.1. It should be noted that the actual distribution of manure management systems in the RoM does not comply with the default values for Eastern European countries (MS%) available in the 2006 IPCC Guidelines, so their use was deemed to be inappropriate. In order to estimate direct N_2O emissions, country-specific information on manure management system usage in the RoM were used (Table 5-35). It is considered good practice to estimate emissions from manure management systems keeping account of storage duration and treatment type. In order to determine the types of treatment of animal manure, temperature and aeration conditions are taken into account. Should the use of country-specific emission factors not be possible, default values provided in the 2006 IPCC Guidelines are used (Table 5-47).

Table 5-47: Default EFs for N_2O emissions from Manure Management Systems

Manure Management System		FE_3, kg N_2O-N/kg N excreted	Uncertainty ranges of EF_3	Reference
Pasture/Range/Paddock: manure from pasture and range grazing animals is allowed to lie as is and is not managed.	cattle, swine, poultry	0.020	0.007-0.06	2006 IPCC Guidelines, Table 11.1
It should be noted that N_2O emissions from pasture, range and paddock are monitored in category 3D 'Agricultural soils'	sheep, goats, horses, asses	0.010	0.003-0.03	

Manure Management System		FE_3, kg N_2O-N/kg N excreted	Uncertainty ranges of EF_3	Reference
Solid Storage: animal manure is collected and stored in solid form for a long time (by default – a few months), before being used.		0.005	Factor of 2	2006 IPCC Guidelines, Table 10.21
Dry lot: a paved or unpaved open confinement area (countries with dry climate) where accumulating manure and may be removed periodically, when dry, to be used accordingly.		0.020	Factor of 2	2006 IPCC Guidelines, Table 10.21
Liquid/Slurry: manure is stored as excreted in either tanks or earthen ponds for six months or more, later applied to land; in order to facilitate manure management, water is added to it; emissions are considered to be insignificant due to the absence of oxidized forms of nitrogen, combined with the low nitrification and denitrification potential in this manure management system.	with natural crust cover	0.005	Factor of 2	2006 IPCC Guidelines, Table 10.21
	without natural crust cover	0.000	Not Applicable	
Pit storage below animal confinements: collection and storage of liquid manure usually with little or no added water typically below a slatted floor in an enclosed animal confinement enclosure.		0.002	Factor of 2	2006 IPCC Guidelines, Table 10.21
Cattle and swine deep bedding: as manure accumulates, bedding is continually added to absorb moisture over a production cycle and possibly for as long as 6 to 12 months. The layers formed of mixed manure with the straw bedding is not mixed or actively mixed.	no mixing	0.010	Factor of 2	2006 IPCC Guidelines, Table 10.21
	active mixing	0.070	Factor of 2	
Composting – In-Vessel: composting, typically in an enclosed channel, with forced aeration and continuous mixing.		0.006	Factor of 2	2006 IPCC Guidelines, Table 10.21
Composting – Static Pile: composting in piles with forced aeration but no mixing.		0.006	Factor of 2	2006 IPCC Guidelines, Table 10.21
Composting – Intensive Windrow: composting in windrows with regular turning for mixing and aeration.		0.100	Factor of 2	2006 IPCC Guidelines, Table 10.21
Composting – Passive Windrow: composting in windrows with infrequent turning for mixing and aeration.		0.010	Factor of 2	2006 IPCC Guidelines, Table 10.21
Poultry manure with litter: manure is excreted on floor with bedding, birds walk on manure.		0.001	Factor of 2	2006 IPCC Guidelines, Table 10.21
Poultry manure without bedding: manure is excreted on floor without bedding, manure is collected and dried.		0.001	Factor of 2	2006 IPCC Guidelines, Table 10.21
Aerobic treatment: The biological oxidation of manure collected as a liquid with either forced or natural aeration. Natural aeration is limited to aerobic ponds and wetland systems and is due primarily to photosynthesis. Nitrification and denitrification are used widely for the removal of nitrogen in the biological treatment of municipal and industrial wastewaters with negligible N_2O emissions. Limited oxidation may increase emissions compared to forced aeration systems.	Natural aeration systems	0.010	Factor of 2	2006 IPCC Guidelines, Table 10.21
	Forced aeration systems	0.005	Factor of 2	

A significant share of the total amount of nitrogen excreted by livestock in different manure management systems (except pasture, range and paddock), is lost before being applied to agricultural lands. Therefore, in order to estimate the amount of nitrogen in manure, which is applied to managed soils, it is necessary to omit the total nitrogen amount excreted by animals in different management systems, nitrogen losses occurring through volatilization (NH_3, NO_x), as well as runoff and leaching.

Indirect N_2O emissions from source category 3B 'Manure Management' were estimated using the Tier 1 methodology (2006 IPCC Guidelines). Indirect N_2O emissions from volatilization of nitrogen in forms of NH_3 and NO_x were estimated by using Equations 10.26 and 10.27 in the 2006 IPCC Guidelines.

$$N_2O_{G(mm)} = \Sigma_{(S)} [\Sigma_{(T)} (N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T,S)}) \bullet (Frac_{GasMS}/100)_{(T,S)}] \bullet FE_4 \bullet 44/28$$

Where:

$N_2O_{G(mm)}$ – indirect N_2O emissions due to volatilization of N (kg N_2O/yr);

$N_{(T)}$ – number of head of livestock species/category T in the country;

$N_{ex\,(T)}$ – annual average N excretion per head of species/category T (kg N/animal/yr);

$MS_{(T,S)}$ – fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S;

$Frac_{GasMS}$ – % of managed manure nitrogen for livestock category T that volatilizes as NH_3 and NO_x in the manure management system S, % (see Table 5-48);

FE_4 – emission factor for N_2O emissions from atmospheric deposition of nitrogen on soils and water surfaces, the default value is 0.01 kg N_2O-N/kg NH_3-N+NO_x-N volatilized;

S – manure management system;

T – species/category of livestock;

44/28 – conversion of $(N_2O\text{-}N)_{(mm)}$ emissions to $N_2O_{(mm)}$ emissions.

Table 5-48: Default values for nitrogen loss, which volatilizes into NH_3 and NO_x in different Manure Management Systems *S*, %

Livestock Category	Manure Management System (MMS)	Total N loss from MMS due to volatilization of N-NH_3 and N-NO_x (%), Frac $_{Gas\ MS}$ (Range)
Dairy cows	Anaerobic lagoon	35% (20-80)
	Liquid/slurry	40% (15-45)
	Pit storage	28% (10-40)
	Dry lot	20% (10-35)
	Solid storage	30% (10-40)
	Daily spread	7% (5-60)
Other cattle	Dry lot	30% (20-50)
	Solid storage	45% (10-65)
	Deep bedding	30% (20-40)
Swine	Anaerobic lagoon	40% (25-75)
	Pit storage	25% (15-30)
	Deep bedding	40% (10-60)
	Liquid/slurry	48% (15-60)
	Solid storage	45% (10-65)
Sheep, goats, horses, asses and mules	Solid storage	25% (10-30)
	Deep bedding	12% (5-20)
Poultry	Litter without bedding	55% (40-70)
	Anaerobic lagoon	40% (25-75)
	Litter with bedding	40% (10-60)

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.22.

Indirect N_2O emissions from leaching and runoff were estimated using Equations 10.28 and 10.29 in the 2006 IPCC Guidelines.

$$N_2O_{L(mm)} = \Sigma_{(S)} [\Sigma_{(T)} (N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T,S)}) \bullet (Frac_{leach\ MS}/100)_{(T,S)}] \bullet FE_5 \bullet 44/28$$

Where:

$N_2O_{L(mm)}$ – indirect N_2O emissions due to N leaching and runoff (kg N_2O/yr);

$N_{(T)}$ – number of head of livestock species/category T in the country;

$N_{ex\ (T)}$ – annual average N excretion per head of species/category T in the country (kg N/animal/yr);

$MS_{(T,S)}$ – fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country;

$Frac_{leach\ MS}$ – % of managed manure nitrogen losses for livestock category T due to runoff and leaching during solid and liquid storage of manure (typical range 1-20%);

FE_5 – emission factor for N_2O emissions from nitrogen leaching and runoff, default value is: 0.0075 kg N_2O-N/kg N leaching/runoff);

S – manure management system;

T – species/category of livestock;

44/28 – conversion of $(N_2O\text{-}N)_{(mm)}$ emissions to $N_2O_{(mm)}$ emissions.

The scientific literature shows that runoff losses are smaller in drier climates (circa 3-6% of nitrogen excreted) than in areas with high humidity (5-19%, respectively). Leaching losses of nitrogen depend on weather conditions, varying between 5 and 16% (2006 IPCC Guidelines).

Table 5-49 shows default values for total nitrogen losses from manure management systems. These default values include losses that occur from the point of excretion, including manure storage losses, and losses from leaching and runoff in the manure storage system.

Table 5-49: Default values for total nitrogen loss in different manure management systems *S*, %

Livestock Category	Manure Management System (MMS)	Total N loss from MMS (%), Frac $_{Loss\ MS}$ (Range)
Dairy cows	Anaerobic lagoon	77% (55-99)
	Liquid/slurry	40% (15-45)
	Pit storage	28% (10-40)
	Dry lot	30% (10-35)
	Solid storage	40% (10-65)
	Daily spread	22% (15-60)

Livestock Category	Manure Management System (MMS)	Total N loss from MMS (%), Frac $_{Loss\ MS}$ (Range)
Other cattle	Dry lot	40% (20-50)
	Solid storage	50% (20-70)
	Deep bedding	40% (10-50)
Swine	Anaerobic lagoon	78% (55-99)
	Pit storage	25% (15-30)
	Deep bedding	50% (10-60)
	Liquid/slurry	48% (15-60)
	Solid storage	50% (20-70)
Sheep, goats, horses, asses and mules	Solid storage	35% (15-40)
	Deep bedding	15% (5-20)
Poultry	Litter without bedding	55% (40-70)
	Anaerobic lagoon	77% (50-99)
	Litter with bedding	50% (20-80)

Source: 2006 IPCC Guidelines, Volume 4, Chapter 10, Table 10.23.

It should be noted that there is a high level of variability in the range of total nitrogen losses from manure management systems, the majority of which are due to volatilization losses, primarily ammonia losses that occur rapidly following the excretion of the manure. Losses also occur in the form of NO_3, N_2O, and N_2, particularly from leaching and runoff, which occur where manure is stored. The values included in the table reflect average values for typical management/storage combinations for each animal category.

Following storage in any manure management system, nearly all the manure is applied to land. The N_2O emissions that subsequently arise from manure application to soil shall not be reported under category 3B 'Manure Management', but under 3D 'Agricultural Soils' instead. The estimated amount of nitrogen from managed manure available for application to managed soils was based on Equation 10.34 in the 2006 IPCC Guidelines.

$$N_{MMS_Avb} = \Sigma_{(S)} \{\Sigma_{(T)} [(N_{(T)} \bullet Nex_{(T)} \bullet MS_{(T,S)}) \bullet (1\text{-}Frac_{Loss\ MS}/100)] + [N_{(T)} \bullet Nex_{(T)} \bullet N_{bedding\ MS}]\}$$

Where:

N_{MMS_Avb} – amount of managed manure nitrogen available for application to managed soils, kg N/yr;

$N_{(T)}$ – number of head of livestock species/category T in the country;

$N_{ex\ (T)}$ – annual average N excretion per animal of species/category T, kg N/animal/yr;

$MS_{(T,\ S)}$ – fraction of total annual nitrogen excretion for each livestock species/category T that is managed in manure management system S in the country;

$Frac_{Loss\ MS}$ – amount of managed manure nitrogen for livestock category T that is lost in the manure management system S,%;

$N_{bedding\ MS}$ – amount of nitrogen from bedding, kg N/animal/year;

S – manure management system;

T – species/category of livestock.

5.3.2.3. Uncertainties and Time-Series Consistency

Uncertainties associated with the estimation of N_2O emissions from source category 3B 'Manure Management' result, particularly, from uncertainties regarding the estimation of livestock (±10%), and those associated with different coefficients and emission factors. With respect to N_2O emissions, uncertainty ranges for the default N excretion rates ($N_{ex(T)}$) are estimated to be circa 50% and they can be reduced to circa 30% should country-specific values be used.

It should be noted that uncertainties associated with FE_3 emission factors are usually very high, from -50% to +100%. For indirect N_2O emissions, uncertainties associated with default values for nitrogen loss due to volatilization of NH_3 and NO_x and total nitrogen loss from manure management are also somewhat high. Uncertainties associated with default emission factors for nitrogen volatilization and re-deposition (EF_4), as well as for leaching and runoff (EF_5), are also somewhat high, ranging from

-100% to +200%. Thus, combined uncertainties associated with AD and EFs for source category 3B 'Manure Management' constitute circa 104.40% for direct N_2O missions, and circa 152.97% for indirect N_2O emissions, respectively (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

5.3.2.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

5.3.2.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective category under Sector 4 'Agriculture', following the Tier 1 approach. It should be mentioned that the AD and methods used in the estimation of direct and indirect N_2O emissions from source category 3B 'Manure Management' were documented and archived both in hard copies and electronically. In order to identify the data entry and N_2O emission estimation process related errors, verifications and quality control procedures were carried out periodically, including for emission factors applied and the emission calculation process.

5.3.2.6. Recalculations

N_2O emissions from source category 3B 'Manure Management' have been recalculated for the years 1990-2020 as a result of revising the $Nex_{(T)}$ nitrogen excretion rates, based on updated country-specific information on typical weight (TAM) of an animal at the end of the year, for the categories 'cattle', 'sheep', 'swine' and 'horses' (Table 5-11), and as a result of updating the values of shares in manure management systems (MS%), respectively, applied in the RoM for livestock and poultry for the period 2015-2020, based on the results of the studies carried out in 2015 and 2021 by National Agency for Food Safety (a new manure management system for swine was considered – the storage and preservation of manure in pits under their enclosure for less than 30 days).

Compared to the emission values recorded in the NC5 of the RoM to the UNFCCC , the changes made resulted in a downward trend in N_2O emissions from source category 3B 'Manure Management' during the years 1990-1999, 2001-2002, 2005, 2015-2016 and 2019-2020, varying from a minimum decrease of 0.09% in 1993, to a maximum decrease of 21.2% in 1996, and in an upward trend in N_2O emissions of nitrogen during the years 2000, 2003-2004, 2006-2014 and 2017-2018, respectively, varying from a minimum increase of 0.9% in 2003 to a maximum increase of 10.6% in 2018 (Table 3-50).

Table 5-50: Recalculations of $N_2O_{TOTAL(mm)}$ emissions from source category 3B 'Manure Management' included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	3.02	2.74	2.43	2.03	1.97	1.80	1.90	1.47	1.37	1.24	1.08
BTR1	2.90	2.71	2.41	2.03	1.96	1.73	1.49	1.35	1.33	1.20	1.09
Difference, %	-3.9	-0.9	-0.9	-0.1	-0.2	-3.9	-21.2	-8.1	-3.6	-3.1	0.8
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	1.10	1.11	1.06	1.03	1.10	1.14	0.86	0.85	0.97	1.01	0.92
BTR1	1.10	1.11	1.07	1.03	1.10	1.15	0.88	0.88	0.99	1.02	0.93
Difference, %	-0.1	-0.1	0.9	0.0	-0.3	1.5	2.4	3.5	2.2	1.5	1.7
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.84	0.79	0.87	0.84	0.86	0.82	0.72	0.65	0.56		
BTR1	0.86	0.81	0.88	0.81	0.82	0.83	0.80	0.63	0.56	0.56	0.51
Difference, %	2.0	2.5	1.7	-2.9	-5.3	1.1	10.6	-3.0	-0.3		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

At the same time, N_2O emissions from source category 3B 'Manure Management' were recalculated for the years 1990-2020 and as a result of the change in the GWP_{100}, the value available in the IPCC AR5 (2014) (GWP_{100} – 265) was used instead of value available in the IPCC AR4 (2007) (GWP_{100} – 298).

Compared to the emission values recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend in N_2O emissions from source category 3B 'Manure Management' during the years 1990-2020 (Table 3-51).

Table 5-51: Recalculations of $N_2O_{TOTAL(mm)}$ emissions from source category 3B 'Manure Management' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	899.71	816.20	723.03	606.17	585.80	537.69	565.06	437.49	409.71	369.56	322.83
BTR1	769.26	718.93	637.42	538.54	519.76	459.54	396.13	357.51	351.14	318.49	289.51
Difference, %	-14.5	-11.9	-11.8	-11.2	-11.3	-14.5	-29.9	-18.3	-14.3	-13.8	-10.3
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	328.71	331.81	314.89	305.88	328.46	338.55	256.73	254.17	287.83	300.39	273.82
BTR1	292.00	294.74	282.44	272.01	291.35	305.62	233.67	233.93	261.60	271.15	247.61
Difference, %	-11.2	-11.2	-10.3	-11.1	-11.3	-9.7	-9.0	-8.0	-9.1	-9.7	-9.6
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	251.47	234.13	258.38	249.90	257.20	243.67	214.87	194.78	166.42		
BTR1	228.08	213.47	233.59	215.77	216.64	219.17	211.31	168.09	147.61	147.36	135.05
Difference, %	-9.3	-8.8	-9.6	-13.7	-15.8	-10.1	-1.7	-13.7	-11.3		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

For years 2021 and 2022, total nitrous oxide emissions from category 3B 'Manure Management' have been estimated for the first time. The results obtained allow us to assert that in the period 1990-2022 total N_2O emissions from the respective category decreased by 82.4%, due to the decrease in animal population, productivity of livestock and poultry, and changes in the share of manure management systems, respectively (the share of liquid/slurry systems decreased significantly whereas the share of pasture and solid storage increased).

Direct $N_2O_{D(mm)}$ (Table 5-51) and indirect $N_2O_{IND(mm)}$ emissions (Table 5-52 and Table 5-53) from category 3B 'Manure Management' were recalculated.

Table 5-52: Recalculations of direct $N_2O_{D(mm)}$ emissions from source category 3B 'Manure Management' included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	1.64	1.52	1.36	1.18	1.14	1.05	1.11	0.86	0.81	0.74	0.65
BTR1	1.58	1.50	1.35	1.18	1.14	1.02	0.88	0.80	0.79	0.72	0.66
Difference, %	-4.0	-1.3	-1.0	-0.3	-0.4	-3.6	-21.1	-6.7	-3.0	-2.5	0.7
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.67	0.67	0.64	0.62	0.66	0.68	0.52	0.51	0.58	0.60	0.55
BTR1	0.67	0.67	0.64	0.62	0.66	0.69	0.53	0.53	0.59	0.61	0.56
Difference, %	-0.1	-0.1	0.6	0.0	-0.3	1.7	2.6	3.8	2.4	1.7	1.9
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.50	0.47	0.52	0.51	0.52	0.49	0.44	0.39	0.34		
BTR1	0.51	0.49	0.53	0.49	0.49	0.50	0.47	0.38	0.33	0.34	0.31
Difference, %	2.2	2.7	1.8	-3.2	-6.1	1.1	8.1	-3.8	-1.5		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

Table 5-53: Recalculations of indirect $N_2O_{IND(mm)}$ emissions from source category 3B 'Manure Management' included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	1.38	1.22	1.06	0.86	0.82	0.75	0.78	0.61	0.56	0.50	0.43
BTR1	1.32	1.21	1.06	0.86	0.82	0.72	0.62	0.55	0.54	0.48	0.43
Difference, %	-3.7	-0.5	-0.7	0.2	0.1	-4.3	-21.3	-10.0	-4.5	-4.0	1.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.44	0.44	0.42	0.41	0.44	0.46	0.34	0.34	0.39	0.41	0.37
BTR1	0.44	0.44	0.42	0.41	0.44	0.46	0.35	0.35	0.40	0.42	0.38
Difference, %	-0.1	-0.1	1.2	0.0	-0.2	1.3	2.0	3.0	1.9	1.3	1.4
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.34	0.31	0.35	0.33	0.35	0.32	0.29	0.26	0.22		
BTR1	0.35	0.32	0.35	0.33	0.33	0.33	0.33	0.26	0.22	0.22	0.20
Difference, %	1.7	2.2	1.5	-2.5	-4.0	1.2	14.4	-1.6	1.6		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

For 2021 and 2022, direct $N_2O_{D(mm)}$ and indirect $N_2O_{IND(mm)}$ emissions resulting from 3B 'Manure Management' have been estimated for the first time. The results allow us to assert that, over the period 1990-2022, direct $N_2O_{D(mm)}$ emissions had decreased by 80.6%, whereas indirect $N_2O_{IND(mm)}$ emissions had decreased by circa 84.6%.

It should be noted that indirect $N_2O_{G(mm)}$ emissions from volatilization of ammonia (NH_3) and nitrogen oxides (NO_x) had decreased in the respective period by 85.2%, whereas $N_2O_{L(mm)}$ emissions from leaching and runoff of nitrogen had decreased by 83.9%, respectively (Table 5-54). This evolution was possible due to the drastic decrease in animal population and poultry, as well as a significant change in livestock and poultry farming practices and in the share of manure management systems.

Table 5-54: Indirect $N_2O_{IND(mm)}$ emissions from volatilization of ammonia (NH_3) and nitrogen oxides (NO_x), and from leaching and runoff of nitrogen, respectively, under source category 3B 'Manure Management' between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Indirect $N_2O_{(G)}$	0.70	0.64	0.55	0.45	0.43	0.37	0.32	0.28	0.28	0.25	0.22
Indirect $N_2O_{(L)}$	0.62	0.57	0.50	0.41	0.40	0.35	0.30	0.27	0.26	0.24	0.21
$N_2O_{IND(mm)}$	**1.32**	**1.21**	**1.06**	**0.86**	**0.82**	**0.72**	**0.62**	**0.55**	**0.54**	**0.48**	**0.43**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Indirect $N_2O_{(G)}$	0.22	0.22	0.22	0.21	0.23	0.24	0.18	0.18	0.20	0.21	0.19
Indirect $N_2O_{(L)}$	0.21	0.22	0.21	0.20	0.22	0.23	0.17	0.17	0.19	0.20	0.18
$N_2O_{IND(mm)}$	**0.44**	**0.44**	**0.42**	**0.41**	**0.44**	**0.46**	**0.35**	**0.35**	**0.40**	**0.42**	**0.38**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Indirect $N_2O_{(G)}$	0.18	0.16	0.18	0.17	0.17	0.17	0.17	0.13	0.11	0.11	0.10
Indirect $N_2O_{(L)}$	0.17	0.16	0.17	0.16	0.16	0.16	0.16	0.12	0.11	0.11	0.10
$N_2O_{IND(mm)}$	**0.35**	**0.32**	**0.35**	**0.33**	**0.33**	**0.33**	**0.33**	**0.26**	**0.22**	**0.22**	**0.20**

Table 5-55 below shows the total amount of nitrogen generated from all manure management systems, as well as the amounts of nitrogen from animal waste available for application to agricultural soils, estimated in accordance with the methodology in the IPCC 2006 Guidelines.

Table 5-55: Total amount of nitrogen excreted ($N_{ex(T)}$) in all manure management systems and amount of nitrogen available (N_{MMS_Avb}) to be introduced into agricultural soils for the period 1990-2022, kt N

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
$N_{ex\ (T)}$	129.88	122.12	109.35	95.10	92.10	82.03	70.85	64.23	63.71	57.90	53.02
N_{MMS_Avb}	82.30	76.73	69.62	59.83	58.04	51.37	44.86	40.56	39.60	36.24	33.13
Share, % from $N_{ex\ (T)}$	63.4	62.8	63.7	62.9	63.0	62.6	63.3	63.2	62.2	62.6	62.5
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
$N_{ex\ (T)}$	53.38	54.16	51.64	49.56	52.03	54.44	42.16	42.48	46.87	48.07	44.15
N_{MMS_Avb}	33.58	33.85	32.29	30.93	32.48	33.80	26.26	26.06	28.74	29.43	27.02
Share, % from $N_{ex\ (T)}$	62.9	62.5	62.5	62.4	62.4	62.1	62.3	61.4	61.3	61.2	61.2
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
$N_{ex\ (T)}$	41.13	39.17	42.74	39.18	38.42	39.52	37.11	29.78	26.29	26.17	23.72
N_{MMS_Avb}	25.03	23.87	25.80	24.04	23.67	24.01	22.26	18.31	16.25	16.35	14.90
Share, % from $N_{ex\ (T)}$	60.9	60.9	60.4	61.4	61.6	60.7	60.0	61.5	61.8	62.5	62.8

5.3.2.7. Planned Improvements

Regarding N_2O emissions from source category 3B 'Manure Management', possible improvements could include activities on periodical collection of updated information on the share of manure management systems at national level during the reference period, and for the more recent period (once every 3 years), as well as information associated with specifying country-specific values of $N_{ex(T)}$ nitrogen excretion rates for different categories of animals in the RoM (kg N/head/year).

5.4. Agricultural Soils (Source Category 3D)

Direct and indirect N_2O emissions are monitored under source category 3D 'Agricultural Soils'. The following nitrogen sources are included in the methodology for estimating direct N_2O emissions from

managed soils: synthetic N fertilizers; organic N applied as fertilizer; urine and dung nitrogen deposited on pasture, range and paddock by grazing animals, N in crop residues and mineralization as a result of loss of soil organic matter resulting from change of land use agricultural soils and management of soils.

Direct N_2O emissions were estimated following the methodology available in the 2006 IPCC Guidelines.

$$N_2O_{direct} = N_2O_{SN} + N_2O_{ON} + N_2O_{PRP} + N_2O_{CR} + N_2O_{SOM}$$

Where:

N_2O_{SN} – N_2O emissions from the amount of synthetic N fertilizer applied to soils, kt/yr;

N_2O_{ON} – N_2O emissions from the use of organic fertilizers in soil;

N_2O_{PRP} – N_2O emissions from urine and dung inputs to grazed soils;

N_2O_{CR} – N_2O emissions from the amount of N in crop residues;

N_2O_{SOM} – N_2O emissions from the amount of N in mineral soils that is mineralized, in association with loss of soil organic matter resulting from change of land use or management of mineral soils (dehumification).

It should be noted, that during the reference period 1990-2022, direct N_2O emissions from source category 3D 'Agricultural Soils' decreased by circa 42.7%, from 3.81 kt in 1990 to 2.18 kt in 2022 (Figure 5-2).

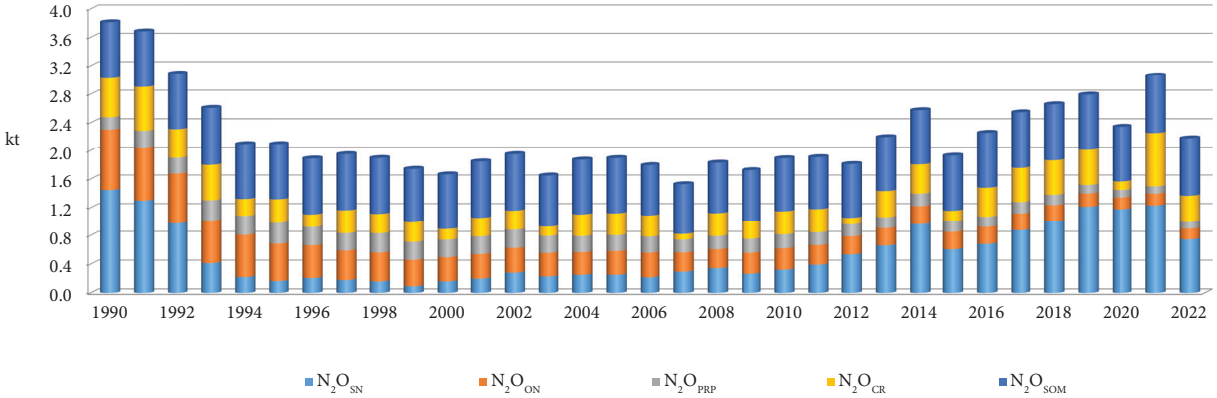


Figure 5-2: Direct N_2O emissions from source category 3D 'Agricultural Soils' between 1990-2022, kt

The contribution of different emission sources in the structure of total direct N_2O emissions has also changed. The share of N_2O_{ON}, N_2O_{SN}, and N_2O_{PRP} has decreased by 69.2%, 9.9% and 9.1%, respectively, whereas the share of N_2O_{CR} and N_2O_{SOM} has increased by circa 21.1% and 80.8%, respectively (Table 5-56).

Table 5-56: Share of direct N_2O emissions from source category 3D 'Agricultural Soils' by source between 1990-2022, % of total

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
N_2O_{SN}	37.9	35.3	31.4	15.9	10.5	7.9	11.0	9.2	8.4	5.3	9.7
N_2O_{ON}	22.5	20.5	22.8	23.2	28.0	24.8	24.1	21.1	21.2	21.1	20.2
N_2O_{PRP}	4.6	6.3	7.1	10.8	13.1	13.9	13.7	12.5	14.3	14.4	14.7
N_2O_{CR}	14.3	16.7	13.4	19.0	11.2	16.2	9.8	16.9	14.9	15.7	9.0
N_2O_{SOM}	20.7	21.2	25.2	31.0	37.1	37.3	41.4	40.3	41.2	43.4	46.5
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
N_2O_{SN}	10.8	14.5	13.9	13.5	13.4	12.1	19.4	18.8	15.5	17.1	20.6
N_2O_{ON}	18.4	17.6	19.8	16.7	17.4	19.1	17.4	14.4	16.9	15.8	14.4
N_2O_{PRP}	13.4	13.2	14.4	12.1	11.8	12.5	11.8	10.1	11.3	10.2	9.4
N_2O_{CR}	14.6	14.2	7.9	16.8	16.6	17.1	5.3	18.1	14.3	17.7	17.5
N_2O_{SOM}	42.7	40.6	43.9	40.9	40.8	39.2	46.2	38.6	42.1	39.2	38.1
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
N_2O_{SN}	29.6	30.1	37.3	31.5	30.2	34.4	38.0	43.4	50.2	40.2	34.2
N_2O_{ON}	14.0	11.0	10.1	12.6	10.6	9.6	8.5	6.6	7.0	5.4	6.9
N_2O_{PRP}	9.3	7.4	6.8	8.3	6.7	6.3	5.4	4.3	4.5	3.3	4.1
N_2O_{CR}	5.5	16.6	15.9	7.5	17.9	18.8	18.2	17.6	5.1	24.8	17.4
N_2O_{SOM}	41.6	34.9	29.9	40.0	34.5	31.0	29.9	28.1	33.2	26.3	37.4

N_2O emission can also take place indirectly through several pathways: the volatilization of N as NH_3 and oxides of nitrogen (NO_x), and the deposition of these gases and their products NH_4^+ and NO_3^- onto soils and the surface of lakes and other waters; while the second pathway is the volatilization of N from synthetic and organic fertilizer additions, urine and dung deposition from grazing animals, as well as from leaching and runoff of nitrogen from synthetic and organic fertilizer additions, urine and dung deposition from grazing animals, crop residue, mineralization of nitrogen associated with loss of carbon in mineral soils as a result of land-use change and management practices.

Indirect N_2O emissions from managed soils were calculated by using the following equation from the 2006 IPCC Guidelines.

$$N_2O_{INDIRECT} = N_2O_{ATD} + N_2O_L$$

Where:

N_2O_{ATD} – indirect N_2O emissions, produced from atmospheric deposition of nitrogen as ammonia (NH_3), nitrogen oxides (NO_x), and their products NH_4^+ and NH_3^- into soils and the surface of lakes and other waters; deposition of agriculturally derived NH_3 and NO_x, following the application of synthetic and organic N fertilizers and/or urine and dung deposition from grazing animals;

N_2O_L – from leaching and runoff from land of nitrogen from synthetic and organic fertilizer additions, crop residues returned to soils, mineralization of nitrogen associated with loss carbon in mineral and drained/managed organic soils through land-use change or management practices and urine and dung deposition from grazing animals.

Between 1990 and 2022, indirect N_2O emissions from source category 3D 'Agricultural Soils' had decreased by circa 49.2%, from 1.18 kt in 1990 to 0.60 kt in 2022 (Figure 5-3).

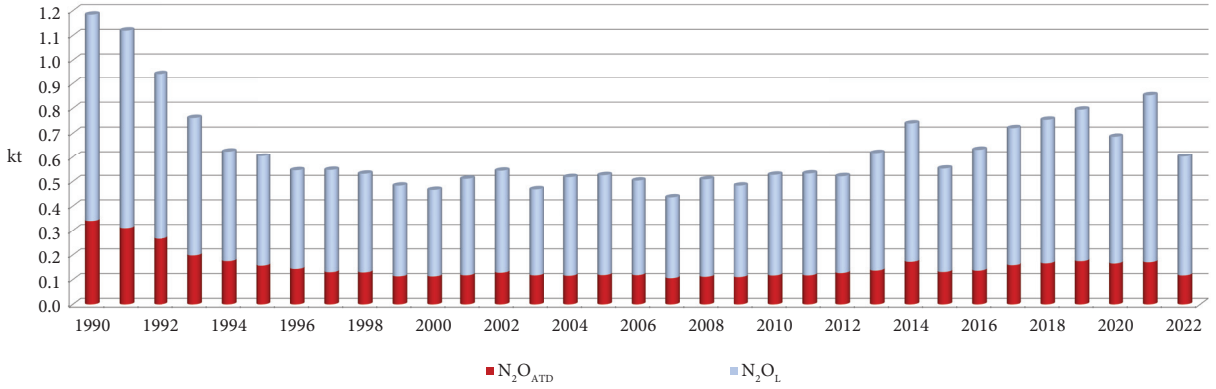


Figure 5-3: Indirect N_2O emissions from source category 3D 'Agricultural Soils' between 1990-2022, kt

The share of emission sources in the structure of total indirect N_2O emissions has also changed. Thus, the share of N_2O_{ATD} emissions from atmospheric deposition of nitrogen decreased by 32%, whereas the share of N_2O_L emissions from leaching and runoff of nitrogen in land increased by 13% (Table 5-57).

Table 5-57: Share of indirect N_2O emissions from source category 3D 'Agricultural Soils' between 1990-2022, %

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
N_2O_{ATD}	28.6	27.7	28.2	26.0	28.0	25.9	26.3	23.7	24.3	23.4	24.2
N_2O_L	71.4	72.3	71.8	74.0	72.0	74.1	73.7	76.3	75.7	76.6	75.8
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
N_2O_{ATD}	23.0	23.5	25.1	22.4	22.6	23.5	24.3	21.9	22.9	22.2	22.0
N_2O_L	77.0	76.5	74.9	77.6	77.4	76.5	75.7	78.1	77.1	77.8	78.0
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
N_2O_{ATD}	24.3	22.1	23.3	23.7	21.5	22.0	22.0	22.0	24.1	20.0	19.5
N_2O_L	75.7	77.9	76.7	76.3	78.5	78.0	78.0	78.0	75.9	80.0	80.5

5.4.1. Direct N_2O Emissions from Managed Soils

5.4.1.1. Inorganic Nitrogen Fertilizers

Source Category Description

Considerable amounts of nitrogen are applied to soils with inorganic nitrogen fertilizers. This nitrogen undergoes transformations such as nitrification and denitrification processes and releases N_2O emissions. The number of emissions from fertilizer consumption depends on certain factors, such as: the amount and type of nitrogen fertilizers applied, crop type, soil type, climate and other environment-related conditions. N_2O emissions from synthetic nitrogen fertilizers vary a lot over the year.

Methodologies, Emission Factors and Activity Data

Direct N_2O_{SN} emissions from applied inorganic nitrogen fertilizers were estimated using the Tier 1 methodology, and Equation 10.6 in the 2006 IPCC Guidelines.

$$N_2O_{SN} = F_{SN} \bullet EF_1 \bullet 44/28$$

Where:

N_2O_{SN} – N_2O emissions from applied inorganic nitrogen fertilizers (kt/yr);

F_{SN} – annual amount of inorganic nitrogen fertilizers applied to soils (kg N/yr);

EF_1 – emission factor for 0.01 kg N_2O-N/kg from N inputs, range: 0.003-0.03 kg N_2O-N/kg N;

[44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

Table 5-58 provides a short overview of inorganic N fertilizers, including complex fertilizers most commonly used in the Republic of Moldova.

Table 5-58: Brief overview of inorganic nitrogen fertilizers most commonly used in the RoM

Type of Fertilizer	Chemical Formula	Active substance, %	Form	Features
Ammonium nitrate	NH_4NO_3	34.5	White macro crystals or pellets	Physiologically it is faintly acid, may be applied to all crops and all soils. Highly hygroscopic.
Urea (carbamide)	$CO(NH_2)_2$	46	White crystals or pellets	Has a physiologically faintly acid/neutral, low hygroscopic. Highly volatile. Applied to soils, may be used in solutions for foliar fertilization.
Ammophos	$NH_4H_2PO_4$	N: 11-12, P_2O_5: 42-50	Grey pellets	Efficient on chernozems, brown soils, and phosphor deficient soils.
Diammophos	$(NH_4)_2HPO_4$	N: 21, P_2O_5: 53	Grey pellets	Efficient on chernozems, and phosphor deficient soils.
Nitroammophos	Complex formula	N: P: K 13-19 each	Pellets of different colours	Efficient on all soils and used for all crops.
Diammophos	Complex formula	N: P: K 10:26:26	Pellets of different colours	Efficient on all soils and used for all crops.

Information on the amounts of applied inorganic N fertilizers (active substance – a.s.) on agricultural soils in the RoM is available in the Statistical Yearbooks of the RoM (for the period until 1992 – for the whole territory of the country, and for the period after 1993 – only for the RBDR), and in the Statistical Yearbooks of ATULBD (for the period 1993-2022).

Table 5-59 indicates that between 1990 and 2022 there was a significant decrease by circa 67.6% in the amounts of inorganic N fertilizers used in the agriculture sector of the RoM, including a decrease by circa 48.4% in inorganic N fertilizers; a decrease by circa 78.5% in inorganic P fertilizers; and a decrease by circa 83.0% in inorganic K fertilizers. The amounts of inorganic fertilizers used per one hectare decreased by circa 68.7%, from 134.1 kg a.s./ha in 1990, to 41.9 kg a.s./ha in 2022.

Table 5-59: Applied inorganic fertilizers between 1990-2022, kt of active substance

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Inorganic fertilizer – total, kt	232.4	191.4	127.6	44.9	20.0	12.5	14.3	12.1	10.3	6.1	10.3
N fertilizer	92.1	82.7	61.8	26.4	14.1	10.5	13.2	11.4	10.2	5.9	10.2
P fertilizer	85.7	75.2	43.4	12.7	8.0	1.4	0.7	0.5	0.1	0.1	0.1
K fertilizer	54.6	33.5	22.4	5.8	1.6	0.6	0.3	0.2	0.0	0.0	0.0
average per 1 sown ha, kg	134.1	111.5	74.6	25.2	11.7	7.2	8.3	7.0	6.0	3.6	6.1
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Inorganic fertilizer – total, kt	12.8	18.4	15.4	17.5	18.0	16.6	22.4	24.7	19.9	25.5	30.9
N fertilizer	12.7	18.0	14.6	16.1	16.1	13.8	18.8	21.9	17.0	20.6	25.0
P fertilizer	0.1	0.3	0.6	1.0	1.5	2.0	2.4	1.7	2.0	3.3	4.1
K fertilizer	0.0	0.1	0.2	0.4	0.5	0.8	1.1	1.1	0.9	1.6	1.8
average per 1 sown ha, kg	7.4	10.6	9.7	10.4	10.6	10.7	14.4	15.9	12.5	15.6	19.3

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Inorganic fertilizer – total, kt	44.0	54.8	84.5	52.4	58.8	81.4	94.2	113.8	114.7	116.0	75.3
N fertilizer	34.1	42.1	61.1	38.7	43.4	55.7	64.3	77.2	75.0	78.4	47.5
P fertilizer	7.1	9.6	19.4	10.8	11.6	19.2	22.2	25.6	27.7	26.7	18.4
K fertilizer	2.8	3.1	4.0	2.9	3.8	6.4	7.8	10.3	12.0	11.0	9.3
average per 1 sown ha, kg	26.6	32.5	49.9	30.9	34.3	46.9	53.9	66.0	67.1	65.6	41.9

Source: Statistical Yearbooks of the RoM for 1988 (page 280), 1994 (page 239), 1999 (page 330), 2003 (page 442), 2006 (page 352), 2011 (page 345), 2014 (page 345), 2019 (page 296), 2021 (page 289). Statistical Yearbooks of ATULBD for 1998 (page 230), 2000 (page 107), 2002 (page 111), 2006 (page 108), 2009 (page 107), 2012 (page 114), 2017 (page 110), 2019 (page 108), 2020 (page 111), 2021 (page 111).

It should be noted that the average consumption of nutrients, in kg of nitrogen per 1 tonne of basic yield in most crops is 30-35 kg, and the yield capacity of crops grown in the RoM, according to the National Complex Soil Fertility Enhancing Program for 2001-2020, varies between 3.5-4.8 t/ha for winter wheat, 4.5-6.4 t/ha for grain maize, 2.1-3.5 t/ha for sunflower, 26.8-37.0 t/ha for sugar beet, etc. The sharp reduction in fertilizer consumption occurred due to a number of reasons, such as: a drop in the import of synthetic fertilizer into the country, the farmers' lack of financial resources in certain periods of the year, particularly in the context of the disorganization of the country's agriculture during the transition to market economy. Additionally, in accordance with the National Complex Soil Fertility Enhancing Program for 2001-2020, the annual amount of synthetic N fertilizer in the RoM was envisioned to increase to 120-130 thousand tonnes of nitrogen by 2020.

Uncertainties and Time-Series Consistency

Uncertainties associated with activity data on applied inorganic N fertilizers in the RoM are considered low (circa 5%). Uncertainties associated with the default emission factor (EF_1 for F_{SN}) may reach circa 6%. Thus, combined uncertainties associated with activity data and emission factors for source category 3D.1.a 'Inorganic Nitrogen Fertilizers' are considered low (circa 7.81%) (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in accordance with the recommendations included in the 2006 IPCC Guidelines.

Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for category 3D 'Agricultural Soils', following the Tier 1 methodological approach.

The AD and methods used in the estimation of N_2O emissions originating from this source category were documented and archived both in hard copies and electronically. In order to identify the data entry and the N_2O emission estimation process-related errors, AD and EF verifications and quality control procedures were periodically applied.

Following the recommendations included in the 2006 IPCC Guidelines, N_2O emissions from applied inorganic N fertilizers were estimated using AD from official reference sources.

Recalculations

Direct emissions of N_2O_{SN} from category 3D.1.a 'Inorganic Nitrogen Fertilizers' have been recalculated for the years 1990-2020 as a result of changing the GWP_{100} for nitrous oxide. Thus, the value available in the IPCC AR5 (2014) (GWP_{100} – 265) was used instead of the value available in the IPCC AR4 (2007) (GWP_{100} – 298).

Table 5-60: N_2O_{SN} emissions from the use of inorganic N fertilizer, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	1.45	1.30	0.97	0.41	0.22	0.17	0.21	0.18	0.16	0.09	0.16
BTR1	1.45	1.30	0.97	0.41	0.22	0.17	0.21	0.18	0.16	0.09	0.16
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.20	0.28	0.23	0.25	0.25	0.22	0.30	0.34	0.27	0.32	0.39
BTR1	0.20	0.28	0.23	0.25	0.25	0.22	0.30	0.34	0.27	0.32	0.39
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.54	0.66	0.96	0.61	0.68	0.88	1.01	1.21	1.18		
BTR1	0.54	0.66	0.96	0.61	0.68	0.88	1.01	1.21	1.18	1.23	0.75
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

Compared to the emission values recorded in NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend of 11.1% in direct N_2O_{SN} emissions from category 3D.1.a 'Inorganic Nitrogen Fertilizers' in the period 1990-2020 (Table 3-61).

Table 5-61: Recalculations of direct N_2O_{SN} emissions from category 3D.1.a 'Inorganic Nitrogen Fertilizers' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	431.29	387.27	289.40	123.52	66.07	49.22	61.90	53.49	47.69	27.69	47.96
BTR1	383.53	344.39	257.35	109.84	58.75	43.77	55.04	47.56	42.40	24.62	42.65
Difference, %	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	59.41	84.12	68.47	75.22	75.40	64.66	88.17	102.70	79.56	96.38	117.07
BTR1	52.83	74.80	60.89	66.89	67.05	57.50	78.41	91.33	70.75	85.70	104.10
Difference, %	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	159.57	197.19	286.17	181.13	203.28	260.88	301.14	361.61			
BTR1	141.90	175.35	254.48	161.07	180.77	231.99	267.79	321.56	312.22	326.34	197.77
Difference, %	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1			

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

For the years 2021 and 2022, direct N_2O_{SN} emissions from category 3D.1.a 'Inorganic Nitrogen Fertilizers' on agricultural lands of the RoM have been estimated for the first time. The obtained results show that in the period 1990-2022 the respective emissions decreased by circa 48.4%.

Planned Improvements

No activities to improve the estimation process regarding direct N_2O emissions from applied inorganic N fertilizers are planned for the next inventory cycle.

5.4.1.2. Organic Nitrogen Fertilizers

Source Category Description

Applied organic nitrogen fertilizers may enhance the processes of nitrification and denitrification, thus contributing to the increase in N_2O emissions from managed soils. While calculating emissions covered by this source category, activity data on the generation of various organic waste obtained in the national economy should be considered. In the Republic of Moldova, processing plants and the animal breeding sector are the major providers of organic fertilizer. However, the latter is still the most important supplier of organic fertilizer: animal manure; composts based on manure and crop residue, diluvial soil, sludge from water basins, manure slurry, household sludge, poultry manure, etc.; sludge from livestock complexes, poultry litter, urine and manure. Another important source is the sludge from the treatment of domestic wastewater and waste from sugar beet processing plants (sludge), as well as from wineries (vinasse, solid wine yeasts, etc.).

Methodologies, Emission Factors and Activity Data

N_2O emissions from applied organic N fertilizers were estimated using the Tier 1 methodology and Equation 11.2 in the 2006 IPCC Guidelines.

$$N_2O_{ON} = F_{ON} \bullet EF_1 \bullet 44/28$$

Where:

N_2O_{ON} – N_2O emissions from applied organic N fertilizers (kt/yr);

$F_{ON} = (F_{AM} + F_{SEW} + F_{COMP} + F_{OOA})$, total annual amount of organic N fertilizers applied to soils (kg N/yr);

F_{AM} – annual amount of animal manure N applied to soils (kg N/yr);

F_{SEW} – annual amount of total sewage N from household waste treatment that is applied to soils (kg N/yr);

F_{COMP} – annual amount of total compost N applied to soils (kg N/yr);
F_{OOA} – annual amount of other organic amendments used as fertilizer (kg N/yr);
EF_1 – default EF: 0.01 kg N_2O-N/kg N applied (range: 0.003-0.03 kg N_2O-N/kg N);
[44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

Data on total amount of organic fertilizers (preponderantly, manure with bedding[100]) applied to managed lands are available in the Statistical Yearbooks of the RoM and ATULBD (Table 5-62).

As the table indicates, between 1990 and 2022, according to the NBS and the State Statistical Service of ATULBD, there was a significant reduction, by circa 70 times, in the amounts of organic N fertilizers applied per hectare of sown fields, from circa 5.6 tonnes per sown hectare in 1990, to circa 0.08 tonnes per sown hectare in 2022.

Table 5-62: Applied organic fertilizers in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Total applied organic N fertilizers, kt	9,740.0	8,600.0	5,300.0	4,200.0	1,620.0	1,779.2	905.7	352.9	227.3	122.1	83.3
tonnes applied to 1 ha of sown field	5.60	5.10	3.40	2.40	1.10	1.20	0.60	0.20	0.10	0.10	0.03
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Total applied organic N fertilizers, kt	98.2	54.2	47.3	42.2	44.2	10.5	7.9	8.0	6.9	17.7	31.5
tonnes applied to 1 ha of sown field	0.10	0.02	0.06	0.04	0.04	0.01	0.00	0.00	0.01	0.02	0.04
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Total applied organic N fertilizers, kt	22.9	42.6	33.8	61.2	74.6	45.5	103.4	84.0	105.5	132.1	84.1
tonnes applied to 1 ha of sown field	0.03	0.05	0.03	0.07	0.08	0.05	0.11	0.08	0.11	0.13	0.08

Source: Statistical Yearbooks of the RoM for 1988 (page 280), 1994 (page 239), 1999 (page 330), 2003 (page 442), 2006 (page 352), 2011 (page 345), 2014 (page 345), 2019 (page 296) and 2021 (page 289). Statistical Yearbooks of ATULBD for 1998 (page 230), 2000 (page 107), 2002 (page 111), 2006 (page 108), 2009 (page 107), 2012 (page 114), 2017 (page 110), 2019 (page 108), 2020 (page 111), 2021 (page 111).

It should be mentioned that the statistical data on the amount of organic N fertilizers applied to soils is collected through Questionnaire no. 9-agr 'The use of phytosanitary products and the introduction of synthetic and organic fertilizers into the crop yield of year…'. This questionnaire is submitted annually to the territorial statistical offices, by December 5, by agricultural enterprises and organizations irrespective of the organizational-legal and property forms (including individual farms with a total area of 50 or more ha) depending on the location of the land. As it can be seen, individual farms with an area less than 50 ha are not required to report data related to the type of fertilizers applied to soil. Considering that most of the livestock and poultry population is found in individual farms (Table 5-37), who also do not report to the territorial statistical offices, it is obvious that the statistical data presented above (Table 5-62) is by far underestimated.

Within the past two inventory cycles, the amount of organic N fertilizers applied to soils was estimated based on the information on the total amount of excreted nitrogen ($N_{ex(T)}$) in all manure management systems and the amount of nitrogen available (N_{MMS_Avb}) for application to managed soils in the RoM (Table 5-54). As it can be seen in Table 5-63, the current statistical system fails to monitor the amounts of organic N fertilizers actually applied to soils in the RoM, as it does not statistically include all producers and individual farmers.

Table 5-63: Organic fertilizers generated and available to be applied to soils between 1990-2022, in comparison to the official statistical data within the same reporting period, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Organic fertilizers available to be applied to soils (calculated AD), kt	14,697.1	13,702.3	12,432.9	10,683.4	10,364.6	9,173.0	8,010.8	7,243.1	7,072.0	6,471.4	5,915.7
Applied organic fertilizers (statistical data), kt	9,740.0	8,600.0	5,300.0	4,200.0	1,620.0	1,779.2	905.7	352.9	227.3	122.1	83.3
Applied organic fertilizers (statistical data), % of the amount available to be applied to soils	66.3	62.8	42.6	39.3	15.6	19.4	11.3	4.9	3.2	1.9	1.4
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Organic fertilizers available to be applied to soils (calculated AD), kt	5,995.7	6,044.9	5,765.8	5,522.6	5,800.0	6,035.7	4,689.2	4,653.7	5,132.2	5,255.7	4,824.8
Applied organic fertilizers (statistical data), kt	98.2	54.2	47.3	42.2	44.2	10.5	7.9	8.0	6.9	17.7	31.5
Applied organic fertilizers (statistical data), % of the amount available to be applied to soils	1.6	0.9	0.8	0.8	0.8	0.2	0.2	0.2	0.1	0.3	0.7

[100] In the early 1990s, the share of animal bedding manure (4-6 kg bedding/animal/day) in Moldova was circa 37.6% of the total amount of animal manure generated in the livestock breeding sector; the share of manure with semi-bedding (1-3 kg bedding/animal/day) constituted circa 26.7%; and the share of manure without bedding – circa 35.4%, respectively (Turcan et al., 1984; Balteanskyi, 1986).

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Organic fertilizers available to be applied to soils (calculated AD), kt	4,470.2	4,263.4	4,607.1	4,292.4	4,227.2	4,287.4	3,975.2	3,269.3	2,902.5	2,918.8	2,659.9
Applied organic fertilizers (statistical data), kt	22.9	42.6	33.8	61.2	74.6	45.5	103.4	84.0	105.5	132.1	84.1
Applied organic fertilizers (statistical data), % of the amount available to be applied to soils	0.5	1.0	0.7	1.4	1.8	1.1	2.6	2.6	3.6	4.5	3.2

The scientific literature[101] shows that 1 tonne of cattle manure with bedding contains circa 5.6 kg of nitrogen. In order to estimate the F_{ON} values (Table 5-64), the applied amount of organic fertilizer (the values for the period 1990-1991 were taken from official statistics; and for 1992-2022 it was inferred that 64.5% of the available amount is actually applied to soil. This value, which represents an arithmetic mean between the value 66.6%, typical of year 1990, and the value 62.8%, typical of year 1991), was multiplied by the conversion factor from bedding manure to nitrogen.

It should be noted that in accordance with the crop rotation structure, the need for organic fertilizer is circa 10-15 t/ha for a neutral humus balance, and circa 20-30 t/ha for a positive balance (to fully compensate for the humus losses, an average amount of organic fertilizer of 10 t/ha is needed).

According to experts in agriculture, the stabilization of the humus content in soil on arable lands and horticultural plantations requires the annual application of circa 20-22 million tonnes of organic fertilizers, whereas current resources of organic matter can ensure application of as much as 2-3 million tonnes of organic fertilizer.

It is considered that the only way to eliminate the deficit of organic fertilizer is to radically change the structure of crops by changing land-use categories, improving crop rotations, and a more comprehensive use of all local sources of organic matter.

Table 5-64: Amount of N applied to agricultural soils with organic fertilizers in the Republic of Moldova between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Organic fertilizers available to be applied to soils, kt	14,697.1	13,702.3	12,432.9	10,683.4	10,364.6	9,173.0	8,010.8	7,243.1	7,072.0	6,471.4	5,915.7
Applied organic fertilizers (63% of the available amounts), kt	9,740.0	8,600.0	7,832.7	6,730.5	6,529.7	5,779.0	5,046.8	4,563.1	4,455.4	4,077.0	3,726.9
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	54.5	48.2	43.9	37.7	36.6	32.4	28.3	25.6	25.0	22.8	20.9
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Organic fertilizers available to be applied to soils, kt	5,995.7	6,044.9	5,765.8	5,522.6	5,800.0	6,035.7	4,689.2	4,653.7	5,132.2	5,255.7	4,824.8
Applied organic fertilizers (63% of the available amounts), kt	3,777.3	3,808.3	3,632.5	3,479.2	3,654.0	3,802.5	2,954.2	2,931.8	3,233.3	3,311.1	3,039.6
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	21.2	21.3	20.3	19.5	20.5	21.3	16.5	16.4	18.1	18.5	17.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Organic fertilizers available to be applied to soils, kt	4,470.2	4,263.4	4,607.1	4,292.4	4,227.2	4,287.4	3,975.2	3,269.3	2,902.5	2,918.8	2,659.9
Applied organic fertilizers (63% of the available amounts), kt	2,816.2	2,685.9	2,902.5	2,704.2	2,663.2	2,701.1	2,504.3	2,059.7	1,828.5	1,838.9	1,675.7
Applied organic fertilizers (F_{ON}), kt of a.s. (N)	15.8	15.0	16.3	15.1	14.9	15.1	14.0	11.5	10.2	10.3	9.4

In this context, specialists recommend that the green mass of the leguminous crops with highly developed semi-fascicular root system be used as an organic fertilizer applied to soil. The best suited cultures are the vetch, and winter and spring peas, respectively.

The use of these crops as a green fertilizer can be achieved in two ways:

1. the vetch or the winter peas sown in September as an intermediate crop and incorporated into the soil by early spring in the following year, at the end of April, before sowing the main crop; the crop rotation would be: winter cereals → vetch or winter peas as an intermediate crop → maize or sunflower, etc.; or
2. in a five-field crop rotation, in which the first field is used during the first year for vetch or winter and spring peas, two crop yields incorporated into the soil as green fertilizers; the crop rotation for the field used in the first year for vetch would be: winter cereals → maize → sunflower → winter cereals.

[101] Ungureanu, Cerbari et al., 2006; Bucataru et al., 2006; Raileanu, Jolondcovschi et al., 2006; Andries, Rusu, et al., 2005; Bucataru, Maciuc, 2005; Toncea, 2004; Banaru, 2003.

It should be noted that a vetch yield (mixed with a cereal crop of circa 20%) or a peas yield, could return to soil circa 8 t/ha of dry matter of organic mass annually, aerial and roots, with an average N content of circa 3.4%, which provides circa 2.0 t/ha/year of humus for synthesis or circa 1.2 t/ha/year of carbon. The systemic use of vetch or peas as green fertilizer, intermediate crop, or in a five-field crop rotation, where a field is occupied with vetch or peas, provides a balance of organic matter and nitrogen in the soil (Wiesmeier et. al, 2015[102]; Leah, Cerbari, 2015[103]; Cerbari, Leah, 2016[104]; Leah, 2018[105]; Leah, Cerbari, 2019[106], 2020[107]).

Uncertainties and Time-Series Consistency

Uncertainties associated with activity data on applied organic N fertilizers to agricultural soils in the RoM reach circa 30%. Uncertainties associated with the default emission factor used (EF_1 for F_{ON}) reach circa 6%. Thus, combined uncertainties associated with activity data and emission factors for source category 3D.1.b 'Organic N Fertilizers' are considered average (circa 30.59%) (Annex 5-3.3).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for Sector 3 'Agriculture', following the Tier 1 methodological approach. Activity Data and methods used in the estimation of N_2O emissions originating from applied organic fertilizers were documented and archived both in hard copies and electronically.

In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied.

Recalculations

Direct N_2O_{ON} emissions from source category 3D.1.b 'Organic N Fertilizers' were recalculated for the period 1990-2020 as a result of changing activity data associated with organic fertilizers available for application to soil, having updated the value of $Nex_{(T)}$ nitrogen excretion rates, based on the updated country-specific information associated with the typical weight (TAM) of an animal at the end of the year, for categories 'cattle', 'sheep', 'swine' and 'horses', and as a result of updating the value of shares of manure management systems (MS%) applied in the RoM for livestock and poultry for the period 2015-2020, based on results of studies carried out by the National Agency for Food Safety in 2015 and 2021.

Compared to the emission values recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend in direct N_2O_{ON} emissions from category 3D.1.b 'Organic N Fertilizers' in 1992-1999, 2001-2002, 2005, 2015-2016 and 2019-2020, varying from a minimum decrease of 0.2% in 1993, to a maximum decrease of 18.1% in 1996, and in an upward trend in N_2O emissions, respectively, in 2000, 2003-2004, 2006-2014 and 2017-2018, varying from a minimum increase of 0.5% in 2003 to a maximum increase of 5.9% in 2018 (Table 3-65).

Table 5-65: Recalculations of direct N_2O_{ON} emissions from category 3D.1.b 'Organic N Fertilizers' included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	0.86	0.76	0.70	0.59	0.58	0.52	0.54	0.43	0.40	0.37	0.33
BTR1	0.86	0.76	0.69	0.59	0.57	0.51	0.44	0.40	0.39	0.36	0.33
Difference, %	0.0	0.0	-0.8	-0.2	-0.3	-3.0	-18.1	-5.9	-2.6	-2.2	0.6

[102] Wiesmeier M., Lungu M., Hübner R. & Cerbari V. (2015), Remediation of degraded arable steppe soils in Moldova using vetch as green manure. Solid Earth, 6: p. 609-620.
[103] Leah, T. & Cerbari V. (2015), Cover crops - Key to storing organic matter and remediation of degraded properties of soils in Moldova. Series Agronomy. USAMV, Bucharest, p. 73-76.
[104] Cerbari V. & Leah C. (2016), Green Manure – the only possibility to save Moldova's arable soils from degradation. USAMV 'Ion Ionescu de la Brad', Iasi. Romania. Scientific papers. Agronomy. Vol. 59(2), p. 155-158.
[105] Leah T. (2018), The importance of crop rotation and the role of legumes in the agriculture of Moldova. Research on the field crops in the Republic of Moldova. Balti, Indigou Color, p. 66-71 (Rom).
[106] Leah T.& Cerbari V. (2019), Effects of green fertilizers on the quality status and production capacity of the cambic chernozem from Moldova. International Journal AGROFOR, Vol.5 (3), 2020, p. 28-38.
[107] Leah T. & Cerbari V. (2020), Evaluation of the conservative agriculture benefits on soil properties and harvests in crop rotation with legumes. Scientific paper. Series Agronomy. Vol. 63, No.2. UASVM 'Ion I. de la Brad', Iasi. 2020, p. 9-14.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.33	0.34	0.32	0.31	0.32	0.33	0.25	0.25	0.28	0.29	0.26
BTR1	0.33	0.34	0.32	0.31	0.32	0.33	0.26	0.26	0.28	0.29	0.27
Difference, %	-0.1	-0.1	0.5	0.0	-0.2	1.4	2.2	3.2	2.1	1.4	1.6
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.24	0.23	0.25	0.24	0.25	0.24	0.21	0.19	0.16		
BTR1	0.25	0.24	0.26	0.24	0.23	0.24	0.22	0.18	0.16	0.16	0.15
Difference, %	1.9	2.4	1.6	-2.7	-5.3	0.6	5.9	-3.7	-1.0		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

At the same time, direct N_2O_{ON} emissions from category 3D.1.b 'Organic N Fertilizers' have been recalculated for the years 1990-2020 and as a result of the change in the GWP_{100}. Thus, the value available in the IPCC AR5 (2014) (GWP_{100} – 265) was used instead of the value available in the IPCC AR4 (2007) (GWP_{100} – 298).

Compared to the emission values recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend in direct N_2O_{ON} emissions from category 3D.1.b 'Organic N Fertilizers' between 1990-2020 (Table 3-66).

Table 5-66: Recalculations of direct N_2O_{ON} emissions from category 3D.1.b 'Organic N Fertilizers' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	255.42	225.53	207.16	176.86	171.77	156.27	161.67	127.23	119.97	109.29	97.17
BTR1	227.14	200.55	182.66	156.96	152.27	134.77	117.69	106.41	103.90	95.07	86.91
Difference, %	-11.1	-11.1	-11.8	-11.3	-11.3	-13.8	-27.2	-16.4	-13.4	-13.0	-10.6
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	99.12	99.97	94.74	91.24	96.05	98.33	75.83	74.48	83.07	85.60	78.46
BTR1	88.09	88.81	84.71	81.14	85.21	88.67	68.89	68.37	75.40	77.22	70.88
Difference, %	-11.1	-11.2	-10.6	-11.1	-11.3	-9.8	-9.2	-8.2	-9.2	-9.8	-9.7
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	72.48	68.82	74.94	72.88	73.77	70.42	62.03	56.08	48.45		
BTR1	65.67	62.64	67.69	63.06	62.10	62.99	58.40	48.03	42.64	42.88	39.08
Difference, %	-9.4	-9.0	-9.7	-13.5	-15.8	-10.6	-5.8	-14.3	-12.0		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

For 2021-2022, direct N_2O_{ON} emissions from category 3D.1.b 'Organic N Fertilizers' have been estimated for the first time. The obtained results allow us to assert that between 1990-2022 the respective emissions had decreased by circa 82.8%, particularly due to the reduction of livestock and poultry populations, and the amounts of organic fertilizers available for application to soil, respectively.

Planned Improvements

No activities to improve the estimation process regarding direct N_2O emissions from applied organic fertilizers in the RoM are planned for the next inventory cycle.

5.4.1.3. Urine and Dung Deposited by Grazing Animals

Source Category Description

By 2022, hayfields and pastures occupied circa 338.1 thousand ha (10.0% of the country's area). Worldwide, permanent grasslands, hayfields and pastures generally occupy a surface twice as big as arable lands. However, this surface is 5 times smaller in the RoM. Generally, the surface of land occupied by pastures varies between 0.3 and 300 ha, these being pastures on steep slopes, where agricultural machinery cannot be used, as well as lowlands with excessive amount of water due to flooding or shallow level of surface waters. In the RoM, grazing takes place for 9 months (March through November), involving a large number of cattle, regardless of weather. Nitrous oxide is produced naturally in soils through the processes of ammonification, nitrification and denitrification of N inputs from urine and dung N deposited on pasture by grazing animals. In these processes, direct N_2O emissions are produced (Table 5-67).

Table 5-67: Land categories according to land use in the RoM between 1992-2022, thousand ha

	1992	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020	2021	2022
Land – total, of which:	**3,376.0**	**3,385.1**	**3,384.4**	**3,384.6**	**3,384.4**	**3,384.6**	**3,384.6**	**3,384.6**	**3,384.7**	**3,384.7**	**3,384.7**	**3,384.7**	**3,384.9**
Agricultural land	2,565.9	2,556.7	2,550.3	2,521.6	2,501.1	2,499.7	2,499.6	2,499.8	2,496.6	2,496.4	2,492.1	2,491.7	2,493.1
of which:													
arable land	1,736.3	1,758.7	1,813.8	1,840.2	1,816.7	1,817.4	1,822.9	1,827.3	1,832.3	1,838.5	1,841.9	1,852.2	1,857.5
perennial plantations	474.8	430.7	352.3	297.8	301.0	291.7	288.9	288.8	290.1	286.6	283.5	278.1	275.5
of which:													
orchards	224.5	208.3	170.8	131.9	132.5	134.5	132.5	133.5	132.5	131.2	129.8	127.6	126.6
vineyards	215.8	202.6	168.9	155.5	153.5	137.5	136.2	135.3	135.8	133.1	130.6	126.2	124.6
grassland	350.5	365.2	373.9	370.8	352.1	346.4	345.0	342.8	340.2	339.1	337.8	335.6	336.0
hayfields	4.3	2.1	2.5	2.7	2.2	2.2	2.1	2.1	2.1	2.0	2.1	2.1	2.1
fallows	0.0	0.0	7.8	10.1	29.1	42.0	40.6	38.8	31.9	30.2	26.7	23.8	22.0
Forests and other lands with forest vegetation	421.7	425.3	422.7	439.5	462.8	464.5	465.2	465.3	466.3	467.2	467.5	467.8	467.8
Rivers, lakes, pools, and ponds	88.7	92.6	95.5	96.8	96.4	96.8	96.7	96.1	96.1	96.5	96.4	96.5	96.5
Other land	299.7	310.5	315.9	326.7	324.3	323.6	323.1	323.4	325.7	324.7	328.7	328.6	327.5

Methodologies, Emission Factors and Activity Data

Direct N_2O emissions from urine and dung deposited by grazing animals were estimated using the Tier 1 methodology applying Equations 11.1 and 11.2 from the 2006 IPCC Guidelines:

$$N_2O_{PRP} = F_{PRP} \bullet EF_{3\ PRP} \bullet 44/28$$

Where:

N_2O_{PRP} – N_2O emissions from urine and dung deposited by grazing animals;

F_{PRP} – annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock (kg N/yr):

$$F_{PRP} = \Sigma_{(s)} [(N_{(T)} \bullet N_{ex\ (T)}) \bullet MS_{(T, PRP)}]$$

Where:

$N_{(T)}$ – number of head of livestock species/category T in the country (see source category 3A);

$N_{ex\ (T)}$ – annual average N excretion per animal of species/category T in the country (kg N/animal/yr) (see source category 3B);

$MS_{(T, PRP)}$ – fraction of annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock/number of head of livestock species/category T (see source category 3B);

$EF_{3\ PRP}$ – default emission factor values are: 0.02 kg N_2O-N/kg N for cattle, swine and poultry; 0.01 kg N_2O-N/kg N for other animal categories;

[44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

In order to estimate the amount of nitrogen from urine and dung deposited by grazing animals (Table 5-68), activity data were used on the total population of livestock and poultry from the Statistical Annual Report No. 24-agr 'Animal Breeding Sector': 'The Number of Livestock and Poultry in all Households Categories as of January 1' (annually for the period 1990-2022), Statistical Yearbooks of ATULBD (identical AD to those used under categories 3A and 3B), country-specific data on nitrogen excretion rate $N_{ex(T)}$ (kg N/head/yr), and country-specific values of the different manure management systems used (identical to those used under source category 3B).

Table 5-68: Annual amount of nitrogen in urine and dung deposited by grazing animals on pasture, range and paddock between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
F_{PRP}	7.35	9.21	8.96	11.27	11.23	11.40	10.05	9.45	10.39	9.68	9.39
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
F_{PRP}	9.46	9.89	9.27	8.86	8.74	8.98	7.33	7.68	8.10	7.98	7.41
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
F_{PRP}	7.11	7.06	7.57	6.81	6.38	7.06	6.33	5.19	4.63	4.51	3.96

Uncertainties and Time-Series Consistency

There is a high degree of uncertainty related to N_2O emission estimations from this source category due to high uncertainties associated with the estimation of the amount of nitrogen excreted with urine and dung deposited by grazing animals (circa 30%), and uncertainties associated with the emission factor (EF_3) specific to this process (circa 50%). Combined uncertainties associated with activity data and emission factors for source category 3D.1.c 'Urine and Dung Deposited by Grazing Animals' are considered average (circa 58.31%) (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for this source category within Sector 3 'Agriculture', following the Tier 1 methodological approach. The AD and methods used in the estimation of N_2O emissions from urine and dung deposited by grazing animals under this category were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied.

Following the recommendations included in the 2006 IPCC Guidelines, N_2O emissions from urine and dung deposited by grazing animals were estimated using AD from official reference sources.

Recalculations

Direct N_2O_{PRP} emissions from source category 3D.1.c 'Urine and Dung Deposited by Grazing Animals' have been recalculated for the period 1990-2020 as a result of changing activity data associated with organic fertilizers available for application to soil, having updated the value of $Nex_{(T)}$ nitrogen excretion rates, based on the updated country-specific information associated with the typical weight (TAM) of an animal at the end of the year, for categories 'cattle', 'sheep', 'swine' and 'horses', and as a result of updating the value of shares of manure management systems (MS%) applied in the Republic of Moldova for livestock and poultry for the period 2015-2020, based on results of studies carried out by the National Agency for Food Safety in 2015 and 2021.

Compared to the emission values recorded in NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend in direct N_2O_{PRP} emissions from source category 3D.1.c 'Urine and Dung Deposited by Grazing Animals' during the years 1990-1999, 2002-2003, 2005, 2015-2017 and 2019-2020, varying from a minimum decrease of 0.02% in 1999, to a maximum decrease of 8.4% in 2016, and in an upward trend in nitrous oxide emissions between 2006-2014 and 2018, respectively, varying from a minimum increase of 1.6% in 2006 to a maximum increase of 3.9% in 2008 (Table 5- 69).

Table 5-69: Recalculations of direct N_2O_{PRP} emissions from source category 3D.1.c 'Urine and Dung Deposited by Grazing Animals' included in the NC5 of the RoM to the UNFCCCF, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	0.18	0.24	0.23	0.29	0.28	0.30	0.28	0.25	0.27	0.25	0.24
BTR1	0.17	0.23	0.22	0.28	0.28	0.29	0.26	0.24	0.27	0.25	0.24
Difference, %	-3.7	-3.4	-1.9	-1.4	-1.5	-2.7	-6.6	-0.9	-0.2	0.0	0.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.25	0.26	0.24	0.23	0.22	0.22	0.18	0.18	0.19	0.19	0.18
BTR1	0.25	0.26	0.24	0.23	0.22	0.22	0.18	0.18	0.19	0.19	0.18
Difference, %	0.0	-0.1	-0.2	0.0	-0.3	1.6	2.4	3.9	2.6	1.9	2.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.16	0.16	0.17	0.17	0.17	0.16	0.14	0.12	0.11		
BTR1	0.17	0.16	0.17	0.16	0.15	0.16	0.14	0.12	0.10	0.10	0.09
Difference, %	2.4	3.0	2.0	-3.7	-8.4	-0.1	3.7	-2.0	-1.5		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

At the same time, direct emissions of N_2O_{PRP} from source category 3D.1.c 'Urine and Dung Deposited by Grazing Animals' have been recalculated for the years 1990-2020 and because of the change in the value of the GWP_{100}. Thus, the value available in the IPCC AR5 (2014) (GWP_{100} – 265) was used instead of the value available in the IPCC AR4 (2007) (GWP_{100} – 298).

Compared to the emission values recorded in NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend in direct N_2O_{PRP} emissions from source category 3D.1.c 'Urine and Dung Deposited by Grazing Animals' during the years 1990-2020 (Table 5-70).

Table 5-70: Recalculations of direct N_2O_{PRP} emissions from source category 3D.1.c 'Urine and Dung Deposited by Grazing Animals' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	53.84	71.36	67.09	85.49	83.61	89.33	82.33	73.15	80.73	74.91	72.91
BTR1	46.10	61.31	58.54	74.97	73.25	77.29	68.38	64.49	71.65	66.60	64.84
Difference, %	-14.4	-14.1	-12.7	-12.3	-12.4	-13.5	-17.0	-11.8	-11.2	-11.1	-11.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	73.93	76.54	71.09	67.35	66.78	65.92	52.34	52.75	56.61	56.56	52.34
BTR1	65.75	68.00	63.11	59.89	59.23	59.57	47.67	48.75	51.65	51.23	47.50
Difference, %	-11.1	-11.2	-11.2	-11.1	-11.3	-9.6	-8.9	-7.6	-8.8	-9.4	-9.3
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	49.16	47.28	50.97	49.71	49.38	47.97	41.38	36.53	31.58		
BTR1	44.78	43.29	46.24	42.59	40.24	42.63	38.17	31.84	27.66	26.73	23.98
Difference, %	-8.9	-8.4	-9.3	-14.3	-18.5	-11.1	-7.7	-12.8	-12.4		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

Planned Improvements

No activities to improve the estimation process regarding direct N_2O emissions from urine and dung deposited by grazing animals are planned for the next inventory cycle.

5.4.1.4. Crop Residues Returned to Soil

Source Category Description

During crop harvesting, a part of the crop, as agricultural residues (above-ground and below-ground), is left in the field to decompose. The nitrogen in crop residues is a relevant source for nitrification and denitrification, contributing to N_2O emissions.

Emission calculation requires taking into account both the amount of crop residues burnt in fields to clean the stubble fields for the next agricultural cycle, as well as the amount of crop residues to be removed annually for purposes such as feed, bedding, burnt for heating and cooking, etc.

Methodologies, Emission Factors and Activity Data

N_2O emissions from this source category were estimated using the *'Methodology of determining the carbon balance in agricultural soils to assess GHG emissions'* (see Annex A3-4.2)[108].

In order to calculate emissions, Equation 11.2 in the 2006 IPCC Guidelines was applied:

$$N_2O_{CR} = F_{CR} \bullet EF_1 \bullet 44/28$$

Where:

F_{CR} – annual amount of N in crop residues returned to soils annually, t N/yr;

EF_1 – default value of emission factor is 0.01 kg N_2O-N/kg N;

[44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

The total amount of N in crop residues returned to soils was estimated using the following equation:

$$F_{CR} = (Crop_{(T)} \bullet R_{AG\,(T)} \bullet (1\text{-}Frac_{Remove\,(T)}) + Crop_{(T)} \bullet R_{BG\,(T)}) \bullet (P_{CR}/10^2) \bullet (k_6/10^2)$$

Where:

$Crop_{(T)}$ – harvested annual dry matter yield for crop T t.d.m./ha;

$$Crop_{(T)} = Yield\ Fresh_{(T)} \bullet DRY$$

[108] Banaru, Anatol (2000), Methodology to Calculate CO2 Emissions from Agricultural Soils, In the collection of papers 'Climate Change: Research, Studies, Solutions', Ministry of Environment / UNDP Moldova. 'Bons Offices' Ltd. Chisinau, 2000, pages 115-123.

Yield Fresh$_{(T)}$ – harvested fresh yield for crop T, t/ha;

DRY – dry matter fraction of harvested crop T, kg dm/t of yield[109] (Table 5-71);

$R_{AG(T)}$ – ratio of above-ground residues dry matter to harvested yield for crop T (Crop(T)), t.d.m$_{AG}$/t.d.m[110] (Table 5-71);

$R_{BG(T)}$ – ratio of below-ground residues to harvested yield for crop T, t.d.m$_{BG}$/t dm[111] (Table 5-71);

Frac$_{Remove(T)}$ – fraction of above-ground residues of crop T removed and used for other purposes[112] (Table 5-71) (it should be noted that in dry years, the fraction of crop residues reaches up to 90%);

P_{CR} – amount of nitrogen in crop residues (% a.s.) (Table 5-72);

k_6 – coefficient reflecting the N in crop residues (Banaru, 2002)[113] (Tab. 5-72).

Coefficients used in the estimation of N_2O emissions from crop residues returned to soils come from different official reference sources, including the 2006 IPCC Guidelines.

Table 5-71: Coefficients used to estimate the amount of carbon in crop residues returned to soils

Crop	DRY	$R_{AG (T)}$	$R_{BG (T)}$	Frac$_{Remove (T)}$
Winter wheat	0.89	1.40	0.23	0.75
Winter rye	0.88	1.30	0.22	0.75
Barley	0.89	1.17	0.22	0.75
Oat	0.89	1.17	0.25	0.75
Buckwheat	0.88	1.17	0.25	0.75
Millet	0.88	1.17	0.22	0.40
Grain maize	0.87	1.17	0.22	0.70
Sorghum	0.89	1.17	0.22	0.50
Pea, bean, vetch	0.90	1.30	0.19	0.40
Soybeans	0.91	1.30	0.19	0.00
Sugar beet	0.22	0.29	0.20	0.00
Sunflower	0.90	3.80	0.22	0.40
Tobacco	0.90	5.77	0.19	0.00
Grain rapeseed	0.88	1.17	0.22	0.00
Potatoes	0.22	0.17	0.20	0.00
Vegetables	0.22	0.17	0.20	0.00
Melons and gourds	0.22	0.17	0.20	0.00
Fodder beet	0.22	0.14	0.20	0.00
Maize for silo and green fodder	0.23	0.25	0.22	0.77
Perennial grasses for green fodder, silo and fodder	0.26	0.25	0.40	0.74
Annual grasses (oat and vetch) for green fodder	0.22	0.25	0.40	0.78

Table 5-72: Amount of N in crop residues (average values from the literature in the field)

Crop	P_{CR}, % (s.a.)	k_6
Winter wheat	0.50	Use of N from crop residues represents 25% of the total contents
Winter rye	1.05	
Winter barley	0.80	
Oat	0.60	
Millet	1.25	
Buckwheat	0.60	
Leguminous crops	2.08	
Grain maize	1.08	
Grain sorghum	1.00	
Other cereal crops	0.60	
Sugar beet	1.65	
Sunflower	0.95	

[109] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[110] Nicolaev N., Boincean B., Sidorov M., Vanicovici Gh., Coltun V. (2006), Agrotechnics. Ministry of Education and Youth of the RM – Balti: Balti University Press, 2006, page 298.
[111] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[112] Expert opinion, Prof. Valerian Cerbari, 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection.
[113] Banaru A. (2002), Methodological Guidelines to Determine Humus Balance in Arable Soils, Ministry of Agriculture and Food Industry of the RM, 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection and TACIS FDMOL 9901 Project 'Support to Developing Education, Research and Extension Services in Agriculture', Chisinau, 2002, 23 pages.

Crop	P_{CR}, % (s.a.)	k_6
Soybeans	2.08	Use of N from crop residues represents 25% of the total contents
Tobacco	1.30	
Grain Rapeseed	1.05	
Potatoes	0.40	
Vegetables	2.09	
Melons and gourds	1.19	
Root crops for fodder	1.65	
Maize for silo and green fodder	1.08	
Perennial grasses for green fodder, silo and fodder	2.48	
Annual grasses for green fodder	1.60	

Activity data on areas sown with crops and average yield per ha for the main crops is available in the Statistical Yearbooks of the RoM and ATULBD (Tables 5-73, 5-74 and 5-75).

Table 5-73: Areas sown with crops between 1990-2022, thousand hectares

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Sown areas – total	**1,733.1**	**1,717.0**	**1,711.1**	**1,779.5**	**1,715.5**	**1,725.4**	**1,717.4**	**1,726.3**	**1,717.6**	**1,663.8**	**1,701.4**
Cereals and leguminous crops – total	**745.7**	**837.0**	**746.6**	**910.7**	**830.1**	**920.5**	**902.4**	**1,055.5**	**1,039.0**	**1,024.7**	**1,077.4**
…wheat (winter and spring)	286.7	303.0	281.7	345.9	300.4	393.9	380.9	410.3	405.8	392.1	423.8
…winter rye	0.9	0.8	0.7	1.1	1.7	2.7	4.7	3.9	3.7	3.9	3.8
…barley (winter and spring)	120.4	134.0	123.0	139.0	147.0	135.0	108.7	129.5	134.0	128.5	125.0
…oat	2.1	3.0	3.0	4.0	5.0	5.8	3.7	6.5	6.1	4.9	4.2
…millet	0.1	0.1	0.1	0.1	0.1	0.2	0.3	0.3	0.3	0.2	0.4
…buckwheat	3.6	6.0	7.0	7.0	8.0	5.5	7.4	7.3	11.1	16.8	12.1
…leguminous crops	72.6	77.0	71.2	70.7	65.5	54.0	44.6	46.2	58.8	64.7	53.6
…grain maize	258.0	310.0	259.4	342.6	283.4	321.3	350.0	450.7	416.7	411.7	454.1
…grain sorghum	1.2	3.1	0.5	0.3	1.2	1.1	0.3	0.3	0.2	0.1	0.4
…other cereal crops	0.1	0.0	0.0	0.0	17.8	1.0	1.8	0.5	2.2	1.7	0.0
Industrial crops – total	**295.3**	**277.0**	**275.3**	**262.7**	**263.5**	**284.0**	**333.7**	**300.0**	**344.7**	**355.1**	**364.9**
…sugar beet	81.5	79.9	82.6	83.0	83.0	90.3	83.9	76.3	76.4	65.5	66.6
…sunflower	134.1	126.9	130.9	125.5	139.5	163.2	225.1	199.0	234.5	246.0	256.9
…soybeans	26.5	24.1	16.6	9.3	5.6	3.6	2.3	2.3	6.3	17.0	11.6
…tobacco	32.1	32.5	28.1	31.2	28.4	20.1	16.4	17.3	22.0	18.8	23.7
…grain rapeseed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	1.0
…other industrial crops	21.1	13.6	17.1	13.7	7.0	6.6	6.0	5.1	5.2	5.9	3.9
Potatoes, vegetables and melons & gourds – total	**131.8**	**141.0**	**143.1**	**156.9**	**140.4**	**142.0**	**130.3**	**135.4**	**127.9**	**131.0**	**132.3**
…potatoes	41.2	46.9	55.3	71.1	62.8	57.1	59.6	62.3	62.0	66.6	65.4
…vegetables	71.1	78.0	73.7	73.2	68.1	74.0	61.4	63.5	58.6	56.3	56.8
…melons and gourds	9.2	8.0	7.0	6.0	5.0	7.6	6.7	7.9	5.2	6.0	7.9
…other	10.3	8.1	7.1	6.6	4.5	3.3	2.6	1.7	2.1	2.1	2.2
Forage crops – total	**560.3**	**462.0**	**546.1**	**449.2**	**481.5**	**379.0**	**351.0**	**235.4**	**206.0**	**153.0**	**126.8**
…forage roots	26.4	30.0	29.0	28.0	24.0	24.5	17.6	16.3	15.5	14.3	11.5
…maize for silo and green fodder	292.3	200.0	299.3	215.8	265.5	179.0	181.0	98.7	97.1	62.8	49.7
…perennial grasses for green fodder, silo and fodder	206.3	205.2	182.9	174.9	157.3	144.7	124.0	102.6	75.2	58.3	53.1
…annual grasses for green fodder	31.4	26.8	35.0	30.5	34.7	29.3	27.0	16.8	17.3	16.9	11.3
…other	3.9	0.0	0.0	0.0	0.0	1.3	1.4	1.0	0.9	0.7	1.1
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Sown areas – total	**1,733.4**	**1,736.2**	**1,593.1**	**1,682.5**	**1,698.1**	**1,546.9**	**1,552.4**	**1,552.0**	**1,593.0**	**1,628.2**	**1,597.3**
Cereals and leguminous crops – total	**1,172.1**	**1,165.7**	**940.6**	**1,144.6**	**1,131.7**	**953.9**	**989.2**	**1,034.8**	**1,033.8**	**1,020.3**	**991.6**
…wheat (winter and spring)	490.0	502.8	213.2	342.4	456.1	316.1	333.6	429.6	395.8	380.8	353.2
…winter rye	5.5	3.6	1.3	2.6	3.2	0.7	0.8	1.0	1.9	1.6	0.6
…barley (winter and spring)	115.4	133.7	96.1	140.8	147.8	123.2	138.1	139.4	184.7	164.9	128.4
…oat	4.8	4.3	4.6	5.9	6.4	4.5	4.4	2.8	2.4	3.0	2.2
…millet	0.0	0.1	0.2	0.5	0.2	0.1	0.4	0.3	0.3	0.5	0.2
…buckwheat	13.7	5.1	4.9	4.1	3.1	3.8	1.3	0.8	1.0	0.2	0.6
…leguminous crops	52.2	59.9	48.3	37.9	43.3	42.2	40.1	28.3	36.1	39.5	30.2

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
…grain maize	488.7	454.7	567.9	604.1	469.1	461.4	469.2	429.5	407.3	425.7	473.8
…grain sorghum	1.0	0.5	3.1	3.8	0.7	0.4	0.2	0.2	0.2	0.2	0.1
…other cereal crops	0.8	0.7	0.8	2.5	1.8	1.4	1.3	2.8	3.8	3.5	2.3
Industrial crops – total	**336.6**	**358.6**	**447.9**	**367.2**	**392.6**	**413.3**	**376.7**	**355.9**	**401.0**	**440.5**	**477.2**
…sugar beet	63.3	52.0	39.7	34.9	34.4	42.4	34.3	24.7	23.4	26.5	25.4
…sunflower	237.8	280.7	381.3	293.0	309.2	299.7	241.1	239.1	249.5	288.1	320.9
…soybeans	11.5	10.2	18.3	28.5	36.9	55.9	50.9	31.0	51.0	61.5	61.0
…tobacco	17.2	9.3	5.6	5.8	4.8	3.5	3.1	2.7	2.5	4.4	3.8
…grain rapeseed	1.0	1.0	1.0	0.9	2.4	7.1	41.3	53.5	67.4	48.9	53.8
…other industrial crops	5.8	4.2	2.0	4.1	4.9	4.7	6.0	4.9	7.2	10.4	12.2
Potatoes, vegetables and melons & gourds – total	**122.5**	**112.6**	**92.5**	**81.4**	**84.0**	**90.1**	**84.0**	**83.2**	**78.7**	**80.5**	**76.4**
…potatoes	43.0	45.1	38.6	34.8	36.7	34.8	35.8	31.3	28.5	28.0	29.7
…vegetables	69.6	58.7	43.7	38.2	39.8	44.4	39.7	41.7	37.0	40.6	37.4
…melons and gourds	7.5	6.5	8.7	7.3	5.2	9.1	7.1	8.8	11.9	10.6	8.2
…other	2.4	2.3	1.5	1.1	2.2	1.8	1.4	1.4	1.3	1.4	1.1
Forage crops – total	**102.3**	**99.3**	**112.1**	**89.3**	**89.9**	**89.6**	**102.4**	**78.1**	**79.5**	**86.8**	**79.7**
…forage roots	4.5	4.1	4.5	3.7	2.5	3.0	1.9	1.9	1.5	1.7	1.2
…maize for silo and green fodder	40.3	35.1	44.5	24.6	18.2	16.1	24.9	10.3	11.3	10.1	10.4
…perennial grasses for green fodder, silo and fodder	48.4	49.8	50.9	53.6	60.2	63.5	68.4	60.2	61.5	66.9	61.8
…annual grasses for green fodder	8.1	8.9	11.3	6.1	8.1	5.8	5.6	4.6	3.5	6.5	4.8
…other	0.6	1.1	0.9	1.2	0.9	1.1	1.6	1.1	1.7	1.6	1.4
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Sown areas – total	**1,653.5**	**1,686.3**	**1,694.3**	**1,693.8**	**1,715.1**	**1,735.8**	**1,749.2**	**1,724.0**	**1,709.7**	**1,767.9**	**1,794.0**
Cereals and leguminous crops – total	**1,037.3**	**1,080.0**	**1,055.1**	**1,065.3**	**1,074.2**	**1,050.7**	**1,095.4**	**1,074.7**	**1,050.9**	**1,102.3**	**1,081.7**
…wheat (winter and spring)	374.2	432.7	415.0	416.9	454.8	410.5	455.2	438.4	362.7	428.2	416.1
…winter rye	1.3	2.0	0.5	0.4	0.6	0.6	0.5	0.6	1.5	1.9	0.6
…barley (winter and spring)	114.1	126.9	120.9	104.8	101.4	96.9	77.9	63.3	63.2	80.0	66.9
…oat	2.3	2.6	2.1	1.7	1.4	1.7	1.3	1.0	1.6	1.6	1.0
…millet	0.2	0.1	0.1	0.1	0.9	0.1	0.1	0.1	0.1	0.2	0.2
…buckwheat	0.9	0.3	0.3	0.3	0.5	0.4	0.3	0.3	0.4	0.5	0.5
…leguminous crops	25.2	23.5	22.5	24.9	26.3	37.1	46.1	42.9	34.9	33.0	34.6
…grain maize	516.9	488.9	490.3	515.1	485.6	500.9	512.0	519.9	575.9	548.2	552.1
…grain sorghum	0.1	0.1	0.1	0.2	1.4	1.3	1.1	7.3	10.1	6.3	5.3
…other cereal crops	1.6	2.0	2.8	0.8	1.3	0.9	0.7	0.7	0.3	1.2	0.7
Industrial crops – total	**462.7**	**463.3**	**501.9**	**499.0**	**510.6**	**558.4**	**538.9**	**530.5**	**531.5**	**545.4**	**599.3**
…sugar beet	31.2	28.7	28.0	21.9	20.9	23.6	19.8	15.3	13.5	15.9	11.7
…sunflower	348.4	348.3	371.0	380.6	416.2	451.0	419.3	410.0	447.0	446.6	501.4
…soybeans	62.5	42.8	56.5	69.7	41.4	35.5	29.4	38.1	29.3	23.2	25.7
…tobacco	2.4	1.5	0.9	0.8	0.6	0.5	0.4	0.3	0.4	0.4	0.2
…grain rapeseed	8.2	36.0	38.2	13.3	22.4	36.1	58.2	53.6	29.9	45.9	46.9
…other industrial crops	10.0	5.9	7.2	12.5	9.0	11.8	11.8	12.9	11.1	13.0	13.1
Potatoes, vegetables and melons & gourds – total	**68.4**	**69.9**	**67.1**	**59.6**	**61.5**	**59.9**	**55.6**	**66.2**	**72.4**	**70.1**	**72.1**
…potatoes	25.1	24.1	23.1	22.5	20.9	19.9	19.2	18.7	23.2	22.7	23.3
…vegetables	34.9	37.0	35.5	29.4	30.5	31.0	30.4	39.4	42.2	40.3	40.6
…melons and gourds	7.3	7.8	7.3	6.7	7.9	7.8	5.5	7.4	6.3	6.5	7.3
…other	1.1	1.0	1.2	1.1	2.2	1.1	0.5	0.7	0.7	0.6	0.9
Forage crops – total	**85.1**	**73.2**	**70.0**	**69.9**	**68.6**	**66.7**	**59.3**	**52.5**	**54.8**	**50.0**	**41.4**
…forage roots	1.4	1.2	1.3	1.3	1.5	1.2	1.0	0.6	0.7	0.6	0.5
…maize for silo and green fodder	22.4	8.8	9.3	11.2	8.0	6.8	6.3	5.7	11.8	6.4	8.7
…perennial grasses for green fodder, silo and fodder	56.7	57.7	54.6	51.6	55.0	54.4	47.9	42.5	39.2	40.0	30.3
…annual grasses for green fodder	3.9	4.4	3.9	4.4	2.2	2.6	2.6	2.1	2.0	1.8	2.0
…other	0.7	1.1	0.9	1.4	1.8	1.7	1.6	1.6	1.0	1.2	0.6

Source: NBS on-line database, Section 'Sown Area, crops average yield and harvest within 1980-2022: <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks of ATULBD for: 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 97), 2011 (page 100), 2014 (page 94), 2019 (page 109), 2020 (page 112), 2021 (page 112).

Table 5-74: Average yield for main agricultural crops for the period 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cereals and leguminous crops	**2,538.6**	**3,105.9**	**2,099.8**	**3,340.2**	**1,753.8**	**2,638.6**	**1,981.2**	**3,512.3**	**2,751.9**	**2,375.0**	**2,070.2**
…wheat (winter and spring)	1,129.0	1,056.5	925.8	1,392.6	658.8	1,154.3	673.7	1,152.6	951.9	797.8	725.0
…winter rye	1.9	1.6	1.4	2.8	2.7	5.9	9.9	10.9	7.0	6.3	5.0
…barley (winter and spring)	417.9	427.0	405.0	481.0	324.9	311.2	136.7	256.9	242.2	203.1	152.3
…oat	3.8	5.0	6.8	10.7	7.1	9.8	4.2	10.3	9.5	5.9	3.5
…millet	0.1	0.1	0.0	0.1	0.1	0.3	0.2	0.5	0.1	0.0	0.1
…buckwheat	1.8	5.0	2.3	5.5	3.5	2.2	3.0	4.8	4.3	6.1	8.0
…leguminous crops	97.1	105.7	121.8	121.6	70.2	55.4	31.6	63.2	76.9	61.6	30.8
…grain maize	885.5	1,501.2	635.6	1,324.5	629.3	948.6	1,006.6	1,788.0	1,272.7	1,151.3	1,050.4
…grain sorghum	1.2	3.1	1.1	1.4	1.1	0.8	0.1	0.5	0.2	0.3	0.5
…other cereal crops	0.3	0.7	0.0	0.0	56.1	0.3	0.2	0.0	4.7	6.0	3.2
Industrial crops											
…sugar beet	2,374.5	1,988.6	1,783.4	2,048.3	1,526.7	1,877.9	1,682.1	1,674.8	1,356.8	956.4	982.5
…sunflower	252.2	151.4	176.2	173.7	149.2	208.1	284.0	174.3	196.4	291.6	305.1
…soybeans	23.8	33.4	7.9	9.3	4.0	3.3	2.5	2.7	6.0	13.7	11.6
…tobacco	66.2	62.8	42.4	50.2	41.5	27.1	19.8	23.9	24.6	22.6	26.3
…grain rapeseed	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.2	1.1
Potatoes, vegetables and melons & gourds											
…potatoes	295.3	290.6	310.8	726.0	474.7	385.3	344.3	392.6	372.5	330.6	330.4
…vegetables	1,177.3	989.2	787.5	777.2	598.5	568.8	362.4	393.6	570.8	535.8	396.1
…melons and gourds	34.4	35.6	9.3	18.6	12.6	23.3	23.3	30.4	25.9	33.9	31.7
Forage crops											
…forage roots	1,171.8	1,416.4	922.5	988.6	547.0	597.0	336.5	310.2	286.4	170.1	125.0
…maize for silo and green fodder	4,509.0	4,979.1	3,025.9	3,358.7	2,285.7	2,136.2	1,212.0	1,065.0	856.5	428.6	350.7
…perennial grasses for green fodder, silo and fodder	4,456.1	6,053.5	3,401.4	3,514.6	2,013.8	1,704.7	1,027.2	855.6	498.5	506.8	317.4
…annual grasses for green fodder	288.9	420.7	339.0	339.1	190.7	222.3	143.4	96.7	106.6	53.7	28.8
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Cereals and leguminous crops	**2,847.5**	**2,791.2**	**1,654.4**	**3,178.0**	**3,059.9**	**2,371.2**	**932.5**	**3,261.6**	**2,375.5**	**2,674.3**	**2,794.6**
…wheat (winter and spring)	1,180.8	1,113.1	102.4	861.2	1,048.6	682.3	406.5	1,286.5	738.9	749.5	797.1
…winter rye	9.3	5.9	0.8	5.1	6.1	1.1	0.8	2.0	3.4	2.4	1.0
…barley (winter and spring)	248.4	241.7	74.4	284.1	240.9	214.6	125.7	362.3	290.5	240.7	218.9
…oat	6.4	4.7	4.0	10.3	7.6	6.1	1.4	3.9	1.6	3.1	3.6
…millet	0.0	0.1	0.1	0.3	0.2	0.0	0.1	0.5	0.7	0.3	0.1
…buckwheat	6.4	1.4	1.6	1.2	1.1	0.5	0.4	0.5	0.6	0.5	0.5
…leguminous crops	79.1	50.2	30.2	51.0	67.1	68.4	14.4	38.0	32.0	40.1	33.1
…grain maize	1,141.9	1,206.3	1,440.2	1,845.1	1,523.4	1,327.6	363.2	1,484.1	1,159.6	1,462.1	1,547.2
…grain sorghum	1.1	0.5	4.4	3.4	0.3	0.5	0.1	0.1	0.2	0.2	0.1
…other cereal crops	5.7	4.2	0.7	3.7	12.3	15.2	1.1	8.1	5.3	7.7	4.8
Industrial crops											
…sugar beet	1,120.6	1,157.4	660.3	911.3	996.2	1,177.3	612.3	960.7	337.4	837.6	588.6
…sunflower	278.3	340.9	421.4	354.8	368.7	396.1	158.7	387.2	310.2	440.2	497.4
…soybeans	10.5	12.6	19.4	40.2	66.4	80.2	40.0	58.8	50.1	113.0	80.6
…tobacco	16.3	12.4	7.2	7.9	6.7	4.9	3.6	3.9	4.4	7.6	5.4
…grain rapeseed	1.0	1.0	1.2	1.1	3.4	6.9	34.9	100.1	81.6	51.0	67.7
Potatoes, vegetables and melons & gourds											
…potatoes	388.6	326.0	303.2	321.8	391.1	384.1	200.9	273.7	264.8	286.7	362.9
…vegetables	487.4	408.4	371.7	328.7	410.3	490.6	226.6	389.4	322.8	365.8	396.0
…melons and gourds	39.3	29.0	72.7	57.3	49.3	92.6	41.2	69.9	102.4	104.9	85.2
Forage crops											
…forage roots	63.5	67.9	55.7	52.7	41.6	34.9	13.8	26.4	20.0	31.7	23.2
…maize for silo and green fodder	316.4	322.8	327.9	219.4	199.6	153.3	104.6	113.0	106.4	143.8	125.2
…perennial grasses for green fodder, silo and fodder	201.5	173.4	145.4	206.7	183.8	194.9	177.0	364.2	213.4	323.9	238.5
…annual grasses for green fodder	19.3	16.0	12.6	12.6	16.3	13.6	7.4	15.3	7.9	10.9	11.3

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Cereals and leguminous crops	**1,359.0**	**3,130.0**	**3,341.0**	**2,587.0**	**3,531.7**	**3,813.4**	**3,946.8**	**4,020.6**	**1,638.9**	**5,366.8**	**2,021.2**
…wheat (winter and spring)	496.9	1,009.6	1,102.6	927.4	1,302.4	1,258.6	1,169.1	1,152.3	655.2	1,956.5	1,058.6
…winter rye	2.6	5.7	1.4	1.0	1.8	2.3	1.7	1.9	3.0	5.9	2.4
…barley (winter and spring)	139.3	241.6	244.7	199.1	273.9	265.0	188.2	178.2	118.4	307.5	160.2
…oat	2.0	3.8	2.9	1.6	2.8	3.6	1.5	1.6	1.7	2.7	1.8
…millet	0.1	0.1	0.2	0.2	1.1	0.1	0.1	0.2	0.0	0.7	0.1
…buckwheat	0.3	0.4	0.4	0.2	0.9	0.7	0.3	0.4	0.6	0.4	0.3
…leguminous crops	17.3	24.1	32.9	25.1	45.1	75.2	51.5	56.6	29.3	42.9	29.1
…grain maize	587.2	1,546.5	1,642.1	1,133.6	1,485.5	1,871.0	2,208.0	2,263.7	821.2	3,008.4	810.3
…grain sorghum	0.1	0.4	0.3	0.2	5.1	4.5	4.6	48.9	12.5	29.3	13.9
…other cereal crops	2.1	5.4	8.3	2.8	4.4	4.5	2.2	1.7	0.7	1.7	2.7
Industrial crops											
…sugar beet	587.0	1,009.0	1,356.2	537.5	664.8	876.3	707.2	607.0	423.2	757.8	478.2
…sunflower	339.1	602.2	627.1	562.3	789.4	925.1	898.7	915.3	547.3	1,084.0	730.1
…soybeans	48.9	67.6	111.4	49.2	43.8	48.5	59.7	64.8	33.4	51.4	33.0
…tobacco	2.9	2.2	1.4	1.2	0.9	1.0	0.7	0.5	0.4	0.5	0.1
…grain rapeseed	8.1	58.8	90.2	25.6	52.4	89.9	120.8	110.2	56.3	119.9	109.2
Potatoes, vegetables and melons & gourds											
…potatoes	191.5	244.0	275.7	163.8	220.3	201.7	177.7	181.8	179.5	226.3	178.1
…vegetables	251.9	319.1	352.3	266.9	320.6	340.9	301.2	339.4	259.8	251.4	276.4
…melons and gourds	52.6	56.6	48.3	56.7	69.3	59.6	49.1	47.0	30.3	44.3	30.3
Forage crops											
…forage roots	10.6	22.2	26.1	14.6	21.0	21.4	19.8	18.2	3.5	2.7	2.4
…maize for silo and green fodder	110.8	166.6	135.7	91.7	139.6	111.7	133.8	116.2	116.6	170.8	90.8
…perennial grasses for green fodder, silo and fodder	116.6	239.3	304.7	136.0	209.6	199.2	203.8	177.3	137.1	215.0	123.6
…annual grasses for green fodder	8.1	15.5	16.9	12.4	13.3	13.2	12.0	16.8	21.7	16.3	9.7

Source: NBS on-line database, Section 'Sown Area, crop average yield and harvest within 1980-2022', <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks ATULBD for 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 98), 2011 (page 101), 2014 (page 95), 2019 (page 110), 2020 (page 113), 2021 (page 113).

Table 5-75: Average yield per hectare for agricultural crops over the period 1990-2022, t/ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cereals and leguminous crops	**3.4**	**3.7**	**2.8**	**3.7**	**2.1**	**2.9**	**2.2**	**3.3**	**2.6**	**2.3**	**1.9**
…wheat (winter and spring)	3.9	3.5	3.3	4.0	2.2	2.9	1.8	2.8	2.3	2.0	1.7
…winter rye	2.1	2.0	2.0	2.6	1.6	2.2	2.1	2.8	1.9	1.6	1.3
…barley (winter and spring)	3.5	3.2	3.3	3.5	2.2	2.3	1.3	2.0	1.8	1.6	1.2
…oat	1.8	1.7	2.3	2.7	1.4	1.7	1.1	1.6	1.6	1.2	0.8
…millet	1.0	1.0	0.4	1.0	0.6	1.4	0.7	1.6	0.4	0.1	0.2
…buckwheat	0.5	0.8	0.3	0.8	0.4	0.4	0.4	0.7	0.4	0.4	0.7
…leguminous crops	1.3	1.4	1.7	1.7	1.1	1.0	0.7	1.4	1.3	1.0	0.6
…grain maize	3.4	4.8	2.5	3.9	2.2	3.0	2.9	4.0	3.1	2.8	2.3
…grain sorghum	1.9	2.6	0.9	1.1	0.9	0.7	0.4	1.2	0.8	2.6	1.2
…other cereal crops	1.7	1.6	1.3	1.8	2.8	1.7	1.3	2.0	1.7	1.9	1.2
Industrial crops											
…sugar beet	29.1	24.9	21.6	24.7	18.4	20.8	20.0	22.0	17.8	14.6	14.8
…sunflower	1.9	1.2	1.3	1.4	1.1	1.3	1.3	0.9	0.8	1.2	1.2
…soybeans	0.9	1.4	0.5	1.0	0.7	0.9	1.1	1.2	0.9	0.8	1.0
…tobacco	2.1	1.9	1.5	1.6	1.5	1.3	1.2	1.4	1.1	1.2	1.1
…grain rapeseed	2.0	2.0	1.6	1.2	1.0	0.8	0.7	1.0	0.9	1.2	1.0
Potatoes, vegetables and melons & gourds											
…potatoes	7.2	6.2	5.6	10.2	7.6	6.8	5.8	6.3	6.0	5.0	5.1
…vegetables	16.6	12.7	10.7	10.6	8.8	7.7	5.9	6.2	9.7	9.5	7.0
…melons and gourds	3.7	4.5	1.3	3.1	2.5	3.1	3.5	3.8	5.0	5.7	4.0
Forage crops											
…forage roots	44.4	47.2	31.8	35.3	22.8	24.4	19.1	19.0	18.5	11.9	10.9
…maize for silo and green fodder	15.4	24.9	10.1	15.6	8.6	11.9	6.7	10.8	8.8	6.8	7.1
…perennial grasses for green fodder, silo and fodder	21.6	29.5	18.6	20.1	12.8	11.8	8.3	8.3	6.6	8.7	6.0
…annual grasses for green fodder	9.2	15.7	9.7	11.1	5.5	9.0	6.5	7.2	7.8	5.4	5.0

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Cereals and leguminous crops	**2.4**	**2.4**	**1.8**	**2.8**	**2.7**	**2.5**	**0.9**	**3.2**	**2.3**	**2.6**	**2.8**
…wheat (winter and spring)	2.4	2.2	0.5	2.5	2.3	2.2	1.2	3.0	1.9	2.0	2.3
…winter rye	1.7	1.6	0.6	2.0	1.9	1.6	1.1	1.9	1.8	1.5	1.8
…barley (winter and spring)	2.2	1.8	0.8	2.0	1.6	1.7	0.9	2.6	1.6	1.5	1.7
…oat	1.3	1.1	0.9	1.7	1.2	1.3	0.3	1.4	0.7	1.0	1.6
…millet	0.8	0.5	0.5	0.7	0.9	0.5	0.1	1.7	2.4	0.5	0.7
…buckwheat	0.5	0.3	0.3	0.3	0.4	0.1	0.3	0.6	0.6	3.2	0.8
…leguminous crops	1.5	0.8	0.6	1.3	1.6	1.6	0.4	1.3	0.9	1.0	1.1
…grain maize	2.3	2.7	2.5	3.1	3.2	2.9	0.8	3.5	2.8	3.4	3.3
…grain sorghum	1.1	1.0	1.4	0.9	0.4	1.3	0.4	0.5	0.9	0.9	0.7
…other cereal crops	1.6	1.5	1.3	1.3	1.4	1.3	0.7	2.5	1.5	1.6	1.9
Industrial crops											
…sugar beet	17.7	22.3	16.6	26.1	29.0	27.8	17.9	38.9	14.4	31.6	23.2
…sunflower	1.2	1.2	1.1	1.2	1.2	1.3	0.7	1.6	1.2	1.5	1.6
…soybeans	0.9	1.2	1.1	1.4	1.8	1.4	0.8	1.9	1.0	1.8	1.3
…tobacco	0.9	1.3	1.3	1.4	1.4	1.4	1.2	1.4	1.8	1.7	1.4
…grain rapeseed	1.0	1.0	1.0	1.2	1.4	1.0	0.8	1.9	1.2	1.0	1.3
Potatoes, vegetables and melons & gourds											
…potatoes	9.0	7.2	7.9	9.2	10.6	11.0	5.6	8.7	9.3	10.2	12.2
…vegetables	7.0	7.0	8.5	8.6	10.3	11.0	5.7	9.3	8.7	9.0	10.6
…melons and gourds	5.2	4.5	8.4	7.8	9.4	10.2	5.8	7.9	8.6	9.9	10.4
Forage crops											
…forage roots	14.0	16.6	12.3	14.2	16.4	11.6	7.4	14.1	13.7	18.5	19.0
…maize for silo and green fodder	7.8	9.2	7.4	8.9	11.0	9.6	4.2	11.0	9.4	14.2	12.0
…perennial grasses for green fodder, silo and fodder	4.2	3.5	2.9	3.9	3.1	3.1	2.6	6.0	3.5	4.8	3.9
…annual grasses for green fodder	9.5	6.4	3.3	5.8	6.5	6.4	3.1	8.6	6.9	5.4	6.5
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Cereals and leguminous crops	**1.3**	**2.9**	**3.2**	**2.4**	**3.3**	**3.6**	**3.6**	**3.7**	**1.6**	**4.9**	**1.9**
…wheat (winter and spring)	1.3	2.3	2.7	2.8	3.7	3.8	3.2	3.3	1.8	4.6	2.5
…winter rye	2.0	2.8	2.8	2.3	2.9	3.6	3.3	3.1	1.9	3.0	1.9
…barley (winter and spring)	1.2	1.9	2.0	2.3	3.2	3.1	2.7	3.1	1.9	3.8	2.4
…oat	0.9	1.5	1.4	1.0	2.3	2.2	1.2	1.7	1.1	1.7	1.9
…millet	0.6	1.8	2.4	1.3	1.2	1.0	1.5	2.0	0.4	3.0	0.5
…buckwheat	0.3	1.3	1.5	0.9	1.9	1.6	1.0	1.3	1.6	0.9	0.6
…leguminous crops	0.7	1.0	1.5	1.0	1.7	2.0	1.1	1.3	0.8	1.3	0.8
…grain maize	1.1	3.2	3.3	2.2	3.1	3.7	4.3	4.4	1.4	5.5	1.5
…grain sorghum	0.5	3.0	2.8	0.9	3.7	3.8	4.0	6.7	2.0	4.7	2.9
…other cereal crops	1.3	2.1	1.1	1.5	2.0	2.7	3.3	2.6	1.2	3.4	2.0
Industrial crops											
…sugar beet	18.8	35.2	48.4	24.5	31.8	37.1	35.7	39.7	31.3	47.7	40.9
…sunflower	1.0	1.7	1.7	1.5	1.9	2.1	2.1	2.2	1.2	2.4	1.5
…soybeans	0.8	1.6	2.0	0.7	1.1	1.4	2.0	1.7	1.1	2.2	1.3
…tobacco	1.2	1.5	1.6	1.5	1.5	2.0	1.8	1.7	1.0	1.3	0.5
…grain rapeseed	1.0	1.6	2.4	1.9	2.3	2.5	2.1	2.1	1.9	2.6	2.3
Potatoes, vegetables and melons & gourds											
…potatoes	7.6	10.1	11.9	7.3	10.5	10.1	9.3	9.7	7.8	10.0	7.7
…vegetables	7.2	8.6	9.9	9.1	10.5	11.0	9.9	8.6	6.2	6.2	6.8
…melons and gourds	7.2	7.3	6.6	8.5	8.8	7.6	8.9	6.3	4.8	6.8	4.1
Forage crops											
…forage roots	7.4	18.5	20.1	11.2	14.0	17.8	19.8	30.2	5.0	4.5	4.8
…maize for silo and green fodder	5.0	19.0	14.5	8.2	17.4	16.4	21.3	20.3	9.8	26.7	10.4
…perennial grasses for green fodder, silo and fodder	1.7	3.4	5.0	2.6	3.8	3.7	4.3	4.2	3.5	5.4	4.1
…annual grasses for green fodder	4.5	5.3	8.2	4.9	4.7	4.3	3.3	5.3	3.5	3.6	3.7

Source: NBS on-line database, Section 'Sown Area, crop average yield and harvest, 1980-2020': <http://statbank.statistica.md/pxweb/Database/RO/16%20AGR/AGR02/AGR02.asp>; Statistical Yearbooks of ATULBD for 1998 (page 218), 2002 (page 113), 2005 (page 101), 2009 (page 99), 2011 (page 102), 2014 (page 96), 2019 (page 112), 2020 (page 115), 2021 (page 115).

Based on the coefficients provided in Tables 5-71 and 5-72, and based on the activity data in Tables 5-73, 5-74 and 5-75, respectively, the total amount of nitrogen in crop residues returned to soils was calculated. The results allow us to assert that the total amount of nitrogen in crop residues returned to soils decreased by 30.6% in the Republic of Moldova between 1990 and 2022 (Table 5-76).

Table 5-76: Amount of nitrogen in crop residues returned to soils between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
$F_{(CR)}$	34.80	39.17	26.30	31.55	14.98	21.64	11.79	20.94	17.92	17.45	9.55
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
$F_{(CR)}$	17.22	17.59	8.25	19.98	20.05	19.49	5.12	21.03	15.64	21.28	21.25
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
$F_{(CR)}$	6.38	23.25	26.03	9.21	25.81	30.40	30.73	31.87	7.60	48.25	24.13

Very modest results in 1992, 1996, 2000, 2003, 2007, 2012, 2015 and 2020 are explained by the severe droughts that were recorded in the RoM and which induced a drastic reduction of agricultural crops.

It should be noted that implementation of activities aimed at reasonable distribution of soil resources depending on the volume and nature of agricultural production, the recommended crop structure (Figure 5-4) will permit the production of the necessary amount of cereal required to ensure food security for the population, fodder for the animal breeding sector, industrial and leguminous crops to meet the needs of the population and processing industry. At the same time, this structure will permit the use of soil protective crop rotation, contributing to stabilizing the humus balance in soil and soil fertility conservation.

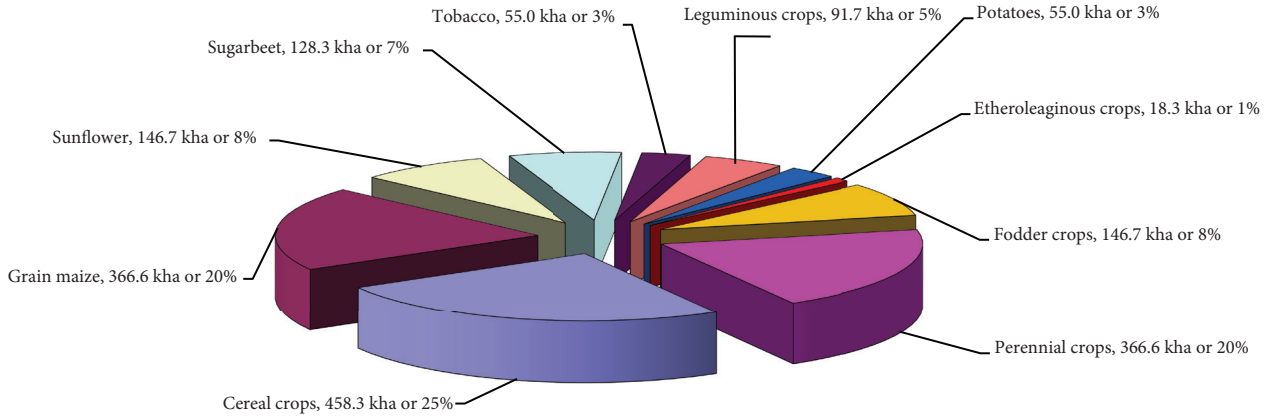


Figure 5-4: Recommended crop structure on agricultural lands[114].

Uncertainties and Time-Series Consistency

Uncertainties associated with activity data on areas sown with crops and average yield per hectare for the main crops in the RoM are considered to have decreased to circa 5%. Uncertainties associated with coefficients used to calculate the amount of nitrogen in agricultural crop residues returned to soils are moderate and were estimated to be circa 25%. Uncertainties associated with the default emission factor (EF_1 for F_{CR}) may reach circa 6%. Thus, combined uncertainties associated with N_2O emissions from crop residues may reach circa 25.50%. In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for Sector 3 'Agriculture' following the Tier 1 methodological approach. It should be noted that the AD and methods used in the estimation of N_2O emissions from crop residues returned to soil under this category were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied. Following the recommendations included in the 2006 IPCC Guidelines, N_2O emissions from crop residues returned to soil were estimated using AD from official reference sources.

[114] Buza, Vasile et al. (2007), Disaster Risks Management in the Republic of Moldova, National Agency for Rural Development in the RM, FAO, Chisinau, 2007, page 104.

Recalculations

Direct N_2O_{CR} emissions from source category 3D.1.d 'Crop Residues Returned to Soil' have been re-calculated for the years 1990-2020 because of the change in the value of the GWP_{100}. Thus, the value available in the IPCC AR5 (2014) (GWP_{100} – 265) was used instead of the value available in the IPCC AR4 (2007) (GWP_{100} – 298). Compared to the emission values recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend in direct N_2O_{CR} emissions from category 3D.1d 'Crop Residues Returned to Soils' between 1990-2020 (Table 5-78).

Table 5-77: Recalculations of direct N_2O_{CR} emissions from source category 3D.1d 'Crop Residues Returned to Soils', included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	0.55	0.62	0.41	0.50	0.24	0.34	0.19	0.33	0.28	0.27	0.15
BTR1	0.55	0.62	0.41	0.50	0.24	0.34	0.19	0.33	0.28	0.27	0.15
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.27	0.28	0.13	0.31	0.32	0.31	0.08	0.33	0.25	0.33	0.33
BTR1	0.27	0.28	0.13	0.31	0.32	0.31	0.08	0.33	0.25	0.33	0.33
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.10	0.37	0.41	0.14	0.41	0.48	0.48	0.49	0.12		
BTR1	0.10	0.37	0.41	0.14	0.41	0.48	0.48	0.49	0.12	0.76	0.38
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

Table 5-78: Recalculations of N_2O_{CR} emissions from source category 3D.1.d 'Crop Residues Returned to Soils', included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	162.96	183.45	123.15	147.72	70.13	101.34	55.19	98.05	83.91	81.73	44.71
BTR1	144.91	163.13	109.51	131.36	62.37	90.12	49.08	87.19	74.62	72.68	39.76
Difference, %	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	80.62	82.38	38.64	93.58	93.89	91.29	23.97	98.49	73.24	99.64	99.53
BTR1	71.69	73.26	34.36	83.22	83.49	81.18	21.32	87.58	65.13	88.60	88.51
Difference, %	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	29.90	108.88	121.90	43.14	120.85	142.35	143.91	146.30	35.59		
BTR1	26.59	96.83	108.40	38.37	107.47	126.59	127.97	130.10	31.65	200.93	100.50
Difference, %	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

For years 2021 and 2022, direct N_2O_{CR} emissions from category 3D.1d 'Crop Residues Returned to Soils' have been estimated for the first time. The results obtained show that between 1990-2022 direct N_2O_{CR} emissions from crop residues returned to soil had decreased by circa 30.6%.

During the period under review, the areas sown with the following crops have increased substantially: sunflower (by 274%), grain maize (by 114%), winter and spring wheat (by 45%) and grain sorghum (by 342%); at the same time, there was also a reduction in average production per hectare for several crops, such as forage roots (by 89%), perennial grasses for green fodder, silo and fodder (by 81%), tobacco (by 76%), vegetables (by 59%), maize (by 57%), leguminous crops (by 37%), wheat (by 35%), maize for silo and green fodder (by 32%), barley (by 31%) and sunflower (by 23%), the impact of which also influenced the downward trend in N_2O emissions from crop residues returned to soil.

Planned Improvements

Planned improvements could include activities focused on specifying country specific coefficients used in the estimation of direct N_2O emissions from crop residues returned to soils in the RoM.

5.4.1.5. Nitrogen Mineralization Associated with Loss of Soil Organic Matter

Source Category Description

The change in land-use and management practices may have a significant impact on soil organic carbon storage. Organic carbon and nitrogen are closely linked in soil organic matter (humus). Where soil carbon is lost through oxidation as a result of land-use or management practice change, this loss will be accompanied by a simultaneous mineralization of nitrogen (biochemical decomposition). Where a loss of soil carbon occurs, this mineralized nitrogen is regarded as an additional source of nitrogen available for conversion into N_2O emissions.

Methodologies, Emission Factors and Activity Data

N_2O emissions from nitrogen mineralization associated with loss of soil organic matter as a result of land-use or management change and soil management practices were estimated by using the Tier 1 methodology (2006 IPCC Guidelines).

In order to calculate emissions from nitrogen mineralization associated with loss of soil organic matter (N_2O_{SOM}), a simplified version of Equation 11.2 available in the 2006 IPCC Guidelines was used:

$$N_2O_{SOM} = F_{SOM} \bullet EF_1 \bullet 44/28$$

Where:

EF_1 – emission factor, 0.01 kg N_2O-N/kg N applied (range: 0.003-0.03 kg N_2O-N/kg N);

[44/28] – mass ratio between the content of nitrogen in N_2O-N and N_2O;

F_{SOM} – the net annual amount of N mineralized in mineral soils as a result of loss of soil carbon through change in land-use or management (t N/yr).

$F_{(SOM)}$ values were estimated using Equation 11.8 in the 2006 IPCC Guidelines:

$$F_{SOM} = \Sigma [(\Delta C_{mineral} \bullet 1/R)]$$

Where:

R – carbon and nitrogen ratio in the soil organic matter (R = C : N); according to the 2006 IPCC Guidelines, the default value of 10 (range: 8-15) is used for arable soils; according to the national scientific sources (Krupenikov, Ganenko, 1984), the C : N ratio in the soil organic matter in the Republic of Moldova is around 10.7 (range: 10.1-11.3);

$\Delta C_{Mineral}$ – annual change in carbon stocks in mineral soils, (t C/yr) (Table 5-78) was estimated using the Tier 2 methodology available in the 2006 IPCC Guidelines.

In order to calculate the annual changes in carbon stocks in mineral soils, equation 2.25 in the 2006 IPCC Guidelines was used (Volume 4, Chapter 2, page 2.30):

$$\Delta C_{Mineral} = (SOC_0 - SOC_{(0\text{-}T)}) / D$$

Where:

$\Delta C_{mineral}$ – annual change in carbon stocks in mineral soils, tonnes C/yr;

SOC_0 – soil organic carbon stock in the last year of an inventory time period, tonnes C;

$SOC_{(0\text{-}T)}$ – soil organic carbon stock at the beginning of the inventory time period, tonnes C;

D – the interval of years corresponding to the change in carbon reserves in mineral soils (T is used in this equation if T ≥ 20 years, where T is the number of years in an inventory cycle).

The following aspects were taken into consideration in the process of assessing annual change in organic carbon stocks in mineral soils in the RoM:

- the agricultural practices applied on arable lands of the RoM and the pedo-climatic conditions allow the highlighting of a single agricultural area of land-use (mineral soils are quite homogeneous in the country, represented mainly by chernozems); significant changes in tillage technologies over the period 1990-2022 had not occurred: the entire arable area of the country is dominated by autumn ploughing; since 1990, the amounts of carbon removals in arable soils decreased significantly, particularly due to the gradual reduction in both the amounts of organic fertilizers applied to soil and the amounts of crop residues returned to soil (including as a result of the significant decrease in main crop yields);

- information on the evolution of organic carbon stocks in arable land has been identified in the national scientific literature; according to the reference sources consulted, soils in the RoM, exploited intensively for circa 150 years, have meanwhile lost circa 45-50% of the accumulated carbon: the content of humus in arable land in 1877 (layer – 0-30 cm, apparent density – 1.19 g/cm^3) in the northern part of the country (Napadova commune, Floresti district) constituted 5.72% (204.2 tonnes of humus/ha or 118.4 tonnes of C/ha); in 1960, the content of humus in the same soil constituted 3.6% (152.3 tonnes of humus/ha or 88.3 tonnes of C/ha); and in 2007 – 3.18% (134.5 tonnes of humus/ha or 78.0 tonnes C/ha);
- in the same context, according to other publications in the scientific literature, by direct measurements performed on leached chernozem located in the northern part of the country, it was established that in circa 60 years of exploitation, the soil lost circa 37% of accumulated carbon, and the average annual rates constituted 300 kg C/ha/year (Moldavian Soils, Volume 1, 1989); according to the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection, in their long-term experiences (circa 40 years) in the main pedo-climatic areas of the country, located on subtypes of chernozems that dominate in the soil cover, it was established that the annual rates of carbon loss are very close to the area and subtype of chernozem, constituting circa 325 kg C/ha/year (Bulletin of Ecopedological Monitoring, 7th Edition, 2000); rates with very close values were established in the oldest long-term experiences in the RoM on carbonated chernozem organised by the State Agrarian University of Moldova in Chetrosu commune, Anenii Noi district (Zagorcha, 1990); values between 300-330 kg C/ha/year regarding carbon losses from soils in agricultural soils have been established by other researchers (Ungureanu et al., 1997; Andries, 1999; Banaru, 2001;
- organic carbon stocks in soil in the first year of inventory ($SOC_{(0-T)}$) were identified in the 'Soil Quality Monitoring of the Republic of Moldova (database, conclusions, forecasts, recommendations)' (2010); according to this publication, the humus content in arable soils in 1990 (layer 0-30 cm, apparent density – 1.41 g/cm^3) in the northern part of the country constituted circa 3.46% (146.1 tonnes of humus/ha or 84.8 tonnes of C/ha); at the same time, in the southern part of the RoM (Lebedenco commune, Cahul district), the humus content in arable soils (layer – 0-30 cm, apparent density – 1.37 g/cm^3) constituted circa 3.25% (133.6 tonnes of humus/ha or 77.5 tonnes of C/ha); in these circumstances, the national average ($SOC/_{(0-T)}$) constituted 139.8 tonnes of humus/ha or circa 81.1 tonnes C/ha;
- organic carbon stocks in soils in the last year of the inventory cycle (SOC_0) were identified in the scientific literature; according to specialists from the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection, the humus content in arable soils in 2022 (layer – 0-30 cm, apparent density – 1.41 g/cm^3) in the northern part of the country (Napadova commune, Floresti district) constituted circa 3.02% (127.8 tonnes of humus/ha or 74.1 tonnes of C/ha); at the same time, in the southern part of the country (Lebedenco commune, Cahul district), the humus content in arable soils (layer – 0-30 cm, apparent density – 1.37 g/cm^3) constituted in that year circa 2.89% (118.8 tonnes of humus/ha or 68.9 tonnes of C/ha), the national average (SOC_0) being circa 123.2 tonnes of humus/ha or circa 71.5 tonnes of C/ha, which corresponds to average annual losses per country of circa 310 kg C/ha/year between 1990 and 2022.

The annual changes in the carbon stocks in mineral soils were calculated based on the respective activity data (Table 5-79).

Table 5-79: Annual loss of soil carbon in the RoM between 1990-2022, kt C

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
$\Delta C_{mineral}$, kt C	-537.07	-532.08	-530.25	-551.45	-531.62	-534.70	-532.21	-534.97	-532.27	-515.60	-527.25
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
$\Delta C_{mineral}$, kt C	-537.18	-538.03	-493.69	-521.39	-526.24	-479.37	-481.07	-480.96	-493.65	-504.55	-495.00
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
$\Delta C_{mineral}$, kt C	-512.42	-522.57	-525.04	-524.90	-531.48	-537.90	-542.06	-534.24	-529.83	-547.85	-555.95

The obtained results show the rates in which changes of carbon stocks in mineral soils occur over the period 1990-2022, equal to circa 309.9 kg C/ha/year. This value is close to the results previously obtained by different authors from the Republic of Moldova in long-term experiences (Zagorcha, 1990; Ungureanu et al., 1997; Andries, 1999; Banaru, 2001; Cerbari, 2010, 2012).

The obtained results on the calculation of the total amount of mineralized nitrogen (F_{SOM}) associated with the loss of carbon stocks in mineral soils are provided in Table 5-80.

Table 5-80: Amount of mineralized nitrogen in mineral soils as a result of loss of soil carbon in the Republic of Moldova between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
F_{SOM}	50.19	49.73	49.56	51.54	49.68	49.97	49.74	50.00	49.74	48.19	49.28
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
F_{SOM}	50.20	50.28	46.14	48.73	49.18	44.80	44.96	44.95	46.14	47.15	46.26
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
F_{SOM}	47.89	48.84	49.07	49.06	49.67	50.27	50.66	49.93	49.52	51.20	51.96

Uncertainties and Time-Series Consistency

Uncertainties associated with activity data on areas of arable lands in the Republic of Moldova are considered low, up to circa 5%. Uncertainties associated with coefficients used in the estimation of N_2O emissions from nitrogen mineralization as a result of loss of soil carbon resulting from land-use or management change were estimated to be circa 25%, whereas uncertainties associated with the default emission factor (EF_1 for F_{SOM}) may reach circa 6%. Combined uncertainties associated with direct N_2O emissions from this emission source are considered average (circa 25.50%).

In view of ensuring time-series consistency of the obtained results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective source category in Sector 3 'Agriculture' following the Tier 1 methodological approach.

It should be noted that the AD and methods used in the estimation of N_2O emissions from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management change in the Republic of Moldova were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process related errors, AD and EF verifications and quality control procedures were applied.

Following the recommendations included in 2006 IPCC Guidelines, N_2O emissions from nitrogen mineralization associated with loss of soil carbon as a result of land-use or management change in the Republic of Moldova were estimated based on AD from official reference sources.

Recalculations

Direct N_2O_{CR} emissions from source category 3D.1.e 'Nitrogen Mineralization Associated with Loss of Soil Organic Matter' have been recalculated for the years 1990-2020 because of the change in the value of the GWP_{100}. Thus, the value available in the IPCC AR5 (2014) (GWP_{100} – 265) was used instead of the value available in the IPCC AR4 (2007) (GWP_{100} – 298). In comparison with the results recorded in the in the NC5 of the RoM to the UNFCCC (2023), the changes made have resulted in a 11.1% reduction in direct N_2O_{SOM} emissions from source category 3D.1.e 'Nitrogen Mineralization Associated with Loss of Soil Organic Matter' from agricultural soils between 1990 and 2020 (Table 5-82).

Table 5-81: N_2O_{SOM} emissions from category 3D.1.e 'Nitrogen Mineralization Associated with Loss of Soil Organic Matter', kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	0.79	0.78	0.78	0.81	0.78	0.79	0.78	0.79	0.78	0.76	0.77
BTR1	0.79	0.78	0.78	0.81	0.78	0.79	0.78	0.79	0.78	0.76	0.77
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.79	0.79	0.73	0.77	0.77	0.70	0.71	0.71	0.72	0.74	0.73
BTR1	0.79	0.79	0.73	0.77	0.77	0.70	0.71	0.71	0.72	0.74	0.73
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.75	0.77	0.77	0.77	0.78	0.79	0.80	0.78	0.78		
BTR1	0.75	0.77	0.77	0.77	0.78	0.79	0.80	0.78	0.78	0.80	0.82
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

Table 5-82: Recalculations of direct N_2O_{SOM} emissions from source category 3D.1.e 'Nitrogen Mineralization Associated with Loss of Soil Organic Matter', included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	235.05	232.87	232.07	241.34	232.66	234.01	232.92	234.13	232.95	225.65	230.75
BTR1	209.02	207.08	206.37	214.62	206.90	208.10	207.13	208.20	207.15	200.66	205.20
Difference, %	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	235.09	235.47	216.06	228.19	230.31	209.80	210.54	210.49	216.05	220.82	216.64
BTR1	209.06	209.39	192.14	202.92	204.80	186.56	187.23	187.18	192.12	196.36	192.65
Difference, %	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	224.26	228.70	229.79	229.72	232.60	235.41	237.23	233.81	231.88		
BTR1	199.42	203.38	204.34	204.28	206.84	209.34	210.96	207.92	206.20	213.21	216.37
Difference, %	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

For 2021 and 2022, direct N_2O_{SOM} emissions have been estimated for the first time. The results obtained show that direct N_2O_{SOM} emissions from nitrogen mineralization because of loss of carbon in agricultural land had increased by circa 3.5% between 1990 and 2022.

Planned Improvements

Planned improvements could include activities focused on updating country-specific coefficients used in the estimation of direct N_2O emissions from nitrogen mineralization associated with loss of soil carbon because of land-use or management change in the RoM. It is thereby necessary to establish the values of humus content in arable soils at least once every three years (layer – 0-30 cm) in the northern part of the country (Napadova commune, Floresti district), and in the southern part of the country, respectively (Lebedenco commune, Cahul district) in order to identify the national average (SOC_0) and the average annual losses in the RoM during the reporting period to the UNFCCC.

5.4.2. Indirect N_2O Emissions from Managed Soils

In addition to direct N_2O emissions from managed soils which occur through a direct pathway (i.e., directly from the soils to which nitrogen is applied), N_2O emissions also take place through two indirect pathways.

The first is the volatilization of nitrogen as NH_3 or nitrogen oxides (NO_x), and the deposition of these gases and their products (NH_4^+ and NO_3^-) into soils and the surface of lakes, rivers and other waters. Sources of nitrogen in the form of ammonia (NH_3) and nitrogen oxides (NO_x) originate not only from the application of organic and synthetic fertilizers to soil, but also from other activities of anthropogenic origin, such as: fossil fuel combustion, biomass burning, and some industrial processes. These processes thereby cause N_2O emissions analogous to those resulting from the deposition of agriculturally derived NH_3 and NO_x, following the application of synthetic, and organic nitrogen fertilizers and/or urine and dung deposition from grazing animals.

The second pathway is nitrogen leaching and runoff in soil (from the application of synthetic and organic fertilizer, animal dung and urine, crop residues, mineralization of nitrogen associated with loss of soil carbon in mineral soils through land-use or management change). Some of the inorganic nitrogen in or on the soil, mainly in the form of NO_3^-, may bypass biological retention mechanisms in the soil/vegetation system by transport in overland water flow (runoff) and/or flow through soil macropores or pipe drains. Should NO_3^- be present in the soil in excess of biological demand, e.g., under cattle urine patches, the excess leaches through the soil. The nitrification and denitrification microbial processes transform some of the NH_4^+ and NO_3^- into N_2O. This may take place in the groundwater where nitrogen ends up, or in riverside areas receiving drain or runoff water, such as canals, rivers and estuaries into which the land drainage water eventually flows.

5.4.2.1. Atmospheric Deposition of Nitrogen Volatilized from Managed Soils (NO_x and NH_4)

Source Category Description

Atmospheric deposition of nitrogen oxides (NO_x^-) and ammonia (NH_4^+) induce soil and surface water fertilization, resulting in biogenic formation of N_2O.

When synthetic or organic (manure) nitrogen fertilizers are applied to managed soils, a portion of nitrogen is lost through volatilization as ammonia and nitrogen oxides. The volatilized nitrogen is then re-deposited in soils and waters and may incur further changes through nitrification and denitrification, resulting in N_2O emissions. The amount of volatilized nitrogen depends on a series of factors, such as the type of fertilizer, technology and time of application, type of soil, atmospheric precipitations, temperature, soil pH, etc.

Methodologies, Emission Factors and Data Sources

N_2O emissions were estimated using the Tier 1 methodology (Equation 11.9 in the 2006 IPCC Guidelines).

$$N_2O_{ATD} = \{(F_{SN} \bullet Frac_{GASF}) + ((F_{ON} + F_{PRP}) \bullet Frac_{GASM})\} \bullet EF_4 \bullet 44/28$$

Where:

F_{SN} – annual amount of inorganic N fertilizers applied to soils (t N/yr);

$Frac_{GASF}$ – fraction of inorganic fertilizers N that volatilizes as NH_3 and NO_x, t N volatilized (the default value is 0.1 t NH_3-N + NO_x-N/t N in inorganic N fertilizers applied to soils) (range from 0.03-0.3 t NH_3-N + NO_x-N/t N in inorganic N fertilizers applied to soils);

F_{ON} – annual amount of managed animal manure, compost, sewage sludge and other organic N additions applied to soils (t N/yr);

F_{PRP} – annual amount of urine and dung N deposited by grazing animals on pasture, range and paddock (t N/yr);

$Frac_{GASM}$ – fraction of applied organic N fertilizers materials (F_{ON}) and of urine and dung N deposited by grazing animals (F_{PRP}) that volatilizes as NH_3 and NO_x, (the default value is 0.2 t NH_3-N + NO_x-N/t N in manure) (range from 0.05 to 0.5 t NH_3-N + NO_x-N/t N in manure);

EF_4 – emission factor for N_2O emissions from atmospheric deposition of N onto soils and water surfaces (the default value is 0.01 t N_2O-N/t per t NH_4-N and NO_x-N emitted) (range from 0.002 to 0.05 t N_2O-N/t per t NH_4-N and NO_x-N emitted);

[44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

Activity data on the amount of nitrogen in synthetic and organic fertilizers, urine and dung of grazing animals applied to soils is available in Tables 5-59, 5-64 and in Table 5-68, respectively.

Uncertainties and Time-Series Consistency

Uncertainties associated with the estimation of indirect N_2O emissions from this source are very high. Uncertainties mostly include estimating the amount of volatilized fertilizer, amount of nitrogen in manure and emission factors, for which it is extremely difficult to verify to what extent they reflect the specific conditions of the RoM. Likewise, uncertainties associated with the estimation of the amount

of nitrogen lost through volatilization of NO_x and NH_4 are high. The nitrogen volatilization fraction varies significantly, from negligible to very high, depending on environmental conditions, soil properties, climate conditions, etc. According to the 2006 IPCC Guidelines, uncertainties associated with the estimation of indirect N_2O emissions from this source may vary up to the factor of 2. In the Republic of Moldova, combined uncertainties associated with indirect N_2O emissions from this source category are considered to be very high (circa 165.53%).

In view of ensuring time-series consistency of the obtained results, the same approach to estimate indirect N_2O emissions from the atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4) was used for the entire period under review.

Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

Quality Assurance and Quality Control

For this source category under Sector 3 'Agriculture', standard verification and quality control forms and checklists were filled in for the respective source category, following the Tier 1 methodological approach. The AD and methods used were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied.

Recalculations

Indirect N_2O_{ATD} emissions from source category 3D.2.a 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' have been recalculated for the period 1990-2020 as a result of revising the $N_{ex(T)}$ nitrogen excretion rate value, based on the updated country-specific information regarding the typical weight (TAM) of an animal at the end of the year, for the following categories: 'cattle', 'sheep', 'swine' and 'horses', and as a result of updating values of shares in manure management systems (MS%) applied in the RoM for livestock and poultry for the period 2015-2020, based on results of studies carried out in 2015 and 2021 by the National Agency for Food Safety.

In comparison with the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend in indirect N_2O_{ATD} emissions from source category 3D.2.a 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' in the years 1990-1991, 1995-1998, 2015-2016 and 2019-2020, varying from a minimum decrease by 0.1% in 2020, to a maximum decrease by 12.3% in 1996, and in an upward trend in nitrous oxide emissions in the years 1992-1994, 1999-2014 and 2017-2018, varying from a minimum increase by 0.1% in 1999, to a maximum increase by 3.9% in 2008 (Table 5-83).

Table 5-83: Recalculations of indirect N_2O_{ATD} emissions from source category 3D.2.a 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)', included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	0.34	0.31	0.26	0.20	0.17	0.16	0.16	0.13	0.13	0.11	0.11
BTR1	0.34	0.31	0.27	0.20	0.18	0.16	0.14	0.13	0.13	0.11	0.11
Difference, %	-0.2	-0.3	0.6	1.1	1.1	-1.0	-12.3	-2.6	-0.3	0.1	1.7
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.12	0.13	0.12	0.11	0.12	0.12	0.10	0.11	0.11	0.11	0.11
BTR1	0.12	0.13	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.12	0.12
Difference, %	1.3	1.2	1.5	1.3	1.1	2.8	3.1	3.9	3.3	2.6	2.5
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.12	0.13	0.17	0.13	0.14	0.16	0.16	0.18	0.17		
BTR1	0.13	0.14	0.17	0.13	0.14	0.16	0.17	0.17	0.17	0.17	0.12
Difference, %	2.4	2.4	1.6	-0.9	-2.9	1.1	2.7	-0.6	-0.1		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

At the same time, indirect N_2O_{ATD} emissions from source category 3D.2.a 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' have been recalculated for the years 1990-2020 because

of the change in the value of the GWP_{100}. Thus, the value available in the IPCC AR5 (2014) (GWP_{100} – 265) was used instead of the value available in the IPCC AR4 (2007) (GWP_{100} – 298).

Compared to the emission values recorded in NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend in indirect N_2O_{ATD} emissions from source category 3D.2.a 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' during the years 1990-2020 (Table 5-84).

Table 5-84: Recalculations of indirect N_2O_{ATD} emissions from source category 3D.2.a 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)', included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	101.31	92.70	78.89	58.40	51.61	47.10	48.69	39.72	38.52	33.70	33.02
BTR1	89.90	82.22	70.60	52.51	46.41	41.47	37.97	34.41	34.17	29.99	29.88
Difference, %	-11.3	-11.3	-10.5	-10.1	-10.1	-12.0	-22.0	-13.4	-11.3	-11.0	-9.5
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	34.63	37.68	34.50	34.07	34.97	34.33	30.60	31.95	31.86	34.02	34.12
BTR1	31.20	33.90	31.15	30.68	31.44	31.39	28.05	29.53	29.26	31.03	31.09
Difference, %	-9.9	-10.0	-9.7	-9.9	-10.1	-8.6	-8.3	-7.6	-8.2	-8.8	-8.9
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	36.87	39.81	50.49	39.36	41.81	46.68	48.21	52.40	49.31		
BTR1	33.56	36.24	45.61	34.69	36.11	41.98	44.01	46.32	43.81	45.17	31.07
Difference, %	-9.0	-9.0	-9.7	-11.8	-13.6	-10.1	-8.7	-11.6	-11.2		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

For the years 2021 and 2022, indirect N_2O_{ATD} emissions from source category 3D.2.a 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' have been estimated for the first time. The obtained results show that indirect N_2O_{ATD} emissions from source category 3D.2.a have decreased by circa 65.4% between 1990-2022. This significant decrease in indirect N_2O_{ATD} emissions from atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4) is due to the significant decrease in the amounts of organic and inorganic fertilizer applied to soils over this period, and the significant reduction of the total livestock population and changes in the share of manure management systems in the RoM.

Planned Improvements

No activities to improve the estimation process regarding indirect N_2O_{ATD} emissions from atmospheric deposition of nitrogen oxides (NO_x) and ammonia (NH_4) in the RoM are planned for the next inventory cycle.

5.4.2.2. Nitrogen Leaching and Run-off

Source Category Description

A considerable part of nitrogen applied to soil through synthetic and organic fertilizer addition, through urine and dung deposition from grazing animals, crop residues and mineralization of nitrogen associated with loss of soil carbon in mineral soils as a result of land-use change or management change is lost through leaching and run-off. Some of the inorganic nitrogen in or on the soil, mainly in the form of NO_3^-, may bypass biological retention mechanisms in the soil/vegetation system and by being transported in water flow (run-off) through soil macropores. Therefore, should nitrogen be present in the soil in excess of biological demand, this excess leaches through the soil profile. This nitrogen may reach groundwater, riverside areas, lakes, rivers and eventually seas and oceans, where it intensifies the biogenic production of N_2O emissions.

Methodologies, Emission Factors and Activity Data

Indirect N_2O emissions from leaching and run-off were estimated using the Tier 1 methodology (Equation 11.10 in the 2006 IPCC Guidelines).

$$N_2O_L = \{(F_{SN} + F_{ON} + F_{PRP} + F_{CR} + F_{SOM}) \bullet Frac_{LEACH-(H)}\} \bullet EF_5 \bullet 44/28$$

Where:

F_{SN} – annual amount of inorganic nitrogen fertilizers applied to soils (t N/yr);

F_{ON} – annual amount of managed animal manure, compost, sewage sludge and other organic nitrogen applied to soils (t N/yr);

F_{PRP} – annual amount of urine and dung nitrogen deposited by grazing animals on pasture, range and paddock (t N/yr);

F_{CR} – nitrogen in crop residues (above- and below-ground) returned to soils (t N/yr);

F_{SOM} – annual amount of nitrogen mineralized in mineral soils associated with loss of soil carbon from soil organic matter as a result of changes to land use or management (t N/yr);

$Frac_{LEACH}$ – fraction of all nitrogen that is lost through leaching and run-off: the default value is 0.3 kg N/kg N applied (range: 0.1-0.8 t N/t N applied with synthetic nitrogen and organic fertilizer);

EF_5 – emission factor for N_2O emissions from nitrogen leaching and run-off (the default value is 0.0075 t N_2O-N/t N), (range: 0.0005-0.025 t N_2O-N/t N leached and run-off).

[44/28] – mass ratio of nitrogen content in N_2O-N and N_2O.

Activity data on the amount of nitrogen in synthetic and organic fertilizers, urine and dung of grazing animals applied to soils as well as the amount of nitrogen returned to soils with crop residues, mineralization of nitrogen associated with loss of soil carbon in mineral soils is available in Tables 5-59, 5-64, 5-68, 5-76 and 5-80.

Uncertainties and Time-Series Consistency

Uncertainties associated with the estimation of indirect N_2O emissions from leaching and run-off are very high, and are caused primarily by the estimation of the amount of nitrogen applied to soil lost through leaching and run-off, as well as by the emission factors, for which it is extremely difficult to verify the extent to which they reflect the specific conditions of the RoM. It should be noted that according to the 2006 IPCC Guidelines, uncertainties associated with the estimation of indirect N_2O emissions from leaching and run-off may vary up to a factor of 2. In the RoM, combined uncertainties associated with indirect N_2O emissions from leaching and run-off are considered very high (circa 167.71%).

In view of ensuring time-series consistency of the obtained results, the same approach and emission factors were used for the entire period under review when assessing indirect N_2O emissions from leaching and run-off through the application of synthetic and organic fertilizers, urine and dung, crop residues, mineralization of nitrogen associated with loss of soil carbon in mineral soils as a result of land-use and soil management change.

Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

Quality Assurance and Quality Control

Standard verification and QC forms and checklists were filled in for Sector 3 'Agriculture', following the Tier 1 methodological approach. It should be noted that the AD and methods used were documented and archived both in hard copies and electronically. In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and QC procedures were periodically applied.

Recalculations

Indirect N_2O_L emissions from source category 3D.2.b 'Nitrogen Leaching and Run-off' have been recalculated for the period 1990-2020 as a result of revising the $N_{ex(T)}$ nitrogen excretion rate value, based on the country-specific updated information regarding the typical weight (TAM) of an animal

at the end of the year, for the following categories: 'cattle', 'sheep', 'swine' and 'horses', and as a result of updating values of shares in manure management systems (MS%) applied in the RoM for livestock and poultry for the period 2015-2020, based on results of studies carried out in 2015 and 2021 by the National Agency for Food Safety.

In comparison with the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend in indirect N_2O_L emissions from source category 3D.2.b 'Nitrogen Leaching and Run-off' in the years 1990-1991, 1995-1998, 2015-2016 and 2019-2020, varying from a minimum decrease by 0.09% in 1990 and 2020, to a maximum decrease by 5.3% in 1996, and in an upward trend in nitrous oxide emissions in the years 1992-1994, 1999-2014 and 2017-2018, varying from a minimum increase by 0.03% in 1999, to a maximum increase by 1.2% in 2008 (Table 5-85).

Table 5-85: Recalculations of indirect $N_2O_{(L)}$ emissions from source category 3D.2.b 'Nitrogen Leaching and Run-off', included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	0.85	0.81	0.68	0.56	0.45	0.45	0.42	0.42	0.40	0.37	0.35
BTR1	0.85	0.81	0.68	0.56	0.45	0.45	0.40	0.42	0.40	0.37	0.35
Difference, %	-0.09	-0.11	0.28	0.44	0.49	-0.39	-5.32	-0.92	-0.10	0.03	0.62
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.39	0.41	0.35	0.40	0.41	0.38	0.33	0.39	0.37	0.41	0.41
BTR1	0.39	0.42	0.35	0.40	0.41	0.38	0.33	0.40	0.37	0.41	0.41
Difference, %	0.44	0.40	0.58	0.41	0.35	0.96	1.10	1.21	1.07	0.81	0.77
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.39	0.48	0.56	0.42	0.50	0.56	0.58	0.62	0.52		
BTR1	0.39	0.48	0.57	0.42	0.50	0.56	0.59	0.62	0.52	0.68	0.48
Difference, %	0.84	0.74	0.54	-0.31	-0.91	0.35	0.83	-0.19	-0.09		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

At the same time, indirect N_2O_L emissions from source category 3D.2.b 'Nitrogen Leaching and Run-off' have been recalculated for the years 1990-2020 because of the change in the value of the GWP_{100}. Thus, the value available in the IPCC AR5 (2014) (GWP_{100} – 265) was used instead of the value available in the IPCC AR4 (2007) (GWP_{100} – 298). In comparison with the emission values recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made have resulted in a downward trend in indirect N_2O_L emissions from category 3D.2.b 'Nitrogen Leaching and Run-off' in the years1990-2020 (Table 5-86).

Table 5-86: Recalculations of indirect $N_2O_{(L)}$ emissions from source category 3D.2.b 'Nitrogen Leaching and Run-off', included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	252.04	241.52	201.23	167.13	133.62	133.98	126.57	125.45	120.00	110.19	104.52
BTR1	223.93	214.54	179.45	149.27	119.41	118.68	106.56	110.53	106.61	98.01	93.53
Difference, %	-11.2	-11.2	-10.8	-10.7	-10.6	-11.4	-15.8	-11.9	-11.2	-11.0	-10.5
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	116.68	123.37	103.82	119.19	120.77	113.64	97.11	117.02	109.88	121.22	122.70
BTR1	104.21	110.15	92.86	106.42	107.78	102.02	87.30	105.32	98.76	108.67	109.95
Difference, %	-10.7	-10.7	-10.6	-10.7	-10.8	-10.2	-10.1	-10.0	-10.1	-10.4	-10.4
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	116.62	142.93	168.12	126.05	149.43	166.86	173.87	185.15	155.25		
BTR1	104.57	128.04	150.31	111.75	131.68	148.91	155.90	164.34	137.93	180.71	128.50
Difference, %	-10.3	-10.4	-10.6	-11.3	-11.9	-10.8	-10.3	-11.2	-11.2		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

For the years 2021 and 2022, indirect N_2O_L emissions from source category 3D.2.b 'Nitrogen Leaching and Run-off' have been estimated for the first time. The obtained results show that indirect N_2O_L emissions from category 3D.2.b had decreased by 49.2% between 1990 and 2022.

Planned Improvements

No activities to improve the estimation process regarding indirect $N_2O_{(L)}$ emissions from nitrogen leaching and run-off in the RoM are planned for the next inventory cycle.

5.5. Urea Application (Source Category 3H)

5.5.1. Source Category Description

Adding urea ($CO(NH_2)_2$) to agricultural soils for fertilization purposes leads to CO_2 losses (previously covered in the industrial production process). Urea is converted into ammonium (NH_4^+), hydroxyl ion (OH^-) and bicarbonate (HCO_3^-) in the presence of water and urease enzymes. The bicarbonate that is formed evolves into CO_2 and water.

5.5.2. Methodologies, Emission Factors and Activity Data

CO_2 emissions from urea application were estimated using the Tier 1 methodology and Equation 11.13 in the 2006 IPCC Guidelines.

$$CO_2 = M \bullet EF \bullet 44/12$$

Where:

CO_2 – annual CO_2 emissions from urea application (kt/yr);

M – annual amount of urea fertilization (kt urea/yr);

EF – emission factor, tonnes C/tonnes urea (default value: 0.2 t C/t urea);

[44/12] – mass ratio of carbon content in CO_2-C and CO_2.

No urea is produced in the RoM. Activity data on urea application to soils as a fertilizer were generated indirectly based on the information provided by the Customs Service on urea imports and exports (Table 5-87). It was considered that the annual consumption of urea is equal to the total urea imports minus total urea exports. As the database of the Customs Service does not cover the period 1990-1994, information regarding urea consumption during the respective period was generated based on the trend of using synthetic N fertilizers between 1990 and 1995. As it can be seen in Table 5-87, an obvious upward trend in urea consumption was recorded in the Republic of Moldova in the last decade, albeit the annual consumption varies significantly from year to year.

Table 5-87: Urea consumption as a fertilizer in the RoM between 1990-2022, t

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Urea import into the RoM, t	793.6	712.6	532.5	174.1	73.2	82.7	124.3	1,499.0	371.1	4.6	599.7
Urea export from the RoM, t	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual urea consumption in the RoM, t	793.6	712.6	532.5	174.1	73.2	82.7	124.3	1,499.0	371.1	4.6	599.7
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Urea import into the RoM, t	204.0	64.2	324.8	500.7	237.2	199.1	358.7	1,159.8	799.6	2,385.5	5,022.2
Urea export from the RoM, t	0.0	0.0	0.1	0.4	0.0	0.0	0.0	0.0	0.0	6.9	10.6
Annual urea consumption in the RoM, t	204.0	64.1	324.7	500.3	237.2	199.1	358.7	1,159.8	799.6	2,378.6	5,011.6
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Urea import into the RoM, t	7,634.2	5,705.4	13,917.0	15,327.6	16,738.2	35,982.3	60,221.6	53,350.0	57,957.4	25,371.4	30,902.9
Urea export from the RoM, t	10.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Annual urea consumption in the RoM, t	7,623.8	5,705.4	13,917.0	15,327.6	16,738.2	35,982.3	60,221.6	53,350.0	57,957.4	25,371.4	30,902.9

Source: Customs Service of the RoM, Letter No. 28/07-8785 dated 26.05.2016, as a response to Letter No. 512/2016-05-01 dated 10.05.2016; Letter No. 28/07-612 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 dated 14.12.2017; Letter No. 28/07-3025 dated 28.02.2020, as a response to Letter No. 08-310/1 dated 11.02.2020; Letter dated 20.02.2023, as a response to the request of the Environment Agency to No. 08/34/2023 dated 28.01.2023.

5.5.3. Uncertainties and Time-Series Consistency

Uncertainties associated with activity data on urea application as a fertilizer in agricultural soils in the RoM reach up to circa 30%. According to the 2006 IPCC Guidelines, uncertainties associated with the default emission factor are circa 50%. Thus, combined uncertainties from source category 3H 'Urea Application' are thereby considered moderate (circa 58.31%) (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach and emission factors were used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidance.

5.5.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

5.5.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the respective source category, following the Tier 1 methodological approach.

The activity data and methods used in the estimation of CO_2 emissions from urea application were documented and archived both in hard copies and electronically.

In order to identify the data entry and GHG emission estimation process-related errors, AD and EF verifications and quality control procedures were applied.

5.5.6. Recalculations

CO_2 emissions from source category 3H 'Urea Application' have been recalculated for the period 2017-2020, as a result of specifying the activity data associated with the import of urea into the Republic of Moldova (code: 3102 10 100 – mineral or chemical N fertilizers: urea, with a nitrogen content of more than 45% of the weight of the anhydrous product in dry state: carbamide (urea), as well as 3102 10 900 – mineral fertilizers: urea granules, with a nitrogen content of 46.0%), offered by the Customs Service from the ASYCUDA World Integrated Customs Information System, which ensures the management and processing of customs forms and documents, used in customs clearance procedures, but being offered in a disaggregated manner only for the period of 2017-2022.

Compared to the emission values recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made resulted in an upward trend in CO_2 emissions from source category 3H 'Urea application' in the years 2017-2018, varying from a minimum of 0.7% in the 2017, to a maximum of 1.8% in 2018, and in a downward trend in the respective emissions in 2019-2020, this varying from a minimum of 0.3% in 2020 to a maximum of 1.3% in 2019 (Table 5-88).

Table 5-88: Recalculations of CO_2 emissions from urea application to agricultural soils included in the NC5 of the RoM to the UNFCCC, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	0.58	0.52	0.39	0.13	0.05	0.06	0.09	1.10	0.27	0.00	0.44
BTR1	0.58	0.52	0.39	0.13	0.05	0.06	0.09	1.10	0.27	0.00	0.44
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	0.15	0.05	0.24	0.37	0.17	0.15	0.26	0.85	0.59	1.74	3.68
BTR1	0.15	0.05	0.24	0.37	0.17	0.15	0.26	0.85	0.59	1.74	3.68
Difference, %	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	5.59	4.18	10.21	11.24	12.27	26.21	43.36	39.63	42.62		
BTR1	5.59	4.18	10.21	11.24	12.27	26.39	44.16	39.12	42.50	18.61	22.66
Difference, %	0.0	0.0	0.0	0.0	0.0	0.7	1.8	-1.3	-0.3		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

For the years 2021 and 2022, the respective emissions have been estimated for the first time. The obtained results show that CO_2 emissions from the source category 3H 'Urea Application' increased by circa 177 times between 1990-2022.

5.5.7. Planned Improvements

No activities to improve the process of estimating CO_2 emissions from urea application as a fertilizer in agricultural soils in the RoM are planned for the next inventory cycle.

CHAPTER 6. SECTOR 4 'LAND USE, LAND-USE CHANGE AND FORESTRY'

6.1. Overview

This chapter covers the estimation of GHG removals/emissions from Sector 4 'Land Use, Land-Use Change and Forestry'. GHG removals/emissions within this sector were estimated following methodologies in the 2006 IPCC Guidelines for National Greenhouse Gas Inventories.

The evolution of removals/emissions recorded between 1990 and 2022 at sectoral level was greatly affected, apart from the state of forests and other vegetation types, by the socio-political and economic changes that occurred over the respective period in the RoM (transition to market economy, land parceling as result of land reform, a sharp decrease in agricultural production, etc.).

Following the implementation of land reforms in the 1990s, land-use in the RoM was relatively stable in the past 10-15 years. The forest area is growing steadily. According to data provided by the General Land Cadastre, by 01.01.2023, forest land constitutes 370.0 thousand ha or 11.2% of the country's territory or +13.8% compared to the level in the base year (1990).

6.1.1. Evolution of CO2 Removal Trends

Over the period 1990-2022, especially since 2009, the evolution of CO_2 removals from Sector 4 'LULUCF' tended to decrease significantly (Figure 6-1), and in 2022 this sector became an emission source.

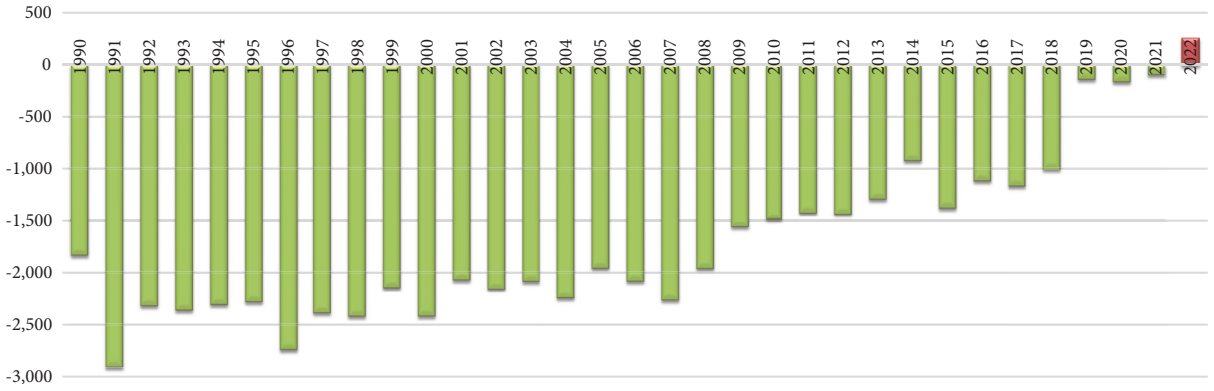


Figure 6-1: CO_2 removals/emissions in Sector 4 'LULUCF' in the RoM between 1990-2022, kt.

The main sources of emission reduction in Sector 4 'LULUCF' are forest lands, grasslands and lands with wood vegetation from croplands, particularly subcategories: 4A1 'Forest Land Remaining Forest Land', 4A2 'Land Converted to Forest Land', 4C2 'Land Converted to Grassland', and 4B2 'Land Converted to Cropland' (Table 6-1; Figure 6-2).

Table 6-1: Emissions/removals in Sector 4 'LULUCF', by subcategory between 1990-2022, kt

Year	Forest Land		Cropland		Grassland		Wetlands		Settlements		Other Land		HWP	LULUCF total	Compared to 1990, %
	4A1	4A2	4B1	4B2	4C1	4C2	4D1	4D2	4E1	4E2	4F1	4F2	4G		
1990	-1579.04	-984.39	2333.34	45.75	0.00	-1205.69	0.00	-555.38	0.00	84.75	0.00	152.36	-122.18	-1830.49	100.0
1991	-1352.65	-990.66	1221.40	27.39	0.00	-1414.32	0.00	-526.46	0.00	88.71	0.00	152.36	-113.61	-2907.84	158.9
1992	-1290.42	-893.82	1301.63	-127.44	0.00	-1428.48	0.00	-595.55	0.00	386.62	0.00	418.78	-94.30	-2322.98	126.9
1993	-1367.44	-826.08	1437.81	5.19	0.00	-1303.52	0.00	-525.84	0.00	114.62	0.00	164.02	-63.45	-2364.70	129.2
1994	-1355.18	-752.83	1209.79	-3.40	0.00	-1577.33	0.00	-497.64	0.00	130.49	0.00	549.46	-14.65	-2311.29	126.3
1995	-1350.20	-694.87	1383.08	-66.35	0.00	-1601.10	0.00	-469.44	0.00	106.92	0.00	401.13	5.97	-2284.87	124.8
1996	-1559.05	-631.39	1219.68	-101.15	0.00	-1548.08	0.00	-441.24	0.00	101.59	0.00	217.33	1.78	-2740.53	149.7
1997	-1639.49	-592.79	1531.81	-146.02	0.00	-1400.86	0.00	-413.03	0.00	100.80	0.00	188.24	-19.24	-2390.60	130.6
1998	-1732.32	-556.17	1566.68	-154.62	0.00	-1436.27	0.00	-384.83	0.00	99.04	0.00	185.01	-9.13	-2422.61	132.3
1999	-1840.91	-495.94	1543.24	-112.44	0.00	-1433.29	0.00	-356.63	0.00	111.83	0.00	425.16	18.54	-2140.44	116.9
2000	-1881.45	-425.98	1349.37	-126.64	0.00	-1291.95	0.00	-328.42	0.00	100.18	0.00	178.52	5.81	-2420.58	132.2
2001	-1873.56	-400.15	1731.69	-171.25	0.00	-1290.65	0.00	-300.22	0.00	67.09	0.00	178.52	-6.26	-2064.79	112.8

Year	Forest Land		Cropland		Grassland		Wetlands		Settlements		Other Land		HWP	LULUCF total	Compared to 1990, %
	4A1	4A2	4B1	4B2	4C1	4C2	4D1	4D2	4E1	4E2	4F1	4F2	4G		
2002	-1913.58	-354.04	1300.69	-144.11	0.00	-1235.14	0.00	-272.02	0.00	67.09	0.00	456.24	-56.69	-2151.54	117.5
2003	-1863.87	-406.25	1376.95	-139.40	0.00	-1007.18	0.00	-243.82	0.00	67.86	0.00	201.66	-65.11	-2079.15	113.6
2004	-1904.34	-430.44	1321.99	-123.40	0.00	-1120.48	0.00	-215.61	0.00	53.67	0.00	223.82	-53.47	-2248.26	122.8
2005	-1966.00	-443.52	1359.37	-87.69	0.00	-1058.12	0.00	-187.41	0.00	53.67	0.00	416.50	-41.11	-1954.31	106.8
2006	-1882.93	-483.58	1391.96	-88.69	0.00	-1056.37	0.00	-159.21	0.00	53.67	0.00	189.50	-40.59	-2076.24	113.4
2007	-1985.96	-474.43	1346.90	-80.78	0.00	-1031.24	0.00	-131.00	0.00	49.27	0.00	83.11	-44.59	-2268.71	123.9
2008	-1985.38	-477.41	1329.19	-92.51	0.00	-932.15	0.00	-102.80	0.00	49.27	0.00	291.00	-35.61	-1956.39	106.9
2009	-2008.95	-517.12	1469.75	-79.07	0.00	-447.69	0.00	-74.60	0.00	45.57	0.00	79.94	-28.47	-1560.64	85.3
2010	-1964.09	-520.08	1344.75	-72.97	0.00	-691.99	0.00	-46.40	0.00	45.57	0.00	441.48	-22.80	-1486.52	81.2
2011	-1871.43	-519.14	1336.69	-106.00	0.00	-638.17	0.00	-75.31	0.00	62.04	0.00	393.73	-4.38	-1421.98	77.7
2012	-1702.27	-592.56	1321.32	-84.81	0.00	-562.75	0.00	-15.47	0.00	11.89	0.00	114.14	76.84	-1433.66	78.3
2013	-1531.88	-609.99	1416.02	-276.10	0.00	-360.17	0.00	-106.10	0.00	13.75	0.00	103.45	61.88	-1289.15	70.4
2014	-1484.67	-650.06	1420.30	-245.69	0.00	-341.11	0.00	-139.75	0.00	18.98	0.00	436.65	58.02	-927.33	50.7
2015	-1496.39	-663.05	1421.96	-309.33	0.00	-418.46	0.00	-82.79	0.00	39.16	0.00	86.82	49.24	-1372.85	75.0
2016	-1433.25	-682.52	1495.48	-383.49	0.00	-402.37	0.00	-82.79	0.00	19.31	0.00	351.63	0.88	-1117.11	61.0
2017	-1324.56	-691.87	1502.19	-412.63	0.00	-384.04	0.00	-82.82	0.00	77.31	0.00	218.21	-67.45	-1165.66	63.7
2018	-1281.36	-687.99	1505.41	-299.01	0.00	-440.15	0.00	-82.83	0.00	21.62	0.00	321.21	-63.50	-1006.61	55.0
2019	-1231.10	-719.55	1516.68	-9.28	0.00	-293.29	0.00	-82.81	0.00	116.50	0.00	611.79	-57.56	-148.62	8.1
2020	-1159.88	-727.44	1558.08	71.82	0.00	-223.15	0.00	-82.81	0.00	27.21	0.00	329.14	34.69	-172.34	9.4
2021	-1198.20	-721.39	1573.00	140.53	0.00	-138.64	0.00	-83.05	0.00	29.73	0.00	285.13	7.73	-105.16	5.7
2022	-912.82	-679.60	1589.32	140.86	0.00	-123.13	0.00	-84.25	0.00	27.50	0.00	304.27	-3.78	258.39	-14.1

Source: Land Use and Land-Use Change Matrix for the period 1970-2022.

Subcategories 4B1 'Cropland Remaining Cropland', 4E2 'Land Converted to Settlements', and 4F2 'Land Converted to Other Land' remain a constant source of CO_2 emissions due to a profoundly negative balance as a result of the conversion of land with different categories of vegetation types, and due to a significant decrease in areas with perennial plantations (-42.7%). This trend is mainly due to changes in land-use and land management practices (Category 4B), which contributed to the significant decrease in organic carbon stocks in cropland [11515], thereby changing the humus balance, from a positive one into a negative and/or profoundly negative one. The respective process was also influenced by some changes in forest management and forest-use (Category 4A), such as the increase in authorized harvesting of wood, significant increase in illegal logging, increased conversion of cropland to forest land, etc.

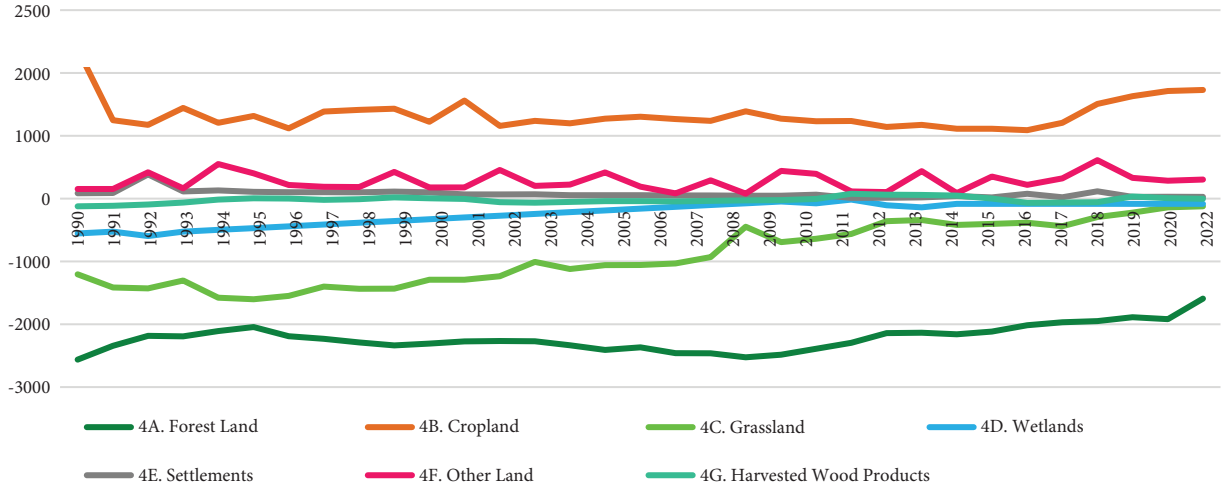


Figure 6-2: CO_2 emissions/removals by category within LULUCF Sector between 1990-2022, kt.

Table 6-2 shows net direct CO_2 emissions/removals in Sector 4 'LULUCF' between 1990-2022.

Table 6-2: Net GHG emissions/removals within LULUCF Sector between 1990-2022, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2	-1830.49	-2907.84	-2322.98	-2364.70	-2311.29	-2284.87	-2740.53	-2390.60	-2422.61	-2140.44	-2420.58
CH_4	2.97	2.69	2.46	3.30	1.85	2.51	1.73	3.01	2.77	2.68	1.02
N_2O	151.51	163.52	181.99	197.92	210.35	223.66	233.22	242.04	252.87	261.32	263.51
Net total	**-1676.01**	**-2741.63**	**-2138.53**	**-2163.47**	**-2099.09**	**-2058.69**	**-2505.59**	**-2145.55**	**-2166.97**	**-1876.44**	**-2156.04**

[11515] Organic carbon and nitrogen in soil are closely related to the humus content in soil; carbon loss through oxidation due to changes in soil management and cropland use are accompanied by the simultaneous nitrogen mineralization (biochemical decomposition).

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO_2	-2064.79	-2151.54	-2079.15	-2248.26	-1954.31	-2076.24	-2268.71	-1956.39	-1560.64	-1486.52	-1421.98
CH_4	1.42	0.30	0.07	0.22	0.28	0.28	1.70	0.86	0.35	0.16	0.18
N_2O	263.71	264.07	261.74	257.99	254.81	251.31	247.23	241.90	235.95	229.62	224.06
Net total	**-1799.66**	**-1887.18**	**-1817.34**	**-1990.04**	**-1699.22**	**-1824.65**	**-2019.78**	**-1713.63**	**-1324.34**	**-1256.74**	**-1197.75**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
CO_2	-1433.66	-1289.15	-927.33	-1372.85	-1117.11	-1165.66	-1006.61	-148.62	-172.34	-105.16	258.39
CH_4	1.31	0.98	0.13	0.73	0.40	0.56	0.19	0.44	0.90	0.30	1.52
N_2O	207.57	193.19	180.05	169.19	159.42	152.82	147.07	143.64	149.40	153.97	160.76
Net total	**-1224.78**	**-1094.98**	**-747.16**	**-1202.92**	**-957.29**	**-1012.29**	**-859.35**	**-4.52**	**-22.04**	**49.11**	**420.66**

Source: Land Use and Land-Use Change Matrix for the period 1970-2022.

6.1.2. Key Categories

The results of key category analysis under Sector 4 'LULUCF' (by level and trend), carried out following the Tier 1 approach, are provided in Table 6-3.

Table 6-3: Key Categories in sector 4 'LULUCF'

Categoria IPCC	GES	Categoria de surse / sechestrare	T1		T2	
			L	T	L	T
4A1	CO_2	Forest Land Remaining Forest Land	X	X	X	X
4A1	non-CO_2	Forest Land Remaining Forest Land				
4A2	CO_2	Land Converted to Forest Land	X	X	X	X
4A2	non-CO_2	Land Converted to Forest Land				
4B1	CO_2	Cropland Remaining Cropland	X	X	X	X
4B1	non-CO_2	Cropland Remaining Cropland				
4B2	CO_2	Land Converted to Cropland				
4B2	non-CO_2	Land Converted to Cropland				
4C1	CO_2	Grassland Remaining Grassland				
4C2	CO_2	Land Converted to Grassland	X	X	X	X
4D1	CO_2	Wetlands Remaining Wetlands				
4D2	CO_2	Land Converted to Wetlands	X	X		X
4E1	CO_2	Settlements Remaining Settlements				
4E2	CO_2	Land Converted to Settlements				
4E2	N_2O	Land Converted to Settlements	X	X	X	
4F1	CO_2	Other Land Remaining Other Land				
4F2	CO_2	Land Converted to Other Land	X	X	X	X
4G	CO_2	Harvested Wood Products		X		X

Abbreviations: L – Level Assessment; T – Trend Assessment; T1 – Tier 1; T2 – Tier 2.

6.1.3. Methodologies

Tier 1 and Tier 2 methodologies (2006 IPCC Guidelines), as well as default and CS emission/removal factors (e.g.: current growth factors, basic wood density; carbon fraction of dry matter, biomass and/or soil carbon decrease/increase due to conversion, etc.) were employed in the estimation of emissions/removals in Sector 4 'LULUCF'. At the same time, in order to estimate the emission reduction achieved in the implementation of afforestation projects through the CDM of the Kyoto Protocol: 'Moldova Soil Conservation Project' (MSCP) and 'Moldova Community Forestry Development Project' (MCFDP) the Tier 3 methodology AR-AM0002 'Restoration of degraded land through afforestation/reforestation" (Version 01 and 03) was used. The summary of estimation methods used to calculate emissions/removals by source and sink categories are presented in Table 6-4, and a more detailed description is provided in subchapters 6.2-6.8 of this Report).

Table 6-4: CO_2 emission/removal methodologies applied within Sector 4 'LULUCF'

IPCC Cateogory	Subcategories	Method used	EF	Notes
4A Forest Land	A1 Forest Land Remaining Forest Land	T2	D, CS	Above-ground biomass (biomass increment in forests; losses due to authorized commercial felling and illegal logging)
	A2 Land Converted to Forest Land	T1, T2, T3	D, CS	Above-ground and below-ground biomass (biomass increment in new forests; losses/gains of biomass due to conversion; forest fires, CH_4, N_2O, NO_x, CO emissions); carbon losses (carbon losses/gains due to conversion)

IPCC Cateogory	Subcategories	Method used	EF	Notes
4B Cropland	B1 Cropland Remaining Cropland, including:	T1, T2	D, CS	
	B1.1 Cropland Covered with Woody Vegetation	T1, T2	CS	Above-ground and below-ground biomass (forest strips, other types of forest vegetation, orchards, vineyards, trees in individual gardens.)
	B1.2 Annual Change in Carbon Stocks in Mineral Soils	T2	D, CS	Carbon stocks in mineral soils (losses/gains of biomass and/or carbon in soil due to agricultural activities)
	B.1.3 Burning of Crop Residue	T1, T2	D, CS	CH_4, N_2O, NOx, CO emissions
	B2 Land Converted to Cropland	T1, T2	D, CS	Above-ground and below-ground biomass (losses/gains of biomass due to conversion), carbon stocks in mineral soils (carbon losses/gains due to conversion); N_2O emissions due to conversion to cropland
4C Grassland	C1 Grassland Remaining Grassland	T2	CS	Neutral balance
	C2 Land Converted to Grassland	T2	CS	Above-ground and below-ground biomass (forest strips, other types of forest vegetation and degraded arable lands converted to grassland; losses/gains of biomass due to conversion), carbon stocks in mineral soils (carbon losses/gains due to conversion)
4D Wetlands	D1 Wetlands Remaining Wetlands	T1	D	Neutral balance
	D2 Land Converted to Wetlands	T1, T2	D, CS	Above-ground and below-ground biomass (losses/gains of biomass due to conversion), carbon stocks in mineral soils (carbon losses/gains due to conversion)
4E Settlements	E1 Settlements Remaining Settlements	T1	D	Neutral balance
	E2 Land Converted to Settlements	T1, T2	D, CS	Above-ground and below-ground biomass (losses/gains of biomass due to conversion), carbon stocks in mineral soils (carbon losses/gains due to conversion), N_2O emissions due to conversion to settlements
4F Other Land	F1 Other Land Remaining Other Land	T1	D	Neutral balance
	F2 Land Converted to Other Land	T1, T2	D, CS	Above-ground and below-ground biomass (losses/gains of biomass due to conversion), carbon stocks in mineral soils (carbon losses/gains due to conversion)
4G HWP	Harvested Wood Products	T1	D	Harvested wood products/processed, imported or exported (raw roundwood; timber, wooden panels, etc.)

Abbreviations: T1, T2, T3 – Tier 1, 2 and 3; CS – country-specific emission/removal factors; D – default emission/removal factors.

The main reference sources for the activity data used under Sector 4 'LULUCF' were: data from State Records on Forestry Resources – areas occupied by forests, distribution by species, volume of standing wood, etc.; forest planning materials – areas occupied and dendrometrical features of forests and other types of forest vegetation; data from the General Land Cadastre, compiled by the Agency for Land Relations and Cadastre (ALRC) – forest areas, areas occupied by forest vegetation not included in forestry resources, grassland, perennial plantations, cropland, settlements, other land, etc.; Statistical Reports from 'Moldsilva' Agency – the volume of wood harvested during forest clearings (by category and species); illegal felling detected in forest fund managed by the Agency, as well as in the forests and forest vegetation managed by other owners; Reports of the Environmental Protection Inspectorate: illegal felling revealed by its forestry sub-divisions; the volume of wood mass subject to authorized harvesting (1990-2018) in forests and forest vegetation managed by local and central public authorities: areas on which crop residue was burnt; Reports from the Environment Agency – volume of wood mass subject to authorized harvesting in forests and forest vegetation managed by local and central public authorities, etc. (2019-2022); Statistical Yearbooks of the RoM and ATULBD – harvesting of wood products, forestlands that suffered from fires, cropping, the total production and the production per hectare on main crops, etc.

6.1.4. Uncertainties and Time-Series Consistency

The uncertainty analysis of CO_2 emissions/removals within Sector 4 'LULUCF' (by source and sink category) is described in detail in subchapters 6.2-6.8 of this Report, as well as in Annex 2.

Combined uncertainties as a percentage of total direct GHG emissions/removals from this sector were estimated to be circa 7.36%. Uncertainties introduced in the trend of total direct GHG emissions from this sector were estimated to be circa 6.94%.

In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

6.1.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

6.1.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists by individual source and sink category were filled in for each category under Sector 4 'LULUCF', following the Tier 1 approach.

It should be noted that AD and methods used in the estimation of CO_2 emissions/removals from this sector were documented and archived both in hard copies and electronically. In order to identify the data entry, as well as GHG emission estimation-related errors, AD and EFs verifications and quality control procedures were applied.

Following the sustainable practices, GHG emissions/removals were estimated based on AD and CS EFs from official reference sources. Likewise, an important factor that positively influenced the quality of the GHG inventory within Sector 4 'LULUCF' was the development of a Land Use and Land-Use Change Matrix for the period 1970-2022.

Quality control (QC) measures consisted of self-monitoring own protocols and data processing procedures. QC is based on using a specific checklist by each compiler, e.g.: re-checking AD or EFs entered into the tables, verifying whether the sum of the land category matches the total area of the country for the entire time series, checking the formulas implemented in the spreadsheets or calculating some parameters (i.e. at disaggregated level or through the IEF values implemented in the spreadsheets), the re-verification of measurement units for all the parameters involved in the inventory estimation.

Quality assurance (QA) activities included verifications by a person not involved in the data collection or processing operation, based on the same checklist as for QC, including troubleshouting inconsistencies in spreadsheets and those set out in the NIR.

6.1.6. Recalculations

Net GHG emissions/removals from Sector 4 'LULUCF' have been recalculated in the current inventory cycle as a result of updating the GWP values for methane (CH_4) and nitrous oxide (N_2O), used in the estimation of non-CO_2 emissions in subcategories 4A2 'Land Converted to Forest Land' (forest fires), 4B1 'Cropland Remaining Cropland' (burning of crop residue), 4B2 'Land Converted to Cropland', and 4E2 'Land Converted to Settlements'. Details and arguments for the recalculations are presented in subchapters 6.2-6.8 of this Report.

Compared to the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made in the current inventory cycle resulted in an upward trend in net CO_2 removals between 1990 and 2020, varying from a minimum of +0.7% in 1991 to a maximum of +524.0% in 2020 (Table 6-5).

Table 6-5: Recalculations of the net CO_2 emissions/removals in Sector 4 'LULUCF' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	-1 657.46	-2 721.56	-2 116.13	-2 139.18	-2 073.10	-2 031.11	-2 476.73	-2 115.73	-2 135.78	-1 844.19	-2 123.34
BTR1	-1 676.01	-2 741.63	-2 138.53	-2 163.47	-2 099.09	-2 058.69	-2 505.59	-2 145.55	-2 166.97	-1 876.44	-2 156.04
Difference, %	**+1.1**	**+0.7**	**+1.1**	**+1.1**	**+1.3**	**+1.4**	**+1.2**	**+1.4**	**+1.5**	**+1.7**	**+1.5**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	-1 766.97	-1 854.32	-1 784.76	-1 957.94	-1 667.52	-1 793.38	-1 989.17	-1 683.60	-1 294.99	-1 228.17	-1 169.86
BTR1	-1 799.66	-1 887.18	-1 817.34	-1 990.04	-1 699.22	-1 824.65	-2 019.78	-1 713.63	-1 324.34	-1 256.74	-1 197.75
Difference, %	**+1.8**	**+1.8**	**+1.8**	**+1.6**	**+1.9**	**+1.7**	**+1.5**	**+1.8**	**+2.3**	**+2.3**	**+2.4**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	-1 199.07	-1 071.02	-724.75	-1 181.93	-937.48	-993.32	-841.05	13.30	-3.54		
BTR1	-1 224.78	-1 094.98	-747.16	-1 202.92	-957.29	-1 012.29	-859.35	-4.52	-22.06	49.11	420.66
Difference, %	**+2.1**	**+2.2**	**+3.1**	**+1.8**	**+2.1**	**+1.9**	**+2.2**	**+134.0**	**+524.0**		

Abbreviations: NC5 – Fifth National Communication, BTR1 – First Biennial Transparency Report, N/A – not applicable.

The results of recalculations performed at source category level are presented in subchapters 6.2-6.8 of this Report.

6.1.7. Assessment of Completeness

The current inventory covers CO_2 emissions/removals from 13 source and sink categories under Sector 4 'LULUCF' (Table 6-6).

Non-CO_2 emissions from forest fires and burning of crop residues (CH_4; N_2O) were estimated for subcategories 4A2 'Land Converted to Forest Land' and 4B1 'Cropland Remaining Cropland'; these emissions, however, are quite insignificant from a quantitative point of view. At the same time, non-

CO_2 emissions were estimated partially (N_2O) for subcategories 4B2 'Land Converted to Cropland' and 4E2 'Land Converted to Settlements'.

Table 6-6: Inventory integrity of emissions/removals from sector 4 'LULUCF'

IPCC category	Category	CO_2	CH_4	N_2O	NO_x	CO
4A1	Forest Land Remaining Forest Land	X	NE	NE	NE	NE
4A2	Land Converted to Forest Land	X	X	X	X	X
4B1	Cropland Remaining Cropland	X	X	X	X	X
4B2	Land Converted to Cropland	X	NE	X	NE	NE
4C1	Grassland Remaining Grassland	X	NE	NE	NE	NE
4C2	Land Converted to Grasslands	X	NE	NE	NE	NE
4D1	Wetlands Remaining Wetlands	X	NE	NE	NE	NE
4D2	Land Converted to Wetlands	X	NE	NE	NE	NE
4E1	Settlements Remaining Settlements	X	NE	NE	NE	NE
4E2	Land Converted to Settlements	X	NE	X	NE	NE
4F1	Other Land Remaining Other Land	X	NE	NE	NE	NE
4F2	Land Converted to Other Land	X	NE	NE	NE	NE
4G	Harvested Wood Products	X	NE	NE	NE	NE

Abbreviations: X – source and sink categories included in the inventory; NE – Not Estimated.

6.1.8. Definitions regarding land-use, classification systems used and their correspondence to land-use categories, land-use change and forestry

In the context of the information presented in Table 6-6, the ways of representing land-use within the cadastre evidence system are also defined in the estimation process of sectoral emission reduction within Sector 4 'LULUCF'. Data on land areas and use categories are provided by land cadastral reports issued by the Agency for Land Relations and Cadastre, subsequently approved by Government decisions. Additionally, information on forest land is available at 'Moldsilva' Agency, the institution responsible to present sectoral statistical reports to the NBS.

The time series begin with 1970 and include circa 25 national categories of aggregated use within 11 major categories which are highlighted in Table 6-7, including correspondence with IPCC categories. According to the table, national circumstances were considered, including the national statistical system and land cadastral records in force, regarding land-use categories applied in the RM, as well as their correspondence with the categories in the 2006 IPCC Guidelines.

Table 6-7: Correspondence of land categories in the national classification and in the 2006 IPCC Guidelines

IPCC Categories	National classification according to Land Cadastre (aggregated in 11 categories)
(1) Forest Land (4A)	**(1) forests** (land covered with forests, forest land in a regeneration process (parks, grooves, forest stands affected by fires, degraded stands, forest crops planted in the Forest Fund and not achieved the canopy closure stage etc.) and **(2) afforestation**
(2) Cropland (4B)	**(3) vineyards**, **(4) orchards** (including fruit orchards, woody vegetation in individual gardens etc.), **(5) other forest vegetation** (including windbreaks for agricultural land, green areas etc.), **(6) arable land**
(3) Grassland (4C)	**(7) pastures and hayfields** (including landslides, land undergoing improvement and fertility restoration)
(4) Wetlands (4D)	**(8) water basins (9) standing waters, flowing waters**
(5) Settlements (4E)	**(10) constructions**, streets, yards, markets, roads
(6) Other Land (4F)	**(11) ravines,** other land categories not included in previous categories

The current inventory covers the entire area of the RoM. Data in Table 6-8 confirms that all the land for the period 1990-2022 is aggregated in the inventory.

Table 6-8: Evolution of land area included in the National Inventory System (NIS) according to the 2006 IPCC Guidelines Use Categories

IPCC Categories	Area, thousand ha							
	1990	1995	2000	2005	2010	2015	2020	2022
I. Forest Land (4A), total	371.40	369.80	372.30	392.82	411.07	414.10	417.05	417.17
1.1. Forests	368.57	369.24	371.95	388.45	410.63	413.48	416.41	415.57
1.2. Afforested Land (conversions)	2.83	0.56	0.35	4.38	0.44	0.62	0.64	1.60
II. Cropland (4B), total	2258.40	2241.80	2212.50	2198.52	2197.76	2203.59	2204.86	2206.77
2.1. Forest Vegetation	47.00	55.20	50.50	50.47	52.03	51.15	50.78	50.70
2.2. Vineyards	218.80	195.90	162.20	157.34	149.58	136.17	126.23	121.65
2.3. Orchards	251.80	216.70	172.70	141.68	149.21	152.73	151.83	147.78
2.4. Cropland	1740.80	1774.00	1827.10	1849.03	1846.95	1863.53	1876.02	1886.63

IPCC Categories	Area, thousand ha							
	1990	1995	2000	2005	2010	2015	2020	2022
III. Grassland (4C), total	390.70	400.60	412.80	399.14	380.92	373.87	362.89	361.11
IV. Wetlands (4D), total	89.40	92.40	96.60	96.08	99.64	96.66	96.54	96.94
V. Settlements (4E), total	218.43	234.10	236.10	235.78	233.64	236.48	244.70	245.24
VI. Other Land (4F), total	56.30	45.93	54.33	62.28	61.60	59.93	58.60	57.40
RoM - Total	**3384.63**	**3384.63**	**3384.63**	**3384.63**	**3384.63**	**3384.63**	**3384.63**	**3384.63**

Source: Land Cadastre of the Republic of Moldova for the period 1970-2022. Land Use and Land-Use Change Matrix in the RM for the period 1970-2022.

According to current research and pedological records, no organic soils are registered in the RoM.

6.1.9. Information on approaches used to represent lands and on land-use databases used for the inventory preparation

In accordance with the provisions of the 2006 IPCC Guidelines, Chapter 3 'Consistent Representation of Lands', Approach 3 is used for Forest Land and Conversions of Forest Land with respect to the cadastral database (the time series starts in 1970). Approach 1 is used for Forest Land Conversion, to the extent that there are no explicit statistics and tracking of land that was converted from Forest Land (thereby resulting in the difference from the net area of the national forest reported at the end of the year and taking into account the conversions to Forest Land). Likewise, Approach 1 is applied to all other categories of Non-Forest Land (due to a combination of cadastral and non-cadastral data).

The Representation of Land Approach may be assessed cumulatively: Approach 3 of the IPCC (considering the cadastral basis of land-use representation and information for net area at the end of the year, as well as conversions to Forest Land through artificial plantations) and Approach 1 (considering that conversion from Forest Land to Non-Forest Land and among other classifications of land are estimated based on assumptions). Conversion parts are generated based on records prior to 1994 regarding explicit conversion among Non-Forest Land categories. Conversion from Forest Land is derived from the net change in the total forest area and the annual afforestation rate.

The RoM has developed the Land Use and Land-Use Change Matrix since 1970 based on the annual data reported by the General Land Cadastre. The Land Use and Land-Use Change Matrix has 11 entries which are then grouped into the six major IPCC categories (the national classification is highlighted in bold in Table 6-7). The matrix implements the 20-year transition period for conversions for mineral soils in all types of conversions, as well as litter and dead wood for conversions to Forest Land. Likewise, a one-year transition period is implemented in the matrix for the loss of biomass, litter and dead wood in conversions from a large stock to a low one or to land-uses where C in biomass, litter, or dead wood is inexistent.

6.1.10. Planned Improvements

Planned improvements at source and sink category level within the Sector 4 'LULUCF' are described in detail in subchapters 6.2-6.8 of this Report. The independent peer reviews and UNFCCC technical reviews are inspiration sources for the development of the inventory.

6.2. Forest Land (category 4A)

6.2.1. Source Category Description

Category 4A 'Forest Land' covers estimations of CO_2 emissions/removals from the Republic of Moldova's forests, including above-ground and below-ground biomass (biomass increments in forests, losses from authorized and illegal harvesting etc.), soil carbon losses (carbon losses/gains due to conversion). The respective estimations were made separately for two categories: 4A1 'Forest Land Remaining Forest Land' and 4A2 'Land Converted to Forest Land'.

According to the national definition, '*forest*' is an element of geographical landscape, a functional unit of the biosphere, composed of the totality of forest vegetation (dominated by trees and shrubbery), live layers, animals and microorganisms which are interdependent in their biological development and affect their habitat. Lands covered with forest vegetation occupying areas over 0.25 ha are regard-

ed as forests. The minimal consistency of trees and shrubbery for the lands with forest vegetation to be considered forests should reach an operational level of 30%. The consistency requirement should apply only to trees and shrubbery with a natural potential to reach a minimum height of 5 meters at maturity, which is in accordance with the definition in the national legislation (Forestry Code, art. 3), and the CDM projects of the RoM.

In the RoM, the areas covered with forests varied considerably over time, from 366.2 thousand ha in 1848 to 222.0 thousand ha in 1945[116], recovering to 370.7 thousand ha in 2022 or circa 11.2% of the country's territory (Figure 6-3).

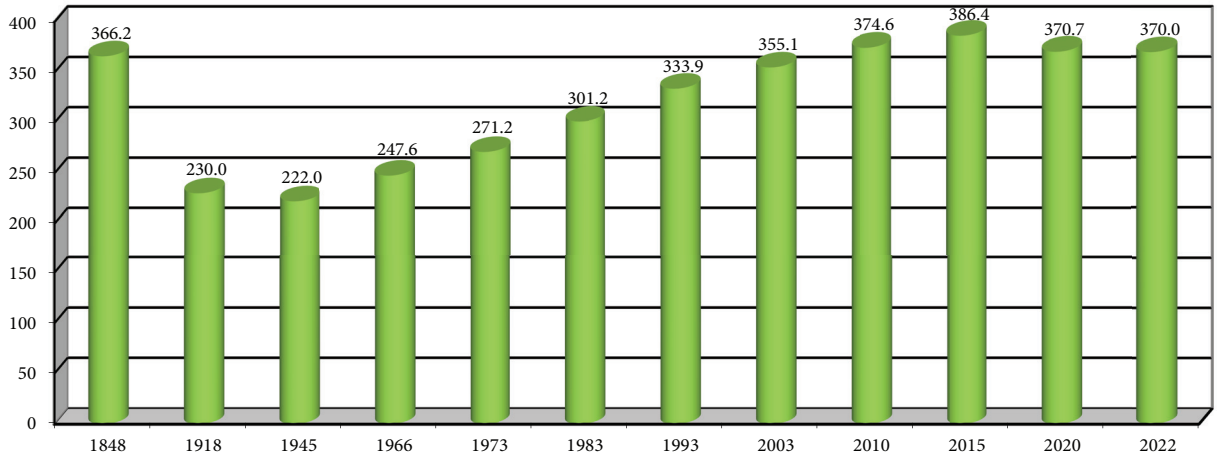


Figure 6-3: Evolution of areas covered with forests in the RoM between 1848-2022, kha.

The total volume of standing wood mass in the forests is circa 45.4 million m^3, on average 118 m^3 per hectare. The average forest increment is 3.8 m^3/year/ha, and the total average increment is circa 1410 thousand m^3/year. The average production class is 3.9[117]. The structure by age in all forest species is misbalanced, particularly in those of low productivity.

6.2.2. Methodologies, Emission Factors and Activity Data

Living Biomass

To estimate CO_2 emissions/removals from subcategory 4A1 'Forest Land Remaining Forest Land', current biomass increments in forest were established (in accordance with production tables and forest planning materials on annual growth of species in forests of the RoM) as well as from losses from authorized and illegal harvesting of wood. This approach allows the implementation of Tier 1 (Gain-Loss) method and Tier 2 method for all data used. The calculation process took place in two stages, using equation 2.9 in Volume 4, Chapter 2 of the 2006 IPCC Guidelines:

1. Annual changes in carbon stocks due to biomass increments in forest land remaining forest land (in stem, branches, leaves, roots), using the following equation:

$$\Delta C_G = \Sigma(A \bullet G_{total} \bullet CF)$$

Where:

ΔC_G – annual increase in biomass carbon stocks due to biomass growth in land remaining forest land, tonnes C/yr;

A – area of forest land remaining forest land, ha;

CF – carbon fraction;

G_{total} – average annual biomass growth above and below-ground (t CM[118]/yr/ha), calculated using equation 2.10 in Vol. 4, Chapter 2 of the 2006 IPCC Guidelines:

$$G_{total} = \Sigma\{Iv \bullet BCEF_I \bullet (1 + R)\}$$

Where:

[116] Vdovii, Gh., Galupa, D. et al. (1997), National Report on the State of the Forest Fund of the Republic of Moldova; Galupa D., Talmaci I., Spitoc L. (2006), Forestry Sector of the Republic of Moldova – Issues, Accomplishments, Perspectives; Galupa, D., Platon, I. et al. (2011), Report on the Conditions of the Forest Resources in the Republic of Moldova: 2006-2010. 'Moldsilva' Agency; Ch., 48 p.; Government Decision No. 52 dated 29.04.2021 on approving the Land Cadastre as of January 1, 2021; Government Decision No. 391 dated 15.06.2022 on approving the Land Cadastre of the RM as of January 1, 2022; Government Decision No. 415 dated 21.06.2023 on approving the Land Cadastre of the RM as of January 1, 2023;

[117] Ion Talmaci, Erii Prosii, Ala Mardari, Alexandru Varzari, Alexandru Galupa (2018), Forests of the Republic of Moldova, current state, qualitative and quantitative indicators. Forest Magazine, No. 3/2018, SC Magic Print Ltd., Onesti. pp. 7-20. ISSN 1583-7890.

[118] Constant mass.

Iv – average annual biomass growth, m³/yr/ha;

R – root-shoot ratio;

$BCEF_I$ – biomass conversion and expansion factor for conversion of net annual increment in volume (including bark) to above-ground biomass growth for specific vegetation type (tonnes above-ground biomass growth / m³ net annual increment), which can be calculated following the following formula:

$$BCEF_I = BEF_I \bullet D$$

Where:

BEF_I – biomass expansion factor for annual net tree biomass increase;

D – basic wood density, t CM/m³ volume for standing wood.

2. Annual decrease in carbon mass through biomass removals (from authorized felling and illegal logging, natural and technogenic disturbances), estimated by the following formula:

$$\Delta C_L = L_{fellings} + L_{fuelwood} + L_{perturbations}$$

Where:

ΔC_L – annual decrease in carbon stocks due to biomass loss (felling and other losses), t C/yr;

$L_{fellings}$ – annual carbon loss due to commercial felling, t C/yr;

$L_{fuelwood}$ – annual carbon loss due to fuelwood removals, t C/yr;

$L_{perturbations}$ – annual carbon loss due to loss of biomass affected by disturbances (diseases and pests, natural calamities, mass droughts, etc.), t C/yr.

The respective indicators were estimated by the following formula:

$$L_{fellings} = \{H \bullet BCEF_R \bullet (1+R)\} \bullet CF$$

Where:

H – annual wood removals m³;

$BCEF_R$ – biomass conversion and expansion factors for extracted roundwood conversion (including tree bark), (t of biomass extracted/m³ extractions), which can be estimated by the following formula:

$$BCEF_R = D \bullet BEF_R$$

Where:

D – basic wood density (t CM/m³ volume for standing wood);

BEF_R – biomass expansion factor for extracted roundwood.

$$L_{fuelwood} = [\{FG_{trees} \bullet BCEF_R \bullet (1+R)\} + FG_{parts\ of\ trees} \bullet D] \bullet CF$$

Where:

FG_{trees} – annual volume of fuelwood removal of whole trees, m³;

$FG_{parts\ of\ trees}$ – annual volume of fuelwood removal as parts of trees, m³ (= 0 to the extent that this method is not used in forestry practice in the Republic of Moldova);

$BCEF_R$ – biomass conversion and expansion factors for extracted fuelwood conversion (including tree bark), (t of biomass extracted/m³ extractions), which can be estimated by the following formula:

$$BCEF_R = D \bullet BEF_R$$

Where:

D – basic wood density (t CM/m³ volume for standing wood);

BEF_R – biomass expansion factor for fuelwood removals.

The volumes from $L_{perturbations}$ were included in $L_{felling}$ and $L_{fuelwood}$, as forests in the Republic of Moldova are intensively managed, being regularly drawn in cleaning cuttings (including selective sanitation treatments), final harvesting (including sanitation cuttings) and various cuttings (including sanitation cuttings).

In principle, for both stages, the methodologies described in the 2006 IPCC Guidelines are applicable under the conditions of the RoM for both estimation stages previously described.

At the same time, country-specific emission/removal factors were used, regarding annual biomass increments, carbon fraction etc., as well as sectoral activity data (forest land areas by species/category of species, afforestation, wood harvesting, etc.).

Eleven groups of species were formed for the inventory process so as to reflect all diversity of forest species growing in the forests of the RoM (Table 6-9).

Table 6-9: Groups of forest species and their structure in the RoM for GHG inventory

No.	Groups of species by name		Species	Abbreviations
	Scientific name	Common		
1.	*Quercus spp.*	Oak tree	English Oak, durmast, downy oak, red oak	QU
2.	*Carpinus ssp.*	Hornbeam	Hornbeam (*Carpinus betulus*), beech (*Fagus sylvatica L.*)	CA
3.	*Fraxinus spp.*	Ash tree	Ash tree, flowering ash etc.	FR
4.	*Acer spp.*	Sycamore maple	Field maple, Common maple, Mountain maple, Silver maple	AC
5.	*Ulmus spp.*	Elm	Field elm, Elm tree, Turkestan elm, etc.	UL
6.	*Tilia spp.*	Linden tree	Foul lime, Silver lime, big leaf linden tree, etc.	TI
7.	*Salix spp.*	Willow	Willow, Osier, etc.	SA
8.	*Pinus spp.*	Pine	Sylvester pine, Black pine, Spruce fir, Fir tree, etc.	PI
9.	*Populus spp.*	Poplar	White poplar, Black poplar, Aspen tree	PO
10.	*Robinia spp.*	Acacia	Acacia, Honey locust, Sophora	RB
11.	*Other species*	Other species	Apple tree, pear tree, cherry tree, mahaleb cherry tree, appricot tree, Tatar maple tree, silver berry tree, ash-leaved maple, etc.	OS

In order to estimate biomass increments in forests and CO_2 removals, data from a series of national/sectoral reports on forestry resources regarding the evolution of forest land in the RoM were used, for the period 1990-2022 (Table 6-10). At the same time, beginning with 2013, information on the distribution of predominant forest species were taken from the Forestry Research and Management Institute database.

Table 6-10: Areas of forest land in the RoM between 1990-2022, kha

Year	Total	Distribution of forest land by species										
		QU	CA	FR	AC	UL	TI	SA	PI	PO	RB	OS
1990	325.4	140.6	9.4	16.6	2.9	3.1	2.9	1.9	6.9	5.7	124.0	11.4
1991	328.2	141.3	9.4	16.7	2.9	3.1	2.9	2.0	6.9	5.9	125.7	11.4
1992	331.0	142.0	9.4	16.8	3.0	3.1	2.9	2.1	6.9	6.0	127.4	11.4
1993	333.9	142.7	9.5	16.9	3.0	3.1	2.9	2.2	6.9	6.1	129.1	11.5
1994	335.4	143.1	9.9	17.2	3.0	3.1	2.9	2.2	6.9	6.2	130.0	10.9
1995	336.9	143.5	10.2	17.6	3.0	3.1	2.9	2.3	6.9	6.2	130.9	10.4
1996	338.4	143.8	10.6	17.9	3.0	3.1	2.9	2.3	6.9	6.3	131.7	9.8
1997	339.9	144.2	11.0	18.2	3.0	3.1	2.9	2.4	6.9	6.3	132.6	9.3
1998	341.4	144.6	11.3	18.6	3.0	3.1	2.9	2.4	6.9	6.4	133.5	8.7
1999	342.9	145.0	11.7	18.9	3.0	3.1	2.9	2.5	6.9	6.5	134.4	8.1
2000	344.4	145.3	12.1	19.2	3.0	3.1	2.9	2.5	6.9	6.5	135.3	7.6
2001	345.9	145.7	12.4	19.6	3.0	3.1	2.9	2.6	6.9	6.6	136.1	7.0
2002	347.3	146.0	12.8	19.9	3.0	3.1	2.9	2.6	6.9	6.6	137.0	6.4
2003	352.4	148.4	12.6	20.1	3.2	3.2	3.1	2.5	6.9	6.7	137.9	7.8
2004	357.6	151.7	12.4	20.2	3.4	3.4	3.2	2.4	6.9	6.8	138.8	8.4
2005	362.7	153.6	12.1	20.3	3.7	3.8	3.4	2.4	7.0	6.9	139.7	9.8
2006	366.0	153.9	12.1	20.5	4.0	3.8	3.4	2.4	7.0	7.0	141.9	10.0
2007	369.0	154.2	11.8	20.7	4.1	3.9	3.5	2.4	7.0	7.0	144.4	10.0
2008	372.0	154.7	11.9	20.8	4.1	3.9	3.5	2.4	6.9	7.1	146.7	10.0
2009	372.9	155.1	12.1	20.9	4.1	3.9	3.5	2.4	6.9	7.1	146.9	10.0
2010	374.5	155.4	12.1	21.0	4.1	3.9	3.5	2.4	6.9	7.1	148.0	10.1
2011	374.8	155.6	12.1	21.0	4.1	3.9	3.5	2.4	6.9	7.1	148.1	10.1
2012	375.3	155.8	12.1	21.0	4.1	3.9	3.5	2.4	6.9	7.1	148.3	10.1
2013	372.8	154.7	12.0	20.9	4.1	3.9	3.5	2.4	6.8	7.1	147.3	10.1
2014	379.4	167.1	16.4	21.8	5.7	4.1	5.7	3.9	6.3	7.5	125.6	15.3
2015	386.4	170.3	16.7	22.2	5.8	4.2	5.8	4.0	6.4	7.7	128.0	15.4
2016	386.5	170.3	16.7	22.2	5.8	4.2	5.8	4.0	6.4	7.7	128.1	15.4
2017	374.3	164.9	16.1	21.5	5.6	4.1	5.6	3.9	6.2	7.4	124.1	14.9
2018	378.7	166.8	16.3	21.7	5.7	4.1	5.7	3.9	6.3	7.5	125.5	15.1
2019	373.2	164.4	16.1	21.4	5.6	4.1	5.6	3.8	6.2	7.4	123.7	14.9

Year	Total	Distribution of forest land by species										
		QU	CA	FR	AC	UL	TI	SA	PI	PO	RB	OS
2020	370.7	163.3	16.0	21.3	5.6	4.1	5.6	3.8	6.2	7.4	122.9	14.8
2021	371.0	163.5	16.0	21.3	5.6	4.0	5.6	3.8	6.2	7.3	122.9	14.8
2022	370.0	163.5	16.0	21.3	5.6	4.0	5.6	3.8	6.2	7.3	122.9	13.8

Source: Galupa, D., Platon, I. et al. (2011), National Report on Forestry Resources of the RoM: 2006-2010, 'Moldsilva' Agency, Ch., 48 p.; OSC Report on updating basic indicators for forest and other types of forest vegetation in the RM (2016); 'Moldsilva' Agency, (2020), Materials of the Scientific-Practical Symposium 'Ensuring sustainable forest management by implementing forestry treatments and promoting natural regeneration of forests'. Chisinau, 61 p.; Land Cadastre of the RoM for 1990-2022; Land Use and Land-Use Change Matrix for 1970-2022.

Forest Land Remaining Forest Land. Final data on species distribution over the period under review was obtained by modelling the primary data set obtained from the Statistical Records and Reports of 'Moldsilva' Agency, according to which the total area of forest species planted over the reference period consisted of: *Robinia species* – circa 80%, *Juglans spp.* (*Regia and Nigra*) – 8%, *Quercus species* – 3%, *Populus* and *Salix species* – 3%, *other species* – 6%. The respective species distribution (Table 6-10) was applied for the area included in subcategory 4A1 'Forest Land Remaining Forest Land' according to the Land Use and Land-Use Change Matrix of the RoM for 1970-2022. Consequently, relevant data was gathered for the GHG inventory in subcategory 4A1 'Forest Land Remaining Forest Land' (Table 6-11).

Table 6-11: Forest land areas remaining forest land (4A1) in the RoM between 1990-2022, kha

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Quercus spp.	97.76	99.33	103.72	107.53	110.63	113.35	116.52	118.55	120.54	123.36	126.75
Carpinus spp.	6.54	6.61	6.87	7.16	7.63	8.08	8.59	9.01	9.45	9.95	10.52
Fraxinus spp.	11.54	11.74	12.27	12.74	13.33	13.88	14.50	14.99	15.48	16.08	16.77
Acer spp.	2.02	2.04	2.19	2.26	2.32	2.37	2.43	2.47	2.50	2.55	2.62
Ulmus spp.	2.16	2.20	2.26	2.34	2.40	2.45	2.51	2.55	2.58	2.64	2.70
Tilia spp.	2.02	2.04	2.12	2.19	2.24	2.29	2.35	2.38	2.42	2.47	2.53
Salix spp.	1.32	1.41	1.53	1.66	1.74	1.81	1.89	1.96	2.02	2.10	2.19
Pinus spp.	4.80	4.85	5.04	5.20	5.34	5.45	5.59	5.67	5.75	5.87	6.02
Populus spp.	3.96	4.15	4.38	4.60	4.76	4.91	5.09	5.21	5.34	5.50	5.69
Robinia spp.	86.22	88.37	93.06	97.28	100.51	103.40	106.73	109.03	111.31	114.36	117.97
Other species	7.93	8.01	8.33	8.67	8.43	8.22	7.94	7.65	7.25	6.89	6.63
Groves[119]	31.99	32.11	30.53	29.99	27.64	25.98	25.54	25.87	26.77	24.63	24.32
Total	**258.25**	**262.85**	**272.30**	**281.60**	**286.95**	**292.20**	**299.67**	**305.34**	**311.41**	**316.42**	**324.71**
Species	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Quercus spp.	128.28	128.06	128.32	130.51	131.76	130.54	131.44	131.78	131.96	132.60	131.93
Carpinus spp.	10.94	11.23	10.90	10.67	10.38	10.26	10.06	10.14	10.29	10.32	10.27
Fraxinus spp.	17.23	17.45	17.38	17.38	17.41	17.39	17.64	17.72	17.78	17.92	17.82
Acer spp.	2.64	2.63	2.77	2.93	3.17	3.39	3.49	3.49	3.49	3.50	3.48
Ulmus spp.	2.73	2.72	2.77	2.93	3.26	3.22	3.32	3.32	3.32	3.33	3.31
Tilia spp.	2.55	2.54	2.68	2.75	2.92	2.88	2.98	2.98	2.98	2.99	2.97
Salix spp.	2.25	2.28	2.16	2.06	2.06	2.04	2.05	2.04	2.04	2.05	2.04
Pinus spp.	6.08	6.05	5.97	5.94	6.00	5.94	5.97	5.88	5.87	5.89	5.85
Populus spp.	5.79	5.82	5.79	5.85	5.92	5.94	5.97	6.05	6.04	6.06	6.02
Robinia spp.	119.87	120.18	119.24	119.39	119.81	120.37	123.09	124.96	124.98	126.29	125.60
Other species	6.16	5.61	6.74	7.23	8.41	8.48	8.52	8.52	8.51	8.62	8.57
Groves	24.48	24.97	27.76	27.79	25.84	28.69	30.43	30.42	34.73	33.39	30.49
Total	**329.01**	**329.57**	**332.48**	**335.43**	**336.94**	**339.15**	**344.96**	**347.30**	**352.00**	**352.95**	**348.34**
Species	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Quercus spp.	127.64	122.80	129.17	128.69	124.88	118.55	117.16	111.24	107.07	105.66	105.83
Carpinus spp.	9.93	9.55	12.64	12.59	12.22	11.60	11.46	10.88	10.48	10.37	10.36
Fraxinus spp.	17.24	16.59	16.81	16.75	16.25	15.43	15.25	14.48	13.93	13.81	13.79
Acer spp.	3.37	3.24	4.42	4.41	4.27	4.06	4.01	3.81	3.66	3.63	3.62
Ulmus spp.	3.20	3.09	3.20	3.19	3.09	2.94	2.90	2.76	2.66	2.59	2.59
Tilia spp.	2.88	2.76	4.41	4.39	4.26	4.04	4.00	3.79	3.65	3.63	3.62
Salix spp.	1.97	1.90	3.02	3.01	2.92	2.77	2.74	2.60	2.50	2.46	2.46
Pinus spp.	5.66	5.40	4.88	4.86	4.72	4.48	4.42	4.20	4.05	4.02	4.01
Populus spp.	5.83	5.64	5.81	5.79	5.62	5.33	5.27	5.01	4.82	4.73	4.73
Robinia spp.	121.51	116.89	97.10	96.73	93.96	89.19	88.15	83.69	80.56	79.66	79.55
Other species	8.29	7.98	11.82	11.65	11.31	10.73	10.61	10.07	9.68	9.59	8.93
Groves	30.27	33.54	26.26	20.94	19.88	29.08	26.44	29.42	30.36	29.89	30.53
Total	**337.79**	**329.39**	**319.53**	**312.99**	**303.38**	**298.19**	**292.40**	**281.95**	**273.43**	**270.05**	**270.04**

Source: Land Cadastre of the RoM for 1990-2022; Land Use and Land-Use Change Matrix in the RoM for 1970-2022.

[119] It includes forest lands with consistency below the average index of 0.3, which are part of the forest management (regenerating patches, forest crops up to the state of massif, forest nurseries, different types of forest plantations, etc.)

Harvested Wood Products. The volume of harvested timber includes commercial timber (without bark), as well as the quantity of fuelwood gathered in the RoM (round fuelwood, branches and tips, bark, illegally harvested wood). In national statistical reports, commercial timber is identified as 'working timber'. BEF_R (Table 6-15) is applied only to the volume of commercial timber and it only comprises bark. Data is provided by 'Moldsilva' Agency and environmental protection organisations (Environmental Protection Inspectorate and the Environment Agency) on authorized felling and illegal logging in forests and other woody vegetation areas managed by the State Forestry Authorities and by the Environmental Protection Inspectorate (Environment Agency) for areas managed by local public authorities, and by the Statistical Yearbooks of ATULBD[120] on wood harvests in forests on the LBDR (Table 6-12).

Thus, the largest wood harvests were reached in 2022 with a volume of about 712 thousand m^3 or circa 51% of the current annual increase. The respective volume also includes the anticipated harvesting of about 125 thousand m^3 at the expense of 2023, which is to be inferred according to strict procedures.

Table 6-12: Wood harvests in the RoM between 1990-2022, thousand m^3

Sort categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Commercial timber	39.42	27.00	27.39	31.50	39.80	68.49	51.69	52.70	38.00	38.79	39.68
Fuelwood	184.80	376.50	490.29	489.18	538.70	531.42	450.43	423.85	398.55	368.62	393.34
Total	**224.22**	**403.50**	**517.68**	**520.68**	**578.50**	**599.91**	**502.12**	**476.55**	**436.55**	**407.41**	**433.02**
Sort categories	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Commercial timber	37.28	50.41	46.99	43.47	39.01	46.51	44.44	42.79	37.34	40.63	33.91
Fuelwood	432.47	381.98	420.20	415.37	394.79	430.10	390.92	401.84	396.83	429.89	485.45
Total	**469.75**	**432.39**	**467.19**	**458.84**	**433.80**	**476.61**	**435.36**	**444.63**	**434.16**	**470.52**	**519.36**
Sort categories	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Commercial timber	31.69	29.92	25.60	28.00	50.16	46.20	47.30	44.40	44.58	37.10	60.90
Fuelwood	541.47	587.20	624.33	607.32	567.42	589.71	596.71	561.29	532.99	486.20	651.24
Total	**573.16**	**617.12**	**649.93**	**635.32**	**617.57**	**635.91**	**644.01**	**605.69**	**577.57**	**523.3**	**712.14**

Source: Statistical Records, 'Moldsilva' Agency Reports, Environmental Protection Inspectorate and the Environment Agency for the period 1990-2022; Galupa, D., Talmaci, I., Spitoc, L. (2005), Study for the Republic of Moldova 'Ensuring Sustainability of Forests and Livelihoods through Improving Governance and Control of Illegal Logging'. Chisinau, Editorial Centre of SAUM, 2005, 116 pages; Statistical Yearbooks of ATULBD (2000-2021), available at http://mer.gospmr.org/deyatelnost/gosudarstvennaya-sluzhba-statistiki-gosstat/informacziya/arhiv/soczialnoe-razvitie-pmr/ezhegodnik-gosudarstvennoj-sluzhby-statistiki/ezhegodnik-po-respublike.html; Galupa D., Ciobanu A., Scobioala ., et al. (2011), Illegal Logging of Forest Vegetation in the Republic of Moldova. Analytical Study, Chisinau, 'Moldsilva' Agency, 38 pages; Bank of statistical data (Moldova), NBS, available at: http://statbank.statistica.md/PxWeb/pxweb/ro/10%20Mediul%20inconjurator/10%20Mediul%20inconjurator__MED050/MED050400.px/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774.

Since the SY of the RoM provide a national aggregated value of harvested wood, division by species is made based on records from 'Moldsilva' Agency (except for some species suitable for industrial processing): (i) hardwood – oak, durmast oak, hornbeam, ash tree, sycamore maple, elm, acacia, etc.; (ii) softwood – poplar, willow, linden tree, birch, etc. The ratio of the estimated volume by species to total volume harvested per year provides data of acceptable quality (the difference between the estimated volume and harvested volume is on average 5-10%). The maximum harvest value of working timber was reached in 1995 – 68.5 thousand m^3 or 11.4% of the total volume of harvested wood mass. Distribution by species of wood for industrial processing and fuelwood, harvested between 1990 and 2022, is presented in Tables 6-13 and 6-14.

Table 6-13: Commercial timber harvests in the RoM between 1990-2022, thousand m^3

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Quercus spp.	7.16	4.32	4.09	4.41	6.88	9.59	10.05	10.26	7.40	7.51	7.77
Carpinus spp.	1.05	0.71	0.72	0.83	1.04	1.79	1.35	1.39	1.00	0.99	1.07
Fraxinus spp.	3.65	2.99	3.24	3.94	4.03	8.56	4.47	4.47	3.23	3.49	3.17
Acer spp.	0.31	0.23	0.23	0.27	0.34	0.58	0.45	0.44	0.32	0.37	0.28
Ulmus spp.	0.17	0.1	0.1	0.12	0.15	0.26	0.19	0.21	0.15	0.13	0.18
Tilia spp.	3.78	2.48	2.52	2.9	3.66	6.31	4.70	4.91	3.54	3.34	3.97
Salix spp.	0.26	0.19	0.19	0.22	0.28	0.48	0.37	0.36	0.26	0.30	0.24
Pinus spp.	0.28	0.17	0.18	0.2	0.26	0.44	0.32	0.35	0.25	0.22	0.30
Populus spp.	4.87	3.2	3.26	3.74	4.73	8.14	6.07	6.33	4.56	4.32	5.11
Robinia spp.	16.74	12.02	12.26	14.18	17.54	30.83	22.66	22.70	16.37	17.67	16.13
Other species	1.15	0.59	0.6	0.69	0.89	1.51	1.06	1.28	0.92	0.45	1.46
Total	**39.42**	**27.00**	**27.39**	**31.50**	**39.80**	**68.49**	**51.69**	**52.70**	**38.00**	**38.79**	**39.68**

[120] Because the ATULBD did not publish the Statistical Yearbook for the years 2021-2022, wood harvests in 2021-2022 in ATULBD forests were calculated as the average of the last five years reported in the published statistical yearbooks of the respective structures.

Species	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Quercus spp.	5.18	10.12	10.31	9.34	7.63	9.26	7.49	7.17	5.84	7.16	5.68
Carpinus spp.	1.09	1.85	1.00	0.92	1.05	1.28	0.92	1.13	0.77	0.87	0.74
Fraxinus spp.	2.96	4.45	3.41	3.03	3.12	5.57	5.94	6.02	5.70	5.83	4.03
Acer spp.	0.30	0.42	0.26	0.19	0.28	0.28	0.28	0.25	0.15	0.20	0.14
Ulmus spp.	0.19	0.24	0.22	0.22	0.18	0.27	0.31	0.20	0.17	0.19	0.24
Tilia spp.	4.86	4.82	4.22	4.47	3.90	4.06	3.45	3.84	3.24	3.42	3.17
Salix spp.	0.32	0.29	0.20	0.21	0.24	0.31	0.42	0.38	0.38	0.14	0.19
Pinus spp.	0.33	0.00	0.00	1.10	0.30	0.79	1.60	0.60	0.89	1.19	1.95
Populus spp.	2.89	5.82	8.28	6.62	5.02	7.81	6.44	6.09	4.87	6.32	5.61
Robinia spp.	18.19	19.94	16.43	15.93	15.85	15.68	16.58	16.01	14.34	14.41	11.47
Other species	0.97	2.46	2.66	1.44	1.44	1.22	1.01	1.10	0.98	0.89	0.69
Total	**37.28**	**50.41**	**46.99**	**43.47**	**39.01**	**46.51**	**44.44**	**42.79**	**37.34**	**40.63**	**33.91**
Species	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Quercus spp.	4.77	6.28	6.05	6.62	12.15	8.56	8.76	8.22	10.39	8.30	17.40
Carpinus spp.	0.49	0.52	0.33	0.36	0.40	1.10	1.12	1.05	0.34	0.10	0.20
Fraxinus spp.	4.52	4.76	4.26	4.66	7.49	5.16	5.29	4.96	9.57	5.10	11.30
Acer spp.	0.11	0.15	0.06	0.06	0.14	0.30	0.31	0.29	0.12	0.10	0.10
Ulmus spp.	0.12	0.17	0.06	0.06	0.07	0.20	0.20	0.19	0.11	0.30	0.10
Tilia spp.	2.67	2.21	2.00	2.19	5.46	4.27	4.37	4.10	3.57	2.70	3.90
Salix spp.	0.24	0.25	0.07	0.08	0.37	0.31	0.32	0.30	0.83	0.10	0.70
Pinus spp.	1.35	0.73	0.62	0.68	0.49	0.67	0.68	0.64	0.61	0.30	0.60
Populus spp.	5.26	5.06	4.69	5.13	9.52	6.39	6.54	6.14	9.96	10.20	14.50
Robinia spp.	11.69	9.43	7.09	7.76	13.50	18.07	18.50	17.37	8.92	9.70	11.40
Other species	0.47	0.36	0.37	0.40	0.56	1.18	1.21	1.13	0.16	0.20	0.70
Total	**31.69**	**29.92**	**25.60**	**28.00**	**50.16**	**46.20**	**47.30**	**44.40**	**44.58**	**37.10**	**60.90**

Source: Statistical Records, Reports from 'Moldsilva' Agency, Environmental Protection Inspectorate and the Environment Agency for the period 1990-2022.

Data on the volume of fuelwood also includes the volume of twigs, boughs, branches, etc., which are also used for heating and cooking. Considering that most illegal loggings occur in forests managed by local public authorities, situated near settlements and composed preponderantly of acacia, the respective volumes were attributed to category 'RB' (*Robinia spp.*).

Table 6-14: Fuelwood harvests in the RoM between 1990-2022, thousand m³

Species	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Quercus spp.	30.10	50.35	49.29	51.15	39.07	63.60	58.99	49.12	64.60	55.32	53.71
Carpinus spp.	12.50	17.96	13.24	13.15	10.05	11.30	15.45	20.41	26.84	24.10	23.40
Fraxinus spp.	15.80	38.99	56.52	73.07	55.81	71.97	73.74	25.80	33.93	30.09	29.22
Acer spp.	8.70	11.39	6.65	6.19	4.73	5.30	5.00	14.12	18.57	16.64	16.16
Ulmus spp.	3.50	6.19	6.54	10.23	7.81	8.76	2.26	5.72	7.52	6.38	6.19
Tilia spp.	10.60	18.97	20.40	29.23	22.32	20.10	19.50	17.29	22.73	19.59	19.02
Salix spp.	3.40	6.68	7.95	12.42	9.49	10.64	4.14	5.57	7.33	6.32	6.13
Pinus spp.	0.40	2.10	4.09	6.58	5.02	5.63	3.80	0.70	0.92	0.74	0.72
Populus spp.	11.80	34.34	55.04	73.07	55.81	74.35	70.09	19.21	25.26	20.32	19.73
Robinia spp.	76.80	172.62	256.75	198.01	316.31	246.00	184.48	247.59	166.76	168.74	199.28
Other species	11.20	16.91	13.82	16.08	12.28	13.77	12.98	18.32	24.09	20.38	19.78
Total	**184.80**	**376.50**	**490.29**	**489.18**	**538.70**	**531.42**	**450.43**	**423.85**	**398.55**	**368.62**	**393.34**
Species	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Quercus spp.	48.34	56.93	65.45	64.16	56.64	71.56	57.00	59.84	59.35	65.69	79.64
Carpinus spp.	22.46	23.41	23.07	25.30	24.68	27.49	23.70	27.73	26.27	30.17	34.86
Fraxinus spp.	28.35	28.91	32.38	30.63	30.81	48.42	47.74	49.05	52.75	62.33	51.55
Acer spp.	14.17	17.49	16.50	17.13	17.04	23.05	21.44	23.48	23.33	23.79	22.06
Ulmus spp.	5.78	6.36	8.32	7.07	6.53	10.45	10.47	8.55	9.90	12.74	20.56
Tilia spp.	18.93	18.35	21.63	23.40	20.06	27.66	24.71	25.19	22.43	22.98	22.18
Salix spp.	5.48	6.55	6.28	8.22	6.47	9.95	8.43	7.85	4.75	5.42	7.79
Pinus spp.	1.41	0.00	0.00	2.09	0.76	3.06	2.80	2.74	3.91	4.78	10.27
Populus spp.	17.37	21.29	28.96	28.19	20.80	27.11	23.26	25.04	23.82	26.00	30.91
Robinia spp.	252.20	181.90	190.09	187.09	190.14	164.27	155.19	153.64	148.00	156.80	182.12
Other species	17.98	20.79	27.52	22.09	20.86	17.08	16.17	18.74	22.32	19.20	23.51
Total	**432.47**	**381.98**	**420.20**	**415.37**	**394.79**	**430.10**	**390.92**	**401.84**	**396.83**	**429.89**	**485.45**

Species	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Quercus spp.	83.02	98.39	106.84	100.82	103.58	84.55	85.56	80.48	104.37	124.40	134.59
Carpinus spp.	40.26	43.26	45.93	44.15	44.61	33.76	34.16	32.13	42.44	40.23	39.51
Fraxinus spp.	63.35	71.66	76.71	74.44	73.67	64.42	65.19	61.32	91.65	86.03	101.15
Acer spp.	12.98	21.90	17.27	31.63	30.81	21.72	21.97	20.67	26.41	40.23	27.41
Ulmus spp.	21.48	20.25	19.15	15.12	17.29	13.15	13.31	12.52	12.81	11.26	12.82
Tilia spp.	28.72	29.86	30.30	31.28	38.27	30.36	30.72	28.90	36.52	31.56	32.01
Salix spp.	9.24	10.71	10.90	12.82	11.92	10.33	10.45	9.83	9.64	7.55	14.20
Pinus spp.	8.92	10.87	17.02	5.59	4.91	5.33	5.39	5.07	3.85	4.58	7.19
Populus spp.	33.72	39.37	42.69	40.88	41.78	45.14	45.67	42.96	40.67	30.33	48.05
Robinia spp.	200.93	208.77	208.91	222.77	164.35	252.34	255.34	240.18	138.82	105.46	202.80
Other species	38.85	32.16	48.61	27.82	36.23	28.61	28.95	27.23	25.81	4.58	31.51
Total	**541.47**	**587.20**	**624.33**	**607.32**	**567.42**	**589.71**	**596.71**	**561.29**	**532.99**	**486.20**	**651.24**

Source: Statistical Records, Reports of 'Moldsilva' Agency, Environmental Protection Inspectorate and the Environment Agency for the period 1990-2022; Capcelea A., Lozan A., Lupu I., et al. (2011), Analytical Study on Wood Mass Consumption in the RoM. 'Moldsilva' Agency, Chisinau, 48 pages; Statistical Yearbooks of ATULBD for 2000-2021, available at: http://mer.gospmr.org/deyatelnost/gosudarstvennaya-sluzhba-statistiki-gosstat/informacziya/arhiv/soczialnoe-razvitie-pmr/ezhegodnik-gosudarstvennoj-sluzhby-statistiki/ezhegodnik-po-respublike.html; Bank of statistical data (Moldova), NBS, available at: http://statbank.statistica.md/PxWeb/pxweb/ro/10%20Mediul%20inconjurator/10%20Mediul%20inconjurator__MED050/MED050400.px/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774.

In order to estimate annual biomass increments and losses, country-specific emission factors were calculated/developed (Tables 6-15 and 6-16). To estimate/develop these, production tables were used, as well as data on actual productivity of stands, according to the forest planning records.

Table 6-15: Coefficients used in the estimation of CO_2 emissions/removals from subcategory 4A1 'Forest Land Remaining Forest Land'[121]

Species	Average annual net increments, m^3/ha/year	Basic wood density, t CM/m^3 fresh volume	Biomass expansion factor for current increments, BEF_1	Biomass expansion factor for the volume of commercial timber harvested, BEF_R
Quercus spp.	3.9	0.835	1.20	1.20
Carpinus spp.	5.0	0.85	1.20	1.10
Fraxinus spp.	4.4	0.72	1.20	1.20
Acer spp.	2.3	0.75	1.20	1.15
Ulmus spp.	2.9	0.70	1.20	1.15
Tilia spp.	6.4	0.55	1.20	1.15
Salix spp.	6.5	0.38	1.20	1.20
Pinus spp.	4.7	0.535	1.15	1.10
Populus spp.	5.2	0.51	1.20	1.20
Robinia spp.	3.2	0.78	1.20	1.20
Other species	3.0	0.70	1.20	1.15

BEF_1 is generated from country-specific data (Table 6-15) so as to consider the increase in aboveground biomass. BEF_R is generated from country-specific data for commercial timber, as it only reflects the contribution of bark, whereas fuelwood includes bark in the amount of fuelwood recorded in national statistics. Thus, BEF does not include the entire amount of biomass lost when harvesting both commercial wood and fuelwood (for instance, small branches) which is left in the forest and represents an additional circa 5% ('Moldsilva' Agency, 1990-2022).

Table 6-16: Coefficients used in the estimation of CO_2 removals from subcategory 4A1 'Forest Land Remaining Forest Land'

Species	Root-shoot correlation coefficients appropriate to increments	Carbon fraction of biomass	Fraction of biomass left to decay in forest,%
Quercus spp.	0.40	0.50	0.05
Carpinus ssp.	0.35	0.50	0.05
Fraxinus spp.	0.28	0.49	0.05
Acer spp.	0.28	0.49	0.05
Ulmus spp.	0.28	0.49	0.05
Tilia spp.	0.21	0.50	0.05
Salix spp.	0.21	0.49	0.05
Pinus spp.	0.46	0.51	0.05
Populus spp.	0.21	0.50	0.05

[121] Ukrainian State Specialised Forest Enterprise, (1988), Forest Fund of the Moldavian SSR according to the accounts as of 01.01.1988. Irpin; Vdovii Gh., Galupa D., et al. (1997), National report on the state of the forest fund of the Republic of Moldova, Osadcev V.G., Ivancov P.T., Sergovski P.S., et al. (1955), Guidebook on woodworking (for Forest Farms Consumer Goods Manufacturing Workshops) (in Russian). Moscow; The Center for Testing and Certification of Wooden Furniture and Articles (2003), Test Report of Wooden Material Samples; Giurgiu V., Decei I., Armasescu S. (1972), Biometrics of trees and stands in Romania; Shvidenko A.Z., Savich Yu.N. (1987), Reference Materials for Evaluation of Forests in Ukraine and Moldova. 'Urozhai', 1987 (in Russian); Kapp, G., Velsen-Zerweck, M., Horst, A., Horn, L., Galupa, D. et al. (2003), Baseline Study for the Soil Conservation Project in Moldova; Talmaci I., Prosii E., Varzari A., Mardari A., Galupa A. (2016), OSC report on updating the basic indicators of forests and other types of forest vegetation in the Republic of Moldova.

Species	Root-shoot correlation coefficients appropriate to increments	Carbon fraction of biomass	Fraction of biomass left to decay in forest,%
Robinia spp.	0.28	0.49	0.05
Other species	0.28	0.50	0.05

Source: Osadcev.G., Ivankov P.T., Sergovskii P.S. et al., Guidebook on Woodworking (for Forest Farms Consumer Goods Manufacturing Workshops). Moscow, 1955 (in Russian); Giurgiu V., Decei I., Armasescu S. Biometry of Trees and Stands in Romania, 1972; Shvidenko A.Z., Savich J.N. (1987), Reference Materials for Evaluation of Forests in Ukraine and Moldova. Kiev, Urozhai, 1987 (in Russian); Kapp G., Velsen-Zerweck M., Horst A., Horn L., Galupa D., Talmaci I. et al.: Baseline Study for the Soil Conservation Project in Moldova, 2003; Vanin S. I., Wood Science, Moscow, 1949 (in Russian).

Carbon stock change in mineral soils, litter and dead wood

Since there have been no significant changes in forests at national level, reporting changes in soil carbon stocks is neutral. In similar circumstances, litter and dead wood pools are also considered neutral.

4A2 'Land Converted to Forest Land'

In order to estimate CO_2 removals from category 4A2 'Land Converted to Forest Land', the same principles were applied as for category 4A1 'Forest Land Remaining Forest Land' – establishing current biomass increments (according to the results obtained in the international monitoring and certification of MSCP and MCFDP). Calculations were made following Equation 2.15 in the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20):

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L$$

Where:

ΔC_B – annual change in carbon stocks in biomass on land converted to forest land, t C/yr;

ΔC_G – annual increase in carbon stocks in biomass due to growth on land converted to forest land, t C/yr;

$\Delta C_{Conversion}$ – initial change in carbon stocks in biomass resulting from the land-use conversion, t C/yr;

ΔC_L – annual decrease in biomass carbon stocks due to losses from harvesting, fuelwood gathering and disturbances on land converted to forest land, t C/yr.

Initial changes in carbon stocks in biomass on land converted to forest land ($\Delta C_{Conversion}$) were calculated using Equation 2.16 in the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20):

$$\Delta C_{Conversion} = \Sigma\{(B_{After} - B_{Before}) \bullet \Delta A_{TO\ OTHERS}\} \bullet CF$$

Where:

B_{After} – biomass stocks on land immediately after the conversion, t CM/ha;

B_{Before} – biomass stocks on land before the conversion, t CM/ha;

$\Delta A_{TO\ OTHERS}$ – area of land-use converted to forest land in a certain year, ha/yr;

CF – carbon fraction of dry matter.

At the same time, the estimation process considered increases in dead organic matter (litter) and in soil organic carbon since afforestation is primarily done on degraded land with low fertility, forest vegetation contributing substantially to carbon gain.

AD for category 4A2 'Land Converted to Forest Land' were taken from the Land Use and Land-Use Change Matrix for 1970-2022 (Table 6-17). The definition of 'afforestation' used in CDM projects is in accordance with 'conversion to forest land'.

Table 6-17: Annual successful afforestation in forest land included in cadastral records between 1970-2022, ha

Land Converted to Forest Land	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Arable lands	0.0	296.8	307.8	335.3	288.0	399.9	417.2	433.1	464.3	543.2	633.9	244.3	227.2	222.4
Orchards, vineyards	0.0	155.5	161.3	175.7	150.9	209.6	218.6	227.0	243.3	284.6	332.2	128.0	119.1	116.5
Grassland	0.0	3428.8	3555.9	3874.3	3327.9	4620.6	4820.8	5004.4	5364.2	6276.1	7324.6	2822.2	2625.1	2569.7
Other land	0.0	719.0	7675.0	4915.0	4833.0	1870.0	2243.0	0.0	0.0	0.0	0.0	1106.0	0.0	0.0
Total	**0.0**	**4600.1**	**11699.9**	**9300.4**	**8599.9**	**7100.0**	**7699.7**	**5664.5**	**6071.7**	**7104.0**	**8290.7**	**4300.5**	**2971.3**	**2909.0**

Land Converted to Forest Land	1984	1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997
Arable lands	225.4	227.7	168.4	197.7	298.9	280.0	216.1	80.8	87.5	43.0	49.5	42.5	24.9	29.6
Orchards, vineyards	118.1	119.3	88.3	103.6	156.6	146.7	113.2	42.4	45.9	22.5	25.9	22.3	13.0	15.5
Grassland	2604.7	2630.3	1945.8	2284.1	3453.4	3234.8	2496.4	933.9	1011.3	496.3	572.1	491.0	287.6	341.5
Other land	0.0	0.0	0.0	3229.6	291.0	1038.5	1174.0	1443.0	0.0	338.5	0.0	0.0	1.2	1113.0
Total	**2948.0**	**2977.0**	**2202.0**	**5815.0**	**4199.9**	**4700.0**	**3999.7**	**2500.1**	**1145.0**	**900.3**	**647.5**	**555.8**	**326.7**	**1499.5**
Land Converted to Forest Land	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Arable lands	33.1	30.3	27.1	23.5	344.3	347.4	336.8	334.7	352.4	355.7	372.3	221.7	33.3	23.4
Orchards, vineyards	17.3	15.9	14.2	12.3	180.4	182.0	176.5	175.4	184.7	186.4	195.1	116.2	17.5	12.3
Grassland	382.3	349.8	312.7	271.9	3978.5	4013.9	3891.4	3866.6	4071.4	4110.1	4302.0	2561.9	384.8	270.3
Other land	1667.9	0.0	146.0	1067.2	0.0	4193.4	996.0	0.8	2383.6	223.0	0.0	3076.3	0.0	1886.4
Total	**2100.6**	**396.0**	**500.0**	**1375.0**	**4503.3**	**8736.7**	**5400.6**	**4377.4**	**6992.1**	**4875.2**	**4869.0**	**5976.1**	**436.0**	**2191.4**
Land Converted to Forest Land	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Arable lands	19.4	19.6	22.0	47.2	121.0	48.8	51.0	60.1	48.7	39.60	122.49	N/A	N/A	N/A
Orchards, vineyards	10.1	10.3	11.5	24.7	63.4	25.6	26.7	31.5	25.5	20.75	64.19	N/A	N/A	N/A
Grassland	223.7	226.3	253.7	544.9	1397.5	563.7	588.8	694.4	562.7	457.56	1415.31	N/A	N/A	N/A
Other land	8916.1	2573.0	4833.0	1894.1	2417.4	405.0	1050.0	3283.0	500.0	0.00	0.00	N/A	N/A	N/A
Total	**9169.3**	**2829.2**	**5120.2**	**2510.9**	**3999.3**	**1043.1**	**1716.5**	**4069.0**	**1136.9**	**517.91**	**1602.00**	**N/A**	**N/A**	**N/A**

Source: General Land Cadastre of the RoM for the period 1970-2020; Land Use and Land-Use Change Matrix for 1970-2022.

CDM projects implemented in the Republic of Moldova

The conversion to forest land during the reference period included afforestation under the Moldova Soil Conservation Project (MSCP) and Moldova Community Forestry Development Project (MCFDP). Both projects are implemented under the CDM of the Kyoto Protocol, and have completed all national and international validation and registration procedures. The total afforested area within MSCP and MCFDP constitutes circa 28.8 thousand ha (Table 6-18).

Table 6-18: Annual afforestation under CDM Projects in the RoM between 2002-2015, ha

Afforested Area	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total
MSC Project	4894.7	4736.6	4219.6	4029.6	891.2	71.9	475.8	152.8	211.3	276.7	98.8	116.5	45.7	68.8	20289.9
MCFD Project	0.0	0.0	0.0	0.0	2009.6	2959.3	2190.4	1224.4	10.0	12.0	8.0	52.6	2.5	0.0	8468.8
Total	**4894.7**	**4736.6**	**4219.6**	**4029.6**	**2900.8**	**3031.2**	**2666.2**	**1377.2**	**221.3**	**288.7**	**106.8**	**169.1**	**48.2**	**68.8**	**28758.7**

Source: 'Moldsilva' Agency (2009), PDD for MCFDP, available at: https://cdm.unfccc.int/Projects/DB/SGS-UKL1216031019.22/view. 'Moldsilva' Agency (2012), PDD for MCFDP, available at: https://cdm.unfccc.int/Projects/DB/TUEV-SUED1352989843.61. 'Moldsilva' Agency (2004-2015), Annual Reports to the World Bank for the period 2004-2016 regarding emission reductions within MSCP and MCFDP. 'Moldsilva' Agency (2012-2013 and 2017-2018) Monitoring Reports for the MSCP and MCFDP, available at: https://cdm.unfccc.int/Projects/DB/SGS-UKL1216031019.22/view and https://cdm.unfccc.int/Projects/DB/TUEV-SUED1352989843.61.

In addition to harvested wood products, the net CO_2 emissions reduction into the atmosphere will account for circa 4.8 million tonnes (MSCP – 3.6 million tonnes; MCFDP – 1.2 million tonnes). The main participants in the implementation process of these projects are 'Moldsilva' Agency and its forestry institutions, the World Bank, the Forestry Research and Management Institute, as well as local public authorities that have allocated land for afforestation (over 500).

The changes in carbon stock from biomass, soil, litter and dead wood for subcategory 4A2 are reported using the Tier 2 methodology. In order to establish annual biomass gains/losses in forest land for subcategory 4A2, national EFs were calculated/developed based on results from MSCP and MCFDP projects (Table 6-19).

Table 6-19: Coefficients used in the estimation of CO_2 emissions/removals from subcategory 4A2 'Land Converted to Forest Land'

Indicators	Unit	Value
Annual average carbon increments of biomass (trees and shrubs)	Mg C/ha/yr	1.74
Annual average carbon increments of dead organic matter (litter)	Mg C/ha/yr	0.41
Annual average carbon increments of dead organic matter (dead wood)	Mg C/ha/yr	0.00
Annual average organic carbon increments of mineral soils	Mg C/ha/yr	0.32
Conversion period	years	20

Source: PDD for MSCP and MCFDP; Agency 'Moldsilva' Monitoring Reports for MSCP and MCFDP (2012; 2013; 2017; 2018).

Non-CO_2 Emissions on Forest Land

According to national statistics, there are no records of wildfires and controlled burning of biomass in forests remaining forests, thereby no non-CO_2 emissions are estimated for category 4A1.

The methodology used in the estimation of non-CO_2 emissions from subcategory 4A2 'Land Converted to Forest Land' is the Tier 1 method (2006 IPCC Guidelines). Calculations were made according to equation 2.27 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.42):

$$L_{fire} = A \bullet M_B \bullet C_f \bullet G_{ef} \bullet 10^{-3}$$

Where:

L_{fire} – amount of GHG emissions (including non-CO_2) from fires, t/yr;

A – area burnt annually, ha/yr;

M_B – mass of fuel available for combustion, t/ha;

C_f – combustion factor, the default value used is 0.45 (2006 IPCC Guidelines, Volume 4, Chapter 2, Table 2.6, Page 2.48);

$M_B \bullet C_f$ – the amount of fuel actually burnt, its value, according to MSCP and MCFDP estimates is 32,632.6 kg CM/ha;

G_{ef} – default emission factor, kg/t CM burnt (Table 6-20).

Table 6-20: EFs for different categories of vegetation, kg GHG/t CM

Vegetation categories	CO	CH_4	N_2O	NO_x
Temperate forests	107	4.7	0.26	3.0

Source: 2006 IPCC Guidelines, Volume 4, Chapter 2, Table 2.5, page 2.47.

Most fires are located in young forests or stands, particularly in the vicinity of croplands. Activity data on forest land affected by fires is available in the Statistical Yearbooks of the RoM and those of ATULBD[122] (Table 6-21).

Table 6-21: Forest land areas affected by fires in the RoM between 1990-2022, ha

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RBDR	120.10	20.10	22.00	1.50	33.50	1.40	0.00	0.00	9.70	0.00	0.00
LBDR	IE	IE	IE	IE	IE	0.53	11.20	3.40	24.00	25.20	0.90
RoM - Total	**120.10**	**20.10**	**22.00**	**1.50**	**33.50**	**1.93**	**11.20**	**3.40**	**33.70**	**25.20**	**0.90**
Categories	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RBDR	41.60	12.50	10.50	42.00	5.50	32.60	683.30	31.00	126.00	20.00	25.90
LBDR	15.40	18.10	23.00	46.00	2.90	58.20	108.00	24.00	8.20	26.90	36.90
RoM - Total	**57.00**	**30.60**	**33.50**	**88.00**	**8.40**	**90.80**	**791.30**	**55.00**	**134.20**	**46.90**	**62.80**
Categories	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RBDR	636.60	460.00	9.50	338.20	119.00	173.00	79.00	169.68	402.00	9.70	568.20
LBDR	35.80	7.10	28.90	18.00	59.8	73.80	5.90	37.40	17.20	32.08	31.60
RoM - Total	**672.40**	**467.10**	**38.40**	**356.20**	**178.8**	**246.80**	**84.90**	**207.08**	**419.20**	**41.78**	**599.80**

Source: Statistical Yearbooks of the RoM for 1994 (page 38), 1999 (page 20), 2007 (page 22), 2011 (page 22), 2014 (page 22), 2015 (page 22); National Bureau of Statistics, Statistics for Geography and Environment (Forest Fires, as of November 1 (2010-2022); Statistical Yearbooks of ATULBD for 2000 (page 88), 2002 (page 91), 2007 (page 81), 2009 (page 80), 2011 (page 82), 2014 (page 78), 2015 (page 88), 2016 (page 88), 2017 (page 91), 2020 (page 92), 2021 (page 90).

6.2.3. Uncertainties and Time-Series Consistency

4A1. 'Forest Land Remaining Forest Land'

Uncertainties associated with CO_2 removals from subcategory 4A1 'Forest Land Remaining Forest Land' at the beginning of the reference period (1990), were rather low, circa 5%. Since 1991, due to socio-political developments, the level of uncertainties has increased significantly. For 2022, the level of activity data precision related to the production processes reached circa 15%. Uncertainties related to removal factors in both cases are circa 5%.

Combined uncertainties within subcategory 4A1 constitute circa 15.81%. Uncertainties in the trend of of total GHG emissions from this subcategory au estimated to be circa 15 (Annex 2).

[122] Because the Administrative-Territorial Units on the Left Bank of the Dniester (ATULBD) did not publish the Statistical Yearbook for the years 2021-2022, the area of forest fires in the years 2021-2022 within ATULBD were calculated as the average of the last ten years reported in the published statistical yearbooks of the respective structures.

The above-mentioned situation is influenced by several factors because part of the data needed to estimate GHG removals by forests in the RoM requires updating. Uncertainties by section are also determined by the volumes of wood mass actually harvested by local public authorities and other forests owners. There is no accurate statistics on the amount of wood mass harvested during authorized felling and/or illegal logging. General information in this field is available to the Environmental Protection Inspectorate only, as it is the institution exercising state control in the field of environment (Article 22 of the Forestry Code on state control and state control data), and the Environment Agency, which authorizes (based on Article 40 of the Law on Environment Protection; article 26 of Law on the plant kingdom) felling of any type of forest vegetation. According to some estimative studies, the annual volume of wood mass from unidentified sources is circa 400-800 thousand m^3.[123] At the same time, the amount of illegal logging recorded annually is only circa 3-4 thousand m^3. The current system of monitoring and control of production processes in the forestry sector is applied only to forests managed by 'Moldsilva' Agency. The forestry resources managed by local public authorities practically do not regulate these activities. A considerable share of illicit logging is not even reported.

4A2. 'Land Converted to Forest Land'

Uncertainties associated with the process of estimating CO_2 removals/emissions from subcategory 4A2 'Land Converted to Forest Land' constitute circa 15%, whereas uncertainties associated with removal/emission factors – circa 5%. Combined uncertainties for this source category reach circa 15.81%. Uncertainties in the trend of total GHG emissions from this subcategory were estimated to be circa 3.99% (Annex 2).

Uncertainties related to the estimation of non-CO_2 emissions from forest land affected by fires result from uncertainties related to the available biomass, as well as those related to emission factors. Uncertainties associated with activity data on forest land affected by fires annually are considered to be relatively low, up to circa 10%. Uncertainties associated with default emission factors for different types of burning are moderate for CH_4 (circa 30%) and N_2O (circa 30%).

Thus, combined uncertainties related to non-CO_2 emissions (CH_4 and N_2O) from the respective subcategory are considered relatively high and constitute circa 31.62% for both CH_4 and N_2O (Annex 2). Uncertainties in the trend of total direct GHG emissions from this subcategory were estimated to be circa 2.95% for N_2O and insignificant (±0.0004%) for CH_4 (Annex 2).

6.2.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

6.2.5. Quality Assurance and Quality Control

The quality of estimations for both subcategories 4A1 'Forest Land Remaining Forest Land' and 4A2 'Land Converted to Forest Land' was ensured by the fact that most of the AD used was taken from official records. Thus, total forest area, as well as areas converted to forest land was taken from the General Land Cadastre of the Republic of Moldova, annual forest land balance drafted annually by the state forest authorities, periodical records of forests (once every 5 years), forest planning materials, etc. At the same time, data quality is ensured through the creation of the Land Use and Land-Use Change Matrix for the period 1970-2022 for Sector 4 'LULUCF'.

Annual biomass increments were taken from production tables, periodical state records of forests (once every 5 years), forest planning materials, by-laws and technical regulations in forestry, as well as from the international monitoring and certification procedures for Moldova Soil Conservation Project (MSCP) and Moldova Community Forestry Development Project (MCFDP).

Data on the volume of wood mass was obtained from the following sectoral statistical reports: Form 3 G.S. 'Statistical Report on volumes of standing wood extracted from forests'; Statistical Form 5 G.S. 'Statistical Report on volumes of illegal logging', and Form 2 G.S. 'Statistical Report on attaining production indicators in forestry' (Section 'Wood mass movement'). At the same time, data on illicit logging detected according to official records were taken from the study *'Illegal logging of forest vegetation*

[123] Galupa, D., Ciobanu, A., Scobioala, M. et al. Illegal logging of forest vegetation in the Republic of Moldova. Analytical study. 2011. Chisinau, 'Moldsilva' Agency, 38 pages.

in the Republic of Moldova"[124], annual reports by 'Moldsilva' Agency, and the Environmental Protection Inspectorate. Standard verification and quality control forms and checklists were filled in for category 4A 'Forest Land', following the Tier 1 methodological approach. Verification was focused on various aspects such as: ensuring correct use of estimation methodologies following the 2006 IPCC Guidelines, correct use of national coefficients, their accuracy, as well as comparing them to the values used by other countries in the region.

6.2.6. Recalculations

For the period 1990-2020, no recalculations were made for the main sources in subcategories 4A1 'Land Remaining Forest Land' and 4A2 'Land Converted to Forest Land'. Recalculations were made only for non-CO_2 emissions from subcategory 4A2 'Land Converted Forest Land'. The recalculations were made as a result of updating the GWP values for methane (CH_4) and nitrous oxide (N_2O) used in the estimation of non-CO_2 emissions from forest fires.

In comparison with the data recorded in NC5 of the RoM to the UNFCCC (2023), the changes made in the current inventory cycle resulted in an upward trend in non-CO_2 emissions in the period 1990-2020, these being constant over the period under review, estimated at +2.8% (Table 6-22).

Table 6-22: Recalculations of non-CO_2 emissions from subcategory 4A2 'Land Converted to Forest Land', included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	0.3438	0.0575	0.0630	0.0043	0.0959	0.0055	0.0321	0.0097	0.0965	0.0721	0.0026
BTR1	0.3536	0.0592	0.0648	0.0044	0.0986	0.0057	0.0330	0.0100	0.0992	0.0742	0.0026
Difference, %	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	0.1632	0.0876	0.0959	0.2519	0.0240	0.2600	2.2655	0.1575	0.3842	0.1343	0.1798
BTR1	0.1678	0.0901	0.0986	0.2591	0.0247	0.2673	2.3296	0.1619	0.3951	0.1381	0.1849
Difference, %	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	1.9251	1.3373	0.1099	1.0198	0.5119	0.7066	0.2431	0.5929	1.2002		
BTR1	1.9796	1.3752	0.1131	1.0487	0.5264	0.7266	0.2499	0.6097	1.2341	0.1230	1.7658
Difference, %	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**	**+2.8**		

Abbreviations: NC5 – Fifth National Communication, BTR1 – First Biennial Transparency Report, N/A – not applicable.

Between 1990 and 2022, CO_2 removals from category 4A 'Forest Land' had fluctuated, recording a considerable decrease compared to the reference year 1990 (Figure 6-4).

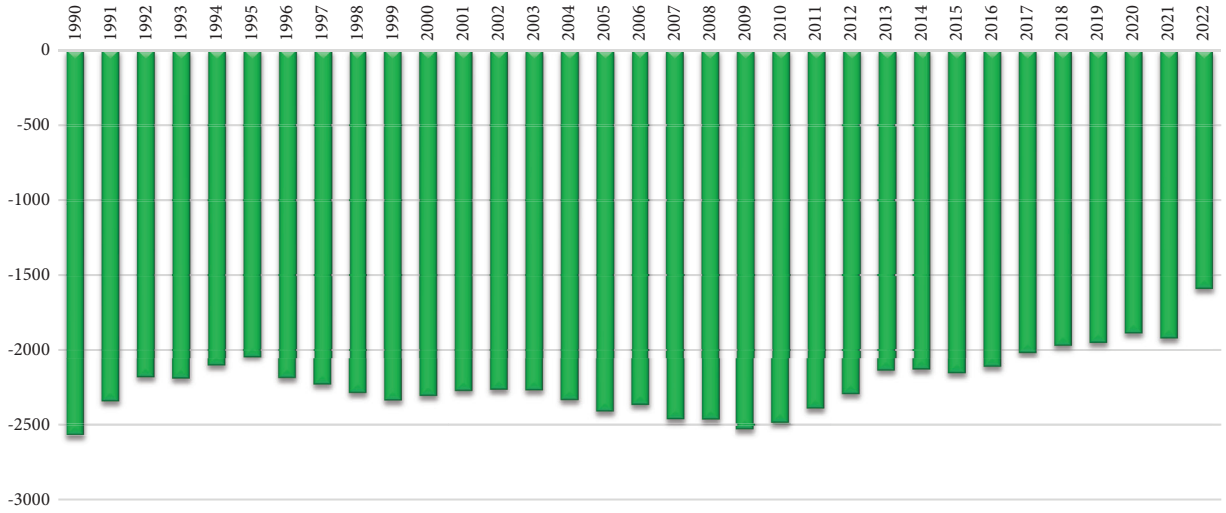


Figure 6-4: Net CO_2 removals from category 4A 'Forest Land' in the RoM between 1990-2022, kt.

Thus, compared to the reference year (1990), a decrease by 37.9% in GHG reduction was recorded in 2022, or a difference of circa 971 kt CO_2 (Table 6-23). This is also due to the increase in the amount of wood officially harvested from forests.

[124] Dumitru Galupa, Anatol Ciobanu, Marian Scobioala et al. (2011), Illegal logging of forest vegetation in the Republic of Moldova. Analytical study, Chisinau, 'Moldsilva' Agency, 38 pages..

Table 6-23: Net CO_2 removals from category 4A 'Forest Land' in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4A1	-1 579.0396	-1 352.6491	-1 290.4237	-1 367.4361	-1 355.1762	-1 350.1974	-1 559.0470	-1 639.4910	-1 732.3177	-1 840.9058	-1 881.4545
4A2	-984.3932	-990.6641	-893.8167	-826.0754	-752.8259	-694.8696	-631.3866	-592.7944	-556.1680	-495.9410	-425.9839
Total 4A	**-2 563.4328**	**-2 343.3131**	**-2 184.2404**	**-2 193.5115**	**-2 108.0022**	**-2 045.0670**	**-2 190.4337**	**-2 232.2854**	**-2 288.4857**	**-2 336.8468**	**-2 307.4384**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
4A1	-1 873.5555	-1 913.5787	-1 863.8705	-1 904.3372	-1 965.9956	-1 882.9327	-1 985.9585	-1 985.3822	-2 008.9453	-1 964.0859	-1 871.4295
4A2	-400.1473	-354.0371	-406.2471	-430.4396	-443.5229	-483.5841	-474.4270	-477.4052	-517.1206	-520.0768	-519.1417
Total 4A	**-2 273.7027**	**-2 267.6159**	**-2 270.1176**	**-2 334.7768**	**-2 409.5185**	**-2 366.5168**	**-2 460.3855**	**-2 462.7874**	**-2 526.0659**	**-2 484.1627**	**-2 390.5712**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
4A1	-1 702.2662	-1 531.8805	-1 484.6747	-1 496.3946	-1433.2460	-1324.5630	-1281.3639	-1231.1003	-1159.8803	-1198.1973	-912.8212
4A2	-592.5559	-609.9898	-650.0643	-663.0493	-682.5162	-691.8743	-687.9943	-719.5474	-727.4426	-721.3915	-679.6009
Total 4A	**-2 294.8221**	**-2 141.8702**	**-2 134.7390**	**-2 159.4439**	**-2115.7622**	**-2016.4373**	**-1969.3582**	**-1950.6476**	**-1887.3228**	**-1919.5888**	**-1592.4222**

Source: Land Use and Land-Use Change Matrix for the period 1970-2022.

As for the individual contribution of the two subcategories (4A1 and 4A2), it should be noted that the share of subcategory 4A1 'Forest Land Remaining Forest Land' is dominant, accounting for circa 61.6% in 1990, and circa 57.3% in 2022, respectively (Figure 6-5).

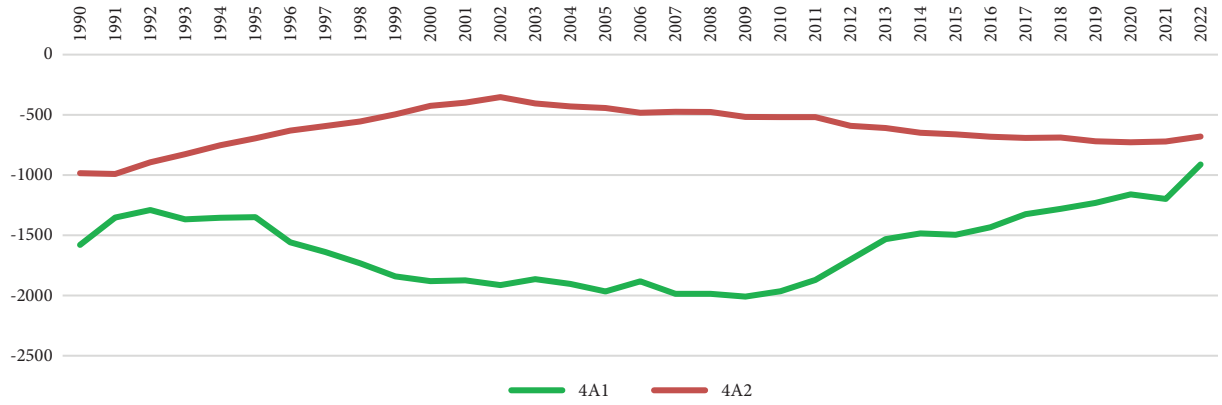


Figure 6-5: CO_2 removals by subcategory from category 4A 'Forest land' between 1990-2022, kt.

In the reference period, non-CO_2 emissions (CH_4 and N_2O) from category 4A 'Forest Land' were relatively constant, except for the years 2007 and 2012, when forest areas affected by fires recorded a historical maximum of 791.0 ha and 672.4 ha due to severe droughts, or a 7-time increase compared to the level in the base year. Compared 1990, non-CO_2 emissions from forest areas affected annually by fires within category 4A 'Forest Land' increased by circa 5 times in 2022 (Table 6-24).

Table 6-24: Non-CO_2 emissions from forest areas annually affected by fires between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CH_4 emissions, kt	0.0083	0.0014	0.0015	0.0001	0.0023	0.0001	0.0008	0.0002	0.0023	0.0017	0.0001
N_2O emissions, kt	0.0005	0.0001	0.0001	0.0000	0.0001	0.0000	0.0000	0.0000	0.0001	0.0001	0.0000
Total, kt CO_2 equivalent	**0.3536**	**0.0592**	**0.0648**	**0.0044**	**0.0986**	**0.0057**	**0.0330**	**0.0100**	**0.0992**	**0.0742**	**0.0026**
NO_x emissions, kt	0.0053	0.0009	0.0010	0.0001	0.0015	0.0001	0.0005	0.0001	0.0015	0.0011	0.0000
CO emissions, kt	0.1887	0.0316	0.0346	0.0024	0.0526	0.0030	0.0176	0.0053	0.0529	0.0396	0.0014
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
CH_4 emissions, kt	0.0039	0.0021	0.0023	0.0061	0.0006	0.0063	0.0546	0.0038	0.0093	0.0032	0.0043
N_2O emissions, kt	0.0002	0.0001	0.0001	0.0003	0.0000	0.0003	0.0030	0.0002	0.0005	0.0002	0.0002
Total, kt CO_2 equivalent	**0.1678**	**0.0901**	**0.0986**	**0.2591**	**0.0247**	**0.2673**	**2.3296**	**0.1619**	**0.3951**	**0.1381**	**0.1849**
NO_x emissions, kt	0.0025	0.0013	0.0015	0.0039	0.0004	0.0040	0.0349	0.0024	0.0059	0.0021	0.0028
CO emissions, kt	0.0896	0.0481	0.0526	0.1383	0.0132	0.1427	1.2432	0.0864	0.2108	0.0737	0.0987
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
CH_4 emissions, kt	0.0464	0.0322	0.0027	0.0246	0.0123	0.0170	0.0059	0.0143	0.0289	0.0029	1.1590
N_2O emissions, kt	0.0026	0.0018	0.0001	0.0014	0.0007	0.0009	0.0003	0.0008	0.0016	0.0002	0.6068
Total, kt CO_2 equivalent	**1.9796**	**1.3752**	**0.1131**	**1.0487**	**0.5264**	**0.7266**	**0.2499**	**0.6008**	**1.2341**	**0.1230**	**1.7658**
NO_x emissions, kt	0.0296	0.0206	0.0017	0.0157	0.0079	0.0109	0.0037	0.0091	0.0185	0.0018	0.0264
CO emissions, kt	1.0564	0.7339	0.0603	0.5596	0.2809	0.3878	0.1334	0.3254	0.6586	0.0656	0.9424

Source: Land Use and Land-Use Change Matrix for the period 1970-2022.

In the context of the attributed competencies, 'Moldsilva' Agency produces regular reports on CO_2 emission reductions following the implementation of CDM Afforestation Projects (MSCP and MCFDP). These calculations are based on the AR-AM0002 Methodology 'Restoration of Degraded Lands through Afforestation/Reforestation' (Version 01 and Version 03), based on the initial modules and documentation of the MSCP and MCFDP, reports submitted by forestry entities participating in the projects (successful forest plantation, repairs, etc.), monitoring events with measurements on sample plots and international certification, etc. Thus, according to these reports, between 2004 and 2017, a decrease in emissions by circa 2.45 Mt of CO_2 equivalent was reported, having implemented the MSCP and MCFDP (Table 6-25).

Table 6-25: CO_2 emission reductions within the CDM Projects (MSCP and MCFDP) between 2004-2022, kt

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Net removals in MSCP	-31.39	-37.36	-86.53	-93.32	-123.30	-138.40	-151.06	-190.60	-191.85	-216.49
Net removals in MCFDP	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-328.81	-58.15
Total	**-31.39**	**-37.36**	**-86.53**	**-93.32**	**-123.30**	**-138.40**	**-151.06**	**-190.60**	**-520.66**	**-274.64**
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Net removals in MSCP	-214.78	-221.90	-203.047	0.000	0.000	0.000	0.000	0.000	0.000	N/A
Net removals in MCFDP	-39.00	-36.00	-41.000	-47.034	0.000	0.000	0.000	0.000	0.000	N/A
Total	**-253.78**	**-257.90**	**-244.047**	**-47.034**	**0.000**	**0.000**	**0.000**	**0.000**	**0.000**	**N/A**

Source: 'Moldsilva' Agency (2009), PDD for MSCP, Available at: https://cdm.unfccc.int/Projects/DB/SGS-UKL1216031019.22/view. 'Moldsilva' Agency (2012), PDD for MCFDP, available at: https://cdm.unfccc.int/Projects/DB/TUEV-SUED1352989843.61. 'Moldsilva' Agency (2004-2015), Annual Reports to the World Bank for the period 2004-2016 on emissions reduction within MSCP and MCFDP. 'Moldsilva' Agency (2012-2013 and 2017-2018) Monitoring Reports for MSCP and MCFDP, available at: https://cdm.unfccc.int/Projects/DB/SGS-UKL1216031019.22/view and https://cdm.unfccc.int/Projects/DB/TUEV-SUED1352989843.61.

6.2.7. Planned Improvements

Towards the next inventory cycle, the possibility of perfecting the records associated with forest land will be analysed (particularly, owned by administrative-territorial units, private individuals/companies), as well as the real consumption of wood mass from the forests of the RoM, the primary data on the categories of land converted to forest land, and updating the national emission/removal factors (wood density, extension coefficients, emission coefficients from forest burning, etc.).

6.3. Cropland (Category 4B)

6.3.1. Source Category Description

Category 4B 'Cropland' includes a wide range of land whose primary purpose is the cultivation of different types of agricultural crops and/or their protection against unfavorable weather conditions. Thus, category 4B 'Cropland' comprises the following lands: perennial plantations (vineyards and orchards, including fruit nurseries, woody vegetation in individual gardens, etc.); other forest vegetation, including windbreaks and green spaces; arable soils. CO_2 emission/removal estimates originating from two subcategories are reported under this category: 4B1 'Cropland Remaining Cropland' and 4B2 'Land Converted to Cropland', including non-CO_2 emissions from post-harvest field burning of agricultural residues (stubble field burning).

4B1. 'Cropland Remaining Cropland'

For a clearer explanation of the calculation exercise carried out for subcategory 4B1 'Cropland Remaining Cropland', the results are presented separately for three sections: 4B1.1 'Cropland Covered with Woody Vegetation', 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' and 4B1.3 'Non-CO_2 Emissions from Post-Harvest Field Burning of Agricultural Residues' (stubble field burning).

4B1.1. 'Cropland Covered with Woody Vegetation'

Category 4B1.1 'Cropland Covered with Woody Vegetation' comprises CO_2 removals/emissions from cropland covered with woody vegetation, including above-ground and below-ground biomass in windbreaks, tree and shrub plantations, other types of forest vegetation, as well as from perennial plantations: orchards, vineyards, trees from private gardens, etc. Despite having a smaller share in CO_2 removals in comparison with forests, the sources described in the respective chapter are still some-

what important in the total balance per sector, as the quantitative share in the general land structure per country reaches up to 10%, thus having an essential contribution to maintaining environmental balance.

In conformity with records available in the RoM, forest vegetation not regarded as forest resources includes the following categories:

- windbreaks along agricultural fields;
- windbreaks, and tree and shrub plantations along communication ways;
- windbreaks as protection against erosion;
- groups of trees and separately standing trees within urban and settlement areas.

According to the general definition, windbreaks represent formations of forest vegetation, located at a particular distance from each other or toward an object in order to protect it against the effects of various harmful factors and/or for climatic, economic and aesthetic-sanitary land improvement.

4B1.2. 'Annual Change in Carbon Stocks in Mineral Soils'

CO_2 emissions from mineral soils are reported under subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils'. This source has a significant share in the total national emissions, as this source includes arable lands with a share of over 65.2% of the country's territory, or 2,206.77 thousand ha (according to the General Land Cadastre of the RoM as of 01.01.2023). It should be mentioned that the areas of arable land remained relatively constant, decreasing only by 2.3% between 1990 and 2022, mainly at the expense of perennial plantations.

Changes in land-use of cropland and soil management practices can considerably affect the organic carbon stocks in mineral soils. Thus, for example, conversion of natural 'Grassland' and 'Forest Land' to 'Cropland' could determine the loss of 20-40% of the original soil carbon stocks (2006 IPCC Guidelines). Soil organic carbon stocks can change with management or disturbance if the net balance between carbon inputs (such as organic fertilizers, agricultural residues) and carbon losses (e.g., carbon loss due to mineralization of organic substances in soil). Carbon stocks also depend on the intensity of the humification process, which is directly influenced by climatic conditions, particularly humidity and temperature regime.

4B1.3. 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues' (stubble field burning)

'Post-Harvest Field Burning of Agricultural Residues' is a rather frequent practice. According to more recent estimations, in some developing countries, up to 40% of crop residues are burnt in fields (in developed countries this percentage is much smaller, less than 10%). It should be noted that in cases in which crop residues are removed from fields to be used as fuel for heating and/or cooking, these emissions from burning are estimated under the Energy sector.

Only non-CO_2 emissions: CH_4, N_2O, NO_x and CO are monitored under this category (CO_2 emissions are not regarded as a source of emissions, as the carbon emitted into atmosphere is considered to be re-absorbed in the following agricultural cycle).

The amount of crop residues varies year-over-year, and depends on crops and management technologies. It should be noted that albeit stubble field burning is prohibited by law, this practice still persists in the RoM. Crop residues are burnt in fields to clear the stubble fields from the straw left after harvesting (in the RoM, stubble fields are most often burnt after wheat and barley harvesting) and to prepare the fields for the next agricultural cycle.

4B2. 'Land Converted to Cropland'

Subcategory 4B2 'Land Converted to Cropland' includes lands subject to conversion which previously had a certain volume of biomass (forests, grasslands, perennial plantations, windbreaks, etc.) or lacked vegetation (settlements, wetlands, etc.).

6.3.2. Methodologies, Emission Factors and Activity Data

4B1. 'Cropland Remaining Cropland'

The calculation methods used in the estimation of CO_2 removals/emissions from subcategory 4B1 'Cropland Remaining Cropland' are those available in the 2006 IPCC Guidelines. At the same time, country-specific emission/removal factors were used regarding the annual biomass increments, as well as AD by sector (windbreaks, tree and shrub plantations, orchards, vineyards, wood harvesting, area of mineral soils used for agriculture).

4B1.1. 'Cropland Covered with Woody Vegetation'

To estimate CO_2 removals/emissions within subcategory 4B1.1 'Cropland Covered with Woody Vegetation', current biomass increments were established in woody vegetation not included in forestry resources and perennial plantations: according to production tables, forest planning, scientific sources, data from 'Moldova – Agricultural Competitiveness Project' (MACP), etc.

The calculation was done based on annual change in carbon stocks as a result of current increments of perennial woody crops (stem, shoots, leaves and roots) by using Equations 2.9-2.14 in the 2006 IPCC Guidelines (pages 2.14-2.18). The estimation of these indicators was performed according to the algorithm and intermediate equations described in the paragraph dedicated to subcategory 4A1 'Forest Land Remaining Forest Land' in the current Report, the difference being in the removal/emission factors used in the calculation process.

Annual wood harvesting from orchards and vineyards occurs during technological cleaning processes of the respective plantations. For wood harvesting from windbreaks and other types of forest vegetation, 90% of which are managed by local public authorities, the volume of wood harvested was included in the total volume authorized annually by the Environmental Protection Inspectorate and/or the Environment Agency (Article 40 of the Environmental Protection Law; Article 22 of the Forestry Code on state control and its data; article 26 of Law on the plant kingdom), since other national records for this type of vegetation are not available. Based on data obtained from the Environmental Protection Inspectorate and/or the Environment Agency on the amount of wood authorized for harvesting by local authorities and other public institutions (except 'Moldsilva' Agency), annual harvested amounts were calculated (Table 6-26).

Table 6-26: Wood harvested from other types of woody vegetation between 1990-2022, thousand m^3

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Volume of wood mass harvested	0.00	24.98	37.80	58.52	36.90	36.18	32.47	2.95	10.75	3.08	1.37
Categories	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Volume of wood mass harvested	0.48	0.30	0.40	2.74	2.11	3.11	1.78	2.36	2.48	5.20	2.10
Categories	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Volume of wood mass harvested	2.91	3.49	8.57	9.51	43.49	38.01	33.37	28.18	39.16	16.74	24.84

Source: Reports of the Environmental Protection Inspectorate and/or the Environment Agency for the period 1990-2022.

In order to estimate biomass increments of perennial woody plantations on croplands, and, implicitly, the resulting CO_2 build-ups, activity data available in the General Land Cadastre was used on the evolution of these areas between 1990 and 2022 (Table 6-27).

Table 6-27: Areas of land covered with woody vegetation in subcategory 4B1 'Cropland Remaining Cropland' between 1990-2022, ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Perennial plantations	288955.4	299617.5	290817.5	278922.5	279873.4	267483.4	278702.1	265402.1	250302.1	231902.1	226234.3
Other forest vegetation	23950.0	23950.0	23950.0	22450.0	22450.0	22450.0	21850.0	18750.0	16650.0	22600.0	22300.0
Total woody vegetation	**312905.4**	**323567.5**	**314767.5**	**301372.5**	**302323.4**	**289933.4**	**300552.1**	**284152.1**	**266952.1**	**254502.1**	**248534.3**
Land Category	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Perennial plantations	197070.3	203977.4	211223.7	219946.8	219771.4	219586.8	219400.3	228261.4	226224.1	288530.4	281941.6
Other forest vegetation	23084.0	23384.0	21615.0	21615.0	30615.0	34315.0	34315.0	35415.0	34115.1	34115.1	34856.0
Total woody vegetation	**220154.3**	**227361.4**	**232838.7**	**241561.8**	**250386.4**	**253901.8**	**253715.3**	**263676.4**	**260339.3**	**322645.5**	**316797.6**

Land Category	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Perennial plantations	278612.7	272655.4	250631.5	242116.3	217331.4	217305.7	213811.6	210573.5	193404.8	190891.3	172961.0
Other forest vegetation	35532.4	33705.8	39839.8	40939.8	40939.8	40880.8	40134.6	35684.6	35463.4	34202.2	34600.2
Total woody vegetation	**314145.1**	**306361.2**	**290471.3**	**283056.1**	**258271.2**	**258186.5**	**253946.2**	**246258.1**	**228868.2**	**225093.5**	**207561.2**

Source: General Land Cadastre of the RM for the period 1970-2022; Land Use and Land-Use Change Matrix in the RM for the period 1970-2022.

According to recorded data, the evolution of areas of other types of woody vegetation had a positive trend between 1990 and 2022, increasing by 42.8%. The area of perennial woody crops decreased continuously over the same period, the total area of perennial plantations decreasing by 43%: the area of orchards – by circa 41%, whereas vineyards – by circa 44%. At the same time, it should be mentioned that category 4B1.1 'Cropland Covered with Woody Vegetation' also includes lands that are subject to internal conversions, which generate certain changes in carbon stocks (Table 6-28).

Table 6-28: Evolution of lands in the RoM subject to internal conversion within category 4B1.1 'Cropland Covered with Woody Vegetation' between 1970-2022, ha

Land Category	1970	1971	1972	1973	1974	1975	1976	1977	1978
Perennial plantations to cropland	0.0	391.8	19923.5	3269.4	0.0	0.0	0.0	5178.6	5948.0
Forest vegetation to cropland	0.0	72.4	72.0	72.4	72.0	181.0	145.0	36.0	778.0
Cropland to forest vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cropland to perennial plantations	0.0	10511.8	0.0	5798.7	18118.8	5607.2	24273.7	0.0	0.0
Total	**0.0**	**10975.9**	**19995.5**	**9140.5**	**18190.8**	**5788.2**	**24418.7**	**5214.6**	**6726.0**
Land Category	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Perennial plantations to cropland	3255.2	0.0	1347.6	0.0	0.0	0.0	23450.9	19160.3	1076.3
Forest vegetation to cropland	0.0	0.0	0.0	0.0	0.0	72.4	0.0	0.0	1157.9
Cropland to forest vegetation	2153.0	36.0	434.0	109.0	0.0	0.0	3257.0	1338.8	0.0
Cropland to perennial plantations	0.0	11521.0	0.0	11606.3	9934.5	8757.6	0.0	0.0	0.0
Total	**5408.2**	**11557.0**	**1781.6**	**11715.3**	**9934.5**	**8830.0**	**26707.9**	**20499.1**	**2234.2**
Land Category	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Perennial plantations to cropland	0.0	1034.5	0.0	0.0	8596.6	17457.5	17159.5	17752.3	13244.2
Forest vegetation to cropland	0.0	0.0	470.0	0.0	0.0	542.8	0.0	0.0	217.1
Cropland to forest vegetation	398.0	615.0	0.0	289.0	253.0	0.0	2569.1	398.0	0.0
Cropland to perennial plantations	8893.1	0.2	63352.0	4166.0	0.0	0.0	0.0	0.0	0.0
Total	**9291.2**	**1649.7**	**63822.0**	**4455.0**	**8849.6**	**18000.3**	**19728.7**	**18150.4**	**13461.3**
Land Category	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Perennial plantations to cropland	13045.4	14811.2	18053.2	17072.9	28626.9	4646.4	2639.8	18.2	0.0
Forest vegetation to cropland	1121.7	759.9	0.0	144.7	150.5	0.0	640.1	0.0	0.0
Cropland to forest vegetation	0.0	0.0	542.8	0.0	0.0	258.7	0.0	103.0	417.0
Cropland to perennial plantations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1415.4
Total	**14167.1**	**15571.1**	**18596.0**	**17217.6**	**28777.5**	**4905.1**	**3279.9**	**121.2**	**1832.4**
Land Category	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Perennial plantations to cropland	0.0	0.0	0.0	1886.7	2150.1	112.4	3259.0	41.2	3497.4
Forest vegetation to cropland	0.0	0.0	0.0	1085.5	0.0	21.4	8.5	660.9	349.5
Cropland to forest vegetation	244.2	116.9	223.0	0.0	1066.3	0.0	0.0	0.0	0.0
Cropland to perennial plantations	2929.0	1107.1	453.7	0.0	0.0	0.0	0.0	0.0	0.0
Total	**3173.2**	**1224.0**	**676.7**	**2972.2**	**3216.4**	**133.8**	**3267.6**	**702.2**	**3846.9**
Land Category	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Perennial plantations to cropland	2730.5	2.9	0.0	3405.0	3031.1	5313.5	2447.9	5938.2	N/A
Forest vegetation to cropland	0.0	0.0	21.3	270.0	0.0	43.9	22.2	6.1	N/A
Cropland to forest vegetation	724.0	178.9	0.0	0.0	20.0	0.0	0.0	0.0	N/A
Cropland to perennial plantations	0.0	0.0	1275.8	0.0	0.0	0.0	0.0	0.0	N/A
Total	**3454.5**	**181.7**	**1297.1**	**3675.1**	**3051.2**	**5357.4**	**2470.0**	**5944.4**	**N/A**

Source: General Land Cadastre of the RoM for the period 1970-2022; Land Use and Land-Use Change Matrix in the RoM for the period 1970-2022.

To establish annual biomass increments and losses of biomass in woody perennials on cropland, country-specific emission/carbon stock change factors were used, based on data in Hungary's NIR (2014), as well as data from the literature in the field regarding perennial plantation management (Table 6-29). Production tables, activity data on windbreak productivity, according to records and forestry manage-

ment practices (Table 6-29) were used for the calculation of the carbon stock change factors for other types of forest vegetation on cropland. In order to estimate carbon stock change factors in perennial plantations (orchards and vineyards), a 15-year production cycle was used, including 14 years with a constant annual biomass increment (represented as a net annual biomass increment), the fifteenth year being the year in which vegetation was cut, thereby assuming the total carbon emitted into the atmosphere.

Table 6-29: Emission/removal factors used in the estimation process for subcategory 4B1.1 'Cropland Covered with Woody Vegetation'

Land category	Annual biomass increments, t C/yr/ha	Biomass losses due to conversion, t C/yr/ha
Other types of forest vegetation	1.42	-24.8
Perennial plantations	0.32	-4.43

Source: Ukrainian Forest Management Service: Forestry Resources of the Moldavian Soviet Socialist Republic, standing as of 1.01.1988, Irpen, 1988; Vdovii Gh., Galupa D. et al. (1997), National Report on Forestry Resources of the Republic of Moldova, Giurgiu V., Decei I., Armasescu S. Biometry of Trees and Stands in Romania, 1972; Kapp G., Velsen-Zerweck M., Horst A., Horn L., Galupa D. Talmaci I. et al.: The Baseline Study for the Moldova Soils Conservation Project, 2003; National GHG Inventory Report for Hungary, 2014.

CS EFs were calculated/developed for lands subject to internal conversion within category 4B1.1, depending on the particularities of the land categories subject to the respective processes (Table 6-30).

Table 6-30: Emission/removal factors used for internal conversion under category 4B1.1 'Cropland Covered with Woody Vegetation'

Internal conversion	Indicators	Period, years	Unit	Indicator value[125]
Perennial plantations to cropland	Annual average carbon increments in biomass	anul 1	Mg C/ha/an	0.57
	Annual average carbon increments in DOM and SOC	anii 1-20	Mg C/ha/an	0.00
Forest vegetation to cropland	Annual average carbon increments/losses in biomass	year 1	Mg C/ha/an	-24.80
	Annual average carbon increments/losses in dead organic matter (litter/DOM)	year 1	Mg C/ha/an	-1.15
	Annual average increments/losses of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/an	-1.1988
Cropland to forest vegetation	Annual average carbon increments/losses in biomass (trees and shrubs)	year 1	Mg C/ha/an	-3.26
	Annual average carbon increments in biomass (trees and shrubs)	years 2-20	Mg C/ha/an	1.74
	Annual average carbon increments in dead organic matter (litter/DOM)	years 1-20	Mg C/ha/an	0.41
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/an	0.32
Cropland to perennial plantations	Annual average carbon increments/losses in biomass (trees and shrubs)	year 1	Mg C/ha/an	-4.68
	Annual average carbon increments in biomass (trees and shrubs)	years 2-20	Mg C/ha/an	0.32
	Annual average carbon increments in dead organic matter (litter/DOM)	years 1-20	Mg C/ha/an	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/an	0.00

Source: Ukrainian Forest Management Service: Forestry Resources of the Moldavian Soviet Socialist Republic, standing as of 1.01.1988, Irpen, 1988; Vdovii Gh., Galupa D. et al. (1997), National Report on Forestry Resources of the Republic of Moldova, Giurgiu V., Decei I., Armasescu S. Biometry of Trees and Stands in Romania, 1972; Kapp G., Velsen-Zerweck M., Horst A., Horn L., Galupa D. Talmaci I. et al.: The Baseline Study for the Moldova Soils Conservation Project, 2003; National GHG Inventory Report for Hungary, 2014.

4B1.2. 'Annual Change in Carbon Stocks in Mineral Soils'

In order to estimate emissions from subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils', the Tier 2 approach was used. For the calculation of annual changes in carbon stocks in mineral soils, Equation 2.25 in the 2006 IPCC Guidelines was used (Volume 4, Chapter 2, Page 2.30):

$$\Delta C_{mineral} = (SOC_0 - SOC_{(0-T)}) / T$$

Where:

$\Delta C_{mineral}$ – annual change in carbon stocks in mineral soils, t C/yr;

SOC_0 – soil organic carbon stock in the last year of an inventory period, t C;

$SOC_{(0-T)}$ – soil organic carbon stock at the beginning of the inventory time period, t C;

T – time dependence of stock change factors which is the default time period for transition from equilibrium SOC values, yr (T is used in this equation if T ≥ 20 years, where T represents number of years over a single inventory time period).

In order to estimate CO_2 emissions from annual change in carbon stocks in mineral soils the following equation was used:

$$CO_2 = \Delta C_{mineral} \bullet 44/12$$

[125] The 'minus' sign indicates losses.

Where:

CO_2 – emissions from carbon losses in mineral soils due to land-use change for cropland and soil management practices, Gg/yr;

[44/12] – mass ratio between carbon content in CO_2 and C.

The following aspects were taken into consideration in the process of assessing the annual change in carbon stocks in mineral soils in the Republic of Moldova:

- agricultural practices applied to arable land and the pedo-climatic conditions allow the highlighting of a single agricultural land use (in the country, the mineral soils cover is quite homogeneous, mainly represented by chernozems); significant changes in soil management technologies between 1990 and 2022 did not occur: autumn plowing is dominant on the entire arable land of the country; since 1990, the amount of carbon stocks in mineral soils had decreased substantially, particularly due to the fact that the amount of organic fertilizers applied to soil have been gradually reduced, as well as the amount of crop residues returned to soil (including as a result of significant reduction of harvests for basic crops);
- information on the evolution of organic carbon stocks in arable soils were identified in the national scientific literature; according to the reference sources consulted, the soils in the RoM, used for the most part for about 150 years, in the meantime lost circa 45-50% of the accumulated carbon: in 1877, the content of humus in arable soils (a layer of 0-30 cm, bulk density – 1.17 g/cm^3) in the northern area of the country (Napadova commune, Floresti district) acounted for 5.72% (200.7 t humus/ha or 116.4 t C/ha); in 1960, the content of humus in the same area acounted for 3.68% (129.0 t humus/ha or 74.8 t C/ha); by 2003 – 3.36% (117.9 t humus/ha or 68.4 t C/ha), whereas in 2010 – 3.11% (109.2 t humus/ha or 63.3 t C/ha);
- in the same context, according to other sources published in the field literature, through direct measurements made on leaching chernozems in the northern part of the country, it was established that in 60 years of exploitation, soils lost about 37% of the accumulated carbon, and the annual average was 300 kg C/ha/yr (Soils of Moldova, Volume 1, 1989); within the long-term experiences (circa 40 years) of the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection, in the main pedo-climatic areas of the country, located on the chernozems subtypes dominant in soil cover, it was established that annual rates of carbon losses are very similar at area and chernozem subtype level – circa 325 kg C/ha/yr (Ecopedological Monitoring Bulletin, 7th Edition, 2000); very similar rates were established through the oldest long-term experiences in the country organized by the Agrarian State University of Moldova in Chetrosu village, Anenii Noi district, on carbonate chernozem (Zagorcea, 1990); values between 300-330 kg C/ha/yr for carbon losses in cropland were established by other researchers as well (Ungureanu et al., 1997; Banaru et al., 2002, Andries, 2017);
- organic carbon stocks in soil in the first year of inventory ($SOC_{(0-T)}$) were identified in 'Soil Quality Monitoring in the Republic of Moldova (database, conclusions, forecasts, recommendations)' (2010); according to the respective publication, in 1990, the content of humus in arable soils (a layer of 0-30 cm, apparent density – 1.17 g/cm^3) in the northern area of the country accounted for circa 3.46% (121.3 t humus/ha or 70.3 t C/ha); at the same time, in the southern part of the country (Lebedenco commune, Cahul district), the content of humus in arable soils (a layer of 0-30 cm, apparent density – 1.30 g/cm^3) accounted for circa 3.27% (127.3 t humus/ha or 73.9 t C/ha); under these circumstances, the country average ($SOC_{(0-T)}$) accounted for circa 124.3 t humus/ha or circa 72.1 t C/ha;
- carbon stock change in mineral soils for the period until 1990 was estimated at -0.15 t C/ha/yr;
- soil organic carbon stocks in the last year of the inventory cycle (SOC_0) were identified in the scientific literature; according to specialists from the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection, the content of humus in arable soils in 2015 (a layer of 0-30 cm, bulk density – 1.17 g/cm^3) in the northern area of the country (Napadova commune, Floresti district) accounted for circa 3.0% (105.3 t humus/ha or 61.1 t C/ha); at the same time, in the southern part of the country (Lebedenco commune, Cahul district), the content of humus in arable soils (a layer of 0-30 cm, apparent density – 1.30 g/cm^3) accounted for circa 2.89% (112.7 t humus/ha or 65.4 t C/ha), the country average (SOC_0) represented circa 109.0 t humus/ha or

circa 63.2 t C/ha, which corresponds to annual average losses of 354.9 kg C/ha/yr between 1990 and 2016. The latest laboratory results and national literature references show that the average humus content in soils is currently 3.1%, whereas its decrease is slower in the period 2006-2010 and 2011-2015 compared to 2001-2005;

- organic carbon stocks in soils in the last year of the inventory cycle (SOC_0) were identified in the scientific literature; according to specialists from the 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection, the humus content in arable soils in 2022 (layer – 0-30 cm, apparent density – 1.41 g/cm^3) in the northern part of the country (Napadova commune, Floresti district) constituted circa 3.02% (127.8 tonnes of humus/ha or 74.1 tonnes of C/ha); at the same time, in the southern part of the country (Lebedenco commune, Cahul district), the humus content in arable soils (layer – 0-30 cm, apparent density – 1.37 g/cm^3) constituted in that year circa 2.89% (118.8 tonnes of humus/ha or 68.9 tonnes of C/ha), the national average (SOC_0) being circa 123.2 tonnes of humus/ha or circa 71.5 tonnes of C/ha, which corresponds to average annual losses per country of 309.9 kg C/ha/year between 1990 and 2022. This value is close to the previous results recorded by various specialists in the RoM in their long-term experiences (Zagorcea, 1990; Ungureanu et al., 1997; Banaru et al., 2002; Andries, 2017; Cerbari, 2010, 2012, 2021).

In order to estimate CO_2 emissions from category 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils', based on the General Land Cadastre of the RoM, the areas of cropland remaining cropland in the period under review were identified (Table 6-31).

Table 6-31: Areas of cropland remaining cropland in the Republic of Moldova between 1990-2022

Land category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Cropland Remaining Cropland, thousand ha	1631.79	1624.65	1632.63	1634.17	1633.41	1631.19	1632.07	1640.22	1645.39	1642.29	1630.57
Land category	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Cropland Remaining Cropland, thousand ha	1622.65	1622.53	1623.10	1620.40	1643.40	1660.27	1659.82	1659.18	1659.99	1659.61	1657.53
Land category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Cropland Remaining Cropland, thousand ha	1647.65	1654.92	1669.46	1685.03	1694.02	1691.57	1700.30	1709.54	1716.88	1742.77	1737.63

Source: Land Cadastre of the Republic of Moldova for the period 1970-2022. Land Use and Land-Use Change Matrix in the RoM for the period 1970-2022.

Based on the respective AD, annual change in carbon stocks in cropland mineral soils were estimated (Table 6-32).

Table 6-32: Annual change in carbon stocks in cropland mineral soils between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
$\Delta C_{mineral}$, t C/yr	-505644.07	-503431.14	-505902.39	-506379.26	-506144.79	-505455.33	-505730.54	-508254.88	-509855.83	-508895.84	-505264.90
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
$\Delta C_{mineral}$, t C/yr	-502809.88	-502774.89	-502949.57	-502112.79	-509239.58	-514468.95	-514329.13	-514130.63	-514382.49	-514263.33	-513618.90
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
$\Delta C_{mineral}$, t C/yr	-510557.67	-512808.79	-517314.10	-522139.83	-524924.75	-524165.73	-529652.45	-532680.21	-534835.86	-540031.99	-538440.01

Source: Land Use and Land-Use Change Matrix for the period 1970-2022.

4B1.3. 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble field burning)'

Non-CO_2 emissions from post-harvest field burning of crop residues (stubble field burning) within 4B 'Cropland' were estimated using the Tier 1 methodology (2006 IPCC Guidelines, Volume 4, Chapter 2.4, pages 2.40-2.49).

$$L_{fire} = A \bullet M_B \bullet C_f \bullet G_{ef} \bullet 10^{-3}$$

Where:

L_{fire} – amount of non-CO_2 greenhouse gas emissions from field burning of crop residues, t/yr;

A – area burned annually in the case of crops for which stubble burning is practiced, ha/yr;

M_B – mass of fuel available for combustion varies from year to year, based on the harvest recorded, t/ha;

C_f – combustion factor; IPCC default value is 0.90 (2006 IPCC Guidelines), used to consider aspects regarding incomplete combustion;

G_{ef} – default EF for non-CO_2 GHG (g/kg CM) (Table 6-33) according to the 2006 IPCC Guidelines: Table 2.5. EFs (g/kg CM burnt) for different types of combustion, and Table 2.6. Combustion factor values (proportion of fuel before fire) for fires depending on the type of vegetation.

Table 6-33: EFs for field burning of crop residues, g/kg CM

Category	CO	CH_4	N_2O	NO_x
Field Burning of Crop Residues	92	2.7	0.07	2.5

In order to determine the amount of non-CO_2 emissions from field burning of crop residues (stubble field burning), activity data is required on areas sown with grain crops (wheat and barley), which is available in the Statistical Yearbooks of the RoM. Information regarding cases recorded annually by environmental inspectors in connection with the phenomenon of burning stubble in the RoM is presented in Table 6-34. As activity data was not available for the period of time between 1990 and 1994, this data was extrapolated based on the assumption that the areas of stubble fields combusted annually account for circa 3 percent of the total areas under the respective cereals (wheat and barley). Between 2017 and 2022, data on fires (biomass) were presented by the Environmental Protection Inspectorate and the General Inspectorate for Emergency Situations.

Table 6-34: Stubble field burning in the Republic of Moldova between 1990-2022

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Burnt stubble fields, thousand ha	12.21	13.11	12.14	14.55	13.42	15.80	18.60	20.70	21.50	24.00	11.50
Burnt stubble fields, % of total	3.00	3.00	3.00	3.00	3.00	2.99	3.80	3.83	3.98	4.61	2.10
Categories	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Burnt stubble fields, thousand ha	9.50	1.96	0.10	0.40	2.20	0.89	2.65	4.47	0.89	0.63	0.48
Burnt stubble fields, % of total	1.59	0.31	0.03	0.08	0.39	0.20	0.56	0.78	0.16	0.12	0.10
Categories	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Burnt stubble fields, thousand ha	0.11	0.58	0.40	0.35	0.32	0.40	0.15	0.24	0.46	1.11	1.82
Burnt stubble fields, % of total	0.02	0.10	0.07	0.08	0.07	0.09	0.03	0.06	0.14	0.30	0.52

Source: Ministry of Ecology, Construction and Territorial Development / National Institute of Ecology (2003), State of the Environment Report of the Republic of Moldova in 2002 (National Report). Chisinau, Mediul Ambiant, 2003, 144 p. (page 60, Figure 2.19, information covering the period 1995-2002); State Ecological Inspectorate (2014), SEI Yearbook-2013 'Environment Protection in the Republic of Moldova' / State Ecological Inspectorate; editorial board: V. Curari [et al.]. – Ch.: Pontos, 2014 (Publishing house 'Europres'). – 300 p. (page 107, Figure 5, data regarding 2000-2013 time series); SEI Yearbook-2014 'Environment Protection in the Republic of Moldova' State Ecological Inspectorate; editorial board: V. Stangaci, red.: D. Osipov – Chisinau: 'Pontos', 2015, Publishing house 'Europres', 336 p. (page 79, Figure 4, data regarding 2000-2014 time series); SEI Yearbook-2015 'Environment Protection in the Republic of Moldova' / Ministry of Environment, State Ecological Inspectorate, editorial board: Igor Talmazan [et al.]; coord.: Dumitru Osipov. Chisinau: Pontos, 2016. Publishing House 'Europres', 348 p. (page 87, Figure 4. data regarding 2000-2015 time series). Reports of the Enviromnental Protection Inspectorate for the period 2016-2022.

The activity data on the amount of crop residues available to be combusted on field (Table 6-35) was inferred from information on average crop yield per hectare, by multiplying it to the dry matter fraction in the basic yield of the respective crop (default value is 0.89). In order to estimate the amount of agricultural residues available for combustion on site, a mean arithmetic value between wheat and barley was used, which is closely related to the average yield per hectare actually recorded in the Republic of Moldova over the reference period.

Table 6-35: Amount of crop residues available for combustion on field between 1990-2022, t CM/ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Winter wheat	3.50	3.10	2.92	3.58	1.95	2.88	1.83	2.92	2.42	2.09	1.71
Barley	3.09	2.84	2.93	3.08	1.97	2.05	1.12	1.77	1.61	1.41	1.08
Average	**3.30**	**2.97**	**2.93**	**3.33**	**1.96**	**2.47**	**1.48**	**2.34**	**2.01**	**1.75**	**1.40**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Winter wheat	2.41	2.22	0.43	2.46	2.30	2.03	1.15	2.79	1.91	2.10	2.01
Barley	1.93	1.61	0.69	1.80	1.51	1.55	0.81	2.31	1.45	1.34	1.52
Average	**2.17**	**1.91**	**0.56**	**2.13**	**1.90**	**1.79**	**0.98**	**2.55**	**1.68**	**1.72**	**1.76**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Winter wheat	1.18	2.08	2.36	1.98	3.12	3.29	2.76	2.94	1.57	4.13	3.31
Barley	1.09	1.69	1.80	1.69	2.76	2.76	2.40	2.85	1.89	1.89	2.19
Average	**1.13**	**1.89**	**2.08**	**1.84**	**2.94**	**3.03**	**2.58**	**2.89**	**1.73**	**3.01**	**2.25**

4B2. 'Land Converted to Cropland'

In the process of estimating CO_2 removals/emissions from subcategory 4B2 'Land Converted to Cropland', increments and losses of biomass and carbon in soil were identified as a result of the conversion of different land categories on which there was a certain increase in biomass (forest land, grassland, perennial plantations, etc.). At the same time, estimations in this subcategory included N_2O emissions resulting from Grassland Converted to Cropland (arable land).

In the process of calculating the annual change in carbon stocks due to conversion of different types of land to cropland, Equation 2.15 in the 2006 IPCC Guidelines (Volume 4, Chapter 2, page 2.20) was used:

$$\Delta C_B = \Delta C_G + \Delta C_{Conversion} - \Delta C_L$$

Where:

ΔC_B – annual change in carbon stocks in biomass on land converted to cropland, t C/yr;

ΔC_G – annual increase in carbon stocks in biomass due to growth on land converted to cropland, t C/yr;

$\Delta C_{Conversion}$ – initial change in carbon stocks in biomass resulting from land conversion to cropland, t C/yr;

ΔC_L – annual decrease in biomass carbon stocks due to the conversion to cropland, t C/yr.

Initial changes in carbon stocks in biomass on land converted to cropland ($\Delta C_{Conversion}$) were estimated using Equation 2.16 in the 2006 IPCC Guidelines (Volume 4, Chapter 2, page 2.20):

$$\Delta C_{Conversion} = \Sigma\{(B_{After} - B_{Before}) \bullet \Delta A_{TO\ OTHERS}\} \bullet CF$$

Where:

B_{After} – biomass stocks on land immediately after the conversion to cropland, t CM//ha;

B_{Before} – biomass stocks on land before the conversion to cropland, t CM/ha;

$\Delta A_{TO\ OTHERS}$ – area of land-use converted to cropland in a certain year, ha/yr;

CF – carbon fraction of dry matter.

The estimation process considered increments of dead wood (litter) and in organic soil carbon, since the change in land-use category has a major impact on the respective stocks.

Non-CO_2 emissions (N_2O) resulting from the conversion of grassland to cropland were estimated using Equation 11.8 in the 2006 IPCC Guidelines (Volume 4, Chapter 11, page 11.16):

$$F_{SOM} = \Sigma_{LU}[(\Delta C_{Mineral,LU} \bullet 1/R) \bullet 1000]$$

Where:

F_{SOM} – the net annual amount of N mineralized in mineral soils as a result of loss of soil carbon through change in land-use or management, kg N;

$\Delta C_{Mineral,LU}$ – average annual loss of soil carbon for each land-use type (LU), tonnes C;

R – $C : N$ ratio of the soil organic matter. A default value of 15 for the $C : N$ ratio (R) may be used for situations involving land-use change from Forest Land or Grassland to Cropland. A default value of 10 may be used in case of internal croplands conversions;

LU – land-use and/or management system type.

AD on areas subject to conversion to category 4B2 'Land Converted to Cropland' is available in the General Land Cadastre, and are included in the Land Use and Land-Use Change Matrix for 1970-2022. The main types of land converted to cropland are grassland and settlements (Table 6-36).

Table 6-36: Areas of land converted to cropland in the RoM between 1970-2022, ha

Conversion activities	1970	1971	1972	1973	1974	1975	1976	1977	1978
Grassland to Cropland	0.0	212.7	737.0	0.0	2749.0	0.0	3967.8	5699.0	238.3
Grassland to Forest Vegetation	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to Perennial Plantations	0.0	192.7	0.0	106.3	332.1	102.8	444.9	0.0	0.0
Wetlands to Cropland	0.0	600.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlements to Cropland	0.0	81.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other Land to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	1757.0	1757.0	1757.0
Total	**0.0**	**1087.1**	**737.0**	**106.3**	**3081.1**	**102.8**	**6169.8**	**7456.0**	**1995.3**
Conversion activities	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Grassland to Cropland	0.0	0.0	935.1	0.0	1324.5	489.5	0.0	476.6	0.0
Grassland to Forest Vegetation	3797.0	64.0	766.0	191.0	0.0	0.0	5743.0	2361.2	0.0
Grassland to Perennial Plantations	0.0	211.2	0.0	212.7	182.1	160.5	0.0	0.0	0.0
Wetlands to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlements to Cropland	0.0	0.0	0.0	490.1	0.0	0.0	1715.5	1470.4	0.0
Other Land to Cropland	3583.9	10181.9	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**7380.9**	**10457.1**	**1701.1**	**893.9**	**1506.6**	**650.1**	**7458.5**	**4308.1**	**0.0**

Conversion activities	1988	1989	1990	1991	1992	1993	1994	1995	1996
Grassland to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to Forest Vegetation	702.0	1085.0	0.0	511.0	447.0	0.0	4530.9	702.0	0.0
Grassland to Perennial Plantations	163.0	0.0	1161.2	76.4	0.0	0.0	0.0	0.0	0.0
Wetlands to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlements to Cropland	408.5	0.0	245.1	0.0	0.0	163.4	0.0	571.8	163.4
Other Land to Cropland	0.0	0.0	0.0	0.0	7460.9	0.0	618.2	0.0	0.0
Total	**1273.4**	**1085.0**	**1406.3**	**587.4**	**7907.9**	**163.4**	**5149.0**	**1273.8**	**163.4**
Conversion activities	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Grassland to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	1039.4	0.0	496.2
Grassland to Forest Vegetation	0.0	0.0	957.2	0.0	0.0	456.3	0.0	181.0	735.0
Grassland to Perennial Plantations	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.9
Wetlands to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlements to Cropland	0.0	326.8	0.0	0.0	58.0	35.1	0.0	236.1	343.9
Other Land to Cropland	0.0	0.0	0.0	0.0	2231.0	1126.5	0.5	0.6	0.6
Total	**0.0**	**326.8**	**957.2**	**0.0**	**2289.0**	**1617.9**	**1039.9**	**417.6**	**1601.6**
Conversion activities	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Grassland to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to Forest Vegetation	430.8	206.1	394.0	0.0	1880.5	0.0	0.0	0.0	0.0
Grassland to Perennial Plantations	53.7	20.3	8.3	0.0	0.0	0.0	0.0	0.0	0.0
Wetlands to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Settlements to Cropland	1016.2	283.5	113.8	314.3	19.8	0.0	30.6	0.0	0.0
Other Land to Cropland	0.6	0.6	1004.5	318.7	330.1	926.6	0.0	10036.4	10591.3
Total	**1501.2**	**510.4**	**1520.6**	**633.0**	**2230.4**	**926.6**	**30.6**	**10036.4**	**10591.3**
Conversion activities	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Grassland to Cropland	0.0	0.0	2110.0	5349.0	904.0	11757.2	3896.0	6932.0	N/A
Grassland to Forest Vegetation	1277.0	315.5	0.0	0.0	35.3	0.0	0.0	0.0	N/A
Grassland to Perennial Plantations	0.0	0.0	23.4	0.0	0.0	0.0	0.0	0.0	N/A
Wetlands to Cropland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	N/A
Settlements to Cropland	0.0	0.0	0.0	27.1	0.0	94.2	0.0	0.0	N/A
Other Land to Cropland	14595.4	17633.0	19376.0	14970.8	1768.0	0.0	0.0	2489.1	N/A
Total	**15872.4**	**17948.5**	**21509.4**	**20346.9**	**2707.3**	**11851.8**	**3896.0**	**9753.1**	**N/A**

Source: General Land Cadastre of the RoM for the period 1970-2022; Land Use and Land-Use Change Matrix for the period 1970-2022.

Country specific EFs were calculateed/developed in order to establish the annual increments/losses of biomass and carbon stocks in soil on lands subject to conversion to cropland. The calculation and development of such factors was based on data on productivity of grasslands according to accounts and forest planning records, 'Moldsilva' Agency Monitoring Reports for MSCP and MCFDP (2012; 2013; 2017; 2018), as well as data in the scientific literature regarding biomass increments and the clearing process of perennial plantations (Table 6-37).

Table 6-37: Removal/emission factors used in the calculation process for category 4B2 'Land Converted to Cropland'

Conversion activities	Indicators	Period, years	Unit	Indictor value
Grassland to Cropland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	1.22
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments/losses of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	-2.2650
Grassland to Forest Vegetation	Annual average carbon increments/losses in biomass (trees and shrubs)	year 1	Mg C/ha/yr	-2.69
	Annual average carbon increments in biomass (trees and shrubs)	years 2-20	Mg C/ha/yr	1.74
	Annual average carbon increments in dead organic matter (litter/DOM)	years 1-20	Mg C/ha/yr	0.41
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	0.32
Grassland to Perennial Plantations	Annual average carbon increments/losses in biomass (trees and shrubs)	year 1	Mg C/ha/yr	-3.46
	Annual average carbon increments in biomass (trees and shrubs)	years 2-14, 16-20	Mg C/ha/yr	0.32
	Annual average carbon increments in biomass (trees and shrubs)	year 15	Mg C/yr	-4.43
	Annual average carbon increments in dead organic matter (litter/DOM)	years 1-20	Mg C/ha/yr	0.00
	Annual average increments/losses of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	-2.2650
Wetlands to Cropland	Annual average carbon increments in biomass (trees and shrubs)	year 1	Mg C/ha/yr	0,8
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon (SOC/SOM)	year 1	Mg C/ha/yr	-2.2650

Conversion activities	Indicators	Period, years	Unit	Indictor value
Settlements to Cropland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	5.00
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	0.2168
Other Land to Cropland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	5.00
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	year 1	Mg C/ha/yr	0.0108

Source: 'Soil Quality Monitoring in the RoM (database, conclusions, forecasts, recommendations), 2010; Miron A., Vedutenco D. et al., Report on Drafting Management Plans for Grasslands in Orhei National Park, 2014; National GHG Inventory Report for Hungary, 2014; 'Moldsilva' Agency Monitoring Reports for MSCP and MCFDP (2012; 2013; 2017; 2018).

6.3.3. Uncertainties and Time-Series Consistency

4B1. 'Cropland Remaining Cropland'

Uncertainties related to CO_2 emissions/removals from subcategory 4.B1.1 'Cropland Covered with Woody Vegetation' may be considered somewhat acceptable, falling within the values reported for other categories under Sector 4 'LULUCF'. Thus, for production processes and emission/removal factors, these uncertainties account for circa 10%. The main uncertainty is associated with the actual volume of wood mass harvested from woody vegetation managed by local public authorities and other owners since there is no accurate official statistics on the volume of wood mass harvested during forest clearings for this category. The situation was overcome after having made additional calculations based on the experience of the MACP Project and data from the Environmental Protection Inspectorate (EPI). Consequently, for subcategory 4B1.1 'Cropland Covered with Woody Vegetation', wood harvests were provided as part of the total volume authorized annually by the EPI and/or the Environment Agency for local authorities and other public institutions (except for 'Moldsilva' Agency).

Uncertainties related to activity data used in the estimation of CO_2 emissions/removals from category 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' are considered to be low (circa 10%). Uncertainties related to factors used in the estimation of CO_2 emissions from carbon loss in mineral soils due to land-use change and soil management practices are considered to be circa 10%.

Thus, cumulatively for category 4B1 'Cropland Remaining Cropland', uncertainties for production processes and emission/removal factors account for circa 10%, whereas combined uncertainties were estimated to be circa 14.14%. Uncertainties in the trend of total direct GHG emissions from subcategory 4B1 under Sector 4 'LULUCF' were estimated to be circa 9.70% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach and the same EFs were used for the entire period under review for estimating emissions/removals subcategory 4B1 'Cropland Remaining Cropland'.

4B1. 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble field burning)'

Uncertainties associated with non-CO_2 emissions from post-harvest field burning of crop residues result from uncertainties related to activity data on the amounts of crop residues available to be burnt on field, as well as those related to emission factors for various types of burning.

Uncertainties related to activity data on land under cereal production and average yield per hectare reported for these crops are considered relatively low, up to circa 10%. At the same time, uncertainties related to the estimation of stubble fields actually burnt are considered to be moderate, up to circa 30%. Uncertainties associated with the default emission factors for various types of burning are moderate for CH_4 (circa 30%) and N_2O (circa 30%); however, in agricultural seasons with high humidity, these uncertainties can increase to higher levels. Thus, combined uncertainties related to direct non-CO_2 (CH_4 and N_2O) emissions from this source category are regarded to be relatively high: circa 31.62% for CH_4 and N_2O, whereas uncertainties in the trend of total direct GHG emissions under Sector 4 'LULUCF' were estimated to be circa 20.93% for CH_4 and insignificant (±0.0009%) for N_2O (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach and the same EFs were used for the entire period under review for estimating emissions from stubble field burning.

4B2. 'Land Converted to Cropland'

Uncertainties related to CO_2 emissions/removals from category 4B2 'Land Converted to Cropland' at the beginning and at the end of the reference period (1990 and 2022) are relatively low, estimated to be circa 10%. Uncertainties related to emission/removal factors are in both cases circa 10%, whereas combined uncertainties in subcategory 4B2 'Land Converted to Cropland' related to CO_2 emissions/removals constitute circa 14.14%. Uncertainties in the trend of total direct GHG emissions from subcategory 4B2 under Sector 4 'LULUCF' were estimated to be circa 0.08% (Annex 2).

As for non-CO_2 emissions from category 4B2, (N_2O) uncertainties related to activity data are estimated to be circa 10%, whereas uncertainties related to emission factors account for circa 30%. Combined uncertainties for non-CO_2 emissions from category 4B2 are estimated to be circa 31.62%, whereas uncertainties in the trend of total direct GHG emissions under Sector 4 'LULUCF' were estimated to be circa 0.74% (Annex 2).

In view of ensuring time-series consistency of the obtained results, the same approach and the same EFs were used for the entire period under review for estimating emissions from subcategory 4B2 'Land Converted to Cropland'.

6.3.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

6.3.5. Quality Assurance and Quality Control

4B1.1. 'Cropland Covered with Woody Vegetation'

Quality assessment for category 4B1.1 'Cropland Covered with Woody Vegetation' is ensured by the fact that most of the AD used is taken from official records[126]. At the same time, the quality of estimates increased due to the development of the Land Use and Land-Use Change Matrix for the period 1970-2022.

Standard verification and quality control forms and checklists were filled in for this category, following the Tier 1 methodological approach. Verification was focused on various aspects such as: ensuring correct use of estimation methodologies according to the 2006 IPCC Guidelines, correct use of country-specific coefficients and indices, their accuracy, as well as comparing them to the values used by other countries in the region.

4B1.2. 'Annual Change in Carbon Stocks in Mineral Soils'

Standard verification and quality control forms and checklists were filled in for this category, following the Tier 1 methodological approach. Verification was focused on various aspects such as: identifying data entry and CO_2 emission estimation-related errors, on AD and EF verifications and quality control procedures, etc. Activity data and methods used in the estimation of CO_2 emissions from annual change in carbon stocks in mineral soils due to land-use change and management practices were documented and archived both in hard copies and electronically.

Following the recommendations of the 2006 IPCC Guidelines, CO_2 emissions from carbon loss in mineral soils as a result of land-use change and management practices were estimated based on AD from official reference sources (General Land Cadastre, Statistical Yearbooks, etc.), and the results of multiannual research from scientific institutions in the country, respectively.

4B1.3. 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble field burning)'

Standard verification and quality control forms and checklists were filled in for this category, following the Tier 1 methodological approach. Verification was focused on various aspects such as: identifying data entry and CO_2 emission estimation-related errors, on AD and EF verifications and quality control procedures, etc.

[126] E.g., the total area of windbreaks and other types of forest vegetation, perennial plantations, is provided annually by the General Land Cadastre, while data on annual biomass increments are provided by Production Tables, Forest State Records – once every 5 years for forests, Forest Planning Materials, Normative and Technical Forestry Regulations Acts.

Activity data and methods used in the estimation of non-CO_2 emissions from field burning of crop residues were documented and archived both in hard copies and electronically.

4B2. 'Land Concerted to Cropland'

The quality of the estimations for subcategory 4B2 'Land Converted to Cropland' is ensured by the fact that most of the activity data used is taken from official records. At the same time, the quality of the estimates in this compartment has also increased the due to the development of the Land Use and Land-Use Change Matrix for the period 1970-2022.

6.3.6. Recalculations

For the period 1990-2022, no recalculations were made for the main CO_2 emission/removal sources from subcategories 4B1 'Cropland Remaining Cropland' and 4B2 'Land Converted to Cropland'. Recalculations were made for Non-CO_2 emissions from field burning of crop residues (stubble field burning), as well as for emissions from grassland converted to cropland.

4B1.3. 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble field burning)'

Recalculations were carried out for subcategory 4B1.3 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble field burning)' as a result of updated GWP values for methane (CH_4) and nitrous oxide (N_2O) utilized in the calculation of non-CO_2 emissions from field burning of crop residues.

Compared to the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made in the current inventory cycle resulted in an upward trend in non-CO_2 emissions between 1990 and 2020, it being constant throughout the entire period under review, estimated to be +6.6% (Table 6-38).

Table 6-38: Recalculations of non-CO_2 emissions from subcategory 4B1.3 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble field burning)' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	3.2021	3.0960	2.8267	3.8540	2.0914	2.9274	1.9920	3.5110	3.1598	3.0702	1.1921
BTR1	3.4119	3.2989	3.0119	4.1065	2.2285	3.1192	2.1225	3.7411	3.3669	3.2714	1.2703
Difference, %	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	1.5340	0.2789	0.0044	0.0642	0.3059	0.1229	0.1997	0.8839	0.1086	0.0761	0.0679
BTR1	1.6345	0.2972	0.0047	0.0684	0.3260	0.1309	0.2128	0.9418	0.1157	0.0810	0.0724
Difference, %	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	0.0097	0.0862	0.0663	0.0505	0.0632	0.0951	0.0308	0.0545	0.1049		
BTR1	0.0103	0.0919	0.0706	0.0538	0.0674	0.1013	0.0328	0.0581	0.1118	0.2719	0.4471
Difference, %	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**	**+6.6**		

Abbreviations: NC5 – Fifth National Communication, BTR1 – First Biennial Transparency Report.

4B2.2. 'Non-CO_2 Emissions from Grassland Converted to Cropland (arable land)'

Recalculations were carried out for subcategory 4B2.2 'Non-CO_2 Emissions from Grassland Converted to Cropland (arable land)' as a result of updated GWP value for nitrous oxide (N_2O) utilized in the calculation of non-CO_2 emissions from grassland converted to cropland.

Compared to the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made in the current inventory cycle resulted in a downward trend in non-CO_2 emissions between 1990 and 2020, it being constant throughout the entire period under review, estimated to be -11.1% (Table 6-39).

Table 6-39: Recalculations of non-CO_2 emissions from subcategory 4B2.2 'Non-CO_2 Emissions from Grassland Converted to Cropland' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	9.4041	9.2497	8.9048	8.8551	7.4135	7.3655	5.3009	2.6346	2.5231	2.5231	2.4243
BTR1	8.3627	8.2254	7.9187	7.8745	6.5926	6.5498	4.7139	2.3428	2.2437	2.2437	2.1558
Difference, %	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	1.9868	1.8873	1.6691	1.3645	1.6090	1.4110	1.4205	1.3481	1.3481	0.8048	0.7691
BTR1	1.7668	1.6783	1.4843	1.2134	1.4309	1.2547	1.2632	1.1988	1.1988	0.7157	0.6839
Difference, %	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	0.7691	0.7691	0.7691	0.7691	0.7691	1.7681	4.2721	4.6931	10.1986		
BTR1	0.6839	0.6839	0.6839	0.6839	0.6839	1.5723	3.7990	4.1734	9.0693	10.6870	13.5723
Difference, %	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**		

Abbreviations: NC5 – Fifth National Communication, BTR1 – First Biennial Transparency Report.

Next, CO_2 removals/emissions within category 4B 'Cropland' are shown for the period 1990-2022. Thus, during the period under review, CO_2 removals from subcategory 4B1.1 'Cropland Covered with Woody Vegetation' were relatively constant, significant fluctuations being recorded over the period 1990-2022 as a result of internal conversions. Towards the end of the period, an increase of circa 182.7% of total CO_2 removals from subcategory 4B1.1 'Cropland Covered with Woody Vegetation' was recorded compared to the level in 1990. The evolution of CO_2 removals within subcategory 4B1.1 'Cropland Covered with Woody Vegetation' between 1990 and 2022 is presented in Table 6-40.

Table 6-40: CO_2 removals from subcategory 4B1.1 'Cropland Covered with Woody Vegetation' in the RoM between 1990-2022, kt

Categories	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Perennial plantations	621.0776	-470.8458	-412.0377	-359.7555	-532.4280	-311.5310	-488.2169	-256.3340	-213.2668	-145.0914	-329.9127
Woody vegetation	-135.1775	-144.0052	-130.6496	-52.8625	-97.8655	-141.0862	-130.0409	-67.6328	-80.0922	-169.2948	-166.3777
Total	**485.9001**	**-614.8510**	**-542.6873**	**-412.6180**	**-630.2934**	**-452.6172**	**-618.2578**	**-323.9667**	**-293.3590**	**-314.3862**	**-496.2904**
Categories	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Perennial plantations	61.4331	-356.7158	-349.4031	-343.8840	-316.4868	-291.7716	-326.2119	-341.7083	-318.5139	-350.9427	-334.2057
Woody vegetation	-168.2494	-179.9304	-117.1359	-171.2571	-195.0093	-209.2384	-213.9407	-215.8986	-110.4438	-193.0869	-216.4818
Total	**-106.8163**	**-536.6462**	**-466.5391**	**-515.1412**	**-511.4961**	**-501.0100**	**-540.1526**	**-557.6069**	**-428.9577**	**-544.0296**	**-550.6875**
Categories	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Perennial plantations	-336.9199	-323.2828	-304.9532	-293.4707	-259.0135	-237.0690	-263.5206	-258.9820	-243.8326	-234.9272	-221.4185
Woody vegetation	-218.5733	-149.0324	-186.7005	-211.8723	-181.5837	-189.2942	-168.4468	-172.4600	-158.0793	-177.0372	-169.0426
Total	**-555.4931**	**-472.3152**	**-491.6537**	**-505.3430**	**-440.5973**	**-426.3631**	**-431.9674**	**-431.4420**	**-401.9119**	**-411.9644**	**-390.4611**

Source: Land Use and Land-Use Change Matrix for the period 1970-2022.

The graphical illustration of the evolution of CO_2 removals within subcategory 4B1.1 'Cropland Covered with Woody Vegetation' is provided in Figure 6-6.

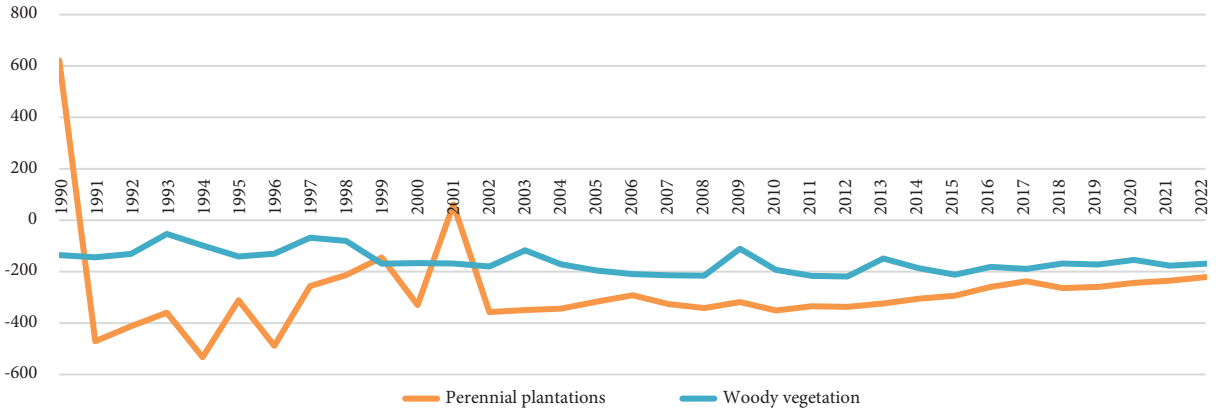


Figure 6-6: CO_2 emissions/removals from cropland covered with woody vegetation in subcategory 4B1 'Cropland Remaining Cropland' in the RoM between 1990-2022, kt.

CO_2 emissions from subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' were relatively constant between 1990 and 2022, with insignificant fluctuations in certain years (Table 6-41). At the same time, due to the above-mentioned factors, CO_2 emissions from category 4B1.2 had increased by 2020 by circa 6.1%, in comparison with the base year.

Table 6-41: CO_2 removals from subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Emissions from cropland mineral soils	1854.0282	1845.9142	1854.9754	1856.7240	1855.8642	1853.3362	1854.3453	1863.6012	1869.4714	1865.9514	1852.6380
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Emissions from cropland mineral soils	1843.6362	1843.5079	1844.1484	1841.0802	1867.2118	1886.3862	1885.8735	1885.1456	1886.0691	1885.6322	1883.2693
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Emissions from cropland mineral soils	1872.0448	1880.2989	1896.8184	1914.5127	1924.7241	1921.9410	1931.8685	1942.3569	1950.7055	1980.1173	1971.0194

Source: Land Use and Land-Use Change Matrix for the period 1970-2022.

The graphical illustration of the evolution of CO_2 emissions from subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' is provided in Figure 6-7.

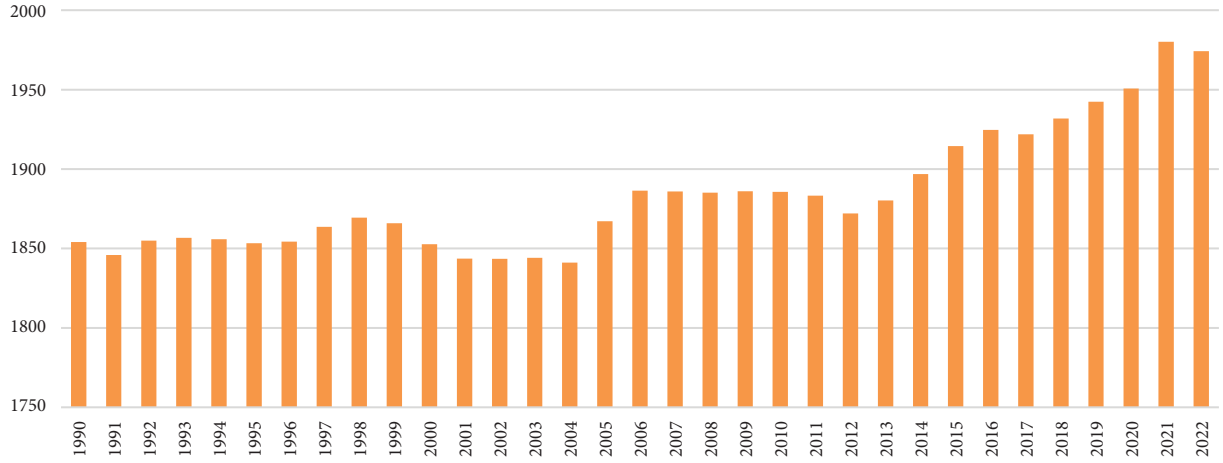


Figure 6-7: CO_2 emissions from subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils' in the RoM between 1990-2022, kt.

4B1.3. 'Non-CO_2 Emissions from Post-Harvest Field Burning of Crop Residues (stubble field burning)'

Non-CO_2 emissions from field burning of crop residues (stubble field burning) for the period 1990-2022 are presented in Table 6-42. Towards the end of the period, the volume of emissions had decreased significantly, by circa 4.5 times compared to 1990. At the same time, it should be noted that the volume fluctuates significantly year-over-year due to adverse weather conditions and anthropogenic factors.

Table 6-42: Non-CO_2 emissions from stubble field burning in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CH_4 emissions, kt	0.09785	0.09460	0.08637	0.11777	0.06391	0.08945	0.06087	0.10729	0.09655	0.09382	0.03643
N_2O emissions, kt	0.00254	0.00245	0.00224	0.00305	0.00166	0.00232	0.00158	0.00278	0.00250	0.00243	0.00094
Total, kt CO_2 equivalent	**3.41190**	**3.29891**	**3.01189**	**4.10652**	**2.22849**	**3.11922**	**2.12250**	**3.74107**	**3.36690**	**3.27139**	**1.27026**
NO_x emissions, kt	0.09060	0.08760	0.07998	0.10904	0.05917	0.08283	0.05636	0.09934	0.08940	0.08687	0.03373
CO emissions, kt	3.33398	3.22358	2.94311	4.01274	2.17760	3.04799	2.07403	3.65564	3.29001	3.19668	1.24126
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CH_4 emissions, kt	0.04687	0.00852	0.00014	0.00196	0.00935	0.00375	0.00610	0.02701	0.00332	0.00232	0.00208
N_2O emissions, kt	0.00122	0.00022	0.00000	0.00005	0.00024	0.00010	0.00016	0.00070	0.00009	0.00006	0.00005
Total, kt CO_2 equivalent	**1.63455**	**0.29720**	**0.00473**	**0.06837**	**0.32598**	**0.13090**	**0.21276**	**0.94182**	**0.11568**	**0.08104**	**0.07238**
NO_x emissions, kt	0.04340	0.00789	0.00013	0.00182	0.00866	0.00348	0.00565	0.02501	0.00307	0.00215	0.00192
CO emissions, kt	1.59722	0.29042	0.00462	0.06681	0.31854	0.12791	0.20790	0.92031	0.11304	0.07919	0.07073
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CH_4 emissions, kt	0.00030	0.00263	0.00202	0.00154	0.00193	0.00290	0.00094	0.00167	0.00321	0.21834	0.35899
N_2O emissions, kt	0.00001	0.00007	0.00005	0.00004	0.00005	0.00008	0.00002	0.00004	0.00008	0.05357	0.08809
Total, kt CO_2 equivalent	**0.01034**	**0.09186**	**0.07060**	**0.05381**	**0.06736**	**0.10128**	**0.03281**	**0.05809**	**0.11176**	**0.27191**	**0.44708**
NO_x emissions, kt	0.00027	0.00244	0.00187	0.00143	0.00179	0.00269	0.00087	0.00154	0.00297	0.00722	0.01187
CO emissions, kt	0.01010	0.08977	0.06898	0.05258	0.06583	0.09897	0.03206	0.05676	0.10921	0.26570	0.43687

Source: Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

Between 1990 and 2022, CO_2 removals from subcategory 4B2 'Land Converted to Cropland' fluctuated, it being influenced by various land conversions to the respective category, including in the period prior to 1990 (Table 6-36). There had been CO_2 emissions in 1990-1991, 1993 and 2020-2022; however, between 1992 and 2019, subcategory 4B2 had been a GHG removal source (Table 6-43). By the end of the period under review, emissions have increased by 3 times compared to the level in the base year.

Table 6-43: CO_2 removals/emissions from category 4B2 'Land Converted to Cropland' in the RoM between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4B2 CO_2 removals/emissions	45.75	27.39	-127.44	5.19	-3.40	-66.35	-101.15	-146.02	-154.62	-112.44	-126.64
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
4B2 CO_2 removals/emissions	-171.25	-144.11	-139.40	-123.40	-87.69	-88.69	-80.78	-92.51	-79.07	-72.97	-106.00
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
4B2 CO_2 removals/emissions	-84.81	-276.10	-245.69	-309.33	-383.49	-412.63	-299.01	-9.28	71.82	140.53	140.86

Source: Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

The graphical illustration of the evolution of CO_2 emissions/removals from subcategory 4B2 'Land Converted to Cropland' is provided in Figure 6-8.

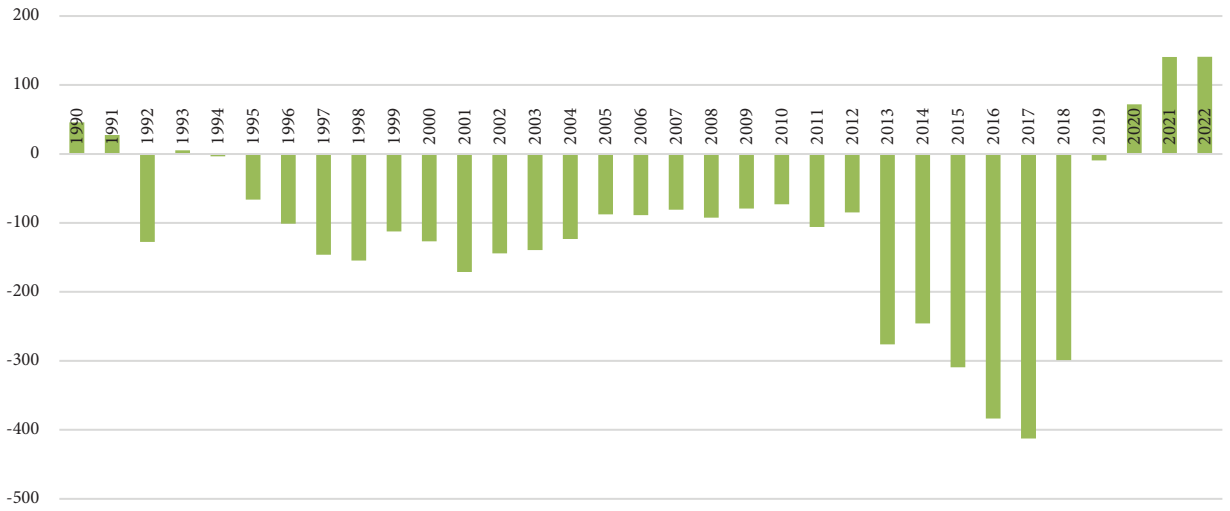


Figure 6-8: CO_2 removals/emissions from category 4B2 'Land Converted to Cropland' in the RoM between 1990-2022, kt.

N_2O emissions resulting from source 4B2.2 'Non-CO_2 emissions from Grassland Converted to Cropland (arable land)' included in category 4B2 'Land Converted to Cropland' fluctuated between 1990 and 2022, except for 1990-1995 and 2022, when significant values were recorded (Table 6-44).

Table 6-44: N_2O emissions resulting from the conversion of grassland to subcategory 4B2 'Land Converted to Cropland' between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
N_2O Emissions, kt	0.0316	0.0310	0.0299	0.0297	0.0249	0.0247	0.0178	0.0088	0.0085	0.0085	0.0081
Total, kt CO_2 equivalent	**8.3627**	**8.2254**	**7.9187**	**7.8745**	**6.5926**	**6.5498**	**4.7139**	**2.3428**	**2.2437**	**2.2437**	**2.1558**
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
N_2O Emissions, kt	0.0067	0.0063	0.0056	0.0046	0.0054	0.0047	0.0048	0.0045	0.0045	0.0027	0.0026
Total, kt CO_2 equivalent	**1.7668**	**1.6783**	**1.4843**	**1.2134**	**1.4309**	**1.2547**	**1.2632**	**1.1988**	**1.1988**	**0.7157**	**0.6839**
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
N_2O Emissions, kt	0.0026	0.0026	0.0026	0.0026	0.0026	0.0059	0.0143	0.0157	0.0342	0.0403	0.0512
Total, kt CO_2 equivalent	**0.6839**	**0.6839**	**0.6839**	**0.6839**	**0.6839**	**1.5723**	**3.7990**	**4.1734**	**9.0693**	**10.6870**	**13.5723**

Source: Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

According to the results obtained, it can be seen that category 4B constitutes a source of CO_2 emissions during the entire period under review (Table 6-45, Figure 6-9). The level of emissions recorded during the reporting period is relatively fluctuating, except for the period 2003-2018, when relatively constant values were recorded. At the end of the period, the value of emissions decreased significantly, in 2022 it reaches -27% compared to 1990, primarily due to subcategory 4B2 'Land Converted to Cropland'.

Table 6-45: CO_2 removals/emissions from category 4B 'Cropland' between 1990-2022, kt

Source Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4B1	2333.3383	1221.3997	1301.6309	1437.8052	1209.7880	1383.0753	1219.6762	1531.8101	1566.6826	1543.2413	1349.3665
4B2	45.7503	27.3853	-127.4433	5.1908	-3.4030	-66.3523	-101.1521	-146.0198	-154.6249	-112.4420	-126.6383
4B Total	**2379.0886**	**1248.7850**	**1174.1876**	**1442.9960**	**1206.3850**	**1316.7230**	**1118.5241**	**1385.7903**	**1412.0577**	**1430.7993**	**1222.7282**
Source Category	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
4B1	1731.6866	1300.6929	1376.9534	1321.9902	1359.3685	1391.9588	1346.9010	1329.1873	1469.7549	1344.7488	1336.6859
4B2	-171.2515	-144.1054	-139.4011	-123.4019	-87.6890	-88.6864	-80.7760	-92.5128	-79.0698	-72.9734	-106.0017
4B Total	**1560.4352**	**1156.5876**	**1237.5523**	**1198.5883**	**1271.6794**	**1303.2724**	**1266.1250**	**1236.6745**	**1390.6850**	**1271.7754**	**1230.6841**
Source Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
4B1	1321.3161	1416.0186	1420.2997	1421.9583	1495.4822	1502.1864	1505.4051	1516.6795	1558.0806	1573.0033	1589.3212
4B2	-84.8145	-276.1037	-245.6852	-309.3304	-383.4881	-412.6261	-299.0102	-9.2832	71.8214	140.5334	140.8619
4B Total	**1236.5016**	**1139.9149**	**1174.6145**	**1112.6279**	**1111.9941**	**1089.5602**	**1206.3949**	**1507.3962**	**1629.9020**	**1713.5367**	**1730.1831**

Source: Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

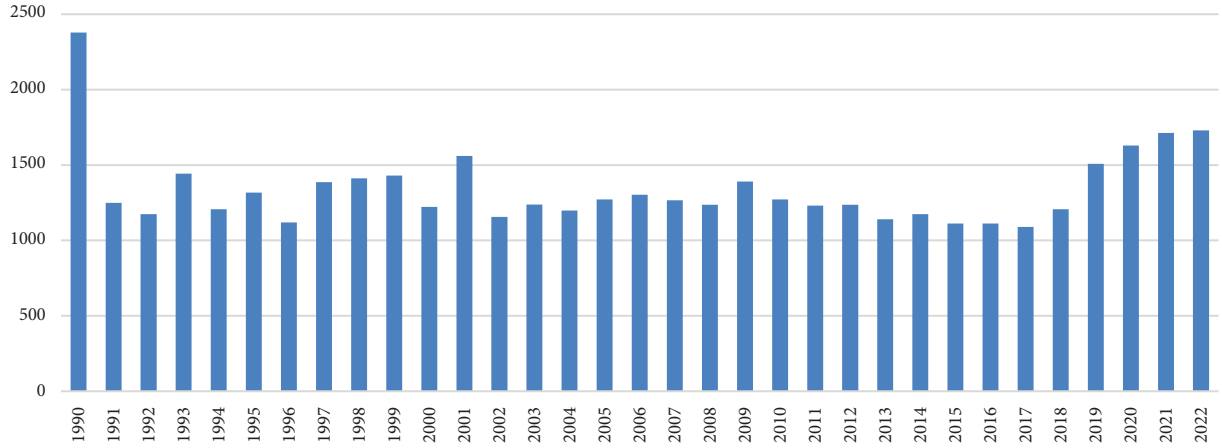


Figure 6-9: CO_2 emissions from category 4B 'Cropland' in the RoM between 1990-2022, kt.

Figure 6-10 shows the individual contribution of the two subcategories (4B1 and 4B2) to CO_2 removals/emissions. As it can be seen, due to land-use change and management practices, as well as conversions processes, subcategory 4B1 is a permanent source of CO_2 emissions, whereas subcategory 4B2 – a source of removals in most years.

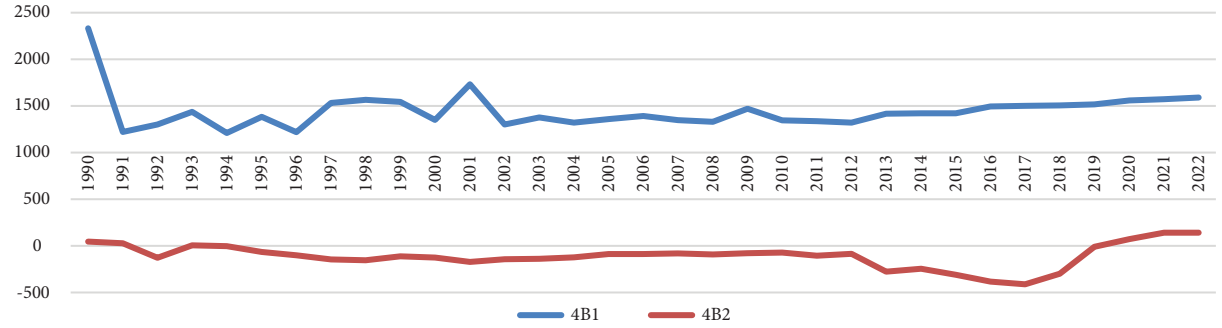


Figure 6-10: CO_2 removals/emissions from category 4B 'Cropland' between 1990-2022, kt.

6.3.7. Planned Improvements

For the next inventory cycle, for subcategory 4B1.1 'Cropland Covered with Woody Vegetation', the possibility of improving records pertaining to the actual volume of wood mass from windbreak management and other types of woody vegetation shall be considered, as well as activities aimed at the verification of emission/removal factors specific to perennial plantations (current biomass increments, biomass harvesting during clearings, etc.).

For subcategory 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils', activities regarding the reduction of obtained uncertainty results are planned, including by improving the country-specific methodology (Banaru, 2000) and improving the quality of activity data used in the estimation of CO_2 emissions/removals. There are no planned improvements for non-CO_2 emissions from post-harvest field burning of crop residues' (stubble field burning) and grassland converted to cropland (arable land). There are no planned improvements for subcategory 4B2 'Land Converted to Cropland'.

6.4. Grassland (Category 4C)

6.4.1. Source Category Description

Category 4C 'Grassland' comprises CO_2 emissions/removals originating from two subcategories, 4C1 'Grassland Remaining Grassland' and 4C2 'Land Converted to Grassland'. Grassland is an area of land covered with perennial herbaceous vegetation used for grazing animals (pastures and hayfields). Under Sector 4 'LULUCF', in 1990, grassland accounted for 27.4% of the total CO_2 removals. In 2022, the share of grassland in this process decreased to 7.5%, remaining a significant source in the total share recorded within this sector.

Subcategory 4C1 'Grassland Remaining Grassland' includes: a) land which has always been covered with perennial herbaceous vegetation used as pastures or hayfields (reported together as a single input in the Land Use and Land-Use Change Matrix), and land covered with perennial herbaceous vegetation from other categories of use, such as b) land under improvement and fertility restoration, and c) land affected by landslides. Subcategory 4C1 likewise includes all land converted to grassland more than 20 years ago (taking into account that the time series commences in 1970).

Within subcategory 4C2 'Land Converted to Grassland', CO_2 emissions/removals are estimated, which result from: a) restoration of natural vegetation on land excluded from agricultural use and converted to grassland; b) conversions of wetlands to grassland; c) conversions of settlements to grassland; d) conversions of land covered with woody vegetation to grassland.

The main sources of activity data utilised in the inventory for the period 1970-2022 were: the General Land Cadastre (all cadastral categories have been converted into IPCC Land-Use categories), reports from 'Moldsilva' Agency and the Environmental Protection Inspectorate (Forest Land Converted to Grassland).

6.4.2. Methodologies, Emission Factors and Activity Data

4C1. 'Grassland Remaining Grassland'

Within subcategory 4C1 'Grassland Remaining Grassland', CO_2 emissions/removals resulting from the following categories of national use were estimated (according to land cadastral records): 'pastures', 'hayfields', 'land under improvement and fertility restoration', 'landslides', as well as various categories of land converted to grassland more than 20 years ago. Activity data, particularly the areas included in subcategory 4C1 'Grassland Remaining Grassland' between 1990 and 2022, are provided in Table 6-46.

Table 6-46: Areas of land included in subcategory 4C1 'Grassland Remaining Grassland' in the RoM between 1990-2022, thousand ha

Land category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Grassland remaining grassland	243.30	241.90	237.35	244.19	237.60	236.73	236.30	235.79	236.49	242.07	247.80
Land category	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Grassland remaining grassland	258.02	266.51	265.20	261.04	264.06	259.07	259.99	269.66	300.88	304.84	310.26
Land category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Grassland remaining grassland	309.63	305.92	308.06	305.45	305.92	305.34	297.16	287.02	277.21	267.92	247.15

Source: Land Use and Land-Use Change Matrix in the RoM for the period 1970-2022; General Land Cadastre of the RoM for the period 1970-2022.

In order to estimate the change of carbon stock in biomass for subcategory 4C1 'Grassland Remaining Grassland', the Tier 1 approach from the 2006 IPCC Guidelines is used, which implies that there are no fluctuations in this subcategory, the stock thereby does not change in time and space on a national scale. Likewise, in order to report carbon stocks in litter, the tier 1 IPCC approach is applied, which implies that the stocks are balanced in the long term.

A country-specific approach is used in order to estimate CO_2 emissions/removals from mineral soils. The humus content is available in recurrent measurements in 1990 vs. 1980 in land categories converted to grassland (annual herbaceous vegetation) from national reference sources (Table 17.16 in Donos A., 2004). The estimated emission factor is -0.0028 tonnes C/ha/yr.

4C2. 'Land Converted to Grassland'

Subcategory 4C2 'Land Converted to Grassland' includes land with woody vegetation, arable land, perennial plantations (vineyards and orchards), as well as wetlands (marshes, wetlands saturated by water), settlements converted to grassland in the last 20 years. GHG emissions/removals from this category result from land-use change and changes in land management, thereby eliminating the existing vegetation and its replacement with grassland vegetation. There are no conversions of forest land to grassland. The areas currently subject to conversion are provided in Table 6-47.

Table 6-47: Area of lands converted to grassland in the RoM between 1970-2022 (annual areas initiating the conversion), ha

Categories of use converted	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
I. Cropland converted to grassland, total	0.0	134.8	493.2	8238.6	128.0	319.0	255.0	158.9	1481.0	59.7	0.0	24.7	13719.0	0.0
- arable land	*0.0*	*0.0*	*0.0*	*8051.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*13719.0*	*0.0*
- forest vegetation	*0.0*	*127.6*	*128.0*	*127.6*	*128.0*	*319.0*	*255.0*	*64.0*	*1372.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*
- vineyards and orchards	*0.0*	*7.2*	*365.2*	*59.9*	*0.0*	*0.0*	*0.0*	*94.9*	*109.0*	*59.7*	*0.0*	*24.7*	*0.0*	*0.0*
II. Wetlands converted to grassland	0.0	0.0	0.0	0.0	800.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	500.0
III. Settlements converted to grassland	0.0	18.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	109.8	0.0
IV. Other land converted to grassland	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9027.1	16419.7	26895.7	26895.7	33104.2
TOTAL	**0.0**	**153.1**	**493.2**	**8238.6**	**928.0**	**319.0**	**255.0**	**158.9**	**1481.0**	**9086.8**	**16419.7**	**26920.4**	**40724.5**	**33604.2**
Categories of use converted	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
I. Cropland converted to grassland, total	127.6	7211.5	351.2	7046.2	15818.4	36651.3	21077.0	3800.8	157.6	3037.1	314.5	2290.9	5582.4	4873.3
- arable land	*0.0*	*6781.7*	*0.0*	*4984.4*	*15818.4*	*36632.3*	*20247.0*	*3800.8*	*0.0*	*1759.9*	*0.0*	*1965.5*	*4956.8*	*2655.9*
- forest vegetation	*127.6*	*0.0*	*0.0*	*2042.1*	*0.0*	*0.0*	*830.0*	*0.0*	*0.0*	*957.2*	*0.0*	*0.0*	*382.9*	*1978.3*
- vineyards and orchards	*0.0*	*429.9*	*351.2*	*19.7*	*0.0*	*19.0*	*0.0*	*0.0*	*157.6*	*320.0*	*314.5*	*325.4*	*242.8*	*239.1*
II. Wetlands converted to grassland	0.0	0.0	0.0	0.0	0.0	0.0	200.0	700.0	0.0	0.0	0.0	200.0	0.0	0.0
III. Settlements converted to grassland	0.0	384.5	329.5	0.0	91.5	0.0	54.9	0.0	0.0	36.6	0.0	100.0	36.6	0.0
IV. Other land converted to grassland	34252.4	43629.7	49532.5	47818.2	46326.6	43488.1	31613.8	33171.0	33154.5	34877.1	46680.4	47554.4	44423.0	42409.5
TOTAL	**34380.0**	**51225.7**	**50213.2**	**54864.4**	**62236.6**	**80139.4**	**52945.8**	**37671.8**	**33312.1**	**37950.8**	**46995.0**	**50145.3**	**50042.0**	**47282.7**
Categories of use converted	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
I. Cropland converted to grassland, total	3376.3	7039.4	17713.1	790.2	85.2	1177.3	0.3	0.0	0.0	407.7	0.0	1949.0	39.4	39.8
- arable land	*1764.7*	*6708.5*	*17144.9*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*407.7*	*0.0*	*0.0*	*0.0*	*0.0*
- forest vegetation	*1340.1*	*0.0*	*255.3*	*265.5*	*0.0*	*1128.9*	*0.0*	*0.0*	*0.0*	*0.0*	*0.0*	*1914.4*	*0.0*	*37.8*
- vineyards and orchards	*271.5*	*330.9*	*312.9*	*524.7*	*85.2*	*48.4*	*0.3*	*0.0*	*0.0*	*0.0*	*0.0*	*34.6*	*39.4*	*2.1*
II. Wetlands converted to grassland	0.0	0.0	0.0	43.0	0.0	1121.0	0.0	731.0	0.0	0.0	0.0	0.0	0.0	175.4
III. Settlements converted to grassland	73.2	0.0	0.0	13.0	7.9	0.0	52.9	77.1	227.8	63.5	25.5	70.4	4.4	0.0
IV. Other land converted to grassland	38942.2	26984.1	11947.5	6222.2	8402.9	0.0	0.0	0.0	0.0	1714.6	3921.3	4039.2	19829.4	18524.4
TOTAL	**42391.7**	**34023.5**	**29660.6**	**7068.4**	**8496.0**	**2298.3**	**53.2**	**808.1**	**227.8**	**2185.8**	**3946.8**	**6058.6**	**19873.3**	**18739.7**
Categories of use converted	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
I. Cropland converted to grassland, total	5259.4	1166.4	680.6	50.1	0.1	1818.6	538.6	55.6	174.7	84.0	8221.7	N/A	N/A	N/A
- arable land	*5184.6*	*0.0*	*0.0*	*0.0*	*0.0*	*1781.0*	*0.0*	*0.0*	*0.0*	*0.0*	*8102.0*	*N/A*	*N/A*	*N/A*
- forest vegetation	*15.0*	*1165.6*	*616.5*	*0.0*	*0.0*	*37.6*	*476.2*	*0.0*	*77.4*	*39.1*	*10.8*	*N/A*	*N/A*	*N/A*
- vineyards and orchards	*59.7*	*0.8*	*64.1*	*50.1*	*0.1*	*0.0*	*62.4*	*55.6*	*97.4*	*44.9*	*108.9*	*N/A*	*N/A*	*N/A*
II. Wetlands converted to grassland	234.0	2405.0	79.0	131.0	526.0	86.0	322.0	60.0	40.7	0.0	69.0	N/A	N/A	N/A
III. Settlements converted to grassland	6.9	0.0	0.0	0.0	0.0	0.0	6.1	0.0	21.1	0.0	0.0	N/A	N/A	N/A
IV. Other land converted to grassland	11761.2	5166.2	0.0	2474.6	4486.8	5201.0	13044.7	3528.0	9260.0	3450.0	0.0	N/A	N/A	N/A
TOTAL	**17261.5**	**8737.5**	**759.6**	**2655.6**	**5012.8**	**7105.6**	**13911.4**	**3643.6**	**9496.5**	**3534.0**	**8290.6**	**N/A**	**N/A**	**N/A**

Source: General Land Cadastre of the RoM for the period 1990-2022, 'Moldsilva' Agency Reports and Reports of the State Ecological Inspectorate on the area of forest land and other types of forest vegetation cleared through illegal logging for the period 1990-2022; Land Use and Land-Use Change Matrix for the period 1970-2022.

GHG inventory for land categories converted to grassland includes the assessment of changes in carbon stocks for the following carbon pools: biomass, litter, soil. In order to estimate the annual change in carbon stock in biomass of land converted to grassland from country-specific data, and the national scientific literature, respectively, national EFs were calculated/developed. The biomass stock was thereby estimated taking into account the distribution of grassland by landscape and productivity (meadows and grassland located on slopes of high, medium, and low productivity), and by consulting national sources in the scientific literature, respectively (Table 6-48).

The amount reported in Table 6-48 represents the maximum harvestable biomass resulting from the collection of hay in two successive stages (harvesting in the first stage represented 93% of the total estimated biomass). To this harvestable above-ground biomass, a percentage of 110 is added (to include the lower part of above-ground biomass and below-ground biomass), inferred from the data provided in Table 2.3, see reference Donos A. (2001).

Table 6-48: Annual biomass increment rates used in the estimation of emissions/removals from subcategory 4C2 'Land Converted to Grassland'

Categories	Productivity categories	Annual biomass stock, t MC/ha/yr
Meadows	high	3.2
	medium	2.0
	low	1.2
Grasslands on slopes	high	2.8
	medium	1.8
	low	1.2
Landslides	low	1.2

Source: Forest Research and Management Institute Reports (2014-2016) on Grassland Inventory within Orhei National Park.

Based on the inventory surveys of grasslands in Orhei National Park (EU/UNDP 'Clima East' Project, 2014-2016), Soroca and Stefan Voda districts[127] it can be observed that grasslands (pastures and hayfields) in these areas, like most grasslands of the RoM, are managed traditionally in an extensive and unsystematic manner. The practiced system is characterized by minimal tending activities, or even inexistent, and by the inexistent correlation between the production capacity of grasslands and their loading with animals. For this reason, grasslands cannot be fully used due `to under-exploitation/ under-loading with animals (which is why the invasion of grassland with spontaneous shrubby vegetation occurs), or they can be overloaded, failing to provide sufficient food for the entire livestock.

In order to estimate CO_2 removals in biomass on land converted to grassland, the annual increments of perennial herbaceous vegetation on newly-formed grasslands, as well as the differences of initial biomass for land previously covered with forest vegetation were established, according to the available data at national level. The calculation process is based on the annual increments in carbon pools due to current biomass increments in new grasslands and uses Equation 2.15 in the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20). Emission factors used in the estimation process, including for litter and soil are provided in Table 6-49.

Table 6-49: EFs used to estimate emissions/removals from subcategory 4C2 'Land Converted to Grassland'

Conversion activities	Indicators	Period,years	Unit	Indicator value
Cropland (arable) converted to grassland	Annual average carbon increments/losses in biomass	year 1	Mg C/ha/yr	-1.22
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	2.2650
Forest vegetation (in cropland) converted to grassland	Annual average carbon increments/losses in biomass	year 1	Mg C/yr	-26.02
	Annual average carbon increments/losses in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	-1.15
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	1.0662
Perennial plantations (in cropland) converted to grassland	Annual average carbon increments/losses in biomass	year 1	Mg C/ha/yr	-0.65
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	2.2650
Wetlands converted to grassland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	0.00
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	years 1-20	Mg C/ha/yr	2.4818

[127] 'Integration of Biodiversity Conservation Priorities into Territorial Planning Policies and Land-Use Practices in Moldova, 2015-2016' Project

Conversion activities	Indicators	Period,years	Unit	Indicator value
Settlements converted to grassland	Annual average carbon increments in biomass	year 1	Mg C/ha/yr	3.78
	Annual average carbon increments in dead organic matter (litter/DOM)	year 1	Mg C/ha/yr	0.00
	Annual average increments of soil organic carbon (SOC/SOM)	year 1	Mg C/ha/yr	0.1241

Source: Giurgiu V., Decei I., Armasescu S. Biometry of Trees and Rammels in Romania, 1972; Kapp G., Velsen-Zerweck M., Horst A., Horn L., Galupa D. Talmaci I. et al.: The baseline study for the 'Soils Conservation Project in Moldova', 2003; Official Monitor No. 46-49, Government Decision No. 367 dated 13.04.2000, 'On approving the National Program to Combat Desertification 2000'; National GHG Inventory Report for Hungary, 2014; 'Soil Quality Monitoring in the Republic of Moldova (database, conclusions, forecasts, recommendations)', 2010; Reports of the Forestry Research and Management Institute (2014-2016) on the inventory of grasslands in Orhei National Park.

6.4.3. Uncertainties and Time-Series Consistency

4C1. 'Grassland Remaining Grassland'

Uncertainties associated with CO_2 emissions/removals from subcategory 4C1 'Grassland Remaining Grassland' are not estimated since there is a neutral balance in the main carbon pools (biomass, litter, soil).

4C2. 'Land Converted to Grassland'

Uncertainties associated with the CO_2 emissions/removals resulting from subcategory 4C2 'Land Converted to Grassland' are within acceptable limits. Land conversion (cropland, forest vegetation, etc.) to grassland is a usual process in the RoM, having different magnitudes between 1970 and 2022. In the base year (1990), the accuracy degree represented circa 5% for 'production processes', which is explained by the fact that state institutions ensured a rigorous control in spring and autumn in terms of forests and forest vegetation owned by local public authorities. Cadastral records thereby recorded systematic changes in land-use categories, etc. By the end of the reference period (2022), the accuracy degree of activity data decreased to circa 15%, which is explained by the lack of veridical records on the evolution of land-use of forest land damaged by illegal logging (grazing, growing crops, etc.). Emission/removal factors have an uncertainty level of circa 10%.

In accordance with current practices, most land with forest vegetation subject to conversion is continuously used primarily for grazing because most of it is degraded, or situated on slopes over 7°, where cultivation of agricultural crops (including through tillage) is economically inefficient. Exclusion of cropland from the agricultural production cycle is a contradictory process, as surface fluctuations for grassland were conditioned both by exclusion of cropland from the cycle and planting forest vegetation and perennial plantation on it (orchards, vineyards).

The General Land Cadastre after 1994 contains only general information in this sense, without specifying to which categories cropland excluded the from the agricultural production cycle was transferred (arable lands, perennial plantations, etc.). One part of them were converted to forest land, while the other (depending on state) were transferred to other categories (grassland, ravines, landslides, etc.). Practically, only the land-use category (in many cases determined by local traditions) reflects, to some extent, the state of such land after conversion from cropland. Thus, combined uncertainties related to CO_2 emissions/removals from subcategory 4C2 'Land Converted to Grassland' can be regarded as moderate, and are estimated to be circa 18.03%. Uncertainties in trend of total direct GHG emissions under Sector 4 'LULUCF' were estimated to be circa 0.13% (Annex 2).

6.4.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

6.4.5. Quality Assurance and Quality Control

Quality of assessment for category 4C 'Grassland' is provided by the fact that most of the AD used is taken from official records. The total area of grassland is thereby provided by the General Land Cadastre of the RoM for each year. Data regarding the area of forest vegetation converted to grassland is available in the sectoral records of the state forestry institutions (Statistical Form 5 G.S. 'Statistical Report on volumes of illegal logging'), as well as in the reports of state institutions for environmental protection. Data on annual biomass increment for forest vegetation converted to grassland is provided by Production Tables and specific records/measurements. For grassland, data is taken from the scientific literature in the field, from normative and technical regulation acts, as well as from the grassland inventory reports of the Forest Research and Management Institute of the inventory of grassland in Orhei National Park. Verification of the GHG inventory quality within category 4C 'Grassland' includes, in addition to com-

plying with the recommendations included in the 2006 IPCC Guidelines, ensuring correct use of national factors, their accuracy, as well as comparing them to the values used by other Eastern and Central European countries. At the same time, the quality of AD increased due to the development of the Land Use and Land-Use Change Matrix for the period 1970-2022 for Sector 4 'LULUCF' as a whole (including for category 4C 'Grassland'). Quality assurance and quality control measures of the GHG inventory are described in section 4A 'Forest Land'. Standard verification and quality control forms and checklists were filled in for this category, following the Tier 1 methodological approach.

It should be noted that according to the recommendations included in the 2006 IPCC Guidelines, CO_2 emissions/removals from grassland use processes within this sector were estimated based on AD from official reference sources (General Land Cadastre and Statistical Yearbooks, etc.).

6.4.6. Recalculations

4C1. 'Grassland Remaining Grassland'

No recalculations were performed in the current inventory cycle for category 4C1 'Grassland Remaining Grassland'.

4C2. 'Land Converted to Grassland'

No recalculations were performed in the current inventory cycle for category 4C2 'Land Converted to Grassland'.

Between 1990 and 2022, CO_2 removals from subcategory 4C2 'Land Converted to Grassland' had continuously decreased. Results regarding CO_2 removal values from this subcategory are presented in Table 6-50. At the beginning of the reporting period (1990), the removals occurring in subcategory 4C2 are quite significant at sectoral level, due to the massive conversion of different categories of land to grassland (Table 6-47). Towards the end of the period, the removals occuring in subcategory 4C2 had decreased significantly. In 2022, the lowest value was recorded, which is only 10.3% of the value in the reference year. Thus, compared to 1990, in 2022 there was a decrease of 89.7% or a difference of circa 1,082.6 kt.

Table 6-50: CO_2 removals from category 4C2 'Land Converted to Grassland' between 1990-2022, kt

Source Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4C1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4C2	-1205.69	-1414.32	-1428.48	-1303.52	-1577.33	-1601.10	-1548.08	-1400.86	-1436.27	-1433.29	-1291.95
4C Total	**-1205.69**	**-1414.32**	**-1428.48**	**-1303.52**	**-1577.33**	**-1601.10**	**-1548.08**	**-1400.86**	**-1436.27**	**-1433.29**	**-1291.95**
Source Category	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
4C1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4C2	-1290.65	-1235.14	-1007.18	-1120.48	-1058.12	-1056.37	-1031.24	-932.15	-447.69	-691.99	-638.17
4C Total	**-1290.65**	**-1235.14**	**-1007.18**	**-1120.48**	**-1058.12**	**-1056.37**	**-1031.24**	**-932.15**	**-447.69**	**-691.99**	**-638.17**
Source Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
4C1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4C2	-562.75	-360.17	-341.11	-418.46	-402.37	-384.04	-440.15	-293.29	-223.15	-138.64	-123.12
4C Total	**-562.75**	**-360.17**	**-341.11**	**-418.46**	**-402.37**	**-384.04**	**-440.15**	**-293.29**	**-223.15**	**-138.64**	**-123.12**

Source: Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

Graphical illustration of the evolution of CO_2 removals from subcategory 4C2 'Land Converted to Grassland' is shown in Figure 6-11.

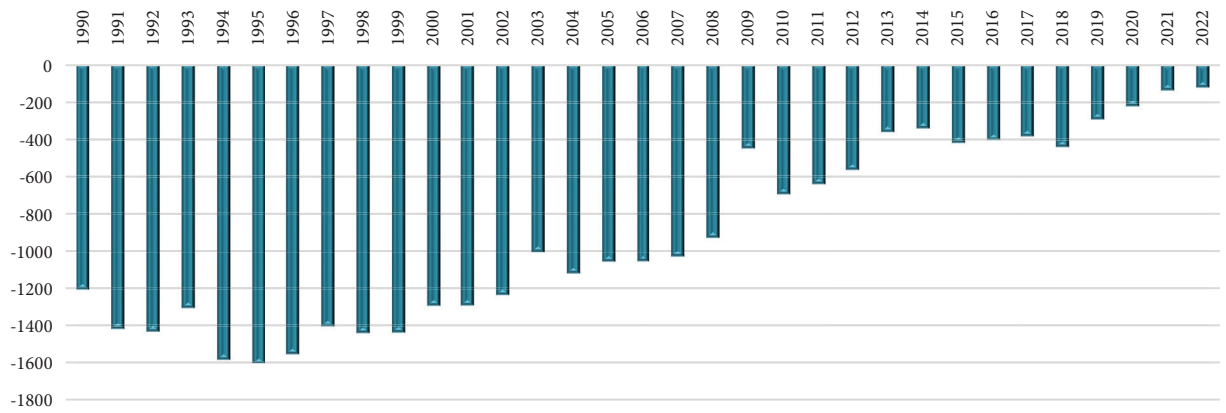


Figure 6-11: CO_2 removals from subcategory 4C2 'Land Converted to Grassland' between 1990-2022, kt.

6.4.7. Planned Improvements

In order to improve GHG inventory quality, in the next inventory cycles, it is necessary to perfect cadastre records with respect to specifying land-use categories from which land is transferred to grassland.

6.5. Wetlands (Category 4D)

6.5.1. Source Category Description

Category 4D 'Wetlands' includes any land that is covered or saturated by water for the entire or only for a part of the year (for example, marshes), and does not fall into categories 'Forest Land', 'Cropland', 'Grassland' or 'Settlements'. It also includes storage water reservoirs (including managed ponds), as well as unmanaged natural lakes and rivers. 4D 'Wetlands' comprises two subcategories: 4D1 'Wetlands Remaining Wetlands' and 4D2 'Land Converted to Wetlands'.

6.5.2. Methodologies, Emission Factors and Activity Data

4D1. 'Wetlands Remaining Wetlands'

Due to the particularities of lands in the RoM included in subcategory 4D1 'Wetlands Remaining Wetlands' (land without forest/herbaceous vegetation and/or no management activities contributing to essential changes in carbon pools), following the Tier 1 methodological approach in the 2006 IPCC Guidelines, a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soil).

AD on areas within category 'Wetlands Remaining Wetlands' are available in the General Land Cadastre of the RoM and are also included in the Land Use and Land-Use Change Matrix for the period 1970-2022. Subcategory 4D1 'Wetlands Remaining Wetlands' also includes lands subject to internal conversion, which do not generate essential changes in carbon pools, maintaining a steady balance (Table 6-51).

Table 6-51: Area of land included in subcategory 4D1 'Wetlands Remaining Wetlands' in the RoM between 1990-2022, ha

Land Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Wetlands with vegetation (marshes)	9200.0	9300.0	9000.0	10000.0	10000.0	9900.0	10200.0	10200.0	10200.0	10400.0	10400.0
Wetlands saturated by water	54600.0	55500.0	53800.0	56399.7	57400.0	59500.0	61100.0	62100.0	62100.0	64900.0	65600.0
Wetlands with vegetation (marshes) converted to wetlands saturated by water	4100.0	4100.0	4200.0	4300.0	3300.0	2500.0	2500.0	2200.0	2200.0	2200.0	1800.0
Wetlands saturated by water converted to wetlands with vegetation (marshes)	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0	200.0
Total	**68100.0**	**69100.0**	**67200.0**	**70899.7**	**70900.0**	**72100.0**	**74000.0**	**74700.0**	**74700.0**	**77700.0**	**78000.0**
Land Category	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Wetlands with vegetation (marshes)	11800.0	12400.0	10911.0	11911.0	11617.0	12017.0	11833.0	12833.0	13126.4	12910.4	12910.4
Wetlands saturated by water	65425.0	67325.0	67325.0	67925.0	68488.0	68688.0	68688.0	70788.0	70888.0	71988.0	70112.6
Wetlands with vegetation (marshes) converted to wetlands saturated by water	1800.0	1800.0	2168.0	2168.0	1768.0	1768.0	2152.0	2152.0	2158.6	1274.6	1274.6
Wetlands saturated by water converted to wetlands with vegetation (marshes)	532.0	532.0	532.0	532.0	532.0	532.0	432.0	432.0	432.0	432.0	432.0
Total	**79557.0**	**82057.0**	**80936.0**	**82536.0**	**82405.0**	**83005.0**	**83105.0**	**86205.0**	**86605.0**	**86605.0**	**84729.6**
Land Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Wetlands with vegetation (marshes)	13262.7	12162.7	13053.7	12902.7	12510.7	12652.7	12730.7	14382.7	15342.0	14265.0	13402.4
Wetlands saturated by water	71585.8	67581.6	67780.8	65580.8	63946.8	63018.8	63018.8	60305.8	59705.8	59496.8	58231.8
Wetlands with vegetation (marshes) converted to wetlands saturated by water	1220.6	1120.6	2150.6	2970.6	2970.6	3270.6	3270.6	3270.6	3670.6	3679.6	4143.2
Wetlands saturated by water converted to wetlands with vegetation (marshes)	432.0	432.0	432.0	432.0	432.0	432.0	432.0	432.0	432.0	109.0	109.0
Total	**86501.1**	**81296.9**	**83417.1**	**81886.1**	**79860.1**	**79374.1**	**79452.1**	**78391.1**	**79150.4**	**77550.4**	**75886.4**

Source: General Land Cadastre of the RoM for the period 1970-2022; Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

4D2. 'Land Converted to Wetlands'

In order to estimate CO_2 removals/emissions from subcategory 4D2 'Land Converted to Wetlands', the Tier 2 approach was utilised for biomass. Losses in biomass are determined by the conversion of land-

use categories which were previously covered with a certain amount of biomass (forest vegetation, grassland, perennial plantations, etc.). At the same time, biomass increments were estimated due to the conversion of land-use categories without initial vegetation (Other Land). The calculation process of CO_2 removals/emissions is based on the annual increments in carbon stocks due to current biomass growth, and Equation 2.15 from the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.22). According to Table 6-52, the main land categories converted to wetlands are grasslands and other land.

Table 6-52: Area of land converted to Wetlands between 1970-2022 (annual areas that initiate conversion), ha

Conversion	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983
Grassland to Wetlands	0.0	0.0	400.0	0.0	0.8	1400.0	1900.0	700.0	0.0	3000.0	300.0	1600.0	2500.0	0.0
Other Land to Wetlands	0.0	1700.0	0.0	1399.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2
Total	**0.0**	**1700.0**	**400.0**	**1399.2**	**3100.0**	**4499.2**	**4999.2**	**3799.2**	**3099.2**	**6099.2**	**3399.2**	**4699.2**	**5599.2**	**3099.2**
Conversion	**1984**	**1985**	**1986**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**
Grassland to Wetlands	1600.0	600.0	600.0	100.0	3100.0	400.0	0.0	0.0	800.0	900.0	2200.0	0.0	400.0	300.0
Other Land to Wetlands	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	3099.2	1399.2	3699.2	0.0	0.0	0.0	0.0	0.0
Total	**4699.2**	**3699.2**	**3699.2**	**3199.2**	**6199.2**	**3499.2**	**3099.2**	**1399.2**	**4499.2**	**900.0**	**2200.0**	**0.0**	**400.0**	**300.0**
Conversion	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Grassland to Wetlands	400.0	2000.0	1100.0	0.0	905.0	0.0	472.0	0.0	178.0	80.0	40.5	28.8	3231.0	63.0
Other Land to Wetlands	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1700.0
Total	**400.0**	**2000.0**	**1100.0**	**0.0**	**905.0**	**0.0**	**472.0**	**0.0**	**178.0**	**80.0**	**40.5**	**28.8**	**3231.0**	**1763.0**
Conversion	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Grassland to Wetlands	47.2	32.0	0.0	3698.9	0.0	0.0	742.0	0.0	165.8	3.0	409.0	N/A	N/A	N/A
Other Land to Wetlands	0.0	3699.2	3698.8	0.0	0.0	1.0	1.0	0.0	0.0	10.0	55.0	N/A	N/A	N/A
Total	**47.2**	**3731.2**	**3698.8**	**3698.9**	**0.0**	**1.0**	**743.0**	**0.0**	**165.8**	**13.0**	**464.0**	**N/A**	**N/A**	**N/A**

Source: General Land Cadastre of the RoM for the period 1970-2022; Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

Carbon stocks in mineral soils within subcategory 4D2 'Land Converted to Wetlands' is estimated based on country-specific data (Soil Quality Monitoring in the Republic of Moldova, 2010). In order to estimate annual biomass increments/losses in land converted to wetlands, national emission factors were calculated/developed (Table 6-53).

Table 6-53: EFs used in the estimation of CO_2 emissions/removals from subcategory 4D2 'Land Converted to Wetlands'

Conversion	Indicators	Period, years	Unit	Indicator value
Grassland converted to wetlands[128]	Annual average carbon increments in biomass (herbaceous cover)	year 1	Mg C/ha/yr	0.0
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments of soil organic carbon	years 1-20	Mg C/ha/yr	0.0
Other land converted to wetlands	Annual average carbon increments in biomass (herbaceous cover)	year 1	Mg C/ha/yr	4.2
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments of soil organic carbon	years 1-20	Mg C/ha/yr	2.4818

6.5.3. Uncertainties and Time-Series Consistency

4D1. 'Wetlands Remaining Wetlands'

Uncertainties associated with CO_2 emissions/removals under subcategory 4D1 'Wetlands Remaining Wetlands' are not estimated since a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soil).

4D2. 'Land Converted to Wetlands'

Uncertainties associated with CO_2 emissions/removals from subcategory 4D2 'Land Converted to Wetlands' at the beginning and the end of the reference period (1990 and 2022) are somewhat low, estimated to be circa 10%. In both cases, emission/removal factors have an uncertainty level of circa 10%. Combined uncertainties in subcategory 4D2 'Land Converted to Wetlands' constitute circa 14.14%. Uncertainties in the trend of total direct GHG emissions under Sector 4 'LULUCF' were estimated to be circa 0.03% (Annex 2).

[128] The indicator value is equal to zero, because wetlands (marshes) are associated with grasslands, thereby after conversion there are no significant changes in carbon pools.

6.5.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

6.5.5. Quality Assurance and Quality Control

The quality of assessment for category 4D 'Wetlands' is ensured by the fact that most of the AD used is taken from official records (the General Land Cadastre of the RoM). Annual biomass increments/losses for lands converted to wetlands were estimated using country-specific EFs developed within EU/UNDP 'Clima East' Project, and based on CDM Projects: MSCP and MCFDP. At the same time, the quality of AD increased due to the development of the Land Use and Land-Use Change Matrix for the period 1970-2022. Standard verification and quality control forms and checklists were filled in for this category, following the Tier 1 methodological approach.

Verification was focused on following the recommendations included in the 2006 IPCC Guidelines (Volume 4 'AFOLU'), time-series consistency for activity data, ensuring correct use of country-specific coefficients, their accuracy, validation of assumptions and calculations used in estimating the parameters inferred from other data available at national level, as well as their comparison with values used in inventories compiled by countries in the region. Also, QA/QC also included monitoring the way in which data is compiled from spreadsheets and conversion among units of measurement.

6.5.6. Recalculations

4D1. 'Wetlands Remaining Wetlands'

No recalculations were performed in the current inventory cycle for subcategory 4D1 'Wetlands Remaining Wetlands'.

4D2. 'Land Converted to Wetlands'

Between 1990 and 2022, CO_2 removals from subcategory 4D2 'Land Converted to Wetlands' had continuously decreased, becoming constant in recent years (2015-2022). Results on CO_2 removal rates from this subcategory are provided in Table 6-54.

Table 6-54: CO_2 removals from category 4D 'Wetlands' in the RoM between 1990-2022, kt

Source Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4D1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4D2	-555.38	-526.46	-595.55	-525.84	-497.64	-469.44	-441.24	-413.03	-384.83	-356.63	-328.42
4D Total	**-555.38**	**-526.46**	**-595.55**	**-525.84**	**-497.64**	**-469.44**	**-441.24**	**-413.03**	**-384.83**	**-356.63**	**-328.42**
Source Category	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
4D1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4D2	-300.22	-272.02	-243.82	-215.61	-187.41	-159.21	-131.00	-102.80	-74.60	-46.40	-75.31
4D Total	**-300.22**	**-272.02**	**-243.82**	**-215.61**	**-187.41**	**-159.21**	**-131.00**	**-102.80**	**-74.60**	**-46.40**	**-75.31**
Source Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
4D1	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4D2	-15.47	-106.10	-139.75	-82.79	-82.79	-82.82	-82.83	-82.81	-82.81	-83.05	-84.25
4D Total	**-15.47**	**-106.10**	**-139.75**	**-82.79**	**-82.79**	**-82.82**	**-82.83**	**-82.81**	**-82.81**	**-83.05**	**-84.25**

Source: Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

At the start of the reporting period (1990), removals from subcategory 4D2 'Land Converted to Wetlands' are somewhat significant at sectoral level, due to massive conversion of different lands to wetlands (Table 6-52). By the end of the period (2022), removals from subcategory 4D2 'Land Converted to Wetlands' had decreased significantly, constituting only 15.2% compared to the base year. Thus, compared to 1990, a decrease by 85% or a difference by circa 471 kt was recorded in 2022. Graphical illustration of the evolution of CO_2 removals from subcategory 4D 'Wetlands' is shown in Figure 6-12.

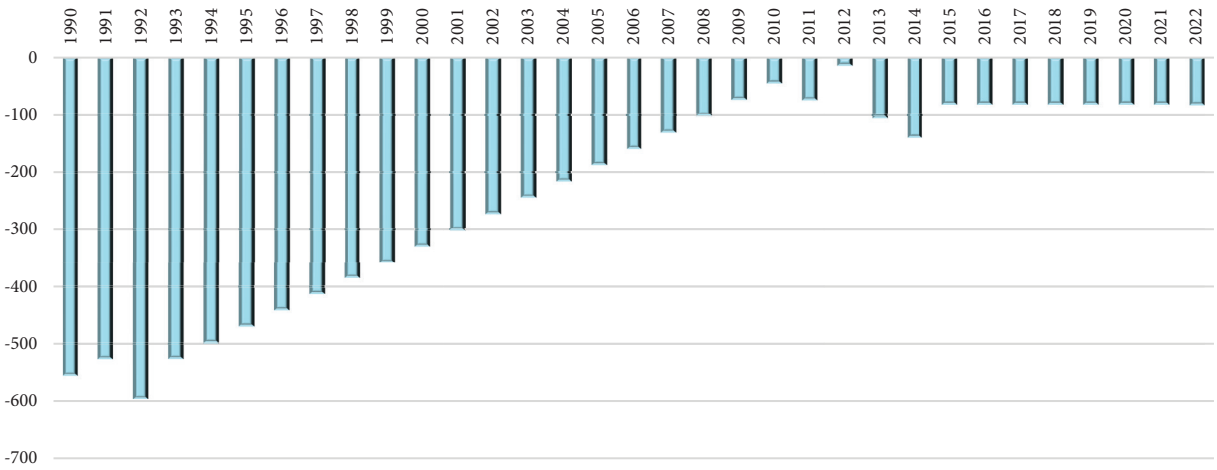


Figure 6-12: CO_2 removals from category 4D 'Wetlands' between 1990-2022, kt.

6.5.7. Planned Improvements

The possibility of perfecting cadastre records (as main sources of activity data) with respect to a more detailed description of initial land-use categories transferred to category 4D 'Wetlands' in explanatory notes will be analysed in the next inventory cycle.

6.6. Settlements (Category 4E)

6.6.1. Source Category Description

Category 4E 'Settlements' includes all developed land (constructions, streets, yards, squares, roads, etc.), including transportation infrastructure and settlements of all sizes if they are not accounted for in another land-use category. Depending on the type of vegetation with which they are covered, a part of land inside settlements was included in categories 4B 'Cropland' (parks, public gardens, green areas, perennial plantations, etc.), and 4C 'Grassland' (pastures and hayfields). 4E 'Settlements' comprises two subcategories: 4E1 'Settlements Remaining Settlements' and 4E2 'Land Converted to Settlements'. Activity data on land in this category are provided by the General Land Cadastre of the Republic of Moldova in annual reports.

6.6.2. Methodologies, Emission Factors and Activity Data

4E1. 'Settlements Remaining Settlements'

Category 4E1 'Settlements Remaining Settlements' includes lands without forest/herbaceous vegetation and/or no management activities which would contribute to essential changes in carbon pools; thus, a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soil). Areas considered in subcategory 4E1 'Settlements Remaining Settlements' for 1970-2022 are shown in Table 6-55.

Table 6-55: Area of land included in subcategory 4E1 'Settlements Remaining Settlements' in the RM between 1990-2022, ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Settlements	181826.1	181826.1	181826.1	184126.1	187326.0	187926.0	190025.9	191225.9	190825.9	194725.9	203425.7
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Settlements	207055.1	207012.1	211012.1	213023.1	212602.1	211358.1	212911.1	212771.8	213987.1	213962.9	214162.9
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Settlements	229325.5	226824.6	224798.7	223498.7	221199.7	220099.7	220066.1	217266.2	209851.5	206150.6	206150.6

Source: General Land Cadastre of the RoM for the period 1970-2022; Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

4E2. 'Land Converted to Settlements'

In order to estimate CO_2 removals/emissions from subcategory 4E2 'Land Converted to Settlements', a loss of carbon in biomass and in mineral soils was established due to conversion of different land types which were previously covered by a certain amount of biomass (forests, grassland, perennial

plantations, etc.). At the same time, non-CO_2 (N_2O) emissions from the conversion of grassland to settlements were also estimated.

The calculation process of CO_2 removals/emissions for subcategory 4E2 'Land Converted to Settlements' is based on the annual increments in carbon stocks due to current biomass growth, and uses Equation 2.15 in the 2006 IPCC Guidelines (Volume 4, Chapter 2, Page 2.20). Non-CO_2 (N_2O) emissions resulting from the conversion of grassland to settlements were estimated using Equation 11.8 in the 2006 IPCC Guidelines (Volume 4, Chapter 11, page 11.16).

Activity data regarding the surfaces subject to conversion to category 4E2 'Lands Converted Settlements' are available in the General Land Cadastre, being also included in the land use and land-use change matrix use for the period 1970-2022. The main categories of land subject to conversion to other land are arable land and grassland (Table 6-56).

Table 6-56: Area of lands converted to settlements in the RoM between 1970-2022, ha

Conversion	1970	1971	1972	1973	1974	1975	1976	1977	1978
Cropland converted to settlements	0.0	0.0	0.0	2042.3	2614.1	1062.0	1878.9	980.3	0.0
Grassland converted to settlements	0.0	0.0	0.0	457.7	585.9	238.0	421.1	219.7	0.0
Other land converted to settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**0.0**	**2500.0**	**3199.9**	**1300.0**	**2300.0**	**1200.0**	**0.0**
Conversion	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Cropland converted to settlements	3185.9	7107.0	3022.5	0.0	3267.6	1878.9	0.0	0.0	1552.1
Grassland converted to settlements	714.0	1592.8	677.4	0.0	732.3	421.1	0.0	0.0	347.9
Other land converted to settlements	0.0	0.0	0.5	0.5	0.6	0.6	0.6	0.6	0.6
Total	**3899.9**	**8699.8**	**3700.5**	**0.5**	**4000.5**	**2300.6**	**0.6**	**0.6**	**1900.6**
Conversion	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Cropland converted to settlements	0.0	1307.0	0.0	163.4	12416.9	0.0	959.0	0.0	0.0
Grassland converted to settlements	0.0	292.9	0.0	36.6	2782.8	0.0	214.9	0.0	0.0
Other land converted to settlements	0.6	0.6	0.6	0.6	0.9	0.0	0.0	0.0	0.9
Total	**0.6**	**1600.6**	**0.6**	**200.6**	**15200.6**	**0.0**	**1174.0**	**0.0**	**0.9**
Conversion	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Cropland converted to settlements	81.7	0.0	898.6	1143.7	0.0	0.0	413.4	0.0	0.0
Grassland converted to settlements	18.3	0.0	201.4	256.3	0.0	0.0	92.6	0.0	0.0
Other land converted to settlements	0.9	0.5	0.5	1.0	0.0	0.0	0.0	0.0	0.0
Total	**100.9**	**0.5**	**1100.5**	**1400.9**	**0.0**	**0.0**	**506.0**	**0.0**	**0.0**
Conversion	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Cropland converted to settlements	0.0	0.0	0.0	0.0	0.0	697.8	0.0	76.7	395.4
Grassland converted to settlements	0.0	0.0	0.0	0.0	0.0	156.4	0.0	17.2	88.6
Other land converted to settlements	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.9	1.0
Total	**0.0**	**0.0**	**0.0**	**0.0**	**0.0**	**854.1**	**0.0**	**94.9**	**485.0**
Conversion	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Cropland converted to settlements	1180.4	224.6	2597.4	0.0	4013.7	0.0	103.9	0.0	N/A
Grassland converted to settlements	264.6	50.3	582.1	0.0	899.5	0.0	23.3	0.0	N/A
Other land converted to settlements	1.2	0.7	1.0	1.0	1.0	0.5	0.0	406.0	N/A
Total	**1446.1**	**275.7**	**3180.6**	**1.0**	**4914.2**	**0.5**	**127.2**	**406.0**	**N/A**

Source: General Land Cadastre of the RoM for the period 1970-2022; Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

Country-specific emission factors were developed within the EU/UNDP 'Clima East' Project, and based on two other CDM Projects of the Kyoto Protocol: MSCP and MCFDP, respectively, as well as from other relevant information in order to estimate annual biomass and soil carbon increments/losses on land converted to settlements (Table 6-57).

Table 6-57: EFs used in the estimation of CO_2 emissions/removals from subcategory 4E2 'Land Converted to Settlements'

Conversion activities	Indicators	Period, years	Unit	Indicator value
Cropland converted to settlements	Annual average carbon increments/losses in biomass (crops)	year 1	Mg C/ha/yr	-5.0
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon	years 1-20	Mg C/ha/yr	-0.2168

Conversion activities	Indicators	Period, years	Unit	Indicator value
Grassland converted to settlements	Annual average carbon increments/losses in biomass (herbaceous cover)	year 1	Mg C/ha/yr	-3.78
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon	years 1-20	Mg C/ha/yr	-2.4818
Other land converted to settlements	Annual average carbon increments in biomass (herbaceous cover)	year 1	Mg C/ha/yr	0.0
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments of soil organic carbon	years 1-20	Mg C/ha/yr	0.0

6.6.3. Uncertainties and Time-Series Consistency

4E1. 'Settlements Remaining Settlements'

Uncertainties associated with CO_2 emissions/removals from subcategory 4E1 'Settlements Remaining Settlements' are not estimated since a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soil).

4E2. 'Land Converted to Settlements'

Uncertainties associated with CO_2 emissions/removals from subcategory 4E2 'Land Converted to Settlements' at the beginning and the end of the reference period (1990 and 2022) are somewhat low, and are estimated to be circa 10%. Uncertainties associated with emission/removal factors in both cases are also estimated to be circa 10%. Combined uncertainties from subcategory 4E2 'Land Converted to Settlements' account for circa 14.14%. Uncertainties in the trend of total direct GHG emissions from subcategory 4E2 under Sector 4 'LULUCF' were estimated to be insignificant (circa 0.01%).

For non-CO_2 emissions, uncertainties related to activity data account for circa 10%, whereas emission/removal factors have an uncertainty level of circa 30%. Combined uncertainties are estimated to be circa 31.62%, and uncertainties in the trend of total direct GHG emissions under Sector 4 'LULUCF' were estimated to be 0.10% (Annex 2).

6.6.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

6.6.5. Quality Assurance and Quality Control

The quality of assessment for category 4E 'Settlements' is ensured by the fact that the AD used is taken from official records (General Land Cadastre). Annual biomass increments/losses for lands converted to settlements were estimated using country-specific EFs developed within the EU/UNDP 'Clima East' Project, respectively based on two other CDM Projects: MSCP and MCFDP. At the same time, the quality of AD is ensured through the development of the Land Use and Land-Use Change Matrix for the period 1970-2022 for the entire Sector 4 'LULUCF'.

Standard verification and quality control forms and checklists were filled in for this category, following the Tier 1 methodological approach. Verification was focused on following the recommendations included in the 2006 IPCC Guidelines, on various aspects such as: verification of correct application of calculation methods set out in the Guidelines, ensuring correct use of country-specific coefficients, their accuracy, as well as comparing them to the values used by other countries in the region. The description of the general and specific verification process of the GHG inventory is presented in the chapter dedicated to category 4A 'Forest Land'.

6.6.6. Recalculations

4E1. 'Settlements Remaining Settlements'

No recalculations on CO_2 emissions/removals were performed for subcategory 'Settlements Remaining Settlements' in the current inventory cycle.

4E2. 'Land Converted to Settlements'

No recalculations on CO_2 emissions/removals were performed for subcategory 'Land Converted to Settlements' in the current inventory cycle. Recalculations were performed only for non-CO_2 emis-

sions from the respective subcategory. Recalculations were carried out as a result of updating global warming potential values for nitrous oxide (N_2O) used in the estimation of non-CO_2 emissions from land converted to settlements.

Compared to the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made in the current inventory cycle resulted in a downward trend in non-CO_2 emissions between 1990-2020, it being constant for the entire period under review, estimated to be -11.1% (Table 6-58).

Table 6-58: Recalculations of non-CO_2 emissions from subcategory 4E2 'Land Converted to Settlements' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	159.7967	173.8786	195.0547	212.8037	228.5960	243.4567	256.4737	268.7144	281.0494	290.5838	293.6176
BTR1	142.1011	154.6236	173.4547	189.2382	203.2816	216.4967	228.0722	238.9575	249.9265	258.4051	261.1029
Difference, %	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	294.1316	294.9625	292.6299	288.6416	284.8502	281.0588	275.6524	270.4086	263.8049	257.3381	251.1010
BTR1	261.5600	262.2989	260.2246	256.6779	253.3064	249.9349	245.1271	240.4641	234.5916	228.8409	223.2945
Difference, %	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	231.8871	215.9302	201.6397	189.0781	178.2795	169.7771	161.0110	156.5897	157.3018		
BTR1	206.2084	192.0185	179.3105	168.1399	158.5371	150.9763	143.1809	139.2492	139.8825	143.1903	146.4885
Difference, %	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**	**-11.1**		

Abbreviations: NC5 – Fifth National Communication, BTR1 – First Biennial Transparency Repor.

Between 1990 and 2022, CO_2 emissions/removals from category 4E 'Settlements' fluctuated, being influenced particularly by the temporary conversion of different lands to this category (Table 6-59). The highest level of emissions recorded in the reference period occurred in 1990 (circa 386.6 kt), whereas the lowest – in years 2012 and 2013 (circa 11.8 kt).

Table 6-59: CO_2 emissions from category 4E 'Settlements' between 1990-2022, kt

Source Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4E 'Settlements'	84.7480	88.7139	386.6196	114.6181	130.4883	106.9167	101.5910	100.7954	99.0440	111.8259	100.1768
Source Category	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
4E 'Settlements'	67.0898	67.0898	67.8615	53.6737	53.6737	53.6737	49.2742	49.2742	45.5694	45.5694	62.0438
Source Category	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
4E 'Settlements'	11.8882	13.7512	18.9848	39.1617	19.3071	77.3098	21.6217	116.5030	27.2098	29.7309	27.5042

Source: Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

Graphical illustration of CO_2 emissions from category 4E 'Settlements' between 1990 and 2022 is presented in Figure 6-13.

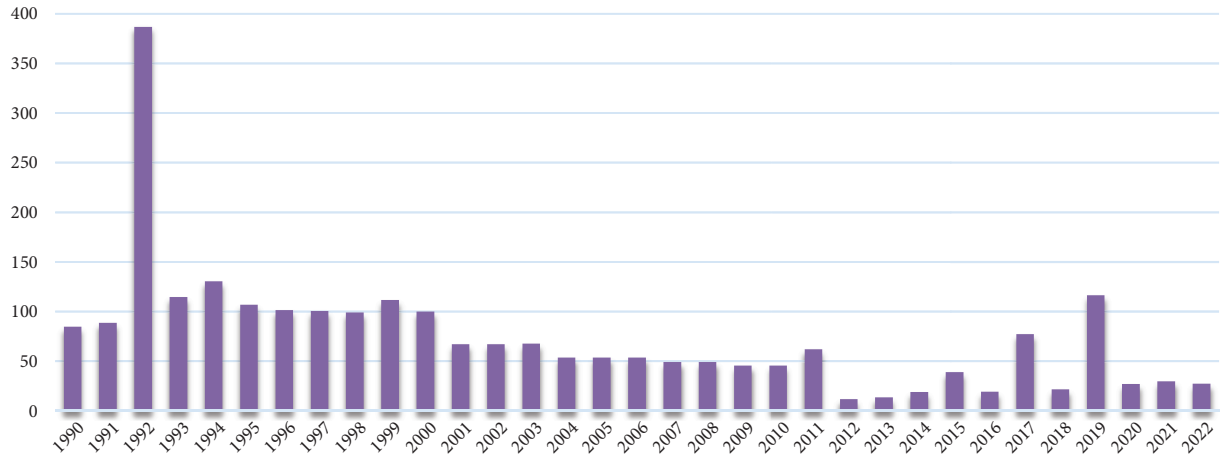


Figure 6-13: Evolution of CO_2 emissions from category 4E 'Settlements' between 1990-2022, kt.

N_2O emissions 4E2 'Land Converted to Settlements' are presented in Table 6-60.

Table 6-60: N_2O emissions from 4E2 'Land Converted to Settlements' between 1990-2022

Conversion activities	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4E.2.1 Cropland to Settlements, kt N_2O	0.5257	0.5729	0.6396	0.6999	0.7535	0.8037	0.8480	0.8894	0.9308	0.9636	0.9759
4E.2.2 Grassland to Settlements, kt N_2O	0.0105	0.0106	0.0149	0.0142	0.0136	0.0133	0.0126	0.0123	0.0123	0.0115	0.0094
4E.2 Conversions to Settlements, kt N_2O	0.5362	0.5835	0.6545	0.7141	0.7671	0.8170	0.8606	0.9017	0.9431	0.9751	0.9853
4E2 Total, kt CO_2 equivalent	**142.1011**	**154.6236**	**173.4547**	**189.2382**	**203.2816**	**216.4967**	**228.0722**	**238.9575**	**249.9265**	**258.4051**	**261.1029**
Conversion activities	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
4E.2.1 Cropland to Settlements, kt N_2O	0.9787	0.9815	0.9747	0.9619	0.9492	0.9365	0.9189	0.9013	0.8796	0.8579	0.8368
4E.2.2 Grassland to Settlements, kt N_2O	0.0083	0.0083	0.0073	0.0067	0.0067	0.0067	0.0061	0.0061	0.0057	0.0057	0.0058
4E.2 Conversions to Settlements, kt N_2O	0.9870	0.9898	0.9820	0.9686	0.9559	0.9432	0.9250	0.9074	0.8853	0.8636	0.8426
4E2 Total, kt CO_2 equivalent	**261.5600**	**262.2989**	**260.2246**	**256.6779**	**253.3064**	**249.9349**	**245.1271**	**240.4641**	**234.5916**	**228.8409**	**223.2945**
Conversion activities	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
4E.2.1 Cropland to Settlements, kt N_2O	0.7767	0.7231	0.6753	0.6328	0.5965	0.5670	0.5376	0.5217	0.5245	0.5369	0.5494
4E.2.2 Grassland to Settlements, kt N_2O	0.0015	0.0015	0.0013	0.0017	0.0018	0.0027	0.0027	0.0038	0.0034	0.0034	0.0034
4E.2 Conversions to Settlements, kt N_2O	0.7781	0.7246	0.6766	0.6345	0.5983	0.5697	0.5403	0.5255	0.5279	0.5403	0.5528
4E2 Total, kt CO_2 equivalent	**206.2084**	**192.0185**	**179.3105**	**168.1399**	**158.5371**	**150.9763**	**143.1809**	**139.2492**	**139.8825**	**143.1903**	**146.4885**

Source: Land Use and Land-Use Change Matrix for the period 1970-2022.

6.6.7. Planned Improvements

The possibility of improving cadastral records (as the main reference sources of activity data) regarding a more detailed specification in their explanatory notes on initial land-use categories converted to settlements will be considered for the next inventory cycle.

6.7. Other Land (Category 4F)

6.7.1. Source Category Description

Category 4F 'Other Land' includes, as a priority, bare soil (ravines, hollows, rocks, etc.), as well as all lands that do not fall into any of the other categories – 4A-4E (for example, river banks, sand quarries, clay pits). Category 4F 'Other Land' is also used to sum up all areas of the country's total official surface. 4F 'Other Land' comprises two categories: 4F1 'Other Land Remaining Other Land' and 4F2 'Land Converted to Other Land'.

6.7.2. Methodologies, Emission Factors and Activity Data

4F1. 'Other Land Remaining Other Land'

Due to the particularities of lands in the RoM included in subcategory 4F1 'Other Land Remaining Other Land' (land without forest/herbaceous vegetation and/or no management activities contributing to essential changes in carbon pools), a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soil). AD on areas within this category are available in the General Land Cadastre and are also included in the Land Use and Land-Use Change Matrix for the period 1970-2022 (Table 6-61).

Table 6-61: Area of land included in 4F1 'Other Land Remaining Other Land' between 1990-2022, ha

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Other land, ha	56300.0	53300.0	45855.0	51255.5	41078.0	40822.0	45444.0	48200.3	50226.0	51330.0	52230.0
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Other land, ha	56459.0	55383.0	54510.1	57649.4	51984.3	52532.2	61311.9	60290.5	60620.4	58553.4	55818.4
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Other land, ha	57268.9	60198.0	52389.0	58031.5	57836.3	55874.0	55426.4	48012.1	44799.4	54400.50	54442.08

Source: General Land Cadastre of the RoM for the period 1970-2022; Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

4F2. 'Land Converted to Other Land'

In order to estimate CO_2 removals/emissions from subcategory 4F2 'Land Converted to Other Land', biomass loss was established due to conversion of different land categories which were previously covered by a certain amount of biomass (forests, grassland, perennial plantations, etc.). Activity data

on areas subject to conversion within category 4F2 is available in the General Land Cadastre and are also included in the Land Use and Land-Use Change Matrix for the period 1970-2022. The main land categories subject to conversion to other land are forest lands, grasslands, and croplands – arable soils and perennial plantations (Table 6-62).

Table 6-62: Area of lands converted to other land in the RoM between 1970-2022, ha

Conversion activities	1970	1971	1972	1973	1974	1975	1976	1977	1978
Forest land to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	664.0	622.0
Cropland to other land	0.0	0.0	6275.0	4614.4	0.0	1112.0	0.0	0.0	0.0
Grassland to other land	0.0	0.0	0.0	0.0	8433.0	1557.8	0.0	3436.0	3078.0
Wetlands to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Perennial plantations to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**6275.0**	**4614.4**	**8433.0**	**2669.8**	**0.0**	**4100.0**	**3700.0**
Conversion activities	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**	**1987**
Forest land to other land	1654.0	1691.0	0.0	1571.7	4308.3	248.5	8177.0	8802.0	1615.0
Cropland to other land	0.0	0.0	0.0	228.6	0.0	0.0	0.0	0.0	0.0
Grassland to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetlands to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Perennial plantations to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**1654.0**	**1691.0**	**0.0**	**1800.4**	**4308.3**	**248.5**	**8177.0**	**8802.0**	**1615.0**
Conversion activities	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**
Forest land to other land	0.0	0.0	0.0	0.0	2245.0	0.0	3248.0	1856.0	226.0
Cropland to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Wetlands to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Perennial plantations to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**0.0**	**0.0**	**2245.0**	**0.0**	**3248.0**	**1856.0**	**226.0**
Conversion activities	**1997**	**1998**	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**
Forest land to other land	0.0	0.0	2096.0	0.0	0.0	2409.0	0.0	0.0	1460.0
Cropland to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2822.5	0.0
Grassland to other land	0.0	0.0	0.0	0.0	0.0	0.0	2874.9	890.1	8834.7
Wetlands to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Perennial plantations to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**0.0**	**0.0**	**2096.0**	**0.0**	**0.0**	**2409.0**	**2874.9**	**3712.6**	**10294.7**
Conversion activities	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**
Forest land to other land	0.0	0.0	1860.0	0.0	3046.6	2511.0	0.0	0.0	1900.0
Cropland to other land	705.6	698.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Grassland to other land	6836.7	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8702.9
Wetlands to other land	0.0	0.0	0.0	0.0	0.0	0.0	694.5	0.0	0.0
Perennial plantations to other land	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	**7542.4**	**698.1**	**1860.0**	**0.0**	**3046.6**	**2511.0**	**694.5**	**0.0**	**10602.9**
Conversion activities	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Forest land to other land	0.0	2241.4	1019.0	1820.0	3740.0	237.0	950.0	1546.0	N/A
Cropland to other land	0.0	0.0	0.0	145.0	1473.0	9821.0	2754.0	0.0	N/A
Grassland to other land	0.0	0.0	0.0	0.0	2633.0	0.0	0.0	460.5	N/A
Wetlands to other land	0.0	0.0	0.0	0.0	1.0	0.0	0.0	0.0	N/A
Perennial plantations to other land	0.0	0.0	0.0	0.0	120.0	0.0	0.0	0.0	N/A
Total	**0.0**	**2241.4**	**1019.0**	**1965.0**	**7967.0**	**10058.0**	**3704.0**	**2006.5**	**N/A**

Source: Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

The calculation process of CO_2 removals/emissions from subcategory 4F2 'Land Converted to Other Land' is based on the annual increments in carbon stocks due to current biomass increments/losses, and uses Equation 2.15 in the 2006 IPCC Guidelines (Volume 4, Chapter 2, page 2.20). Country-specific emission factors were developed within CDM Projects: MSCP and MCFDP, as well as from other relevant information in order to estimate annual biomass increments/losses in land converted to other land (Table 6-63).

Table 6-63: EFs used in the estimation of CO_2 emissions/removals from subcategory 4F2 'Land Converted to Other Land'

Conversion activities	Indicators	Period, years	Unit	Indicator value
Forest land to other land	Annual average carbon increments/losses in biomass (trees and shrubs)	year 1	Mg C/ha/yr	-29.8
	Annual average carbon increments/losses in dead organic matter (litter)	year 1	Mg C/ha/yr	-1.15
	Annual average increments/losses of soil organic carbon	years 1-20	Mg C/ha/yr	-1.4156
Cropland (arable) to other land	Annual average carbon increments/losses in biomass (crops)	year 1	Mg C/ha/yr	-5.0
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon	years 1-20	Mg C/ha/yr	-0.2168
Grassland to other land	Annual average carbon increments/losses in biomass (crops)	year 1	Mg C/ha/yr	-3.78
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon	years 1-20	Mg C/ha/yr	-0.1241
Wetlands to other land	Annual average carbon increments/losses in biomass (crops)	year 1	Mg C/ha/yr	-4.2
	Annual average carbon increments in dead organic matter (litter)	year 1	Mg C/ha/yr	0.0
	Annual average increments/losses of soil organic carbon	anii 1-20	Mg C/ha/an	-2.4818

6.7.3. Uncertainties and Time-Series Consistency

4F1 'Other Land Remaining Other Land'

Uncertainties associated with CO_2 emissions from subcategory 4F1 'Other Land Remaining Other Land' are not estimated, since a neutral balance was established in the main carbon pools (above-ground and below-ground biomass, dead organic matter, soils).

4F2 'Land Converted to Other Land'

Uncertainties associated with CO_2 emissions/removals from subcategory 4F2 'Land Converted to Other Land' at the beginning and end of the reference period (1990 and 2022) are somewhat low, and are estimated to be circa 10%. In both cases, emission/removal factors have an uncertainty level of circa 10%. Combined uncertainties within subcategory 4F2 'Land Converted to Other Land' constitute circa 14.14%. Uncertainties introduced in the trend of total direct GHG emissions from subcategory 4F2 under Sector 4 'LULUCF' were estimated to be circa 0.36% (Annex 2).

6.7.4. Description of applied flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

6.7.5. Quality Assurance and Quality Control

The quality of assessment for category 4F 'Other Land' is ensured by the fact that most of the AD used is taken from official records (General Land Cadastre of the Republic of Moldova). Annual biomass increments/losses for lands converted to settlements were estimated using country-specific EFs developed within two CDM Projects: MSCP and MCFDP. At the same time, the quality of AD increased due to the development of the Land Use and Land-Use Change Matrix for the period 1970-2022 for Sector 4 'LULUCF' as a whole.

Within this category, verification was focused on following the recommendations included in the 2006 IPCC Guidelines (Volume 4 'AFOLU'), on various aspects such as: verification of correct application of calculation methods set out in the Guidelines, ensuring correct use of country-specific coefficients and indices, their accuracy, as well as comparing them to values used by other countries in the region.

6.7.6. Recalculations

No recalculations were performed in the estimation of CO_2 emissions/removals from category. Between 1990 and 2022, CO_2 emissions from category 4F 'Other Land' fluctuated (Table 6-64), being influenced particularly by the conversion of different lands to this category.

Table 6-64: CO_2 emissions from category 4F 'Other Land' between 1990-2022, kt

Source Category	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
4F2 CO_2 Emissions/removals	152.3638	152.3638	418.7786	164.0168	549.4579	401.1281	217.3293	188.2363	185.0077	425.1554	178.5246
Source Category	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
4F2 CO_2 Emissions/removals	178.5246	456.2431	201.6619	223.8177	416.5012	189.4964	83.1072	291.0044	79.9357	441.4824	393.7285

Source Category	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
4F2 CO_2 Emissions/removals	114.1449	103.4500	436.6463	86.8192	351.6349	218.2055	321.2138	611.7881	329.1262	285.1257	304.2726

Source: Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

The graphical illustration of the evolution of CO_2 emissions from category 4F 'Other Land' in the Republic of Moldova between 1990 and 2022 is shown in Figure 6-14.

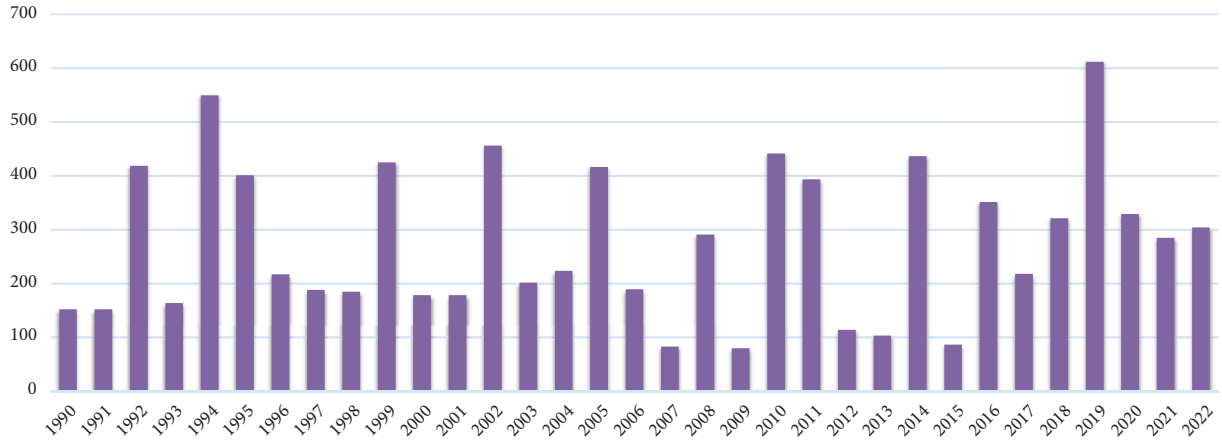


Figure 6-14: CO_2 emissions from category 4F 'Other Land' between 1990-2022, kt.

6.7.7. Planned Improvements

The possibility of improving cadastral records (as main reference sources for activity data) regarding a more detailed specification in their explanatory notes on initial land-use categories converted to category 4F 'Other Land' will be considered for the next inventory cycle in the RoM. At the same time, it is necessary to analyze the input and output process of land within category 4F 'Other Land', including in terms of establishing the average conversion period.

6.8. Harvested Wood Products (Category 4G)

6.8.1. Source Category Description

Category 4G 'Harvested Wood Products' includes CO_2 removals/emissions from wood products harvested/processed, imported or exported (rough roundwood; saw logs, timber, wood panels, etc.) used in the national economy. In the Republic of Moldova, wood harvesting from forests takes place during the process of cutting secondary products (spacing, cleaning, thinning and sanitary cutting), main products (regeneration cuts, preservation, sanitation cutting) and ecological reconstruction.

Due to the classification of the RoM's forests in functional Group I, harvesting in exploitable forests is made depending on their state, in order to ensure the regeneration/continuity of the stands.

In this context, the low quality of the harvested wood products is noticeable, including the share of commercial timber in the total volume of the harvested wood. Thus, according to official records, between 1990 and 2022, the share of commercial wood in the total volume of harvested wood was the highest in 1990 (17.6%), whereas the lowest – in 2014 (3.9%).

6.8.2. Methodologies, Emission Factors and Activity Data

For category 4G 'Harvested Wood Products', the Tier 1 methodological approach was used (2006 IPCC Guidelines), and default emission/removal factors, respectively. The IPCC 'HWP Calculator' module was used for calculations, applying the 'Production Approach' methodology.

AD for the period 1961-2022 on wood products included in category 4G 'Harvested Wood Products' is partly available in the national statistics, particularly for the period 1961-1993. For 1994-2022, AD from the FAOSTAT database was used, as well as 'Moldsilva' Agency Reports on harvested wood products. The evolution of wood products volumes included in category 4G 'Harvested Wood Products' between 1961 and 2022 is presented in Table 6-65.

Table 6-65: Evolution of wood product volume considered in category 4G 'Harvested Wood Products' in the RoM between 1961-2022

Wood products by category	Source	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
Rough roundwood, m^3	Produced	26960	26960	26960	26960	26960	24920	22880	20840	18800	16750	15100	13450	11800
	Import	73040	73040	73040	73040	73040	71480	69920	68360	66800	65240	63680	62120	60560
	Export	5620	5850	6080	6310	6540	6770	7000	7230	7460	7690	7920	8150	8380
Other types of round-wood, m^3	Produced	32300	32300	32300	32300	32300	29860	27420	24980	22540	20100	18110	16120	14130
	Import	67700	67700	67700	67700	67700	66730	65760	64790	63820	62850	61880	60910	59940
	Export	0	0	0	0	0	0	0	0	0	0	0	0	0
Paper and cardboard, t	Produced	0	0	0	0	0	0	0	0	63150	64460	65770	67080	68390
	Import	37270	38760	40250	41740	43230	44720	46210	47700	49190	50680	52170	53660	55150
	Export	0	0	0	0	0	0	0	0	0	0	90	130	170
Timber, m^3	Produced	42370	55720	69070	82420	95770	107700	119650	131550	142060	154070	154070	152920	151780
	Import	59240	60080	60920	61760	62600	62370	62140	61910	61680	61450	61220	60990	60760
	Export	1930	1990	2050	2110	2170	2230	2290	2350	2410	2470	2530	2590	2650
Wood panels, m^3	Produced	660	1320	1980	2640	3300	4540	5780	7020	8260	9500	18540	27580	36620
	Import	2580	2690	2800	2910	3020	3130	3240	3350	3460	3570	3680	3790	3900
	Export	2580	2690	2800	2910	3020	3130	3240	3350	3460	3570	3680	3790	3900
Wood products by category	**Source**	**1974**	**1975**	**1976**	**1977**	**1978**	**1979**	**1980**	**1981**	**1982**	**1983**	**1984**	**1985**	**1986**
Rough roundwood, m^3	Produced	10150	8480	8620	8760	8900	9040	9200	11750	8160	21080	26170	31260	36350
	Import	59000	57440	55880	54320	52760	51200	49640	48080	46520	44960	43400	41840	40280
	Export	8610	8840	9070	9300	9530	9760	9990	10220	10450	10680	10910	11140	11370
Other types of round-wood, m^3	Produced	12140	10160	10340	10520	10700	10880	11050	14080	9780	25260	27160	29060	30960
	Import	58970	58000	57030	56060	55090	54120	53150	52180	51210	50240	49270	48300	47330
	Export	0	0	0	0	0	0	0	0	0	0	0	0	0
Paper and cardboard, t	Produced	69700	71010	72320	73630	74940	76250	77560	78870	80180	81490	84000	82690	81380
	Import	56640	58130	59620	61110	62600	64090	65580	67070	68560	70050	71560	71560	71560
	Export	210	250	290	330	370	410	450	490	530	570	610	650	690
Timber, m^3	Produced	150730	149700	136260	122820	109400	95970	82530	80180	79380	86440	87610	86080	83860
	Import	60530	60300	60070	59840	59610	59380	59150	58920	58690	58460	58230	58000	57770
	Export	2710	2770	2830	2890	2950	3010	3070	3130	3190	3250	3310	3370	3430
Wood panels, m^3	Produced	45660	54700	56260	57820	59380	60940	62500	64800	67100	71600	86000	81670	77340
	Import	4010	4120	4230	4340	4450	4560	4670	4780	4890	5000	5110	5220	5330
	Export	4010	4120	4230	4340	4450	4560	4670	4780	4890	5000	5110	5220	5330
Wood products by category	**Source**	**1987**	**1988**	**1989**	**1990**	**1991**	**1992**	**1993**	**1994**	**1995**	**1996**	**1997**	**1998**	**1999**
Rough roundwood, m^3	Produced	41440	46530	51620	56710	61800	66890	71980	77070	82200	71800	82600	67400	74500
	Import	38720	37160	35600	34040	32480	30920	29360	26200	28300	28300	28300	28300	28300
	Export	11600	11830	12060	12290	12520	12824	6910	1000	200	200	200	800	900
Other types of round-wood, m^3	Produced	32860	34760	36660	38560	40460	42360	44260	46160	48100	41700	46900	37600	41300
	Import	46360	45390	44420	43450	42480	41510	40540	39570	38600	37630	36660	35690	34720
	Export	0	0	0	0	0	0	0	0	0	0	0	0	0
Paper and cardboard, t	Produced	80070	78760	77450	74140	68830	54470	40110	25750	11360	11010	13640	12220	5930
	Import	71560	71560	71560	71560	71560	5005	10114	20000	18400	18400	18400	27106	27106
	Export	730	770	810	850	890	993	993	6900	5200	5200	5200	9970	9970
Timber, m^3	Produced	81640	79320	77190	74970	72740	70520	68300	63480	59100	59300	65300	59700	39000
	Import	57540	57310	57080	56850	56620	55970	60000	74260	68190	65790	56090	118190	118190
	Export	3490	3550	3610	3670	3730	3821	2711	5600	900	600	300	300	0
Wood panels, m^3	Produced	73010	68680	64350	60020	55690	51360	47000	14000	10000	10000	10000	10000	10000
	Import	5440	5550	5660	5770	5880	44	6400	10600	37400	37400	37400	25962	25962
	Export	5440	5550	5660	5770	5880	44	6400	10600	37400	37400	37400	25962	25962
Wood products by category	**Source**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**
Rough roundwood, m^3	Produced	80800	71000	92500	94000	86600	83800	45000	43000	43000	43000	43000	43000	32600
	Import	28300	28300	28300	28300	28300	28300	43400	39000	39000	39000	39000	45448	49980
	Export	300	300	300	300	300	300	370	2548	2548	2548	2548	134	150
Other types of round-wood, m^3	Produced	47100	39200	49400	53800	49500	49500	17900	17000	17000	17000	17000	17000	12800
	Import	33750	32780	31810	30840	29870	28900	27930	26960	25990	25020	24050	23080	22110
	Export	0	0	0	0	0	0	0	0	0	0	0	0	0

Wood products by category	Source	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
Paper and cardboard, t	Produced	12220	14460	19220	31040	30530	26530	84200	97500	97500	97500	97500	97500	4410
	Import	27106	27106	27106	27106	27106	27106	48682	80001	80001	80001	80001	40066	35840
	Export	9970	9970	9970	9970	9970	9970	27880	6100	6100	6100	6100	19898	17860
Timber, m^3	Produced	39100	46800	74100	71200	68100	65300	58040	60480	60480	60480	60480	60480	50834
	Import	118190	118190	118190	118190	118190	118190	147020	155100	155100	155100	155100	151113	132290
	Export	16	16	16	16	16	16	3900	4000	4000	4000	4000	1678	1980
Wood panels, m^3	Produced	10000	10000	10000	10000	10000	10000	18000	2800	2800	2800	2800	2800	15055
	Import	25962	25962	25962	25962	25962	25962	91	122	122	122	122	161514	167030
	Export	25962	25962	25962	25962	25962	25962	91	122	122	122	122	161514	167030
Wood products by category	**Source**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
Rough roundwood, m^3	Produced	29900	25600	25600	52000	46000	46000	46000	31000	5565	8891	N/A	N/A	N/A
	Import	36252	29100	29100	29100	394	364	364	82	82	82	N/A	N/A	N/A
	Export	56	56	56	56	0	0	0	0	0	0	N/A	N/A	N/A
Other types of round-wood, m^3	Produced	8600	8800	8800	15000	12000	12000	12000	14000	31535	30866	N/A	N/A	N/A
	Import	21140	20170	18900	29652	9510	4688	4688	0	0	0	N/A	N/A	N/A
	Export	0	0	0	56	0	22	22	0	813	0	N/A	N/A	N/A
Paper and cardboard, t	Produced	14100	11800	11700	26000	39800	40328	40328	31172	32268	17232	N/A	N/A	N/A
	Import	34929	36066	36066	101456	97957	102837	102837	69147	77424	77424	N/A	N/A	N/A
	Export	16406	14833	14833	17621	29648	31314	31314	22200	22200	22200	N/A	N/A	N/A
Timber, m^3	Produced	37580	31700	33317	53000	51689	52735	52735	12724	10659	19330	N/A	N/A	N/A
	Import	137595	150517	150517	153900	230697	232141	232141	223000	223000	223000	N/A	N/A	N/A
	Export	1378	2081	2081	2081	256	224	224	432	432	432	N/A	N/A	N/A
Wood panels, m^3	Produced	15270	15000	15000	0	2487	2787	2787	425	28522	45239	N/A	N/A	N/A
	Import	169818	212560	212560	145001	329594	334958	334958	187077	187305	187305	N/A	N/A	N/A
	Export	169818	212560	212560	3164	4264	4813	4813	3155	2910	2910	N/A	N/A	N/A

Source: Statistical Yearbooks of the RoM for 1961-2022; FAOSTAT database for 1994-2022; 'Moldsilva' Agency Reports for 1990-2022.

In order to estimate annual carbon increments/losses from use of wood products included in source category 4G 'Harvested Wood Products', emission/removal factors were used according to the 2006 IPCC Guidelines (Table 6-66).

Table 6-66: EFs used in the estimation of CO_2 emissions/removals from category 4G 'Harvested Wood Products' in the RoM

Categories	Indicator	Unit	Indicator value
Period of use	Solidwood products (timber, wood chips and veneer, rough roundwood, wood panels, etc.)	ani	30.0
	Paper products	ani	3.0
Conversion factor	Timber, other types of roundwood (wood chips and veneer, rafter, etc.)	t C/m^3	0.5
	Wood panels	t C/m^3	0.295
	Paper and cardboards	t C/t	0.45

Source: IPCC Guidelines 2006 (Volume 4, Chapter 12, Table 12.2, page 12.17 and Table 12.4, page 12.19).

6.8.3. Uncertainties and Time-Series Consistency

Uncertainties associated with CO_2 emissions/removals from category 4G 'Harvested Wood Products' at the beginning and the end of the reference period (1990 and 2022) are somewhat high, and are estimated to be circa 30%. In both cases, emission/removal factors have an uncertainty level of circa 10%. Combined uncertainties from category 4G 'Harvested Wood Products' constitute circa 31.62%. Uncertainties in the trend of total direct GHG emissions from subcategory 4G under Sector 4 'LULUCF' were estimated to be circa 0.02% (see Annex 2).

6.8.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

6.8.5. Quality Assurance and Quality Control

The quality of assessment for 4G 'Harvested Wood Products' is ensured by the fact that most of the AD used is taken from official records (Statistical Yearbooks of the RoM; FAOSTAT database, etc.). At

the same time, it should be noted that the export and import data for the period 1961-1993 (while the RoM was part of the USSR and in the first years after independence) was calculated indirectly, considering the estimated needs of wood products of the national economy, as well as the local production capacities. Standard verification and quality control forms and checklists were filled in for this category, following the Tier 1 methodological approach. Within this category, verification was focused on following the recommendations included in the 2006 IPCC Guidelines (Volume 4 'AFOLU'), on various aspects such as: verification of correct application of estimation methods set out in the Guidelines, ensuring correct use of country-specific coefficients and indices, their accuracy, as well as comparing them to the values used by other countries in the region.

6.8.6. Recalculations

No recalculations were performed to estimate CO_2 emissions/removals from category 4G 'Harvested Wood Products' in the current inventory cycle for the period 1990-2020.

Between 1990 and 2022, CO_2 emissions/removals from category 4G 'Harvested Wood Products' fluctuated significantly (Figure 6-15), being influenced particularly by the temporary harvesting/production of wood with a long period of use.

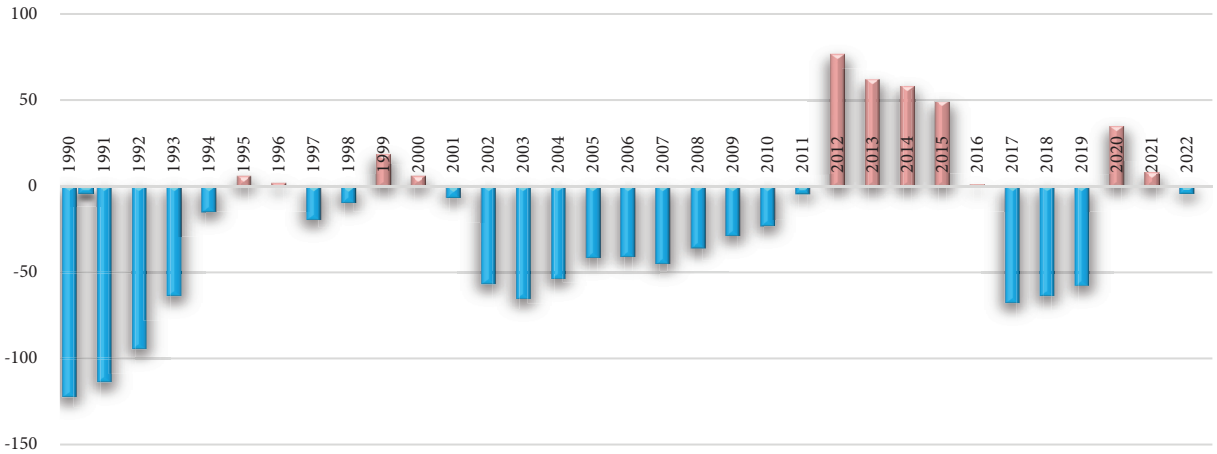


Figure 6-15: Evolution of CO_2 removals/emissions from category 4G 'Harvested Wood Products' between 1990-2022, kt.

The largest removal volumes were recorded in 1990 (-122.2 kt), whereas the most reduced in 2011 (-4.4 kt) (Table 6-67). At the same time, CO_2 emissions were recorded for 11 years (1995-1996, 1999-2000, 2012-2016; 2020; 2021) – with a minimum of 0.9 kt in 2016, and a maximum of 76.8 kt in 2012.

Table 6-67: CO_2 removals/emissions from category 4G 'Harvested Wood Products' between 1990-2022, kt

Indicators	1990	1991	1992	1993	1994	1995	1996	1997	1998
4G CO_2 removals/emissions	-122.1804	-113.6108	-94.2986	-63.4504	-14.6464	5.9727	1.7792	-19.2429	-9.1293
Indicators	**1999**	**2000**	**2001**	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**
4G CO_2 removals/emissions	18.5414	5.8073	-6.2594	-56.6873	-65.1129	-53.4745	-41.1098	-40.5864	-44.5936
Indicators	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
4G CO_2 removals/emissions	-35.6078	-28.4708	-22.8014	-4.3808	76.8444	61.8814	58.0208	49.2353	0.8816
Indicators	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**	**2024**	**2025**
4G CO_2 removals/emissions	-67.4476	-63.5037	-57.5604	34.6883	7.7300	-3.7792	N/A	N/A	N/A

Source: Land Use and Land-Use Change Matrix of the RoM for the period 1970-2022.

6.8.7. Planned Improvements

The possibility of improving statistical records (as the main reference sources for activity data) regarding wood product production/export/import within category 4G 'Harvested Wood Products' will be considered for the next inventory cycle.

CHAPTER 7. SECTOR 5 'WASTE'

7.1. Overview

Sector 5 'Waste' covers direct GHG emissions (CO_2, CH_4 and N_2O) from managing municipal and industrial waste, incineration and open burning of waste, as well as from wastewater treatment and discharge, estimated based on methodologies in the 2006 IPCC Guidelines. The source categories covered by this sector are: 5A 'Solid Waste Disposal', 5B 'Biological Treatment of Solid Waste', 5C 'Incineration and Open Burning of Waste' and 5D 'Wastewater Treatment and Discharge'. A brief overview, methodological issues and data sources, key categories, uncertainties and times-series consistency, quality assurance and quality control verification, recalculations performed and planned improvements are described for each source category within this sector.

7.1.1. Summary of Emission Trends

In 2022, Sector 5 'Waste' accounted for circa 10.8% of total net national direct GHG emissions (with Sector 4 'LULUCF'), being the second major source of GHG emissions in the RoM, following Sector 1 'Energy'. It should be noted that Sector 5 'Waste' is a major source of CH_4 emissions, accounting for circa 60.4%% of the total methane emissions reported at national level.

The evolution of total GHG emissions originating from Sector 5 'Waste' recorded a slight upward trend between 1990 and 2022, increasing from 1,690.28 kt CO_2 equivalent in 1990 to 1,801.08 kt CO_2 equivalent in 1993, and later decreasing to 1,445.09 kt CO_2 equivalent in 2022 (Table 7-1).

Table 7-1: Total direct GHG emissions from Sector 5 'Waste' between 1990-2022

Year	5A, CH_4 emissions, kt CO_2 eq.	5B, CH_4 emissions, kt CO_2 eq.	5B, N_2O emissions, kt CO_2 eq.	5C, CO_2 emissions, kt CO_2 eq.	5C, CH_4 emissions, kt CO_2 eq.	5C, N_2O emissions, kt CO_2 eq.	5D, CH_4 emissions, kt CO_2 eq.	5D, N_2O emissions, kt CO_2 eq.	5. Total emissions, kt CO_2 eq.
1990	1,228.0895	1.5229	0.8648	14.9667	8.6101	1.4298	356.5846	78.2105	1,690.2788
1991	1,277.4955	1.5432	0.8763	14.9994	8.6251	1.4325	345.9170	72.1809	1,723.0700
1992	1,331.6340	1.6100	0.9143	15.0476	8.6493	1.4368	327.5649	66.1383	1,752.9952
1993	1,384.6265	0.8057	0.4575	15.0447	8.6444	1.4362	328.0245	62.0396	1,801.0793
1994	1,390.8445	0.7510	0.4264	15.0947	8.6700	1.4406	313.1718	60.2194	1,790.6184
1995	1,388.0667	0.7080	0.4021	15.0979	8.6683	1.4406	315.7944	60.9671	1,791.1450
1996	1,385.6710	0.7299	0.4145	15.0960	8.6639	1.4401	313.5987	60.0470	1,785.6612
1997	1,373.8362	0.6866	0.3899	15.0456	8.6328	1.4351	318.5703	61.1459	1,779.7423
1998	1,357.4411	0.6932	0.3936	15.0794	8.6502	1.4381	309.4460	62.0745	1,755.2161
1999	1,349.6788	0.6504	0.3694	15.0071	8.6153	1.4318	300.9779	60.7346	1,737.4653
2000	1,318.2688	0.5867	0.3331	14.9965	8.6036	1.4303	301.7489	62.1804	1,708.1482
2001	1,280.3988	0.5326	0.3024	14.9689	8.5885	1.4277	306.1775	62.8757	1,675.2722
2002	1,242.3374	0.5847	0.3320	14.9402	8.5658	1.4244	328.0738	64.5038	1,660.7621
2003	1,204.2917	0.6138	0.3486	14.9100	8.5413	1.4208	333.5034	62.2991	1,625.9289
2004	1,191.1814	0.6445	0.3660	14.8621	8.5080	1.4156	337.1894	59.3042	1,613.4712
2005	1,195.7876	0.6737	0.3826	14.3313	8.2026	1.3649	332.3447	54.3579	1,607.4454
2006	1,185.9875	0.7297	0.4144	14.0179	8.0233	1.3351	319.2939	56.0136	1,585.8154
2007	1,180.6812	0.8458	0.4803	13.7054	7.8446	1.3053	308.1750	51.9619	1,564.9995
2008	1,182.0113	0.9986	0.5671	13.4037	7.6663	1.2761	309.3803	47.6673	1,562.9707
2009	1,191.4146	1.0408	0.5910	13.1228	7.4994	1.2487	291.4873	48.6341	1,555.0386
2010	1,196.0452	1.0947	0.6217	12.8395	7.3312	1.2211	297.3144	47.0680	1,563.5358
2011	1,194.2747	1.1589	0.6581	12.5690	7.1686	1.1946	290.1132	47.2977	1,554.4348
2012	1,179.5443	1.1392	0.6469	12.2745	6.9957	1.1661	286.3747	47.6782	1,535.8195
2013	1,109.3989	1.2331	0.7002	11.9268	6.8011	1.1334	287.6922	47.8973	1,466.7830
2014	1,101.0747	1.3421	0.7621	11.5760	6.6060	1.1006	278.0681	47.3891	1,447.9188
2015	1,098.5478	1.3446	0.7636	11.3821	6.5070	1.0833	271.7799	48.2143	1,439.6225
2016	1,106.5936	1.3351	0.7582	11.1405	6.3766	1.0611	270.7899	48.7957	1,446.8507
2017	1,191.5422	1.2913	0.7333	10.8683	6.2293	1.0360	265.5271	50.2953	1,527.5228
2018	1,180.1724	1.2513	0.7105	10.5805	6.0724	1.0093	266.6533	51.7941	1,518.2439
2019	1,168.0946	1.2817	0.7278	10.2841	5.9138	0.9822	256.6320	52.0099	1,495.9262
2020	1,156.7049	1.3985	0.7941	10.4735	6.0115	0.9992	247.0621	51.9943	1,475.4381
2021	1,144.5600	1.3255	0.7527	10.0573	5.7718	0.9594	256.9871	51.0604	1,471.4742
2022	1,130.3853	1.3783	0.7827	9.8895	5.6807	0.9439	246.6845	49.3425	1,445.0875
1990-2022, %	-8.0	-9.5	-9.5	-33.9	-34.0	-34.0	-30.8	-36.9	-14.5

The economic growth recorded in the last 20 years resulted in a higher level of welfare and industrial production, and increased consumption also results in a greater capacity to generate waste.

In 1990, CO_2, CH_4 and N_2O emissions accounted for circa 0.9%, 94.4% and 4.8% respectively, of the total GHG emissions from Sector 5 'Waste'. By 2022, the share of pollutants had not changed significantly, constituting circa 0.7%, 95.8%, and 3.5% respectively, of the total GHG emissions at sectoral level. At the same time, between 1990 and 2022, total direct GHG emissions originating from Sector 5 'Waste' decreased by circa 12.7%, CH_4 emissions decreased by 13.2%, whereas CO_2 and N_2O emissions decreased by 33.9%, and 32.6% respectively (Figure 7-1).

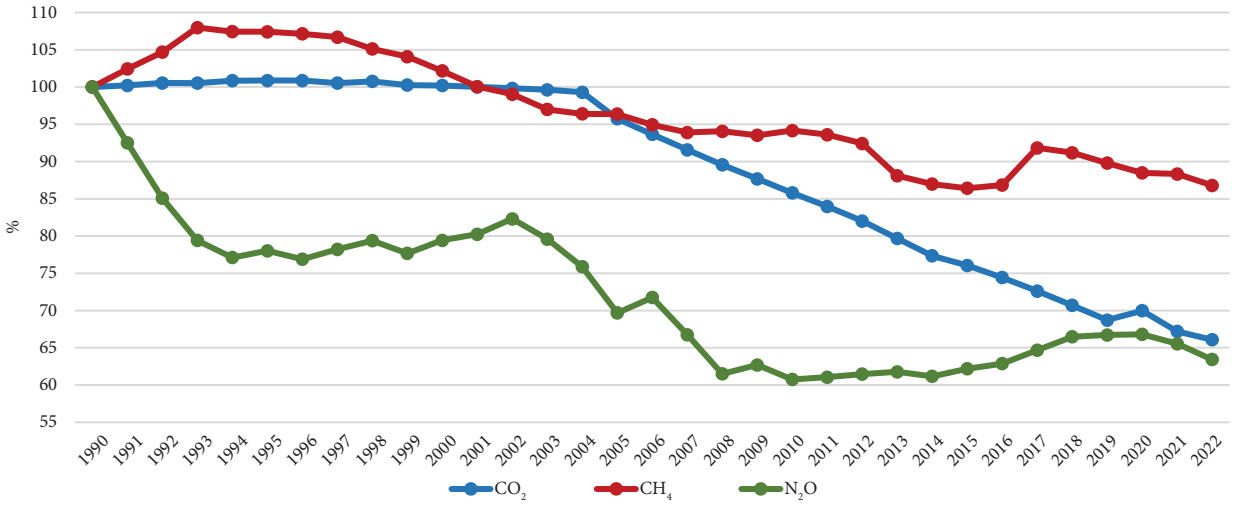


Figure 7-1: Direct GHG emissions from Sector 5 'Waste' between 1990-2022, where 1990 represents 100%.

Source category 5A 'Solid Waste Disposal' was the largest source of direct GHG emissions between 1990 and 2022, with a share varying between a minimum of 72.7% of the total in 1990, and a maximum of 78.2% of the total in 2022; followed by source category 5D 'Wastewater Treatment and Discharge', with a share varying between a minimum of 20.5% of the total in 2022 and a maximum of 25.7% of the total in 1990; source category 5C 'Incineration and Open Burning of Waste', with a share varying between 1.5% and 1.1% of the total sectoral emissions between 1990 and 2022, and source category 5B 'Biological Treatment of Solid Waste', which constituted 0.1% in 2022.

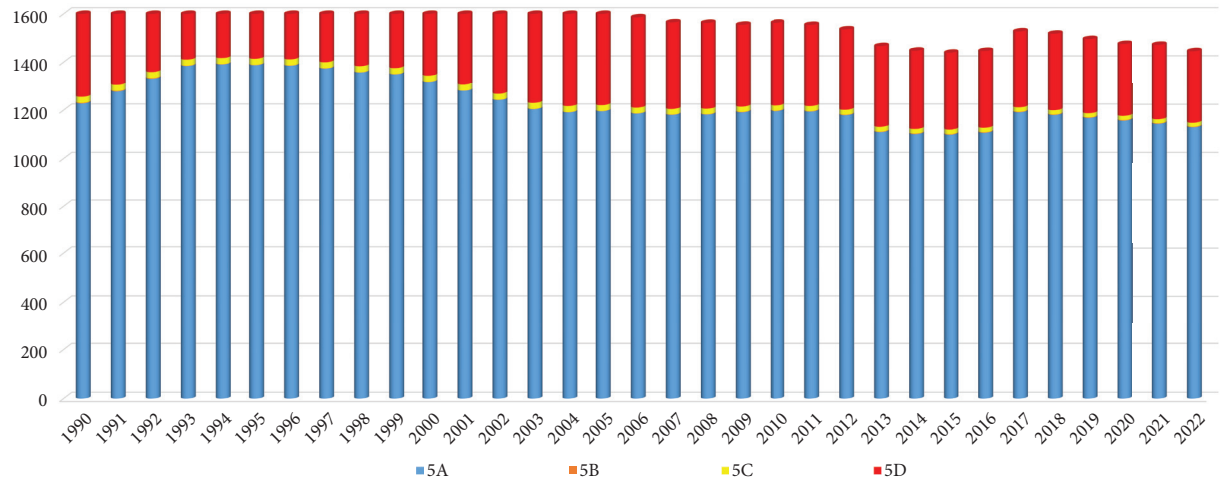


Figure 7-2: Breakdown of direct GHG emissions from Sector 5 'Waste' by source category between 1990-2022, kt CO_2 equivalent.

Within the reference period, direct GHG emissions from source category 5A 'Solid Waste Disposal' decreased by circa 7.8%; from source category 5B 'Biological Treatment of Solid Waste' – by 9.5%; from source category 5C 'Incineration and Open Burning of Waste', emissions decreased by circa 34.0%, whereas emissions from source category 5D 'Wastewater Treatment and Discharge' decreased by circa 31.9% (Figure 7-2, Table 7-2).

Table 7-2: Direct GHG emissions by category and their share in the total sectoral emissions between 1990-2022

Year	5A, kt CO_2 eq.	5B, kt CO_2 eq.	5C, kt CO_2 eq.	5D, kt CO_2 eq.	5. Total, kt CO_2 eq.	5A, % of total	5B, % of total	5C, % of total	5D, % of total
1990	1,228.0895	2.3877	25.0066	434.7951	1,690.2788	72.7	0.1	1.5	25.7
1991	1,277.4955	2.4196	25.0571	418.0979	1,723.0700	74.1	0.1	1.5	24.3
1992	1,331.6340	2.5243	25.1337	393.7032	1,752.9952	76.0	0.1	1.4	22.5
1993	1,384.6265	1.2633	25.1253	390.0641	1,801.0793	76.9	0.1	1.4	21.7
1994	1,390.8445	1.1774	25.2053	373.3912	1,790.6184	77.7	0.1	1.4	20.9
1995	1,388.0667	1.1101	25.2067	376.7614	1,791.1450	77.5	0.1	1.4	21.0
1996	1,385.6710	1.1444	25.2000	373.6457	1,785.6612	77.6	0.1	1.4	20.9
1997	1,373.8362	1.0764	25.1135	379.7162	1,779.7423	77.2	0.1	1.4	21.3
1998	1,357.4411	1.0868	25.1677	371.5205	1,755.2161	77.3	0.1	1.4	21.2
1999	1,349.6788	1.0198	25.0543	361.7125	1,737.4653	77.7	0.1	1.4	20.8
2000	1,318.2688	0.9198	25.0304	363.9292	1,708.1482	77.2	0.1	1.5	21.3
2001	1,280.3988	0.8350	24.9851	369.0533	1,675.2722	76.4	0.0	1.5	22.0
2002	1,242.3374	0.9167	24.9304	392.5776	1,660.7621	74.8	0.1	1.5	23.6
2003	1,204.2917	0.9624	24.8721	395.8026	1,625.9289	74.1	0.1	1.5	24.3
2004	1,191.1814	1.0105	24.7857	396.4936	1,613.4712	73.8	0.1	1.5	24.6
2005	1,195.7876	1.0563	23.8988	386.7026	1,607.4454	74.4	0.1	1.5	24.1
2006	1,185.9875	1.1441	23.3762	375.3075	1,585.8154	74.8	0.1	1.5	23.7
2007	1,180.6812	1.3261	22.8553	360.1369	1,564.9995	75.4	0.1	1.5	23.0
2008	1,182.0113	1.5657	22.3461	357.0476	1,562.9707	75.6	0.1	1.4	22.8
2009	1,191.4146	1.6318	21.8708	340.1214	1,555.0386	76.6	0.1	1.4	21.9
2010	1,196.0452	1.7164	21.3918	344.3824	1,563.5358	76.5	0.1	1.4	22.0
2011	1,194.2747	1.8169	20.9323	337.4109	1,554.4348	76.8	0.1	1.3	21.7
2012	1,179.5443	1.7860	20.4363	334.0529	1,535.8195	76.8	0.1	1.3	21.8
2013	1,109.3989	1.9333	19.8614	335.5894	1,466.7830	75.6	0.1	1.4	22.9
2014	1,101.0747	2.1043	19.2826	325.4572	1,447.9188	76.0	0.1	1.3	22.5
2015	1,098.5478	2.1082	18.9723	319.9942	1,439.6225	76.3	0.1	1.3	22.2
2016	1,106.5936	2.0933	18.5781	319.5856	1,446.8507	76.5	0.1	1.3	22.1
2017	1,191.5422	2.0246	18.1336	315.8224	1,527.5228	78.0	0.1	1.2	20.7
2018	1,180.1724	1.9618	17.6622	318.4474	1,518.2439	77.7	0.1	1.2	21.0
2019	1,168.0946	2.0096	17.1801	308.6419	1,495.9262	78.1	0.1	1.1	20.6
2020	1,156.7049	2.1926	17.4842	299.0564	1,475.4381	78.4	0.1	1.2	20.3
2021	1,144.5600	2.0782	16.7885	308.0475	1,471.4742	77.8	0.1	1.1	20.9
2022	1,130.3853	2.1609	16.5142	296.0271	1,445.0875	78.2	0.1	1.1	20.5
1990-2022, %	-7.8	-9.5	-34.0	-31.9	-14.4	7.7	5.7	-22.9	-20.5

The table below shows the evolution of direct GHG emissions from Sector 5 'Waste' in the Republic of Moldova by source and gas (Table 7-3).

Table 7-3: Direct GHG emissions from Sector 5 'Waste', by source and gas, between 1990-2022

Year	5A, CH_4 emissions, kt CO_2 eq.	5B, CH_4 emissions, kt CO_2 eq.	5B, N_2O emissions, kt CO_2 eq.	5C, CO_2 emissions, kt CO_2 eq.	5C, CH_4 emissions, kt CO_2 eq.	5C, N_2O emissions, kt CO_2 eq.	5D, CH_4 emissions, kt CO_2 eq.	5D, N_2O emissions, kt CO_2 eq.	5. Total emissions, kt CO_2 eq.
1990	1,228.0895	1.5229	0.8648	14.9667	8.6101	1.4298	356.5846	78.2105	1,690.2788
1991	1,277.4955	1.5432	0.8763	14.9994	8.6251	1.4325	345.9170	72.1809	1,723.0700
1992	1,331.6340	1.6100	0.9143	15.0476	8.6493	1.4368	327.5649	66.1383	1,752.9952
1993	1,384.6265	0.8057	0.4575	15.0447	8.6444	1.4362	328.0245	62.0396	1,801.0793
1994	1,390.8445	0.7510	0.4264	15.0947	8.6700	1.4406	313.1718	60.2194	1,790.6184
1995	1,388.0667	0.7080	0.4021	15.0979	8.6683	1.4406	315.7944	60.9671	1,791.1450
1996	1,385.6710	0.7299	0.4145	15.0960	8.6639	1.4401	313.5987	60.0470	1,785.6612
1997	1,373.8362	0.6866	0.3899	15.0456	8.6328	1.4351	318.5703	61.1459	1,779.7423
1998	1,357.4411	0.6932	0.3936	15.0794	8.6502	1.4381	309.4460	62.0745	1,755.2161
1999	1,349.6788	0.6504	0.3694	15.0071	8.6153	1.4318	300.9779	60.7346	1,737.4653
2000	1,318.2688	0.5867	0.3331	14.9965	8.6036	1.4303	301.7489	62.1804	1,708.1482
2001	1,280.3988	0.5326	0.3024	14.9689	8.5885	1.4277	306.1775	62.8757	1,675.2722
2002	1,242.3374	0.5847	0.3320	14.9402	8.5658	1.4244	328.0738	64.5038	1,660.7621

Year	5A, CH_4 emissions, kt CO_2 eq.	5B, CH_4 emissions, kt CO_2 eq.	5B, N_2O emissions, kt CO_2 eq.	5C, CO_2 emissions, kt CO_2 eq.	5C, CH_4 emissions, kt CO_2 eq.	5C, N_2O emissions, kt CO_2 eq.	5D, CH_4 emissions, kt CO_2 eq.	5D, N_2O emissions, kt CO_2 eq.	5. Total emissions, kt CO_2 eq.
2003	1,204.2917	0.6138	0.3486	14.9100	8.5413	1.4208	333.5034	62.2991	1,625.9289
2004	1,191.1814	0.6445	0.3660	14.8621	8.5080	1.4156	337.1894	59.3042	1,613.4712
2005	1,195.7876	0.6737	0.3826	14.3313	8.2026	1.3649	332.3447	54.3579	1,607.4454
2006	1,185.9875	0.7297	0.4144	14.0179	8.0233	1.3351	319.2939	56.0136	1,585.8154
2007	1,180.6812	0.8458	0.4803	13.7054	7.8446	1.3053	308.1750	51.9619	1,564.9995
2008	1,182.0113	0.9986	0.5671	13.4037	7.6663	1.2761	309.3803	47.6673	1,562.9707
2009	1,191.4146	1.0408	0.5910	13.1228	7.4994	1.2487	291.4873	48.6341	1,555.0386
2010	1,196.0452	1.0947	0.6217	12.8395	7.3312	1.2211	297.3144	47.0680	1,563.5358
2011	1,194.2747	1.1589	0.6581	12.5690	7.1686	1.1946	290.1132	47.2977	1,554.4348
2012	1,179.5443	1.1392	0.6469	12.2745	6.9957	1.1661	286.3747	47.6782	1,535.8195
2013	1,109.3989	1.2331	0.7002	11.9268	6.8011	1.1334	287.6922	47.8973	1,466.7830
2014	1,101.0747	1.3421	0.7621	11.5760	6.6060	1.1006	278.0681	47.3891	1,447.9188
2015	1,098.5478	1.3446	0.7636	11.3821	6.5070	1.0833	271.7799	48.2143	1,439.6225
2016	1,106.5936	1.3351	0.7582	11.1405	6.3766	1.0611	270.7899	48.7957	1,446.8507
2017	1,191.5422	1.2913	0.7333	10.8683	6.2293	1.0360	265.5271	50.2953	1,527.5228
2018	1,180.1724	1.2513	0.7105	10.5805	6.0724	1.0093	266.6533	51.7941	1,518.2439
2019	1,168.0946	1.2817	0.7278	10.2841	5.9138	0.9822	256.6320	52.0099	1,495.9262
2020	1,156.7049	1.3985	0.7941	10.4735	6.0115	0.9992	247.0621	51.9943	1,475.4381
2021	1,144.5600	1.3255	0.7527	10.0573	5.7718	0.9594	256.9871	51.0604	1,471.4742
2022	1,130.3853	1.3783	0.7827	9.8895	5.6807	0.9439	246.6845	49.3425	1,445.0875
1990-2022, %	-8.0	-9.5	-9.5	-33.9	-34.0	-34.0	-30.8	-36.9	-14.5

Indirect GHG emissions, ozone and aerosol precursors (NO_x, CO, NMVOC and SO_2), from Sector 5 'Waste' were also recorded in the current inventory cycle (Table 7-4), in accordance with the methodologies available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019).

Table 7-4: Indirect GHG emissions from Sector 5 'Waste' between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NO_x emissions, kt	0.1503	0.1506	0.1510	0.1508	0.1512	0.1512	0.1511	0.1505	0.1508	0.1502	0.1500
CO emissions, kt	2.6430	2.6451	2.6506	2.6428	2.6482	2.6451	2.6417	2.6305	2.6344	2.6281	2.6204
NMVOC emissions, kt	3.1194	3.2557	3.0827	2.9041	2.7991	1.7494	1.5880	1.4614	1.4245	1.3300	1.3258
SO_2 emissions, kt	0.0052	0.0053	0.0053	0.0053	0.0054	0.0054	0.0054	0.0054	0.0054	0.0053	0.0054
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NO_x emissions, kt	0.1497	0.1493	0.1488	0.1481	0.1428	0.1397	0.1366	0.1334	0.1304	0.1274	0.1245
CO emissions, kt	2.6161	2.6051	2.5930	2.5791	2.4858	2.4318	2.3784	2.3214	2.2669	2.2122	2.1581
NMVOC emissions, kt	1.2028	1.1284	1.0181	1.0739	1.2256	1.3087	1.3803	1.4953	1.6658	1.8762	1.8082
SO_2 emissions, kt	0.0054	0.0054	0.0054	0.0054	0.0052	0.0051	0.0050	0.0049	0.0048	0.0048	0.0047
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NO_x emissions, kt	0.1215	0.1181	0.1148	0.1132	0.1110	0.1085	0.1059	0.1032	0.1048	0.1006	0.0991
CO emissions, kt	2.1027	2.0473	1.9926	1.9708	1.9366	1.8976	1.8552	1.8149	1.8378	1.7638	1.7399
NMVOC emissions, kt	1.6435	1.7302	1.6303	1.7562	1.9054	1.9091	1.5374	1.5317	1.4902	1.5238	1.4914
SO_2 emissions, kt	0.0046	0.0045	0.0043	0.0042	0.0041	0.0039	0.0038	0.0036	0.0037	0.0036	0.0035

7.1.2. Key Categories

The results of key category analysis under Sector 5 'Waste' (Table 7-5), carried out following the Tier 1 methodological approach, are presented in Annex 1 of this Report.

Table 7-5: Key Categories identified under Sector 5 'Waste'

IPCC Category	GHG	Source category	Key categories
5A	CH_4	Solid Waste Disposal	Yes (L, T)
5B	CH_4	Biological Treatment of Solid Waste	No
5B	N_2O	Biological Treatment of Solid Waste	No
5C	CO_2	Incineration and Open Burning of Waste	No
5C	CH_4	Incineration and Open Burning of Waste	No
5C	N_2O	Incineration and Open Burning of Waste	No
5D	CH_4	Wastewater Treatment and Discharge	Yes (L, T)
5D	N_2O	Wastewater Treatment and Discharge (Human Sewage)	No

Abbreviations: L – Level Assessment; T – Trend Assessment; T1 – Tier 1; T2 – Tier 2.

7.1.3. Methodologies

In order to estimate GHG emissions from source categories 5A 'Solid Waste Disposal', 5B 'Biological Treatment of Solid Waste', 5C 'Incineration and Open Burning of Waste', and 5D 'Wastewater Treatment and Discharge', Tier 1 and Tier 3 methodologies were applied, and default EFs respectively, available in the 2006 IPCC Guidebook, as well as country-specific emission factors (Table 7-6). A detailed description of methods and EFs used in the estimation of emissions is available in the respective subchapters of the NIR (7.2-7.5).

Table 7-6: Estimation methods used in the estimation of GHG emissions from Sector 5 'Waste'

IPCC Category	Source Category	CO_2		CH_4		N_2O	
		Method	EF	Method	EF	Method	EF
5A	Solid Waste Disposal	NA	NA	T3	D, CS	NA	NA
5B	Biological Treatment of Solid Waste	NA	NA	T1	D	T1	D
5C	Incineration and Open Burning of Waste	T1	D, CS	T1	D, CS	T1	D
5D	Wastewater Treatment and Discharge	NA	NA	T1	D, CS	T1	D

Abbreviations: T1 – Tier 1; T2 – Tier 2; CS – country-specific; D – default; NA –Not Applicable; NO – Not Occurring.

7.1.4. Uncertainties and Time-Series Consistency

The uncertainty analysis of GHG emissions from the Sector 5 'Waste' (including by source category) is described in detail in subchapters 7.2-7.5, as well as in the Annex 5-3.5 of this Report.

Combined uncertainties as a percentage of total direct sectoral emissions were estimated to be circa 40.3%. Uncertainties introduced in trend of total direct sectoral emissions were estimated to be circa 29.7%.

In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

7.1.5. Quality Assurance and Quality Control

Standard verification and quality control forms by individual source categories were filled in for each source category under Sector 5 'Waste', following the Tier 1 methodological approach.

It should be noted that AD and methods used for the estimation of GHG emissions from Sector 5 'Waste' were documented and archived both in hard copies and electronically.

In order to identify the data entry, as well GHG emission estimation-related errors, AD and EF verifications and QC procedures are constantly applied.

Following the recommendations included in the 2006 IPCC Guidelines, GHG emissions from Sector 5 'Waste' were estimated based on AD and EFs from official reference sources.

7.1.6. Recalculations

GHG emissions from Sector 5 'Waste' were recalculated for source categories 5A 'Solid Waste Disposal', 5C 'Incineration and Open Burning of Waste', and 5D 'Wastewater Treatment and Discharge'.

In the current inventory cycle, GHG emissions were recalculated from categories:

- 5A 'Solid Waste Disposal' for the period 1990-2020, as a result of revising the following parameters: the transformation coefficient of the volume of MSW in mass units, DOC, DOC_f, and the fraction of CH_4 in gas generated from solid waste disposal sites;
- 5C 'Incineration and Open Burning of Waste' for years 2005-2020, as a result of revising activity data on the population number, and for years 2015-2020 as a result of revising the rate of waste generated per capita for the urban and rural population;
- 5D 'Wastewater Treatment and Discharge' for the years 2005-2020, as a result of revising activity data associated with the population number and for years 1990-2020, as a result of revising activity data on industrial production.

Likewise, GWP values for the 100-year horizon (GWP_{100}) were used in the current inventory cycle in order to transfer direct GHG emissions into CO_2 equivalent, available in the IPCC AR5 (2014): for CH_4 – 28 and for N_2O – 265, instead of GWP_{100} values available in the IPCC AR4 (2007): for CH_4 – 25

and for N_2O – 298, which prompted the recalculation of direct and indirect GHG emissions for the entire period 1990-2020.

Compared to the results recorded in the previous inventory cycle, the changes made in the compilation of the current inventory resulted in an upward trend in direct GHG emissions between 1990-2015, varying from a minimum of 1.2% and a maximum of 9.4%, followed by a downward trend between 2016-2022, varying from a minimum of -0.2% and a maximum of -5.8% in 2022 (Table 7-7).

Table 7-7: Recalculation results of direct GHG emissions for the period 1990-2020, included in the NC5 of the RoM to the UNFCCC (Sector 5 'Waste'), kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	1,573.5058	1,604.4244	1,604.4001	1,661.8969	1,641.7795	1,637.3163	1,638.1749	1,630.4848	1,604.6693	1,598.8266	1,573.8873
BTR1	1,690.2788	1,723.0700	1,752.9952	1,801.0793	1,790.6184	1,791.1450	1,785.6612	1,779.7423	1,755.2161	1,737.4653	1,708.1482
Difference, %	7.4	7.4	9.3	8.4	9.1	9.4	9.0	9.2	9.4	8.7	8.5
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	1,545.9346	1,533.8650	1,499.1811	1,480.8235	1,478.4941	1,464.8920	1,452.4962	1,466.9534	1,478.8246	1,501.4555	1,510.4300
BTR1	1,675.2722	1,660.7621	1,625.9289	1,613.4712	1,607.4454	1,585.8154	1,564.9995	1,562.9707	1,555.0386	1,563.5358	1,554.4348
Difference, %	8.4	8.3	8.5	9.0	8.7	8.3	7.7	6.5	5.2	4.1	2.9
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	1,494.1816	1,435.4525	1,423.7490	1,423.2385	1,449.8546	1,539.4310	1,555.2113	1,560.4663	1,566.5908		
BTR1	1,535.8195	1,466.7830	1,447.9188	1,439.6225	1,446.8507	1,527.5228	1,518.2439	1,495.9262	1,475.4381	1,471.4742	1,445.0875
Difference, %	2.8	2.2	1.7	1.2	-0.2	-0.8	-2.4	-4.1	-5.8		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

Recalculated results at emissions category level are presented in subchapters 7.2-7.5 of this Report.

7.1.7. Assessment of Completeness

The current inventory covers direct GHG emissions from four source categories (Table 7-8).

Table 7-8: Assessment of Completeness under Sector 5 'Waste'

IPCC Category	Source Category	CO_2	CH_4	N_2O
5A	Solid Waste Disposal	NE	X	NE
5B	Biological Treatment of Solid Waste	NO	X	X
5C	Incineration and Open Burning of Waste	X	X	X
5D	Wastewater Treatment and Discharge	NE	X	X
5E	Other	NO, NE	NO, NE	NO, NE

Abbreviations: X – source categories included into the inventory; NO – Not Occurring; NE – Not Estimated; NA – Not Applicable.

7.1.8. Planned Improvements

Planned improvements at source category level within Sector 5 'Waste' are described in detail in subchapters 7.2-7.5 of this Report.

7.2. Source Category 5A 'Solid Waste Disposal'

7.2.1. Source Category Description

Source category 5A 'Solid Waste Disposal', covers CH_4 emissions from the storage of municipal solid waste on the ground. The methane generation potential depends on the morphological composition of the MSW, the disposal practice and characteristics (managed or unmanaged). In the process of calculating emissions within this category, activity data and emission factors previously used in the development of the GHG inventory from source category 5A 'Solid Waste Disposal' will be used.

Currently, the most used method of treating waste is waste disposal on the ground, which is often a major source of soil pollution and groundwater contamination. In this context, sanitation and waste management services are an important goal for local and governmental structures. These sites were established in each locality by local public authorities and are exploited according to the decision of local councils – 989 landfills with an area of 1,052.6 ha albeit none of them meets ecological require-

ments. The authority only confirms that the land below the landfill has been designated as a place where waste can be disposed of, based on a decision of the local council. In most cases, MSW disposal sites do not meet the sanitary and ecological requirements, and the volume of domestic waste accumulated since their operation is unknown. Thus, 164 disposal sites are located in the protection area of water bodies, and 292 sites are located at a distance of less than 500 m from residential areas.

It must be recognized, however, that the statistical information does not reflect the real situation in the field of municipal solid waste management. Thus, for example, the volumes of MSW generated in rural areas are not subject to statistical records, as there are usually no sanitation services. Likewise, albeit there are waste processing enterprises operating in the RoM, the information on the volumes of recycled waste is not subject to a strict statistical record. Considering the Republic of Moldova's tendency to align with EU standards, the sector is to be fundamentally restructured. In this context, most MSW sites are to be recultivated, and their number – drastically reduced.

There is no statistical evidence carried out on the volumes of previously accumulated waste in landfills, there are only visual estimates of environmental inspectors, who estimate the total volume of MSW accumulated in landfills at circa 40 million tonnes. In most district towns, landfills are overfilled, the disposed waste layer being circa 10-15 metres (e.g., in Ungheni, Cahul, Ocnita, etc.); the layer may reach circa 10-20 metres at some landfills (e.g., in Briceni, Balti, Ialoveni, etc.); and even circa 25-30 metres (Cretoaia and Orhei municipality). Circa ¾ of district towns landfills have been used for circa 30-40 years, being at over 80% of their capacity.



Figure 7-3: Landfills in Cahul, Balti and Stefan Voda towns, 2020.

There have been changes in waste management in Chisinau municipality in recent years, especially regarding the establishment of the landfill in Tintareni commune, which became operational by the end of 1990 (the de facto exploitation began in 1991). According to the project, it was designed to store circa 44 million m^3 of MSW until the end of 2010. By 2011, when its operation was discontinued, only 19 million m^3 of solid waste were stored, which is less than half of the capacity of the landfill. In the summer of 2017, Chisinau municipality has recommenced storing its waste at the Tintareni landfill, after negotiating conditions for reusing the landfill with the local public authorities, including solutions for environmental protection problems. Between 2018 and 2019, measures were taken to recultivate and remedy the environmental pollution caused by the landfill, the leachate treatment station at the Tantareni landfill was recently established (November 2020), together with the protection dam of the landfill.



Figure 7-4: Landfill in Tantareni commune and the leachate treatment facility.

The impact of waste on the environment has alarmingly increased in recent years, and its mismanagement leads to contamination of soil and groundwater, as well as CH_4, CO_2, and toxic gas emissions with direct effects on public health and the environment.

Between 1990 and 2022, methane emissions from source category 5A 'Solid Waste Disposal' decreased by circa 7.8%, from circa 43.86 kt in 1990, to circa 40.43 kt in 2022 (Figure 7-5).

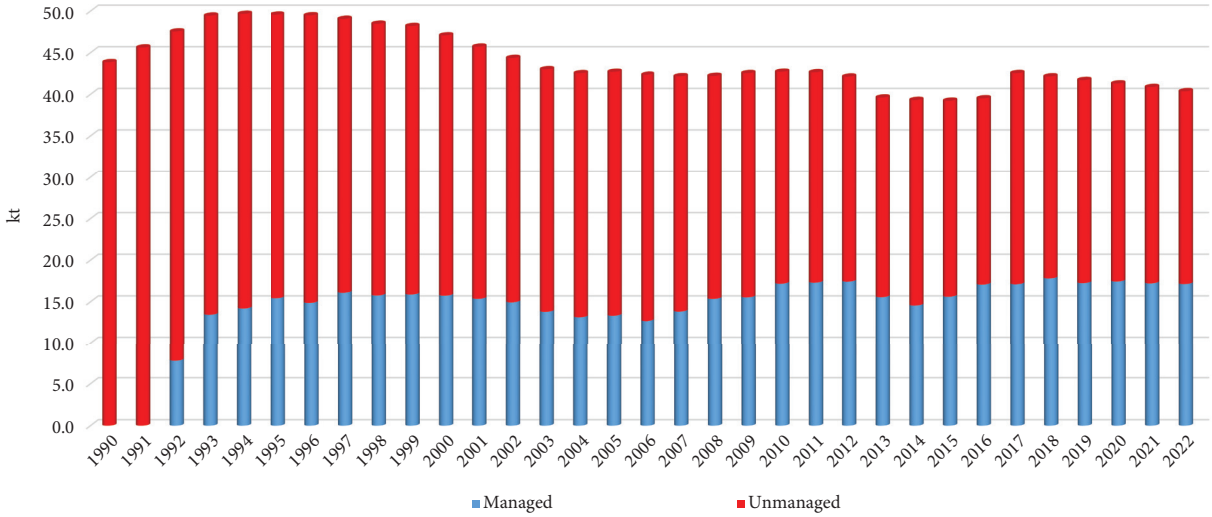


Figure 7-5: CH_4 emissions from source category 5A 'Solid Waste Disposal' between 1990-2022, kt.

7.2.2. Methodologies

In order to estimate methane emissions from solid waste disposal, the 2006 IPCC Guidelines recommends using the First Order Decay Method, with three alternative methodological approaches – Tier 1, 2 and 3; the Tier 1 method mainly uses activity data and default EFs; the Tier 2 method implies the partial application of default emission factors, requiring country-specific activity data on waste disposal at SWDS for historical periods longer than 10 years; the Tier 3 method implies using national statistical data on solid waste disposal for longer time-series (e.g., longer than 25 years), with country-specific emission factors and relevant parameters resulting from measurements and research conducted periodically at national level (e.g., DOC fraction or degradable organic carbon in year x; DOC_f fraction or DOC fraction dissimilated; L_o – methane generation potential, etc.).

Estimation method

In the RoM, methane emissions from 5A 'Solid Waste Disposal' were estimated using the First Order Decay Method (IPCC FOD), with the Tier 3 methodological approach.

Methane emissions were estimated using Equation 3.1 in the 2006 IPCC Guidelines (Volume 5, Chapter. 3, page 3.8):

$$CH_4\ Emissions = [\Sigma_x\ CH_4\ generated_{x,T} - R_T] \bullet (1\text{-}OX_T)$$

Where:

CH_4 Emissions – amount of methane generated in year *T*, kt;

T – inventory year;

x – waste category or type/material;

R_T – recovered methane in year *T*, kt;

OX_T – oxidation factor in year *T* (fraction).

One key input in the IPCC FOD model is the amount of degradable organic matter (DOCm) in waste disposed into SWDS (Solid Waste Disposal Sites). This value is estimated using data on disposal of different waste categories (municipal solid waste [MSW], sludge, industrial and other waste) and the different waste types/material (food, paper, wood, textiles, etc.) included in these categories, or alternatively as mean DOC in bulk waste disposed.

The basis for the estimation of methane emissions is the amount of Decomposable Degradable Organic Carbon – DDOCm). DDOCm is the part of the organic carbon that will degrade under anaerobic conditions in SWDS.

The amount of DDOCm (where the index m is used for mass) is calculated using Equation 3.2 provided by the 2006 IPCC Guidelines (Volume 5, Chapter 3, page 3.9):

$$DDOCm = W \bullet DOC \bullet DOCf \bullet MCF$$

Where:

DDOCm – mass of decomposable DOC deposited at SWDS, kt;

W – mass of waste deposited, kt;

DOC – degradable organic carbon in the year of deposition, fraction, kt C/kt waste;

DOCf – fraction of DOC that can decompose (fraction);

MCF – CH_4 correction factor for aerobic decomposition in the year of deposition (fraction).

Using DDOCm, the methane generation potential (L_o) can be estimated by applying Equation 3.3 provided by the 2006 IPCC Guidelines (Volume 5, Chapter 3, Page 3.9):

$$L_o = DDOCm \bullet F \bullet 12/16$$

Where:

Lo – CH_4 generation potential, kt CH_4;

DDOCm – mass of decomposable DOC deposited at SWDS, kt;

F – fraction of CH_4 in generated landfill gas (volume fraction);

16/12 – molecular weight ratio CH_4/C (ratio), used for the conversion of C to CH_4.

DDOCm accumulated in SWDS at the end of year T is estimated using Equation 3.4 provided by the 2006 IPCC Guidelines (Vol. 5, Chapter. 3, Page 3.9), while DDOCm decomposed at the end of inventory year, by using Equation 3.5 respectively, provided by the 2006 IPCC Guidelines (Volume 5, Chapter 3, Page 3.9).

$$DDOCma_T = DDOCmd_T + (DDOCma_{T-1} \bullet e^{-k})$$

$$DDOCm\ decomp_T = DDOCma_{T-1} \bullet (1 - e^{-k})$$

Where:

T – inventory year;

$DDOCma_T$ – DDOCm accumulated in the SWDS at the end of year T, kt;

$DDOCma_{T-1}$ – DDOCm accumulated in the SWDS at the end of year T-1, kt;

$DDOCmd_T$ – DDOCm deposited into the SWDS in year T, kt;

DDOCm decomp $_T$ – DDOCm decomposed in the SWDS in year T, kt;

k – constant, $k = \ln(2)/t_{1/2}$ (y^{-1});

$t_{1/2}$ – half-life time (y).

The amount of methane formed from decomposable material can be found by using Equation 3.6 provided by the 2006 IPCC Guidelines (Volume 5, Chapter 3, Page 3.10):

$$CH_4\ generated_T = DDOCm\ decomp_T \bullet F \bullet 16/12$$

Where:

CH_4 generated in year $_T$ – amount of CH_4 generated from decomposable material;

DDOCm decomp $_T$ – DDOCm decomposed in year T, kt;

F – fraction of CH_4, by volume, in generated landfill gas (fraction);

16/12 – molecular weight ratio CH_4/C, used for the conversion of C to CH_4.

Emission Factors

Degradable organic carbon (DOC) is the organic carbon in waste that is accessible to biochemical decomposition and can be calculated using Equation 3.7 provided by the 2006 IPCC Guidelines (Volume 5, Chapter 3, page 3.13):

$$DOC = \Sigma_i (DOC_i \bullet W_i)$$

Where:

DOC – fraction of degradable organic carbon in bulk waste, kt C/kt solid waste;

DOC_i – fraction of degradable organic carbon in waste type *i* (e.g., the default value for paper is 0.4 (wet weight basis);

W_i – fraction of waste type *i* by waste category (e.g., the default value for paper in MSW in Eastern Europe is 0.218 (wet weight basis).

The default DOC values for these fractions for MSW are available in Table 2.4 in the 2006 IPCC Guidelines (Volume 5, Chapter 2, Page 2.14), whereas for industrial waste by industry in Table 2.5 in the 2006 IPCC Guidelines (Volume 5, Chapter 2, Page 2.16). A similar approach can be used to estimate the DOC content in total waste disposed in the country annually. In the IPCC FOD model, the estimation of the DOC in MSW is needed only for the bulk waste option and constitutes the average DOC for the MSW disposed in the SWDS, including inert materials.

The inert part of the waste (glass, plastics, metals and other non-degradable waste (default values are available in Table 2.3 in the 2006 IPCC Guidelines (Vol. 5, Chapter. 2, Pages 2.12-2.13) is relevant when estimating the total amount of DOC in MSW. It is thereby good practice in this exercise to consider country-specific values of the share of inert waste in MSW to the detriment of default values, which probably do not entirely consider the country's national circumstances.

Country-specific values can be obtained by performing waste generation studies focused on identifying solid waste generation rates combined with the analysis of the degradable carbon content in municipal solid waste generated.

Methane Correction Factor (MCF)

The MCF refers to the effect of solid waste management practices on the generation of CH_4 emissions. Unmanaged SWDS produce less CH_4 from a given amount of waste than anaerobic managed SWDS since a larger fraction of waste decomposes aerobically in the top layer in the respective disposal sites. Table 7-9 presents the default values of the MCF for different types of SWDS.

Table 7-9: MCF values used to estimate CH_4 emissions from Solid Waste Disposal Sites

Type of site	MCF	MCF used in the Republic of Moldova
Managed – anaerobic[1]	1.0	Chisinau municipality, for the period 1991-2022
Managed – semi-aerobic[2]	0.5	NA
Unmanaged – deep (> 5 m)[3]	0.8	Chisinau municipality, until 1990. Balti Municipality and district towns
Unmanaged – shallow (< 5 m)[4]	0.4	Rural Areas in the Republic of Moldova
Uncategorised SWDS[5]	0.6	NA

Notes: [1] Anaerobic managed solid waste disposal sites include the following: cover material, mechanical compacting or levelling of municipal solid waste; [2] semi-aerobic managed solid waste disposal sites include the following: permeable cover material, leachate drainage system, regulating pondage and gas ventilation system; [3] all SWDS do not meet the criteria of managed SWDS and have depths greater than or equal to 5 metres, or when affected by surface water; [4] all solid waste disposal sites do not meeting the criteria of managed SWDS and have depths of less than 5 metres; [5]used if countries cannot categorise their SWDS into above four categories of managed and unmanaged SWDS.

Degradable Organic Carbon (DOC)

Degradable organic carbon (*DOC*) is the organic carbon that is accessible to biochemical decomposition. The DOC value is calculated based on the fraction of cardboard waste, textiles, garden waste, park waste and other degradable non-food waste, food and wood waste.

Based on waste morphological composition of municipal solid waste, DOC values for the period 1986-2016 were calculated. Figure 7-5 illustrates the share of biodegradable waste in the MSW stream in the RM, indicating a decrease from circa 77% in 1986 to circa 54.0% in 2001, with a further increase to circa 72.4% in 2005, and a subsequent decrease to circa 58.9% in 2016.

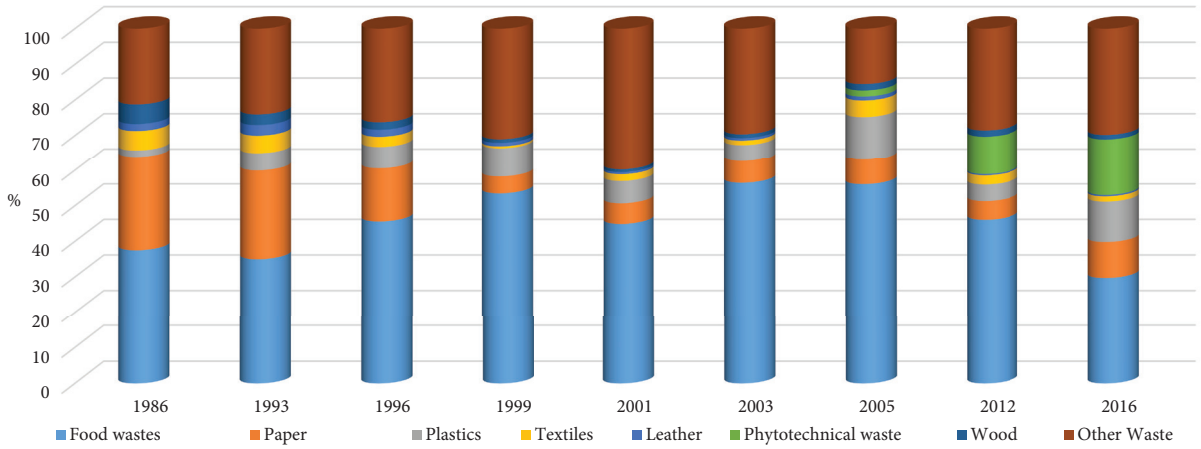


Figure 7-6: Biodegradable waste in the MSW stream in the RoM between 1986-2016.

It should be also mentioned that between May 2023 and March 2024, in collaboration with the Project Management Consulting Group (PMCG) Inc., the Association of Experts 'ProMediu' from the Republic of Moldova was involved in the development of the 'Study on the Morphological Composition of Municipal Solid Waste', which was implemented by the United States Agency for International Development (USAID) funded project 'Moldova Energy Security Activity' (MESA).

The results of the USAID/MESA Study on the Morphological Composition of Municipal Solid Waste[129] will be the basis for determining the perspectives of the Republic of Moldova for the production of energy from waste (Waste-to-Energy or WtE). The study covered two out of eight possible Waste Management Regions (WMRs 4 and 7). The regions are defined in the Waste Management Strategy of the Republic of Moldova for the period 2013-2027: WMR 4 – Chisinau municipality and Straseni, Hancesti, Ialoveni, Criuleni, Anenii Noi and Dubasari districts; and WMR 7 – Balti municipality and Glodeni, Falesti, Sangerei, Floresti, Soroca, Drochia and Rascani districts.



Figure 7-7: Waste sampling and sorting within the morphological analysis of municipal waste.

The analysis of the morphological composition of municipal solid waste was carried out during one year (May 2023 - March 2024), according to the European Commission Methodology for the Analysis of Solid Waste (SWA-Tool), in large urban areas (Chisinau and Balti municipalities), smaller urban areas (Ialoveni, Straseni, Floresti, Rascani towns), as well as in rural areas (Siret and Corlateni villages), the composition of household waste and similar waste and the composition of waste in the commercial sector being analysed (commercial units/markets).

Likewise, within this regular study together with the determination of the moisture content, the elemental analysis of waste will be carried out for the first time by determining the percentage of chemical elements in the fractions of the waste such as (carbon [C], hydrogen [H], nitrogen [N], sulphur [S], oxygen [O]) and the determination of thermal power of the waste fractions in question with the determination of calorific values, volatile matter content and ash.

Waste sampling and sorting was carried out in each of the four seasons of the year to capture seasonal variations in waste consumption and generation. Events such as Easter, Christmas and other holidays, which lead to increased waste generation consumption, were avoided.

[129] <https://mediu.gov.md/ro/node/4872>.

The collection of samples for the elemental analysis of waste was carried out with the support of the representative of the Laboratory within the Environment Agency, and the analysis was carried out in the Waste Analysis Laboratory within the National Institute for Research – Development for Industrial Ecology – ECOIND in Bucharest, Romania.



Figure 7-8: Elemental analysis of waste in the ECOIND Laboratory (Romania).

The results of the analysis show a relative stability of the morphological composition of municipal waste in spring and summer with a tendency to increase the organic fraction in autumn (Figure 7-9), which is explained by the presence of vegetable and fruit remains. Analyses continued in the winter (December 2023 - February 2024) and spring (March 2024) seasons.

After the analyses have been finalised, the morphological composition of the municipal waste was established based on the studies during all four seasons. The new values for degradable organic carbon (DOC) and dissimilable degradable organic carbon (DOC_f) will be used in the estimation of GHG emissions for the next inventory cycle. In the current inventory cycle, the average values for the spring and summer seasons were used (Table 7-10).

Table 7-10: Country-specific values for DOC and DOC_f fractions used in the estimation of CH_4 emissions from SWDS for 1986-2023

	1986	1993	1996	1999	2001	2003	2005	2012	2016	2023
DOC_f	0.5178	0.5258	0.5667	0.6353	0.6207	0.6277	0.5935	0.4985	0.4204	0.4067
DOC	0.2069	0.1891	0.1522	0.1091	0.1009	0.1201	0.1410	0.1405	0.1475	0.1359

Fraction of Dissimilable Degradable Organic Carbon (DOC_f)

DOC_f is the fraction of Degradable Organic Carbon, which is then converted to biogas and reflects the fact that part of the carbon does not degrade or decomposes extremely slowly in SWDS. It is considered that the DOC_f value is dependent of the temperature in the anaerobic area of the site, revealed by the following relation: 0.014T + 0.28 (Tabasaran, 1981). The recommended default value in the 2006 IPCC Guidelines (Volume 5, Chapter 3, page 3.13) is 0.5. In the RoM, the country-specific values for DOC and DOC_f fractions (Table 7-11) were calculated using the 'MSW Learning Tool' developed by the University of Florida (1996) based on the laboratory experiments conducted by Dr Morton Barlaz (1987, 1997) and further investigations by Chandler, Van Soest (1980).

Table 7-11: Country-specific values of biogas composition in the RoM for 1986-2023, based on the extended Buswell equation, %

	1986	1993	1996	1999	2001	2003	2005	2012	2016	2023
C --> CH_4	53.1	54.0	54.5	55.4	55.1	54.5	55.6	54.2	55.2	55.9
C --> CO_2	46.9	46.0	45.5	44.6	44.9	45.5	44.4	45.8	44.8	44.1

Fraction of CH_4 in biogas

The 2006 IPCC Guidelines (Volume 5, Chapter 3, page 3.15) recommends the use of a 0.5 default value for the fraction of CH_4 in generated biogas (*F*). It is known that the *F* value can vary between 0.4 and 0.6, depending on several factors which can influence the process of decomposition of solid household waste, including the morphological composition of MSW (Bingemer, Crutzen, 1987).

In the Republic of Moldova, the biogas composition was estimated based on the Buswell extended equation (Table 7-11 and Figure 7-9), using AD on the MSW morphological composition eliminated by storage, which also served as the basis to estimate *DOC* and DOC_f values.

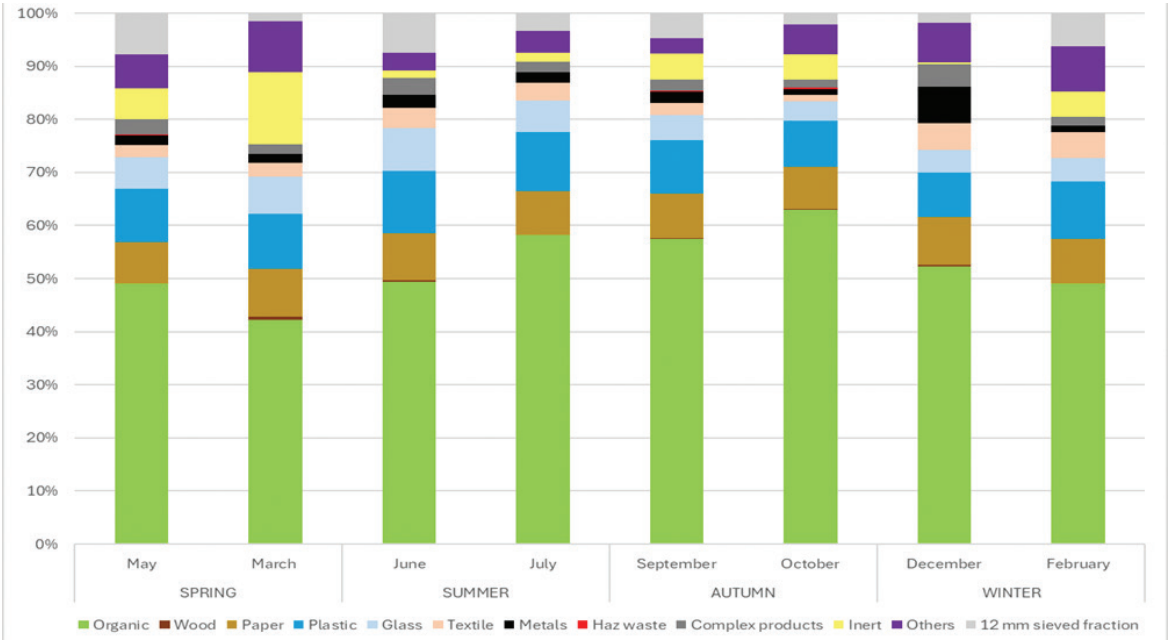


Figure 7-9: Comparison of MSW fractions per weight between the different seasons.

Methane Recovery (R)

CH_4 generated at SWDS can be recovered and combusted (with or without energy recovery). The amount of methane recovered is expressed as *R* in Equation 3.1 in the 2006 IPCC Guidelines (Volume 5, Chapter 3, Page 3.8). The default value for CH_4 recovery is zero. CH_4 recovery should be reported in the inventory only when there are documents confirming this practice in SWDS in the country.

As for Republic of Moldova, AD on methane recovered and combusted at the SWDS in Tintareni (2,519.9 t of biogas in 2013, 2,905.8 t biogas in 2014, 3,166.5 t biogas in 2015 and 3,389.8 t biogas in 2016) were provided by the project document CDM 'PDD Landfill Gas Recovery and Energy Production at the Tintareni Landfill Site, Chisinau, Moldova'. Indirectly, the information can also be deduced from the Annual Reports on the activity of the National Agency for Energy Regulation[130] (which contains activity data on the amount of electricity generated annually from the biogas recovered at the SWDS in Tintareni by 'Tevas Grup' Ltd., which manages the respective site).

Oxidation Factor (OX)

The oxidation factor reflects the amount of methane from SWDS that is oxidised to CO_2 in the soil or to other material covering the waste. If OX is zero, methane oxidation does not occur but should the value of the oxidation factor be 1, methane oxidation represents 100%. Managed SWDS tend to have higher oxidation rates, whereas unmanaged landfills have a lower oxidation factor. The default value used for the oxidation factor is zero, according to the 2006 IPCC Guidelines (Volume 5, Chapter 3, page 3.15) (Table 7-12).

Table 7-12: Oxidation factor

Types of SWDS	Oxidation factor (OX)
Managed[1], unmanaged and uncategorised SWDS	0.0
Unmanaged, covered with CH_4 oxidising material[2]	0.1

Note: [1]Managed but not covered with aerated material; [2]e.g: soil or compost.

Constant k and half-life $t_{1/2}$

The half-life value $t_{1/2}$ is the time taken for the DOC_m in waste to decay to half of its initial mass. The relationship between the constant k and $t_{1/2}$ is the following: $k = \ln(2)/t_{1/2}$. The half-life is affected by a wide variety of factors related with the composition of waste, climatic conditions at the site where the SWDS is located, characteristics of the SWDS, waste disposal practices and others, etc. The most rapid rate is for $k = 0.2$ or $t_{1/2} = 3$ years – associated with food waste in high moisture conditions, respectively the slowest decay rate is for $k = 0.02$ or $t_{1/2} = 35$ years for wood or paper waste and dry climate. There

[130] <http://anre.md/ro/reports/8>.

are two alternative approaches for the estimation of the half-life: calculation of the weighted average for $t_{1/2}$ for mixed MSW or division of the waste flow into categories of waste according to their degradation speed. The default values used for the constant *k* as well as the half-life value $t_{1/2}$ are available in Tables 3.3 and 3.4 in the 2006 IPCC Guidelines (Volume 5, Chapter 3, Pages 3.17 and 3.18).

Activity data on waste generation, composition and management serve as the starting point for the estimation of GHG emissions from the waste sector. In the previous inventory cycle, multiple statistical sources on solid waste management records were examined, such as, Statistical Forms: F-1 'Toxic Waste' and F-2 'Waste' and Statistical Form 'Special Road Transport'; and since 2003, also Statistical Form No. 2-gc 'Urban Settlement Sanitation' approved by the Order of the Department of Statistics and Sociology, No. 83, dated 01.08.2003, which reflects the amount of MSW disposed.

The performed analyses revealed that only municipal solid waste is being transported to dumps by means of waste collection services, whereas other organic types of waste such as waste from the food processing industry, from animal breeding and phytotechnical waste disposed are not included in Statistical Form Nr. 2-gc 'Urban Settlements Sanitation', because they are disposed of by the beneficiary's own transport.

Under these circumstances, data on the amount of waste from the food processing industry, from animal breeding and phytotechnical waste disposed were collected through Statistical Form F-2 'Waste'.

The report refers only to the urban landfills where waste collection services operate and provides activity data to the NBS. Historical AD for the period 1959-1984 were inferred based on the population number, the socio-economic development conditions as well as waste generation trends. At the same time, the average value of the MCF was estimated considering SWDS characteristics, such as managed or unmanaged SWDS and the depth of the disposed waste layer.

In the current inventory cycle, the same approach was taken in the collection of activity data, for household waste the information on the evacuation of solid household waste reported through statistical form no. 2-gc 'Urban Settlement Sanitation' was used.

At the same time, the activity data reported in the Automated Information System 'National Register of emissions and pollutants' and in the automated information system 'Waste Management' by sanitation services in the country were analysed. The reported information covers both the amount of waste collected and stored on sites and data on the management of the sites.

Table 7-13: Population number in the RoM between 1990-2022, thousand people

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Urban population	2069.3	2073.6	2052.2	2039.2	2036.6	2033.0	2004.1	1995.3	2001.6	1990.7	1983.4
Rural population	2292.3	2292.7	2306.9	2308.6	2316.1	2314.9	2330.3	2324.7	2324.2	2324.3	2320.1
Share of urban population, %	47.4	47.5	47.1	46.9	46.8	46.8	46.2	46.2	46.3	46.1	46.1
Share of rural population, %	52.6	52.5	52.9	53.1	53.2	53.2	53.8	53.8	53.7	53.9	53.9
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Urban population	1948.8	1940.1	1932.5	1919.2	1833.3	1792.2	1751.4	1711.0	1671.8	1636.6	1598.5
Rural population	2337.5	2329.6	2318.8	2311.5	2254.2	2214.6	2174.7	2134.3	2093.8	2050.2	2009.9
Share of urban population, %	45.5	45.4	45.5	45.4	44.9	44.7	44.6	44.5	44.4	44.4	44.3
Share of rural population, %	54.5	54.6	54.5	54.6	55.1	55.3	55.4	55.5	55.6	55.6	55.7
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Urban population	1560.6	1523.4	1486.3	1476.4	1454.7	1441.3	1429.6	1421.1	1420.3	1426.6	1429.8
Rural population	1969.6	1929.0	1888.1	1870.7	1845.4	1810.1	1769.0	1728.7	1688.6	1665.8	1637.6
Share of urban population, %	44.2	44.1	44.0	44.1	44.1	44.3	44.7	45.1	45.7	46.1	46.6
Share of rural population, %	55.8	55.9	56.0	55.9	55.9	55.7	55.3	54.9	54.3	53.9	53.4

Table 7-14 reflects only sites in urban localities where the sanitation services operate, which report information on their activity to the NBS. Historical activity data for the period 1959-1984 was inferred based on population numbers, socio-economic development conditions and waste generation trends. At the same time, the average value of the methane correction factor was also inferred, based on the characteristics of managed solid waste landfills, especially the mode of operation (managed or unmanaged and the depth of waste layer stored.

Towards the end of 1990, the municipal solid waste site in Cretoaia commune was put into operation, which served Chisinau municipality (de facto operation of the site began in 1991), and the estimation of GHG emissions generated by this landfill began in 1992, with MCF = 1 being used. This activity data was used in the development of the NC5 of the RoM to the UNFCCC (2023) and were updated in the current inventory cycle.

Table 7-14: AD on the amount of MSW and industrial waste disposed at SWDS in the Republic of Moldova between 1959-2022

	Total	MSW			D_{ind}, kt	SWDS			MCF average
	DMS + D_{ind}, kt	Total, kt	Inert material, kt	Without inert material, kt		managed, MCF=1.0	unmanaged, >5 m, MCF=0.8	unmanaged, <5 m, MCF=0.4	
1959	595.26	357.16	103.56	253.60	238.11	0.0	10.0	90.0	0.4400
1960	626.59	375.96	109.01	266.95	250.64	0.0	10.0	90.0	0.4400
1961	659.57	395.74	114.75	280.99	263.83	0.0	15.0	85.0	0.4600
1962	694.29	416.57	120.79	295.79	277.71	0.0	15.0	85.0	0.4600
1963	730.83	438.50	127.17	311.33	292.33	0.0	15.0	85.0	0.4600
1964	769.29	461.58	133.84	327.74	307.72	0.0	15.0	85.0	0.4600
1965	809.78	485.87	140.88	344.99	323.91	0.0	15.0	85.0	0.4600
1966	852.40	511.44	148.31	363.13	340.96	0.0	20.0	80.0	0.4800
1967	897.26	538.36	156.11	382.25	358.91	0.0	20.0	80.0	0.4800
1968	944.49	566.69	164.31	402.38	377.80	0.0	20.0	80.0	0.4800
1969	994.20	596.52	172.90	423.62	397.68	0.0	20.0	80.0	0.4800
1970	1046.53	627.92	182.09	445.82	418.61	0.0	20.0	80.0	0.4800
1971	1162.81	697.68	202.30	495.38	465.12	0.0	25.0	75.0	0.5000
1972	1224.01	734.40	212.98	521.43	489.60	0.0	25.0	75.0	0.5000
1973	1288.43	773.06	224.19	548.87	515.37	0.0	25.0	75.0	0.5000
1974	1356.24	813.74	235.97	577.77	542.50	0.0	25.0	75.0	0.5000
1975	1427.62	856.57	248.44	608.13	571.05	0.0	25.0	75.0	0.5000
1976	1502.76	901.66	261.46	640.19	601.10	0.0	30.0	70.0	0.5200
1977	1581.85	949.11	275.24	673.87	632.74	0.0	30.0	70.0	0.5200
1978	1665.11	999.06	289.73	709.34	666.04	0.0	30.0	70.0	0.5200
1979	1752.74	1051.65	306.12	745.52	701.10	0.0	30.0	70.0	0.5200
1980	1844.99	1014.75	294.26	720.48	830.25	0.0	35.0	65.0	0.5400
1981	1892.30	1040.77	301.80	738.96	851.54	0.0	35.0	65.0	0.5400
1982	1940.82	1067.45	309.55	757.91	873.37	0.0	35.0	65.0	0.5400
1983	1990.59	1094.82	317.49	777.33	895.76	0.0	35.0	65.0	0.5400
1984	2041.63	1122.89	325.64	797.25	918.73	0.0	35.0	65.0	0.5400
1985	2093.98	1163.32	337.36	825.96	930.66	0.0	40.0	60.0	0.5600
1986	2236.52	1242.51	360.33	882.18	994.01	0.0	40.0	60.0	0.5600
1987	2217.94	1232.19	357.34	874.85	985.75	0.0	40.0	60.0	0.5600
1988	2307.89	1282.16	371.83	910.33	1025.73	0.0	45.0	55.0	0.5800
1989	2414.81	1341.56	389.04	952.53	1073.25	0.0	45.0	55.0	0.5800
1990	2311.52	1359.72	394.31	965.41	951.80	0.0	45.0	55.0	0.5800
1991	2204.61	1377.88	399.56	978.32	826.73	0.0	45.0	55.0	0.5800
1992	2156.28	1437.52	416.88	1020.65	718.76	16.3	30.0	53.7	0.6179
1993	1279.31	719.41	208.63	510.78	559.90	27.2	30.0	42.8	0.6831
1994	1161.65	670.52	194.45	476.07	491.14	28.6	30.0	41.4	0.6915
1995	1070.97	632.19	183.34	448.85	438.78	31.1	30.0	38.9	0.7067
1996	1074.35	651.73	208.42	443.31	422.62	30.0	30.0	40.0	0.7003
1997	1003.87	613.00	196.16	416.84	390.87	32.8	30.0	37.2	0.7167
1998	1003.69	618.92	198.05	420.87	384.77	32.5	30.0	37.5	0.7151
1999	947.81	580.75	220.67	360.08	367.06	32.9	30.0	37.1	0.7176
2000	878.76	523.80	199.04	324.76	354.96	33.4	30.0	36.6	0.7205
2001	823.19	475.49	213.98	261.52	347.69	33.6	30.0	36.4	0.7215
2002	880.35	522.07	235.22	286.85	358.28	33.7	30.0	36.3	0.7220
2003	930.06	548.08	186.35	361.73	381.98	32.1	30.0	37.9	0.7125
2004	993.40	575.44	195.64	379.80	417.96	30.9	30.0	39.1	0.7052
2005	1005.57	601.55	162.68	438.88	405.60	31.2	30.0	38.8	0.7073
2006	1092.07	651.56	176.47	475.09	443.90	29.9	35.0	35.1	0.7196
2007	1251.13	755.16	228.77	526.39	502.68	32.8	35.0	32.2	0.7367
2008	1424.89	891.64	270.92	620.72	543.91	36.4	35.0	28.6	0.7581

	Total	MSW			D_{ind}, kt	SWDS			MCF average
	DMS + D_{ind}, kt	Total, kt	Inert material, kt	Without inert material, kt		managed, MCF=1.0	unmanaged, >5 m, MCF=0.8	unmanaged, <5 m, MCF=0.4	
2009	1408.88	929.27	300.86	628.41	493.43	36.5	35.0	28.5	0.7590
2010	1290.04	977.44	290.27	687.17	329.87	40.2	35.0	24.8	0.7813
2011	1309.05	1034.71	294.73	739.97	333.45	40.6	35.0	24.4	0.7833
2012	1332.62	1017.10	346.55	670.55	339.73	41.4	35.0	23.6	0.7881
2013	1437.97	1100.98	376.40	724.57	366.78	39.3	35.0	25.7	0.7756
2014	1546.59	1198.33	393.73	804.60	382.96	37.0	35.0	28.0	0.7620
2015	1547.88	1200.57	393.92	806.65	383.82	39.8	35.0	25.2	0.7788
2016	1434.22	1192.09	517.87	674.22	278.58	43.2	35.0	21.8	0.7991
2017	1362.40	1152.97	472.72	680.25	269.53	40.2	35.0	24.8	0.7812
2018	1311.67	1117.19	458.05	659.14	263.68	42.2	35.0	22.8	0.7935
2019	1318.55	1144.40	469.20	675.20	270.20	41.3	35.0	23.7	0.7881
2020	1328.12	1248.66	511.95	736.71	188.21	42.2	35.0	22.8	0.7932
2021	1254.82	1183.50	485.24	698.27	184.42	42.1	35.0	22.9	0.7927
2022	1302.33	1230.60	504.55	726.06	190.03	42.4	35.0	22.6	0.7946

7.2.3. Uncertainties and Time-Series Consistency

For countries with efficient statistical systems, the 2006 IPCC Guidelines recommends the use of a value of circa 10-30% of uncertainties associated with AD, whereas for countries with poor quality data, uncertainties can be of a factor of two.

In the Republic of Moldova, it was deemed rational to use the value of ±30% for uncertainties associated with managed and unmanaged MSW. It was taken into consideration that some types of waste (e.g., waste from the food processing industry, which account for approximately 10% of the total amount of MSW generated in the country) were not completely taken into account while estimating methane emissions from source category 5A. Considering the results of studies undertaken in the RoM to identify MSW morphological composition, (*DOC and* DOC_f fraction), and the study of biogas composition (CH_4 fraction in biogas), it was deemed appropriate to use the value of ±40% for uncertainties associated with emission factors for source category 5A. Therefore, combined uncertainties for category 5A 'Solid Waste Disposal' constitute circa 50% (Annex 2).

In view of ensuring time series consistency of results, the same approach was used for the entire period under review, in conformity with good practices applied in the GHG emissions inventory.

7.2.4. Description of applied flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

7.2.5. Quality Assurance and Quality Control

Standard verification and quality control forms and checklists were filled in for the category 5A 'Solid Waste Disposal' following the Tier 1 methodological approach.

Verification was focused on various aspects such as: ensuring correct use of the default emission factors available in the 2006 IPCC Guidelines; use of country-specific factors; correct use of AD obtained from different reference sources, etc.

It should be noted that the AD and methods used for the estimation of GHG emissions from the category 5A 'Solid Waste Disposal' were documented and archived both in hard copies and electronically.

7.2.6. Recalculations

In the current inventory cycle, recalculations of CH_4 emissions from category 5A 'Solid Waste Disposal' were carried out for the entire period under review (1990-2020), as result of revising the following parameters: the conversion coefficient of the volume of MSW into mass units; DOC; DOC_f; CH_4 fraction in the gas generated at solid waste landfills; and due to the use of the GWP_{100} value for CH_4 available in the IPCC AR5 (2014) (GWP_{100} – 28), instead of the GWP_{100} value available in the IPCC AR 4 (2007) (GWP_{100} – 25).

Transformation coefficient of the volume of MSW into quantity

In the recent years, there have been tendencies to increase the share of packaging in the total amount of waste generated per capita, and the Chisinau Sanitation Service indicates that 1 m^3 of MSW constitutes 180-250 kg, which caused the revision of the 0.4 t/1 m^3 of MSW. Recently, the activity data reported in the Automated Information System 'National Register of emissions and pollutants' and in the automated information system 'Waste Management', by the sanitation services in the country, it was found that most services used values between 0.20-0.35 t/m^3 as the conversion coefficient of the volume of MSW to quantity. At the same time, from the information presented by the Chisinau Sanitation Service regarding the amounts of waste handed over for sorting at the 'ABS' plant and the amounts of waste disposed of at the Tintareni site, the share of recyclable waste is approximately 15%. Thus, the utilised trucks show a reduced degree of compaction from 0.11-0.16 t/m^3 (ZIL, MAZ – 12-14 m^3) to 0.27-0.35 t/m^3 (Mercedes, MAZ – 16-18 m^3). Based on this data, the MSW volume conversion factor was revised (Table 7-15).

Table 7-15: Transformation coefficient of the volume of MSW into quantity

Years	Coefficient value for MSW, t/m^3
1990-2006	0.40
2007-2016	0.35
2017-2022	0.30

Compared to the results recorded in the previous inventory cycle included in the NC5 of the RoM to the UNFCCC (2023), the changes made resulted in a downward trend in CH_4 emissions from category 5A 'Solid Waste Disposal' in the years 1990-2020, varying from a minimum decrease of 0.6% in 1992, up to a maximum decrease of 17.1% in 2020 (Table 7-16).

Table 7-16: Recalculations of CH_4 emissions from category 5A 'Solid Waste Disposal' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	1,238.716	1,293.596	13,39.055	1,407.333	1,410.195	1,406.801	1,413.250	1,396.251	1,377.729	1,382.812	1,351.881
BTR1	1,228.090	1,277.496	1,331.634	1,384.627	1,390.844	1,388.067	1,385.671	1,373.836	1,357.441	1,349.679	1,318.269
Difference, %	-0.9	-1.2	-0.6	-1.6	-1.4	-1.3	-2.0	-1.6	-1.5	-2.4	-2.5
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	1,313.675	1,278.795	1,234.208	1,215.583	1,224.844	1,220.483	1,222.297	1,242.549	1,275.725	1,299.951	1,318.003
BTR1	1,280.399	1,242.337	1,204.292	1,191.181	1,195.788	1,185.988	1,180.681	1,182.011	1,191.415	1,196.045	1,194.275
Difference, %	-2.5	-2.9	-2.4	-2.0	-2.4	-2.8	-3.4	-4.9	-6.6	-8.0	-9.4
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	1,303.396	1,236.387	1,233.449	1,237.037	1,267.796	1,367.416	1,380.373	1,387.915	1,395.724		
BTR1	1,179.544	1,109.399	1,101.075	1,098.548	1,106.594	1,191.542	1,180.172	1,168.095	1,156.705	1,144.560	1,132.155
Difference, %	-9.5	-10.3	-10.7	-11.2	-12.7	-12.9	-14.5	-15.8	-17.1		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

7.2.7. Planned Improvements

In the RoM, statistical information currently does not fully reflect the real situation in the field of municipal solid waste management. For example, the volumes of MSW generated in rural localities are not subject to statistical records, as there are usually no sanitation services. Also, albeit there are waste processing enterprises operating in the RoM, the information on the volumes of recycled waste is not subject to a strict statistical record. Considering the tendency of the RoM to align with EU standards, the sector is to be fundamentally restructured. In this context, most of the MSW sites are to be recultivated, and their number – drastically reduced.

Morphological Composition of MSW

During the period May 2023 - March 2024, the USAID/MESA Study[131] on the morphological composition of solid household waste took place. The analysis included four seasonal campaigns – the spring campaign: May 2023 and March 2024; summer campaign: June-August 2023; autumn campaign: September-October 2023; winter campaign: December 2023-February 2024. At the same time, waste samples were taken with the involvement of the Environment Agency's Environmental Laboratory,

[131] <https://mediu.gov.md/ro/node/4872>.

to be analysed at the National Research Institute – Development for Industrial Ecology, Bucharest, Romania.

Chemical analyses covered the following:

- proximate analysis, determination of moisture content, volatile matter and ash content of waste fractions;
- elemental analysis, concerned with determining the percentage of chemical elements in the waste fractions (carbon [C], hydrogen [H], nitrogen [N], sulphur [S] and oxygen [O]);
- determination of the calorific value of waste fractions.

The Study provided information on waste composition for different components including food waste, leaves and other garden waste, paper, cardboard, plastic film, plastic bottles, hard plastic, packaging, textiles, leather, glass, ferrous metals, aluminium, construction debris, hazardous waste, other fuels and other non-combustible/inert waste, etc.

The sampling and sorting procedures were carried out in accordance with the European Commission Methodology for Solid Waste Analysis (SWA-Tool) and waste characterization standards approved in the Republic of Moldova (which are also those applied in the EU MS). The obtained results will be considered in the next GHG emission inventory cycle.

Another important aspect that needs to be mentioned is the signing of financing contracts between the RoM and the European Investment Bank (EIB) and the European Bank for Reconstruction and Development (EBRD) regarding the implementation of the 'Solid Wastes in Moldova' project.

Through these agreements, a loan of 200 million euros will be granted to improve solid waste management services in the country. The loan will be offered in several instalments, the first instalment being 25 million euros.

The Agreement aims to implement the Waste Management Strategy of the Republic of Moldova for 2013-2027 periods, involving projects aimed at the modernization and development of solid waste management systems and facilities in eight regions of our country. The projects will provide localities with new collection systems, mechanical-biological waste treatment facilities and new sanitary regional sites for the whole country.

The projects will aim to reduce the negative impact on the environment and people's health, by modernizing waste collection systems and separate collection of recyclable materials and biological waste, as well as rehabilitating landfills or closing them. The regional waste sites will be equipped with biogas recovery systems, which will contribute to the reduction of GHG emissions and therefore to the achievement of the determined national contribution, according to the provisions of the Paris Agreement.

In order to estimate the emissions in category 5A 'Solid Waste Disposal', activity data on waste disposal and its categorization into more detailed disposal classes are to be improved.

7.3. Source Category 5B 'Biological Treatment of Solid Waste'

7.3.1. Source Category Description

Composting and anaerobic digestion of organic waste, such as food waste, garden and park waste, and sludge are common practices in both developed and developing countries. The advantages of biological treatment include low waste, stabilization of waste, destruction of pathogens in the residual material and biogas production for energy consumption. The final products of the biological treatment, depending on its quality, can be used as fertilizer and to improve soil quality or can be disposed in SWDS.

Anaerobic treatment is usually associated with the recovery of CH_4 and its combustion for energy, and thereby greenhouse gas emissions from this process should be reported under Sector 1 'Energy'.

Anaerobic treatment of sludge at wastewater treatment plants is addressed in Chapter 5D 'Wastewater Treatment and Discharge'. However, when sludge from wastewater treatment is transferred into an anaerobic plant that co-digests sludge with MSW or other waste, any related CH_4 and N_2O emissions should be reported within category 5B 'Biological Treatment of Solid Waste'. Should these gases be used to generate energy, the associated emissions should be reported under Sector 1 'Energy'.

Composting is an aerobic process and much of the degradable organic carbon (DOC) in the waste material is converted to CO_2. Methane is formed in the anaerobic sections of the compost but is largely oxidized in the aerobic sections of the compost, so less than 1% of the initial carbon content of the composted material is emitted into the atmosphere.

Anaerobic digestion of organic waste accelerates the natural decomposition of oxygen-free organic material by keeping the temperature, moisture content and pH close to their optimum values. The generated CH_4 can be used for the production of heat and/or electricity, which is why emissions are usually reported under Sector 1 'Energy'. CO_2 emissions are of biogenic origin and are reported only in Sector 1 'Energy'. CH_4 emissions from such installations are between 0 and 10% of the amount of CH_4 generated, being motivated by accidental leaks during process disturbances or other unexpected events. In the absence of additional information, the default value of 5% is recommended for CH_4 emissions. Should technical standards for biogas plants ensure the avoidance of CH_4 emissions, they are considered to be close to zero. N_2O emissions from the process are assumed to be negligible, but data on these emissions are extremely rare.

Mechanical-biological treatment (MBT) of waste is becoming more and more often practised in Europe, being expected in the RoM as well. In MBT, waste undergoes a series of mechanical and biological operations, which aim to reduce the volume of waste and stabilize it to reduce emissions from final disposal. Mechanical operations separate the residual material into fractions that will be subject to additional treatment (composting, anaerobic decomposition, combustion, recycling). These may include separating and crushing the material. Biological operations include composting and anaerobic decomposition. Composting can take place in piles or in composting facilities for optimized conditions, as well as filtration of gas produced, which allows the quantitative reduction of the organic fraction to be disposed in landfills (which is 40-60%). Due to the small amount of material subject to biological treatment, including its organic content and biological activity, waste subject to mechanical-biological treatment will produce up to 95% less CH_4 than untreated waste when disposed in SWDS. CH_4 and N_2O emissions in the different phases of MBT depend on the specific operations and the duration of the process.

In general, biological treatment of waste affects the amount and composition of waste that will be disposed in SWDS. Waste flow analyses are recommended methodologies for estimating the impact of biological treatment on emissions from SWDS.

7.3.2. Methodologies

The assessment of CH_4 and N_2O emissions from source category 5B 'Biological Treatment of Solid Waste' can be done using the First Order Decay Model (IPCC FOD).

Methane emissions were estimated using Equation 4.1 available in the 2006 IPCC Guidelines (Volume 5, Chapter 4, page 4.5):

$$CH_4\ Emissions = \sum(M_i \bullet EF_i) \bullet 10^{-3} - R$$

Where:

CH_4 Emissions – total CH_4 Emissions in inventory year, kt CH_4;

M_i – mass of organic waste treated by biological treatment type *i*, kt;

EF – emission factor for treatment *i*, g CH_4/kg waste treated;

i – composting or anaerobic digestion;

R – total amount of CH_4 recovered in inventory year, kt CH_4.

When CH_4 emissions from anaerobic digestion are reported, the amount of recovered gas should be subtracted from the amount CH_4 generated. The recovered gas can be combusted in a flare or to produce

energy. The amount of CH_4 which is recovered is expressed as *R* in Equation 4.1. Should the recovered gas be used for energy, the resulting greenhouse gas emissions from the combustion of gas should also be reported under the Energy Sector. Emissions from combustion of the recovered gas are insignificant, however, as CO_2 emissions are of biogenic origin, and CH_4 and N_2O emissions are very small so good practice in the Waste Sector does not require their estimation. N_2O emissions from source category 5B 'Biological Treatment of Solid Waste' are estimated using the First Order Decay Model (IPCC FOD), according to equation 4.2 in the 2006 IPCC Guidelines (Volume 5, Chapter 4, page 4.5):

$$N_2O\ Emissions = \Sigma(M_i \bullet EF_i) \bullet 10^{-3}$$

Where:

N_2O Emissions – total N_2O emissions in inventory year, kt N_2O

M_i – mass of organic waste treated by biological treatment type *i*, kt;

EF – emission factor for treatment *i*, g N_2O/kg waste treated;

i – composting or anaerobic digestion.

In the current inventory cycle, the Tier 1 methodology was used with IPCC default emission factors.

Emission Factors

Emissions from composting and anaerobic digestion in biogas plants will depend on factors such as the type of composting of waste, the amount and type of support material (such as wood chips and peat), temperature, moisture content and aeration during the process.

Table 7-17: CH_4 and N_2O default emission factors from biological treatment of waste

Type of Biological Treatment	CH_4 Emission Factor (g CH_4/kg waste treated)		N_2O Emission Factor (g N_2O/kg waste treated)		Comments
	dry fraction	wet fraction	dry fraction	wet fraction	
Composting	10 (0.08-20)	4 (0.03-8)	0.6 (0.2-1.6)	0.24 (0.06-0.6)	Assumptions on the waste treated: 25-50% DOC in dry matter, 2% N in dry matter, moisture content 60%. The emission factors for dry waste are estimated from those for wet waste assuming a moisture content of 60% in wet waste.
Anaerobic digestion at biogas facilities	2 (0-20)	0.8 (0-8)	Assumed negligible		

Table 7-18: Direct GHG emissions from source category 5B 'Biological Treatment of Solid Waste' between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Direct GHG emissions, kt CO_2 eq.	2.3877	2.4196	2.5243	1.2633	1.1774	1.1101	1.1444	1.0764	1.0868	1.0198	0.9198
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Direct GHG emissions, kt CO_2 eq.	0.8350	0.9167	0.9624	1.0105	1.0563	1.1441	1.3261	1.5657	1.6318	1.7164	1.8169
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Direct GHG emissions, kt CO_2 eq.	1.7860	1.9333	2.1043	2.1082	2.0933	2.0246	1.9618	2.0096	2.1926	2.0782	2.1609

CO Emissions

The calculation of CO emissions from biological waste treatment was carried out according to the methodological approach available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019):

$$CO\ Emissions = W \bullet EF \bullet 10^{-6}$$

Where:

CO Emissions – CO emissions in inventory year, kt/year;

W – amount of solid waste composted, kt/year;

EF – emission factor, kg CO/kt waste (the default value used, 0.56 kg CO/tonne solid waste, is available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), Source Category 5.B1; 'Biological Treatment of Solid Waste – composting', Table 3-2, page 6);

10^{-6} – conversion factor, from kg to kt.

Activity Data

Between 2000 and 2016, Chisinau City Hall managed the land of the 'Purcel' quarry ('Macon' JSC mining perimeter for clay extraction) to store leaves, branches, construction material waste, sand and garbage accumulated as a result of city sanitation. Upon request for activity data, the project team was informed about the lack of such data. Since 2022-2023, a new plot was allocated for the storage of foliage, branches, construction material waste in the vicinity of 'Pruncul' quarry. Chisinau City Hall initiated the Environmental Impact Assessment procedure to obtain the authorization for waste management.

In the absence of activity data for the test model, it was inferred that the amount of waste subject to composting constitutes 1% for the period 1990-2022 depending on the total amount of municipal waste stored (Table 7-19).

Table 7-19: AD used to estimate direct and indirect GHG emissions from source category 5B 'Biological Treatment of Solid Waste'

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Amount of waste composted, kt	13.60	13.78	14.38	7.19	6.71	6.32	6.52	6.13	6.19	5.81	5.24
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Amount of waste composted, kt	4.75	5.22	5.48	5.75	6.02	6.52	7.55	8.92	9.29	9.77	10.35
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Amount of waste composted, kt	10.17	11.01	11.98	12.01	11.92	11.53	11.17	11.44	12.49	11.84	12.31

The energy potential of biodegradable waste produced annually in the agricultural and industrial sectors could play a key role in solving the energy problem, and the use of this waste as fuel contributes to reducing GHG emissions.

Thus, with the support of the Program 'Addressing the impact of the energy crisis in the Republic of Moldova', financed by the EU and implemented by UNDP Moldova, a study of the solid biofuel market was carried out, and the findings are as follows: the volume of solid biofuel production varied between 30.6 kt in 2020 and 21.7 kt in year 2021, the average for the analysed period being 25.5 kt. Together with the average annual imports of 4.3 kt of briquettes and pellets, we have a market of almost 30 kt annually. Regarding biofuel consumption, according to NBS data, the annual average of the last three years is 25.3 kt. This consumption is ensured by 265 public institutions, which have thermal power plants which combust solid biofuels, with a total capacity of 57 MW, and 1,159 households that have power plants which combust solid biofuels, with a total installed capacity of 26.2 MW.

Animal manure is a dangerous source of environmental pollution. At the same time, the sources of biodegradable waste in the livestock sector represent the highest potential for the production of organic fertilizers and biogas through anaerobic fermentation, which is not used enough in domestic practice. Plants that produce biogas from waste from the animal breeding sector operate in Firladeni village, Hancesti district ('Farma Grup' Ltd.), Tarnova village, Donduseni district ('Rom-Cris' Ltd.), and Zabriceni Monastery, Zabriceni village, Edinet district. The Sugar Factory (JSC 'Sudzucker Moldova') in Drochia, uses waste resulting from sugar extraction from beets to obtain biogas, producing electricity for the energy needs of the company.

Table 7-20 contains activity data on biogas production plants (emissions from biogas are reported under Sector 1 'Energy').

Table 7-20: AD on biogas production plants

Nr. d/o	Enterprise, Legal address	Est.	Raw material used, 2018		Plant capacity	Energy use
			Name	Amount (t)		
1.	'Garma Grup' Ltd. Firladeni village, Hancesti district	2014	Manure; Vinasse from alcohol production; Molasses	29,000.0 6,200.0 6,500.0	25-30 thousand m^3/day	Boiler, Electricity production
2.	'Rom-Cris' Ltd., Tirnova village, Donduseni district	2017	Manure Maize stalk	9,125.0 3,000.0	627 kW/hour	Delivery in the electrical network
3.	'Sudzucker Moldova' JSC, Drochia	2012	Vinasse from sugar production	83,000	11,000,000 m^3/year	Own consumption
4.	Zabriceni Monastery, Zabriceni village, Edinet district	2016	Animal manure	280.0	15 m^3/day	Own consumption
5.	'Biogaz Inter' Ltd.	2008	Buried MSW	20.0 million	Not operational	Electricity production

The Environmental Strategy of the RoM for the years 2014-2023 and the Action Plan for its implementation, approved through the Government Decision No. 301/2014 provides the creation of integrated waste and chemical management systems, which would contribute to a 30% decrease in the amount of waste stored and a 20% increase in the recycling rate by 2023.

7.3.3. Uncertainties and Time-Series Consistency

The quality of data on the amount of waste subject to biological decomposition by composting is considered uncertain for category 5B 'Biological Treatment of Solid Waste', having been inferred by expert assumption, and we thereby consider an uncertainty of circa 50%.

Default emission factors recommended by the 2006 IPCC Guidelines were used for the calculation, so we consider it appropriate to use the value of circa 50%. Thus, uncertainties associated with combined uncertainties of activity data and emission factors for category 5B 'Biological Treatment of Solid Waste" are considered to be circa 70.7% (Annex 2).

In view of ensuring time-series consistency of the results, the same approach was used for the entire period under review, in conformity with the recommendations included in the 2006 IPCC Guidelines.

7.3.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

7.3.5. Quality Assurance and Quality Control

For category 5B 'Biological Treatment of Solid Waste', standard verification and quality control forms and checklists were also filled in following the Tier 1 methodological approach.

Verification was focused on various aspects such as: ensuring correct use of emission factors, including default emission factors available in the 2006 IPCC Guidelines; use of country-specific factors; verification and correct use of AD obtained from different reference sources, etc.

It should be noted that the AD and methods used for the estimation of GHG emissions under category 5B 'Biological Treatment of Solid Waste' were documented and archived both in hard copies and electronically. The quality of this activity data will be verified and adjusted in the next inventory cycle, through additional studies.

7.3.6. Recalculations

No recalculations were performed in the current inventory cycle for GHG emissions from category 5B 'Biological Treatment of Solid Waste'.

7.3.7. Planned Improvements

For the estimation of emissions in the case of category 5B 'Biological Treatment of Solid Waste', activity data is to be improved in the following inventory cycles. For example, organic waste composting practices are to be specified at national level in order to determine the existence of these platforms in urban and rural localities, especially where there are waste collection services. Since the implementation of a new integrated waste management system is delayed, the development of waste composting facilities will be initiated no sooner than 2025.

7.4. Source Category 5C 'Incineration and Open Burning of Waste'

7.4.1. Source Category Description

Thermal treatment of waste is classified into incineration, pyrolysis, gasification, plasma processing and open burning of waste. Pyrolysis, gasification and plasma processing are considered new technologies for solid waste treatment.

Waste incineration is defined as the burning of solid and liquid waste in controlled incineration plants. Municipal solid waste, industrial waste, hazardous waste, medical waste and sewage sludge are disposed of by incineration. The practice of incinerating municipal waste is common for developed countries, while developing countries mainly incinerate waste from medical activities.

Pyrolysis is defined as a reduction process that thermochemically transforms, at elevated temperatures and in the absence of oxygen, organic materials into gaseous and liquid products containing mostly hydrocarbon components and a solid residue with a higher carbon content.

Gasification is a process that converts organic materials into carbon monoxide, hydrogen and carbon dioxide, at temperatures above 700°C in the presence of a sub-stoichiometric percentage of an oxidizing agent, usually air (oxygen). The resulting gas mixture is called synthesis gas (syngas), used as fuel and/or chemical raw material.

Plasma processing is a process of partial oxidation of organic materials in an oxygen-free environment at elevated temperatures to produce gas and solid products.

The new technologies are mainly applied to produce fuels and chemical raw materials from waste tires and plastics and are also applied to the treatment of MSW to avoid the generation of air pollutants, which would result from the conventional incineration of MSW. Albeit many pyrolysis, gasification and plasma plants are established for waste treatment, many of them have been closed down due to technical problems as well as high costs. Increasing environmental standards and the demand for clean energy have recently revived interest in these new technologies. However, little official greenhouse gas emissions data are available for these technologies.

Since the gaseous products generated from the new technologies are usually collected and used primarily as fuel or chemical feedstock, direct CH_4 and N_2O emissions from the new technologies are assumed to be quite low, unless the gaseous products that contain CH_4 and N_2O are intentionally released into the atmosphere.

GHG emissions from waste thermal treatment including incineration, pyrolysis, gasification, plasma and open-air combustion without energy recovery are reported in the waste sector, while those with energy recovery are reported in the energy sector, both with the distinction between fossil and biogenic CO_2 emissions.

The methodology described in this chapter is applicable for both incineration with and without energy recovery. Co-firing of specific waste flows as alternative fuels is reported only within the energy sector (e.g., emissions from the incineration of tires in cement plant kilns will be reported only in the energy sector).

Simultaneously, emissions from burning of agricultural residue are considered in Sector 3 'Agriculture' or, alternatively, in category 4B 'Cropland' within Sector 4 'LULUCF'.

Open burning of waste can be defined as the unintentional combustion of combustible materials such as paper, wood, plastics, textiles, rubber, waste oils and other debris in nature (open-air) or in open dumps, where smoke and other emissions are released directly into the air without passing through a chimney or stack. Open burning can also include incineration devices that do not control the combustion gas to maintain an adequate temperature and do not provide sufficient time for complete combustion. This waste management practice is used in many developing countries whereas in developed countries open burning of waste may either be strictly regulated, or otherwise occur more frequently in rural areas than in urban areas.

Incineration and open burning of waste are sources of direct (CO_2, CH_4, and N_2O) and indirect (NO_x, CO, NMVOC, and SO_2) GHG emissions. Normally, CO_2 emissions from waste incineration are more significant than those of CH_4 and N_2O. Only CO_2 emissions resulting from oxidation, during incineration and open burning of carbon in fossil waste (e.g. plastics, certain textiles, rubber, liquid solvents and waste oils) are considered net emissions and should be included in the estimation of national CO_2 emissions. CO_2 emissions from burning biomass materials (e.g., paper, food and wood waste) contained in waste are biogenic emissions and are not included in the total national estimated emissions.

Intentional burning of waste on solid waste disposal sites is a waste management practice used in some developing countries. Emissions resulting from this practice and those from unintentional fires on SWDS will be estimated and reported according to the methodology and guidance provided for open burning of waste.



Figure 7-10: Incineration at ABS Recycling's warehouse in Chisinau and Tantareni commune.

7.4.2. Methodologies

CO_2, CH_4 and N_2O emissions from the open burning of MSW and clinical waste were estimated within category 5C 'Incineration and open Burning of Waste'.

The amount of waste open-burned each year was estimated using Equation 5.7 available in the 2006 IPCC Guidelines (Volume 5, Chapter 5.3.2, page 5.16):

$$MSW_B = P \bullet P_{frac} \bullet MSW_P \bullet B_{frac} \bullet 365 \bullet 10^{-6}$$

Where:

MSW_B – total amount of municipal solid waste open-burned, kt/yr;

P – population, capita;

P_{frac} – fraction of population burning waste (fraction);

MSW_P – per capita waste generation, kg waste/capita/day;

B_{frac} – fraction of the waste amount that is burned relative to the total amount of waste treated (fraction);

365 – number of days by year;

10^{-6} – conversion factor from kg to kt.

The total population of the RoM (as well as separately for the right and left bank of the Dniester River) is presented below in Table 7-21.

Table 7-21: Total population of the RoM between 1990-2022, million people

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RoM: LBDR	0.731	0.731	0.730	0.730	0.703	0.702	0.692	0.679	0.671	0.666	0.660
RoM: RBDR	3.631	3.636	3.629	3.618	3.650	3.646	3.643	3.641	3.655	3.649	3.644
RoM: total	**4.362**	**4.366**	**4.359**	**4.348**	**4.353**	**4.348**	**4.334**	**4.320**	**4.326**	**4.315**	**4.304**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
RoM: LBDR	0.652	0.643	0.634	0.624	0.554	0.548	0.541	0.534	0.528	0.523	0.518
RoM: RBDR	3.635	3.627	3.618	3.607	3.533	3.459	3.386	3.312	3.238	3.164	3.091
RoM: total	**4.286**	**4.270**	**4.251**	**4.231**	**4.087**	**4.007**	**3.926**	**3.845**	**3.766**	**3.687**	**3.609**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
RoM: LBDR	0.5134	0.5094	0.5052	0.5007	0.4745	0.4706	0.4690	0.4651	0.4652	0.4658	0.4636
RoM: RBDR	3.0168	2.9431	2.8693	2.8463	2.8256	2.7807	2.7296	2.6848	2.6437	2.6266	2.6038
RoM: total	**3.5302**	**3.4525**	**3.3745**	**3.3470**	**3.3001**	**3.2513**	**3.1986**	**3.1499**	**3.1089**	**3.0924**	**3.0674**

According to the 2006 IPCC Guidelines, open burning includes regular burning and sporadic burning of municipal solid waste. Regular burning means that this is the only practice used by the population to eliminate solid waste. Sporadic burning means that this practice is used in addition to other practices. For countries that have well-functioning waste collection systems in place, it is good practice to investigate the type of fossil carbon which is open burned.

In developed countries, P_{frac} can be assumed to be the rural population for a rough estimate. In regions where the urban population exceeds 80% of the total population, it can be assumed that no open burning of waste occurs. In developing countries, mainly in urban areas, P_{frac} can be roughly estimated as being the sum of population whose waste is not collected by waste collection services and population whose waste is collected and disposed in open dumps that are open burned at solid waste landfills.

In the RoM, the share of urban population varied between 1990 and 2022 between 47.4% and 46.6%, whereas the rural population between 52.6 and 53.4%, respectively (Table 7-22).

Table 7-22: Urban and rural population of the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Urban pop., thousand people	2069.3	2073.6	2052.2	2039.2	2036.6	2033.0	2004.1	1995.3	2001.6	1990.7	1983.4
Rural pop., thousand people	2292.3	2292.7	2306.9	2308.6	2316.1	2314.9	2330.3	2324.7	2324.2	2324.3	2320.1
Share of urban population, %	47.4	47.5	47.1	46.9	46.8	46.8	46.2	46.2	46.3	46.1	46.1
Share of rural population, %	52.6	52.5	52.9	53.1	53.2	53.2	53.8	53.8	53.7	53.9	53.9
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Urban pop., thousand people	1948.8	1940.1	1932.5	1919.2	1833.3	1792.2	1751.4	1711.0	1671.8	1636.6	1598.5
Rural pop., thousand people	2337.5	2329.6	2318.8	2311.5	2254.2	2214.6	2174.7	2134.3	2093.8	2050.2	2009.9
Share of urban population, %	45.5	45.4	45.5	45.4	44.9	44.7	44.6	44.5	44.4	44.4	44.3
Share of rural population, %	54.5	54.6	54.5	54.6	55.1	55.3	55.4	55.5	55.6	55.6	55.7
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Urban pop., thousand people	1560.6	1523.4	1486.3	1476.4	1454.7	1441.3	1429.6	1421.1	1420.3	1426.6	1429.8
Rural pop., thousand people	1969.6	1929.0	1888.1	1870.7	1845.4	1810.1	1769.0	1728.7	1688.6	1665.8	1637.6
Share of urban population, %	44.2	44.1	44.0	44.1	44.1	44.3	44.7	45.1	45.7	46.1	46.6
Share of rural population, %	55.8	55.9	56.0	55.9	55.9	55.7	55.3	54.9	54.3	53.9	53.4

The incineration of waste is predominantly characteristic to rural areas, both in households and on landfills in order to reduce the volume of solid waste disposed, mainly by burning organic waste (paper, cardboard, plastics and vegetable waste). For the calculation of emissions from open burning, the fossil fraction will be considered. In the case of the RoM, the share of population that burns waste in open-air *(P_{frac})* is estimated based on the share of the rural population *($P_{frac\ rural}$)* plus the urban population *($P_{frac\ urban}$)* that does not benefit from waste collection services ($P_{frac} = P_{frac\ rural} + P_{frac\ urban}$).

Approximately 75%-90% of the urban population is provided with waste collection services, and in some district centres the town waste collection systems serve neighbouring rural localities, and in rural areas – approximately 15-25% of the population is provided with waste collection services.

Municipal waste generation indicators indicate that the level of well-being of the population, by increased consumption in the last decade, but also the increased urbanization rate, which resulted in a capacity to generate a higher amount of waste per capita. Based on the Waste Management Strategy in the RoM for 2013-2027[132], the generation of municipal waste per capita varied in rural areas between 0.3-0.4 kg/capita/day, and for urban areas – 0.9 kg/capita/day.

As mentioned above in Chapter 7.2.2, in May 2023 – March 2024, the USAID/MESA Study on the morphological composition of municipal solid waste was undertaken. The Study results demonstrate the fact that, albeit the volume of waste is increasing, its weight is increasing proportionally, since most of the waste is represented by plastic packaging. Thus, in the context of the inventory, the waste generation rate per capita constituted the value of 0.5 kg/capita/day for the rural population for the period 1990-2022, and the value of 0.9 kg/capita/day for the urban population, respectively.

The morphological composition of municipal solid waste was considered, and the fractions of waste that can be burned by the rural and urban population were identified. In fact, the share of combustible waste varies in large municipalities, such as Chisinau and Balti, and in the district centres, such as Leova and Causeni, respectively, usually varying depending on the population's purchasing power. In order to estimate emissions, the results obtained from the most recent analysis of the morphological composition of solid waste in the Republic of Moldova were used (Figure 7-6).

It was considered that circa 20% of the urban population that does not benefit from waste disposal services burns solid waste in open-air, and the fraction for solid waste burned (B_{frac}) from the total amount of treated waste in urban areas is 0.15 (15% of the total). It should be noted that the population of Chisinau was excluded from the urban population, as it is considered that the population does not burn waste in open air, as waste disposal services are available in the city. In rural areas, it was considered that 40% of the population burns solid fossil waste in open-air, and B_{frac} is 0.2 (20% of the total).

The total amount of MSW burned in open-air by the population was estimated using the following equation:

$$MSW_B = MSW_{B\ rural} + MSW_{B\ urban}$$

[132] https://www.legis.md/cautare/getResults?doc_id=67104&lang=ro

Where:

$$MSW_{B\ rural\ RM}\ (kt) = P_{rural}\ (inhabitants) \bullet MSW_{P\ rural}\ (kg/capita/day) \bullet 0.20 \bullet 365 \bullet 10^{-6}$$

$$MSW_{B\ urban\ RM}\ (kt) = P_{urban}\ (inhabitants) \bullet MSW_{P\ urban}\ (kg/capita/day) \bullet 0.15 \bullet 365 \bullet 10^{-6}$$

Although there are no authorized incinerators in the RoM for the incineration of clinical waste, a certain category of plastic clinical waste generated by several medical institutions in the country is treated through the pyrolysis method by certain authorised economic agents ('UISPAC' Ltd.[133], 'Trisumg' Ltd.[134] and 'Ecostat' Ltd.[135]). Medical institutions in the RoM practise three different methods of open burning of clinical waste: 1) open burning; 2) closed burning in heating boilers or metal barrels; and 3) transport for pyrolysis treatment. As a response, the Ministry of Health, Labour and Social Protection[136], mentioned that in 2018, according to data reported from 26 territories (70.3%) in the structure of waste generated, non-hazardous waste prevails by 77.13%, followed by hazardous waste – 21.74% (986.057 kg), anatomopathological waste – 0.61% (27,813.9 kg), stinging-cutting waste – 0.27% (11,972.3 kg), and other hazardous waste – 0.25% (chemical, etc.). Outsourcing of waste treatment services, including infectious and stinging, was reported in 32 territories (86.5%).

In order to determine AD for the estimation of direct GHG emissions (CO_2, CH_4, and N_2O) and indirect emissions (NO_x, CO, NMVOC, and SO_2) from open burning of clinical waste, as a first step, the amount of clinical waste generated annually was estimated based on the rate of waste generation reported per hospital bed. The second step was to estimate the share of waste burned in open-air in the total clinical waste generated. Thus, the data received from the National Centre of Public Health[137] on clinical waste burned by medical institutions across the country, who practise the three above-mentioned methods, was used for the years 2010-2014. Additionally, for the years 2015-2019, similar data was received from several medical institutions in the country, being requested through the Circular of the Ministry of Health, Labour and Social Protection[138]. For the years 2020-2022, the data was derived by correlating the generation rate per bed with the number of beds based on expert opinion.

Historical data for the years 1990-2009 was inferred by correlating the generation rate per hospital bed with the number of beds (available in the database of the NBS), and the burning coefficient was estimated based on expert opinion, considering that in the 1990s the burning rate was somewhat low. The tables below reveal AD used to estimate GHG emissions from open burning of clinical waste.

Table 7-23: Amount of total clinical waste burned in open-air between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Number of hospital beds, units	57,334	56,992	55,653	54,275	53,140	52,986	52,457	50,101	48,261	35,089	32,423
Generation per hospital bed, kg/day	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.06
Total country, tonnes	1,046.3	1,040.1	1,015.7	990.5	969.8	967.0	957.3	914.3	880.8	640.4	710.1
Burning rate, %	10.0	14.5	19	23.5	28	32.5	37.0	41.5	46.0	50.5	55.0
Total open burning amount, tonnes	104.63	150.82	192.98	232.77	271.55	314.27	354.22	379.45	405.15	323.39	390.54
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Number of hospital beds, units	25,044	24,443	24,097	23,113	22,961	22,471	21,892	21,798	21,938	22,021	22,031
Generation per hospital bed, kg/day	0.07	0.08	0.09	0.1	0.1	0.1	0.1	0.11	0.12	0.13	0.14
Total country, tonnes	639.9	713.7	791.6	843.6	838.1	820.2	799.1	875.2	960.9	1,044.9	1,125.8
Burning rate, %	59.5	64.0	68.5	72.5	72.5	72.5	72.5	72.5	72.5	72.5	74.6
Total open burning amount, tonnes	380.73	456.79	542.24	611.59	607.57	594.60	579.28	634.47	696.60	757.50	840.26
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Number of hospital beds, units	22,162	20,760	20,131	18,803	18,805	18,398	18,138	18,042	20,519	17,168	17,329
Generation per hospital bed, kg/day	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.28	0.28	0.2
Total country, tonnes	1,213.4	1,136.6	1,102.2	1,029.5	1,029.6	1,007.3	993.1	987.8	2,097	2,136	2,157
Burning rate, %	72.60	71.43	66.17	55.88	45.58	35.29	25.00	10.29	11.40	10.00	8.00
Total open burning amount, tonnes	880.87	811.83	729.29	575.23	469.32	355.49	248.26	101.67	196.48	170.92	129.40

Note: *The number of beds has been increased, due to the COVID 19 pandemic, when the allocation coefficient for the number of beds per 10.000 inhabitants was increased from 57 to 66.1 (based on the information on the NBS web page: https://statistica.gov.md/category.php?l=ro&idc=198). At the same time, the generation rate of waste per bed has been increased, from 0.15 to 0.28 kg/bed (based on the deductions of the expert, including based on the reports submitted on www.siamd.gov.md by economic agents authorized in the collection and treatment of medical waste), and in 2022 the generation rate has been reduced as the scale of the pandemic has shrunk, with the burning rate also decreasing due to tougher regulations.

[133] Authorization issued by the Environment Agency, Series 005, AM 20091601 dated 02.10.2020 on the collection, transport and processing (pyrolysis method) of plastic waste and of waste from clinical or veterinary care activities and/or related research.
[134] Authorization issued by the Environment Agency, Series 005, AM 20090802 dated 30.09.2020 on the transport and processing of clinical waste by autoclaving.
[135] Authorization No. 071/2016 dated 27.05.2016 issued by the Ministry of Environment.
[136] Letter from the Ministry of Health, Labor and Social Protection No. 04/677 dated 04.02.2019 as an official response to the Letter from the MARDE No. 14-0//16 dated 03.01.2019.
[137] Letter from the Ministry of Health No. 06t-3/2521 dated 30.10.2015 as an official response to the Letter from the Ministry of Environment No. 05-07/1425 dated 13.08.2015.
[138] Circular of the Ministry of Health, Labor and Social Protection No.06/2218 dated 23.04.2020 addressed to Health Carters/Family Medical Centers/ Territorial Medical Associations, District/ Municipal/ Republican Hospitals, prepared as a response to the interpellation of the MARDE No. 14-07/1356 dated 16.03.2020.

CO_2 emissions from open burning of waste were estimated using Equation 5.1 available in the 2006 IPCC Guidelines (Volume 5, Chapter 5, page 5.7):

$$CO_2\ Emissions = \Sigma_i\ (SW_i \bullet dm_i \bullet CF_i \bullet FCF_i \bullet OF_i) \bullet 44/12$$

Where:

CO_2 Emissions – CO_2 emissions in inventory year, kt/yr;

SW_i – total amount of solid waste of type *i* (wet weight) incinerated or open-burned, kt/yr;

dm_i – dry matter content in the waste (wet weight) incinerated or open-burned (fraction) (default values used – 76% for MSW and 90% for clinical waste are available in Table 2.4 in the 2006 IPCC Guidelines, Volume 5, Chapter 2, page 2.14);

CF_i – fraction of carbon in the dry matter (total carbon content) (default values used – 47% for MSW and 60% for clinical waste are available in Table 2.4 in the 2006 IPCC Guidelines, Volume 5, Chapter 2, page 2.14, and in Table 5.2 in the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.18, respectively);

FCF_i – fraction of fossil carbon in the total carbon (default values used – 90% for industrial waste, 42% for MSW and 40% for clinical waste are available in Table 2.4 in the 2006 IPCC Guidelines, Volume 5, Chapter 2, page 2.14, and in Table 5.2 in the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.18, respectively);

OF_i – oxidation factor (default value used – 58% is available in Table 5.2 in the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.18);

44/12 – conversion factor from C to CO_2.

i – type of waste incinerated/open-burned specified as follows: MSW – municipal solid waste (if not estimated using Equation 5.2 in the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.7); ISW – industrial solid waste; SS – sewage sludge; HW – hazardous waste; CW – clinical waste, others (to be specified).

Methane emissions from incineration and open burning of waste are a result of incomplete combustion. Important factors affecting the emissions are temperature, residence time, and air ratio (air volume in relation to the waste amount incinerated or open-burned).

In large and well-functioning industrial incinerators, CH_4 emissions are usually very low. Methane can also be generated in the incinerator bunker if there are low oxygen levels (anaerobic process), particularly where waste is wet, stored for long periods and not well agitated. However, if storage gases are fed into the air supply of the incineration chamber for a long period, emissions decrease significantly.

The calculation of methane emissions is based on Equation 5.4 available in the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.12):

$$CH_4\ Emissions = \Sigma_i\ (IW_i \bullet EF_i) \bullet 10^{-6}$$

Where:

CH_4 Emissions – CH_4 emissions in inventory year, kt/yr;

IW_i – amount of solid waste of type *i* incinerated or open-burned, kt/yr;

EF_i – aggregate CH_4 emission factor, kg CH_4/kt waste type *i* (default value used – 6.5 kg CH_4/t MSW is available in the 2006 IPCC Guidelines, Volume. 5, Chapter 5, page 5.20);

10^{-6} – conversion factor, from kg to kt;

i – category or type of waste incinerated/open-burned, specified as follows: MSW – municipal solid waste; ISW – industrial solid waste; HW – hazardous waste; CW – clinical waste, SS – sewage sludge; others (to be specified).

Nitrous oxide is emitted in combustion processes at relatively low combustion temperatures between 500 and 950°C. Other important factors affecting emissions are the types of air pollution control devices, type and nitrogen content of the waste and the fraction of excess air.

The calculation of nitrous oxide emissions is based on Equation 5.5 in the 2006 IPCC Guidelines, Volume 5, Chapter 5, page 5.14):

$$N_2O\ Emissions = \Sigma_i\ (IW_i \bullet EF_i) \bullet 10^{-6}$$

Where:

N_2O Emissions – N_2O emissions in inventory year, kt/yr;

IW_i – amount of solid waste of type *i* incinerated or open-burned, kt/yr;

EF_i – N_2O emission factor, kg N_2O/kt waste type *i* (default value used – 0.15 kg N_2O/t of MSW, is available in the 2006 IPCC Guidelines, Volume 5, Chapter 5, Table 5.6, page 5.22);

10^{-6} – conversion factor, from kg to kt;

i – category or type of waste incinerated/open-burned, specified as follows: MSW – municipal solid waste; ISW – industrial solid waste; HW – hazardous waste; CW – clinical waste, SS – sewage sludge; others (to be specified).

The calculation of indirect GHG emissions (NO_x, CO, NMVOC, and SO_2) from incineration or open burning of waste is based on the methodology available in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019):

$$Indirect\ GHG\ Emissions = \Sigma_i\ (IW_i \bullet EF_i) \bullet 10^{-6}$$

Where:

Indirect GHG Emissions – indirect GHG emissions (NO_x, CO, NMVOC, and SO_2), ozone precursors and aerosols in inventory year, kt/yr;

IW_i – amount of solid waste of type *i* incinerated or open-burned, kt/yr;

EF_i – emission factor, kg indirect GHG/kt waste (default values are presented below, in Table 7-24);

i – category or type of waste incinerated/open-burned, specified as follows: MSW – municipal solid waste; ISW – industrial solid waste; HW – hazardous waste; CW – clinical waste, SS – sewage sludge; others (to be specified);

10^{-6} – conversion factor, from kg to kt.

Table 7-24: Default EFs used to estimate indirect GHG emissions from source category 5C 'Incineration and Open Burning of Waste' using the Tier 1 methodological approach

	NO_x, kg/t of waste	CO, kg/t of waste	NMVOC, kg/t of waste	SO_2, kg/t of waste
Solid Waste[1]	3.8	55.83	1.23	0.11
Clinical Waste[2]	2.3	0.19	0.7	0.54

Source: [1]EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Source Category 5.C.2 'Open Burning of Waste', Table 3-1, page 6; [2]EMEP/EEA Atmospheric Emissions Inventory Guidebook (2019), Source Category 5.C.1.b.iii 'Clinical Waste Incineration', Table 3-1, page 8.

Activity data used to estimate CO_2, CH_4, and N_2O emissions from source category 5C 'Incineration and Open Burning of Waste' are presented in Table 7-25.

Table 7-25: Activity data used to estimate direct and indirect GHG emissions from source category 5C 'Incineration and Open Burning of Waste'

	Urban Population, thousand inhabitants (without Chisinau)	Rural population, thousand inhabitants	Daily ratio of generated MSW in urban areas, kg/capita/day	Daily ratio of generated MSW in rural areas, kg/capita/day	Amount of MSW burnt in urban areas, kt	Amount of MSW burnt in rural areas, kt	Total amount of MSW burnt in the RoM, kt	Amount of clinical waste incinerated, kt
1990	1,393.8	2,292.3	0.9	0.5	13.7359	33.4676	47.2035	104.6346
1991	1,396.9	2,292.7	0.9	0.5	13.7664	33.4734	47.2399	150.8151
1992	1,385.1	2,306.9	0.9	0.5	13.6502	33.6807	47.3309	192.9768
1993	1,375.8	2,308.6	0.9	0.5	13.5585	33.7056	47.2641	232.7719
1994	1,375.0	2,316.1	0.9	0.5	13.5506	33.8151	47.3657	271.5454
1995	1,371.5	2,314.9	0.9	0.5	13.5161	33.7975	47.3137	314.2732
1996	1,342.2	2,330.3	0.9	0.5	13.2274	34.0224	47.2498	354.2159
1997	1,330.6	2,324.7	0.9	0.5	13.1131	33.9406	47.0537	379.4524
1998	1,338.4	2,324.2	0.9	0.5	13.1899	33.9333	47.1233	405.1511
1999	1,327.1	2,324.3	0.9	0.5	13.0786	33.9348	47.0134	323.3890
2000	1,320.0	2,320.1	0.9	0.5	13.0086	33.8735	46.8821	390.5350
2001	1,286.8	2,337.5	0.9	0.5	12.6814	34.1275	46.8089	380.7251
2002	1,278.1	2,329.6	0.9	0.5	12.5957	34.0122	46.6078	456.7908
2003	1,271.8	2,318.8	0.9	0.5	12.5336	33.8545	46.3881	542.2367

	Urban Population, thousand inhabitants (without Chisinau)	Rural population, thousand inhabitants	Daily ratio of generated MSW in urban areas, kg/capita/day	Daily ratio of generated MSW in rural areas, kg/capita/day	Amount of MSW burnt in urban areas, kt	Amount of MSW burnt in rural areas, kt	Total amount of MSW burnt in the RoM, kt	Amount of clinical waste incinerated, kt
2004	1,257.0	2,311.5	0.9	0.5	12.3877	33.7479	46.1356	611.5891
2005	1,172.1	2,254.2	0.9	0.5	11.5506	32.9113	44.4619	607.5670
2006	1,132.0	2,214.6	0.9	0.5	11.1555	32.3337	43.4892	594.6012
2007	1,093.0	2,174.7	0.9	0.5	10.7718	31.7509	42.5227	579.2804
2008	1,047.9	2,134.3	0.9	0.5	10.3267	31.1613	41.4880	634.4724
2009	1,008.6	2,093.8	0.9	0.5	9.9393	30.5695	40.5087	696.5971
2010	973.2	2,050.2	0.9	0.5	9.5909	29.9329	39.5238	757.5020
2011	933.8	2,009.9	0.9	0.5	9.2027	29.3451	38.5478	840.2565
2012	893.0	1,969.6	0.9	0.5	8.8002	28.7566	37.5569	880.8691
2013	851.6	1,929.0	0.9	0.5	8.3929	28.1641	36.5570	811.8347
2014	811.8	1,888.1	0.9	0.5	8.0006	27.5667	35.5672	729.2895
2015	798.2	1,870.7	0.9	0.5	7.8659	27.3115	35.1774	575.2263
2016	773.6	1,845.4	0.9	0.5	7.6241	26.9428	34.5669	469.3228
2017	755.4	1,810.1	0.9	0.5	7.4441	26.4272	33.8713	355.4939
2018	739.6	1,769.0	0.9	0.5	7.2892	25.8272	33.1164	248.2639
2019	725.7	1,728.7	0.9	0.5	7.1522	25.2394	32.3916	101.6652
2020	825.8	1,688.6	0.9	0.5	8.1383	24.6530	32.7913	239.0370
2021	725.8	1,665.8	0.9	0.5	7.1531	24.3200	31.4731	240.0370
2022	723.6	1,637.6	0.9	0.5	7.1310	23.9093	31.0403	172.5447

7.4.3. Uncertainties and Time-Series Consistency

The main factors affecting uncertainties are associated with the estimation methodology, the EFs used in the estimation of GHG emissions from source category 5C 'Incineration and Open Burning of Waste' as well as the quality of the AD available.

Thus, uncertainties associated with the default emission factors used in the estimation of CO_2, CH_4, and N_2O emissions from source category 5C 'Incineration and Open Burning of Waste' reach circa 25% for CO_2, circa 50% for CH_4, and circa 100% for N_2O. Uncertainties associated with the activity data on the estimated amount of waste burnt by the rural and urban population could reach circa 40%.

Thus, combined uncertainties of activity data and emission factors for source category 5C 'Incineration and Open Burning of Waste' constitute circa 47.17% for CO_2 emissions, circa 64.03% for CH_4, and circa 107.70% for N_2O emissions, respectively (Annex 2).

In view of ensuring time series consistency of results, the same approach was used for the entire period under review, in conformity with good practices applied in the GHG emissions inventory.

7.4.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

7.4.5. Quality Assurance and Quality Control

Standard verification and quality control form and checklist was filled in for the respective category following the Tier 1 methodological approach.

Verification was focused on various aspects such as: correct use of AD obtained from different reference sources, including the Statistical Yearbooks of the RoM and ATULBD, on ensuring correct use of the default emission factors available in the 2006 IPCC Guidelines.

AD and methods used for the estimation GHG emissions from category 5C 'Incineration and Open Burning of Waste' were documented and archived both in hard copies and electronically.

7.4.6. Recalculations

In the current inventory cycle, recalculations of direct GHG emissions from source category 5C 'Incineration and Open Burning of Waste' were carried out for the years 2005-2020 due to the revision of data associated with the population number, and for the years 2015-2020 due to the revision of the waste generation rate per capita for the urban and rural population.

At the same time, in order to transfer direct GHG emissions into CO_2 equivalent, in the current inventory cycle, the 100-year global warming potential (GWP_{100}) values available in the Fifth Assessment Report (IPCC AR 5, 2014) were used (for CH_4 – 28 and for N_2O – 265), instead of the GWP_{100} values from the Fourth Assessment Report (IPCC AR 4, 2007) (for CH_4 – 25 and for N_2O – 298), which led to the recalculation of direct GHG emissions for the entire period 1990-2020.

Thus, recalculations resulted in differences compared to the results obtained in the previous inventory cycle, as follows: an upward trend by about 2.1-3.1% of direct GHG emissions in the period 1990-2014, followed by a downward trend in direct GHG emissions in the period 2015-2020 (Table 7-26).

Table 7-26: Recalculations of direct GHG emissions from source category 5C 'Incineration and Open Burning of Waste' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	24.2621	24.3113	24.3859	24.3780	24.4557	24.4574	24.4511	24.3673	24.4200	24.3095	24.2867
BTR1	25.0066	25.0571	25.1337	25.1253	25.2053	25.2067	25.2000	25.1135	25.1677	25.0543	25.0304
Difference, %	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1	3.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	24.2427	24.1900	24.1339	24.0505	23.4100	22.8582	22.2776	21.7640	21.2853	20.8019	20.3296
BTR1	24.9851	24.9304	24.8721	24.7857	23.8988	23.3762	22.8553	22.3461	21.8708	21.3918	20.9323
Difference, %	3.1	3.1	3.1	3.1	2.1	2.3	2.6	2.7	2.8	2.8	3.0
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	19.8260	19.2357	18.6487	21.5422	21.0986	23.7193	23.1496	22.5896	22.2913		
BTR1	20.4363	19.8614	19.2826	18.9723	18.5781	18.1336	17.6622	17.1801	17.4842	16.7885	16.5142
Difference, %	3.1	3.3	3.4	-11.9	-11.9	-23.5	-23.7	-23.9	-21.6		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

The obtained results allow us to assert that direct GHG emissions from the respective category decreased in the RoM by circa 34% between 1990 and 2022.

The table below shows the evolution of direct and indirect GHG emissions from incineration and open burning of municipal and clinical waste between 1990 and 2022 (Table 7-27).

Table 7-27: Direct and indirect GHG emissions from source category 5C 'Incineration and Open Burning of Waste' in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
CO_2 emissions, kt	14.9667	14.9994	15.0476	15.0447	15.0947	15.0979	15.0960	15.0456	15.0794	15.0071	14.9965
CH_4 emissions, kt	0.3075	0.3080	0.3089	0.3087	0.3096	0.3096	0.3094	0.3083	0.3089	0.3077	0.3073
N_2O emissions, kt	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054	0.0054
NO_x emissions, kt	0.1503	0.1506	0.1510	0.1508	0.1512	0.1512	0.1511	0.1505	0.1508	0.1502	0.1500
CO emissions, kt	2.6354	2.6374	2.6425	2.6388	2.6445	2.6416	2.6380	2.6271	2.6310	2.6248	2.6175
NMVOC emissions, kt	0.0581	0.0582	0.0584	0.0583	0.0584	0.0584	0.0584	0.0581	0.0582	0.0581	0.0579
SO_2 emissions, kt	0.0052	0.0053	0.0053	0.0053	0.0054	0.0054	0.0054	0.0054	0.0054	0.0053	0.0054
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
CO_2 emissions, kt	14.9689	14.9402	14.9100	14.8621	14.3313	14.0179	13.7054	13.4037	13.1228	12.8395	12.5690
CH_4 emissions, kt	0.3067	0.3059	0.3050	0.3039	0.2930	0.2865	0.2802	0.2738	0.2678	0.2618	0.2560
N_2O emissions, kt	0.0054	0.0054	0.0054	0.0053	0.0052	0.0050	0.0049	0.0048	0.0047	0.0046	0.0045
NO_x emissions, kt	0.1497	0.1493	0.1488	0.1481	0.1428	0.1397	0.1366	0.1334	0.1304	0.1274	0.1245
CO emissions, kt	2.6134	2.6022	2.5899	2.5759	2.4824	2.4281	2.3742	2.3164	2.2617	2.2068	2.1523
NMVOC emissions, kt	0.0578	0.0576	0.0574	0.0572	0.0551	0.0539	0.0527	0.0515	0.0503	0.0491	0.0480
SO_2 emissions, kt	0.0054	0.0054	0.0054	0.0054	0.0052	0.0051	0.0050	0.0049	0.0048	0.0048	0.0047
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
CO_2 emissions, kt	12.2745	11.9268	11.5760	11.3821	11.1405	10.8683	10.5805	10.2841	10.4735	10.0573	9.8895
CH_4 emissions, kt	0.2498	0.2429	0.2359	0.2324	0.2277	0.2225	0.2169	0.2112	0.2147	0.2061	0.2029
N_2O emissions, kt	0.0044	0.0043	0.0042	0.0041	0.0040	0.0039	0.0038	0.0037	0.0038	0.0036	0.0036
NO_x emissions, kt	0.1215	0.1181	0.1148	0.1132	0.1110	0.1085	0.1059	0.1032	0.1048	0.1006	0.0991
CO emissions, kt	2.0970	2.0411	1.9859	1.9641	1.9300	1.8911	1.8489	1.8084	1.8308	1.7572	1.7330
NMVOC emissions, kt	0.0468	0.0455	0.0443	0.0437	0.0428	0.0419	0.0409	0.0399	0.0405	0.0389	0.0383
SO_2 emissions, kt	0.0046	0.0045	0.0043	0.0042	0.0041	0.0039	0.0038	0.0036	0.0037	0.0036	0.0035

7.4.7. Planned Improvements

In the coming years, it should be mentioned that the Waste Management Automated Information System (<www.siamd.gov.md>) and the Register of Emissions and Transfer of Pollutants (<www.retp.gov.md>) will include most of the waste collection operators, which will facilitate data collection on municipal waste or similar waste collected from the population and economic agents, as well as on the number of people benefiting from waste collection systems.

At the same time, the USAID/MESA Study of the morphological composition of waste[139], carried out in May 2023 - March 2024, will provide additional details regarding the composition of waste, combustion fractions, and generation rate per capita.

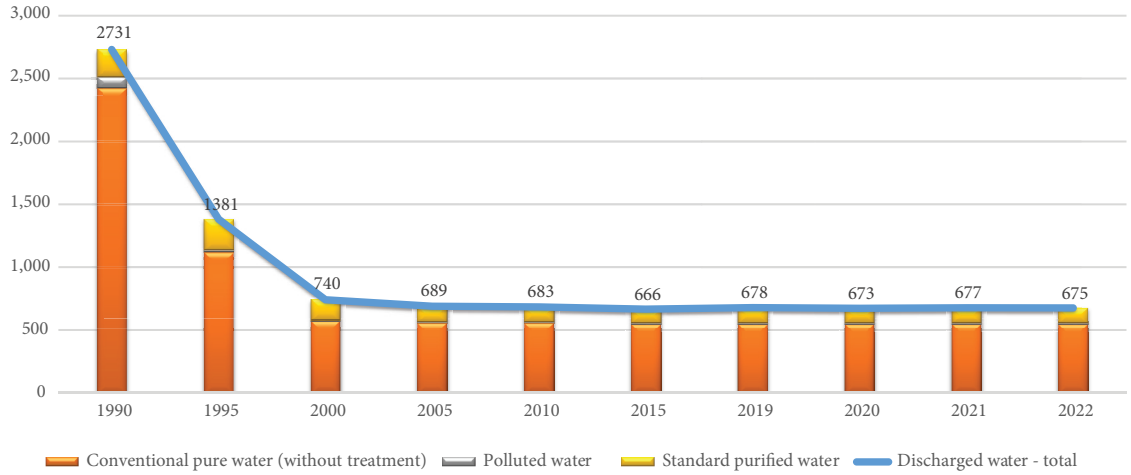
It shall thereby be possible to improve the quality of the activity data used for estimating emissions from source category 5C 'Incineration and Open Burning of Waste'. In the next inventory cycle, it is proposed to estimate the activity data for the calculation of carbon emissions of biogenic origin.

7.5. Source Category 5D 'Wastewater Treatment and Discharge'

The public sewage system represents an assembly of technological installations, functional equipment and specific facilities through which the public sewage service is operating. The system comprises the following components: public sewage networks, pumping stations, treatment plants, discharging facilities.

In the Republic of Moldova, the current sewage system is underdeveloped and has a low capacity in the context of fully ensuring the population's access to quality sewage services. At the same time, there is a lack of applying new technologies, and a lack of experience in this field. With recent investments in the water supply and sewage sector, attempts have been made to apply well-known European practices. These refer to the implementation of new technologies for wastewater treatment, drinking water treatment, the use of new materials (plastics) for pipes in water and sewage systems, which are superior to pipes made of corrosive and expensive metal materials.

Water quality is influenced by the discharge of untreated or insufficiently treated wastewater from wastewater treatment plants from natural sources. The biggest volumes of untreated used waters come from areas supplied with water from centralised systems, but do not have sewage systems and treatment plants. It should be noted that the last 30 years have been marked by a constant decrease in the volume of wastewater discharge (Figure 7-11), which is similar to the volume of water captured and used. Based on statistical data, the volume of wastewater discharged has been relatively stable. During this period, the volume of polluted wastewater discharged into water bodies decreased by approximately 91.1%, from 90 million m³ in 1990 to 8 million m³ in 2022. In 2022, the total volume of discharged wastewater was 70.9 million m³ of which 68.2 million m³ from urban localities (96.2%) and 2.7 million m³ from rural areas (3.8%).



Source: NBS.

Figure 7-11: Discharge of wastewater, mine water and groundwater drained in surface water bodies, mil. m³.

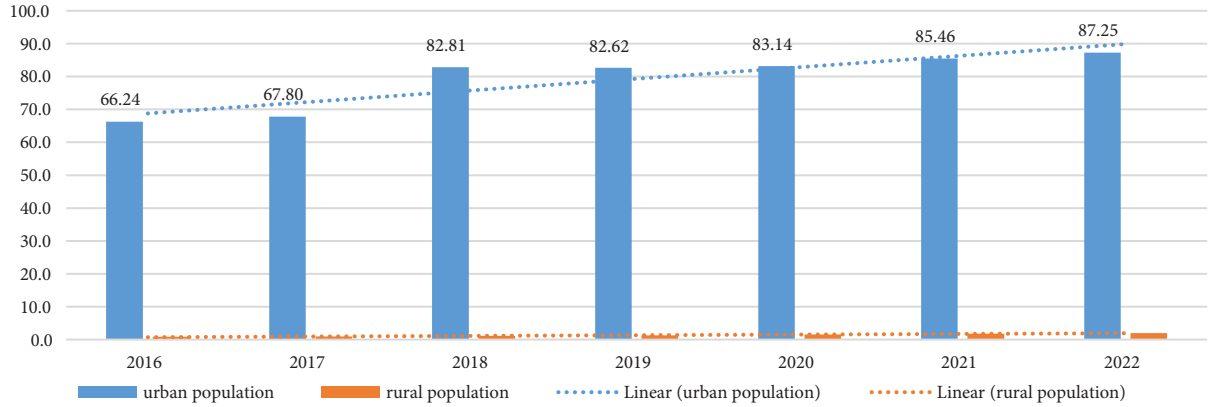
[139] <https://mediu.gov.md/ro/node/4872>.

In RoM, there is an insufficiency of the application of new technologies, as well as a lack of experience in this field. The pollution of the Dniester River continues, due to the delay in the construction of wastewater treatment facilities in Soroca, causing pollution of the Dniester River ecosystem. With the recent investments in the water supply and sewerage sector, an attempt has been made to apply practices that are well-known in European countries. They refer to the implementation of new technologies for wastewater treatment, drinking water treatment, the use of new materials (plastics) for pipes in water and sewage systems, which are superior to pipes made of corrosive and expensive metal materials.

Municipal wastewater is collected centrally, together with industrial wastewater collected on a contract basis, from economic agents that do not have treatment plants and is directed to treatment in municipal wastewater treatment facilities. The wastewater treatment scheme is the classic one and has a different level of treatment in urban and rural areas and depends on the degree of technical equipment of the facilities. The main methods of wastewater treatment according to the data presented are mechanical, biological based on the degradation of organic substances, and chemical with the use of regents, as well as combined methods.

Starting from 2016, the NBS keeps a centralised record of the data related to the connection of the population to the sewage services in districts, in urban and rural localities, including the total volume of wastewater discharged into the centralised sewage system (in thousands of m^3), the volume of treated wastewater (thousand m^3) in the primary (mechanical) and secondary (biological) stages. In 2021 and 2022, no data was collected on the number of the population connected to the sewage service, but only the number of connected homes. Therefore, the trends associated with the number of dwellings were used to estimate the number of people connected to the sewage service.

The diagram below shows the evolution of the degree of connection to sewage services of the urban and rural population between 2016 and 2022. For the urban population, a much higher pace and rate of reaching the established target is attested, while in the rural population the evolution is much more modest. However, in ATULDB the degree of connection of the rural population to the sewage service is higher, being circa 40% in 2022.



Source: NBS, expert calculations.

Figure 7-12: Population connected to the public sewage system, people, % (except ATULBD).

Currently, the management of sludge produced at wastewater treatment plants is inadequate and does not comply with the requirements of the regulations in force. A major problem that exists in the wastewater treatment process that significantly influences the environment is the lack of modern processing facilities for sludge formed as a result of wastewater treatment.

Sewage systems, which ensure the evacuation and purification of wastewater, have an increased degree of wear, are physically degraded and obsolete, as they have been operated for more than 25-30 years without reconstruction, and require a technological modernization of the purification steps.

In 2009, in order to overcome the existing situation, for the purpose of sludge processing and odour removal, the wastewater treatment plant in Chisinau implemented the pilot-project for raw sludge dewatering using the 'Geotube' method. The annual capacity of the sludge dewatering process is 584 thousand m^3 with 95% humidity, which has a capacity of 97.3 thousand m^3 after dewatering and 70%

humidity. Two open storage facilities were built to store the sludge from the 'Geotube' bags after the dewatering process.

It should be noted that rehabilitation works of the Wastewater Treatment Plant in Chisinau were initiated in 2018 within the project 'Rehabilitation of the sewage treatment plant and the new sludge treatment line in Chisinau municipality'. The project includes the construction of a new sludge treatment facility, infrastructure renovation, construction of several specialized facilities and installation of the wastewater filtering equipment. A power plant using sludge as raw material is planned to be built. Electricity will be produced as a result of biogas production, providing the wastewater treatment plant with 50% of the electricity required to operate. As of 2023, works were estimated to be circa 85% finished, three secondary decanters being put into operation, the installation works of the mechanical equipment, the pressure collector, the raw water flow meter were completed, also installation works of thermal and natural gas networks were completed, as well as the installation works of the electrical equipment. Other constructions, sludge management projects at other sewage treatment plants in the country are currently not foreseen. The methods of sludge recovery from treatment plants need to be determined within the execution projects and in accordance with Law No. 209/2016 on waste and legislative acts in the field of wastewater management.

7.5.1. Source Category Description

Within source category 5D 'Wastewater Treatment and Discharge' CH_4 and N2O emissions from 5D1 'Domestic Wastewater', as well as CH_4 emissions from 5D2 'Industrial Wastewater' were estimated.

5D1 'Domestic Wastewater'

Domestic wastewater is the product of using water for domestic purposes. The process of treating domestic wastewaters and sludge from treatment facilities implies CH_4 generation and NMVOC, but in a smaller amount. The wastewater treatment scheme is a classic one and has a different treatment level in urban and rural areas, depending on the technical equipment of the installations. The main wastewater treatment methods are mechanical, biological (based on organic matter decomposition), chemical (using reagents), as well as combined methods. In some cases, wastewater is discharged directly into surface basins without special treatment, and in other cases they are treated and discharged with different levels of organic matter load.

Domestic wastewater is discharged through a network, which currently does not fully cover the country's localities. The quality of sewage services provided to the population is poor. All urban areas in the developing regions have wastewater treatment facilities, but most of them are run-down and inefficient. Most existing facilities provide only a mechanical treatment, while biological facilities with a larger energy consumption are shut down due to high operation costs. The quality of treated wastewater in all urban areas, except for certain cities, do not meet the existing discharging standards. Exceedances of maximum concentrations of pollutants in treated wastewater are detected in ammonia, suspended substances and organic substances expressed in BOD_5.

The amount of GHG emissions generated under this source category depends on domestic wastewater management practices used in the RoM, as well as the percentage of the population connected to centralized sewer systems and wastewater treatment. The most widespread wastewater treatment method used in the RoM is the traditional biological aerobic treatment. Another source of GHG emissions is from the sludge from the wastewater treatment, which is subject to aerobic and anaerobic treatment, by storage on sludge fields.

Currently, domestic wastewater treatment is carried out only partially in most urban areas of the RoM. It should be noted that in most rural localities the sewage systems were run-down. In urban localities, where wastewater treatment plants operate, the sludge is treated by storing it on sludge platforms. Because the design capacities of all existing facilities are usually larger (circa 2-10 times, and in some localities even more) than the actual recorded volumes of water generation; there are free surfaces to store sludge at all these sites. Only in large cities, such as Chisinau, Balti and Cahul, due to the lack of sludge treatment technologies, its storage is carried out in layers larger than 50 cm, which causes

anaerobic processes and induces the formation of methane emissions. However, compared to the total sludge storage area, these areas are insignificant to be considered in the emission calculation process. Domestic wastewater from individual households in urban and rural areas not connected to a sewer system are usually collected in septic tanks or latrines.

5D2 'Industrial Wastewater'

In the Republic of Moldova, industrial wastewater is treated using the network for municipal domestic wastewater. After generation, industrial wastewater is discharged into the sewage systems of the domestic wastewater, being thus treated together. Industrial wastewater is redirected to sewage systems based on the technical conditions issued by the operators of 'Apa-Canal' enterprises.

At the same time, based on the results of the inventory of existing wastewater treatment plants, it was found that the respective enterprises allowed the connection of several economic agents from the industrial sector to the urban sewer systems due to insufficient volume of wastewater needed for the proper functioning of domestic wastewater treatment plants, which meant that economic agents did not have to build local industrial wastewater treatment plants. Within the industrial sector, the processing industries contribute the most to the generation of wastewater with an increased content of organic biodegradable substances.

7.5.2. Methodologies

Methane emissions from source category 5D 'Wastewater Treatment and Discharge' were estimated using the Tier 1 method available in the 2006 IPCC Guidelines, following several steps.

5D1 'Domestic Wastewater'

Step I: Estimating total organically degradable carbon in wastewater (TOW)

Estimation of total organically degradable carbon in wastewater (TOW). Available methodology in the 2006 IPCC Guidelines implies estimating total organically degradable carbon in wastewater generated by all households, either connected or not to the sewage system. The value of this index is influenced, particularly, by the population number (urban and rural population), and by the organically degradable component (BOD) in wastewater, respectively.

Total organically degradable carbon in wastewater was estimated following Equation 6.3 available in the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.13):

$$TOW = P \bullet BOD \bullet 0.001 \bullet I \bullet D$$

Where:

TOW – total organics in wastewater in inventory year, kg BOD/yr;

P – country population in inventory year;

BOD – country-specific per capita BOD in inventory year, g/person/day, the default value used for European countries represents 60 g BOD_5/person/day (2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.4, page 6.14); in the RoM the CS value is 60 BOD/person/day (SNIP G.03.02-2015 Table 7.1);

0.001 = conversion from grams BOD to kg BOD;

I – correction factor for additional industrial BOD discharged into sewers (the value used by default for common sewage system is 1.25, for uncollected sewage the value used by default is 1.00);

D – number of days in a calendar year (365 days in regular years and 366 days in leap years: 1992, 1996, 2000, 2004, 2008, 2012, 2016, 2020).

Table 7-28: AD used to estimate CH_4 emissions from source category 5D1 'Domestic Wastewater' in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
TOW $_{rural}$, kt BOD_5/yr	50.2014	50.2101	50.6595	50.5583	50.7226	50.6963	51.1734	50.9109	50.9000	50.9022	50.9494
TOW $_{urban}$, kt BOD_5/yr	50.9494	51.1913	51.0182	50.7817	50.7605	49.3670	48.5006	47.6263	46.8701	45.8542	43.5555
TOW $_{total,}$ kt BOD_5/yr	95.5190	95.6220	95.7258	95.2168	95.3241	95.2190	95.1834	94.6080	94.7350	94.4985	94.5049

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
TOW $_{rural}$, kt BOD_5/yr	51.1913	51.0182	50.7817	50.7605	49.3670	48.5006	47.6263	46.8701	45.8542	44.8994	44.0177
TOW $_{urban}$, kt BOD_5/yr	42.6787	42.4882	42.3218	42.1456	40.1482	39.2483	38.3564	37.5727	36.6114	35.8416	35.0074
TOW $_{total,}$ kt BOD_5/yr	93.8700	93.5064	93.1035	92.9062	89.5152	87.7489	85.9827	84.4428	82.4656	80.7409	79.0251
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
TOW $_{rural}$, kt BOD_5/yr	43.2531	42.2462	41.3500	40.9673	40.5250	39.6407	38.7408	37.8592	37.0808	36.5799	35.9623
TOW $_{urban}$, kt BOD_5/yr	34.2702	33.3634	32.5506	32.3323	31.9458	31.5637	31.3093	31.1230	31.1901	31.3289	31.3981
TOW $_{total,}$ kt BOD_5/yr	77.5233	75.6095	73.9006	73.2996	72.4708	71.2044	70.0501	68.9822	68.2709	67.9088	67.3604

Step II: Selecting wastewater treatment systems and discharge pathways

The second step consists of selecting wastewater treatment and discharge pathways according to national conditions and by taking into consideration country-specific activity data. By applying Equation 6.2 in the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.12) it is possible to obtain the EFs for each wastewater treatment system and discharge pathway.

The value of the country-specific emission factor depends on the methane producing capacity (B_0), and the methane correction factor (MCF) specific to the respective wastewater treatment system and discharge pathway, respectively. B_0 represents the maximum methane producing capacity in a certain number of organic substances (expressed in BOD) in wastewater. MCF reveals the extent to which the methane producing capacity (B_0) is achieved within each type of wastewater treatment and discharge system. This is also an index of the degree that demonstrates to what extent the wastewater treatment system is anaerobic.

$$EFj = B_0 \bullet MCF_j$$

Where:

EF_j – emission factor, kg CH_4/kg BOD_5;

j – each treatment/discharge pathway or system;

B_0 – maximum methane producing capacity, kg CH_4/kg BOD_5 (according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.2, page 6.12, the default value used is 0.6);

MCF_j – methane correction factor (fraction) (Table 7-29).

Table 7-29: EFs used to estimate CH_4 emissions from source category 5D1 'Domestic Wastewater'

Type of systems	Wastewater treatment systems and discharge pathways, j	B_o, kg CH_4/kg BOD_5	MCF	EF, kg CH_4/kg BOD_5
Systems without wastewater treatment	River and lake discharge without the preventive wastewater treatment	0.6	0.1	0.06
	Stagnant sewer	0.6	0.5	0.30
	Sewer with rapid flow (open or closed)	0.6	0.0	0.0
Systems with wastewater treatment	Centralized, aerobic treatment plant, well managed (normative treatment)	0.6	0.1	0.6
	Centralized, aerobic treatment plant, not well managed (inefficient treatment)	0.6	0.2	0.12
	Anaerobic digester for sludge from wastewater treatment	0.6	0.8	0.48
	Anaerobic shallow lagoon (<2 m)	0.6	0.2	0.12
	Anaerobic deep lagoon (>2 m)	0.6	0.8	0.48
	Septic system (half of BOD settles in anaerobic tank)	0.6	0.3	0.18
	Latrine, dry climate, ground water table lower than latrine, small family (3-5 persons)	0.6	0.1	0.06
	Latrine, dry climate, ground water table lower than latrine, communal (many users)	0.6	0.5	0.30
	Latrine, wet climate/flush water use, ground water table higher than latrine	0.6	0.7	0.42
	Latrine, regular sediment removal to be used as fertilizer	0.6	0.1	0.06

Step III: Estimating total methane emissions from wastewater treatment and discharge

The third step consists of estimating total methane emissions from source category 5D1 'Domestic Wastewater' as a sum of emissions from each wastewater treatment and discharge system typical of the respective country. The assessment is done is according to Equation 6.1 in the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.11):

$$CH_4\ Emissions = [\sum_{ij}(U_i \bullet T_{ij} \bullet EF_j)] \bullet (TOW - S) - R$$

Where:

CH_4 Emissions – methane emissions in inventory year, kg CH_4/yr;

TOW – total organics in wastewater in inventory year, kg BOD/yr;

S – organic component removed as sludge in inventory year, kg BOD/yr;

Ui – fraction of population in income group *i,* in inventory year (fraction);

$T_{i,j}$ – degree of utilisation of treatment/discharge pathway or system, *j*, for each income group fraction *i,* in inventory year (fraction);

i – income group: rural – low income, urban – low income, urban – high income;

j – each treatment/discharge pathway or system;

EF_j – emission factor, kg CH_4/kg BOD;

R – amount of methane recovered in inventory year, kg CH_4/yr.

According to the recommendations set out in the 2006 IPCC Guidelines (Volume 5, Chapter 6, pages 6.14-6.15), the population generating wastewater is to be divided into groups depending on the level of economic development and, implicitly, by the urbanization degree of localities (Table 7-30), on which the access to wastewater collection and treatment systems, and the efficiency of these systems depends.

Table 7-30: Share of different groups from the total population in the RoM (U_i fraction, where 100% = 1.0) for 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
U_{rural}	0.5256	0.5251	0.5292	0.5310	0.5321	0.5324	0.5376	0.5381	0.5373	0.5387	0.5391
$U_{urban, low income}$	0.1857	0.1871	0.1839	0.1840	0.1845	0.1862	0.1837	0.1850	0.1886	0.1890	0.1905
$U_{urban, high income}$	0.2887	0.2879	0.2869	0.2850	0.2834	0.2813	0.2786	0.2768	0.2741	0.2724	0.2704
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
U_{rural}	0.5453	0.5456	0.5454	0.5464	0.5515	0.5527	0.5539	0.5551	0.5560	0.5561	0.5570
$U_{urban, low income}$	0.1860	0.1874	0.1892	0.1965	0.1872	0.1806	0.1763	0.1717	0.1667	0.1630	0.1583
$U_{urban, high income}$	0.2686	0.2670	0.2653	0.2572	0.2613	0.2667	0.2698	0.2733	0.2773	0.2809	0.2847
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
U_{rural}	0.5579	0.5587	0.5595	0.5589	0.5592	0.5567	0.5530	0.5488	0.5431	0.5387	0.5339
$U_{urban, low income}$	0.1533	0.1485	0.1434	0.1464	0.1442	0.1444	0.1453	0.1451	0.1452	0.1453	0.1475
$U_{urban, high income}$	0.2887	0.2928	0.2971	0.2947	0.2966	0.2989	0.3016	0.3060	0.3116	0.3160	0.3186

In the Republic of Moldova, the population was divided into the following groups:

- population with high urbanization rate and high incomes; this group comprises the population of Chisinau, Balti, Tiraspol, Bender, Rabnita and Cahul municipalities (Table 7-31);

Table 7-31: Population of the RoM with high urbanization rate and high income between 1990-2022, thousand inhabitants

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Chisinau	675.5	672.6	669.8	666.9	664.0	661.2	658.3	655.4	652.6	649.7	646.8
Balti	161.7	159.0	156.3	153.6	150.9	148.2	145.4	142.7	140.0	137.3	134.6
Bender	132.2	133.0	132.7	129.3	128.6	126.8	124.7	123.4	122.4	121.2	119.6
Tiraspol	183.7	186.0	186.2	185.1	185.6	183.1	176.8	173.1	170.5	168.0	164.9
Rabnita	62.2	62.9	63.0	62.4	63.2	63.4	62.5	62.0	61.6	61.1	60.5
Cahul	44.0	43.3	42.6	42.0	41.3	40.6	39.9	39.3	38.6	37.9	37.2
Total, $P_{urban, high income}$	**1259.3**	**1256.8**	**1250.6**	**1239.2**	**1233.6**	**1223.2**	**1207.7**	**1195.9**	**1185.7**	**1175.2**	**1163.6**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Chisinau	644.0	641.1	638.2	635.4	632.5	629.6	626.8	623.9	621.0	618.1	615.3
Balti	131.9	129.2	126.5	123.8	121.1	118.3	115.6	112.9	110.2	107.5	104.8
Bender	117.6	116.0	114.8	96.9	85.8	95.0	94.4	94.1	93.8	93.3	93.0
Tiraspol	161.9	159.2	155.8	144.0	142.1	140.4	138.6	137.3	137.8	136.8	135.7
Rabnita	59.6	58.5	57.5	53.5	52.8	52.2	51.4	50.8	50.1	49.4	48.8
Cahul	36.5	35.9	35.2	34.5	33.8	33.1	32.5	31.8	31.1	30.4	29.8
Total, $P_{urban, high income}$	**1151.5**	**1139.8**	**1128.0**	**1088.0**	**1068.1**	**1068.7**	**1059.3**	**1050.8**	**1044.0**	**1035.6**	**1027.3**
	2012	**2013**	**2014***	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Chisinau	612.4	609.5	606.7	604.0	599.1	594.2	590.1	589.8	594.5	602.3	604.4
Balti	102.1	99.4	96.7	96.0	96.3	95.6	95.1	94.6	94.2	94.2	92.2

Bender	92.4	91.9	91.0	84.7	83.8	83.7	83.2	83.4	83.4	83.4	83.4
Tiraspol	134.8	133.8	132.9	128.9	128.2	128.0	127.0	127.7	128.4	129.1	129.8
Rabnita	48.5	47.9	47.6	45.4	44.8	44.7	44.4	44.0	44.0	44.0	44.0
Cahul	29.1	28.4	27.7	27.2	26.6	25.8	25.0	24.4	24.2	24.2	23.5
Total, $P_{urban, high income}$	**1019.3**	**1010.9**	**1002.6**	**986.2**	**978.8**	**971.9**	**964.7**	**963.9**	**968.8**	**977.2**	**977.3**

*Due to the lack of statistical data regarding the population for 1991-2013, the population of Chisinau, Balti and Cahul was inferred using the extrapolation method.

Source:<http://statbank.statistica.md/pxweb/pxweb/ro/20%20Populatia%20si%20procesele%20demografice/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>; Statistical Yearbooks of ATULBD for the period 1998-2020 http://mer.gospmr.org/gosudarstvennaya-sluzhba-statistiki/informacziya/ezhegodnik-gosudarstvennoj-sluzhby-statistiki.html.

- population of Chisinau, Balti, Tiraspol, Bender, Rabnita and Cahul municipalities is connected to sewer systems and has access to centralized aerobic treatment plants for domestic and industrial wastewater collected together; their efficiency varies from efficient to less efficient; it is worth mentioning that a small part of the population of these municipalities is not connected to the centralized sewer system, the wastewater being collected in latrines and septic systems (with or without discharge);
- population with low urbanization level and low incomes; this group comprises the population of other cities in the Republic of Moldova, whose population is largely connected to sewage systems, which are rather not well managed; another part of the population within this group is not connected to sewage systems, the wastewater being collected in latrines and septic systems (with or without discharge);
- rural population; this group comprises the rural population of the Republic of Moldova, whose income is generally significantly lower than the level attributed to the urban population; a small part of the population of this group is connected to sewage systems that are not well managed; while most of the population is not connected to any sewage system, wastewater is collected in latrines (usually without discharge).

Thus, considering the level of economic development of the localities of the Republic of Moldova, the degree of urbanization, and the degree of connection to wastewater collection and treatment systems, according to statistical data on the access to sewage systems and to expert opinion, the values of country-specific emission factors used to estimate CH_4 emissions from the most representative wastewater treatment and discharge systems and for each population group of the Republic of Moldova during the reference period were established (1990-2022) (Table 7-32).

5D2 'Industrial Wastewater'

Step I: Estimating total organically degradable carbon in industrial wastewater (TOW)

According to the methodology available in the 2006 IPCC Guidelines, the amount of organically degradable carbon in wastewater is a function of industrial output, wastewater generation W (m^3/tonne of product) and degradable organics concentration in wastewater COD (kg COD/m^3).

The amount of total organically degradable carbon in wastewater (TOW) for the industrial sector was estimated using Equation 6.6 from the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.22):

$$TOW_{ind} = P_i \bullet W_i \bullet D_{ind}$$

Where:

TOW_{ind} – total organically degradable material in wastewater for industry *i*, kg COD/yr[140];

P_i – total industrial product for industrial sector *i*, t/yr;

W_i – wastewater generated per industrial production unit, $m^3/t_{product}$;

D_{ind} – chemical oxygen demand (industrial degradable organic component in wastewater) kg CCO/m^3. For this purpose, activity data on the generation of industrial wastewater (by industry) and its discharge into sewage networks was used.

Each industry branch was assigned a certain value of the degradable organic component expressed in kg COD/m^3 of industrial wastewater, the amount of wastewater generated per industrial production output unit expressed in m^3/tonnes of product (Table 7-32), as well as the amount of annual output for each industry branch (Table 7-33).

[140] COD – chemical oxygen demand.

Table 7-32: Country-specific factors used to estimate CH_4 emissions from source category 5D1 'Domestic Wastewater' for 1990-2022

Year		Degree of use of the wastewater treatment systems and discharge pathways j, for each population group – T_{ij}														
		U = urban, high income				U = urban, low income						U = rural				
	U_i	Centralized, aerobic treatment system (normative treatment)	Centralized, aerobic treatment system (insufficient treatment)	Latrines, ground water table lower than latrine, (3-5 persons)	Septic tanks	U_i	Centralized, aerobic treatment system (normative treatment)	Centralized, aerobic treatment system (insufficient treatment)	Latrines, ground water table lower than latrine, (3-5 persons)	Septic tanks	Wastewater discharge in river and lakes	U_i	Centralized, aerobic treatment system (normative treatment)	Centralized, aerobic treatment system (insufficient treatment)	Latrines, ground water table lower than latrine, (3-5 persons)	Septic tanks
1990	0.289	0.900	0.000	0.100	0.186	0.300	0.300	0.400	0.000	0.000	0.186	0.526	0.100	0.000	0.900	0.000
1991	0.288	0.882	0.020	0.098	0.187	0.280	0.320	0.400	0.000	0.000	0.187	0.525	0.100	0.000	0.900	0.000
1992	0.287	0.874	0.030	0.096	0.184	0.260	0.340	0.400	0.000	0.020	0.184	0.529	0.080	0.000	0.920	0.000
1993	0.285	0.866	0.040	0.094	0.184	0.240	0.360	0.360	0.000	0.040	0.184	0.531	0.060	0.000	0.940	0.000
1994	0.283	0.858	0.050	0.092	0.184	0.220	0.380	0.340	0.000	0.060	0.184	0.532	0.040	0.000	0.960	0.000
1995	0.281	0.800	0.060	0.140	0.186	0.180	0.400	0.340	0.000	0.080	0.186	0.532	0.020	0.000	0.980	0.000
1996	0.279	0.800	0.070	0.130	0.184	0.140	0.420	0.340	0.000	0.100	0.184	0.538	0.010	0.000	0.990	0.000
1997	0.277	0.790	0.070	0.140	0.185	0.090	0.440	0.350	0.000	0.120	0.185	0.538	0.000	0.015	0.985	0.000
1998	0.274	0.780	0.070	0.150	0.189	0.060	0.460	0.340	0.000	0.140	0.189	0.537	0.000	0.015	0.985	0.000
1999	0.272	0.770	0.070	0.160	0.189	0.020	0.480	0.350	0.000	0.150	0.189	0.539	0.000	0.017	0.983	0.000
2000	0.270	0.760	0.070	0.170	0.190	0.010	0.490	0.340	0.000	0.160	0.190	0.539	0.000	0.018	0.982	0.000
2001	0.269	0.750	0.070	0.180	0.186	0.010	0.490	0.320	0.000	0.180	0.186	0.545	0.001	0.019	0.980	0.000
2002	0.267	0.740	0.070	0.190	0.187	0.020	0.480	0.300	0.000	0.200	0.187	0.546	0.002	0.020	0.978	0.000
2003	0.265	0.730	0.070	0.200	0.189	0.030	0.470	0.300	0.000	0.200	0.189	0.545	0.003	0.021	0.976	0.000
2004	0.257	0.730	0.070	0.200	0.196	0.040	0.460	0.320	0.000	0.180	0.196	0.546	0.004	0.022	0.974	0.000
2005	0.261	0.730	0.070	0.200	0.187	0.040	0.460	0.330	0.000	0.170	0.187	0.551	0.005	0.023	0.972	0.000
2006	0.267	0.730	0.070	0.200	0.181	0.060	0.440	0.340	0.000	0.160	0.181	0.553	0.007	0.023	0.970	0.000
2007	0.270	0.730	0.070	0.190	0.176	0.070	0.430	0.350	0.000	0.150	0.176	0.554	0.009	0.023	0.968	0.000
2008	0.273	0.730	0.070	0.190	0.172	0.080	0.420	0.355	0.005	0.140	0.172	0.555	0.011	0.023	0.966	0.000
2009	0.277	0.730	0.070	0.190	0.167	0.090	0.410	0.335	0.015	0.150	0.167	0.556	0.013	0.023	0.959	0.005
2010	0.281	0.730	0.070	0.190	0.163	0.110	0.390	0.340	0.020	0.140	0.163	0.556	0.014	0.023	0.956	0.007
2011	0.285	0.730	0.070	0.190	0.158	0.150	0.350	0.340	0.030	0.130	0.158	0.557	0.015	0.024	0.946	0.015
2012	0.289	0.730	0.070	0.190	0.153	0.170	0.330	0.340	0.040	0.120	0.153	0.558	0.016	0.025	0.941	0.018
2013	0.293	0.730	0.070	0.185	0.148	0.200	0.300	0.340	0.050	0.110	0.148	0.559	0.017	0.026	0.937	0.020
2014	0.297	0.730	0.070	0.185	0.143	0.230	0.270	0.340	0.060	0.100	0.143	0.560	0.018	0.028	0.932	0.022
2015	0.295	0.730	0.070	0.185	0.146	0.230	0.270	0.350	0.060	0.090	0.146	0.559	0.019	0.028	0.928	0.025
2016	0.297	0.730	0.070	0.185	0.144	0.240	0.270	0.350	0.060	0.080	0.144	0.559	0.022	0.022	0.930	0.026
2017	0.299	0.740	0.060	0.182	0.144	0.270	0.270	0.328	0.062	0.070	0.144	0.557	0.026	0.020	0.927	0.027
2018	0.302	0.800	0.060	0.122	0.145	0.310	0.270	0.288	0.062	0.070	0.145	0.553	0.028	0.020	0.924	0.028
2019	0.306	0.830	0.050	0.102	0.145	0.320	0.270	0.278	0.062	0.070	0.145	0.549	0.030	0.020	0.922	0.028
2020	0.312	0.850	0.040	0.090	0.145	0.330	0.270	0.280	0.070	0.050	0.145	0.543	0.033	0.020	0.917	0.030
2021	0.316	0.870	0.030	0.070	0.145	0.350	0.270	0.250	0.080	0.050	0.145	0.539	0.035	0.020	0.915	0.030
2022	0.319	0.900	0.020	0.050	0.148	0.380	0.270	0.220	0.080	0.050	0.148	0.534	0.038	0.020	0.912	0.030

Table 7-33: EFs used to estimate CH_4 emissions from source category 5D2 'Industrial Wastewater'

Industrial production	D_{ind} – industrial degradable organic component, kg CDO/m^3	W_{ind} – amount of wastewater generated per industrial production output unit, m^3/t
Canned meat	4.1	13.0
Canned vegetables and fruit	5.0	20.0
Beer	2.9	6.3
Wine and sparkling wine	1.5	23.0
Cognac and brandy	11.0	24.0
Meat and sausages	4.1	13.0
Dairy products	2.7	7.0
Sugar	3.2	11.0
Fish	2.5	13.0
Oil and fats	0.8	3.1
Soft drinks	1.0	3.8
Corrugated cardboard	9.0	162.0
Plastic and rubber	3.7	0.6
Paint and varnishes	3.0	67.0
Detergents and soap	0.6	2.5
Leather	7.0	4.2
Textiles	1.0	42.6

Source: 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.9, page 6.22; Mircea Gh. Negulescu et al. (1968), Industrial Wastewater Treatment, Technical Publishing House, Bucharest, 1968; CEC VNII VODGEO GOSSTROI of the USSR (1982), Consolidated Norms in Water Supply and Water Disposal for Different Industries, Moscow, 1982; Sewage System for Populated Areas and Industrial Plants. Handbook. 'Stroiizdat' Moscow, 1981.

Table 7-34: AD on industrial output used to estimate CH_4 emissions from source category 5D2 'Industrial Wastewater', kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Canned meat	15.000	9.600	5.808	3.269	1.723	1.750	1.500	3.100	2.350	1.860	2.845
Canned vegetables and fruit	149.600	143.000	257.350	244.900	175.850	121.400	59.200	93.600	61.400	69.127	43.769
Fruit and vegetable juices	273.600	260.000	89.100	104.600	50.800	44.800	49.400	88.300	67.400	32.100	46.700
Canned and processed fruit	76.100	59.400	48.200	53.900	17.600	10.600	17.600	18.200	6.600	5.216	6.116
Beer	76.000	66.000	43.000	36.000	28.500	30.290	25.600	26.270	30.010	22.090	25.790
Grape wine	163.000	143.000	92.000	103.000	97.780	99.690	145.800	194.150	123.960	69.010	109.224
Sparkling wine	8.040	7.830	8.540	8.880	7.420	9.480	14.190	13.450	5.190	6.752	4.162
Cognac production	13.940	14.020	7.500	7.400	7.930	10.270	4.570	5.860	4.970	4.859	7.177
Brandy and liqueurs	5.590	5.560	6.760	13.940	26.470	41.270	33.580	23.700	17.410	8.700	4.890
Meat	257.900	218.500	136.000	114.200	85.900	58.400	52.600	50.800	27.300	25.717	13.351
Sausages	50.000	52.900	27.300	14.700	9.000	8.900	8.000	9.600	8.000	9.434	10.168
Butter	27.000	21.833	18.803	11.052	9.660	6.800	4.700	2.956	2.895	2.374	2.844
Margarine	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.024
Cheese and cottage cheese	12.200	10.000	5.400	4.900	3.200	2.100	1.700	1.213	1.328	1.325	1.212
Curd, curd cream, yogurt, kefir, sour cream	138.000	115.400	70.100	65.100	48.800	21.700	11.900	20.500	26.800	20.700	17.100
Ice cream	11.520	9.600	6.400	2.900	2.500	2.400	3.000	3.251	4.389	4.264	4.395
Milk and whipped cream with a fat content <6 %	454.800	382.600	180.500	175.100	86.700	39.500	36.100	26.600	32.400	25.984	26.764
Milk and whipped cream in solid form	15.500	12.000	9.200	4.300	4.700	4.400	3.100	2.647	2.389	1.962	3.114
Crude oils, not chemically modified	125.600	117.900	57.300	60.300	50.400	50.700	39.400	35.200	28.700	24.264	31.343
Granulated sugar	435.800	236.900	208.000	230.200	166.700	218.700	264.500	213.300	194.500	100.500	105.400
Fish and fish products	9.500	5.200	6.500	9.500	2.100	0.000	0.000	0.900	0.800	1.000	1.900
Mineral and aerated water	51.924	34.616	19.774	13.749	11.382	10.003	10.120	9.772	18.578	24.585	30.917
Other non-alcoholic drinks	131.330	86.220	32.407	18.703	17.081	20.490	15.080	14.330	15.570	15.140	19.180
Paper and corrugated cardboard	5.340	4.650	1.110	1.020	0.240	0.420	0.510	0.720	0.390	0.180	0.168
Boxes and crates of paper or corrugated cardboard	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Paper and items of paper for household use	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Synthetic resins	17.500	14.600	5.839	4.792	1.510	1.424	1.350	1.276	1.202	1.127	1.053
Paint and Varnishes	11.700	8.800	6.000	3.100	1.200	0.800	0.700	0.509	0.370	0.674	2.054
Soaps	11.700	8.000	4.800	2.700	0.700	0.600	0.500	0.608	0.301	0.231	0.231
Washing and cleaning products	15.000	10.100	9.900	4.900	1.200	1.400	1.600	0.293	0.172	0.258	0.386
Rough leather goods	0.439	0.404	0.106	0.064	0.027	0.047	0.054	0.053	0.055	0.018	0.013
Leather boxing clothes	1.174	1.173	0.897	0.611	0.182	0.143	0.177	0.214	0.095	0.040	0.043
Cotton yarn	31.600	32.600	16.668	8.561	4.252	2.655	6.524	5.364	10.552	8.131	13.030
Fabrics	33.540	16.770	11.372	7.575	5.048	3.761	7.681	7.297	13.644	11.486	17.064
Polymer film	5.200	4.400	2.600	2.300	1.200	0.712	1.896	1.285	1.268	0.701	1.734

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Canned meat	2.071	2.213	3.192	2.200	0.739	1.062	1.377	1.555	1.195	1.598	1.433
Canned vegetables and fruit	56.426	44.374	38.234	24.939	56.241	52.909	23.651	46.439	28.555	75.977	71.009
Fruit and vegetable juices	59.700	31.256	56.884	36.872	30.023	29.732	53.777	39.042	28.163	31.852	34.758
Canned and processed fruit	5.423	5.231	16.076	18.596	18.332	17.276	16.524	17.781	3.738	7.985	6.758
Beer	33.620	46.240	59.910	69.570	77.780	91.327	101.463	86.659	78.174	95.260	106.812
Grape wine	156.423	149.398	192.183	335.140	364.350	188.677	125.812	155.297	126.305	128.550	126.057
Sparkling wine	5.843	6.130	7.385	9.383	10.513	4.016	5.407	5.720	4.997	5.561	6.864
Cognac production	9.556	10.381	13.611	14.280	17.108	7.914	8.236	10.373	6.978	7.465	9.118
Brandy and liqueurs	5.940	7.790	13.980	21.291	23.876	19.625	17.216	12.911	11.080	12.711	14.021
Meat	7.301	11.262	14.855	10.180	6.651	10.228	16.122	12.809	16.260	24.699	28.509
Sausages	11.655	13.842	15.026	15.566	17.241	18.035	20.775	22.466	17.057	16.697	17.963
Butter	3.360	2.717	2.863	3.840	3.593	3.521	3.587	4.697	4.222	4.586	4.258
Margarine	1.034	2.616	3.301	3.515	3.390	2.624	2.225	1.940	1.657	1.274	1.119
Cheese and cottage cheese	1.484	1.895	1.895	1.941	2.435	2.081	2.311	2.609	1.463	1.828	2.153
Curd, curd cream, yogurt, kefir, sour cream	21.900	16.839	22.262	20.958	26.532	28.278	32.351	32.373	32.961	32.999	35.412
Ice cream	5.182	6.321	8.073	7.287	8.105	8.609	8.228	7.679	7.010	8.490	8.313
Milk and whipped cream with a fat content <6 %	35.171	43.060	16.925	16.049	20.784	50.349	55.271	66.597	61.398	65.056	62.921
Milk and whipped cream in solid form	5.000	4.186	3.709	5.059	4.565	3.806	2.676	2.693	1.821	1.217	0.625
Crude oils, not chemically modified	43.486	53.632	77.007	96.092	83.394	81.471	84.967	79.307	83.881	80.705	89.787
Granulated sugar	132.600	167.600	107.100	110.900	133.472	149.046	73.964	133.966	38.373	103.209	88.436
Fish and fish products	2.300	2.700	2.700	2.700	3.000	2.500	2.300	4.600	3.700	1.300	7.578
Mineral and aerated water	39.039	54.222	62.804	75.273	97.310	108.489	136.518	130.358	117.804	122.668	114.370
Other non-alcoholic drinks	30.910	51.370	63.450	69.743	69.438	81.344	101.594	87.526	67.617	73.043	80.746
Paper and corrugated cardboard	0.385	0.189	0.185	0.471	0.605	1.950	2.700	1.140	0.870	1.290	2.520
Boxes and crates of paper or corrugated cardboard	0.000	19.459	21.436	20.916	19.407	18.314	15.661	18.835	16.910	18.575	15.245
Paper and items of paper for household use	0.000	0.000	0.000	0.000	1.230	1.237	1.738	3.121	3.622	4.573	4.257
Synthetic resins	0.979	0.776	0.708	0.910	1.048	0.825	1.026	0.961	0.777	1.516	1.657
Paint and Varnishes	2.870	4.095	3.443	5.136	6.269	8.319	11.045	11.557	11.822	12.864	18.011
Soaps	0.280	0.232	0.339	0.386	0.317	0.526	0.562	0.399	0.380	0.538	0.523
Washing and cleaning products	0.821	0.255	0.243	0.493	0.533	0.769	1.034	0.451	0.482	0.618	0.727
Rough leather goods	0.012	0.004	0.002	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Leather boxing clothes	0.060	0.135	0.042	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cotton yarn	12.400	12.501	13.300	16.200	18.537	18.728	21.319	20.635	14.867	16.155	13.078
Fabrics	16.342	16.837	19.292	20.625	23.823	23.661	26.440	26.787	18.129	21.777	17.544
Polymer film	2.141	3.324	4.211	4.227	4.618	3.899	3.990	3.651	2.926	3.827	4.221
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Canned meat	1.654	0.969	0.825	0.769	0.806	0.886	0.926	0.917	1.109	0.957	1.177
Canned vegetables and fruit	81.109	100.844	104.250	70.864	86.085	96.595	115.820	20.703	21.743	22.732	20.222
Fruit and vegetable juices	55.428	60.119	59.077	45.869	60.264	67.861	79.355	101.970	51.504	77.139	73.770
Canned and processed fruit	0.436	10.741	7.598	7.895	9.427	8.239	12.544	9.422	5.099	13.106	9.325
Beer	111.844	102.927	98.475	99.454	84.784	86.647	81.954	83.920	83.260	92.450	88.650
Grape wine	142.202	155.166	140.946	135.653	134.575	165.232	171.726	178.330	174.300	158.070	145.070
Sparkling wine	6.539	5.995	5.220	5.023	6.332	6.524	6.744	6.790	6.626	9.653	10.004
Cognac production	10.940	11.797	9.395	7.016	5.014	8.400	8.769	9.190	7.330	9.606	7.792
Brandy and liqueurs	16.586	19.614	18.338	16.234	16.278	15.694	15.192	14.298	13.702	13.429	12.490
Meat	31.597	35.495	44.072	45.958	45.941	55.931	62.233	62.645	70.723	65.415	72.933
Sausages	19.633	21.265	20.824	21.739	21.271	23.225	24.798	25.951	26.964	27.177	29.526
Butter	4.392	5.811	5.008	5.062	6.138	5.053	4.270	4.303	4.069	3.958	3.535
Margarine	0.484	0.706	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Cheese and cottage cheese	2.250	2.525	2.481	2.500	2.497	2.993	2.951	2.697	3.013	3.100	2.834
Curd, curd cream, yogurt, kefir, sour cream	39.283	41.212	40.890	41.840	43.346	43.868	44.485	45.987	44.831	44.578	46.572
Ice cream	9.436	10.173	10.477	10.706	11.076	11.394	11.810	11.367	8.853	8.849	10.530
Milk and whipped cream with a fat content <6 %	62.397	65.313	78.723	79.970	85.957	79.991	69.061	61.287	56.535	55.365	48.025
Milk and whipped cream in solid form	0.536	0.439	1.042	1.357	1.675	2.474	2.276	0.864	0.953	0.617	0.629
Crude oils, not chemically modified	96.828	65.502	113.223	109.534	79.963	86.811	106.306	124.661	154.904	104.574	230.293
Granulated sugar	83.440	140.297	177.695	84.519	99.999	128.980	73.906	86.900	50.500	102.500	74.000

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Fish and fish products	7.732	8.490	8.774	9.966	8.086	7.788	7.954	7.403	7.617	8.481	8.371
Mineral and aerated water	114.375	100.470	115.695	126.312	132.573	145.461	158.805	171.473	164.510	171.949	178.949
Other non-alcoholic drinks	79.734	70.545	70.700	70.413	50.792	53.204	56.008	58.050	55.270	67.170	71.970
Paper and corrugated cardboard	1.324	2.467	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Boxes and crates of paper or corrugated cardboard	14.464	14.100	11.800	11.700	11.986	13.739	14.390	14.395	14.554	19.276	15.562
Paper and items of paper for household use	3.827	5.058	5.656	6.740	5.541	5.239	5.253	5.544	4.167	5.462	6.286
Synthetic resins	1.774	1.842	1.739	0.929	1.453	1.346	2.128	2.470	2.186	2.206	2.206
Paint and Varnishes	17.907	12.345	17.689	26.861	32.838	30.069	29.838	29.524	30.820	32.071	19.179
Soaps	0.570	0.637	0.786	0.993	0.995	1.243	1.261	1.540	2.042	1.579	1.883
Washing and cleaning products	0.798	1.892	1.416	1.760	2.821	2.155	2.674	3.715	3.724	4.052	4.148
Rough leather goods	0.000	0.007	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007
Leather boxing clothes	0.000	0.035	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.007
Cotton yarn	14.290	14.886	13.193	10.445	13.547	13.345	12.934	12.456	11.727	13.244	13.244
Fabrics	19.628	24.239	18.287	13.980	17.670	17.671	17.227	16.466	15.199	17.441	17.441
Polymer film	3.760	4.099	4.532	3.581	3.527	3.351	3.673	3.354	4.021	4.073	4.336

Source: National Bureau of Statistics of the Republic of Moldova through Letter 06-39/08 dated 23.02.2011 (activity data for the period 1990-2010); Statistical Reports PRODMOLD-A "Total production, as a natural expression, in the Republic of Moldova, by product type, for the period 2005-2022"; Statistical Yearbooks of ATULBD 1998 (p. 176-184), 2000 (p. 99-100), 2002 (p. 103-104), 2006 (p. 93-94), 2009 (p. 92-93), 2011 (p. 94-96), 2014 (p. 89-90), 2015 (p. 89-90), 2016 (p. 98-99), 2020 (p. 102-104); Express information, key performance indicators of the republic's industry for years 2020, 2019, 2018, 2017, 2016. <http://mer.gospmr.org/gosudarstvennaya-sluzhba-statistiki/informacziya/ezhegodnik-gosudarstvennoj-sluzhby-statistiki.html, http://mer.gospmr.org/gosudarstvennaya-sluzhba-statistiki/informacziya/osnovnye-pokazateli-raboty-promyshlennosti.html>.

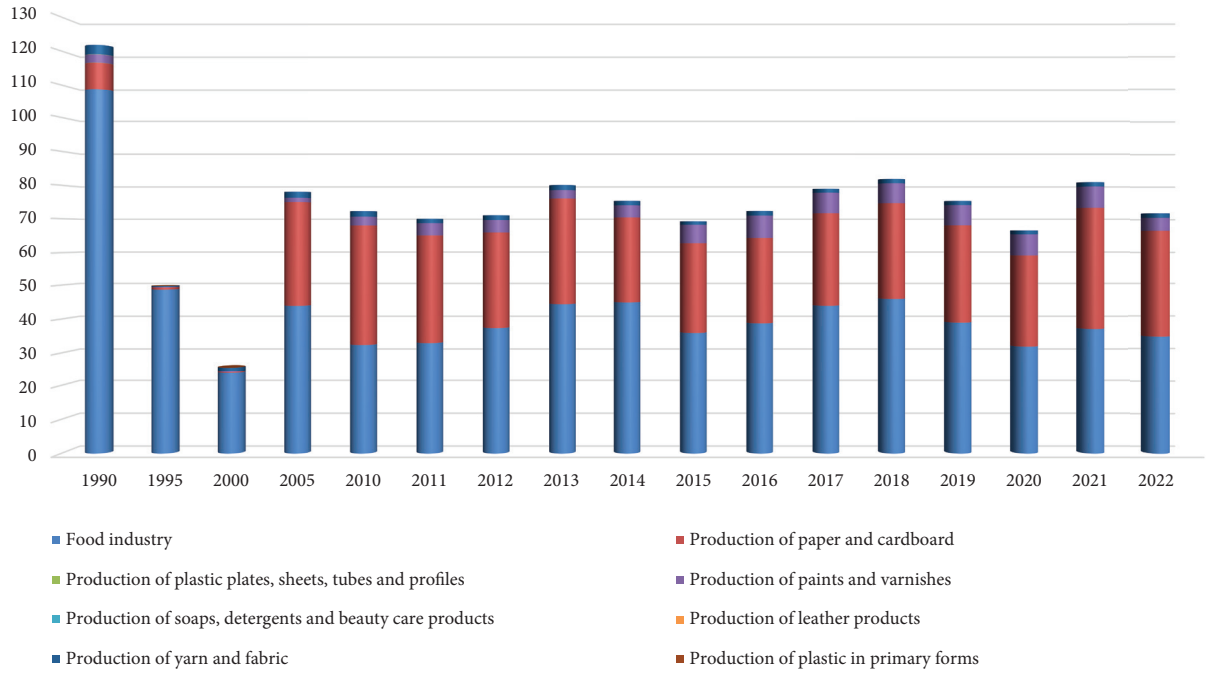


Figure 7-13: Total amount of organic substances in industrial wastewater (TOW_{ind}) by types of industrial activities in the Republic of Moldova between 1990-2022, kt COD/year.

Table 7-35: Total industrial organic wastewater (TOW_i) by industry branch in the RoM between 1990-2022, kt COD/yr

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Food industry	108.69813	92.47741	69.85920	71.19798	51.91604	48.67995	42.63622	47.63729	34.85916	24.06507	23.72038
Paper and cardboard	7.78572	6.77970	1.61838	1.48716	0.34992	0.61236	0.74358	1.04976	0.56862	0.26244	0.24494
Plastics production in primary forms	0.03885	0.03241	0.01296	0.01064	0.00335	0.00316	0.00300	0.00283	0.00267	0.00250	0.00234
Paints and varnishes production	2.35170	1.76880	1.20600	0.62310	0.24120	0.16080	0.14070	0.10231	0.07437	0.13547	0.41285
Soap, detergents and beauty care production	0.04005	0.02715	0.02205	0.01140	0.00285	0.00300	0.00315	0.00135	0.00071	0.00073	0.00093
Leather goods production	0.04742	0.04637	0.02949	0.01984	0.00615	0.00558	0.00679	0.00784	0.00440	0.00171	0.00163
Cotton yarn and fabrics production	2.77496	2.10316	1.19450	0.68741	0.39618	0.27330	0.60513	0.53934	1.03076	0.83568	1.28200
Plastic plates, sheets, tubes and profiles production	0.01154	0.00977	0.00577	0.00511	0.00266	0.00158	0.00421	0.00285	0.00281	0.00156	0.00385
Total (TOW_{ind}, kt COD/year)	**121.74838**	**103.24477**	**73.94835**	**74.04263**	**52.91836**	**49.73973**	**44.14278**	**49.34358**	**36.54350**	**25.30516**	**25.66892**

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Food industry	30.07709	28.53857	33.78991	37.96727	43.89397	35.26870	30.34485	33.70561	23.08315	32.36756	32.94512
Paper and cardboard	0.56162	28.64684	31.52380	31.18205	30.97103	31.34892	29.30481	33.67306	31.20295	35.63016	32.10874
Plastics production in primary forms	0.00217	0.00172	0.00157	0.00202	0.00233	0.00183	0.00228	0.00213	0.00172	0.00337	0.00368
Paints and varnishes production	0.57687	0.82310	0.69204	1.03234	1.26007	1.67216	2.22011	2.32302	2.37630	2.58574	3.62025
Soap, detergents and beauty care production	0.00165	0.00073	0.00087	0.00132	0.00127	0.00194	0.00239	0.00127	0.00129	0.00173	0.00187
Leather goods production	0.00210	0.00410	0.00130	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Cotton yarn and fabrics production	1.22439	1.24981	1.38844	1.56873	1.80454	1.80578	2.03455	2.02018	1.40564	1.61587	1.30448
Plastic plates, sheets, tubes and profiles production	0.00475	0.00738	0.00935	0.00938	0.01025	0.00866	0.00886	0.00811	0.00650	0.00850	0.00937
Total (TOW_{ind}, kt COD/year)	**32.45066**	**59.27224**	**67.40728**	**71.76311**	**77.94347**	**70.10798**	**63.91784**	**71.73338**	**58.07756**	**72.21293**	**69.99351**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Food industry	37.3690	44.3918	44.9077	35.9115	38.7600	43.9236	45.9287	38.9731	31.8953	37.0934	34.7001
Paper and cardboard	28.5999	31.5298	25.4503	26.8853	25.5545	27.6703	28.6396	29.0711	27.2952	36.0680	31.8544
Plastics production in primary forms	0.0039	0.0041	0.0039	0.0021	0.0032	0.0030	0.0047	0.0055	0.0049	0.0049	0.0049
Paints and varnishes production	3.5994	2.4813	3.5554	5.3991	6.6004	6.0438	5.9974	5.9343	6.1949	6.4463	3.8550
Soap, detergents and beauty care production	0.0021	0.0038	0.0033	0.0041	0.0057	0.0051	0.0059	0.0079	0.0086	0.0084	0.0090
Leather goods production	0.0000	0.0012	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Cotton yarn and fabrics production	1.4449	1.6667	1.3410	1.0405	1.3299	1.3213	1.2849	1.2321	1.1471	1.3072	1.3072
Plastic plates, sheets, tubes and profiles production	0.0083	0.0091	0.0101	0.0080	0.0078	0.0074	0.0082	0.0074	0.0089	0.0090	0.0096
Total (TOW_{ind}, kt COD/year)	**71.0276**	**80.0879**	**75.2717**	**69.2506**	**72.2615**	**78.9746**	**81.8693**	**75.2313**	**66.5549**	**80.9373**	**71.7403**

Step II: Selecting wastewater treatment systems and discharge pathways for industrial wastewater

The second step consists of selecting wastewater treatment and discharge pathways according to national conditions and by taking into consideration country-specific activity data. EFs for each wastewater treatment system and discharge pathway can be obtained by applying Equation 6.2 in the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.12).

The value of the emission factor typical of a wastewater treatment and discharge system depends on the methane producing capacity (B_0), and the methane correction factor (MCF) specific to the respective wastewater treatment system and discharge pathway, respectively. B_0 constitutes the maximum methane producing capacity in a certain number of organic substances (expressed in COD) within industrial wastewater. MCF indicates the extent to which the methane producing capacity (B_0) is achieved within each type of wastewater treatment and discharge system. This is also an index of degree that demonstrates to what extent the wastewater treatment system is anaerobic.

$$EFj = B_0 \bullet MCF_j$$

Where:

EF_j – emission factor, kg CH_4/kg COD;

j – each treatment/discharge pathway or system;

B_0 – maximum methane producing capacity, kg CH_4/kg COD (according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.2, page 6.12, the default value used for industrial wastewater is 0.25);

MCF_j – methane correction factor (fraction) (Table 7-36).

Table 7-36: EFs used to estimate CH_4 emissions from source category 5D2 'Industrial Wastewater'

Type of system	Wastewater treatment systems and discharge pathways, j	B_o, kg CH_4/ kg CBO_5	MCF	EF, kg CH_4/kg CBO_5
Systems without wastewater treatment	River and lake discharge without the preventive wastewater treatment	0.25	0.1	0.025
Systems with wastewater treatment	Centralized, aerobic treatment system, well managed (normative treatment)	0.25	0.1	0.050
	Centralized, aerobic treatment plant, not well managed (insufficient treatment)	0.25	0.3	0.025

Step III: Estimating total methane emissions from industrial wastewater treatment and discharge

The third step consists of estimating total methane emissions from source category 5D2 'Industrial wastewater' as a sum of emissions from each wastewater treatment discharge system. Similarly to domestic wastewater, the assessment for industrial wastewater is done according to Equation 6.1 in the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.11):

$$CH_4\ Emissions = [\Sigma_{ij}(U_i \bullet T_{ij} \bullet EF_j)] \bullet (TOW\text{-}S)\text{-}R$$

Where:

CH_4 Emissions – methane emissions in inventory year, kg CH_4/yr;

TOW – total organics in wastewater in inventory year, kg COD/yr;

S – organic component removed as sludge in inventory year, kg BOD/yr;

Ui – fraction of population in income group *i,* in inventory year (fraction);

$T_{i,j}$ – degree of utilisation of treatment/discharge pathway or system, *j*, for each income group fraction *i,* in inventory year (fraction);

i – income group: rural – low income, urban – low income;

j – each treatment/discharge pathway or system;

EF_j – emission factor, kg CH_4/kg COD;

R – amount of methane recovered in inventory year, kg CH_4/yr.

It should be noted that as industrial wastewater is discharged together with domestic wastewater, and most of the economic agents connected to the sewage systems operate in urban areas, the distribution among different wastewater management practices was allocated to the urban population, and subsequently divided into two subcategories: population with a high level of urbanization and population with a low level of urbanization, considering only centralised wastewater collecting systems and direct wastewater discharge into rivers and lakes (a situation which occurs in certain cities in the country).

Thus, similarly to domestic wastewater, by considering the level of economic development of localities of the RoM, degree of urbanization, and degree of connection to wastewater collection and treatment systems, respectively, according to expert opinion, the values of country-specific factors used to estimate CH_4 emissions from industrial wastewater during the reference period were established (1990-2022) (Table 7-37). These values are based on statistical data related to the number of economic agents by economic activity in the territory.

Table 7-37: Country-specific factors used to estimate CH_4 emissions from source category 5D2 'Industrial Wastewater' for 1990-2022

Year	Degree of use of the wastewater treatment systems and discharge pathways j, for each population group – T_{ij}						
	U = urban, high income			U = urban, low income			
	U_i	Centralized, aerobic treatment system (normative treatment)	Centralized, aerobic treatment system (insufficient treatment)	U_i	Centralized, aerobic treatment system (normative treatment)	Centralized, aerobic treatment system (insufficient treatment)	Wastewater discharge in rivers and lakes
1990	0.639	1.00	0.00	0.361	0.30	0.70	0.00
1991	0.641	0.98	0.02	0.359	0.35	0.65	0.00
1992	0.642	0.97	0.03	0.358	0.40	0.60	0.00
1993	0.644	0.96	0.04	0.356	0.42	0.58	0.00
1994	0.646	0.95	0.05	0.354	0.42	0.58	0.00
1995	0.647	0.94	0.06	0.353	0.44	0.56	0.00
1996	0.649	0.93	0.07	0.351	0.44	0.51	0.05
1997	0.651	0.92	0.08	0.349	0.44	0.51	0.05
1998	0.653	0.91	0.09	0.347	0.46	0.49	0.05
1999	0.654	0.90	0.10	0.346	0.48	0.47	0.05
2000	0.656	0.90	0.10	0.344	0.50	0.40	0.10
2001	0.658	0.90	0.10	0.342	0.52	0.38	0.10
2002	0.660	0.90	0.10	0.340	0.52	0.38	0.10
2003	0.661	0.90	0.10	0.339	0.50	0.34	0.16
2004	0.663	0.90	0.10	0.337	0.48	0.36	0.16
2005	0.662	0.91	0.09	0.338	0.49	0.35	0.16
2006	0.669	0.92	0.08	0.331	0.47	0.35	0.18
2007	0.668	0.93	0.07	0.332	0.46	0.34	0.20

Year	Degree of use of the wastewater treatment systems and discharge pathways j, for each population group – T_{ij}						
	U = urban, high income			U = urban, low income			
	U_i	Centralized, aerobic treatment system (normative treatment)	Centralized, aerobic treatment system (insufficient treatment)	U_i	Centralized, aerobic treatment system (normative treatment)	Centralized, aerobic treatment system (insufficient treatment)	Wastewater discharge in rivers and lakes
2008	0.672	0.94	0.06	0.328	0.45	0.35	0.20
2009	0.674	0.95	0.05	0.326	0.44	0.37	0.19
2010	0.670	0.95	0.05	0.330	0.41	0.40	0.19
2011	0.662	0.95	0.05	0.338	0.39	0.42	0.19
2012	0.657	0.95	0.05	0.343	0.38	0.43	0.19
2013	0.651	0.95	0.05	0.349	0.36	0.43	0.21
2014	0.652	0.95	0.05	0.348	0.34	0.46	0.20
2015	0.631	0.95	0.05	0.369	0.32	0.47	0.21
2016	0.629	0.95	0.05	0.371	0.28	0.52	0.20
2017	0.628	0.96	0.04	0.372	0.27	0.55	0.18
2018	0.628	0.96	0.04	0.372	0.27	0.55	0.18
2019	0.627	0.96	0.04	0.373	0.27	0.55	0.18
2020	0.624	0.97	0.03	0.376	0.30	0.52	0.18
2021	0.614	0.97	0.03	0.386	0.32	0.50	0.18
2022	0.617	0.97	0.03	0.383	0.35	0.47	0.18

N_2O Emissions from source category 5D1 'Domestic Wastewater'

Wastewater disposal into natural waterways is an important source of nitrous oxide emissions. These may be direct emissions from wastewater treatment plants or indirect emissions from wastewater after disposal of effluent into water bodies (rivers, lakes, or the sea).

Nitrous oxide emissions from source category 5D1 'Domestic Wastewater' were estimated following recommendations set in the 2006 IPCC Guidelines, based on the Tier 1 approach.

The assessment is done according to Equation 6.7 in the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.25):

$$N_2O\ Emissions = N_{EFFLUENT} \bullet EF_{EFFLUENT} \bullet 44/28$$

Where:

N_2O Emissions – N_2O emissions in inventory year, kg N_2O/yr;

$N_{EFFLUENT}$ – total nitrogen in the effluent discharged to aquatic environments, kg N/yr;

$EF_{EFFLUENT}$ – emission factor for N_2O emissions from discharged wastewater, kg N_2O-N/kg N; the default value used is 0.005 kg N_2O-N/kg N (2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.11, page 6.27);

[44/28] – mass ratio of N_2O-N to N_2O.

Activity data that is needed to estimate N_2O emissions is the nitrogen content in the wastewater effluent, country population and average annual per capita protein consumption.

To estimate average annual per capita protein consumption, the 'non-consumed' protein, as well as industrial and commercial protein discharged into the sewer systems will additionally be considered.

Food and food waste in the residential sector, which is not consumed but can be washed down the drain, as well as bath and laundry water, and industrial production waste and commercial food waste, e.g. from grocery stores and butcher shops, respectively, can be expected to contribute to nitrogen loadings and should be taken into consideration in the assessment process.

The total nitrogen in the effluent is estimated according to Equation 6.8 in the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.25):

$$N_{EFFLUENT} = (P \bullet Protein \bullet F_{NPR} \bullet F_{NON-CON} \bullet F_{IND-COM}) - N_{SLUDGE}$$

Where:

$N_{EFFLUENT}$ – total annual amount of nitrogen in the wastewater effluent, kg N/yr;

P – human population;

Protein – annual per capita protein consumption, kg/person/yr;

F_{NPR} – fraction of nitrogen in protein, default = 0.16 kg N/kg protein (2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.11, page 6.27);

$F_{NON-CON}$ – factor for non-consumed protein added to the wastewater (according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.11, page 6.27, default values are 1.1 for countries with no garbage disposals, and 1.4 for countries with garbage disposals);

$F_{IND-COM}$ – factor for industrial and commercial co-discharged protein into the sewer system (according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.11, page 6.27, the default value is 1.25);

N_{SLUDGE} – nitrogen removed with sludge (according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, page 6.25, the default value is 0), kg N/yr.

Activity data on average per capita protein consumption in the RoM is provided by the FAO database and the NBS (Table 7-38).

Table 7-38: AD used to estimate N_2O emissions from domestic wastewater treatment and discharge

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Protein consumption, g/per capita/day	84.27	77.69	71.11	67.06	65.02	65.90	64.93	66.52	67.44	66.15	67.72
Protein consumption, kg/per capita/day	0.08	0.08	0.07	0.07	0.07	0.07	0.06	0.07	0.07	0.07	0.07
Protein consumption, kg/per capita/year	30.76	28.36	26.03	24.48	23.73	24.05	23.76	24.28	24.62	24.14	24.79
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Protein consumption, g/per capita/day	68.94	71.00	68.87	65.70	62.50	65.70	62.20	58.10	60.70	60.00	61.60
Protein consumption, kg/per capita/day	0.07	0.07	0.07	0.07	0.06	0.07	0.06	0.06	0.06	0.06	0.06
Protein consumption, kg/per capita/year	25.16	25.92	25.14	24.05	22.81	23.98	22.70	21.26	22.16	21.90	22.48
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Protein consumption, g/per capita/day	63.30	65.20	66.00	67.70	69.30	72.70	76.10	77.60	78.6	77.6	75.6
Protein consumption, kg/per capita/day	0.06	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08
Protein consumption, kg/per capita/year	23.17	23.80	24.09	24.71	25.36	26.54	27.78	28.32	28.7	28.32	27.59

Source: UN database on food, FAOSTAT, FAO Statistics Division 2017, 13 June 2018, <http://www.fao.org/faostat/en/#data/CL>, since 2006 protein consumption is available in the NBS database <https://statbank.statistica.md/pxweb/pxweb/ro/30%20Statistica%20sociala/30%20Statistica%20sociala__04%20NIV__04%20NIV__NIV060/NIV060300.px/table/tableViewLayout1/?rxid=b2ff27d7-0b96-43c9-934b-42e1a2a9a774>.

N_2O emissions from advanced centralised wastewater treatment plants are typically much lower than those from effluent and may only be of interest for countries that have predominantly advanced centralized wastewater treatment plants with controlled nitrification and denitrification technologies.

N_2O emissions from such plants can be estimated according to Equation 6.9 in the 2006 IPCC Guidelines (Volume 5, Chapter 6, page 6.26):

$$N_2O_{PLANT} = P \bullet T_{PLANT} \bullet F_{IND-COM} \bullet EF_{PLANT}$$

Where:

N_2O_{PLANT} – total N_2O emissions from plants in inventory year, kg N_2O/yr;

P – human population covered by high-powered centralised wastewater treatment plants;

T_{PLANT} – degree of utilisation of modern, centralized WWT plants, % (in the RoM, it corresponds to $U_{urban, high\ income}$);

$F_{IND-COM}$ – fraction of industrial and commercial co-discharged protein (default = 1.25, according to the 2006 IPCC Guidelines, Volume 5, Chapter 6, Table 6.11, page 6.27);

EF_{PLANT} – emission factor, 3.2 g N_2O/person/yr (2006 IPCC Guidelines, Volume 5, Chapter 6, page 6.26).

If we consider including N_2O emissions from modern, centralized plants (N_2O_{PLANT}), the amount of nitrogen associated with these emissions (N_{WWT}) will be calculated and subtracted from the $N_{EFFLUENT}$. The N_{WWT} can be calculated by multiplying the values obtained for N_2O_{PLANTS} by 28/44 (conversion factor from N_2O to N_2O-N).

NMVOC Emissions from Source Category 5D1 'Domestic Wastewater'

NMVOC emissions from source category 5D1 'Domestic Wastewater' were estimated following recommendations set in the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019):

$$NMVOC\ Emissions = AR \bullet EF \bullet 10^{-6}$$

Where:

NMVOC Emissions – NMVOC emissions in inventory year, kt/yr;

AR = the activity rate for total wastewater discharged in inventory year, million m^3/yr (Table 7-28);

EF – emission factor, mg NMVOC/m^3 wastewater discharged (according to the EMEP/EEA Air Pollutant Emission Inventory Guidebook (2019), source category 5D 'Wastewater Treatment and Discharge', Table 3-1, page 7, the default value is 15 kg NMVOC/million m^3 wastewater discharged);

10^{-6} – conversion factor, from kg to kt.

7.5.3. Uncertainties and Time-Series Consistency

The primary factors affecting uncertainties are the estimation methodology, the emission factors used to estimate CH_4 and N_2O emissions from source category 5D 'Wastewater Treatment and Discharge' and the quality of the available activity data.

According to the information available in the 2006 IPCC Guidelines (Volume 5, Chapter 6, pages 6-17 and 6-23), uncertainties associated with the maximum methane producing capacity (B_0) could reach circa 30%; uncertainties associated with the methane correction factor (fraction) (MCF) for well managed plants could reach circa 10%, for not well managed plants – circa 30%, whereas for latrines – circa 50%.

Uncertainties related to population (P) could reach circa 5%; uncertainties related to BOD values (g/per capita/day) – circa 30%; uncertainties related to the fraction of population divided on income level could reach circa 15%; uncertainties related to the urbanisation level and access to wastewater treatment systems and discharge pathways could vary from 3% (for countries that have well developed statistical systems) up to circa 50% (for countries with poorly developed statistical systems).

Uncertainties related to activity data regarding industrial production for countries with poorly developed statistical systems could reach circa 25%; whereas those related to the W product (water consumption per unit of production) and COD (kg COD per cubic meter of wastewater) could reach magnitude two (-50%, +100%).

In the RoM, total uncertainties related to activity data used to estimate CH_4 and N_2O emissions from source category 5D 'Wastewater Treatment and Discharge' were considered to be circa 40%, whereas total uncertainties related to emission factors – circa 40% for methane emissions, and circa 50% for nitrous oxide emissions, respectively. Thus, combined uncertainties of activity data and emission factors for methane emissions constitute circa 56.56%, whereas for nitrous oxide emissions – circa 64.03% (Annex 2).

In view of ensuring time series consistency of results, the same approach was used for the entire period under review, in conformity with good practices applied in the GHG emissions inventory.

7.5.4. Description of Applied Flexibility

In the current inventory cycle, there was no need to apply the flexibility clause.

7.5.5. Quality Assurance and Quality Control

A standard verification and quality control form was filled in for this category following the Tier 1 methodological approach.

Verification was focused on various aspects such as: comparing and ensuring correct use of the emission factors, including the default emission factors available in the 2006 IPCC Guidelines; correct use of AD obtained from different reference sources, including from the Statistical Yearbooks of the RoM and ATULBD, as well as the FAO database; using the scientific literature in the field regarding planning water norms for different industries.

The AD and methods used for estimating GHG emissions from category 5D 'Wastewater Treatment and Discharge' were documented and archived both in hard copies and electronically.

7.5.6. Recalculations

In the current inventory cycle, recalculations of CH_4 emissions from category 5D 'Wastewater Treatment and Discharge' were carried out for the years 2005-2020 due to the revision of data associated with the number of the population, and for the years 1990-2020 – of the activity data regarding industrial production.

At the same time, in order to transfer CH_4 and N_2O emissions into CO_2 equivalent emissions, in the current inventory cycle, the GWP_{100} values available in the Fifth Assessment Report (IPCC AR5, 2014) were used for CH_4 – 28 and for N_2O – 265, instead of the GWP_{100} values available in the Fourth Assessment Report (IPCC AR4, 2007) (for CH_4 – 25 and for N_2O – 298), which led to the recalculation of direct GHG emissions for the entire period 1990- 2020.

Thus, recalculations resulted in an increase compared to the results obtained in the previous inventory cycle, as follows: about 1% in the years 1990-1991 and an increase from 4.2% to 12.9% in the period 1992-2020 (Table 7-39).

The CH_4 emissions from the respective category have decreased in the RoM between 1990-2022 by approximately 30.8%.

Table 7-39: Recalculations of CH_4 emissions from source category 5D 'Wastewater Treatment and Discharge' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	352.9650	341.5835	307.5895	309.9724	289.3528	287.1429	283.2511	289.6535	279.2682	270.5697	271.7416
BTR1	356.5846	345.9170	327.5649	328.0245	313.1718	315.7944	313.5987	318.5703	309.4460	300.9779	301.7489
Difference, %	1.0	1.3	6.5	5.8	8.2	10.0	10.7	10.0	10.8	11.2	11.0
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	294.4618	302.0785	303.7548	299.3127	288.2073	278.9966	280.4470	261.8981	265.2106	258.2525	294.4618
BTR1	328.0738	333.5034	337.1894	332.3447	319.2939	308.1750	309.3803	291.4873	297.3144	290.1132	328.0738
Difference, %	11.4	10.4	11.0	11.0	10.8	10.5	10.3	11.3	12.1	12.3	11.4
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	255.0776	256.3568	248.3385	240.8280	239.7768	235.7799	239.0924	237.9196	237.2010		
BTR1	286.3747	287.6922	278.0681	271.7799	270.7899	265.5271	266.6533	256.6320	247.0621	256.9871	246.6845
Difference, %	12.3	12.2	12.0	12.9	12.9	12.6	11.5	7.9	4.2		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

Recalculations of N_2O emissions from category 5D 'Wastewater Treatment and Discharge' were also carried out for 2005-2020, as a result of revising activity data associated with the population number and for the entire period under review – as a result of changing the GWP_{100} value used to transfer N_2O emissions into CO_2 equivalent emissions, as it was already mentioned above.

The recalculations resulted in a downward trend in N_2O emissions by circa 11% for the entire calculation period (Table 7-40), compared to the results obtained in the previous inventory cycle.

The N_2O emissions from the respective category decreased in the Republic of Moldova between 1990-2022 by circa 36.9%.

Table 7-40: Recalculations of N_2O emissions from source category 5D 'Wastewater Treatment and Discharge' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	87.9499	81.1694	74.3744	69.7653	67.7185	68.5592	67.5246	68.7603	69.8045	68.2978	69.9236
BTR1	78.2105	72.1809	66.1383	62.0396	60.2194	60.9671	60.0470	61.1459	62.0745	60.7346	62.1804
Difference, %	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	70.7055	72.5363	70.0571	66.6893	61.1268	62.9886	58.4323	53.6028	54.6899	52.9287	53.1868
BTR1	62.8757	64.5038	62.2991	59.3042	54.3579	56.0136	51.9619	47.6673	48.6341	47.0680	47.2977
Difference, %	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1	-11.1

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	53.6146	53.8608	53.2891	54.1915	54.8516	56.5448	58.2573	58.5106	58.4843		
BTR1	47.6782	47.8973	47.3891	48.2143	48.7957	50.2953	51.7941	52.0099	51.9943	51.0604	49.3425
Difference, %	-11.1	-11.1	-11.1	-11.0	-11.0	-11.1	-11.1	-11.1	-11.1		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

The total direct GHG emissions from category 5D 'Wastewater Treatment and Discharge' decreased in the Republic of Moldova between 1990-2022 by circa 31.9%.

Table 7-41: Recalculations of direct GHG emissions from source category 5D 'Wastewater Treatment and Discharge' included in the NC5 of the RoM to the UNFCCC, kt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	440.9149	422.7530	381.9639	379.7377	357.0713	355.7021	350.7757	358.4138	349.0727	338.8674	341.6652
BTR1	434.7951	418.0979	393.7032	390.0641	373.3912	376.7614	373.6457	379.7162	371.5205	361.7125	363.9292
Difference, %	-1.4	-1.1	3.1	2.7	4.6	5.9	6.5	5.9	6.4	6.7	6.5
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	347.9523	366.9981	372.1356	370.4440	360.4395	351.1959	337.4289	334.0498	316.5880	318.1393	311.4394
BTR1	369.0533	392.5776	395.8026	396.4936	386.7026	375.3075	360.1369	357.0476	340.1214	344.3824	337.4109
Difference, %	6.1	7.0	6.4	7.0	7.3	6.9	6.7	6.9	7.4	8.2	8.3
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	308.6921	310.2176	301.6276	295.0195	294.6284	292.3246	297.3497	296.4302	295.6853		
BTR1	334.0529	335.5894	325.4572	319.9942	319.5856	315.8224	318.4474	308.6419	299.0564	308.0475	296.0271
Difference, %	8.2	8.2	7.9	8.5	8.5	8.0	7.1	4.1	1.1		

Abbreviations: NC5 – Fifth National Communication; BTR1 – First Biennial Transparency Report.

NMVOC emissions from category 5D 'Wastewater Treatment and Discharge' decreased by circa 75.1% in the 1990-2022 period (Table 7-42).

Table 7-42: NMVOC emissions from source category 5D 'Wastewater Treatment and Discharge'

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NMVOC emissions, kt	0.0410	0.0373	0.0335	0.0299	0.0272	0.0207	0.0208	0.0186	0.0155	0.0119	0.0111
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NMVOC emissions, kt	0.0106	0.0104	0.0103	0.0103	0.0103	0.0103	0.0102	0.0102	0.0102	0.0102	0.0102
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NMVOC emissions, kt	0.0101	0.0101	0.0100	0.0100	0.0100	0.0100	0.0102	0.0102	0.0102	0.0101	0.0102

7.5.7. Planned Improvements

In order to improve the population's access to quality water supply and sewage systems, various sector action plans are adopted at different levels in the Republic of Moldova.

At the national level, the Strategy on Water Supply and Sanitation (2014-2030)[141] was approved by Government Decision No. 199/2014 (it was modified by Government Decision No. 442/2020[142]). The general objective of the Strategy is to ensure the gradual access to safe water and adequate sanitation for all localities and population of the Republic of Moldova, thus contributing to the improvement of health, dignity and quality of life and economic development of the country. The strategy denotes the impact of climate change, combined with the lack of water in the country, noting that ensuring water supply in the future requires integrated urban planning, which does not include actions to reduce GHG emissions from the wastewater management sector.

The Regulation on Wastewater Discharge in Water Bodies, approved through the Government Decision No. 802 as of 09.10.2013, aims to regulate the provisions of discharge, the introduction of specific substances into a body of surface water, groundwater or the lands of the water fund. Thus, the Regulation specifies the emission limit values applicable to the discharge of wastewater from industrial sectors (activities) into a body of surface water.

The Regulation on the requirements for the provisions of collection, treatment and discharge of wastewater in the sewage system and/or in water outlets for urban and rural localities, approved by Government Decision No. 950/2013[143] aims to regulate the conditions of collection, treatment of wastewater

[141] <http://lex.justice.md/index.php?action=view&view=doc&lang=1&id=352311>.
[142] < https://www.legis.md/cautare/getResults?doc_id=122313&lang=ro>
[143] < https://www.legis.md/cautare/getResults?doc_id=120783&lang=ro>

in the sewage system and/or in water outlets. Thus, the Regulation provides maximum permissible limit values for the wastewater loading with pollutants into natural discharges, which will contribute to the safe reduction of emissions from this sector.

The planning perspective of the sector may significantly improve the management of wastewater and sludge from source category 5D 'Wastewater Treatment and Discharge'. Sludge treatment will reduce the risk of affecting the quality of natural water resources, which is becoming increasingly sensitive to climate change, and, at the same time, will reduce GHG emissions from this sector, contributing to achieving the provisions of the Paris Agreement. The above-listed actions will contribute to the fulfilment of the obligations of the Republic of Moldova towards the implementation of the provisions of the Protocol on Water and Health and other international treaties, which aim to reduce the share of the population without access to drinking water sources and sewer systems, as well as the provisions of the UNFCCC.

The planning of phased harmonization of national water legislation with that of the European Union is also a good tool to enhance the implementation of best practices on wastewater treatment technologies and sludge within this sector, which would allow the capture and sustainable use of methane emissions from sludge storage fields (including for the production of thermal and electric energy). Studying the possibility of using country-specific information on the BOD fraction removed with sludge, maximum methane formation capacity, methane correction factor and other relevant parameters used to estimate emissions from source category 5D 'Wastewater Treatment and Discharge' in the process of estimating methane emissions will improve the quality of the next national GHG inventories.

CHAPTER 8. GHG RECALCULATIONS AND PLANNED IMPROVEMENTS

This chapter summarizes the explanations and justifications for the recalculations of direct GHG emissions performed for the period 1990-2020, included in the Fifth National Communication of the RoM to the UNFCCC (2023), as well as planned improvements for the next inventory cycles.

Specific information at source category level associated with the respective recalculations and planned improvements can also be found in Chapters 3-7 of the National Inventory Report: 1990-2022.

8.1. Explanations and Justifications for Recalculations

The National Inventory Team reviewed and recalculated GHG emissions and removals for each calendar year covered by the GHG inventory for the period from 1990 through 2020, a component of the Fifth National Communication of the RoM to the UNFCCC (2023).

These activities were carried out within the continuous process of improving the quality of the national GHG inventory (including by taking into account updated activity data, methodological approaches available in the 2006 IPCC Guidelines, considering new source categories for the first time in the inventory, updating the values of country-specific emission factors and correcting the errors identified, also resulting from the change of the global warming potential values for the 100-year horizon (GWP) available in the Fifth Assessment Report (IPCC AR5, 2014), instead of those available in the Fourth Assessment Report (IPCC AR4, 2007).

In the current inventory cycle, improvements were made for all sectors, and the need arose to recalculate national GHG emissions for the period 1990-2020, respectively, reflected in NC5 of the RoM to the UNFCCC (Chapter 2 'National Inventory of Greenhouse Gases').

Compared to the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes undertaken in the process of compiling this inventory resulted in a slight upward trend in total direct GHG emissions during the period 1990-2018, varying from a minimum increase by +0.3% in 2014, to a maximum increase by +2.3% in 2000, and in a slight downward trend in total direct GHG emissions in the years 2019 and 2020, varying from a minimum decrease by -1.1% in 2019, to a maximum decrease by -2.0% in 2020 (Table 8-1).

Table 8-1: Recalculated results of total national direct GHG emissions included in the NC5 of the RoM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	45.25	38.97	31.14	24.41	21.06	17.66	17.44	15.83	14.15	11.89	10.97
BTR1	45.48	39.21	31.44	24.70	21.38	17.94	17.59	16.04	14.39	12.12	11.22
Difference, %	0.5	0.6	1.0	1.2	1.5	1.6	0.8	1.3	1.7	1.9	2.3
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	11.66	11.56	12.00	12.56	12.95	12.13	12.17	12.64	12.61	13.36	13.70
BTR1	11.90	11.80	12.25	12.80	13.18	12.37	12.39	12.84	12.77	13.50	13.82
Difference, %	2.0	2.1	2.1	1.9	1.8	1.9	1.8	1.6	1.3	1.0	0.9
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	13.29	12.98	13.23	13.01	13.28	13.13	13.76	13.75	13.66		
BTR1	13.40	13.06	13.27	13.16	13.40	13.27	13.90	13.60	13.39	14.61	12.95
Difference, %	0.9	0.7	0.3	1.2	0.9	1.1	1.0	-1.1	-2.0		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

With reference to the net direct GHG emissions included in the NC5 of the RoM to the UNFCCC (2023), we will specify that the changes made in the process of compiling this inventory resulted in a slight upward trend in net direct GHG emissions between 1990-2018, varying from a minimum increase by +0.1% in 2014, to a maximum increase by +2.5% in 2000, and in a slight downward trend in net direct GHG emissions in 2019 and 2020, varying from a minimum decrease by -1.2% in 2019, to a maximum decrease by -2.1% in 2020 (Table 8-2).

Table 8-2: Recalculated results of total net direct GHG emissions included in the NC5 of the RoM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	43.59	36.25	29.02	22.27	18.99	15.63	14.97	13.71	12.02	10.04	8.84
BTR1	43.81	36.47	29.30	22.53	19.28	15.88	15.08	13.90	12.22	10.24	9.06
Difference, %	0.5	0.6	1.0	1.2	1.6	1.6	0.8	1.3	1.7	2.0	2.5
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	9.90	9.70	10.22	10.61	11.28	10.34	10.18	10.96	11.31	12.13	12.53
BTR1	10.10	9.91	10.44	10.81	11.49	10.54	10.37	11.13	11.45	12.24	12.62
Difference, %	2.1	2.1	2.1	2.0	1.8	2.0	1.9	1.6	1.2	0.9	0.7
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	12.09	11.91	12.50	11.83	12.34	12.13	12.92	13.77	13.66		
BTR1	12.18	11.97	12.52	11.96	12.44	12.26	13.04	13.60	13.37	14.66	13.37
Difference, %	0.8	0.5	0.1	1.1	0.8	1.0	0.9	-1.2	-2.1		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

8.1.1. Sector 1 'Energy'

The recalculation of direct GHG emissions from sector 1 'Energy' was carried out based on the change of the global warming potential values for the 100-year horizon (GWP) available in the Fifth Assessment Report (IPCC AR5, 2014), instead of those available in the Fourth Assessment Report (IPCC AR4, 2007) (for CH_4 – 28 instead of 25, for N_2O – 265 instead of 298). Likewise, the activity data associated with fuel consumption has been updated and specified for each individual source category; some errors associated with incorrect entry of activity data have also been removed.

Other reasons for the impactful source categories are presented below:

1A1. Energy Industries

- updated activity data for the years 2017, 2018 and 2020 for source 1A1b 'Petroleum Refining';
- estimation of GHG emissions from source 1A1c 'Manufacture of Solid Fuels' for the period 2012-2020 for the first time.

1A2. Manufacturing Industries and Construction

- the emission factors for liquefied petroleum gases and coal were specified;
- updating the value of natural gas consumption for the year 2020, for the territory on the LBDR.

1A5. Other

- the presentation by the Ministry of Defence of information on fuel consumption for the operation of military transport for the years 2017-2020;
- the exclusion of activity data from the calculations considered in the previous inventory cycle for the territory on the LBDR for the period 2014-2020 (these were generated indirectly, but the source of information was not considered sufficiently credible).

CO_2 Emissions from Biomass

- activity data on biomass consumption for the years 2012-2020 have been updated.

Compared to the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made in the current inventory cycle have resulted in a slight upward trend in direct GHG emissions from sector 1 'Energy' between 1990-2019, varying from a minimum increase by +0.3% in 1990-1992, to a maximum increase by 2.6% in 2017. Only in 2020 there was a 0.9% decrease in direct GHG emissions, compared to similar emissions reported in the NC5 of the RoM to the UNFCCC (Table 8-3).

Table 8-3: Recalculated results of total direct GHG emissions from Sector 1 'Energy' included in the NC5 of the RoM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	36.99	31.26	24.42	18.25	15.38	12.39	12.37	11.12	9.65	7.64	6.94
BTR1	37.09	31.35	24.50	18.32	15.45	12.47	12.46	11.18	9.71	7.70	7.02
Difference, %	0.3	0.3	0.3	0.4	0.5	0.6	0.7	0.5	0.6	0.8	1.1

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	7.57	7.36	8.04	8.55	8.84	7.98	8.15	8.45	8.88	9.50	9.79
BTR1	7.65	7.44	8.13	8.64	8.94	8.07	8.25	8.54	8.96	9.57	9.88
Difference, %	1.0	1.1	1.1	1.1	1.1	1.1	1.1	1.1	0.9	0.8	0.9
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	9.47	9.04	9.07	9.12	9.26	8.92	9.41	9.40	9.55		
BTR1	9.55	9.12	9.13	9.32	9.48	9.16	9.64	9.45	9.47	10.46	9.25
Difference, %	0.9	0.9	0.7	2.2	2.4	2.6	2.5	0.5	-0.9		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

8.1.2. Sector 2 'Industrial Processes and Product Use'

The recalculation of total direct GHG emissions from sector 2 'Industrial Processes and Product Use' was carried out based on the following considerations:

2A3. Glass Production

- CO_2 emissions from glass production were recalculated for the period 2014-2020 as a result of updating the activity data regarding the amount of glass produced based on the information collected through surveys from State Enterprise 'Chisinau Glass Factory', as well as from 'Vetropack Chisinau' JSC glass factories (M.E. 'Glass Container Company' JSC and M.E. 'Glass Container Prim' JSC), and as a result of updating the conversion coefficients, respectively (the average weight of a conventional glass container and the average weight of a glass sterilizing jar).

2A4. Other Uses of Soda Ash

- CO_2 emissions from other uses of soda ash have been recalculated for the years 2017-2020 as a result of updating the information on glass production in the Republic of Moldova, and the annual consumption of soda ash in the glass industry, respectively (the values associated with the annual consumption of soda ash in glass industry were estimated by directly surveying functional glass factories in the Republic of Moldova).

2D3. Solvent Use

- CO_2 emissions from category 2D3 'Solvent Use' have been recalculated for the period 2006-2020, as a result of updating data related to the country's population by the National Bureau of Statistics of the RoM; the use of the information regarding the production of bituminous products based on natural asphalt or natural bitumen available in the PRODMOLD-A Statistical Reports 'Total production, as a natural expression, in the RoM, by product type, in 2020', instead of the information received from SOE 'State Road Administration'; considering the quantities of varnishes and paints produced in ATULBD between 2012-2020 for the first time; using specified information regarding the number of cars imported into the RoM in the years 2015-2017 and 2020, based on the data provided by the Customs Service of the RoM.

2F1. Refrigeration and Air Conditioning

- HFC emissions from source category 2F1 'Refrigerating and Air Conditioning' were recalculated for the years 1995-2020 as a result of updating the share of refrigerants incorporated in refrigeration and air-conditioning equipment in the RoM; updating the information regarding the share of transport units equipped with air conditioning equipment, offered by the Public Services Agency of the RoM, based on the information included in the State Register of Transport; change in global warming potential values for the 100-year horizon (GWP_{100}), instead of the values available in the Fourth Assessment Report (IPCC AR4, 2007), the values available in the Fifth Assessment Report (IPCC AR5, 2014) were used (for HFC-32, the GWP_{100} 677 value was used instead of 675; for HFC-125, the GWP_{100} 3,170 value was used instead of 3,500; for HFC-134a, the GWP_{100} 1,300 value was used instead of 1,430; and for HFC-143a, the GWP_{100} 4,800 was used instead of 4,470).

2F2. Foam Blowing Agents

- HFC emissions from source category 2F2 'Foam Blowing Agents' have been recalculated for the years 1995-2020 as a result of the change in the 100-year global warming potential values (GWP_{100}), instead of the values available in the Fourth Assessment Report (IPCC AR4, 2007),

the values available in the Fifth Assessment Report (IPCC AR5, 2014) were used (in the case of HFC-134a, the GWP_{100} 1,300 value was used instead of 1,430; for HFC-152a: the GWP_{100} 138 value was used instead of 124; for HFC-245fa: the GWP_{100} 858 value was used instead of 1,030; and in the case of HFC-365mfc: the GWP_{100} 804 value was used instead of 794).

2F3. Fire Protection

- The emissions of HFC-227ea from source category 2F3 'Fire Protection' were recalculated in the current inventory cycle, as a result of using updated information on the import and commercialization of HFC-227ea in the RoM, provided by the company 'Micasa International' Ltd., the only importer and distributor of this substance on the territory of the RoM (in the previous inventory cycle, only the information provided by the Customs Service regarding the import of HCF-227ea in the RoM was available and used), as well as a result of the change in the global warming potential value for the 100-year horizon, the value (GWP_{100} 3,350) available in the Fifth Assessment Report (IPCC AR5, 2014) was used instead of the value (GWP_{100} 3,220) available in the Fourth Assessment Report (IPCC AR4, 2007).

2F4. Aerosols

- Emissions of HFC-134a from source category 2F4 'Aerosols' have been recalculated for the period 2003-2020 as a result of changing the global warming potential value for the 100-year horizon, the value (GWP_{100} 1300) available in the Fifth Assessment Report (IPCC AR5, 2014) was used instead of the value (GWP_{100} 1430) available in the Fourth Report Assessment (IPCC AR4, 2007).

2G1. Electrical Equipment

- SF_6 and CF_4 emissions from category 2G1 'Electrical Equipment' have been recalculated for the period 2003-2020 as a result of changing the 100-year global warming potential values (GWP_{100}). The value available in the Fifth Assessment Report (IPCC AR5, 2014) was used (in the case of SF_6, the GWP_{100} value used in the current inventory cycle is 23,500) instead of the values available in the Fourth Assessment Report 4 (IPCC AR4, 2007) (GWP_{100} value 22,800), whereas for CF_4, the GWP_{100} value used in the current inventory cycle is 6,630, instead of the value in the previous inventory cycle – 7,390).

2G3. N_2O from Product Uses

N_2O emissions from source category 2G3 'N_2O from Product Uses' have been recalculated for the period 1990-2006, as a result of changing the 100-year global warming potential value (GWP_{100}). The GWP_{100} 265 value available in the Fifth Assessment Report (IPCC AR5, 2014) was used instead of the GWP_{100} 298 value available in the Fourth Assessment Report (IPCC AR4, 2007).

Compared to the results recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made in the current inventory cycle resulted in an insignificant downward trend in direct GHG emissions between 1990-2020, varying from a minimum decrease by -0.02% in 1995 to a maximum decrease by -3.91% in 2019 (Table 8-4).

Table 8-4: Recalculated results of total direct GHG emissions from sector 2 'Industrial Processes and Product Use' included in the NC5 of the RoM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	1.61	1.41	0.82	0.74	0.56	0.46	0.42	0.45	0.38	0.34	0.32
BTR1	1.61	1.41	0.82	0.74	0.56	0.46	0.42	0.45	0.38	0.34	0.32
Difference, %	0.00	0.00	0.00	0.00	0.00	-0.02	-0.04	-0.05	-0.08	-0.11	-0.15
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
NC5	0.32	0.37	0.40	0.47	0.57	0.68	0.94	1.03	0.53	0.56	0.66
BTR1	0.32	0.37	0.40	0.47	0.57	0.68	0.93	1.02	0.52	0.55	0.65
Difference, %	-0.19	-0.22	-0.30	-0.34	-0.40	-0.49	-0.47	-0.54	-1.21	-1.34	-1.49
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
NC5	0.68	0.73	0.76	0.77	0.75	0.78	0.96	0.99	1.00		
BTR1	0.67	0.72	0.75	0.75	0.73	0.75	0.93	0.95	0.97	1.00	0.90
Difference, %	-1.80	-1.81	-1.96	-2.00	-2.09	-3.70	-3.42	-3.91	-2.83		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

8.1.3. Sector 3 'Agriculture'

Recalculations of total direct GHG emissions from sector 3 'Agriculture' were carried out as a result of changing the global warming potential values for the 100-year horizon (GWP) available in the Fifth Assessment Report (IPCC AR5, 2014), instead of those available in the Fourth Assessment Report (IPCC AR4, 2007) (for CH_4 – 28 instead of 25, for N_2O – 265 instead of 298). Other reasons are presented below at source category level:

3A. Enteric Fermentation

- Methane emissions from source category 3A 'Enteric Fermentation' have been recalculated for the years 2006-2020 as a result of updating the country-specific emission factor for sheep, following the use of a new series of activity data associated with the average weight of a head at the end of the year, available since 2006 for category 'ewes and rams' in Statistical Annual Report No. 24-agr 'Animal Breeding Sector. Basic indicators of the development of the livestock sector in households of all categories in the Republic of Moldova'.

3B. Manure Management

- Methane emissions from source category 3B 'Manure Management' have been recalculated for the years 2010-2020 as a result of updating the values of manure management systems applied in the Republic of Moldova for the categories of livestock and poultry, based on results of studies carried out in 2015 and 2021 by the National Agency for Food Safety.
- Nitrous oxide emissions from source category 3B 'Manure Management' have been recalculated for the years 1990-2020 as a result of revising the $N_{ex(T)}$ nitrogen excretion rates, based on updated country-specific information on typical weight (TAM) of an animal at the end of the year, for the categories 'cattle', 'sheep', 'swine' and 'horses', and as a result of updating the values of the share of manure management systems (MS%) applied in the RoM for livestock and poultry for the period 2015-2020, based on results of studies carried out in 2015 and 2021 by the National Agency for Food Safety (a new manure management system for swine was considered – the storage and preservation of manure in pits under their enclosure for more than 30 days).

3D.1.b. Organic N Fertilizers

- Direct N_2O_{ON} emissions from source category 3D.1.b 'Organic N Fertilizers' were recalculated for the period 1990-2020 as a result of changing activity data associated with organic fertilizers available for application to soil, having updated the value of $Nex_{(T)}$ nitrogen excretion rates, based on the updated country-specific information associated with the typical weight (TAM) of an animal at the end of the year, for categories 'cattle', 'sheep', 'swine' and 'horses', and as a result of updating the value of shares of manure management systems (MS%) applied in the RoM for livestock and poultry for the period 2015-2020, based on results of studies carried out by the National Agency for Food Safety in 2015 and 2021.

3D.1.c. Urine and Dung Deposited by Grazing Animals

- Direct N_2O_{PRP} emissions from source category 3D.1.c 'Urine and Dung Deposited by Grazing Animals' have been recalculated for the period 1990-2020 as a result of revising the value of $N_{ex(T)}$ nitrogen excretion rates, based on the updated country-specific information associated with the typical weight (TAM) of an animal at the end of the year, for categories 'cattle', 'sheep', 'swine' and 'horses', and as a result of updating the value of shares of manure management systems (MS%) applied in the RoM for livestock and poultry for the period 2015-2020, based on results of studies carried out by the National Agency for Food Safety in 2015 and 2021.

3D.2.a. Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)

- Indirect N_2O_{ATD} emissions from source category 3D.2.a 'Atmospheric Deposition of Nitrogen Oxides (NO_x) and Ammonia (NH_4)' have been recalculated for the period 1990-2020 as a result of revising the $N_{ex(T)}$ nitrogen excretion rate value, based on the updated country-specific information regarding the typical weight (TAM) of an animal at the end of the year, for the following categories: 'cattle', 'sheep', 'swine' and 'horses', and as a result of updating values of shares in ma-

nure management systems (MS%) applied in the RoM for livestock and poultry for the period 2015-2020, based on results of studies carried out in 2015 and 2021 by the National Agency for Food Safety.

3D.2.b. Nitrogen Leaching and Run-off

- Indirect N_2O_L emissions from source category 3D.2.b 'Nitrogen Leaching and Run-off' have been recalculated for the period 1990-2020 as a result of revising the $N_{ex(T)}$ nitrogen excretion rate value, based on the country-specific updated information regarding the typical weight (TAM) of an animal at the end of the year, for the following categories: 'cattle', 'sheep', 'swine' and 'horses', and as a result of updating values of shares in manure management systems (MS%) applied in the RoM for livestock and poultry for the period 2015-2020, based on results of studies carried out in 2015 and 2021 by the National Agency for Food Safety.

3H. Urea Application

- CO_2 emissions from source category 3H 'Urea Application' have been recalculated for the period 2017-2020, as a result of specifying the activity data associated with the import of urea into the RoM (code: 3102 10 100 – mineral or chemical N fertilizers: urea, with a nitrogen content of more than 45% of the weight of the anhydrous product in dry state: carbamide (urea), as well as 3102 10 900 – mineral fertilizers: urea granules, with a nitrogen content of 46.0%), offered by the Customs Service from the ASYCUDA World Integrated Customs Information System, which ensures the management and processing of customs forms and documents, used in customs clearance procedures, but being offered in a disaggregated manner only for the period of 2017-2022.

Compared to the results reported in NC5 of the RoM to the UNFCCC (2023), the changes made in the process of compiling this inventory resulted in an upward trend in direct greenhouse gas emissions between 1990-1995 and 1997-2009, varying from a minimum increase by 0.02% in 2010, to a maximum increase by 2.8% in 1994, and in a downward trend in direct greenhouse gas emissions in the years 1996 and 2011-2020, respectively, varying from a minimum decrease by 0.1% in 2012, to a maximum decrease by 5.2% in 2019 (Table 8-5).

Table 8-5: Recalculated results of total direct GHG emissions from sector 3 'Agriculture' included in the NC5 of the RoM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	5.08	4.70	4.29	3.75	3.48	3.17	3.01	2.62	2.52	2.31	2.14
BTR1	5.10	4.73	4.36	3.84	3.58	3.22	2.92	2.63	2.55	2.34	2.18
Difference, %	0.5	0.7	1.6	2.2	2.8	1.5	-3.1	0.1	1.1	1.2	2.0
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	2.23	2.30	2.06	2.06	2.06	2.01	1.62	1.70	1.73	1.80	1.74
BTR1	2.26	2.33	2.10	2.08	2.07	2.03	1.65	1.71	1.74	1.80	1.73
Difference, %	1.5	1.3	1.7	0.8	0.4	1.4	1.4	1.0	0.7	0.02	-0.3
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	1.65	1.77	1.97	1.70	1.83	1.88	1.84	1.80	1.55		
BTR1	1.64	1.76	1.94	1.66	1.74	1.83	1.81	1.71	1.48	1.68	1.36
Difference, %	-0.1	-0.7	-1.7	-2.7	-4.6	-2.5	-1.7	-5.2	-4.4		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

8.1.4. Sector 4 'Land Use, Land-Use Change and Forestry'

The recalculation of net direct GHG emissions from sector 4 'Land Use, Land-Use Change and Forestry' ('LULUCF') was carried out based on the following considerations:

4A2. Land Converted to Forest Land

- Recalculations of non-CO_2 emissions from forest fires were carried out, as a result of changing the global warming potential values for the 100-year horizon (GWP) available in the Fifth Assessment Report (IPCC AR5, 2014) instead of those available in the Fourth Assessment Report (IPCC AR4, 2007) (for CH_4 – 28 instead of 25, for N_2O – 265 instead of 298).

4B1. Cropland Remaining Cropland

- Recalculations of non-CO_2 emissions from post-harvest field burning of agricultural residues (stubble field burning) were carried out, as a result of changing the global warming potential values for the 100-year horizon (GWP) available in the Fifth Assessment Report (IPCC AR5, 2014) instead of those available in the Fourth Assessment Report (IPCC AR4, 2007) (for CH_4 – 28 instead of 25, for N_2O – 265 instead of 298).

4B2.2 Grassland Converted to Cropland

- For subcategory 4B2.2 'Non-CO_2 Emissions from Grasslands Converted to Cropland' recalculations were carried out as a result of changing the global warming potential value for the 100-year horizon (GWP) available in the Fifth Assessment Report (IPCC AR5, 2014), instead of those available in the Fourth Assessment Report (IPCC AR4, 2007) (for N_2O – 265 instead of 298).

4E2. Land Converted to Settlements

- For subcategory 4E2 'Land Converted to Settlements' (non-CO_2 emissions from land converted to settlements), recalculations were performed as a result of changing the global warming potential value for the 100-year horizon (GWP) available in the Fifth Assessment Report (IPCC AR5, 2014), instead of those available in the Fourth Assessment Report (IPCC AR4, 2007) (for N_2O – 265 instead of 298).

Compared to the data recorded in the NC5 of the RoM to the UNFCCC (2023), the changes made in the current inventory cycle have resulted in an upward trend in net CO_2 removals between 1990-2020, varying from a minimum of +0.7% in 1991 to a maximum of +524.0% in 2020 (Table 8-6).

Table 8-6: Recalculated net CO_2 removals from sector 4 'LULUCF' included in the NC5 of the RoM to the UNFCCC, Mt CO_2

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	-1.66	-2.72	-2.12	-2.14	-2.07	-2.03	-2.48	-2.12	-2.14	-1.84	-2.12
BTR1	-1.68	-2.74	-2.14	-2.16	-2.10	-2.06	-2.51	-2.15	-2.17	-1.88	-2.16
Difference, %	1.1	0.7	1.1	1.1	1.3	1.4	1.2	1.4	1.5	1.7	1.5
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	-1.77	-1.85	-1.78	-1.96	-1.67	-1.79	-1.99	-1.68	-1.29	-1.23	-1.17
BTR1	-1.80	-1.89	-1.82	-1.99	-1.70	-1.82	-2.02	-1.71	-1.32	-1.26	-1.20
Difference, %	1.8	1.8	1.8	1.6	1.9	1.7	1.5	1.8	2.3	2.3	2.4
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	-1.20	-1.07	-0.72	-1.18	-0.94	-0.99	-0.84	0.01	-0.004		
BTR1	-1.22	-1.09	-0.75	-1.20	-0.96	-1.01	-0.86	-0.005	-0.02	0.05	0.42
Difference, %	2.1	2.2	3.1	1.8	2.1	1.9	2.2	133.9	524.0		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

8.1.5. Sector 5 'Waste'

Recalculations of direct GHG emissions from sector 5 'Waste' were carried out based on the following considerations:

5A Solid Waste Disposal

- GHG emissions from category 5A 'Solid Waste Disposal' have been recalculated for the entire period 1990-2020, including as a result of revising the following parameters: the conversion coefficient of the MSW volume into mass units, DOC, DOC_f and the CH_4 fraction in the gas generated at solid waste landfills. At the same time, in order to transfer methane emissions into CO_2 equivalent, the GWP_{100} value available in the IPCC AR5 (2014) (GWP_{100} – 28) was used, instead of the GWP_{100} value from the IPCC AR4 (2007) (GWP_{100} – 25).

5C Incineration and Open Burning of Waste

- Direct and indirect GHG emissions from category 5C 'Incineration and Open Burning of Waste' have been recalculated for the years 2005-2020 as a result of revising data associated with the population number, and for the years 2015-2020 as a result of revising the waste generation

rate per capita for the urban and rural population. At the same time, to transfer direct GHG emissions into CO_2 equivalent, the global warming potential values for the 100-year horizon (GWP_{100}) available in the IPCC AR5 (2014) were used (for CH_4 – 28 and for N_2O – 265) instead of the GWP_{100} values from the IPCC AR4 (2007) (for CH_4 – 25 and for N_2O – 298).

5D Wastewater Treatment and Discharge

- CH_4 emissions from category 5D 'Wastewater Treatment and Discharge' have been recalculated for the years 2005-2020 as a result of revising data associated with the population number, and for the years 1990-2020 as a result of revising activity data regarding industrial production. At the same time, in order to transfer direct GHG emissions into CO_2 equivalent in the current inventory cycle, the global warming potential values (GWP) for the 100-year horizon (GWP_{100}) available in the IPCC AR5 (2014) were used (for CH_4 – 28 and for N_2O – 265) instead of the GWP_{100} values from the IPCC AR4 (2007) (for CH_4 – 25 and for N_2O – 298).

Compared to the results recorded in the previous inventory cycle, the changes made in the process of compiling this inventory resulted in an upward trend in direct GHG emissions between 1990-2015, varying between a minimum increase by 1.2% in 2015 and a maximum increase by 9.4% in 1995, and in a downward trend in direct GHG emissions between 2016-2020, respectively, varying between a minimum decrease by 0.2% in 2016 to a maximum decrease by 5.8% in 2020 (Table 8-7).

Table 8-7: Recalculated results of total direct GHG emissions from Sector 5 'Waste' included in the NC5 of the RoM to the UNFCCC, Mt CO_2 equivalent

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
NC5	1.57	1.60	1.60	1.66	1.64	1.64	1.64	1.63	1.60	1.60	1.57
BTR1	1.69	1.72	1.75	1.80	1.79	1.79	1.79	1.78	1.76	1.74	1.71
Difference, %	7.4	7.4	9.3	8.4	9.1	9.4	9.0	9.2	9.4	8.7	8.5
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
NC5	1.55	1.53	1.50	1.48	1.48	1.46	1.45	1.47	1.48	1.50	1.51
BTR1	1.68	1.66	1.63	1.61	1.61	1.59	1.56	1.56	1.56	1.56	1.55
Difference, %	8.4	8.3	8.5	9.0	8.7	8.3	7.7	6.5	5.2	4.1	2.9
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
NC5	1.49	1.44	1.42	1.42	1.45	1.54	1.56	1.56	1.57		
BTR1	1.54	1.47	1.45	1.44	1.45	1.53	1.52	1.50	1.48	1.47	1.45
Difference, %	2.8	2.2	1.7	1.2	-0.2	-0.8	-2.4	-4.1	-5.8		

Abbreviations: NC5 – Fifth National Communication of the RoM to the UNFCCC; BTR1 – First Biennial Transparency Report of the RoM to the UNFCCC.

8.2. Planned Improvements

A number of improvements are planned for the next inventory cycles. Institutional and procedural improvements, as well as those planned at the sectoral level, are listed below.

8.2.1. Institutional and Procedural Improvements

The estimations process of anthropogenic GHG emissions and removals could be enhanced through the following institutional and procedural improvements:

- enhancing the data management system used in each inventory cycle, as well as the periodical archiving of the inventory and the documentation based on which inventory was prepared, in order to comply with the principle of transparency;
- enhancing the level of knowledge of national experts and institutions involved in the compilation of the national GHG emission inventory by organising a series of thematic trainings, including those dedicated to the appropriation of reporting tools to UNFCCC and the Energy Community (EnC) Secretariat, and to the European Environment Agency (EEA), respectively;
- enhancing the professional skills of national experts involved in the inventory of GHG emissions from Key Categories, with the purpose of transitioning from default emission factors and Tier 1 methodologies to country-specific emission factors and Tiers 2 and 3 methodologies.

8.2.2. Planned improvements at sectoral level

Sector 1 'Energy'

The process of monitoring GHG emissions from Sector 1 'Energy' could be improved with:

- availability of new activity data on fuel consumption for electricity and heat production (source category 1A1 'Energy Industries); for industrial production and the construction sector (source category 1A2 'Manufacturing Industries and Construction'); for energy supply to the commercial/ institutional, residential, agriculture/forestry/fishing sectors (source category 1A4 'Other Sectors'), and for other works and energy needs (source category 1A5 'Other'), respectively, for the territory on the LBDR (filling in existing gaps for some years); there could also be potential improvements in identifying additional data sources or updating activity data in official statistical publications;
- for source category 1A3a 'Civil Aviation' in the EBs of the RoM, clear information regarding aviation gasoline consumption can be found only for the years 1990, 1993 and 1998; there is also a series of AD associated with aviation gasoline consumption for the years 2011-2022 provided by the Civil Aeronautical Authority, all of which allowed reconstruction by the interpolation method and/or by reallocations of fuel consumption within source category 1A3a 'Civil Aviation' from other source categories. The national inventory team is aware of the inconsistency of activity data associated with aviation gasoline consumption (the data being collected from two separate reference sources); however, this inconsistency would be difficult to eliminate at the moment. In the next inventory cycle, various options shall be analysed in order to improve the quality of the national greenhouse gas inventory for the respective source category;
- collecting additional activity data necessary for the use of the COPERT 5.7.1 programme (version from September, 2023) for source category 1A3b 'Road Transportation' for the entire period under review (for the time being, it has been possible to collect the activity data necessary to run the respective program only for the period 1995-2022);
- availability of additional data on fugitive leaks from oil and natural gas distribution networks (from the infrastructure needed to produce, collect, process, refine and distribute oil products and natural gases to final consumers; from equipment functioning, evaporation and venting losses, flaring, accidental releases from pipeline dig-ins, etc.) (source category 1B2 'Fugitive Emissions from Oil and Natural Gas), and in the case of adopting a higher-ranking estimation methodology, respectively; the possibility of obtaining AD associated with LPG consumption on the LBDR for the entire period under review will also be assessed;
- using higher-tier methodology (Tier 2 or 3) for source categories 1A1 'Energy Industries', 1A3a 'Civil Aviation', 1A3b 'Road Transportation', 1A3c 'Railways', and 1B2 'Fugitive Emissions from Oil and Natural Gas';
- extension of the data recording method on biomass consumption used in the Research on 'Energy Consumption in Households', conducted by the NBS of the RoM with the support of experts in the EnC in 2015 and for the period 1990-2009, thus ensuring the consistency of the results obtained for this source category for the entire time series covered by the inventory;
- availability of new AD on biomass consumption (source category 'CO_2 Emissions from Biomass') on the LBDR and filling existing gaps for some years.

Sector 2 'Industrial Processes and Product Use'

The process of monitoring GHG emissions from Sector 2 'IPPU' could be improved with:

- updating the activity data used in the estimation of GHG emissions from category 2A 'Mineral Industry' for the period 1990-2022;
- updating activity data on raw material consumption per tonne of production, as well as the specific electrode consumption per tonne of steel produced by enterprises in the RoM (source category 2C1 'Iron and Steel Production';

- updating the activity data used in the estimation of GHG emissions from category 2D 'Non-Energy Products from Fuels and Solvent Use' for the period 1990-2022;
- capacity-building activities by setting up an on-line information system for collecting AD from companies that import, use, dispose, and recycle freons and equipment which contain refrigerants. Such an information system will provide the Environment Agency and the MoEnv with more accurate activity data, which could potentially contribute to reducing uncertainties in the estimation of GHG emissions from category 2F 'Product Uses as Substitutes for ODS' in the RoM;
- updating the activity data used in the estimation of GHG emissions from category 2G 'Other Product Manufacture and Use' for the period 1990-2022.

Sector 3 'Agriculture'

The process of monitoring GHG emissions from Sector 3 'Agriculture' could be improved with:

- updating AD and productivity indicators used in the estimation of GHG emissions from category 3A 'Enteric Fermentation' based on the Tier 2 methodology, particularly for cattle and sheep, the categories of animals with the highest share in the structure of CH_4 emissions from this source category;
- updating AD and productivity indicators used to estimate methane emissions from category 3B 'Manure Management', particularly for cattle and swine, the categories of animals with a higher share in the structure of methane emissions from this source category; likewise activities on specifying coefficient values used to estimate national EFs based on the Tier 2 methodology;
- collecting additional data used to estimate N_2O emissions from source category 3B 'Manure Management', particularly data related to the share of manure management systems at national level during the period under review (historical data, starting with 1990, as well as for the recent period, periodically – once every 3 years), as well as data associated with specifying country-specific values of $N_{ex(T)}$ excretion rates (kg N/head/year) for the categories of animals in the RoM;
- updating AD and country-specific coefficients used in the estimation of direct N_2O emissions from crop residues returned to soils in the RoM;
- updating country-specific coefficients used in the estimation of direct N_2O emissions from nitrogen mineralization as a result of carbon losses resulting from land-use changes and soil management practices in the RoM; it is thereby relevant to establish the values of humus content in arable soils once every 3 years, (layer – 0-30 cm) in the northern part of the country (Napadova commune, Floresti district), and in the south of the country (Lebedenco commune, Cahul district) in order to identify the national average (SOC_0) and the average annual losses in the RoM during the reporting period to the UNFCCC.

Sector 4 'Land Use, Land-Use Change and Forestry'

The process of monitoring GHG emissions/removals from Sector 4 'LULUCF' could be improved with:

- improving records on actual wood consumption from forests in the RoM, as well as updating national emission/removal factors within category 4A 'Forest Land' (e.g., wood density, biomass expansion factor, emission factors from forest fires, etc.);
- improving records pertaining to the actual volume of wood mass from windbreak management and other types of forest vegetation (subcategory 4B1.1 'Cropland Covered with Woody Vegetation'), as well as activities aimed at the verification of emission/removal factors specific to perennial plantations (current biomass increments, biomass harvesting during clearings, etc.);
- improving the country-specific methodology (Banaru, 2000) and improving the quality of activity data used in the estimation of CO_2 emissions/removals from source category 4B1.2 'Annual Change in Carbon Stocks in Mineral Soils';

- improving cadastral records (as main sources of activity data) by mentioning in their explanatory notes the land-use categories to which the land excluded from the agricultural circuit is transferred (category 4C 'Grassland');
- improving cadastral records (as main sources of activity data) by accurately mentioning in their explanatory notes the initial land-use categories transferred to category 4D 'Wetlands';
- improving cadastral records (as main sources of activity data) by accurately mentioning in their explanatory notes the initial land-use categories transferred to category 4E 'Settlements';
- improving cadastral records (as main sources of activity data) by accurately mentioning in their explanatory notes the initial land-use categories transferred to category 4F 'Other Land'; at the same time, it is necessary to analyse the input-output process of land to category 4F 'Other Land', including in terms of establishing the average conversion period;
- improving statistical records (as main sources of activity data) regarding wood product production/ export/ import within category 4G 'Harvested Wood Products'.

Sector 5 'Waste'

The process of monitoring direct GHG emissions from Sector 5 'Waste' could be improved with:

- imposing a new approach to dealing with environmental issues in the RoM, in accordance with the country's commitments under ratified international conventions and agreements, and in terms of sustainable development, as well as from the perspective of the country's integration to the EU respectively; promoting statistical records on waste generated and the essential restructuring of waste management by taking into account international practices and EU standards in the field of MSW management;
- in the context of implementing Government Decision No. 501/2018 of the Instruction on keeping records and transmitting data on waste and its management, and in the context of implementing Government Decision No. 682/2018 on the Concept of the Waste Management Automated Information System (SIAMD) respectively, through which the reporting system www.siamd.gov.md was developed, given that between 2019 and 2022 were the first reporting years in the new system, it is recognized that the information collected does not reflect the actual situation in the field of waste management; thus, for example, the amount of MSW generated in rural localities are not subject to statistical records, as there are usually no waste collection services; likewise, albeit there are waste processing companies operating in the RoM, the information on the amount of recycled waste is not subject to strict statistical records; taking into account the RoM's trend towards alignment with EU standards, the sector is to be significantly restructured; in this context, most SWDS are to be re-established, and their number – drastically reduced;
- the necessity of updating activity data, particularly the revision of the transformation coefficient of the volume of MSW into quantity. In recent years, there have been upward trends in the share of packaging in the total amount of waste generated per capita, and the Sanitation Service in Chisinau shows that 1 m^3 of MSW constitutes between 150-200 kg, which means that the coefficient of 0.4 kg/1m^3 of MSW will be reviewed. In the next period, we shall analyse the AD reported in the Automated Information System, in the National Register of Emissions and Transfer of Pollutants, and in the Waste Management Automated Information System, by the waste collection services in the country;
- likewise, between May 2023 and March 2024, the Study on the morphological composition of municipal solid waste was undertaken with the support of the 'Energy Security of the Republic of Moldova' (MESA) Project, financed by USAID, with the involvement of the Environmental Reference Laboratory of to the Environment Agency, to be analysed at the National Research Institute – Development for Industrial Ecology, Bucharest, Romania, of the municipal solid waste generated in the Waste Management Regions (WMR) – 4 in Chisinau, and 7 in Balti. The chemical analyses carried out in the study covered: proximate analysis, establishing moisture content, volatile matter and ash content of waste fractions; elemental analysis, concerned with establishing the percentage of chemical elements in the waste fractions (carbon [C], hydrogen [H], nitro-

gen [N], sulphur [S] and oxygen [O]); establishing the thermal power of the waste components, which refers to the establishment of the calorific value of waste. The USAID/MESA Study provided information on waste composition for different components including: food waste, leaves and other garden waste, paper, cardboard, plastic film, plastic bottles, hard plastic, packaging, textiles, leather, glass, ferrous metals, aluminium, construction debris, hazardous waste, other fuels and other non-combustible/ inert waste, etc. The sampling and sorting procedures were carried out in accordance with the European Commission Methodology for Analysis of Solid Waste (SWA-Tool) and waste standards approved in the RoM (which are also those applied in the EU). All the information generated in the study will be processed and fully considered in the next inventory cycle of GHG emissions;

- the proper implementation of the Waste Management Strategy in the RoM for 2013-2027, which stipulates the development of integrated municipal waste management systems by harmonizing the legislative, institutional and regulatory framework with EU standards, based on the regional approach (geographical location, economic development, the existence of access roads, pedological and hydrogeological conditions, population number, etc.); promoting and implementing selective collection systems in all localities in both the residential and industrial sectors, as well as sorting, composting and recycling facilities; development of municipal waste disposal capacities through the construction of seven SWDS at regional level and two mechanical-biological treatment plants in Chisinau and Balti municipalities; in this context, it should be mentioned that Law No. 89 on the ratification of the Financing Agreement between the RoM and the European Investment Bank regarding the implementation of the 'Moldova Solid Wastes' project was approved in June 2020. Through this agreement between the European Investment Bank and the Government of the RoM, a loan of 200 Million Euro will be granted for the improvement of solid waste management services in the country. The loan will be offered in several instalments, the first instalment being 25 Million Euro. This Agreement aims to implement the Waste Management Strategy 2013-2027 in the RoM, involving projects aimed at modernizing and developing Solid Waste Management Systems and facilities in eight regions of our country; the projects will provide localities with new waste collection systems, mechanical-biological waste treatment plants and new regional sanitary landfills for the entire country; the projects will aim to reduce the negative impact on the environment and human health, by modernizing waste collection systems and separate collection of recyclable materials and bio-waste, as well as rehabilitating or discontinuing landfills; regional landfills will be equipped with biogas recovery systems, as it will contribute to the reduction of GHG emissions and thereby to the achievement of the NDC 2.0 targets, in accordance with to the provisions of the Paris Agreement;
- with respect to source category 5B 'Biological Treatment of Solid Waste', the practices of composting organic waste at national level are to be specified in order to determine the existence of these platforms in urban and rural localities, especially those with waste collection services; at the same time, with the implementation of a new integrated waste management system, waste composting facilities shall be developed, which would considerably reduce the impact on the environment and take control of biogas emissions;
- with reference to source category 5C 'Incineration and Open Burning of Waste', it is necessary to mention the fact that the Waste Management Automated Information System has already been developed and economic agents have submitted the first reports for the years 2019-2022; in the coming years, when the respective system becomes fully operational and includes all economic operators, all data on waste management shall be available, including treatment by incineration or burning; at the same time, the system will allow the collection of data on municipal waste or similar waste collected from the population and economic agents, as well as on the number of people benefiting from the waste collection service, this data being reported by the waste collection operators; at the same time, the Study of the morphological composition of waste, carried out with the support of the USAID funded project 'Moldova Energy Security Activity' (MESA), between May 2023 and March 2024, will provide additional details regarding the composition of waste, combustible fractions, and waste generation rate per capita; it shall thereby be possible

to improve the quality of activity data used for estimating emissions from the respective source category; in the next inventory cycle, the opportunity to estimate activity data for the calculation of carbon emissions of biogenic origin will be analysed;

- improving the population's access to quality water supply and waste collection services, in the context of implementing Government Decision no. 199 dated 20.03.2014 on the Strategy of Water Supply and Sanitation (2014-2028) (modified through Government Decision no. 442/2020), ensuring gradual access to quality water supply and proper sanitation for all localities and population of the RoM, thus contributing to the improvement of health, quality of life as well as to the economic development of the country;
- providing the entire population with access to improved waste collection systems by 2025, including up to 50% with sewage systems; increasing the performance levels of collective systems of water supply, sanitation and other types; increasing the degree of implementation of good practices recognized in the field of integrated water management as well as water supply and sanitation; reducing the amount of untreated wastewater discharged by 50%, and reducing untreated rainwater discharged into natural receptors; improving sludge management and quality of treated wastewater from centralised sewer systems or other waste collection systems, in the context of fully implementing Government Decision no. 1063 dated 16.09.2016 on approving the National Program for the Implementation of the Protocol on Water and Health in the Republic of Moldova for 2016-2025; the respective program also plans to establish several indicators to ensure the population's access to improved waste collection systems, and efficiency for managing the collective sanitation systems as well as other systems; ensuring effective collective sewer systems in 7 cities in the country by 2025; the application of good practices in the field of water supply management, water and sanitation management; ensuring sludge disposal or reutilisation from centralized collective sewer systems or other types of sewer systems;
- regulating conditions of discharge, the introduction of specific substances into a body of surface water, groundwater or lands of the water fund, in the context of implementing the Regulation on Wastewater Discharge in Water Bodies, approved through Government Decision no. 802 dated 09.10.2013; the Regulation indicates the emission limit values applicable to the discharge of wastewater from the industrial sectors (activities) into a body of surface water; it is expected that this regulation will produce a positive effect on the quality of AD and a decrease in emissions from source category 5D 'Wastewater Treatment and Discharge', respectively;
- regulating the conditions for wastewater collection, treatment and discharge in the sewer system and/or in emissaries, in the context of implementing the Regulation on Requirements for Wastewater Collection, Treatment and Discharge in the Sewage System and/or in Emissaries for Urban and Rural Areas, approved through Government Decision no. 950 dated 25.11.2013; the Regulation stipulates what the maximum allowable limit values for pollutants in discharged water into natural water emissaries are, which will contribute to a decrease in emissions within source category 5D 'Wastewater Treatment and Discharge';
- the planning of phased harmonization of national water legislation with that of the EU will enhance the implementation of best practices on sludge and wastewater treatment technologies within the sector, which would allow the capture and the sustainable use of methane emissions from sludge storage fields (including for the production of thermal and electric energy);
- using country-specific information on the degradable organic component (BOD_5) in wastewater; the BOD fraction removed with sludge; maximum methane formation capacity; methane correction factor and other relevant parameters used in the estimation of emissions from source category 5D 'Wastewater Treatment and Discharge' in the process of calculating methane emissions will improve the quality of the next national GHG inventories.

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ANNEXES

Annex 1. Key Categories

Annex 1-1. Key Categories – Methodology

According to the 2006 IPCC Guidelines, it is considered good practice to identify key categories of emissions and removals so as to contribute to the inventory quality. The identification practice is intended to help prioritize efforts to improve inventory quality. A key category is defined as *'a priority category within the national inventory system because its estimates influence total national direct greenhouse gas emissions, both in terms of absolute annual emissions as a trend over a period, or both'*.

This annex describes the key category analysis carried out for the Republic of Moldova's inventory, covering the period 1990-2022. The 2006 IPCC Guidelines first requires that inventories be disaggregated into categories from which key source and sink categories may be identified. Source and sink categories are defined according to the following recommendations:

- source category emissions, identified according to standard classification (2006 IPCC Guidelines), expressed in CO_2 equivalent units, calculated using the Global Warming Potential for 100 years (GWP) (**IPCC AR5, 2014**);
- a source category should be identified for each gas emitted by the source, since the methodological approaches, emission factors, and uncertainties utilised differ for each gas;
- source categories that use the same emission factors based on common methodological approaches are to be aggregated before analysis.

The analysis of key source and sink categories in the RoM was carried out following the Tier 1 approach in the 2006 IPCC Guidelines (key categories were identified by quantitative methods using a predetermined cumulative emission threshold) and the Tier 2 approach (key categories were identified by considering the uncertainties of the inventory results for the respective categories).

The quantitative approach identifies key categories from two perspectives. The first analyses each category's contribution to total national emissions. The second perspective analyses the trend of emission contributions from each category to identify where the greatest absolute changes (either increases or decreases) were recorded over a given time. The percentage contributions to both levels and trends in emissions are calculated and sorted from greatest to least. A cumulative total is calculated for both approaches. The 2006 IPCC Guidelines determined that a cumulative contribution threshold of 95% for both level and trend assessments is a reasonable approximation of circa 90% uncertainty for the Tier 1 methodological approach. The 95% cumulative contribution threshold was used in this analysis to define a higher threshold for identifying key categories. Thus, when source and/or sink contributions are sorted in decreasing order (from highest to lowest), those that contribute to 95% of the cumulative total, from a quantitative point of view, are considered key categories.

When using a Tier 1 approach, the level contribution of each source is calculated according to Equation A1-1.1 (Equation 4.1 in the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.1):

Equation A1-1.1:

$$\mathbf{L_{x,t} = \left| E_{x,t} \right| / \Sigma \left| E_{y,t} \right|}$$

Where:

$L_{x,t}$ = level assessment for source or sink *x* in latest inventory year (year *t*);

$\left| E_{x,t} \right|$ = absolute value of emission or removal estimate of source or sink category *x* in year *t* (expressed in CO_2 equivalent);

$\Sigma \left| E_{y,t} \right|$ = total contribution, which is the sum of the absolute values of emissions and removals in year *t* calculated using the aggregation level chosen by the country for key category analysis.

Because both GHG emissions and removals are entered with positive sign, the total contribution/ level can be larger than a country's total emissions, less removals.

Trend contribution of each source is calculated according to Equation A1-1.2 (Equation 4.2 in the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.1):

Equation A1-1.2:

$$T_{x,t} = \left| E_{x,0} \right| / \sum \left| E_{y,0} \right| \bullet \left| [(E_{x,t} - E_{x,0})/E_{x,0}] - [(\sum E_{y,t} - \sum E_{y,0}) / \left| \sum E_{y,0} \right|] \right|$$

Where:

$T_{x,t}$ = trend assessment of source or sink category *x* in year *t*, compared to the base year (year 0);

$E_{x,0}$ | = absolute value of emission or removal estimate of source or sink category *x* in year 0;

$E_{x,t}$ and $E_{x,0}$ = absolute value of emission or removal estimate of source or sink category *x* in years *t* and 0, respectively;

$\sum E_{y,t}$ and $\sum E_{y,0}$ = total inventory estimates in years *t* and 0, respectively.

Should a Tier 2 approach be utilised, the level contribution of each category is calculated following Equation A1-1.3 (Equation 4.4 in the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.2):

Equation A1-1.3:

$$LU_{x,t} = (L_{x,t} \bullet U_{x,t}) / \sum [(L_{y,t} \bullet U_{y,t})]$$

Where:

$LU_{x,t}$ = level assessment for category *x* in latest inventory year (year *t*) with uncertainty;

$L_{x,t}$ = level assessment for source or sink *x* in latest inventory (year *t*);

$U_{x,t}$ = category percentage uncertainty in year *t* calculated following the methodologies described in the 2006 IPCC Guidelines, Volume 1, Chapter 3 (Column G in Table 3.3); it should be noted that the uncertainties reported in Table 3.3 are asymmetrical, the relative uncertainty should be used; the relative uncertainty will always have a positive sign.

When using a Tier 2 approach (considering GHG emission uncertainty), a cumulative contribution threshold of 90% of the sum of all $LU_{x,t}$ was used in this analysis in order to define the limits in identifying key categories. Thus, when $LU_{x,t}$ contributions sorted in decreasing order (from highest to lowest) constitute 90% of the cumulative total, from a quantitative point of view, they are considered key categories.

Trend contribution of each source is calculated following Equation A1-1.4 (Equation 4.5 in the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.2):

Equation A1-1.4:

$$TU_{x,t} = (T_{x,t} \bullet U_{x,t})$$

Where:

$TU_{x,t}$ = trend assessment for category *x* in latest inventory year (year *t*) with uncertainty;

$T_{x,t}$ = trend assessment for source or sink category *x* in year *t* in the latest inventory year (year *t*) calculated according to Equation 4.2 in the 2006 IPCC Guidelines, Volume 1, Chapter 4.3.1;

$U_{x,t}$ = category percentage uncertainty in year *t* calculated following the methodologies described in the 2006 IPCC Guidelines, Volume 1, Chapter 3 (Column G in Table 3.3); the relative uncertainty will always have a positive sign.

When using a Tier 2 approach (considering GHG emission uncertainty), a cumulative contribution threshold of 90% of the sum of all $TU_{x,t}$ was used in this analysis in order to define the limits in identifying the key categories. Thus, when $TU_{x,t}$ contributions sorted in decreasing order (from highest to

lowest) constitute 90% of the cumulative total, from a quantitative point of view, they are considered key categories.

The key category analysis was performed using the Key Category Estimation Tool developed by the United States Environment Protection Agency (US EPA) (US EPA's Key Category Calculation Tool v2.8)[144].

Annex 1-2. Results of Key Category Analysis, following Tier 1 and Tier 2 methods, without LULUCF

Tier 1 – Level Assessment for 1990

Key Categories estimated using a Tier 1 method, Level Assessment, Base Year (1990)	GHG Emissions in 1990 (kt CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2	7,447	0.16	16.4%
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	7,414	0.16	32.7%
1A4 - Fuel Combustion Activities - Other Sectors - CO_2	7,372	0.16	48.9%
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CO_2	6,439	0.14	63.0%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO_2	4,112	0.09	72.1%
3A - Enteric Fermentation - CH_4	2,452	0.05	77.5%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO_2	1,899	0.04	81.6%
5A - Solid Waste Disposal - CH_4	1,228	0.03	84.3%
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural gas - CH_4	1,020	0.02	86.6%
3Da - Direct N_2O Emissions from Managed Soils - N_2O	1,011	0.02	88.8%
2A1 - Mineral industry - Cement Production - CO_2	972	0.02	90.9%
3B - Manure Management - CH_4	555	0.01	92.2%
3B1 - Direct N_2O Emissions from Manure Management - N_2O	418	0.01	93.1%
1A3c - Fuel Combustion Activities - Transport - Railways - CO_2	403	0.01	94.0%
5D - Wastewater Treatment and Discharge - CH_4	357	0.01	94.8%
3B5 - Indirect N_2O Emissions from Manure Management - N_2O	351	0.01	95.5%

Tier 1 – Level Assessment for 2022

Key Categories estimated using a Tier 1 method, Level Assessment, 2022	GHG Emissions in 2022 (kt CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	3,128	0.24	24.2%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO_2	2,705	0.21	45.0%
1A4 - Fuel Combustion Activities - Other Sectors - CO_2	1,965	0.15	60.2%
5A - Solid Waste Disposal - CH_4	1,130	0.09	68.9%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO_2	670	0.05	74.1%
3Da - Direct N_2O Emissions from Managed Soils - N_2O	579	0.04	78.6%
3A - Enteric Fermentation - CH_4	415	0.03	81.8%
2A1 - Mineral industry - Cement Production - CO_2	408	0.03	84.9%
5D - Wastewater Treatment and Discharge - CH_4	247	0.02	86.8%
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural gas - CH_4	228	0.02	88.6%
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2	214	0.02	90.2%
1A4 - Fuel Combustion Activities - Other Sectors - CH_4	194	0.01	91.7%
3Db - Indirect N_2O Emissions from Managed Soils - N_2O	160	0.01	93.0%
2D - Non-Energy Products from Fuels and Solvent Use - CO_2	159	0.01	94.2%
2F1 - Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs	156	0.01	95.4%

[144] US EPA's Key Category Calculation Tool v2.8, <https://www.epa.gov/ghgemissions/toolkit-building-national-ghg-inventory-systems>

Tier 1 – Trend Assessment

Key Categories estimated using a Tier 1 method, Trend Assessment	GHG Emissions in 2022 (kt CO_2 eq.)	Trend Assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2	214	0.04	20.4%
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CO_2	0	0.04	40.1%
1A3b - Fuel Combustion Activities - Transport - Road Transportation - CO_2	2,705	0.03	56.5%
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	3,128	0.02	67.4%
5A - Solid Waste Disposal - CH_4	1,130	0.02	75.7%
3Da - Direct N_2O Emissions from Managed Soils - N_2O	579	0.01	78.8%
3A - Enteric Fermentation - CH_4	415	0.01	81.9%
2F1 - Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs	156	0.00	83.6%
5D - Wastewater Treatment and Discharge - CH_4	247	0.00	85.1%
1A4 - Fuel Combustion Activities - Other Sectors - CO_2	1,965	0.00	86.5%
2A1 - Mineral industry - Cement Production - CO_2	408	0.00	88.0%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO_2	670	0.00	89.3%
3B - Manure Management - CH_4	46	0.00	90.5%
1A4 - Fuel Combustion Activities - Other Sectors - CH_4	194	0.00	91.6%
1A3c - Fuel Combustion Activities - Transport - Railways - CO_2	19	0.00	92.7%
2D - Non-Energy Products from Fuels and Solvent Use - CO_2	159	0.00	93.6%
2F2 - Product Uses as Substitutes for Ozone Depleting Substances - Foam Blowing Agents - HFCs	75	0.00	94.4%
3Db - Indirect N_2O Emissions from Managed Soils - N_2O	160	0.00	95.2%
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas - CH_4	228	0.00	95.9%

Tier 2 – Level Assessment for 1990

Key Categories estimated using a Tier 2 method, Base Year Level Assessment	GHG Emissions in 1990 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
3Da - Direct N_2O Emissions from Managed Soils - N_2O	1,011	0.17	16.9%
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2	7,447	0.09	25.7%
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	7,414	0.09	34.4%
1A4 - Fuel Combustion Activities - Other Sectors - CO_2	7,372	0.09	43.0%
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CO_2	6,439	0.08	50.6%
5D - Wastewater Treatment and Discharge - CH_4	357	0.06	57.0%
5A - Solid Waste Disposal - CH_4	1,228	0.06	63.1%
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas - CH_4	1,020	0.06	69.1%
1A3b - Fuel Combustion Activities - Transport - Road Transportation - CO_2	4,112	0.05	74.0%
3Db - Indirect N_2O Emissions from Managed Soils - N_2O	314	0.05	78.7%
3A - Enteric Fermentation - CH_4	2,452	0.04	82.8%
1A4 - Fuel Combustion Activities - Other Sectors - CH_4	322	0.03	85.4%
3B1 - Direct N_2O Emissions from Manure Management - N_2O	418	0.03	88.0%
3B5 - Indirect N_2O Emissions from Manure Management - N_2O	351	0.02	90.2%

Tier 2 – Level Assessment for 2022

Key Categories estimated using a Tier 2 method, Current Year Level Assessment	GHG Emissions in 2022 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
3Da - Direct N_2O Emissions from Managed Soils - N_2O	579	0.23	23.4%
5A - Solid Waste Disposal - CH_4	1,130	0.14	37.0%
5D - Wastewater Treatment and Discharge - CH_4	247	0.11	47.7%
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	3,128	0.09	56.6%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO_2	2,705	0.08	64.3%
3Db - Indirect N_2O Emissions from Managed Soils - N_2O	160	0.06	70.1%
1A4 - Fuel Combustion Activities - Other Sectors - CO_2	1,965	0.06	75.7%
1A4 - Fuel Combustion Activities - Other Sectors - CH_4	194	0.04	79.6%
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas - CH_4	228	0.03	82.8%
2F1 - Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs	156	0.03	85.4%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO_2	670	0.02	87.3%
2F2 - Product Uses as Substitutes for Ozone Depleting Substances - Foam Blowing Agents - HFCs	75	0.02	89.0%
3A - Enteric Fermentation - CH_4	415	0.02	90.7%

Tier 2 – Trend Assessment

Key Categories estimated using a Tier 2 method, Trend Assessment	GHG Emissions in 2022 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
3Da - Direct N_2O Emissions from Managed Soils - N_2O	579	0.19	18.6%
5A - Solid Waste Disposal - CH_4	1,130	0.15	33.6%
5D - Wastewater Treatment and Discharge - CH_4	247	0.10	43.5%
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2	214	0.09	52.1%
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CO_2	0	0.08	60.4%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO_2	2,705	0.07	67.3%
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	3,128	0.05	71.9%
3Db - Indirect N_2O Emissions from Managed Soils - N_2O	160	0.04	75.9%
2F1 - Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs	156	0.04	80.0%
1A4 - Fuel Combustion Activities - Other Sectors - CH_4	194	0.03	83.2%
2F2 - Product Uses as Substitutes for Ozone Depleting Substances - Foam Blowing Agents - HFCs	75	0.03	86.0%
3A - Enteric Fermentation - CH_4	415	0.02	87.8%
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas - CH_4	228	0.01	89.2%
2D - Non-Energy Products from Fuels and Solvent Use - CO_2	159	0.01	90.6%

Key Category Summary Table

Key Categories Summary Table based on Results of Level and Trend Assessments
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CO_2
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO_2
1A3b - Fuel Combustion Activities - Transport - Road Transportation - CO_2
1A3c - Fuel Combustion Activities - Transport - Railways - CO_2
1A4 - Fuel Combustion Activities - Other Sectors - CO_2
1A4 - Fuel Combustion Activities - Other Sectors – CH_4
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas - CH_4
2A1 - Mineral industry - Cement Production - CO_2
2D - Non-Energy Products from Fuels and Solvent Use - CO_2
2F1 - Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs
2F2 - Product Uses as Substitutes for Ozone Depleting Substances - Foam Blowing Agents - HFCs
3A - Enteric Fermentation - CH_4
3B - Manure Management - CH_4
3B1 - Direct N_2O Emissions from Managed Soils - N_2O
3B5 - Indirect N_2O Emissions from Manure Management - N_2O
3Da - Direct N_2O Emissions from Managed Soils - N_2O
3Db - Indirect N_2O Emissions from Managed Soils - N_2O
5A - Solid Waste Disposal - CH_4
5D - Wastewater Treatment and Discharge - CH_4

Annex 1-3. Results of Key Category Analysis, following Tier 1 and Tier 2 methods, with LULUCF

Tier 1 – Level Assessment for 1990

Key Categories estimated using a Tier 1 method, Base Year Level Assessment	GHG Emissions in 1990 (kt CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2	7,447	0.14	14.1%
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	7,414	0.14	28.2%
1A4 - Fuel Combustion Activities - Other Sectors - CO_2	7,372	0.14	42.2%
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CO_2	6,439	0.12	54.4%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO_2	4,112	0.08	62.2%
3A - Enteric Fermentation - CH_4	2,452	0.05	66.9%
4B1 - Cropland Remaining Cropland (Emissions) - CO_2	2,333	0.04	71.3%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO_2	1,899	0.04	74.9%
4A1 - Forest Land Remaining Forest Land (Removals) - CO_2	-1,579	0.03	77.9%
5A - Solid Waste Disposal - CH_4	1,228	0.02	80.2%
4C2 - Land Converted to Grassland (Removals) - CO_2	-1,206	0.02	82.5%
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas - CH_4	1,020	0.02	84.4%
3Da - Direct N_2O Emissions from Managed Soils - N_2O	1,011	0.02	86.4%
4A2 - Land Converted to Forest Land (Removals) - CO_2	-984	0.02	88.2%
2A1 - Mineral industry - Cement Production - CO_2	972	0.02	90.1%
4D2 - Land Converted to Wetlands (Removals) - CO_2	-555	0.01	91.1%
3B - Manure Management - CH_4	555	0.01	92.2%
3B1 - Direct N_2O Emissions from Manure Management - N_2O	418	0.01	93.0%
1A3c - Fuel Combustion Activities - Transport - Railways - CO_2	403	0.01	93.7%
5D - Wastewater Treatment and Discharge - CH_4	357	0.01	94.4%
3B5 - Indirect N_2O Emissions from Manure Management - N_2O	351	0.01	95.1%
1A4 - Fuel Combustion Activities - Other Sectors - CH_4	322	0.01	95.7%

Tier 1 – Level Assessment for 2022

Key Categories estimated using a Tier 1 method, Current Year Level Assessment	GHG Emissions in 2022 (kt CO_2 eq.)	Level Assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	3,128	0.18	18.4%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO_2	2,705	0.16	34.4%
1A4 - Fuel Combustion Activities - Other Sectors - CO_2	1,965	0.12	45.9%
4B1 - Cropland Remaining Cropland (Emissions) - CO_2	1,589	0.09	55.3%
5A - Solid Waste Disposal - CH_4	1,130	0.07	61.9%
4A1 - Forest Land Remaining Forest Land (Removals) - CO_2	-913	0.05	67.3%
4A2 - Land Converted to Forest Land (Removals) - CO_2	-680	0.04	71.3%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO_2	670	0.04	75.3%
3Da - Direct N_2O Emissions from Managed Soils - N_2O	579	0.03	78.7%
3A - Enteric Fermentation - CH_4	415	0.02	81.1%
2A1 - Mineral industry - Cement Production - CO_2	408	0.02	83.5%
4F2 - Land Converted to Other Lands (Emissions) - CO_2	304	0.02	85.3%
5D - Wastewater Treatment and Discharge - CH_4	247	0.01	86.8%
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas - CH_4	228	0.01	88.1%
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2	214	0.01	89.4%
1A4 - Fuel Combustion Activities - Other Sectors - CH_4	194	0.01	90.5%
4E2 - Land Converted to Settlements (Emissions) - N_2O	160	0.01	91.5%
3Db - Indirect N_2O Emissions from Managed Soils - N_2O	160	0.01	92.4%
2D - Non-Energy Products from Fuels and Solvent Use - CO_2	159	0.01	93.3%
2F1 - Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs	156	0.01	94.3%
4B2 - Land Converted to Cropland (Emissions) - CO_2	141	0.01	95.1%
4C2 - Land Converted to Grassland (Removals) - CO_2	-123	0.01	95.8%

Tier 1 – Trend Assessment

Key Categories estimated using a Tier 1 method, Trend Assessment	GHG Emissions in 2022 (kt CO_2 eq.)	Trend Assessment	Cumulative Sum (%)
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2	214	0.04	12.4%
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CO_2	0	0.04	24.2%
4C2 - Land Converted to Grassland (Removals) - CO_2	-123	0.04	35.7%
4A1 - Forest Land Remaining Forest Land (Removals) - CO_2	-913	0.03	46.3%
1A3b - Fuel Combustion Activities - Transport - Road Transportation - CO_2	2,705	0.03	55.1%
4A2 - Land Converted to Forest Land (Removals) - CO_2	-680	0.02	61.0%
4B1 - Cropland Remaining Cropland (Emissions) - CO_2	1,589	0.02	66.3%
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	3,128	0.02	71.5%
4D2 - Land Converted to Wetlands (Removals) - CO_2	-84	0.02	76.6%
5A - Solid Waste Disposal - CH_4	1,130	0.01	81.2%
3A - Enteric Fermentation - CH_4	415	0.01	83.2%
1A4 - Fuel Combustion Activities - Other Sectors - CO_2	1,965	0.01	84.9%
3Da - Direct N_2O Emissions from Managed Soils - N_2O	579	0.01	86.5%
4F2 - Land Converted to Other Lands (Emissions) - CO_2	304	0.00	88.1%
4G - Harvested Wood Products - CO_2	-4	0.00	89.3%
2F1 - Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs	156	0.00	90.2%
5D - Wastewater Treatment and Discharge - CH_4	247	0.00	91.1%
4B2 - Land Converted to Cropland (Emissions) - CO_2	141	0.00	91.8%
3B - Manure Management - CH_4	46	0.00	92.6%
4E2 - Land Converted to Settlements (Emissions) - N_2O	160	0.00	93.3%
2A1 - Mineral industry - Cement Production - CO_2	408	0.00	93.9%
1A3c - Fuel Combustion Activities - Transport - Railways - CO_2	19	0.00	94.6%
1A4 - Fuel Combustion Activities - Other Sectors - CH_4	194	0.00	95.1%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO_2	670	0.00	95.7%

Tier 2 – Level Assessment for 1990

Key Categories estimated using a Tier 2 method, Base Year Level Assessment	GHG Emissions in 1990 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
4A2 - Land Converted to Forest Land (Removals) - CO_2	-984	0.13	13.3%
4A1 - Forest Land Remaining Forest Land (Removals) - CO_2	-1,579	0.07	20.3%
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2	7,447	0.07	27.3%
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	7,414	0.07	34.3%
1A4 - Fuel Combustion Activities - Other Sectors - CO_2	7,372	0.07	41.2%
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CO_2	6,439	0.06	47.3%
5D - Wastewater Treatment and Discharge - CH_4	357	0.05	52.4%
5A - Solid Waste Disposal - CH_4	1,228	0.05	57.3%
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas - CH_4	1,020	0.05	62.1%
3Da - Direct N_2O Emissions from Managed Soils - N_2O	1,011	0.04	66.4%
1A3b - Fuel Combustion Activities - Transport - Road Transportation - CO_2	4,112	0.04	70.2%
3Db - Indirect N_2O Emissions from Managed Soils - N_2O	314	0.04	74.0%
4B1 - Cropland Remaining Cropland (Emissions) - CO_2	2,333	0.03	77.5%
3A - Enteric Fermentation - CH_4	2,452	0.03	80.7%
4C2 - Land Converted to Grassland (Removals) - CO_2	-1,206	0.03	83.6%
1A4 - Fuel Combustion Activities - Other Sectors - CH_4	322	0.02	85.8%
3B1 - Direct N_2O Emissions from Manure Management - N_2O	418	0.02	87.8%
3B5 - Indirect N_2O Emissions from Manure Management - N_2O	351	0.02	89.6%

Tier 2 – Level Assessment for 2022

Key Categories estimated using a Tier 2 method, Current Year Level Assessment	GHG Emissions in 2022 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
4A2 - Land Converted to Forest Land (Removals) - CO_2	-680	0.20	20.3%
5A - Solid Waste Disposal - CH_4	1,130	0.10	30.3%
4A1 - Forest Land Remaining Forest Land (Removals) - CO_2	-913	0.09	39.4%
5D - Wastewater Treatment and Discharge - CH_4	247	0.08	47.2%
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	3,128	0.07	53.8%
1A3b - Fuel Combustion Activities - Transport - Road transportation - CO_2	2,705	0.06	59.4%
3Da - Direct N_2O Emissions from Managed Soils - N_2O	579	0.05	64.8%
4B1 - Cropland Remaining Cropland (Emissions) - CO_2	1,589	0.05	70.1%
3Db - Indirect N_2O Emissions from Managed Soils - N_2O	160	0.04	74.3%
1A4 - Fuel Combustion Activities - Other Sectors - CO_2	1,965	0.04	78.4%
1A4 - Fuel Combustion Activities - Other Sectors - CH_4	194	0.03	81.3%
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas - CH_4	228	0.02	83.7%
2F1 - Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs	156	0.02	85.5%
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO_2	670	0.01	86.9%
2F2 - Product Uses as Substitutes for Ozone Depleting Substances - Foam Blowing Agents - HFCs	75	0.01	88.2%
4F2 - Land Converted to Other Lands (Emissions) - CO_2	304	0.01	89.5%
3A - Enteric Fermentation - CH_4	415	0.01	90.7%

Tier 2 – Trend Assessment

Key Categories estimated using a Tier 2 method, Trend Assessment	GHG Emissions in 2022 (kt CO_2 eq.)	Relative Level Assessment with Uncertainty	Cumulative Sum (%)
4A2 - Land Converted to Forest Land (Removals) - CO_2	-680	0.27	27.4%
4A1 - Forest Land Remaining Forest Land (Removals) - CO_2	-913	0.16	43.6%
4C2 - Land Converted to Grassland (Removals) - CO_2	-123	0.09	53.0%
5A - Solid Waste Disposal - CH_4	1,130	0.06	59.2%
5D - Wastewater Treatment and Discharge - CH4	247	0.04	63.3%
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2	214	0.04	67.3%
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CO_2	0	0.04	71.1%
4D2 - Land Converted to Wetlands (Removals) - CO_2	-84	0.03	74.4%
1A3b - Fuel Combustion Activities - Transport - Road Transportation - CO_2	2,705	0.03	77.2%
4B1 - Cropland Remaining Cropland (Emissions) - CO_2	1,589	0.03	79.9%
3Da - Direct N_2O Emissions from Managed Soils - N_2O	579	0.02	82.2%
4G - Harvested Wood Products - CO_2	-4	0.02	84.0%
2F1 - Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs	156	0.02	85.7%
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2	3,128	0.02	87.4%
3Db - Indirect N_2O Emissions from Managed Soils - N_2O	160	0.02	89.0%
1A4 - Fuel Combustion Activities - Other Sectors - CH_4	194	0.01	90.3%

Key Category Summary Table

Key Categories Summary Table based on Results of Level and Trend Assessments
1A1 - Fuel Combustion Activities - Energy Industries (Gaseous Fuel) - CO_2
1A1 - Fuel Combustion Activities - Energy Industries (Liquid Fuel) - CO_2
1A1 - Fuel Combustion Activities - Energy Industries (Solid Fuel) - CO_2
1A2 - Fuel Combustion Activities - Manufacturing Industries and Construction - CO_2
1A3b - Fuel Combustion Activities - Transport - Road Transportation - CO_2
1A3c - Fuel Combustion Activities - Transport - Railways - CO_2
1A4 - Fuel Combustion Activities - Other Sectors - CH_4
1A4 - Fuel Combustion Activities - Other Sectors - CO_2
1B2b - Fugitive Emissions from Fuels - Oil and Natural Gas - Natural Gas - CH_4
2A1 - Mineral industry - Cement Production - CO_2
2D - Non-Energy Products from Fuels and Solvent Use - CO_2
2F1 - Product Uses as Substitutes for Ozone Depleting Substances - Refrigeration and Air Conditioning - HFCs
2F2 - Product Uses as Substitutes for Ozone Depleting Substances - Foam Blowing Agents - HFCs
3A - Enteric Fermentation - CH_4
3B - Manure Management - CH_4
3B1 - Direct N_2O Emissions from Manure Management - N_2O
3B5 - Indirect N_2O Emissions from Manure Management - N_2O
3Da - Direct N_2O Emissions from Managed Soils - N_2O
3Db - Indirect N_2O Emissions from Managed Soils - N_2O
4A1 - Forest Land Remaining Forest Land (Removals) - CO_2
4A2 - Land Converted to Forest Land (Removals) - CO_2
4B1 - Cropland Remaining Cropland (Emissions) - CO_2
4B2 - Land Converted to Cropland (Emissions) - CO_2
4C2 - Land Converted to Grassland (Removals) - CO_2
4D2 - Land Converted to Wetlands (Removals) - CO_2
4E2 - Land Converted to Settlements (Emissions) - N_2O
4F2 - Land Converted to Other Lands (Emissions) - CO_2
4G - Harvested Wood Products - CO_2
5A - Solid Waste Disposal - CH_4
5D - Wastewater Treatment and Discharge - CH_4

Anex 2. Uncertainty of Greenhouse Gas Emissions

The uncertainty analysis of national GHG emissions has been carried out by applying Approach 1 from 2006 IPCC Guidelines for National Greenhouse Gas Inventories. The obtained results of the uncertainty calculations are presented in the format of Table 3.2 from Chapter 3, Volume 1 of the 2006 IPCC Guidelines.

Annex 2-1. Overall Inventory Uncertainty in the Republic of Moldova for 2022

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty (1)	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\left\|\frac{D}{\sum C}\right\|$	I*F	J*E*sqrt(2)	K^2 + L^2
1A1. Energy industries	CO_2	21,300.29	3,341.56	5	5	7.0711	3.1221	0.0718	0.0763	0.3590	0.5394	0.4198
1A1. Energy industries	CH_4	13.76	2.43	5	50	50.2494	0.0001	0.0000	0.0001	0.0020	0.0004	0.0000
1A1. Energy industries	N_2O	45.95	1.94	3	50	50.0899	0.0001	0.0003	0.0000	0.0138	0.0002	0.0002
1A2. Manufacturing industries and construction	CO_2	1,898.61	669.56	5	5	7.0711	0.1254	0.0021	0.0153	0.0103	0.1081	0.0118
1A2. Manufacturing industries and construction	CH_4	2.39	1.20	5	50	50.2494	0.0000	0.0000	0.0000	0.0005	0.0002	0.0000
1A2. Manufacturing industries and construction	N_2O	3.84	1.53	3	50	50.0899	0.0000	0.0000	0.0000	0.0004	0.0001	0.0000
1A3. Transport	CO_2	4,698.24	2,724.89	5	5	7.0711	2.0761	0.0294	0.0622	0.1472	0.4398	0.2151
1A3. Transport	CH_4	37.71	13.78	5	40	40.3113	0.0017	0.0001	0.0003	0.0021	0.0022	0.0000
1A3. Transport	N_2O	94.91	38.11	5	50	50.2494	0.0205	0.0002	0.0009	0.0104	0.0062	0.0001
1A4. Other sectors	CO_2	7,372.26	1,964.95	5	5	7.0711	1.0796	0.0065	0.0449	0.0325	0.3172	0.1017
1A4. Other sectors	CH_4	322.01	194.13	5	50	50.2494	0.5322	0.0022	0.0044	0.1094	0.0313	0.0129
1A4. Other sectors	N_2O	161.43	58.16	3	50	50.0899	0.0475	0.0002	0.0013	0.0101	0.0056	0.0001
1A5. Other	CO_2	113.97	2.64	5	5	7.0711	0.0000	0.0007	0.0001	0.0037	0.0004	0.0000
1A5. Other	CH_4	0.31	0.04	5	50	50.2494	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
1A5. Other	N_2O	1.18	0.03	3	50	50.0899	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000
1B2. Oil and natural gas and other emissions from energy production	CO_2	0.66	1.52	25	25	35.3553	0.0000	0.0000	0.0000	0.0008	0.0012	0.0000
1B2. Oil and natural gas and other emissions from energy production	CH_4	1,020.03	233.17	25	25	35.3553	0.3800	0.0018	0.0053	0.0446	0.1882	0.0374
1B2. Oil and natural gas and other emissions from energy production	N_2O	0.00	0.00	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2A1. Cement production	CO_2	971.70	408.47	2	3	3.6056	0.0121	0.0026	0.0093	0.0077	0.0264	0.0008
2A2. Lime production	CO_2	264.31	28.00	10	2	10.1980	0.0005	0.0012	0.0006	0.0024	0.0090	0.0001
2A3. Glass production	CO_2	27.49	37.34	15	10	18.0278	0.0025	0.0007	0.0009	0.0066	0.0181	0.0004
2A4. Other processes uses of carbonates	CO_2	75.46	17.57	20	5	20.6155	0.0007	0.0001	0.0004	0.0006	0.0113	0.0001

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty (1)	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
2C1. Iron and steel production	CO_2	28.50	12.20	5	10	11.1803	0.0001	0.0001	0.0003	0.0008	0.0020	0.0000
2D1. Lubricant use	CO_2	24.80	4.77	5	50	50.2494	0.0003	0.0001	0.0001	0.0032	0.0008	0.0000
2D2. Paraffin wax use	CO_2	0.11	0.16	20	100	101.9804	0.0000	0.0000	0.0000	0.0003	0.0001	0.0000
2D3. Solvent use	CO_2	204.15	150.49	20	35	40.3113	0.2058	0.0020	0.0034	0.0704	0.0972	0.0144
2D4. Other (urea-based catalysts)	CO_2	5.30	3.69	20	2	20.0998	0.0000	0.0000	0.0001	0.0001	0.0024	0.0000
2F1. Refrigeration and air conditioning	HFCs		156.03	20	50	53.8516	0.3948	0.0036	0.0036	0.1781	0.1007	0.0419
2F2. Foam blowing agents	HFCs		74.97	30	30	42.4264	0.0566	0.0017	0.0017	0.0513	0.0726	0.0079
2F3. Fire protection	HFCs		3.84	5	20	20.6155	0.0000	0.0001	0.0001	0.0018	0.0006	0.0000
2F4. Aerosols	HFCs		0.01	5	5	7.0711	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G1. Electrical equipment	SF_6		1.65	5	20	20.6155	0.0000	0.0000	0.0000	0.0008	0.0003	0.0000
2G1. Electrical equipment	PFC		0.04	5	20	20.6155	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G3. N_2O from product uses	N_2O	0.02		5	3	5.8310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G4. Other product use	CO_2	3.40	0.78	5	50	50.2494	0.0000	0.0000	0.0000	0.0003	0.0001	0.0000
3A. Enteric fermentation	CH_4	2,452.16	414.83	10	20	22.3607	0.4812	0.0076	0.0095	0.1523	0.1339	0.0411
3B. Manure management	CH_4	554.51	46.34	10	30	31.6228	0.0120	0.0028	0.0011	0.0842	0.0150	0.0073
3B1. Direct N_2O emissions from manure management	N_2O	418.17	80.93	30	100	104.4031	0.3992	0.0011	0.0018	0.1066	0.0784	0.0175
3B5. Indirect N_2O emissions from manure management	N_2O	351.09	54.12	30	150	152.9706	0.3833	0.0012	0.0012	0.1816	0.0524	0.0357
3D1a. Synthetic N Fertilizers Application	N_2O	383.53	197.77	5	6	7.8102	0.0133	0.0018	0.0045	0.0111	0.0319	0.0011
3D1b. Organic N Applied as Fertilizer	N_2O	227.14	40.01	30	6	30.5941	0.0084	0.0007	0.0009	0.0040	0.0387	0.0015
3D1c. Urine and Dung N Deposited on Pasture	N_2O	46.10	23.98	30	50	58.3095	0.0109	0.0002	0.0005	0.0113	0.0232	0.0007
3D1d. N in Crop Residue	N_2O	144.91	100.50	5	25	25.4951	0.0367	0.0013	0.0023	0.0321	0.0162	0.0013
3D1e. N Mineralization	N_2O	209.02	216.37	5	25	25.4951	0.1702	0.0035	0.0049	0.0871	0.0349	0.0088
3D2a. Atmospheric Deposition of N volatilized	N_2O	89.90	31.07	70	150	165.5295	0.1480	0.0001	0.0007	0.0124	0.0702	0.0051
3D2b. N Leaching/Runoff from Managed Soils	N_2O	223.93	128.50	75	150	167.7051	2.5972	0.0014	0.0029	0.2059	0.3111	0.1392
3H. Urea application	CO_2	0.58	22.66	30	50	58.3095	0.0098	0.0005	0.0005	0.0257	0.0219	0.0011
4.A.1. Forest Land Remaining Forest Land. Annual change in carbon stocks in living biomass (includes above and below ground biomass).	CO_2	-1,579.04	-912.82	15	5	15.8114	1.1649	0.0098	0.0208	0.0492	0.4420	0.1978
4.A.2. Land Converted to Forest Land. Annual change in carbon stocks in living biomass (includes above and below ground biomass).	CO_2	-984.39	-679.60	15	5	15.8114	0.6457	0.0087	0.0155	0.0433	0.3291	0.1102
4.A.2. Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires.	CH_4	0.23	1.16	10	30	31.6228	0.0000	0.0000	0.0000	0.0007	0.0004	0.0000
4.A.2. Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires.	N_2O	0.12	0.61	10	30	31.6228	0.0000	0.0000	0.0000	0.0004	0.0002	0.0000

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty (1)	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
4.B.1. Cropland Remaining Cropland. Annual change in carbon stocks.	CO_2	2,333.34	1,589.32	10	10	14.1421	2.8251	0.0200	0.0363	0.2001	0.5131	0.3033
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	CH_4	2.74	0.36	10	30	31.6228	0.0000	0.0000	0.0000	0.0003	0.0001	0.0000
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	N_2O	0.67	0.09	10	30	31.6228	0.0000	0.0000	0.0000	0.0001	0.0000	0.0000
4.B.2. Land Converted to Cropland. Annual change in carbon stocks in living biomass.	CO_2	45.75	140.86	10	10	14.1421	0.0222	0.0029	0.0032	0.0290	0.0455	0.0029
4.B.2. Land Converted to Cropland. Non-CO_2 Emissions from converted lands.	N_2O	8.61	13.57	10	30	31.6228	0.0010	0.0002	0.0003	0.0075	0.0044	0.0001
4.C.1. Grassland Remaining Grassland. Annual change in carbon stocks in living biomass (includes above and below ground biomass)	CO_2	0.00	0.00	15	10	18.0278	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.C.2. Land Converted to Grassland. Annual change in carbon stocks in living biomass (includes above and below ground biomass).	CO_2	-1,205.69	-123.13	15	10	18.0278	0.0276	0.0056	0.0028	0.0559	0.0596	0.0067
4.D.1. Wetlands Remaining Wetlands	CO_2	0.00	0.00	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.D.2. Land Converted to Wetlands	CO_2	-555.38	-84.25	10	10	14.1421	0.0079	0.0019	0.0019	0.0195	0.0272	0.0011
4.E.1. Settlements Remaining Settlements	CO_2	0.00	0.00	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.E.2. Land Converted to Settlements	CO_2	84.75	27.50	10	10	14.1421	0.0008	0.0000	0.0006	0.0004	0.0089	0.0001
4.E.2. Land Converted to Settlements. Non-CO_2 Emissions	N_2O	142.10	146.49	10	30	31.6228	0.1200	0.0024	0.0033	0.0706	0.0473	0.0072
4.F.1. Other Land Remaining Other Land	CO_2	0.00	0.00	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.F.2. Land Converted to Other Land	CO_2	152.36	304.27	10	10	14.1421	0.1035	0.0059	0.0069	0.0588	0.0982	0.0131
4.G. Harvested wood products	CO_2	-122.18	-3.78	30	10	31.6228	0.0001	0.0008	0.0001	0.0077	0.0037	0.0001
5.A. Solid waste disposal	CH_4	1,228.09	1,130.39	30	40	50.0000	17.8636	0.0172	0.0258	0.6896	1.0947	1.6740
5.B. Biological treatment of solid waste	CH_4	1.52	1.38	50	50	70.7107	0.0001	0.0000	0.0000	0.0010	0.0022	0.0000
5.B. Biological treatment of solid waste	N_2O	0.86	0.78	50	50	70.7107	0.0000	0.0000	0.0000	0.0006	0.0013	0.0000
5.C. Incineration and open burning of waste	CO_2	14.97	9.89	40	25	47.1699	0.0012	0.0001	0.0002	0.0030	0.0128	0.0002
5.C. Incineration and open burning of waste	CH_4	8.61	5.68	40	50	64.0312	0.0007	0.0001	0.0001	0.0035	0.0073	0.0001
5.C. Incineration and open burning of waste	N_2O	1.43	0.94	40	100	107.7033	0.0001	0.0000	0.0000	0.0012	0.0012	0.0000
5.D. Waste water treatment and discharge	CH_4	356.58	246.68	40	40	56.5685	1.0890	0.0031	0.0056	0.1258	0.3185	0.1173
5.D. Waste water treatment and discharge	N_2O	78.21	49.34	40	50	64.0312	0.0558	0.0006	0.0011	0.0291	0.0637	0.0049
END												
Total		**43,808.10**	**13,372.49**				**36.26**					**3.56**
Total Uncertainties						**Uncertainty in total inventory %:**	**6.02**				**Trend uncertainty %:**	**1.89**

Annex 2-2. Summary of Direct Greenhouse Gas Uncertainties

Annex 2-2.1. Carbon Dioxide Uncertainties

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\lvert\frac{D}{\sum C}\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
1A1. Energy industries	CO_2	21,300.29	3,341.56	5	5	7.0711	5.9835	0.0709	0.0950	0.3544	0.6718	0.5768
1A2. Manufacturing industries and construction	CO_2	1,898.61	669.56	5	5	7.0711	0.2402	0.0042	0.0190	0.0211	0.1346	0.0186
1A3. Transport	CO_2	4,698.24	2,724.89	5	5	7.0711	3.9788	0.0407	0.0775	0.2037	0.5478	0.3415
1A4. Other sectors	CO_2	7,372.26	1,964.95	5	5	7.0711	2.0690	0.0017	0.0559	0.0085	0.3950	0.1561
1A5. Other	CO_2	113.97	2.64	5	5	7.0711	0.0000	0.0008	0.0001	0.0041	0.0005	0.0000
1B2. Oil and natural gas and other emissions from energy production	CO_2	0.66	1.52	25	25	35.3553	0.0000	0.0000	0.0000	0.0010	0.0015	0.0000
2A1. Cement production	CO_2	971.70	408.47	2	3	3.6056	0.0232	0.0040	0.0116	0.0121	0.0328	0.0012
2A2. Lime production	CO_2	264.31	28.00	10	2	10.1980	0.0009	0.0013	0.0008	0.0025	0.0113	0.0001
2A3. Glass production	CO_2	27.49	37.34	15	10	18.0278	0.0049	0.0008	0.0011	0.0085	0.0225	0.0006
2A4. Other processes uses of carbonates	CO_2	75.46	17.57	20	5	20.6155	0.0014	0.0001	0.0005	0.0004	0.0141	0.0002
2C1. Iron and steel production	CO_2	28.50	12.20	5	10	11.1803	0.0002	0.0001	0.0003	0.0012	0.0025	0.0000
2D1. Lubricant use	CO_2	24.80	4.77	5	50	50.2494	0.0006	0.0001	0.0001	0.0029	0.0010	0.0000
2D2. Paraffin wax use	CO_2	0.11	0.16	20	100	101.9804	0.0000	0.0000	0.0000	0.0004	0.0001	0.0000
2D3. Solvent use	CO_2	204.15	150.49	20	35	40.3113	0.3944	0.0027	0.0043	0.0940	0.1210	0.0235
2D4. Other (urea-based catalysts)	CO_2	5.30	3.69	20	2	20.0998	0.0001	0.0001	0.0001	0.0001	0.0030	0.0000
2G4. Other product use	CO_2	3.40	0.78	5	50	50.2494	0.0000	0.0000	0.0000	0.0002	0.0002	0.0000
3H. Urea application	CO_2	0.58	22.66	30	50	58.3095	0.0187	0.0006	0.0006	0.0320	0.0273	0.0018
4.A.1. Forest Land Remaining Forest Land. Annual change in carbon stocks in living biomass (includes above and below ground biomass).	CO_2	-1,579.04	-912.82	15	5	15.8114	2.2325	0.0136	0.0260	0.0681	0.5505	0.3077
4.A.2. Land Converted to Forest Land. Annual change in carbon stocks in living biomass (includes above and below ground biomass).	CO_2	-984.39	-679.60	15	5	15.8114	1.2375	0.0116	0.0193	0.0582	0.4099	0.1714
4.B.1. Cropland Remaining Cropland. Annual change in carbon stocks.	CO_2	2,333.34	1,589.32	10	10	14.1421	5.4143	0.0269	0.0452	0.2695	0.6390	0.4809
4.B.2. Land Converted to Cropland. Annual change in carbon stocks in living biomass.	CO_2	45.75	140.86	10	10	14.1421	0.0425	0.0036	0.0040	0.0365	0.0566	0.0045
4.C.1. Grassland Remaining Grassland. Annual change in carbon stocks in living biomass (includes above and below ground biomass)	CO_2	0.00	0.00	15	10	18.0278	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\lvert\frac{D}{\sum C}\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
4.C.2. Land Converted to Grassland. Annual change in carbon stocks in living biomass (includes above and below ground biomass).	CO_2	-1,205.69	-123.13	15	10	18.0278	0.0528	0.0059	0.0035	0.0591	0.0743	0.0090
4.D.1. Wetlands Remaining Wetlands	CO_2	0.00	0.00	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.D.2. Land Converted to Wetlands	CO_2	-555.38	-84.25	10	10	14.1421	0.0152	0.0019	0.0024	0.0194	0.0339	0.0015
4.E.1. Settlements Remaining Settlements	CO_2	0.00	0.00	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.E.2. Land Converted to Settlements	CO_2	84.75	27.50	10	10	14.1421	0.0016	0.0001	0.0008	0.0012	0.0111	0.0001
4.F.1. Other Land Remaining Other Land	CO_2	0.00	0.00	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.F.2. Land Converted to Other Land	CO_2	152.36	304.27	10	10	14.1421	0.1984	0.0075	0.0087	0.0746	0.1223	0.0205
4.G. Harvested wood products	CO_2	-122.18	-3.78	30	10	31.6228	0.0002	0.0008	0.0001	0.0085	0.0046	0.0001
5.C. Incineration and open burning of waste	CO_2	14.97	9.89	40	25	47.1699	0.0023	0.0002	0.0003	0.0041	0.0159	0.0003
END												
Total		**35,174.33**	**9,659.53**				**21.91**					**2.12**
Total Uncertainties						**Uncertainty in total inventory %:**	**4.68**				**Trend uncertainty %:**	**1.45**

Annex 2-2.2 Methane Uncertainties

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\lvert\frac{D}{\sum C}\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
1A1. Energy industries	CH_4	13.76	2.43	5	50	50.2494	0.0028	0.0005	0.0004	0.0235	0.0029	0.0006
1A2. Manufacturing industries and construction	CH_4	2.39	1.20	5	50	50.2494	0.0007	0.0000	0.0002	0.0024	0.0014	0.0000
1A3. Transport	CH_4	37.71	13.78	5	40	40.3113	0.0588	0.0001	0.0023	0.0041	0.0162	0.0003
1A4. Other sectors	CH_4	322.01	194.13	5	50	50.2494	18.1214	0.0119	0.0324	0.5926	0.2288	0.4035
1A5. Other	CH_4	0.31	0.04	5	50	50.2494	0.0000	0.0000	0.0000	0.0006	0.0000	0.0000
1B2. Oil and natural gas and other emissions from energy production	CH_4	1,020.03	233.17	25	25	35.3553	12.9415	0.0260	0.0389	0.6504	1.3738	2.3103
3A. Enteric fermentation	CH_4	2,452.16	414.83	10	20	22.3607	16.3850	0.0866	0.0691	1.7315	0.9777	3.9538

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\lvert\frac{D}{\sum C}\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
3B. Manure management	CH_4	554.51	46.34	10	30	31.6228	0.4089	0.0275	0.0077	0.8263	0.1092	0.6946
4.A.2. Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires.	CH_4	0.23	1.16	10	30	31.6228	0.0003	0.0002	0.0002	0.0054	0.0027	0.0000
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	CH_4	2.74	0.36	10	30	31.6228	0.0000	0.0001	0.0001	0.0034	0.0008	0.0000
5.A. Solid waste disposal	CH_4	1,228.09	1,130.39	30	40	50.0000	608.3095	0.1100	0.1884	4.3998	7.9922	83.2329
5.B. Biological treatment of solid waste	CH_4	1.52	1.38	50	50	70.7107	0.0018	0.0001	0.0002	0.0066	0.0162	0.0003
5.C. Incineration and open burning of waste	CH_4	8.61	5.68	40	50	64.0312	0.0252	0.0004	0.0009	0.0199	0.0536	0.0033
5.D. Waste water treatment and discharge	CH_4	356.58	246.68	40	40	56.5685	37.0822	0.0184	0.0411	0.7362	2.3255	5.9500
END												
Total		**6,000.65**	**2,291.58**				**693.34**					**96.55**
Total Uncertainties						**Uncertainty in total inventory %:**	**26.33**				**Trend uncertainty %:**	**9.83**

Annex 2-2.3. Nitrous Oxide Uncertainties

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\lvert\frac{D}{\sum C}\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
1A1. Energy industries	N_2O	45.95	1.94	3	50	50.0899	0.0067	0.0071	0.0007	0.3557	0.0031	0.1265
1A2. Manufacturing industries and construction	N_2O	3.84	1.53	3	50	50.0899	0.0042	0.0001	0.0006	0.0037	0.0025	0.0000
1A3. Transport	N_2O	94.91	38.11	5	50	50.2494	2.6118	0.0017	0.0145	0.0873	0.1023	0.0181
1A4. Other sectors	N_2O	161.43	58.16	3	50	50.0899	6.0450	0.0055	0.0221	0.2748	0.0937	0.0843
1A5. Other	N_2O	1.18	0.03	3	50	50.0899	0.0000	0.0002	0.0000	0.0096	0.0000	0.0001
1B2. Oil and natural gas and other emissions from energy production	N_2O	0.00	0.00	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\lvert\frac{D}{\sum C}\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
2G3. N_2O from product uses	N_2O	0.02		5	3	5.8310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
3B1. Direct N_2O emissions from manure management	N_2O	418.17	80.93	30	100	104.4031	50.8503	0.0407	0.0307	4.0662	1.3040	18.2347
3B5. Indirect N_2O emissions from manure management	N_2O	351.09	54.12	30	150	152.9706	48.8256	0.0394	0.0206	5.9087	0.8721	35.6737
3D1a. Synthetic N Fertilizers Application	N_2O	383.53	197.77	5	6	7.8102	1.6996	0.0096	0.0751	0.0573	0.5311	0.2854
3D1b. Organic N Applied as Fertilizer	N_2O	227.14	40.01	30	6	30.5941	1.0672	0.0236	0.0152	0.1416	0.6446	0.4356
3D1c. Urine and Dung N Deposited on Pasture	N_2O	46.10	23.98	30	50	58.3095	1.3928	0.0012	0.0091	0.0615	0.3864	0.1531
3D1d. N in Crop Residue	N_2O	144.91	100.50	5	25	25.4951	4.6763	0.0134	0.0382	0.3349	0.2699	0.1850
3D1e. N Mineralization	N_2O	209.02	216.37	5	25	25.4951	21.6758	0.0464	0.0822	1.1604	0.5810	1.6841
3D2a. Atmospheric Deposition of N volatilized	N_2O	89.90	31.07	70	150	165.5295	18.8466	0.0036	0.0118	0.5342	1.1683	1.6502
3D2b. N Leaching/Runoff from Managed Soils	N_2O	223.93	128.50	75	150	167.7051	330.8220	0.0105	0.0488	1.5790	5.1763	29.2875
4.A.2. Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires.	N_2O	0.12	0.61	10	30	31.6228	0.0003	0.0002	0.0002	0.0063	0.0033	0.0001
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	N_2O	0.67	0.09	10	30	31.6228	0.0000	0.0001	0.0000	0.0024	0.0005	0.0000
4.B.2. Land Converted to Cropland. Non-CO2 Emissions from converted lands.	N_2O	8.61	13.57	10	30	31.6228	0.1312	0.0037	0.0052	0.1105	0.0729	0.0175
4.E.2. Land Converted to Settlements. Non-CO_2 Emissions	N_2O	142.10	146.49	10	30	31.6228	15.2854	0.0313	0.0556	0.9400	0.7868	1.5025
5.B. Biological treatment of solid waste	N_2O	0.86	0.78	50	50	70.7107	0.0022	0.0001	0.0003	0.0075	0.0210	0.0005
5.C. Incineration and open burning of waste	N_2O	1.43	0.94	40	100	107.7033	0.0074	0.0001	0.0004	0.0114	0.0203	0.0005
5.D. Waste water treatment and discharge	N_2O	78.21	49.34	40	50	64.0312	7.1105	0.0054	0.0187	0.2686	1.0600	1.1958
END												
Total		**2,633.12**	**1,184.85**				**511.06**					**90.54**
Total Uncertainties						**Uncertainty in total inventory %:**	**22.61**				**Trend uncertainty %:**	**9.52**

Annex 2-3. GHG Emission Uncertainty at Sectoral Level

Annex 2-3.1. Overall Inventory Uncertainty for Sector 1 'Energy'

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\lvert\frac{D}{\sum C}\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
1A1. Energy industries	CO_2	21,300.29	3,341.56	5	5	7.0711	6.5256	0.0528	0.0901	0.2642	0.6371	0.4757
1A1. Energy industries	CH_4	13.76	2.43	5	50	50.2494	0.0002	0.0000	0.0001	0.0013	0.0005	0.0000
1A1. Energy industries	N_2O	45.95	1.94	3	50	50.0899	0.0001	0.0003	0.0001	0.0128	0.0002	0.0002
1A2. Manufacturing industries and construction	CO_2	1,898.61	669.56	5	5	7.0711	0.2620	0.0053	0.0181	0.0264	0.1277	0.0170
1A2. Manufacturing industries and construction	CH_4	2.39	1.20	5	50	50.2494	0.0000	0.0000	0.0000	0.0008	0.0002	0.0000
1A2. Manufacturing industries and construction	N_2O	3.84	1.53	3	50	50.0899	0.0001	0.0000	0.0000	0.0008	0.0002	0.0000
1A3. Transport	CO_2	4,698.24	2,724.89	5	5	7.0711	4.3393	0.0418	0.0735	0.2091	0.5195	0.3136
1A3. Transport	CH_4	37.71	13.78	5	40	40.3113	0.0036	0.0001	0.0004	0.0047	0.0026	0.0000
1A3. Transport	N_2O	94.91	38.11	5	50	50.2494	0.0429	0.0004	0.0010	0.0195	0.0073	0.0004
1A4. Other sectors	CO_2	7,372.26	1,964.95	5	5	7.0711	2.2564	0.0034	0.0530	0.0170	0.3746	0.1406
1A4. Other sectors	CH_4	322.01	194.13	5	50	50.2494	1.1123	0.0031	0.0052	0.1534	0.0370	0.0249
1A4. Other sectors	N_2O	161.43	58.16	3	50	50.0899	0.0992	0.0005	0.0016	0.0241	0.0067	0.0006
1A5. Other	CO_2	113.97	2.64	5	5	7.0711	0.0000	0.0007	0.0001	0.0035	0.0005	0.0000
1A5. Other	CH_4	0.31	0.04	5	50	50.2494	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
1A5. Other	N_2O	1.18	0.03	3	50	50.0899	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000
1B2. Oil and natural gas and other emissions from energy production	CO_2	0.66	1.52	25	25	35.3553	0.0000	0.0000	0.0000	0.0009	0.0015	0.0000
1B2. Oil and natural gas and other emissions from energy production	CH_4	1,020.03	233.17	25	25	35.3553	0.7943	0.0006	0.0063	0.0143	0.2223	0.0496
1B2. Oil and natural gas and other emissions from energy production	N_2O	0.00	0.00	25	25	35.3553	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
END												
Total		**37,087.56**	**9,249.65**				**15.4360**					**1.0227**
Total Uncertainties						**Uncertainty in total inventory %:**	**3.93**				**Trend uncertainty %:**	**1.01**

Annex 2-3.2. Overall Inventory Uncertainty for Sector 2 'Industrial Processes and Product Use'

IPCC Category	Gas	Emissions / Removals in 1990	Emissions/ Removals in 2022	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\left\|\frac{D}{\sum C}\right\|$	I*F	J*E*sqrt(2)	K^2 + L^2
2A1. Cement production	CO_2	971.70	408.47	2	3	3.6056	2.6778	0.0844	0.2545	0.2532	0.7197	0.5821
2A2. Lime production	CO_2	264.31	28.00	10	2	10.1980	0.1007	0.0747	0.0174	0.1495	0.2467	0.0832
2A3. Glass production	CO_2	27.49	37.34	15	10	18.0278	0.5594	0.0137	0.0233	0.1366	0.4935	0.2622
2A4. Other processes uses of carbonates	CO_2	75.46	17.57	20	5	20.6155	0.1619	0.0154	0.0109	0.0770	0.3095	0.1017
2C1. Iron and steel production	CO_2	28.50	12.20	5	10	11.1803	0.0230	0.0024	0.0076	0.0235	0.0537	0.0034
2D1. Lubricant use	CO_2	24.80	4.77	5	50	50.2494	0.0708	0.0057	0.0030	0.2846	0.0210	0.0814
2D2. Paraffin wax use	CO_2	0.11	0.16	20	100	101.9804	0.0003	0.0001	0.0001	0.0063	0.0029	0.0000
2D3. Solvent use	CO_2	204.15	150.49	20	35	40.3113	45.4350	0.0224	0.0937	0.7847	2.6516	7.6469
2D4. Other (urea-based catalysts)	CO_2	5.30	3.69	20	2	20.0998	0.0068	0.0004	0.0023	0.0009	0.0650	0.0042
2F1. Refrigeration and air conditioning	HFCs	NO	156.03	20	50	53.8516	87.1583	0.0972	0.0972	4.8599	2.7492	31.1766
2F2. Foam blowing agents	HFCs	NO	74.97	30	30	42.4264	12.4896	0.0467	0.0467	1.4011	1.9814	5.8890
2F3. Fire protection	HFCs	NO	3.84	5	20	20.6155	0.0077	0.0024	0.0024	0.0479	0.0169	0.0026
2F4. Aerosols	HFCs	NO	0.01	5	5	7.0711	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G1. Electrical equipment	SF_6	NO	1.65	5	20	20.6155	0.0014	0.0010	0.0010	0.0206	0.0073	0.0005
2G1. Electrical equipment	PFC	NO	0.04	5	20	20.6155	0.0000	0.0000	0.0000	0.0005	0.0002	0.0000
2G3. N_2O from product uses	N_2O	0.02	NO	5	3	5.8310	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2G4. Other product use	CO_2	3.40	0.78	5	50	50.2494	0.0019	0.0007	0.0005	0.0351	0.0034	0.0012
END												
Total		**1,605.24**	**900.00**				**148.69**					**45.84**
Total Uncertainties						**Uncertainty in total inventory %:**	**12.19**				**Trend uncertainty %:**	**6.77**

Annex 2-3.3. Overall Inventory Uncertainty for Sector 3 'Agriculture'

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\lvert\frac{D}{\sum C}\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
3A. Enteric fermentation	CH_4	2,452.16	414.83	10	20	22.3607	46.7194	0.0463	0.0813	0.9269	1.1501	2.1818
3B. Manure management	CH_4	554.51	46.34	10	30	31.6228	1.1659	0.0198	0.0091	0.5944	0.1285	0.3699
3B1. Direct N_2O emissions from manure management	N_2O	418.17	80.93	30	100	104.4031	38.7618	0.0059	0.0159	0.5940	0.6731	0.8058
3B5. Indirect N_2O emissions from manure management	N_2O	351.09	54.12	30	150	152.9706	37.2184	0.0077	0.0106	1.1543	0.4502	1.5351
3D1a. Synthetic N Fertilizers Application	N_2O	383.53	197.77	5	6	7.8102	1.2955	0.0188	0.0388	0.1125	0.2742	0.0878
3D1b. Organic N Applied as Fertilizer	N_2O	227.14	40.01	30	6	30.5941	0.8135	0.0040	0.0078	0.0240	0.3328	0.1113
3D1c. Urine and Dung N Deposited on Pasture	N_2O	46.10	23.98	30	50	58.3095	1.0617	0.0023	0.0047	0.1148	0.1995	0.0530
3D1d. N in Crop Residue	N_2O	144.91	100.50	5	25	25.4951	3.5646	0.0121	0.0197	0.3035	0.1393	0.1115
3D1e. N Mineralization	N_2O	209.02	216.37	5	25	25.4951	16.5229	0.0315	0.0424	0.7876	0.2999	0.7102
3D2a. Atmospheric Deposition of N volatilized	N_2O	89.90	31.07	70	150	165.5295	14.3662	0.0014	0.0061	0.2104	0.6031	0.4079
3D2b. N Leaching/Runoff from Managed Soils	N_2O	223.93	128.50	75	150	167.7051	252.1766	0.0135	0.0252	2.0261	2.6720	11.2444
3H. Urea application	CO_2	0.58	22.66	30	50	58.3095	0.9481	0.0044	0.0044	0.2206	0.1885	0.0842
END												
Total		**5,101.04**	**1,357.09**				**414.61**					**17.70**
Total Uncertainties						**Uncertainty in total inventory %:**	**20.36**				**Trend uncertainty %:**	**4.21**

Annex 2-3.4. Overall Inventory Uncertainty for Sector 4 'LULUCF'

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\lvert\frac{D}{\sum C}\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
4.A.1. Forest Land Remaining Forest Land. Annual change in carbon stocks in living biomass (includes above and below ground biomass).	CO_2	-1,579.04	-912.82	15	5	15.8114	12.8403	0.0044	0.1265	0.0218	2.6830	7.1987
4.A.2. Land Converted to Forest Land. Annual change in carbon stocks in living biomass (includes above and below ground biomass).	CO_2	-984.39	-679.60	15	5	15.8114	7.1172	0.0180	0.0942	0.0901	1.9975	3.9980
4.A.2. Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires.	CH_4	0.23	1.16	10	30	31.6228	0.0001	0.0001	0.0002	0.0043	0.0023	0.0000
4.A.2. Land Converted to Forest Land. Non-CO_2 Emissions from Vegetation Fires.	N_2O	0.12	0.61	10	30	31.6228	0.0000	0.0001	0.0001	0.0022	0.0012	0.0000
4.B.1. Cropland Remaining Cropland. Annual change in carbon stocks.	CO_2	2,333.34	1,589.32	10	10	14.1421	31.1398	0.0397	0.2202	0.3966	3.1142	9.8556
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	CH_4	2.74	0.36	10	30	31.6228	0.0000	0.0002	0.0000	0.0049	0.0007	0.0000
4.B.1. Cropland Remaining Cropland. Non-CO_2 Emissions from Vegetation Fires	N_2O	0.67	0.09	10	30	31.6228	0.0000	0.0000	0.0000	0.0012	0.0002	0.0000
4.B.2. Land Converted to Cropland. Annual change in carbon stocks in living biomass.	CO_2	45.75	140.86	10	10	14.1421	0.2446	0.0160	0.0195	0.1598	0.2760	0.1017
4.B.2. Land Converted to Cropland. Non-CO_2 Emissions from converted lands.	N_2O	8.61	13.57	10	30	31.6228	0.0114	0.0012	0.0019	0.0364	0.0266	0.0020
4.C.1. Grassland Remaining Grassland. Annual change in carbon stocks in living biomass (includes above and below ground biomass)	CO_2	0.00	0.00	15	10	18.0278	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4C.2. Land Converted to Grassland. Annual change in carbon stocks in living biomass (includes above and below ground biomass).	CO_2	-1,205.69	-123.13	15	10	18.0278	0.3037	0.0760	0.0171	0.7604	0.3619	0.7092
4.D.1. Wetlands Remaining Wetlands	CO_2	0.00	0.00	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.D.2. Land Converted to Wetlands	CO_2	-555.38	-84.25	10	10	14.1421	0.0875	0.0312	0.0117	0.3125	0.1651	0.1249
4.E.1. Settlements Remaining Settlements	CO_2	0.00	0.00	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.E.2. Land Converted to Settlements	CO_2	84.75	27.50	10	10	14.1421	0.0093	0.0027	0.0038	0.0274	0.0539	0.0037
4.E.2. Land Converted to Settlements. Non-CO_2 Emissions	N_2O	142.10	146.49	10	30	31.6228	1.3227	0.0093	0.0203	0.2792	0.2870	0.1604
4.F.1. Other Land Remaining Other Land	CO_2	0.00	0.00	10	10	14.1421	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
4.F.2. Land Converted to Other Land	CO_2	152.36	304.27	10	10	14.1421	1.1413	0.0304	0.0422	0.3037	0.5962	0.4477
4.G. Harvested wood products	CO_2	-122.18	-3.78	30	10	31.6228	0.0009	0.0089	0.0005	0.0892	0.0222	0.0085
END												
Total		**-1,676.01**	**420.66**				**54.22**					**22.61**
Total Uncertainties						**Uncertainty in total inventory %:**	**7.36**				**Trend uncertainty %:**	**4.76**

Annex 2-3.5. Overall Inventory Uncertainty for Sector 5 'Waste'

IPCC Category	Gas	Emissions / Removals in 1990	Emissions / Removals in 2022	Activity Data Uncertainty	Emission Factor Uncertainty	Combined Uncertainty	Contribution to Variance by Category in 2022	Type A Sensitivity	Type B Sensitivity	Uncertainty in the Trend in GHG Emissions Introduced by the Emission Factor	Uncertainty in the Trend in GHG emissions Introduced by AD	Uncertainty Introduced into the Trend of Total Sectoral Emissions
		kt CO_2 equivalent	kt CO_2 equivalent	%	%	%		%	%	%	%	%
		Input Data	Input Data	Input Data	Input Data	$\sqrt{E^2 + F^2}$	$\frac{(G \cdot D)^2}{(\sum D)^2}$		$\lvert\frac{D}{\sum C}\rvert$	I*F	J*E*sqrt(2)	K^2 + L^2
5.A. Solid waste disposal	CH_4	1,228.09	1,130.39	30	40	50.0000	1529.6946	0.0472	0.6688	1.8899	28.3729	808.5957
5.B. Biological treatment of solid waste	CH_4	1.52	1.38	50	50	70.7107	0.0045	0.0000	0.0008	0.0023	0.0577	0.0033
5.B. Biological treatment of solid waste	N_2O	0.86	0.78	50	50	70.7107	0.0015	0.0000	0.0005	0.0013	0.0327	0.0011
5.C. Incineration and open burning of waste	CO_2	14.97	9.89	40	25	47.1699	0.1042	0.0017	0.0059	0.0430	0.3310	0.1114
5.C. Incineration and open burning of waste	CH_4	8.61	5.68	40	50	64.0312	0.0634	0.0010	0.0034	0.0497	0.1901	0.0386
5.C. Incineration and open burning of waste	N_2O	1.43	0.94	40	100	107.7033	0.0049	0.0002	0.0006	0.0165	0.0316	0.0013
5.D. Waste water treatment and discharge	CH_4	356.58	246.68	40	40	56.5685	93.2493	0.0343	0.1459	1.3738	8.2558	70.0453
5.D. Waste water treatment and discharge	N_2O	78.21	49.34	40	50	64.0312	4.7801	0.0104	0.0292	0.5181	1.6513	2.9954
END												
Total		**1,690.28**	**1,445.09**				**1,627.90**					**881.79**
Total Uncertainties						**Total Uncertainties %:**	**40.35**				**Trend uncertainty %:**	**29.69**

Annex 3. Comparison of CO_2 emissions calculated using the reference approach and the sectoral approach

According to the 2006 IPCC Guidelines, the reference approach is a top-down inventory based on production, imports, exports, stock change and international fuel consumption (bunker).

The methodology available in the 2006 IPCC Guidelines, used in the estimation of CO_2 emissions through the reference approach, is based on the country's apparent fuel consumption.

Apparent consumption of primary fuels was calculated using the following formula:

Apparent consumption = Production + Imports - Exports – Change (increase/decrease) in Stocks – International Bunkers

Apparent consumption does not include the consumption of fuels for non-energy purposes. Paraffins, bitumen, lubricants, white spirit used for non-energy purposes, as well as fuels used for aviation transport are excluded.

Production, import, export, inventory variation and international bunkers were collected from the Energy Balances of the Republic of Moldova for all primary fuels and petroleum products in energy units (TJ).

It should be noted that the Energy Balances of the Republic of Moldova have a classification of fuels, which differs from that of the 2006 IPCC Guidelines, and a correspondence table of names had thereby been prepared, Table A.3-1.

Table A.3-1: Correspondence of fuels in international and national classification

Allocated fuels according to the IPCC classification for sector 1A	Allocated fuels according to the Energy Balance
Crude oil	Crude oil
Gasoline	Gasoline, aviation gasoline
Jet kerosene	Jet kerosene
Other kerosene	Kerosene
Gas/diesel	Fuel for oven, fuel for engines, diesel
Residual fuel oil	Residual fuel oil
Liquefied petroleum gases (LPG)	Liquefied petroleum gases (LPG)
Bitumen	Bitumen
Lubricants	Greases (lubricants), motor oils, diesel oil
Petroleum coke	Petroleum coke
Other oil	White spirit, paraffins, other petroleum products, processed oils
Anthracite	Anthracite
Other bituminous coal	Bituminous coal
Sub-bituminous coal	Other hard coal
Lignite	Lignite
Coke oven/gas coke	Coke
Peat	Peat and peat products
Natural gas (dry)	Natural gas
Solid biomass	Fuelwood, wood waste, agricultural residues, briquettes and pellets, charcoal
Liquid biomass	Bioethanol, biodiesel
Gas biomass	Biogas

Carbon content coefficients (t C/TJ) in fuels are used by default according to 2006 IPCC Guidelines (Volume 2, Chapter 1, pages 1.21-1.22, Table 1.3), carbon oxidation coefficients are taken equal to 1 for all fuel types.

The statistical data collected for the territory on the LBDR were also considered. As it can be seen, the differences between the CO_2 emissions calculated using the two methodological approaches are within the permissible limit of 5% (2006 IPCC Guidelines, Volume 2, Chapter 6.8, page 6.11) (Table A.3-2).

The reasons for the observed differences are as follows:

1. For several categories in the Energy Balances of the RoM, the initial activity data is missing, and the necessary information was obtained based on requests addressed to various institutions. Activity data received in natural units were then transferred to energy units (TJ) using country-specific net calorific values (NCV).
2. Average NCV values were used (based on NBS instructions when compiling the Energy Balances of the RoM), and the resulting values are used with decimals, whereas in the Energy Balances of the RoM the information is presented as whole values, without decimals.

Table A.3-2: Comparison of CO_2 emissions calculated using the reference approach (RA) and the sectoral approach (SA) for the period 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
RA	34,484.70	29,721.61	23,180.29	16,975.65	14,476.87	11,428.59	11,350.12	10,288.66	8,836.80	6,892.32	6,180.95
SA	35,383.38	29,883.72	23,299.66	17,332.99	14,491.98	11,471.26	11,374.65	10,257.83	8,874.46	6,903.32	6,188.18
Difference, %	-2.61	-0.55	-0.51	-2.10	-0.10	-0.37	-0.22	0.30	-0.43	-0.16	-0.12
	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
RA	6,813.13	6,467.66	7,077.78	7,561.71	7,785.98	7,014.80	7,116.62	7,408.16	7,964.62	8,594.79	8,777.41
SA	6,817.59	6,536.60	7,177.44	7,625.53	7,870.60	7,112.32	7,249.08	7,546.38	8,092.21	8,716.70	8,924.86
Difference, %	-0.07	-1.07	-1.41	-0.84	-1.09	-1.39	-1.86	-1.87	-1.60	-1.42	-1.68
	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
RA	8,435.62	8,044.43	8,000.17	8,432.35	8,486.51	8,044.90	8,332.05	8,343.30	8,580.46	9,624.41	8,903.24
SA	8,612.61	8,223.26	8,189.06	8,389.57	8,483.26	8,068.33	8,480.96	8,558.64	8,840.57	9,815.46	8,703.60
Difference, %	-2.10	-2.22	-2.36	0.51	0.04	-0.29	-1.79	-2.58	-3.03	-1.99	2.24

Annex 4. Quality Assurance and Quality Control

Annex 4.1. Quality Assurance and Quality Control Form for the National GHG Inventory of the Republic of Moldova (National Inventory Report: 1990-2022. Greenhouse Gas Sources and Sinks in the Republic of Moldova)

Document: National Inventory Document: 1990-2022. Greenhouse Gas Sources and Sinks in the Republic of Moldova

Stage of Report Preparation: final draft report

Highlight all categories subject to verification: tables and figures, equations, references, general editing, content editing

Surname and first name of expert: _____

Organization in which he/she operates and his/her function: _____

INSTRUCTIONS FOR COMPLETING THIS FORM:

This form is to be completed for each chapter and provides a record of the checks performed and any corrective actions taken.

The form should be completed electronically. Once completed, the form should be submitted to the National Inventory Team Leader on the electronic address: <tsaranu.lilia@gmail.com>, together with paper copies, signed and personally presented at the following address: 5 Gheorghe Tudor St., MD 2028, Chisinau, Republic of Moldova.

The first page of this form summarizes the results of control/verifications (once completed) and highlights any significant findings or actions to be undertaken on quality assurance of the National GHG Inventory. The expert takes personal responsibility for the process of inventory quality assurance and control at sectoral level (separate chapter of the National Inventory Document for 1990-2022). Checks/rows that are not relevant or not available should indicate 'n/r' or 'n/a' (not left blank or crossed out).

All information sources associated with the inventory compilation process for each sector require clear references in the respective column of the form (support documentation).

Document Verification Summary: National Inventory Document: 1990-2022. Greenhouse Gas Sources and Sinks in the Republic of Moldova	
Summary of results of checks and corrective actions taken:	
Suggested checks to be performed in the future:	Unsolved problems after corrective actions taken:

Quality Assurance and Quality Control Form: National Inventory Document: 1990-2022. Greenhouse Gas Sources and Sinks in the Republic of Moldova.
Chapter: _____

	Item	Completed Check			Corrective Action		
		Date	Individual (first name, last name)	Errors (Y/N)	Date	Individual (first name, last name)	Supporting documents (reference sources)
TABLES AND FIGURES							
1	Check whether numbers in tables in the respective chapter match numbers in reporting tables (the reporting format provided by the 2006 IPCC Guidelines and/or the decisions of the COP)						
2	Check whether numbers in tables specific to source categories (see the respective subchapters of the Report) correspond to numbers in tables from 'Overview of the sector'						
3	Check whether numbers in the text are consistent with numbers in tables						
4	Check whether table formatting is consistent						
5	Check whether the information presented in figures is consistent with tables and the content						
6	Check whether table titles and numbers included are consistent with the content						
EQUATIONS – ALL EQUATIONS WILL CONTAIN THE FOLLOWING FEATURES							

7	Equation should be written in the text according to the following example: z = x + y						
8	For the multiplication sign – use the • symbol, not the letter x or * symbol						
9	Equation is to be centred						
10	After an equation, use: Where, and define the variables						
11	Defining variables is paragraphed with the following style 'Table No.: Text' (first word in bold)						
REFERERENCES							
12	Check consistency of references used in multiple sections (e.g.: the 2006 IPCC Guidelines, not the IPCC Guidelines)						
13	Check whether text citations and references in the text correspond to the ones in the Bibliography						
14	Check that the style of references is consistent						
15	Web-addresses should not include hyperlinks, but need to be included in brackets < >						
	GENERAL FORMAT						
16	All acronyms are spelled out the first time, not subsequent times throughout each chapter						
17	Check that all dashes are similar, use the symbol 'insert' to insert a dash (–)						
18	Check whether all fonts in text, headings, titles, and subheadings are consistent						
19	Check whether notes and comments are removed from document						
20	Check whether all references to annexes in the text are consistent with the corresponding number of annexes						
21	Check whether the name of all gases, such as CO_2 and N_2O use the letter 'O', not '0'						
22	All numbers in the GHG formulas are to be subscribed (e.g.: CO_2, SF_6, CH_4, N_2O, etc.)						
23	Notes under tables are to be written in a smaller font than the text						
24	Check whether the number of decimal points used in text and tables correspond						
25	Check whether the size, style and indenting of chapter and subchapter numbers are consistent						
26	Check whether spell check is complete						
27	Check whether the numbering of tables, figures, annexes, and references in the text is correct						
OTHER ASPECTS							
28	Other (specify):						

Annex 4.2. Category-Specific Tier 1 Quality Control Procedures

National Inventory Report: 1990-2022

Source Category: _____

Surname and first name of expert: _____

Organization in which he/she operates and his/her function: _____

INSTRUCTIONS FOR COMPLETING THIS FORM:

This form is to be completed for each individual source category (according to the Tier 1 methodological approach), ensuring the control/verifications performed, as well as the corrective actions taken. The form is to be completed electronically. Once completed, the form should be submitted to the National Inventory Team Leader on the electronic address: <tsaranu.lilia@gmail.com>, together with paper copies, signed and personally presented at the following address: 5 Gheorghe Tudor St., MD 2028, Chisinau, Republic of Moldova.

The first page of this form summarizes the results of the control/verifications (once completed) and highlights any significant findings or actions to be undertaken on ensuring the high quality of the National GHG Inventory. The expert takes personal responsibility for the process of inventory quality assurance and control at individual source category level. Not all checks included in the forms will be applicable at source category level; checks/rows that are not relevant or not available should indicate 'n/r' or 'n/a' (not left blank or crossed out). All information sources associated with the inventory compilation process for each source category require clear references in the respective column of the form (support documentation).

Summary of Verifications, Quality Control and Corrective Actions	
Summary of results of checks and corrective actions taken:	
Suggested checks to be performed in the future:	Unsolved problems after corrective actions taken:

Verification and Quality Control Form for Individual Source Categories

Source Category: _____

	Quality Control Activities/Verifications and Quality Control Procedures	**Check Completed**			**Corrective Action**		**Supporting documents (reference sources)**
		Date	**Individual (first name, last name)**	**Errors (Y/N)**	**Individual (first name, last name)**	**Date**	
Data Gathering, Input, and Handling Checks							
1	Check whether assumptions and criteria for the selection of activity data and emission factors are documented: • cross-check descriptions of activity data and emission factors with information on categories and ensure that these are properly recorded and archived						
2	Check for transcription errors in data input and reference: • confirm that bibliographical data references are properly cited in the internal documentation • cross-check a sample of input data from each category (parameters used in calculations) for transcription errors • use electronic data where possible to minimize transcription errors • check that spreadsheet features are used to minimize user/entry error: - avoid hardwiring factors into formulas - create automatic look-up tables for common values used throughout calculations - use cell protection so fixed data cannot accidentally be changed - use cross-checks for calculations performed						

Verification and Quality Control Form for Individual Source Categories

Source Category: _____

Quality Control Activities/Verifications and Quality Control Procedures		Check Completed			Corrective Action		Supporting documents (reference sources)
		Date	Individual (first name, last name)	Errors (Y/N)	Individual (first name, last name)	Date	
3	Check whether emissions/removals are calculated correctly: • reproduce a representative calculation sample of GHG emissions/ removals • Should calculation models be used, selectively simulate calculations to determine relative accuracy						
4	Check whether parameters and measurement units of emissions/removals units are correctly recorded and whether appropriate conversion factors are used: • check whether measurement units are properly labelled in calculation sheets • check whether measurement units are correctly used from beginning to end of calculations • check whether conversion factors are correctly used • check whether temporal and spatial adjustment factors are used correctly						
5	Check the integrity of database files and archive: • confirm that the appropriate data processing steps are correctly represented in the database • confirm that data relationships are correctly represented in the database • ensure whether data sets are properly labelled and have the correct design specifications • ensure whether adequate documentation of database and model structure and operation are archived						
6	Check the consistency of data used in more categories: • identify parameters (e.g., activity data, constants) that are common for multiple categories and confirm that there is consistency in the values used for these parameters in the emission/removal calculations						
7	Check whether the movement of inventory data among processing steps is correct: • check whether emission/removal data are correctly aggregated from lower reporting levels to higher reporting levels when preparing summaries at category and sectoral levels • check whether emission/removal data are correctly transcribed in different intermediate products						
DATA DOCUMENTATION							
8	Review of internal documentation and archiving: • check whether there is detailed internal documentation to support the estimates and enable duplication of calculations • check that every primary data element has a reference for the source of the data (via cell comments or another system) • check whether inventory data, supporting data, and inventory records are archived and stored to facilitate detailed review • check whether the archive is closed and retained in secure place following completion of the inventory • check integrity of any data archiving arrangements of outside organizations involved in inventory preparation						
CALCULATION CHECKS							
9	Check methodological and data changes resulting in recalculations of emissions/removals: • check for temporal consistency in time series input data for each category • check for consistency in the algorithm/method used for calculations throughout the time series • reproduce a representative sample of emission calculations to ensure mathematical correctness						
10	Check time series consistency: • check for temporal consistency in time series input data for each category • check for consistency in the algorithm/method used for calculations throughout the time series • check methodological and data changes resulting in recalculations of emissions/removals • check whether the effects of mitigation activities have been appropriately reflected in time series calculations						

Verification and Quality Control Form for Individual Source Categories Source Category: _____							
Quality Control Activities/Verifications and Quality Control Procedures		Check Completed			Corrective Action		Supporting documents (reference sources)
		Date	Individual (first name, last name)	Errors (Y/N)	Individual (first name, last name)	Date	
11	Check completeness: • confirm that estimates are reported for all categories and for all years from the base year to the latest year covered by the inventory • for subcategories, confirm that calculations cover the entire category • provide clear definition of 'Other' type categories • check that known data gaps that result in incomplete category emission/removal estimates are properly documented, including qualitative evaluation of the importance of the estimated value in connection with total net emissions (e.g., subcategories classified as 'not estimated')						
12	Trend checks: • for each category, compare current inventory estimates with previous estimates, if available. Should there be significant changes or deviations from expected trends, re-check estimates and explain differences. Significant changes in emissions or removals from previous years may indicate possible input or calculation errors. • check value of default emission factors (aggregated emissions/removals divided by activity data) across time series. Are changes in emissions or removals reflected in the evolution trends of these values? • check whether there are any unusual or inexplicable trends for activity data or other parameters used to estimate GHG emissions/removals						

Annex 4.3. Category-Specific Tier 2 Quality Control Procedures

National Inventory Document: 1990-2022

Source Category: _____

Surname and first name of expert: _____

Organization in which he/she operates and his/her function: _____

INSTRUCTIONS FOR COMPLETING THIS FORM:

This form is to be completed for each individual source category (according to the Tier 2 methodological approach), ensuring the control/verifications performed, as well as the corrective actions taken. The form is to be completed electronically. Once completed, the form should be submitted to the National Inventory Team Leader on the electronic address: <tsaranu.lilia@gmail.com>, together with paper copies, signed and personally presented at the following address: 5 Gheorghe Tudor St., MD 2028, Chisinau, Republic of Moldova.

The first page of this form summarizes the results of the control/verifications and highlights any significant findings or actions to be undertaken on ensuring the high quality of the National GHG Inventory. The expert takes personal responsibility for the process of inventory quality assurance and control at individual source category level. Not all checks included in the forms will be applicable at source category level; checks/rows that are not relevant or not available should indicate 'n/r' or 'n/a' (not be left blank or crossed out). All sources of information associated with the inventory compilation process for each source category require clear references in the respective column of the form (support documentation).

Summary of Verifications, Quality Control and Corrective Actions	
Summary of results of checks and corrective actions taken:	
Suggested checks to be performed in the future:	Unsolved problems after corrective actions taken:

Verification and Quality Control Form for Individual Source Categories
Source Category: _____

	Quality Control Activities/Verifications and Quality Control Procedures	Check Completed			Corrective Action		Supporting documents (reference sources)
		Date	Individual (first name, last name)	Errors (Y/N)	Individual (first name, last name)	Date	
1	Assess the applicability of default factors: • assess whether national circumstances are similar to those used to develop the IPCC default factors • compare default factors with factors for specific site, enterprise, or location of emissions source • consider options for obtaining country-specific factors • document results of this assessment						
2	Review country-specific factors: • QC the data used to develop the country-specific factor • assess whether general QC activities (Level 1) were applied during the studies carried out to develop country-specific factors • compare country-specific factors with defaults factors, document any significant discrepancies • compare country-specific factors to site or plant-level factors • compare country-specific factors with factors from other countries (using the IPCC Emission Factor Database) • document results of this assessment						

Verification and Quality Control Form for Individual Source Categories

Source Category: _____

	Quality Control Activities/Verifications and Quality Control Procedures	Check Completed			Corrective Action		Supporting documents (reference sources)
		Date	Individual (first name, last name)	Errors (Y/N)	Individual (first name, last name)	Date	
3	Review measurements on site, enterprise, or location of the emission source: • determine whether national or international (e.g., ISO) standards were used in measurements • ensure measurement equipment is calibrated and maintained properly • compare direct measurements with estimates using a default factor; document any significant discrepancies						
4	Evaluate time series consistency: • review significant (>10%) changes in year-over-year estimates for categories and subcategories • compare top-down and bottom-up estimates for similar orders of magnitude • conduct reference calculations that use stoichiometric ratios and conservation of mass and energy						
5	Review national level activity data: • determine the level of QC performed by the data collection agency. If inadequate, consider alternative data sources such as IPCC defaults and international data sets. Adjust the relevant uncertainty accordingly • evaluate time series consistency • compare activity data from multiple references if possible						
6	Review site-specific activity data: • determine if national or international (e.g., ISO) standards were used in estimates • compare aggregated site-specific data (e.g., production) to national statistics/data • compare data across similar sites (national or international) • compare top-down and bottom-up estimates for similar orders of magnitude						
7	QC uncertainty estimates: • apply QC techniques to uncertainty estimates • review uncertainty calculations • document uncertainty assumptions and qualifications of any expert consulted						
8	Verify emission/removal estimates: • compare GHG emission/removal estimates to other national or international results at the national, sectoral, sub-sectoral, or GHG level as available						

Annex 5. Additional information associated with activity data, country-specific coefficients/parameters and methodologies used in the estimation of GHG emissions at sectoral level

Annex 5-1: Additional information associated with activity data and calculation methodologies used in the estimation of GHG emissions from sector 1 'Energy'

Annex 5-1.1: Energy Balances of the Republic of Moldova for 2022 (in natural units) (without ATULBD)

SUPPLY AND CONSUMPTION	Coal, including														Peat and peat products, kt	Shale, kt	Natural Gas, million m³ stand.**
	Anthracite, kt	Coke coal, kt	Other bituminous coal, kt	Semibituminous coal, kt	Lignite, kt	Coke, kt	Coke gas, kt	Coke dust, kt	Semicoke, kt	Solid fuel briquettes, kt	Brown coal briquettes, kt	Coal tar, kt	Coal gas, water gas, generator gas and similar gases, except for gas from wells, and other gaseous hydrocarbons, million m³	Other coal products, kt			
	110	121	129	210	220	311	312	313	314	320	330	340	350	390	1110	2000	3000
A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Primary production	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Inputs from other sources	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Import	99	-	27	-	-	-	-	-	-	-	1	-	-	0	0	-	964
Export	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Stock variation	22	-	-2	-	-	0	-	-	-	-	0	-	-	0	0	-	85
Stock at the start of the year	40	-	3	-	-	0	-	0	-	-	0	-	-	0	0	-	16
Stock at the end of the year	62	-	1	-	-	0	-	0	-	-	0	-	-	-	0	-	101
CALCULATED GROSS DOMESTIC CONSUMPTION	77	-	29	-	-	0	-	-	-	-	1	-	-	0	0	-	879
REAL GROSS DOMESTIC CONSUMPTION	77	-	29	-	-	0	-	-	-	-	1	-	-	0	0	-	879
TRANSFORMATION, INPUTS	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	300
Power plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Combined heat plants – public energy producers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	217
Combined heat plants – producers for own consumption	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5
Heat plants – public energy producers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	33
Heat plants – producers for own consumption	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	45
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petrochemical plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liquefaction plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Charcoal production units	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other transformation installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SUPPLY AND CONSUMPTION	Coal, including														Peat and peat products, kt	Shale, kt	Natural Gas, million m³ stand.**
	Anthracite, kt	Coke coal, kt	Other bituminous coal, kt	Semibituminous coal, kt	Lignite, kt	Coke, kt	Coke gas, kt	Coke dust, kt	Semicoke, kt	Solid fuel briquettes, kt	Brown coal briquettes, kt	Coal tar, kt	Coal gas, water gas, generator gas and similar gases, except for gas from wells, and other gaseous hydrocarbons, million m³	Other coal products, kt			
	110	121	129	210	220	311	312	313	314	320	330	340	350	390	1110	2000	3000
A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
TRANSFORMATION, OUTPUTS	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Power plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined heat plants – public energy producers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined heat plants – producers for own consumption	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat plants – public energy producers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat plants – producers for own consumption	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petrochemical plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liquefaction plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Charcoal production units	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other transformation installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy used in the Energy Sector	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petrochemical plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Power, combined heat plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Pumped-storage plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Not specified elsewhere	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
LOSSES	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	24
FINAL CONSUMPTION	77	-	29	-	-	0	-	-	-	-	1	-	-	0	0	-	555
FINAL ENERGY CONSUMPTION	77	-	29	-	-	0	-	-	-	-	1	-	-	0	0	-	555
INDUSTRY	8	-	9	-	-	0	-	-	-	-	-	-	-	-	-	-	81
Mining	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Food processing, beverages and tobacco	2	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	22
Textiles and leather industry	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Wood processing, manufacture of wood and cork products, except furniture; manufacture of straw products and from other woven vegetable materials	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Printing and reproduction of recorded media	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	1

SUPPLY AND CONSUMPTION	Coal, including														Peat and peat products, kt	Shale, kt	Natural Gas, million m³ stand.**
	Anthracite, kt	Coke coal, kt	Other bituminous coal, kt	Semibituminous coal, kt	Lignite, kt	Coke, kt	Coke gas, kt	Coke dust, kt	Semicoke, kt	Solid fuel briquettes, kt	Brown coal briquettes, kt	Coal tar, kt	Coal gas, water gas, generator gas and similar gases, except for gas from wells, and other gaseous hydrocarbons, million m³	Other coal products, kt			
	110	121	129	210	220	311	312	313	314	320	330	340	350	390	1110	2000	3000
A	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
Chemical and petrochemical industry (including the pharmaceutical industry)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Non-metallic minerals	6	-	9	-	-	-	-	-	-	-	-	-	-	-	-	-	52
Metal industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Car engineering industry	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Production of trailers, semitrailers and other transportation means	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Other industries n.c.e.	0	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Construction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
TRANSPORT	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
Railways	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Terrestrial passenger and cargo transport by vehicles	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	18
Pipeline transportation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0
Navigation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aviation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other supplementary activities for transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER	69	-	20	-	-	-	-	-	-	-	1	-	-	0	0	-	456
Agriculture/forestry/fishing	3	-	0	-	-	-	-	-	-	-	0	-	-	-	-	-	7
Commercial/institutional	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	11
Utilities	23	-	1	-	-	-	-	-	-	-	0	-	-	-	-	-	93
Residential	42	-	19	-	-	-	-	-	-	-	1	-	-	0	0	-	345
Not specified elsewhere	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSUMED FOR NON-ENERGY PURPOSES	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Statistical differences	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SUPPLY AND CONSUMPTION	Oil products, including																					
	Oil, kt	Other gaseous hydrocarbons (ethylene, propylene, butylene, butadiene and others), million m³ stand.**	Raw materials for refineries, kt	Additives and oxygenated compounds, kt	Other hydrocarbons, kt	Gas from wells, million m³	Ethane, million m³	Liquefied (petroleum) gases, kt	Naphtha, kt	Aviation gasoline, kt	Gasoline, kt	Gasoline for jet engines, kt	Kerosene for jet engines, kt	Other kerosene gases, kt	Diesel, kt	Residual fuel oil, kt	White-spirit petroleum, kt	Oils and greases (lubricants), kt	Paraffins, kt	Petroleum coke, kt	Petroleum bitumen, kt	Other petroleum products, kt
	4100	4200	4300	4400	4500	4610	4620	4630	4640	4651	4652	4653	4661	4669	4671	4680	4691	4692	4693	4694	4695	4699
A	18	19	20	21	22	23	24	25	26	27	28	31	32	33	34	35	36	37	38	39	40	41
Primary production	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Inputs from other sources	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Import	-	-	-	-	-	-	-	55	-	0	292	-	45	0	699	87	0	8	0	29	48	0
Export	2	-	-	-	-	-	-	0	-	-	121	-	-	-	54	1	-	0	-	-	-	-
Stock variation	1	-	-	0	-	-	-	-2	-	0	-2	-	0	-	-14	6	0	-	-	-1	3	0
Stock at the start of the year	1	-	-	0	-	-	-	6	-	1	15	-	3	-	53	35	0	3	0	5	3	0
Stock at the end of the year	0	-	-	0	-	-	-	4	-	1	13	-	3	-	39	41	0	3	0	4	6	0
CALCULATED GROSS DOMESTIC CONSUMPTION	**2**	**-**	**-**	**0**	**-**	**-**	**-**	**57**	**-**	**0**	**173**	**-**	**45**	**0**	**659**	**80**	**0**	**8**	**0**	**30**	**45**	**0**
REAL GROSS DOMESTIC CONSUMPTION	**2**	**-**	**-**	**0**	**-**	**-**	**-**	**57**	**-**	**0**	**173**	**-**	**45**	**0**	**659**	**80**	**0**	**8**	**0**	**30**	**45**	**0**
TRANSFORMATION, INPUTS	**2**	**-**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**2**	**80**	**0**	**0**	**-**	**-**	**-**	**-**
Power plants	-	-	-	-	-	-	-	-	-	-	0	-	-	-	0	-	-	-	-	-	-	-
Combined heat plants – public energy producers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	69	-	-	-	-	-	-
Combined heat plants – producers for own consumption	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	11	-	-	-	-	-	-
Heat plants – public energy producers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat plants – producers for own consumption	1	-	-	-	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petrochemical plants	1	-	-	0	-	-	-	-	-	-	2	-	-	-	1	-	0	0	-	-	-	-
Liquefaction plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Charcoal production units	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other transformation installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANSFORMATION, OUTPUTS	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**2**	**-**	**-**	**-**	**1**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
Power plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined heat plants – public energy producers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined heat plants – producers for own consumption	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat plants – public energy producers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SUPPLY AND CONSUMPTION	Oil products, including																					
	Oil, kt	Other gaseous hydrocarbons (ethylene, propylene, butylene, butadiene and others), million m³ stand.**	Raw materials for refineries, kt	Additives and oxygenated compounds, kt	Other hydrocarbons, kt	Gas from wells, million m³	Ethane, million m³	Liquefied (petroleum) gases, kt	Naphtha, kt	Aviation gasoline, kt	Gasoline, kt	Gasoline for jet engines, kt	Kerosene for jet engines, kt	Other kerosene gases, kt	Diesel, kt	Residual fuel oil, kt	White-spirit petroleum, kt	Oils and greases (lubricants), kt	Paraffins, kt	Petroleum coke, kt	Petroleum bitumen, kt	Other petroleum products, kt
	4100	4200	4300	4400	4500	4610	4620	4630	4640	4651	4652	4653	4661	4669	4671	4680	4691	4692	4693	4694	4695	4699
A	18	19	20	21	22	23	24	25	26	27	28	31	32	33	34	35	36	37	38	39	40	41
Heat plants – producers for own consumption	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petrochemical plants	-	-	-	-	-	-	-	-	-	-	2	-	-	-	1	1	-	-	-	-	-	-
Liquefaction plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Charcoal production units	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other transformation installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy used in the Energy Sector	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petrochemical plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Power, combined heat plants	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pumped-storage plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Not specified elsewhere	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
LOSSES	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**1**	**-**	**0**	**-**	**1**	**0**	**-**	**0**	**-**	**-**	**-**	**-**
FINAL CONSUMPTION	**0**	**-**	**-**	**0**	**-**	**-**	**-**	**56**	**-**	**0**	**172**	**-**	**45**	**0**	**657**	**1**	**0**	**8**	**0**	**30**	**45**	**0**
FINAL ENERGY CONSUMPTION	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**56**	**-**	**0**	**172**	**-**	**45**	**0**	**657**	**1**	**-**	**-**	**-**	**30**	**-**	**0**
INDUSTRY	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**0**	**-**	**-**	**-**	**9**	**1**	**-**	**-**	**-**	**30**	**-**	**-**
Mining	-	-	-	-	-	-	-	-	-	-	0	-	-	-	4	-	-	-	-	-	-	-
Food processing, beverages and tobacco	0	-	-	-	-	-	-	0	-	-	-	-	-	-	0	0	-	-	-	-	-	-
Textiles and leather industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-
Wood processing, manufacture of wood and cork products, except furniture; manufacture of straw products and from other woven vegetable materials	-	-	-	-	-	-	-	0	-	-	0	-	-	-	0	-	-	-	-	-	-	-
Printing and reproduction of recorded media	-	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	-
Chemical and petrochemical industry (including the pharmaceutical industry)	-	-	-	-	-	-	-	0	-	-	0	-	-	-	0	-	-	-	-	-	-	-
Non-metallic minerals	0	-	-	-	-	-	-	0	-	-	0	-	-	-	0	0	-	-	-	30	-	-
Metal industry	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SUPPLY AND CONSUMPTION	Oil products, including																					
	Oil, kt	Other gaseous hydrocarbons (ethylene, propylene, butylene, butadiene and others), million m³ stand.**	Raw materials for refineries, kt	Additives and oxygenated compounds, kt	Other hydrocarbons, kt	Gas from wells, million m³	Ethane, million m³	Liquefied (petroleum) gases, kt	Naphtha, kt	Aviation gasoline, kt	Gasoline, kt	Gasoline for jet engines, kt	Kerosene for jet engines, kt	Other kerosene gases, kt	Diesel, kt	Residual fuel oil, kt	White-spirit petroleum, kt	Oils and greases (lubricants), kt	Paraffins, kt	Petroleum coke, kt	Petroleum bitumen, kt	Other petroleum products, kt
	4100	4200	4300	4400	4500	4610	4620	4630	4640	4651	4652	4653	4661	4669	4671	4680	4691	4692	4693	4694	4695	4699
A	18	19	20	21	22	23	24	25	26	27	28	31	32	33	34	35	36	37	38	39	40	41
Car engineering industry	-	-	-	-	-	-	-	0	-	-	0	-	-	-	0	-	-	-	-	-	-	-
Production of trailers, semitrailers and other transportation means	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other industries n.c.e.	-	-	-	-	-	-	-	0	-	-	-	-	-	-	0	-	-	-	-	-	-	-
Construction	0	-	-	-	-	-	-	0	-	-	0	-	-	-	5	1	-	-	-	-	-	-
TRANSPORT	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**9**	**-**	**0**	**172**	**-**	**45**	**-**	**528**	**-**	**-**	**-**	**-**	**-**	**-**	**0**
Railways	-	-	-	-	-	-	-	-	-	-	-	-	-	-	5	-	-	-	-	-	-	-
Terrestrial passenger and cargo transport by vehicles	-	-	-	-	-	-	-	9	-	-	172	-	-	-	522	-	-	-	-	-	-	0
Pipeline transportation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Navigation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-
Aviation	-	-	-	-	-	-	-	-	-	0	-	-	45	-	-	-	-	-	-	-	-	-
Other supplementary activities for transport	-	-	-	-	-	-	-	0	-	-	0	-	-	-	1	-	-	-	-	-	-	-
OTHER	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**47**	**-**	**-**	**0**	**-**	**-**	**0**	**120**	**0**	**-**	**-**	**-**	**-**	**-**	**0**
Agriculture/forestry/fishing	0	-	-	-	-	-	-	0	-	-	0	-	-	-	119	0	-	-	-	-	-	0
Commercial/institutional	0	-	-	-	-	-	-	0	-	-	0	-	-	-	0	-	-	-	-	-	-	-
Utilities	0	-	-	-	-	-	-	0	-	-	0	-	-	-	1	0	-	-	-	-	-	-
Residential	-	-	-	-	-	-	-	47	-	-	0	-	-	0	0	-	-	0	0	-	-	0
Not specified elsewhere	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSUMED FOR NON-ENERGY PURPOSES	**0**	**-**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**	**-**	**0**	**-**	**0**	**8**	**0**	**-**	**45**	**0**
Statistical differences	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

SUPPLY AND CONSUMPTION	Biofuels and waste, including															Waste, including		Electricity, million kWh	Heat, thousand Gcal.	Other types of fuel, kt
	Briquettes and wood pellets and other vegetable waste, kt	Fuelwood, thousand m^3 comp.***	Wood waste, kt	Animal waste, kt	Black lye, kt	Agricultural fuel residues, kt	Charcoal, kt	Biogasoline, kt	Biodiesel, kt	Biodiesel for jet engines, kt	Other types of liquid fuels, kt CC	Gas from organic waste, million m^3	Gas from sewage sludge, million m^3	Other types of biogases from anaerobic fermentation, million m^3	Biogas from heating processes million m^3	Industrial waste, kt	Urban waste, kt			
	5111	5112	5119	5130	5140	5150	5160	5210	5220	5230	5290	5311	5312	5319	5320	6100	6200	7000	8000	9900
A	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	63	64	65
Primary production	50	2007	136	5	-	204	-	-	-	-	0	23	-	-	-	-	-	234	-	-
Inputs from other sources	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2703	-	-
Import	1	3	3	-	-	-	2	-	0	-	-	-	-	-	-	-	-	1048	-	-
Export	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	94	-	-
Stock variation	6	-185	-30	-	-	-35	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Stock at the start of the year	7	878	46	-	-	58	0	-	-	-	-	-	-	-	-	-	-	-	-	-
Stock at the end of the year	13	693	16	-	-	23	0	-	-	-	-	-	-	-	-	-	-	-	-	-
CALCULATED GROSS DOMESTIC CONSUMPTION	**39**	**2195**	**169**	**5**	**-**	**239**	**2**	**-**	**0**	**-**	**0**	**23**	**-**	**-**	**-**	**-**	**-**	**3891**	**-**	**-**
REAL GROSS DOMESTIC CONSUMPTION	**39**	**2193**	**169**	**5**	**-**	**239**	**2**	**-**	**0**	**-**	**0**	**23**	**-**	**-**	**-**	**-**	**-**	**3891**	**-**	**-**
TRANSFORMATION, INPUTS	**9**	**7**	**2**	**-**	**-**	**51**	**-**	**-**	**-**	**-**	**-**	**18**	**-**	**-**	**-**	**-**	**-**	**234**	**-**	**-**
Power plants	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	234	-	-
Combined heat plants – public energy producers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Combined heat plants – producers for own consumption	-	-	-	-	-	-	-	-	-	-	-	9	-	-	-	-	-	-	-	-
Heat plants – public energy producers	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Heat plants – producers for own consumption	8	1	2	-	-	51	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petrochemical plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liquefaction plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Charcoal production units	-	6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other transformation installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
TRANSFORMATION, OUTPUTS	**-**	**-**	**-**	**-**	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**995**	**2112**	**-**
Power plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	248	-	-
Combined heat plants – public energy producers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	715	1279	-
Combined heat plants – producers for own consumption	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	32	112	-
Heat plants – public energy producers	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	307	-

SUPPLY AND CONSUMPTION	Biofuels and waste, including															Waste, including		Electricity, million kWh	Heat, thousand Gcal.	Other types of fuel, kt
	Briquettes and wood pellets and other vegetable waste, kt	Fuelwood, thousand m^3 comp.***	Wood waste, kt	Animal waste, kt	Black lye, kt	Agricultural fuel residues, kt	Charcoal, kt	Biogasoline, kt	Biodiesel, kt	Biodiesel for jet engines, kt	Other types of liquid fuels, kt CC	Gas from organic waste, million m^3	Gas from sewage sludge, million m^3	Other types of biogases from anaerobic fermentation, million m^3	Biogas from heating processes million m^3	Industrial waste, kt	Urban waste, kt			
	5111	5112	5119	5130	5140	5150	5160	5210	5220	5230	5290	5311	5312	5319	5320	6100	6200	7000	8000	9900
A	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	63	64	65
Heat plants – producers for own consumption	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	414	-
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Petrochemical plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Liquefaction plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Charcoal production units	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-
Other transformation installations	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Energy used in the Energy Sector	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**147**	**8**	**-**
Oil refineries	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Petrochemical plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0	-	-
Power, combined heat plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	106	3	-
Pumped-storage plants	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Not specified elsewhere	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	40	5	-
LOSSES	**0**	**1**	**0**	**-**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**463**	**303**	**-**
FINAL CONSUMPTION	**30**	**2187**	**167**	**5**	**-**	**188**	**3**	**-**	**0**	**-**	**0**	**5**	**-**	**-**	**-**	**-**	**-**	**4042**	**1801**	**-**
FINAL ENERGY CONSUMPTION	**30**	**2184**	**165**	**-**	**-**	**137**	**3**	**-**	**0**	**-**	**0**	**5**	**-**	**-**	**-**	**-**	**-**	**4042**	**1801**	**-**
INDUSTRY	**0**	**1**	**0**	**-**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**5**	**-**	**-**	**-**	**-**	**-**	**722**	**475**	**-**
Mining	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	16	-	-
Food processing, beverages and tobacco	0	1	0	-	-	0	-	-	-	-	-	-	-	-	-	-	-	347	378	-
Textiles and leather industry	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	43	8	-
Wood processing, manufacture of wood and cork products, except furniture; manufacture of straw products and from other woven vegetable materials	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7	-	-
Printing and reproduction of recorded media	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	14	4	-
Chemical and petrochemical industry (including the pharmaceutical industry)	0	0	-	-	-	0	-	-	-	-	-	5	-	-	-	-	-	31	81	-
Non-metallic minerals	-	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	150	-	-
Metal industry	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-

SUPPLY AND CONSUMPTION	Biofuels and waste, including															Waste, including		Electricity, million kWh	Heat, thousand Gcal.	Other types of fuel, kt
	Briquettes and wood pellets and other vegetable waste, kt	Fuelwood, thousand m^3 comp.***	Wood waste, kt	Animal waste, kt	Black lye, kt	Agricultural fuel residues, kt	Charcoal, kt	Biogasoline, kt	Biodiesel, kt	Biodiesel for jet engines, kt	Other types of liquid fuels, kt CC	Gas from organic waste, million m^3	Gas from sewage sludge, million m^3	Other types of biogases from anaerobic fermentation, million m^3	Biogas from heating processes million m^3	Industrial waste, kt	Urban waste, kt			
	5111	5112	5119	5130	5140	5150	5160	5210	5220	5230	5290	5311	5312	5319	5320	6100	6200	7000	8000	9900
A	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	63	64	65
Car engineering industry	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	20	2	-
Production of trailers, semitrailers and other transportation means	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	1	-
Other industries n.c.e.	0	0	0	-	-	-	-	-	-	-	-	-	-	-	-	-	-	59	1	-
Construction	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	17	-	-
TRANSPORT	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**47**	**-**	**-**
Railways	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Terrestrial passenger and cargo transport by vehicles	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	46	-	-
Pipeline transportation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
Navigation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Aviation	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Other supplementary activities for transport	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
OTHER	**30**	**2183**	**165**	**-**	**-**	**137**	**3**	**-**	**0**	**-**	**0**	**-**	**-**	**-**	**-**	**-**	**-**	**3273**	**1326**	**-**
Agriculture/forestry/fishing	1	4	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	94	0	-
Commercial/institutional	1	2	0	-	-	1	2	-	-	-	0	-	-	-	-	-	-	490	10	-
Utilities	7	25	1	-	-	3	0	-	-	-	-	-	-	-	-	-	-	943	313	-
Residential	21	2152	164	-	-	133	1	-	0	-	-	-	-	-	-	-	-	1746	1003	-
Not specified elsewhere	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
CONSUMED FOR NON-ENERGY PURPOSES	**-**	**3**	**2**	**5**	**-**	**51**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Statistical differences	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Annex 5-1.2: Additional information associated with activity data for the ATULBD used in the estimation of GHG emissions from sector 1 'Energy'

Table A5-1.2.1: Fuel consumption for heat and power generation (source category 1A1 'Energy Industries') in ATULBD between 1994-2022

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Natural gas, million m^3, including:	1,297.95	1,098.40	1,281.50	1,261.40	1,081.33	1,028.50	1,030.80	1,187.80	862.50	931.50
MTPP Dnestrovsk	1,030.00	1,098.40	1,231.80	1,113.30	856.60	841.30	768.40	937.40	719.30	756.20
Residual fuel oil, kt	228.00	26.10	23.60	6.05	26.92	NO	NO	NO	NO	NO
Other bituminous coal, kt	1,686.60	882.90	806.34	281.87	182.42	NO	NO	NO	NO	NO
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Natural gas, million m^3, including:	970.50	972.10	611.10	885.70	995.20	1,448.30	1,549.90	1,428.80	1,458.80	958.40
MTPP Dnestrovsk	838.70	805.40	429.40	719.00	766.20	1,267.20	1,339.40	1,220.00	1,255.80	754.30
Residual fuel oil, kt	NO	NO	NO	NO	NO	NO	NO	NO	2.56	1.84
Other bituminous coal, kt	NO	NO	NO	NO	NO	NO	NO	NO	13.17	312.19
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Natural gas, million m^3, including:	1,350.70	1,539.00	1,504.00	1,296.00	1,419.70	1,495.00	1,585.00	1,598.00	1,396.55	NE
MTPP Dnestrovsk	1,162.60	1,348.00	1,312.00	999.27	1,111.52	1,095.51	1,362.63	1,353.70	1,217.49	NE
Residual fuel oil, kt	1.47	1.37	2.00	0.67	0.84	0.37	0.57	NO	NO	NE
Other bituminous coal, kt	2.64	1.98	7.38	0.00	0.44	0.73	0.18	NO	NO	NE

Table A5-1.2.2: Fuel consumption within source category 1A2 'Manufacturing Industries and Construction' for ATULBD between 1994-2022

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Natural gas, million m^3	275.10	71.72	52.11	151.50	146.50	136.10	143.90	174.50	73.20	79.00
	2004	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
Natural gas, million m^3	71.90	102.50	133.90	232.60	250.50	121.90	113.50	123.00	134.90	110.80
Residual fuel oil, kt	NO	NO	NO	NO	0.8715	0.5705	0.3208	0.3098	0.2581	0.3713
Other bituminous coal, kt	NO	NO	NO	NO	0.0737	0.1473	0.1108	0.1102	0.0840	0.0324
LPG, kt	NO	NO	NO	NO	NO	NO	NO	0.057	0.0346	0.0291
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**	**2023**
Natural gas, million m^3	129.70	108.00	120.00	100.00	108.00	112.00	118.00	124.00	130.50	NE
Residual fuel oil, kt	0.3713	0.3713	0.3713	0.3606	0.289	0.1269	0.1269	0.13	NO	NE
Other bituminous coal, kt	0.0722	0.0641	0.0622	0.335	0.0206	0.0151	0.0109	0.01	NO	NE
LPG, kt	0.0249	0.0204	0.0204	0.0133	0.011	0.0121	0.0000	0.01	NO	NE

Source: JSC 'Moldovagaz' through Letters No. 604 dated 01.04.1999, as a response to Letter No. 02-541 dated 28.05.2001; to Letter No. 02-156 dated 06.02.2004, as a response to Letter No. 257-01-07 dated 26.01.2004; to Letter No. 06-1253 dated 27.09.2006, as a response to Letter No.01-07/1400 dated 25.08.2006; to Letter No. 07-730 dated 6.6.2007, as a response to Letter No. 47/21-103 dated 31.05.2007; to Letter No. 02/1-476 dated 23.02.2011, as a response to Letter No. 03-07/175 dated 02.02.2011; to Letter No. 02/1-288 dated 22.01.2014, as a response to Letter No. 320/2014-01-01 dated 03.01.2014; to Letter No. 02/1-507 dated 10.02.2015, as a response to Letter No. 407/2015-01-09 dated 29.01.2015; to Letter No. 02/1-2183 dated 03.06.2016, as a response to Letter No. 512/2016-05-01 dated 10.05.2016; to Letter No. 03/2-74 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 dated 14.12.2017; to Letter No. Nr. 03/4-676 dated 03.03.2020, as a response to Letter No. 08-310/1 dated 11.02.2020. State Statistical Service of the Transnistrian Moldovan Republic, *Socio-economic development of the TMR for 2009-2021. Chapter 4 'Material Resources'.*

Table A5-1.2.3: Fuel consumption within source category 1A3b 'Road Transportation' for ATULBD between 2009-2016

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Compressed natural gas, million m^3	4.1	6.9	1.8	2.2	5.2	4.8	5.0	5.0	NE	NE	NE	NE	NE	NE

Source: 'Moldovagaz' JSC through Letter No. 02/1-476 dated 23.02.2011, as a response to Letter No. 03-07/175 dated 02.02.2011; to Letter No. 02/1-288 dated 22.01.2014, as a response to Letter No. 320/2014-01-01 dated 03.01.2014; to Letter No. 02/1-507 dated 10.02.2015, as a response to Letter No. 407/2015-01-09 dated 29.01.2015; to Letter No. 02/1-2183 dated 03.06.2016, as a response to Letter No. 512/2016-05-01 dated 10.05.2016; to Letter No. 03/2-74 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 dated 14.12.2017.

Table A5-1.2.4: Fuel consumption within source category 1A4a 'Commercial/Institutional' for ATULBD between 1999-2022

	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Natural gas, million m^3	6.8	9.3	13.6	81.8	87.4	229.0	181.6	151.9	14.4	19.80	16.10	37.70
Bituminous coal, kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.062	0.0626	0.0127
Residual fuel oil, kt	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0868	0.1369	0.1063
	2011	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Natural gas, million m^3	209.20	202.30	99.900	105.10	27.00	17.6852	19.00	22.00	18.80	16.40	19.80	20.00
Bituminous coal, kt	0.0412	0.0087	0.0356	0.0127	0.0050	0.0027	0.0021	0.0302	0.0214	0.0138	NO	NO
Residual fuel oil, kt	0.0399	0.0400	0.0430	0.0820	0.0283	0.0776	0.0181	NO	3.000	NO	NO	NO
LPG, kt	0.0026	0.00109	0.0012	0.0011	0.0012	0.06571	0.0016	0.0014	0.0013	0.0023	0.004	0.004

Table A5-1.2.5: Fuel consumption within source category 1A4b 'Residential' for ATULBD between 1995-2022

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
LPG, kt *	2.5	2.3	1.4	1.3	0.8	0.4	0.3	0.4	0.5	0.5	0.5	0.5	0.4486	0.4962
Natural gas, mil. m^3 *	216.6	163.4	354.8	321.6	293.2	NO	196.4	175.4	176.6	162.8	164.8	161.2	150.8	150.0
Natural gas, mil. m^3 **	NO	NO	NO	NO	294.2	217.9	196.4	163.5	176.6	132.0	144.2	157.0	149.2	148.7
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
LPG, kt *	0.3869	0.5798	0.606	0.477	0.3836	0.3525	0.2753	0.2310	0.1439	0.1466	0.1176	0.1118	0.09	0.12
Natural gas, mil. m^3*	156.0	174.3	184.5	184.1	180.6	180.1	175.0	185.7	190.7	199.1	183.6	180.8	210.0	188.9
Natural gas, mil. m^3**	154.7	173.0	184.5	184.1	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Fuelwood, thousand m^3 comp.*	10.2	10.8	10.0	5.4	4.7	7.7	10.9	6.9	5.4	4.6	8.2	7.2	6.2	6.2

Source: *Statistical Yearbooks of ATULBD for 2000 (page 22), 2006 (page 22), 2009 -2013 (page 23); Press-Release The State of Housing and Communal Services of the Republic for 2011-2020; **'Moldovagaz' JSC Letter No. 06-1253 dated 27.09.2006 and Letter No. 02/1476 dated 23.02.2011; Letter No. 02/1-288 dated 22.12.2014, as a response to Letter No. 320/2014-01-01 dated 03.01.2014; 2013-2014 'Moldovagaz' JSC Letter No. 02/1-507 dated 10.02.2015; 2015 – through Letter No. 02/1-2183 dated 03.06.2015, as a response to Letter No. 512/2016-05-01 dated 10.05.2016; Letter No. 03/2-74 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 dated 14.12.2017; Letter No. 03/4-676 dated 03.03.2020, as a response to Letter No. 08-310/1 dated 11.02.2020.

Table A5-1.2.6: Fuel consumption within source category 1A4c 'Agriculture/Forestry/Fishing' for ATULBD between 1995-2022

	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
Diesel, kt *[1)]	26.8	21.4	28.6	22.1	20.4	14.6	14.4	11.2	7.7	6.9	4.9	4.0	2.9	2.7
Gasoline, kt *	9.7	6.1	8.9	5.8	3.1	1.8	1.7	1.2	1.3	0.8	0.6	0.6	0.4	0.3
Natural gas, mil. m^3**	NO	NO	NO	NO	NO	NO	NO	NO	0.9	0.7	0.4	NO	NO	0.1
Residual fuel oil, kt ***	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0032
Coal, kt ***	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.0153
	2009	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Diesel, kt *[1)]	3.5	7.4	8.4	9.2	10.5	10.2	9.7	NO	NO	NO	NO	NO	NO	NO
Gasoline, kt *	0.4	0.6	0.6	0.6	0.8	0.7	0.6	NO	NO	NO	NO	NO	NO	NO
Natural gas, mil. m^3**	NO	0.1	0.1	0.2	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Residual fuel oil, kt ***	0.0032	0.0032	0.193	0.0032	0.0032	NO	NO	NO	NO	NO	NO	NO	NO	NO
Coal, kt ***	0.0115	0.0090	0.031	0.024	0.024	0.024	0.022	0.0373	0.014	0.014	0.006	0.006	0.006	0.006

[1)] 90% diesel 1A4c

Source: *Statistical Yearbooks of ATULBD for the years 2000 (page 106), 2006 (page 107), 2009 (page 106) 2010 (page 108), 2011 (page 109), 2012 (page 113), 2013 (page 102); 2014 (page 102); 2015 (page 95); **Official Letter from 'Moldovagaz' JSC as a response to Letter No. 06-1253 dated 27.09.2006 and to No. 02/1476 dated 23.02.2011; Letter No. 02/1-288 dated 22.02.2014; Letter No. 02/1-507 dated 10.02.2015; Letter No. 02/1-2183 dated 03.06.2016, as a response to Letter No. 512/2016-05-01 dated 10.05.2016; Letter No. 03/2-74 dated 12.01.2018, as a response to Letter No. 601/2017-12-03 dated 14.12.2017; Letter No. 03/4-676 dated 03.03.2020, as a response to Letter No. 08-310/1 dated 11.02.2020. ***State Statistical Service of the Transnistrian Moldovan Republic, *Socio-economic development of the TMR for 2009-2021, Chapter 4 'Energy Resources'*.

Annex 5-2. Additional information associated with activity data and country-specific coefficients/ parameters, used in the estimation of GHG emissions from sector 2 'IPPU'

Table A5-2.1: Typical raw material and energy balance for cement production at 'LAFARGE Ciment' cement plant in Rezina JSC between 1990-1998

No.	Name	Measure units	Consumption norm	No.	Name	Measure units	Consumption norm
Input				**Output**			
Materials							
1	Clinker	kg/t cement	786.9	1	Cement	kg	1000
2	Gypsum	- „ – „ -	57.7	2	Technological losses	kg/t cement	30
3	Mineral Supplements	- „ – „ -	185.4				
Fuel							
1	Fuel, total	kg c.e./t cement	126.4	1	Clinker drying	kg c.e./t cement	121.7
				2	Supplements drying	kg c.e./t cement	4.7

Table A5-2.2: Raw material consumption for cement production at 'LAFARGE Ciment' JSC cement plant in Rezina between 1990-2022, tonnes

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Consumption of calcite	1,139,917	877,122	156,176	127,367	51,947	136,326	NO	171,006	95,184	90,549	219,650
Consumption of red clay	318,063	232,613	41,562	32,710	14,017	40,484	NO	50,435	25,596	29,347	75,307
Consumption of aluminate clay	62,945	46,446	11,941	11,524	6,101	5,826	NO	7,799	4,628	4,657	8,100
Consumption of slurry	26,507	23,303	4,192	4,862	1,881	2,305	NO	4,354	3,093	2,254	NO
Consumption of gypsum	63,347	25,825	5,070	4,590	1,930	2,827	NO	8,524	3,723	2,645	12,981
Consumption of pyrite	16,687	3,560	929	NO	NO	541	NO	NO	NO	NO	5,880

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
Consumption of calcite	175,683	348,944	376,458	486,137	810,842	959,597	1,097,230	943,266	589,749	628,769	687,956
Consumption of red clay	45,075	86,454	91,414	111,758	192,791	230,363	251,722	198,668	112,955	143,433	NO
Consumption of aluminate clay	6,296	5,838	7,103	9,893	9,371	1,669	1,088	NO	NO	NO	NO
Consumption of slurry	NO	NO	NO	NO	11,851	27,230	39,172	32,557	14,867	2,533	NO
Consumption of gypsum	8,683	15,592	16,583	26,569	39,551	52,862	59,086	49,675	34,485	29,713	30,986
Consumption of chek	NO	8,943	12,682	18,766	30,061	41,024	49,605	44,884	24,723	25,777	30,986
Consumption of pyrite	4,469	2,309	928	259	NO	NO	NO	NO	NO	539	2,717
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Consumption of calcite	682,260	896,124	749,284	862,611	585,320	563,919	659,457	732,541	826,162	899,407	493,359
Consumption of red clay	NO	206,823	156,902	171,333	108,655	119,830	145,162	151,825	162,660	164,060	108,586
Consumption of aluminate clay	NO	NO	NO	NO	NO	3,977	4,491	6,415	5,007	4,630	NO
Consumption of slurry	NO	NO	NO	NO	NO	11,668	10,559	15,931	3,397	4,470	4,169
Consumption of gypsum	27,655	37,202	29,420	32,498	21,184	12,967	23,626	26,601	24,063	36,856	27,730
Consumption of chek	27,655	29,151	19,181	25,284	14,875	7,210	7,457	4,962	NO	NO	NO
Consumption of pyrite	21,177	6,216	6,577	3,372	9,013	6,317	4,746	9,488	6,570	NO	NO

Table A5-2.3: Fuel consumption during the production of cement at 'LAFARGE Ciment' JSC cement plant in Rezina between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Natural gas, million m^3	NO	NO	NO	NO	NO	11.4	NO	16.2	8.7	9.1	18.7
Petcoke, kt	112.1	97.9	21.3	14.7	7.2	0.5	NO	NO	NO	NO	NO
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Natural gas, million m^3	16.6	30.3	32.1	40.2	67.3	76.2	85.4	18.5	3.4	3.6	3.4
Petcoke, kt	NO	NO	NO	NO	NO	NO	NO	81.0	54.8	49.4	60.0
Organic waste, kt	NO	NO	NO	NO	NO	NO	NO	NO	2.0	9.9	7.0
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Natural gas, million m^3	4.1	7.4	2.9	2.7	1.9	2.3	2.9	0.8	2.3	2.9	2.0
Coal, kt	26.3	53.3	50.8	68.6	33.3	44.8	37.6	36.1	22.3	49.0	14.3
Petcoke, kt	NO	NO	NO	0.3	6.9	14.7	27.3	32.1	28.3	20.0	29.3
Organic waste, kt	37.0	34.3	12.2	6.9	8.7	10.7	NO	NO	NO	NO	NO

Table A5-2.4: Activity indicators for glass production at SOE 'Chisinau Glass Factory' between 2015-2022

	2015	2016	2017	2018	2019	2020	2021	2022
Total amount of glass melted, t	57,407.4	35,661.1	28,185.1	60,158.8	60,860.4	56,418.1	59,414.4	61,456.7
Recyclable glass (glass shards) used, t	14,407.9	10,777.8	7,909.6	12,736.4	14,691.7	20,758.4	22,205.8	22,980.2
Glass shards used, %	25.1	30.2	28.1	21.2	24.1	36.8	37.4	37.4
Glass packaging, million conventional jars, 0.5 l	190.4	123.2	82.1	133.7	100.9	94.3	128.3	132.8
Glass packaging, million conventional jars, 0.7 l	136.0	88.0	58.6	37.7	52.7	62.4	40.5	47.7
Dolomite and limestone used as raw material, t	10,182.7	5,950.4	4,285.8	9,262.4	8,805.9	7,861.7	6,755.3	7,725.4
Sodium carbonate used as raw material, t	9,788.9	5,664.8	4,584.1	10,871.6	10,632.6	8,386.7	8,549.2	8,343.6
Natural gas consumption for glass production, million m^3	9.3	6.2	4.8	8.5	8.6	8.1	9.7	8.6
Net calorific value of gases, kcal/m^3	8,246	8,207	8,216	8,197	8,217	8,225	8,211	8,240
Net calorific value of gases, TJ/million m^3	34.5	34.4	34.4	34.3	34.4	34.4	34.4	34.5
Natural gas consumption for glass production, TJ	321.0	213.0	165.1	292.0	294.6	277.4	331.8	298.0
CO_2 emissions from fuel combustion, t	**18,008.9**	**11,949.2**	**9,261.1**	**16,381.2**	**16,525.4**	**15,563.6**	**18,613.2**	**16,717.0**
Emission factor, t CO_2/TJ	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1
Implied combustion emission factor, kg CO_2/t glass	313.7	335.1	328.6	272.3	271.5	275.9	313.3	272.0
Implied process-related emission factor, kg CO_2/t glass	149.8	139.6	143.9	157.7	151.7	126.4	125.3	125.2
Process-related CO_2 emissions, t	**8,599.9**	**4,976.7**	**4,055.1**	**9,484.5**	**9,233.7**	**7,131.9**	**7,441.7**	**7,695.3**
Total CO_2 emissions, t	**26,608.8**	**16,925.8**	**13,316.2**	**25,865.7**	**25,759.1**	**22,695.5**	**26,054.9**	**24,412.3**

Table A5-2.5: Activity indicators for glass production at 'Vetropack Chisinau' JSC between 2015-2022

	2015	2016	2017	2018	2019	2020	2021	2022
Total amount of glass melted, t	117,300	123,700	119,400	123,300	104,700	145,900	147,100	171,300
Recyclable glass (glass shards) used, t	14,304	17,895	40,800	39,200	29,200	30,400	29,600	37,550
Glass shards used, %	12.2	14.5	34.2	31.8	27.9	20.8	20.1	21.9
Total production quantity manufactured, t	93,190	95,820	90,830	112,160	94,540	121,300	114,900	138,700
Glass packaging, million conventional jars, 0.5 l	28.1347	23.8388	17.3278	5.1011	2.9922	15.9083	38.2103	30.6701
Glass packaging, million conventional jars, 0.7 l	167.8186	176.8261	171.9675	192.3029	159.3792	228.5713	219.5051	257.8344
Dolomite and limestone used as raw material, t	14,929	14,320	17,500	20,282	17,036	24,214	22,982	26,154
Sodium carbonate used as raw material, t	16,104	16,500	19,100	19,000	21,260	25,100	24,987	28,706
Natural gas consumption for glass production, million m^3	19.6	21.5	22.0	25.8	18.7	24.1	21.9	24.2
Net calorific value of gases, kcal/m^3	8,246	8,207	8,216	8,197	8,217	8,225	8,211	8,240
Net calorific value of gases, TJ/million m^3	34.5	34.4	34.4	34.3	34.4	34.4	34.4	34.5
Natural gas consumption for glass production, TJ	676.5	738.6	756.6	885.3	643.2	829.8	752.7	834.7
CO_2 emissions from fuel combustion, t	**37,954.3**	**41,436.7**	**42,446.8**	**49,663.4**	**36,084.2**	**46,549.5**	**42,228.2**	**46,827.9**
Emission factor, t CO_2/TJ	56.1	56.1	56.1	56.1	56.1	56.1	56.1	56.1
Implied combustion emission factor, kg CO_2/t glass	323.6	335.0	355.5	402.8	344.6	319.1	287.1	273.4
Implied process-related emission factor, kg CO_2/t glass	175.6	171.1	131.7	136.4	144.2	158.3	159.8	156.2
Process-related CO_2 emissions, t	**20,599.2**	**21,161.0**	**15,720.0**	**16,820.0**	**15,100.0**	**23,100.0**	**23,500.0**	**26,750.0**
Total CO_2 emissions, t	**58,553.5**	**62,597.7**	**58,166.8**	**66,483.4**	**51,184.2**	**69,649.5**	**65,728.2**	**73,577.9**

Table A5-2.6: Average concentration of CaO and MgO in clay used for brick production at 'Macon' JSC in Chisinau between 1990-2022

Year	Average concentration of CaO in clay used, %				Average concentration of MgO in clay used, %			
	From Horungii Mici quarry	From Pruncul quarry	From Micauti quarry	From Purcel quarry	From Horungii Mici quarry	From Pruncul quarry	From Micauti quarry	From Purcel quarry
1990-1996	6.915	4.08	8.22	8.44	2.67	3.21	3.57	3.03
1997-2004	6.915	4.08	8.22	8.44	2.67	3.21	3.57	3.21
2005-2010	5.87-7.96	4.08	8.22	8.44	2.16-3.18	3.21	3.57	3.03
2011-2022	6.66	4.08	6.70	8.44	2.60	3.21	2.93	3.03

Table A5-2.7: Clay consumption for brick production at 'MACON' JSC between 1990-2022, kt

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Clay from Horungii Mici quarry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Clay from Pruncul quarry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
Clay from Micauti quarry	NO	NO	NO	NO	NO	NO	NO	43.4	61.1	61.4	58.3
Clay from Purcel quarry	61.3	65.8	64.7	80.3	34.6	32.0	35.0	NO	NO	NO	NO
Total clay consumption	**61.3**	**65.8**	**64.7**	**80.3**	**34.6**	**32.0**	**35.0**	**43.4**	**61.1**	**61.4**	**58.3**
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Clay from Horungii Mici quarry	NO	NO	NO	38.6	45.0	51.4	44.3	40.5	38.5	35.3	18.7
Clay from Pruncul quarry	3.3	6.7	14.3	19.6	68.9	49.4	80.2	74.0	2.9	1.2	NO
Clay from Micauti quarry	58.2	73.3	71.6	58.7	5.6	21.0	NO	7.9	53.4	67.8	95.7
Clay from Purcel quarry	NO	NO	NO	NO	NO	3.6	NO	NO	0.2	NO	NO
Total clay consumption	**61.5**	**79.9**	**85.9**	**116.8**	**119.5**	**125.4**	**124.6**	**122.4**	**95.0**	**104.3**	**114.5**
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Clay from Horungii Mici quarry	27.3	26.8	22.1	15.6	14.0	18.0	NO	21.9	10.1	13.2	6.6
Clay from Pruncul quarry	NO	NO	NO	0.7	NO	NO	0.4	NO	NO	NO	NO
Clay from Micauti quarry	67.3	81.0	78.6	79.1	87.4	50.1	28.4	9.8	6.7	50.4	41.8
Clay from Purcel quarry	NO	NO	0.1	1.9	0.6	25.0	49.5	58.0	45.8	16.0	NO
Total clay consumption	**94.6**	**107.8**	**100.8**	**97.3**	**102.0**	**93.2**	**78.3**	**89.7**	**62.7**	**79.6**	**48.4**

Table A5-2.8: Consumption of energy resources in the production of bricks at 'MACON' JSC between 2005-2022, tonnes

	2005	2006	2007	2008	2009	2010	2011	2012	2013
Natural gas, million m^3	9.0	9.5	10.2	7.7	6.8	5.0	6.0	5.6	3.8
Residual fuel oil, t	NO	NO	NO	NO	NO	NO	NO	NO	NO
	2014	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Natural gas, million m^3	4.1	4.4	5.1	4.0	4.2	4.0	3.1	3.9	2.3
Residual fuel oil, t	NO	148.9	115.5	144.6	0.0	201.8	96.0	126.0	51.4

Table A5-2.9: Clay consumption in the production of expanded clay at 'MACON' JSC in Chisinau between 2004-2022, tonnes

	2004	2005	2006	2007	2008	2009	2010	2011	2012
Expanded clay, m^3	55,050	63,400	72,200	80,555	64,963	61,199	61,420	30,363	38,150
Specific weight, kg/m^3	371.1	392.8	399.7	385.4	376.2	399.4	353.3	324.8	403.5
Expanded clay produced, t	20,431	24,907	28,859	31,043	24,438	24,440	21,699	9,863	15,394
Specific weight of clay, t/m^3	0.731	0.710	0.711	0.550	0.624	0.629	0.572	0.617	0.717
Clay consumption, t	40,242	45,014	51,334	44,305	40,537	38,494	35,132	18,734	27,354
	2013	**2014**	**2015**	**2016**	**2017**	**2019**	**2020**	**2021**	**2022**
Expanded clay, m^3	42,011	34,568	22,978	19,581	26,704	34,131	14,335	18,800	9,445
Specific weight, kg/m^3	376.88	375.71	389.8	368.1	377.5	374.3	376.5	379.2	384.3
Expanded clay produced, t	15,833	12,988	8,960	7,208	10,080	12,775	5,397	7,129	3,630
Specific weight of clay, t/m^3	0.639	0.639	0.680	0.703	0.673	0.642	0.703	0.703	0.703
Clay consumption, t	26,845	22,089	15,615	13,765	17,976	21,915	10,078	13,216	6,640

Table A5-2.10: Consumption of clay and energy resources in the production of bricks at 'Sigiliu Lux' Ltd brick factory in Chirca village, Anenii Noi district, between 2017-2022

	2017	2018	2019	2020	2021	2022
Thickened hollow ceramic brick, 250x120x88 mm, 24% hollow	1,513.6	8,051.3	4,170.1	71.8	6.8	
Thickened hollow ceramic brick 250x120x88 mm, 40% hollow						
Thickened hollow ceramic brick 250x120x88 mm, 41% hollow			2,679.9	9,937.5	14,192.7	8,280.8
Thickened hollow ceramic brick 250x120x88 mm, 42% hollow			2,171.6		166.2	
Thickened hollow ceramic brick 250x120x65 mm, 40% hollow						
Regular solid section ceramic brick 240x115x63 mm	263.3	565.0	409.5	343.5	222.2	207.8
Solid ceramic brick 205x100x50 mm		211.9		1,953.6		
Hollow ceramic brick 205x100x50 mm				484.1		
Hollow ceramic block 250x90x145 mm, 38% hollow						
Hollow ceramic block 250x165x138 mm			5.7			
Hollow ceramic block 250x150x140 mm				24.8	113.6	15.0
Hollow ceramic block 250x120x140 mm		26.4				
Hollow ceramic block 250x90x140 mm				0.9	263.1	482.0
Hollow ceramic block 250x90x170 mm			186.8	261.7	15.6	
Total bricks produced, thousand units	**1,776.9**	**8,854.6**	**9,623.6**	**13,077.9**	**14,980.2**	**8,985.7**
Specific weight per brick produced, kg/unit	3.7	3.7	3.3	2.8	3.0	3.0
Total bricks produced, t	**6,571.4**	**32,656.0**	**31,925.8**	**36,906.0**	**44,835.5**	**27,057.0**
Clay consumption, kg/conventional brick produced	4.26	4.84	3.27	2.45	2.34	2.56
Total clay consumption for brick production, kt	**7.578**	**42.878**	**31.501**	**31.979**	**34.979**	**23.038**
EF, t CO_2/t	0.100	0.102	0.096	0.097	0.101	0.101
Process-related CO_2 emissions from brick production, kt	**0.8**	**4.4**	**3.0**	**3.1**	**3.5**	**2.3**
Natural gas consumption, million m^3	0.425	1.616	1.552	1.718	2.102	0.900
Net calorific value of gases, kcal m^3	8,216	8,197	8,217	8,225	8,211	8,240
Net calorific value of gases, TJ/million m^3	34.4	34.3	34.4	34.4	34.4	34.5
Natural gas consumption, TJ	14.6	54.7	52.6	58.2	71.2	30.5
Total direct GHG emissions from natural gas combustion, kt	**0.8**	**3.1**	**3.0**	**3.3**	**4.0**	**1.7**
Total direct GHG emissions from brick factory in Chirca village, kt	**1.6**	**7.5**	**6.0**	**6.4**	**7.5**	**4.0**

Table A5-2.11: Activity indicators for steel production at the Moldovan Metallurgical Plant (MMZ) in Rabnita between 2015-2022

	2015	2016	2017	2018	2019	2020	2021	2022
Amount of steel produced, kt	430.0	127.5	469.4	502.9	392.1	464.9	554.2	302.2
Amount of laminates produced, kt	318.8	222.5	451.4	497.9	394.6	455.6	557.0	261.9
Carbon content in steel produced, %	0.25	0.25	0.25	0.25	0.25	0.25	0.25	0.25
Mass of carbon in produced steel, kt	1.0749	0.3189	1.1736	1.2572	0.9804	1.1622	1.3855	0.7555
Specific consumption of electrodes, kg/t steel produced	1.3	1.3	1.3	1.3	1.3	1.3	1.3	1.3
Electrode consumption for steel production, kt	0.5590	0.1658	0.6103	0.6537	0.5098	0.6044	0.7205	0.3929
Carbon content in electrodes used, %	97.0	97.0	97.0	97.0	97.0	97.0	97.0	97.0
Mass of carbon in consumed electrodes, kt	0.5422	0.1608	0.5920	0.6341	0.4945	0.5862	0.6988	0.3811
Specific lime consumption, kg/t steel produced	45.0	45.0	45.0	45.0	45.0	45.0	45.0	45.0
Mass of carbon in lime used, kt (C_L = 0.2142 t C/t)	4.1445	1.2294	4.5250	4.8473	3.7799	4.4811	5.3419	2.9130
Specific consumption of dolomite lime, kg/t steel produced	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0
Mass of carbon in dolomite lime used, kt (C_L = 0.2492 t C/t)	1.0715	0.3179	1.1699	1.2532	0.9772	1.1585	1.3811	0.7531

Process-related CO_2 emissions, kt	17.17	5.09	18.75	20.08	15.66	18.57	22.13	12.07
Natural gas consumption in steel production, million m^3 (resulting from the specific consumption of 14.8 m^3/tonne of steel)	6.4	1.9	6.9	7.4	5.8	6.9	8.2	4.4
Natural gas consumption in laminates production, million m^3 (resulting from the specific consumption of 42.0 m^3/ tonne of laminates)	13.4	9.3	19.0	20.9	16.6	19.1	23.4	12.7
Total natural gas consumption, million m^3	19.8	11.2	25.9	28.4	22.4	26.0	31.6	17.0
Net calorific value of gases, kcal/m^3	8,246	8,237	8,205	8,186	8,203	8,226	8,211	8,306
Net calorific value of gases, TJ/million m^3	34.5	34.5	34.3	34.3	34.3	34.4	34.4	34.8
Natural gas consumption, TJ	681.9	387.3	889.8	971.6	768.4	895.8	1,086.0	591.2
Direct GES emissions from combustion, kt CO_2 equivalent	**38.29**	**21.75**	**49.97**	**54.56**	**43.15**	**50.30**	**60.98**	**33.20**
Total direct GES emissions, kt CO_2 equivalent	**55.46**	**26.84**	**68.71**	**74.64**	**58.81**	**68.87**	**83.12**	**45.27**

Table A5-2.12: Results of the annual survey of economic agents active in the commercial and industrial refrigeration sector, carried out between 2016-2022

Refrigerant	Indices	2016	2017	2018	2019	2020	2021	2022
R-404A	**Units installed annually**	**27**	**33**	**47**	**72**	**65**	**35**	**61**
	Equipment capacity, kW	696.6	1,179.0	1,297.8	1,072.1	1,604.4	426.9	2,330.7
	Amount of refrigerant charged, kg	998.1	1,286.0	1,892.4	1,643.9	2,194.7	596.2	2,184.3
	Amount of refrigerant used for servicing, kg	111.6	187.5	341.8	187.2	319.8	160.8	388.4
R-507A	**Units installed annually**	33	52	48	33	58	27	38
	Equipment capacity, kW	1,627.5	1,661.5	2,358.8	1,045.1	4,568.2	1,627.2	2,384.1
	Amount of refrigerant charged, kg	2,366.0	2,716.2	3,724.3	1,786.2	4,932.8	2,648.5	2,010.4
	Amount of refrigerant used for servicing, kg	473.5	387.8	732.1	303.8	604.8	295.9	432.0
R-134a	**Units installed annually**	**5**	**4**	**2**	**7**	**4**	**6**	**7**
	Equipment capacity, kW	47.2	38.0	44.0	50.0	52.0	196.5	1,278.0
	Amount of refrigerant charged, kg	156.4	85.0	24.0	91.0	89.6	355.2	1,059.6
	Amount of refrigerant used for servicing, kg	32.0	19.0	11.5	28.0	26.0	67.9	141.5
R-407c	**Units installed annually**	**2**	**1**	**9**	**5**	**3**	**3**	**21**
	Equipment capacity, kW	14.0	90.0	498.3	487.0	383.0	286.0	1,996.6
	Amount of refrigerant charged, kg	4.0	95.0	933.6	616.3	376.5	162.0	933.0
	Amount of refrigerant used for servicing, kg	1.0	9.5	94.2	148.7	51.5	50.2	337.8
R-422d	**Units installed annually**	**NO**	**NO**	**1**	**NO**	**NO**	**NO**	**NO**
	Equipment capacity, kW	NO	NO	5.9	NO	NO	NO	NO
	Amount of refrigerant charged, kg	NO	NO	5.0	NO	NO	NO	NO
	Amount of refrigerant used for servicing, kg	NO	NO	0.5	NO	NO	NO	NO
R-448a	**Units installed annually**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**4**
	Equipment capacity, kW	NO	NO	NO	NO	NO	NO	44.0
	Amount of refrigerant charged, kg	NO	NO	NO	NO	NO	NO	54.6
	Amount of refrigerant used for servicing, kg	NO	NO	NO	NO	NO	NO	5.5
R-290	**Units installed annually**	**NO**	**2**	**NO**	**NO**	**NO**	**NO**	**NO**
	Equipment capacity, kW	NO	38.3	NO	NO	NO	NO	NO
	Amount of refrigerant charged, kg	NO	5.3	NO	NO	NO	NO	NO
	Amount of refrigerant used for servicing, kg	NO	0.5	NO	NO	NO	NO	NO
R-744	**Units installed annually**	**NO**	**NO**	**NO**	**NO**	**1**	**NO**	**NO**
	Equipment capacity, kW	NO	NO	NO	NO	3.8	NO	NO
	Amount of refrigerant charged, kg	NO	NO	NO	NO	18.5	NO	NO
	Amount of refrigerant used for servicing, kg	NO	NO	NO	NO	2.0	NO	NO
TOTAL	**Total units installed**	**67**	**92**	**107**	**117**	**131**	**71**	**131**
	Total capacity of refrigerant equipment, kW	2,385.3	3,006.8	4,204.8	2,654.2	6,611.3	2,536.6	8,033.4
	Total amount of refrigerant charged, kg	3,524.5	4,187.5	6,579.3	4,137.4	7,612.1	3,761.9	6,241.9
	Amount of refrigerant used for servicing, kg	618.1	604.3	1,180.1	667.7	1,004.1	574.9	1,305.2
	Refrigerant used for servicing, % of total	**17.5**	**14.4**	**17.9**	**16.1**	**13.2**	**15.3**	**20.9**

Note: The survey was carried out by the Ministry of Environment / Environment Agency, through requests to economic agents to No. 601/2017-12-03 dated 14.12.2017, to No. 08-310/1 dated 11.02.2020, to Nr. 13-07/186 dated 20.01.2021, to No. 05-07/219 dated 01.02.2022 and to No. 08/62/2023 dated 31.01.2023.

Table A5-2.13: Refrigerators and cold stores created and modernized with the support of the Agency of Intervention and Payments in Agriculture (AIPA) from the financial means allocated to the National Fund for Agriculture and the Rural Development (FNDAMR) between 2012-2022

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	Total
Refrigerators and cold stores created and modernised, units	49	45	82	120	7	94	168	129	253	123	107	1,177

Note: Financial resources were allocated for Sub-measure 1.6: Stimulating investments for the development of post-harvest and processing infrastructure.

Source: http://aipa.gov.md/ro/rapoarte.

Table A5-2.14: Results of the survey of economic agents active in the agro-industrial refrigeration sector, carried out between February and March 2022

No. of cold stores	Administrative division/ district	No. of cold stores for which the refrigerant is known	Refrigerant used	Refrigerant equipment capacity, kW	Amount of refrigerant, kg
13	Anenii Noi	0	Unknown	Unknown	Unknown
15	Edinet	0	Unknown	Unknown	Unknown
5	Drochia	0	Unknown	Unknown	Unknown
23	Criuleni	0	Unknown	3,410	10,090
2	**Taraclia**	1	R-507A	227.00	96.00
3	**Rezina**	3	R-404A	227.35	279.00
		2	R-22	38.00	27.00
		2	R-404A	165.00	190.00
18	**Hincesti**	**4**		**203.00**	**217.00**
		1	R-22	160.00	100.00
		4	R-507A	1,932.00	800.00
6	**Singerei**	**5**		**2,092.00**	**900.00**
		1	R-22	260.00	120.00
		1	R-404A	24.00	18.00
		5	R-507A	567.40	286.00
8	**Falesti**	**7**		**851.40**	**424.00**
		2	R-22	210.00	100.00
		2	R-401A	200.00	100.00
		1	R-404A	20.00	20.00
		1	R-449A	150.00	100.00
		5	R-507A	880.00	350.00
11	**Calarasi**	**11**		**1,460.00**	**670.00**
		5	R-22	98.89	129.0
		1	R-134A	372.00	86.0
		6	R-404A	528.80	578.00
		1	R-407C	120.00	80.0
		1	R-507A	189.70	68.0
16	**Cimislia**	**14**		**1,309.39**	**941.0**
		11	R-22	331.25	216.0
		1	R-134a	25.00	27.0
		3	R-404A	105.07	122.0
		1	R-407C	25.00	27.0
		1	R-507A	127.00	94.0
17	**Donduseni**	**17**		**613.32**	**486.0**
		12	R-22	742.00	736.0
		17	R-404A	1,941.30	1,235.0
		3	R-406A	67.00	114.2
		8	R-407C	397.00	251.0
		1	R-408A	100.00	160.0
		22	R-507A	1,849.11	2,051.2
67	**Ialoveni**	**63**		**5,096.41**	**4,547.4**
		2	R-22	47.00	39.0
		2	R-134A	42.00	42.0
		5	R-404A	742.00	1,536.0
		1	R-406A	30.00	28.0
		1	R-407C	135.00	500.0
		2	R-410A	65.00	98.0
		1	R-507A	95.00	150.0
14	**Riscani**	**14**		**1,156.00**	**2,393.0**

No. of cold stores	Administrative division/ district	No. of cold stores for which the refrigerant is known	Refrigerant used	Refrigerant equipment capacity, kW	Amount of refrigerant, kg
		13	R-22	417.5	743.0
		1	R-404A	7.0	10.9
		1	R-407C	48.0	80.0
		1	R-507A	36.0	110.0
		1	R-744	18.0	21.0
22	**Nisporeni**	**17**		**526.5**	**964.9**
		3	R-22	120.0	115.0
		1	R-32	15.0	20.0
		2	R-507A	70.0	65.0
7	**Ungheni**	**6**		**205.0**	**200.0**
		2	R-404A	364.0	530.0
		2	R-407C	95.0	70.0
		3	R-507A	213.0	265.0
13	**Causeni**	**6**		**672.0**	**865.0**
		1	R-32	18	30
		1	R-404A	15.0	30.0
		1	R-407C	35.0	48.0
		1	R-507A	101.0	58.0
4	**Glodeni**	**4**		**151.0**	**136.0**
		2	R-22	396	290
		5	R-404A	999.5	1,030.6
		1	R-507A	552.0	570.0
8	**Soldanesti**	**8**		**1,551.5**	**1,600.6**
		2	R-22	69.2	55.4
		4	R-407C	78.2	109.5
6	**Dubasari**	**6**		**147.4**	**164.9**
		2	R-404A	596	210
		1	R-406A	60.0	30.0
4	**Cantemir**	**3**		**656.0**	**240.0**
		13	R-22	1,239.00	562.0
		9	R-404A	637.00	587.0
		4	R-407C	242.00	180.0
		6	R-507A	894.80	870.1
36	**Cahul**	**32**		**3,012.80**	**2,199.1**
		2	R-407C	137.1	192.0
		1	R-410A	64.0	96.0
12	**UTA Gagauzia**	**3**		**201.1**	**288.0**
		4	R-22	213.00	198.0
		2	R-32	39.00	27.0
		13	R-404A	1,780.00	1,618.0
		1	R-407C	17.00	6.0
		5	R-507A	642.60	520.0
25	**Ocnita**	**25**		**2,691.60**	**2,369.0**
		4	R-22	474.72	452.0
		30	R-404A	4,701.03	4,613.1
		5	R-407C	382.00	866.0
		1	R-449A	310.00	280.0
		8	R-507A	1,085.40	918.4
53	**Briceni**	**48**		**6,953.15**	**7,129.5**
		10	R-404A	809.2	785.0
		1	R-406A	120.0	90.0
		4	R-407C	370.6	395.5
		1	R-408A	60.0	90.0
		1	R-422D	120.0	90.0
17	**Chisinau municipality**	**17**		**1,479.8**	**1,450.5**

No. of cold stores	Administrative division/ district	No. of cold stores for which the refrigerant is known	Refrigerant used	Refrigerant equipment capacity, kW	Amount of refrigerant, kg
		77	R-22	4,816.56	3,882.40
		4	R-32	72.00	77.00
		4	R-134A	439.00	155.00
		2	R-401A	200.00	100.00
		111	R-404A	13,662.25	13,392.60
		6	R-406A	277.00	262.20
		35	R-407C	2,081.92	2,805.00
		2	R-408A	160.00	250.00
		3	R-410A	129.00	194.00
		1	R-422D	120.00	90.00
		2	R-449A	460.00	380.00
		67	R-507A	9,462.01	7,271.70
		1	R-744	18.00	21.00
425	**Total, cold stores**	**315**		**31,897.74**	**28,880.9**
		24.4	R-22	15.1	13.4
		1.3	R-32	0.2	0.3
		1.3	R-134A	1.4	0.5
		0.6	R-401A	0.6	0.3
		35.2	R-404A	42.8	46.4
		1.9	R-406A	0.9	0.9
		11.1	R-407C	6.5	9.7
		0.6	R-408A	0.5	0.9
		1.0	R-410A	0.4	0.7
		0.3	R-422D	0.4	0.3
		0.6	R-449A	1.4	1.3
		21.3	R-507A	29.7	25.2
		0.3	R-744	0.1	0.1
100.0	**Total, percentage share**	**100.0**		**100.0**	**100.0**

Note: The survey was carried out at the request of the Ministry of Environment to No. 05/07/201 dated 31.01.2022, addressed to the Ministry of Agriculture and Food Industry (MAIA), which in turn re-addressed the survey to District Councils by request No. 04-04/47/338 dated 08.02.2022.

Annex 5-3. Additional information associated with activity data and calculation methodologies used in the estimation of GHG emissions from sector 3 'Agriculture'

Annex 5-3.1: Information on livestock and poultry breeds in the Republic of Moldova used in the estimation of GHG emissions from Sector 3 'Agriculture'

Cattle

The most widespread breeds in the RoM in the early 1990s were *Steppe Red* and *Estonian Red* (in the South and partially in the Centre), *Simmental* (in the North and partially in the Centre), and *Spotted Black* (most often used in cross-breeding with local breeds, but also bred as purebred); *Holstein, Ayrshire* and *Jersey* were not bred as purebred, but used for cross-breeding (Bucataru, Radionov, 1997; Bucataru, Radionov, Urzica, 2002; Bivol, Ciubotaru, 2005) (Table A5-3.1).

Table A5-3.1: Features of cattle bred in the Republic of Moldova

Cattle breed	Production	Live weight, kg		Milk yield, kg	Content of:		Weight of calf at birth, kg
		♀	♂		fat in milk, %	protein in milk, %	
Spotted Black	milk	650-750	900-1100	5000-7000	3.4-3.7	3.2-3.3	35-39
Simmental	mixed	600-800	1100-1300	3000-5500	3.9-4.2	3.4-3.5	40-43
Steppe Red	milk	450-550	800-900	3000-5000	3.7-3.9	3.3-3.5	28-35
Estonian Red	milk	500-550	850-950	3500-5000	3.8-4.3	3.2-3.5	34-38
Holstein	milk	650-750	900-1150	6000-10000	3.3-3.6	3.0-3.1	40-45
Ayrshire	milk	400-500	600-700	4000-5000	3.9-4.5	3.5-3.6	30-33
Jersey	milk	300-350	400-450	3000-4000	5.0-6.5	3.7-4.5	20-25

Currently, most cattle bred in the RoM are half-breeds from crossbreeding, not purebred. It should be mentioned that lately, a new kind of cattle (*Moldovan Spotted Black*[145]) was crossbred as a result of crossbreeding of *Steppe Red* and *Simmental* with the improved races *Spotted Black* and *Holstein*.

[145] The features of the type Moldovan Spotted Black are the following: cows yield big amounts of milk (6000 kg) after the first birth, the milking intensity is 1.8-2.5 kg/minute, production maturity is 25-27 months, effective production term is 4-6 births, weight of calf at birth is 30-35 kg; breeding heifers at 6 months of age weight 165 kg, at 12 months – circa 270 kg, and at 18 months – circa 375 kg, and young cattle left for fattening have daily weight gain of 1200 g, slaughtering efficiency being of 55%.

Swine

The following breeds and types of swine are bred in the country: *Big White* (as purebreds and as maternal form in industrial crosses and in crossbreeding), *Bacon Estonian* (used for industrial crosses with *Big White*, *Steppe White Ukrainian* and for crossbreeding), *Steppe White Ukrainian* (boars are used for industrial crosses with other breeds), *Southern Moldavian type for meat 'Sudic'* (Southern) (used in crossbreeding as paternal form) (Bucataru, Radionov, Urzica, 2002; Bivol, Ciubotaru, 2005) (Table A5-3.2).

Table A5-3.2: Features of swine breeds and types bred in the Republic of Moldova

Breeds and types of swine	Production	Live weight, kg		Proliferation, piglets in one birth	Average daily weight gain, g	Nutrition units per 1 kg of weight gain
		♂	♀			
Big White	meat	300-350	220-260	11-12	600-650	4.0-4.1
Bacon Estonian	bacon	280-310	230-250	10-11	600-700	3.8-4.0
Steppe White Ukrainian	meat and fat	300-350	230-250	10-12	600-650	3.9-4.2
Moldavian type for meat 'Southern'	meat	330-350	240-250	10-11	700-800	3.3-3.7
Ladrace	bacon	300-320	230-250	10-12	600-700	3.8-3.9
Duroc	meat	270-300	230-250	8-9	700-750	3.5-3.9
Hampshire	meat	230-280	200-230	9-10	650-700	3.7-4.0

Breeds more often used for crossbreeding in the RoM are *Landrace* (used in crossbreeding with other brees to obtain F_1 half-bred gilts), *Duroc* (used as a paternal breed in three-way and four-way crossbreeding), and *Hampshire* (used as paternal form in various crossbreeding schemes).

Sheep

The sheep bred in the Republic of Moldova are represented by the *Karakul, Tsigaie, Turcana* and *Frisian* breeds (Table A5-3.3).

Table A5-3.3: Features of sheep bred in the Republic of Moldova

Sheep breeds	Production	Live weight, kg		Fertility, lambs per 100 sheep	Wool sheared, kg	Milk yield, kg	Content in milk, %:	
		♂	♀				Fat	proteins
Karakul	skins-milk	70-80	45-50	110-120	2.0-3.5	60-80	7.0-8.0	5.5-6.5
Tsigaie	wool-milk, wool-meet	85-95	45-50	110-130	3.5-7.5	75-120	6.5-7.0	5.0-6.0
Frisian	milk	80-90	65-70	190-210	3.5-5.0	500-600	5.9-6.5	5.0-5.5

The most typical colours of the *Karakul* breed are black and greyish. This breed was regionalized in the northern and central part of the country; it is well adaptable and is not demanding in terms of feed and maintenance conditions. *Tsigaie* sheep are well adaptable to warm climate, are bred in the South of the country and are a breed of sheep with semi-fine wool and has considerable fattening abilities. In comparison with other breeds, the *Frisian* breed has high milk yield indicators and high fertility performance at crossbreeding and improves these features in crossbreeds under special feeding and maintenance conditions (Bucataru, Radionov, Urzica, 2002; Bucataru, Radionov, Varban, 2003; Bivol, Ciubotaru, 2005).

Goats

Most native goats (90%) have thick and short hairy caver, consisting of thick and long fibres (over 70%) and down (less than 30%) of white colour (21.2%), red (20.9%), black (25.2%), and spotted (32.7%), with horns (73.0%) and with no 'ear rings' (73.3%). The research made revealed that the goats gene pool is represented to a large extent by less productive crossbreeds, but well adapted to the climate conditions of the country. Among the improved breeds, recommended for improving goat productivity in the Republic of Moldova are *Saanen* (a breed with high milk productivity and high indices for fertility and longevity, which is used for crossbreeding aimed to improve milk yield of local goats), *French Alpine* (well adapted for grasslands and not demanding in terms of feeding and maintenance conditions, is used to improve native breeds), and *Angora* (the most valuable breed of wool goats; it may be used for crossbreeding with other breeds to improve the quality of the wool cover) (Bucataru, Radionov, Urzica, 2002; Bucataru, Radionov, Varban, 2003; Bivol, Ciubotaru, 2005) (Table A5-3.4).

Table A5-3.4: Features of goat breeds in the Republic of Moldova

Goat breeds	Production	Live weight, kg		Fertility, lambs per 100 goats	Wool sheared, kg	Milk yield	Content in milk, %:	
		♂	♀				fat	proteins
French Alpine	milk	75-85	45-55	150-170	2.0-3.5	700-800	3.7	3.0
Angora	wool, down	80-95	50-65	125-135	2.5-3.5	550-650	3.7	3.0
Local Goats	milk	50-60	30-40	120-130	3.0-4.0	150-200	4.2	3.8
Saanen	milk	42-49	35-41	164-169	2.0-3.0	224-323	4.7	3.4

Horses and mules

The following breeds of horses and interspecies hybrids are bred in the RoM: *Orlov* (resistant, easily adaptable, hound-gutted, with light traction and riding abilities, live weight: 500-550 kg), *of Don* (resistant, can be used for different kinds of work in the most diverse environmental conditions, with light traction and riding abilities, live weight: 500-550 kg) and *Vladimir Heavy Draft* has harmonious features and energetic temper, with heavy traction and rapid motion abilities, live weight: 700-750 kg), and also assess and mules[146] in the Southern part of the country (Bucataru, Radionov, Urzica, 2002).

Rabbits

Breeds of rabbits in the RoM (Table A5-3.5) can be classified by the following criteria: main production – meat, fur, mix, wool; live weight – big (over 5 kg), medium (3-5 kg), small (2-3 kg) and dwarf (less than 2 kg); length of hair – normal, short, long (Bucataru, Maciuc, 2005).

Table A5-3.5: Features of rabbit breeds in the Republic of Moldova

Rabbit Breeds	Production	Live weight, kg	Fertility, rabbits per one birth
Big White	Meat and fur	5.5-9.0	6-8
Big Grey	Meat and fur	5.5-6.5	6-8
Butterfly	Meat and fur	5.0-6.0	6-8
Big Chinchilla	Meat and fur	3.5-5.5	6-8
Vienna Blue	Meat and fur	4.0-5.0	6-12
Silver	Meat and fur	4.0-5.0	6-12
Black-red	Meat and fur	4.5-5.5	8-12
New Zeeland White	Meat and fur	3.5-5.5	8-12
California	Meat and fur	3.6-4.8	6-8
Himalaya (Russian)	Meat and fur	2.4	6-8
Angora	Meat and wool	2.5-5.0	6-9

Chicken

The most widespread chicken breeds in the Republic of Moldova are: *Leghorn, Moldovan Bare Neck, Silver Adler, Kucino, Rhode Island, Plymouth-rock, New-Hampshire*, and *Cornish* (Bucataru, Radionov, Urzica, 2002; Bivol, Ciubotaru, 2005) (Table A5-3.6).

Table A5-3.6: Features of chicken breeds in the Republic of Moldova

Chicken breeds	Production	Live weight, kg		Annual number of laid eggs, pieces	Egg weight, g
		♂	♀		
Leghorn	eggs	2.6-3.0	1.8-2.0	220-240	57-61
Moldovan Bare Neck	meat-eggs	2.7-3.3	2.0-2.5	160-190	58-62
Silver Adler	meat-eggs	3.3-3.7	2.5-3.0	170-180	58-61
Kucino	meat-eggs	3.7-4.1	2.5-3.0	170-190	58-61
Rhode Island	meat-eggs	3.5-4.0	2.5-3.0	170-180	55-63
Plymouth-rock	meat-eggs	3.5-4.0	2.5-3.0	160-180	58-60
New-Hampshire	meat-eggs	3.8-4.1	2.5-3.0	170-200	56-62
Cornish	meat	4.5-5.0	3.4-4.0	100-130	60-65

Turkeys

The most widespread turkey breeds in the Republic of Moldova are *Broad Breasted Bronze, Broad Breasted White*, and *North-Caucasian Bronze* (Bucataru, Radionov, Urzica, 2002) (Table A5-3.7).

[146] A mule is an interspecies hybrid, obtained by crossbreeding of a mare and an ass, with a live weight of 370-390 kg, of 130-150 cm height in withers and a span of life of 30-40 years, is resistant to diseases, and is well adaptable to the environment, not demanding in terms of feeding and maintenance conditions, has a greater working power than a horse, but is sterile.

Table A5-3.7: Features of turkey breeds in the Republic of Moldova

Turkey breeds	Live weight, kg		Annual number of laid eggs, pieces	Egg weight, g
	♂	♀		
Broad Breasted Bronze	14-17	8-11	70-90	80-90
Broad Breasted White	9-20	6-10	70-110	78-82
North-Caucasian Bronze	13-14	6.5-7.0	75-80	80-85

Geese

The most widespread goose breeds in the Republic of Moldova are: *Holmogor, White Italian, Kuban,* and *Chinese* (Bucataru, Radionov, Urzica, 2002) (Table A5-3.8).

Table A5-3.8: Features of goose breeds in the Republic of Moldova

Geese breeds	Category	Live weight, kg		Annual number of laid eggs, pieces	Egg weight, g
		♂	♀		
Holmogor	Heavy breed	9.0-10.0	7.0-8.0	30-40	180-200
White Italian	Semi-heavy breed	7.5-8.5	6.5-7.5	30-40	160-170
Kuban	Light breed	5.0-5.5	4.0-4.5	70-75	140-160
Chinese	Light breed	5.0-5.5	4.0-4.5	60-70	140-160

Ducks

There are preponderantly four breeds of ducks in the Republic of Moldova: *Beijing, Mallard, Grey Ukrainian* and *Polish* (Bucataru, Radionov, Urzica, 2002) (Table A5-3.9).

Table A5-3.9: Features of duck breeds in the Republic of Moldova

Ducks Breeds	Production	Live weight, kg		Annual number of laid eggs, pieces	Egg weight, g
		♂	♀		
Beijing	meat	3.5-4.5	3.0-3.5	90-120	80-90
Mallard	meet-eggs	3.2-3.8	2.8-3.2	150-180	80-90
Grey Ukrainian	meat	3.3-3.7	2.8-3.2	110-130	80-90
Polish	meat	5.0-6.0	2.0-3.0	80-100	70-80

Annex 5-3.2: Information associated with determining the share of manure management systems as a result of the inventory of animal manure collection, storage and use systems in all administrative-territorial divisions of the Republic of Moldova

Table A5-3.10: Survey used to determine the share of different manure management systems following the inventory of animal manure collection, storage and use systems in the administrative-territorial divisions of the Republic of Moldova, as of June 30, 2021

No.	Indices	Column to be filled with information
1	**Locality** (address to be specified):	
2	Name of the organization/business:	
3	Type of livestock and domestic poultry farms (dairy cows, beef cattle, fattening bulls, swine, sheep, goats, poultry, rabbits, etc. *to be specified*)	
4	Livestock and poultry (information to be specified according to statistical report F-24):	
5	**Manure management systems:**	
5.1	Solid storage (*to be specified, on concrete platforms or directly on land*)	
5.2	Drying of manure on land during the grazing process (*to be specified how many days per year animals graze*)	
5.3	Lagoons, anaerobic lagoons	
5.4	Liquid manure management systems	
5.5	Pit storage below animal confinements	
5.6	Daily spreading on agricultural land	
5.7	Manure storage with permanent straw bedding	
5.8	Poultry manure with straw bedding, sawdust, etc.	
5.9	Poultry manure without straw bedding	
5.10	Digestion of manure in fermenters with the aim of obtaining biogas	
5.11	Separation of manure with the help of special separators	

No.	Indices	Column to be filled with information
5.12	Other systems of storing and using manure, *for example: obtaining biohumus by processing manure with the help of California earthworms, etc.*	
6	**After specifying the animal manure storage system, the following information will be specified:**	
6.1	The volume of manure storage capacities, m^3	
6.2	Periodicity of manure evacuation from storage capacities	

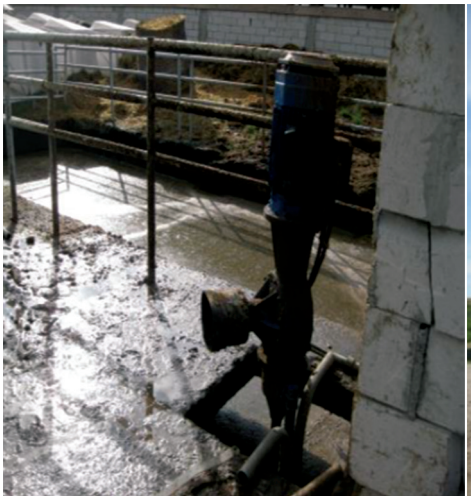
Table A5-3.11: Form used to present the results obtained regarding the determination of the share of different manure management systems in the Republic of Moldova as a result of the inventory of animal manure collection, storage and use systems, as of June 30, 2021

Animal categories (T) and manure management systems (MMS)	Farms, units	Share, % of total in the country	Livestock, heads	Share, % of total in the country
Dairy cows				
Solid storage, including				
On concrete platforms				
Directly on the ground				
Liquid manure management systems, including:				
Special anaerobic tanks				
Ponds and lakes				
Anaerobic digestion of manure in digesters				
Other manure management systems, to be specified				
Other cattle				
Solid storage, including				
On concrete platforms				
Directly on the ground				
Liquid manure management systems, including:				
Special anaerobic tanks				
Ponds and lakes				
Anaerobic digestion of manure in digesters				
Other manure management systems, to be specified				
Swine				
Solid storage, including				
On concrete platforms				
Directly on the ground				
Storage in pits below floor of animal confinement area				
Less than 30 days				
More than 30 days				
Liquid manure management systems, including:				
Special anaerobic tanks				
Ponds and lakes				
Anaerobic digestion of manure in digesters				
Other manure management systems, to be specified				
Sheep and goats				
Solid storage, including				
On concrete platforms				
Directly on the ground				
Anaerobic digestion of manure in digesters				
Other manure management systems, to be specified				
Rabbits				
Solid storage, including				
On concrete platforms				
Directly on the ground				
Anaerobic digestion of manure in digesters				
Other manure management systems, to be specified				
Poultry				
Solid storage, including				

Animal categories (T) and manure management systems (MMS)	Farms, units	Share, % of total in the country	Livestock, heads	Share, % of total in the country
On concrete platforms				
Directly on the ground				
Liquid manure management systems, including:				
Special anaerobic tanks				
Ponds and lakes				
Anaerobic digestion of manure in digesters				
Other manure management systems, to be specified				

Note: Explanatory information to support the process of completing the forms above.

Manure management systems	Brief overview of manure management systems
Grazing animals	Dung of grazing domestic animals remain uncollected where they were excreted 
Daily spread	For 24 hours after excretion, manure is collected from the confinements where animals are kept and spread on agricultural land
Solid storage	Animal manure is collected and stored in solid form for a long time (not less than several months) before being used as organic fertilizers.  

Enclosure for the maintenance of livestock, especially fattening animals and young cattle	An open platform without vegetation, from which the dung is periodically discharged 
Specially designed liquid systems	Artificial ponds where manure in liquid or suspension form is stored for about 6 months or more, and then transported to fields. To facilitate the management of manure, water is added. There are ponds with natural crust and without natural crust (to be specified).  
Lagoons and ponds	Liquid systems in which water is used to transport animal manure to storage in lagoons or ponds, where it is stored for 30 to 200 days, the water can be recycled or used to irrigate agricultural land.  

Storage in pits under the floor of the confinement area where animals are kept	Collection and storage of manure under the slatted floor in closed rooms for the maintenance of animals. Animal manure can be kept this way, less than 30 days and more than 30 days, to be specified.  
Permanent straw bedding for cattle and swine	The management system provides for a daily addition of straw bedding for moisture absorption during the entire technological process, usually for a period of 6-12 months. 
Poultry manure with straw bedding	Analogous to the permanent bedding system for cattle and swine. As a rule, it is used to raise broilers, turkeys and breeding poultry. Manure is excreted on the floor with bedding, the birds step on the manure. 

Poultry manure without straw bedding	The droppings are excreted on the floor without bedding, the birds do not step on the manure. This system is used to raise and maintain birds in wire mesh cages, manure falls under the cage.
Digestion of manure in digesters with the aim of producing biogas	Manure is collected and subjected to anaerobic fermentation in special capacities, closed with the help of microorganisms in order to obtain and collect biogas 
Separation of manure with the help of special separators	Separation of the liquid fraction from the solid one of the dung. Further separation of solid and liquid fraction. The liquid fraction can be recycled or used for irrigation.  
Other systems (to be specified)	Obtaining biohumus by processing dung with the help of California earthworms, etc.  

Table A5-3.12: Share of different manure management systems, as a result of the inventory of manure collection, storage and use systems, as of June 30, 2021, compared to June 30, 2015

Animal categories (T) and manure management systems (MMS)	2021				2015			
	Farms, units	Share, % of total	Livestock, heads	Share, % of total	Farms, units	Share, % of total	Livestock, heads	Share, % of total
Dairy cows	**188**	**100.0**	**12,222**	**100.0**	**94**	**100.0**	**7,149**	**100.0**
Solid storage, including:	170	90.4	9,700	79.4	81	86.2	4,879	68.2
On concrete platforms	37	19.7	2,000	16.4	12	12.8	714	10.0
Directly on the ground	133	70.7	7,700	63.0	69	73.4	4,165	58.3
Liquid manure management systems, including:	17	9.0	2,100	17.2	13	13.8	2,270	31.8
Special anaerobic tanks	0	0.0	0	0.0	4	4.3	591	8.3
Ponds and lakes	17	9.0	2,100	17.2	9	9.6	1,679	23.5
Anaerobic digestion of manure in digesters	1	0.5	422	3.5	0	0.0	0	0.0
Other cattle	**17**	**100.0**	**16,483**	**100.0**	**96**	**100.0**	**9,179**	**100.0**
Solid storage, including:	12	70.6	13,100	79.5	83	86.5	5,578	60.8
On concrete platforms	0	0.0	0	0.0	10	10.4	593	6.5
Directly on the ground	12	70.6	13,100	79.5	73	76.0	4,985	54.3
Liquid manure management systems, including:	5	29.4	3,383	20.5	13	13.5	3,601	39.2
Special anaerobic tanks	1	5.9	2,400	14.6	6	6.3	1,981	21.6
Ponds and lakes	4	23.5	983	6.0	7	7.3	1,620	17.6
Anaerobic digestion of manure in digesters	0	0.0	0	0.0	2	2.1	1,350	14.7
Swine	**114**	**100.0**	**236,774**	**100.0**	**66**	**100.0**	**177,186**	**100.0**
Solid storage, including:	0	0.0	0	0.0	36	54.5	17,310	9.8
On concrete platforms	0	0.0	0	0.0	2	3.0	115	0.1
Directly on the ground	0	0.0	0	0.0	34	51.5	17,195	9.7
Storage in pits below floor of animal confinement area	4	3.5	120,000	50.7	0	0.0	0	0.0
Less than 30 days	4	3.5	120,000	50.7	0	0.0	0	0.0
More than 30 days	0	0.0	0	0.0	0	0.0	0	0.0
Liquid manure management systems, including:	110	96.5	116,774	49.3	30	45.5	159,876	90.2
Special anaerobic tanks	20	17.5	35,774	15.1	8	12.1	54,598	30.8
Ponds and lakes	89	78.1	4,300	1.8	22	33.3	105,278	59.4
Anaerobic digestion of manure in digesters	1	0.9	38,000	16.0	0	0.0	0	0.0
Sheep and goats	188	100.0	64,822	100.0	0	100.0	0	100.0
Solid storage, including:	188	100.0	64,822	100.0	0	100.0	0	100.0
On concrete platforms	0	0.0	0	0.0	0	0.0	0	0.0
Directly on the ground	188	100.0	64,822	100.0	0	100.0	0	100.0
Anaerobic digestion of manure in digesters	0	0.0	0	0.0	0	0.0	0	0.0
Horses and asses	6	100.0	253	100.0	0	100.0	0	100.0
Solid storage, including:	6	100.0	253	100.0	0	100.0	0	100.0
On concrete platforms	0	0.0	0	0.0	0	0.0	0	0.0
Directly on the ground	6	100.0	253	100.0	0	100.0	0	100.0
Anaerobic digestion of manure in digesters	0	0.0	0	0.0	0	0.0	0	0.0
Rabbits	13	100.0	16,600	100.0	0	100.0	0	100.0
Solid storage, including:	13	100.0	16,600	100.0	0	100.0	0	100.0
On concrete platforms	0	0.0	0	0.0	0	0.0	0	0.0
Directly on the ground	13	100.0	16,600	100.0	0	100.0	0	100.0
Anaerobic digestion of manure in digesters	0	0.0	0	0.0	0	0.0	0	0.0
Poultry	67	100.0	2,832,475	100.0	17	100.0	1,784,655	100.0
Solid storage, including:	67	100.0	2,832,475	100.0	17	100.0	1,784,655	100.0
On concrete platforms	0	0.0	0	0.0	7	41.2	760,812	42.6
Directly on the ground	65	97.0	2,682,475	94.7	10	58.8	1,023,843	57.4
Liquid manure management systems, including:	0	0.0	0	0.0	0	0.0	0	0.0
Special anaerobic tanks	0	0.0	0	0.0	0	0.0	0	0.0
Ponds and lakes	0	0.0	0	0.0	0	0.0	0	0.0
Anaerobic digestion of manure in digesters	2	3.0	150,000	5.3	0	0.0	0	0.0

Note: Livestock enterprises equipped for biogas production: 'Porco Bello' Ltd., Cimiseni village, Criuleni district (swine complex); 'Garma-Grup' Ltd., Firladeni village, Hincesti district (cattle complex); 'Rom-Cris' Ltd., Tarnova village, Donduseni district (poultry farm); 'Agro Don' Ltd., Tarnova village, Donduseni district (poultry farm); 'Tehno-Ifagro' Ltd., Pohrebeni village, Orhei district (cattle complex).

Annex 5-4. Additional information associated with country-specific coefficients / parameters used in the estimation of CO2 removals / emissions from sector 4 'LULUCF'

Annex 5-4.1. Additional information associated with category 4A 'Forest Land'

Table A5-4.1.1: General structure of the forestry fund in the Republic of Moldova

Structure elements	Total / average	Species							
		ST	GO	STP	PLA	SA	PA	FR	TE
Area, ha	386 395.4	57 152.1	46 289.2	7 240.8	5 071.2	4 707.1	6 859.1	30 290.6	13 666.8
Proportions of above-ground species, %	100.0	14.8	12.0	1.9	1.3	1.2	1.8	7.8	3.5
Average production class	3.9	3.6	2.8	3.0	3.1	4.0	3.7	3.4	3.1
Average consistency	0.76	0.75	0.76	0.73	0.75	0.66	0.76	0.77	0.78
Average age, years	45	68	79	79	38	35	35	60	67
Current growth, m³/yr/ha	3.8	4.2	3.9	0.9	5.6	6.5	2.3	4.4	6.4
Annual growth, m³	1 457 791	241 111	178 467	6 875	28 262	30 540	16 046	134 292	87 863
Average volume per standing wood, m³/ha	118	184	234	119	174	106	90	195	238
Standing wood, m³	45 407 785	10 536 945	10 843 035	863 755	881 432	498 840	615 719	5 909 773	3 256 044
Proportion of species per volume, %	100.0	23.2	23.9	1.9	1.9	1.1	1.3	13.0	7.2
Structure elements	**Total / average**	**Species**							
		CA	ULC	NU	SC	DR	DM	DT	EX
Area, ha	386 395.4	20 576.9	6 261.9	11 762.7	127 902.7	6 033.0	3 886.9	38 257.4	437.0
Proportions of above-ground species, %	100.0	5.3	1.6	3.1	33.1	1.6	1.0	9.9	0.1
Average production class	3.9	3.6	4.4	4.8	4.6	3.9	3.7	4.1	4.5
Average consistency	0.76	0.79	0.68	0.63	0.77	0.69	0.67	0.72	0.74
Average age, years	45	60	28	34	17	34	33	37	28
Current growth, m³/yr/ha	3.8	5.0	2.9	2.7	3.2	4.7	4.6	3.1	2.6
Annual growth, m³	1 457 791	102 138	17 927	32 332	414 757	28 455	18 012	119 572	1142
Average volume per standing wood, m³/ha	118	152	62	34	30	89	116	84	70
Standing wood, m³	45 407 785	3 131 245	386 897	403 949	3 841 412	534 891	450 882	3 222 509	30 457
Proportion of species per volume, %	100.0	6.9	0.8	0.9	8.5	1.2	1.0	7.1	0.1

Table A5-4.1.2: Abbreviations used in category 4A 'Forest Land'

Full name of species	Abbreviations in Romanian
Pedunculate oak	ST
Durmast	GO
Downy oak	STP
White poplar	PLA
White willow	SA
Field maple	PA
Common maple	FR
Lime*	TE
Hornbeam	CA
Field elm	ULC
Common walnut	NU
Field elm	ULC
Acacia	SC
Various resinous species	DR
Various softwood species	DM
Various hardwood species	DT
Various exotic species	EX

Note: *includes 3 species (silver lime, big leaf linden tree, foul lime).

Table A5-4.1.3: Abbreviations used in the process of forest management in the RoM

Full name of species	Abbreviation	Full name of species	Abbreviation	Full name of species	Abbreviation
Turkish hazel	ALT	Wilmott	FRP	Sycamore	PTL
Grey alder	AN	Italian oak	GI	White Willow	SA
Black alder	ANN	Honey locust	GL	Goat willow	SAC
Tatar maple	AR	Durmast	GO	Brittle willow	SAP
American maple	ARA	Field maple	JU	Sorb	SB

Full name of species	Abbreviation	Full name of species	Abbreviation	Full name of species	Abbreviation
Fir tree	BR	Larch	LA	Acacia	SC
Hornbeam	CA	Apple tree	MA	Russian olive	SL
Horse chestnut	CAP	Birch	ME	Rowan	SR
Sweet chestnut	CAS	Flowering ash	MJ	Pedunculate oak	ST
Cherry plum	CD	Spruce	MO	Greyish oak	STB
Turkey oak	CE	Common walnut	NU	Downy oak	STP
Cherry tree	CI	American walnut	NUA	Red oak	STR
Oriental hornbeam	CR	Sumac	OT	Taxodium	TA
Tree of heaven	CS	Norway maple	PA	Silver lime	TS
Mulberry	DD	Mountain maple	PAM	Big leaf linden tree	TEM
Various softwood	DM	Sylvester pine	PI	Foul lime	TEP
Various resinous	DR	Black pine	PIN	Yew	TI
Various hardwood	DT	White poplar	PLA	White cedar	TU
Douglas fir	DU	Grey poplar	PLC	Field elm	ULC
Various exotic	EX	Black poplar	PLN	Mountain elm	ULM
Beech	FA	Trembling poplar	PLT	European white elm	ULV
Common ash tree	FR	Pear tree	PR	Turkish cherry	VIT
American ash tree	FRA	Plum tree	PRN		

Annex 5-4.2. Methodology used to determine carbon balance in agricultural soils for the estimation of GHG emissions

The methodology for determining the carbon balance in agricultural soils for the estimation of GHG emissions (Banaru, 2000)[147] was used by the Republic of Moldova to compile its GHG emission inventories within the First National Communication to the UNFCCC (2000). In 2010, the methodology was updated[148], due to the availability of new scientific data and considering available data in the 2006 IPCC Guidelines.

Principles laid at the basis of the method are, as follows:

- carbon balance represents the difference between carbon entering the soil (humification of vegetable residues and organic fertilizers) and carbon coming out of the soil due to organic matter mineralization process;
- amount of organic matter in soil can be estimated considering the nitrogen export accumulated in crop yield (main and additional) removed from the cropland;
- amount of carbon entered and stored in soil can be estimated according to the mass of crop residues and the amount of organic fertilizers applied considering the carbon content and the humification coefficients;
- a positive and neutral carbon balance indicates the absence of GHG emissions;
- a negative balance occurs when the carbon coming out of the soil exceeds the amount of organic matter stored through humification processes and indicates the existence of GHG emissions to the extent of the assessed deficit;
- carbon balance estimation by the proposed method can be used for one field, crop rotation, agricultural farm, administrative-territorial unit, as well as for the total area of agricultural lands in the country, for a period of one year or longer.

Arguments supporting the principles used to develop the methodology

The possibility of using nitrogen export from soil by crops for the estimation of humus consumption was argued by I.V. Tiurin (1965), the idea being further developed by A.M. Likov (1979). The close link between carbon emissions and the amount of nitrogen released from soils due to the biochemical decomposition of organic matter was considered. The content of carbon and nitrogen in humus is stable with minor variations within the limits of the pedogeographical areas. The carbon-nitrogen

[147] Banaru, Anatol (2000), Methodology to Calculate CO2 Emissions from Arable Soils. In the collection of papers 'Climate Change. Research, Studies, Solutions'. Ministry of Environment / UNDP Moldova. 'Bons Offices' Ltd. Chisinau, 2000. P. 115-123.
[148] Cerbari, V., Scorpan, V., Taranu, M. (2010), The potential for reducing the CO2 emissions from arable soils of the Republic of Moldova. Mediul Ambiant (Environment), Scientific Journal of Information and Ecological Culture, No. 1 (49), February 2010, ISSN: 1810-9551. P. 6-13.

ratio in humus in the RM's soils is circa 10.7, varying closely from 10.1 to 11.3 (Krupenikov, 1967; Krupenikov, Ganenco, 1984). This is the typical ratio of the surface layer of soils, decreasing slightly in deeper layers.

Considering the stable carbon-nitrogen ratio of the soil organic matter and knowing the nitrogen export stored in crop yield (main and additional) removed from the cropland, it is possible to estimate the amount of carbon released from soil together with the nitrogen, i.e., the carbon released through carbon dioxide emissions.

While performing calculations, it should be considered that part of the nitrogen used by plants may have a different source than the humus. Therefore, the atmospheric nitrogen fixed by leguminous crops, from synthetic and organic fertilizers, as well as from crop residues should be subtracted from the total nitrogen export. A small amount of nitrogen enters the soil with atmospheric precipitations (circa 7 kg/ha), and through non-symbiotic fixation (circa 5 kg/ha). The nitrogen from these sources corresponds to denitrification and leaching losses and should not be considered.

In order to estimate the carbon balance and the GHG emissions from soil, the amount of CO_2 entered and fixed in the soil together with the crop yield that was not removed and the organic fertilizers used should be determined. Other carbon sources entering the soil, such as the carbon from seeds and the atmospheric carbon fixed by the blue algae are considered to be insignificant.

The amount of carbon entering the soil is determined by considering the humification coefficients of crop residues and organic fertilizers, as well as by the carbon content in humus.

The difference between the carbon coming out and the carbon entering the soil (balance) should consider CO_2 emissions should the mineralization processes prevail over the humification processes.

The exposed principles were used by several authors to determine the humus balance in agricultural soils and to develop measures for fertility conservation and enhancement (Likov, 1979; Diakonova, 1984, 1990; Lozanovskaya et al., 1987; Popov et al., 1987; Turcan, Banaru, 1994). Obtaining satisfactory results is conditioned by specifying the indicators used at local and regional level in connection with their variation according to pedo-climatic factors.

The developed methodology aims to estimate CO_2 emissions from cropland of the Republic of Moldova. Data from both the international and national scientific literature was used, including information published in the last 15 years: Ungurean et al., 1997; Boincean, 1999; Rusu et al., 2005; Nicolaev, Boincean et al., 2006.

Carbon balance is estimated using the following equation:

$$B_C \pm = (V_I - C_O) \bullet Area_{(T)}$$

Where:

B_C – carbon balance, tonnes;

V_I – carbon entered into the soil through crop yield and organic matter humification, tonnes/yr;

C_O – carbon coming out from the soil through CO_2 emissions as a result of humus mineralization, tonnes/yr;

$Area_{(T)}$ – area covered with crop T, ha.

The amount of carbon entered in soil (V) is estimated using the following equation:

$$V = V_1 + V_2$$

Where:

V_1 – carbon returned to soils with crop residues, tonnes/yr;

V_2 – carbon returned to soils with organic fertilizers, tonnes/yr.

The amount of carbon in crop residues returned to soils (V_1) is estimated using the following equation:

$$V_1 = [\ (Crop_{(T)} \bullet R_{AG\,(T)} \bullet (1\text{-}Frac_{Remove\,(T)}) + Crop_{(T)} \bullet R_{BG\,(T)}) \bullet k_1\ ] / 1.724$$[149]

Where:

$Crop_{(T)}$ – harvested annual dry matter yield for crop T, (t CM)/ha;

Where:

$$Crop_{(T)} = YieldFresh_{(T)} \bullet DRY$$

$YieldFresh_{(T)}$ – harvested fresh yield for crop T, t/ha;

DRY – dry matter fraction of harvested crop T, kg CM/t of yield[150];

$R_{AG\,(T)}$ – ratio of above-ground residues dry matter to harvested yield for crop T (Crop(T)), t CM_{AG}/t CM[151];

$R_{BG\,(T)}$ – ratio of below-ground residues to harvested yield for crop T, CM m_{BG}/t CM[152];

$Frac_{Remove\,(T)}$ – fraction of above-ground residues of crop T removed and used for other purposes[153];

k_1 – coefficient reflecting the humification of crop residues[154];

1.724 – coefficient reflecting the conversion from humus to carbon[155].

The coefficients used to estimate the amount of carbon from crop residues returned to soils come from different reference sources, including the 2006 IPCC Guidelines (Table A5-4.2.1).

Table A5-4.2.1: Coefficients used to estimate the amount of C in crop residues returned to soils

Crop	DRY	$R_{AG\,(T)}$	$R_{BG\,(T)}$	$Frac_{Remove\,(T)}$	k_1
Winter wheat (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.40	0.23	0.75	0.11
Winter wheat (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.40	0.23	0.75	0.19
Winter rye (crop residues returned to soils without N inputs during stubble-turning)	0.88	1.30	0.22	0.75	0.11
Winter rye (crop residues returned to soils with N inputs during stubble-turning)	0.88	1.30	0.22	0.75	0.19
Barley (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.17	0.22	0.75	0.11
Barley (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.17	0.22	0.75	0.20
Oat (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.17	0.25	0.75	0.11
Oat (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.17	0.25	0.75	0.20
Buckwheat (crop residues returned to soils without N inputs during stubble-turning)	0.88	1.17	0.25	0.75	0.11
Buckwheat (crop residues returned to soils with N inputs during stubble-turning)	0.88	1.17	0.25	0.75	0.20
Millet (crop residues returned to soils without N inputs during stubble-turning)	0.88	1.17	0.22	0.40	0.11
Millet (crop residues returned to soils with N inputs during stubble-turning)	0.88	1.17	0.22	0.40	0.20
Grain maize (crop residues returned to soils without N inputs during stubble-turning)	0.87	1.17	0.22	0.70	0.11
Grain maize (crop residues returned to soils with N inputs during stubble-turning)	0.87	1.17	0.22	0.70	0.20
Sorghum (crop residues returned to soils without N inputs during stubble-turning)	0.89	1.17	0.22	0.50	0.11
Sorghum (crop residues returned to soils with N inputs during stubble-turning)	0.89	1.17	0.22	0.50	0.20
Pea, bean, vetch	0.90	1.30	0.19	0.40	0.25
Soy	0.91	1.30	0.19	0.00	0.25
Sugar beet	0.22	0.29	0.20	0.00	0.10
Sunflower (crop residues returned to soils without N inputs during stubble-turning)	0.90	3.80	0.22	0.40	0.08
Sunflower (crop residues returned to soils with N inputs during stubble-turning)	0.90	3.80	0.22	0.40	0.15
Tobacco	0.90	5.77	0.19	0.00	0.10
Grain rapeseed	0.88	1.17	0.22	0.00	0.11
Potatoes	0.22	0.17	0.20	0.00	0.13
Vegetables	0.22	0.17	0.20	0.00	0.13
Melons and gourds	0.22	0.17	0.20	0.00	0.13
Fodder beet	0.22	0.14	0.20	0.00	0.10
Maize for silo and green fodder	0.23	0.25	0.22	0.77	0.17

[149] Arinushkina E.V. Guidelines for Chemical Analysis of Soils (in Russian). Moscow, Moscow State University Press, 1961. P.136.
[150] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, P. 11.17.
[151] Nicolaev N., Boincean B., Sidorov M., Vanicovici Gh., Coltun V. (2006), Agrotechnics. Ministry of Education and Youth of the RoM – Balti: Balti University Press, 2006, P. 298.
[152] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[153] Expert opinion, Prof. Valerian Cerbari, 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection.
[154] Rusu M., Marghitas M., Oroian I., Mihailescu T., Dumitras A. (2005), Agrochemistry Treaty (in Romanian). Bucuresti, 'Ceres' Publishing House, 2005. 672 P.
[155] Arinushkina E.V. Guidelines for Chemical Analysis of Soils (in Russian). Moscow, Moscow State University Press, 1961. P 136.

Crop	DRY	$R_{AG\,(T)}$	$R_{BG\,(T)}$	$Frac_{Remove\,(T)}$	k_1
Perennial grasses for green fodder, silage and fodder	0.26	0.25	0.40	0.74	0.25
Annual grasses (vetch and oat) for green fodder	0.22	0.25	0.40	0.78	0.22
Annual grasses (peas and oat) for green fodder	0.22	0.25	0.40	0.78	0.22

The amount of carbon in organic fertilizers returned to soils (V_2) is estimated using the following equation:

$$V_2 = (F_{ON} \bullet k_2) / 1.724$$

Where:

F_{ON} – Total annual amount of organic N applied to soils, (t/yr);

$$F_{ON} = F_{AM} + F_{SEW} + F_{COMP} + F_{OOA}$$

Where:

F_{AM} – annual amount of animal manure N applied to soils, t/yr;

F_{SEW} – annual amount of total sewage N that is applied to soils, t/yr;

F_{COMP} – annual amount of total compost N applied to soils, t/yr;

F_{OOA} – annual amount of other organic amendments used as fertilizer t/yr;

k_2 – coefficient reflecting the humification of organic fertilizers (Table A5-4.2.2)[156];

1.724 – coefficient reflecting the transition from humus to carbon[157].

Table A5-4.2.2: Norms of humus accumulation in soil on account of applied organic fertilizers and their humification coefficients

Organic fertilizers	Applied dose, t/ha	Humus accumulation		k_2
		from the applied dose, t/ha	from 1 t of fertilizer, kg/t	
Animal manure with bedding (moisture 52%)	40	5.2	130	0.13
Semiliquid manure (moisture 82%)	50	1.6	29	0.03
Solid fraction of manure without bedding (moisture 65%)	40	3.1	78	0.08
Compost of manure solid fraction and soil (moisture 50%)	40	3.2	81	0.08
Poultry manure (moisture 48%)	10	1.8	180	0.18
Sludge from wastewater treatment (moisture 56%)	40	4.1	102	0.10
Defecate from sugar factories (moisture 44%)	40	1.0	25	0.03
Lignin from bio-chemical factories (moisture 66%)	80	13.3	165	0.17
Sludge from bio-chemical factories (moisture 80%)	80	3.5	45	0.05
Compost from manure and sludge from wastewater treatment (moisture 54%)	80	9.8	121	0.12
Compost from manure and defecate (moisture 48%)	80	9.5	119	0.12
Compost of sludge from wastewater treatment and defecate (moisture 50%)	80	5.4	67	0.07
Compost of sludge from wastewater treatment, defecate and manure (moisture 51%)	120	10.8	90	0.09
Average	**44**	**4.1**	**93**	**0.10**

The amount of carbon coming out of the soils is estimated using the following equation:

$$C = [E_R - (E_M + E_O + E_V + E_S)] \bullet r_1 \bullet r_2 \bullet R$$

Where:

E_R – the amount of N exported from the main and additional crop yield, t/yr; can be estimated using the following equation:

$$E_{r\,(T)} = (Yield\ Fresh_{(T)} \bullet k_{3\,(T)}) / 10^3$$

Where:

$Yield\ Fresh_{(T)}$ – harvested fresh yield for crop T, t/ha;

$k_{3(T)}$ – coefficient reflecting the N export with the crop yield for crop T, kg/t (Table A5-4.2.3)[158].

[156] Banaru A. (2003), Guidebook for Organic Fertilisers Use (in Romanian). ACSA/Agricultural Extension and Education Agency, the World Bank Project RISP – Rural Investments and Services and TACIS FDMOL 9901 Support to Developing Education, Research and Extension Services in Agriculture Project. Chisinau, 2003, 52 P.

[157] Arinushkina E.V. Guidelines for Chemical Analysis of Soils (in Russian). Moscow, Moscow State University Press, 1961. P. 136

[158] Banaru A. (2002), Methodological Guidelines to Determine Humus Balance in Agricultural Soils. Ministry of Agriculture and Food Industry. 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection and TACIS FDMOL 9901 Support to Developing Education, Research and Extension Services in Agriculture Project, Chisinau, 2002. 23 P.

Table A5-4.2.3: Export of nitrogen with the crop yield, kg per 1 tonne of the main crop, taking into account the secondary crop (average data for the RM)

Crop	Export of nitrogen, kg/t
Winter wheat	33
Winter barley	30
Spring barley	30
Oat	30
Grain maize	28
Peas	44
Beans	40
Vetch, vetch mixtures	50
Sorghum	30
Sugar beat	6
Sunflower	49
Soy	65
Tobacco	36
Potatoes	7
Vegetables	3
Fodder beet	3
Silo maize and green fodder	4
Annual herbs for hay	21
Annual herbs for green fodder	5
Perennial herbs for hay	30
Perennial herbs for green fodder	9
Vineyards	7
Orchards	2
Pastures and hay fields	18

E_M – the amount of N export from inorganic fertilizers can be estimated using the following equation:

$$E_M = F_{SN} \bullet k_4$$

Where:

F_{SN} – total amount of inorganic N fertilizers applied to soils (t/a.s./yr); is estimated using the following equation:

$$F_{SN} = F_T \bullet (P_{SN}/10^2)$$

Where:

F_T – total amount of inorganic fertilizers applied to soils, t/yr;

P_{SN} – percentage share of N in inorganic fertilizers, % of active substance (Table A5-4.2.4);

k_4 – coefficient reflecting the N use from inorganic fertilizers; constitutes circa 50% of the applied quantity (Banaru, 2002).

Table A5-4.2.4: Nitrogen content in inorganic fertilizers applied more frequently

Inorganic fertilizers	Chemical formula	Active substance, %
Anhydrous ammonia	NH_3	82.0
Sulphate of ammonia	$(NH_4)_2SO_4$	20.5
Ammonium chloride	NH_4Cl	26.0
Potassium nitrate	KNO_3	13.5
Calcium nitrate	$Ca(NO_3)_2$	15.0
Sodium nitrate	$NaNO_3$	16.0
Ammonia nitrate	NH_4NO_3	34.4
Calcium ammonium nitrate	$NH_4NO_3 \bullet CaCO_3$	20.0
Ammonium sulphate	$NH_4NO_3 \bullet (NH_4)_2SO_4$	26.0
Urea	$CO(NH_2)_2$	46.0
Calcium cyanamide	$CaCN_2$	21.0
Ammonium phosphate	$NH_4H_2PO_4$	11.0

Inorganic fertilizers	Chemical formula	Active substance, %
Diammonium phosphate	$(NH_4)_2HPO_4$	16.0
Superphosphate	Complex formula	4.0
Ammonium polyphosphate	Complex formula	18.0
Nitrophosphate	Complex formula	22.0
Nitro-ammonium phosphate	Complex formula	23.0
Nitroammophos	Complex formula	16.0
Mixed liquid fertilizers	Complex formula	10.0

E_O – the amount of N exported from organic fertilizers; is estimated using the following equation:

$$E_O = F_{ON} \bullet k_5$$

Where:

F_{ON} – total N content in organic fertilizers applied to soils, t/yr; is estimated using the following equation:

$$F_{ON} = F_T \bullet (P_{ON}/10^2)$$

Where:

F_T – total amount of organic fertilizers applied to soils, t/yr;

P_{ON} – percentage share of N in organic fertilizers, % active substance (Table A5-4.2.5);

k_5 – average coefficient reflecting the N content in organic fertilizers (Table A5-4.2.5).

Table A5-4.2.5: Nitrogen content in organic fertilizers applied in the country (Banaru, 2002)

Organic fertilizers	Nitrogen content, %	Average coefficients for nitrogen use from organic fertilizers, %
Manure	0.71	13
Semiliquid manure	0.30	14
Solid fraction of manure	0.57	13
Poultry manure	1.53	33
Sludge from wastewater treatment	0.86	12
Defecate from sugar factories	0.13	12
Lignin of hydrolysis	0.14	1
Sludge of hydrolysis	0.33	9
Solid fraction of manure + soil	0.71	16
Manure + sludge from wastewater treatment	0.79	16
Manure + defecate	0.45	16
Manure + defecate + sludge	0.58	16

The use of recalculation coefficients available in Table A5-4.5.6, enables AD conversion regarding the use of various organic fertilizers in animal manure with bedding.

Table A5-4.2.6: Coefficients for re-calculation of different forms and types of organic fertilizers in animal manure with bedding

Type and form of organic fertilizers	Recalculation coefficients
Animal manure with bedding (up to 77% moisture), solid fraction of manure	1.00
Manure without bedding and semiliquid manure (90-93% moisture)	0.50
Liquid manure (93-97% moisture)	0.25
Residual wastewater from zoo-technical facilities (moisture over 97%)	0.10
Compost of peat and manure (1:1)	1.20
Compost of peat and poultry manure	1.30
Poultry manure	1.20
Straw (with added nitrogen – 10 kg per 1 t)	3.40
Sapropel	0.25
Defecate from sugar factories	0.25
Green fertilizers (natural moisture)	0.25
Sludge from wastewater treatment	0.80
Composts from municipal solid waste	0.90

E_V – the amount of N from crop residues returned to soils; is estimated using the following equation:

$$E_V = F_{CR} \bullet k_6$$

Where:

F_{CR} – annual amount of N in crop residues returned to soils, t N/yr; is estimated using the following equation:

$$F_{CR} = (Crop_{(T)} \bullet R_{AG(T)} \bullet (1\text{-}Frac_{Remove(T)}) + Crop_{(T)} \bullet R_{BG(T)}) \bullet (P_{CR}/10^2) \bullet (k_6/10^2)$$

Where:

$Crop_{(T)}$ – harvested annual dry matter yield for crop T t CM/ha;

$R_{AG(T)}$ – ratio of above-ground residues to harvested yield for crop T (Crop(T)), t CM_{AG}/t CM[159];

$R_{BG(T)}$ – ratio of below-ground residues to harvested yield for crop T, t CM_{BG}/t CM[160];

$Frac_{Remove(T)}$ – fraction of above-ground residues of crop T removed and used for other purposes[161];

P_{CR} – amount of Nitrogen in crop residues, % active substance (Table A5-4.2.7);

k_6 – coefficient reflecting the N in crop residues (Table A5-4.2.7).

Table A5-4.2.7: Amount of N in crop residues (country-specific average values) (Banaru, 2002)

Crop	k_6, content of nitrogen, %	Amount of used N from crop residues, % of total
Winter wheat	0.50	Amount of used N from crop residues constitutes 25% of the total
Winter rye	1.05	
Winter barley	0.80	
Oat	0.60	
Millet	1.25	
Buckwheat	0.60	
Leguminous crops	2.08	
Grain maize	1.08	
Grain sorghum	1.00	
Other cereal crops	0.60	
Sugar beet	1.65	
Sunflower	0.95	
Soy	2.08	
Tobacco	1.30	
Grain rapeseed	1.05	
Potatoes	0.40	
Vegetables	2.09	
Melons and gourds	1.19	
Root crops for fodder	1.65	
Maize for silo and green fodder	1.08	
Perennial grasses for green fodder, silage and fodder	2.48	
Annual grasses for green fodder	1.60	
Vetch green manure, above-ground dry mass	4.20	
Vetch green manure, below-ground dry mass	1.40	

E_S – the amount of N fixed and exported from soils by vegetables and perennial herbs; the quality of symbiotic nitrogen is estimated using the following equation:

$$E_{S(T)} = YieldFresh_{(T)} \bullet (k_{7(T)} / 10^3) \bullet (k_{8(T)} / 10^2)$$

Where:

$YieldFresh_{(T)}$ – harvested fresh yield for crop T, t/ha;

$k_{7(T)}$ – coefficients reflecting symbiotic nitrogen fixation for crop T (Table A5-4.2.8);

$k_{8(T)}$ – coefficients reflecting symbiotic nitrogen export for crop T (Table A5-4.2.8).

[159] Nicolaev N., Boincean B., Sidorov M., Vanicovici Gh., Coltun V. (2006), Agrotechnics. Ministry of Education and Youth of the RoM. – Balti: Balti University Press, 2006, P. 298.
[160] 2006 IPCC Guidelines, Volume 4, Chapter 11, Table 11.2, Page 11.17.
[161] Expert opinion, Prof. Valerian Cerbari, 'Nicolae Dimo' Institute of Pedology, Agrochemistry and Soil Protection.

Table A5-4.2.8: Fixation and export of nitrogen by vegetables and perennial herbs (average values from the scientific literature in the field) (Banaru, 2002)

Crops	Nitrogen fixation, kg/t production	Nitrogen export, % of the total export
Peas	44	60
Beans	37	60
Soy	70	60
Vetch	50	60
Vetch in mixtures	5	37
Perennial herbs	30	70

r_1 – coefficient reflecting the humus mineralization dependence by soil granulometry[162] (Table A5-4.2.9).

Table A5-4.2.9: Humus mineralization correction coefficient based on soil granulometry (according to Likov, 1979)

Soil granulometry	Correction coefficient (r_1)
Argillaceous clay	0.8
Clay	1.0
Sandy clay	1.2
Clayey sand	1.4
Sand	1.8

r_2 – coefficient reflecting the humus mineralization dependence based on the technology applied to crop[163] (Table 5-4.2.10).

Table A5-4.2.10: Humus mineralization correction coefficient based on technology applied to crop (according to Likov, 1979)

Crops	Correction coefficient (r_2)
Perennial herbs	1.0
One year cereal crops	1.2
Perishable crops	1.6

R – carbon-nitrogen ratio of the soil organic matter (humus) (R = C : N), according to the 2006 IPCC Guidelines, the default value for Cropland Remaining Cropland is 10 (range from 8 to 15); according to national sources (Krupenikov, 1967; Krupenikov, Ganenco, 1984; Banaru, 2002) the carbon-nitrogen ratio of humus in the RM's soils is 10.7 (range from 10.1 to 11.3).

CO_2 emissions from soils engaged in farming can be estimated using the following equation:

$$CO_2 = \pm B \bullet 44/12$$

Where:

B – carbon balance, tonnes;

[44/12] – mass ratio between C and CO_2.

As for the results obtained using this methodology, it is necessary to mention that over the last two decades, agriculture in the RoM has mainly been based on exploitation of the natural fertility of soils (and/or the existing humus content in soils). As a result, any increase in crop yield (as it happened, for example, in 1994, 1997, 2004, 2008, 2013, 2014, 2016 or 2021) caused particularly by favourable climatic factors, and not followed by the compensation of organic matter loss in soil, used for crop development, leads to increased CO_2 emissions.

Thus, the intensification of the dehumification processes (mineralization of organic matter in soil) within the current subsistence agriculture leads to decreased carbon stocks removed in humus over centuries, and to increased CO_2 emissions as well as to the decrease in soil quality and fertility, respectively.

[162] Likov A.M. On the Methods of Estimating the Humus Balance in Soils Used in Intensive Agriculture (in Russian). Timiryazev Agricultural Academy Bulletin, 1979. Nr. 6, pp. 14-20.
[163] Idem.

The significant decrease between 1990 and 2022 in carbon returned to soil with animal manure (by 82%), and in below-ground and above-ground crop residues, respectively (by 42%) led to a shift from a positive carbon balance between 1990 and 1992 (the period before the agrarian reform in the RoM) to a deeply negative balance in the last 20 to 25 years (Table A5-4.2.11).

Table A5-4.2.11: Carbon balance in arable land in the RoM between 1990-2022

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Carbon introduced in soil with organic fertilizers, kt	364.4	409.2	281.2	363.0	119.6	182.2	92.6	177.4	150.0	142.3	76.9
Carbon introduced in soil with above- and below-ground residues, kt	556.5	491.4	458.2	393.7	382.0	338.0	295.2	266.9	260.6	238.5	218.0
Carbon losses from soil due to humus mineralization, kt	-388.0	-393.5	-322.1	-1,028.1	-617.5	-955.5	-832.7	-1,270.5	-1,035.7	-957.8	-910.8
Carbon balance in arable land, kt	532.9	507.0	417.3	-271.3	-116.0	-435.3	-444.9	-826.2	-625.1	-577.1	-616.0
Carbon balance in arable land, t/ha	0.31	0.30	0.25	-0.15	-0.07	-0.25	-0.26	-0.48	-0.37	-0.35	-0.36
	2001	**2002**	**2003**	**2004**	**2005**	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**
Carbon introduced in soil with organic fertilizers, kt	148.5	148.3	62.1	165.3	169.4	157.3	44.4	184.2	134.9	174.8	175.0
Carbon introduced in soil with above- and below-ground residues, kt	221.0	222.8	212.5	203.5	213.7	222.4	172.8	171.5	189.1	193.7	177.8
Carbon losses from soil due to humus mineralization, kt	-1,045.2	-1,100.8	-860.9	-1,257.1	-1,219.3	-1,065.9	-362.7	-1,289.8	-906.6	-1,100.0	-1,142.8
Carbon balance in arable land, kt	-675.8	-729.6	-586.4	-888.3	-836.1	-686.1	-145.5	-934.1	-582.5	-731.5	-790.0
Carbon balance in arable land, t/ha	-0.39	-0.42	-0.37	-0.53	-0.49	-0.45	-0.09	-0.60	-0.37	-0.45	-0.49
	2012	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**	**2022**
Carbon introduced in soil with organic fertilizers, kt	54.0	189.9	214.1	81.1	212.4	245.7	248.4	253.0	66.5	424.6	212.2
Carbon introduced in soil with above- and below-ground residues, kt	164.7	157.1	169.8	158.2	155.8	158.0	146.5	120.5	107.0	107.6	98.0
Carbon losses from soil due to humus mineralization, kt	-517.4	-1,201.5	-1,221.9	-998.3	-1,366.0	-1,532.6	-1,532.6	-1,492.5	-560.9	-2,121.5	-945.6
Carbon balance in arable land, kt	-298.7	-854.4	-838.1	-759.1	-997.8	-1,128.9	-1,137.7	-1,119.0	-387.5	-1,589.3	-635.4
Carbon balance in arable land, t/ha	-0.18	-0.52	-0.50	-0.45	-0.59	-0.66	-0.66	-0.66	-0.23	-0.91	-0.36

It should be noted that the carbon balance in the arable land constituted on average -0.23 t/ha per year between 1990 and 2005, whereas for the 2006-2020 time series it already reached an average of circa -0.46 t/ha per year (Table A5-4.2.12).

Table A5-4.2.12 presents other relevant information in the calculation process, including the total area of cropland, as well as data on crop yields recorded between 1990 and 2022.

Regarding the 'Methodology to Calculate CO_2 Emissions from Agricultural Soils for the estimation of GHG emissions' the following should also be mentioned:

- the balance (difference) between the carbon entered and coming out of the soil, related to one unit of area (ha), is multiplied by total area ($Area_{(T)}$) of crop *T*;
- in the described order, the carbon balance is estimated for each crop (*T*) separately;
- the estimation of the carbon balance for the total area of croplands in the country is performed by adding the data for each crop (*T*);
- the positive and negative values are summed;
- should the sum have a positive value, the carbon balance should be considered well-balanced or positive, and proves that the soils in croplands are a source of CO_2 removals;
- should the sum have a negative value, the carbon balance should be considered negative and proves that the soils in croplands are a source of CO_2 emissions.

Table A5-4.2.12: Carbon balance and CO_2 emissions from all arable lands in the Republic of Moldova between 1990-2022

Years	Area of cropland, ha	Crop yields, t	Crop yields, t d.m.	Carbon					CO_2	
				Carbon introduced in soil with organic fertilizers, t	Carbon introduced in soil with above- and below-ground residues, t	Carbon losses from soil due to humus mineralization, kt	Carbon balance		Emissions balance	
							tonnes	t/ha	tonnes	t/ha
1990	1,697,840	17,188,730	5,922,312	364,400	556,491	-387,994	532,896	0.31	-1,953,954	-1.15
1991	1,695,380	19,527,955	6,809,184	409,193	491,357	-393,501	507,049	0.30	-1,859,181	-1.10
1992	1,686,980	12,907,263	4,556,155	281,237	458,176	-322,131	417,282	0.25	-1,530,035	-0.91
1993	1,759,280	15,345,591	5,922,214	363,033	393,702	-1,028,069	-271,334	-0.15	994,891	0.57
1994	1,704,040	9,598,540	3,510,318	119,589	381,956	-617,536	-115,992	-0.07	425,303	0.25
1995	1,713,799	10,244,424	4,155,627	182,191	338,041	-955,521	-435,289	-0.25	1,596,059	0.93
1996	1,707,440	7,306,163	3,100,899	92,624	295,213	-832,697	-444,860	-0.26	1,631,153	0.96
1997	1,718,540	8,317,933	4,185,792	177,412	266,920	-1,270,523	-826,191	-0.48	3,029,367	1.76
1998	1,709,040	6,870,799	3,391,396	149,951	260,616	-1,035,689	-625,122	-0.37	2,292,112	1.34
1999	1,654,100	5,583,312	2,953,880	142,264	238,481	-957,841	-577,097	-0.35	2,116,022	1.28
2000	1,692,900	4,885,494	2,630,067	76,860	218,005	-910,847	-615,982	-0.36	2,258,601	1.33
2001	1,724,235	5,621,814	3,229,053	148,467	220,951	-1,045,185	-675,767	-0.39	2,477,812	1.44
2002	1,726,800	5,495,606	3,205,702	148,343	222,764	-1,100,756	-729,648	-0.42	2,675,377	1.55
2003	1,588,474	4,057,652	2,290,355	62,085	212,481	-860,922	-586,355	-0.37	2,149,968	1.35
2004	1,676,000	5,579,823	3,530,408	165,334	203,516	-1,257,146	-888,296	-0.53	3,257,084	1.94
2005	1,690,054	5,640,911	3,471,787	169,437	213,741	-1,219,286	-836,108	-0.49	3,065,728	1.81
2006	1,539,051	5,345,640	3,043,778	157,349	222,425	-1,065,883	-686,108	-0.45	2,515,730	1.63
2007	1,543,304	2,534,568	1,331,746	44,403	172,805	-362,665	-145,457	-0.09	533,344	0.35
2008	1,544,512	5,948,617	3,802,219	184,168	171,497	-1,289,788	-934,123	-0.60	3,425,117	2.22
2009	1,582,620	4,054,261	2,676,943	134,921	189,130	-906,596	-582,546	-0.37	2,136,001	1.35
2010	1,613,660	5,223,762	3,230,241	174,835	193,683	-1,100,034	-731,515	-0.45	2,682,222	1.66
2011	1,609,878	5,088,336	3,287,993	174,994	177,801	-1,142,783	-789,988	-0.49	2,896,622	1.80
2012	1,641,372	2,975,829	1,756,507	53,958	164,734	-517,359	-298,667	-0.18	1,095,111	0.67
2013	1,652,276	5,640,731	3,619,055	189,946	157,113	-1,201,468	-854,409	-0.52	3,132,833	1.90
2014	1,684,385	6,381,750	3,982,576	214,072	169,780	-1,221,920	-838,068	-0.50	3,072,916	1.82
2015	1,678,526	4,208,990	2,878,957	81,061	158,181	-998,314	-759,072	-0.45	2,783,263	1.66
2016	1,701,597	5,667,955	3,921,977	212,412	155,781	-1,366,030	-997,838	-0.59	3,658,739	2.15
2017	1,720,985	6,374,212	4,432,581	245,655	158,000	-1,532,592	-1,128,937	-0.66	4,139,435	2.41
2018	1,735,120	6,311,629	4,517,039	248,420	146,492	-1,532,607	-1,137,695	-0.66	4,171,548	2.40
2019	1,708,205	6,300,092	4,572,429	252,965	120,480	-1,492,462	-1,119,017	-0.66	4,103,063	2.40
2020	1,696,161	3,451,768	2,283,059	66,459	106,961	-560,940	-387,521	-0.23	1,420,911	0.84
2021	1,751,505	8,296,277	6,216,148	424,564	107,565	-2,121,459	-1,589,331	-0.91	5,827,546	3.33
2022	1,776,559	4,141,255	2,885,483	212,168	98,021	-945,596	-635,407	-0.36	2,329,826	1.31
1990-2022	**1,676,504**	**7,033,869**	**3,675,875**	**185,599**	**231,602**	**-1,016,792**	**-599,591**	**-0.36**	**2,198,501**	**1.31**
1990-2005	1,696,556	9,010,751	3,929,072	190,776	310,776	-887,228	-385,676	-0.23	1,414,144	0.84
2006-2022	**1,657,630**	**5,173,275**	**3,437,572**	**180,726**	**157,085**	**-1,138,735**	**-800,923**	**-0.48**	**2,936,719**	**1.76**

Annex 6. Sectoral and Summary Reports on GHG Emissions in the Republic of Moldova within 1990-2022

Annex 6-1. Sectoral Report for Sector 1 'Energy' within 1990-2022

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**35,384.04**	**49.86**	**1.16**	**91.72**	**270.67**	**31.87**	**149.47**	**37,087.56**
1.A. Fuel combustion activities (sectoral approach)	35,383.38	13.43	1.16	91.72	270.67	31.21	149.47	36,066.86
1.A.1. Energy industries	**21,300.29**	**0.49**	**0.17**	**39.47**	**7.21**	**0.63**	**102.36**	**21,359.99**
1.A.1.a. Public electricity and heat production	21,300.29	0.49	0.17	39.47	7.21	0.63	102.36	21,359.99
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**1,898.61**	**0.09**	**0.01**	**8.86**	**3.45**	**0.87**	**2.67**	**1,904.84**
1.A.2.a. Iron and steel	140.43	0.00	0.00	0.19	0.21	0.06	0.14	140.65
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	19.52	0.00	0.00	0.06	0.01	0.01	0.00	19.55
1.A.2.d. Pulp, paper and print	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.e. Food processing, beverages and tobacco	204.24	0.02	0.00	1.00	0.85	0.14	0.72	205.38
1.A.2.f. Non-metallic minerals	1,409.45	0.05	0.01	7.35	1.88	0.53	1.45	1,413.57
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	77.05	0.00	0.00	0.12	0.18	0.04	0.15	77.24
1.A.2.i. Mining and quarrying	5.53	0.00	0.00	0.01	0.03	0.00	0.02	5.55
1.A.2.j. Wood and wood production	8.81	0.00	0.00	0.04	0.09	0.05	0.00	9.10
1.A.2.k. Construction	13.31	0.00	0.00	0.05	0.02	0.01	0.00	13.39
1.A.2.l. Textile and leather	20.27	0.00	0.00	0.03	0.17	0.02	0.17	20.40
1.A.2.m. Other industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3. Transport	**4,698.24**	**1.35**	**0.36**	**21.04**	**70.89**	**9.04**	**0.78**	**4,830.86**
1.A.3.a. Domestic aviation	72.33	0.00	0.00	0.00	0.03	0.00	0.00	72.89
1.A.3.b. Road transportation	4,112.35	1.32	0.20	14.05	69.42	8.44	0.68	4,202.23
1.A.3.c. Railways	403.47	0.02	0.16	6.71	1.37	0.60	0.10	445.37
1.A.3.d. Domestic navigation	18.91	0.00	0.00	0.00	0.00	0.00	0.00	19.10
1.A.3.e. Other transportation	91.18	0.00	0.00	0.28	0.07	0.00	0.00	91.27
1.A.4. Other sectors	**7,372.26**	**11.50**	**0.61**	**21.60**	**188.29**	**20.55**	**43.34**	**7,855.70**
1.A.4.a. Commercial/institutional	1,413.84	0.25	0.02	2.83	11.41	1.23	10.81	1,426.18
1.A.4.b. Residential	4,410.07	10.96	0.06	4.73	166.34	17.71	31.58	4,732.75
1.A.4.c. Agriculture/forestry/fishing	1,548.35	0.30	0.53	14.04	10.54	1.61	0.95	1,696.77
1.A.4.ci. Stationary	160.58	0.19	0.00	0.52	0.67	0.09	0.63	166.47
1.A.4.cii. Mobile	1,387.76	0.10	0.53	13.51	9.87	1.52	0.31	1,530.31
1.A.5. Other	**113.97**	**0.01**	**0.00**	**0.76**	**0.83**	**0.12**	**0.33**	**115.46**
1.A.5.a. Stationary	41.96	0.00	0.00	0.09	0.35	0.05	0.31	42.21
1.A.5.b. Mobile	72.01	0.01	0.00	0.67	0.48	0.08	0.02	73.24
1.B. Fugitive emissions from fuels	**0.66**	**36.43**	**0.00**	**NO**	**NO**	**0.66**	**NO**	**1,020.70**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.66**	**36.43**	**0.00**	**NO**	**NO**	**0.66**	**NO**	**1,020.70**
1.B.2.a. Oil	0.11	0.00	0.00	NO	NO	0.00	NO	0.11
1.B.2.b. Natural gas	0.56	36.43			NO	0.66	NO	1,020.59
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**191.63**	**0.01**	**0.01**	**0.76**	**0.57**	**0.21**	**0.06**	**193.68**
1.D.1.a. Aviation	191.63	0.01	0.01	0.76	0.57	0.21	0.06	193.68
1.D.1.b.Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**232.81**							**232.81**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_X	CO	NMVOC	SO_X	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**29,884.36**	**44.13**	**0.86**	**74.95**	**196.18**	**23.17**	**123.69**	**31,348.82**
1.A. Fuel combustion activities (sectoral approach)	29,883.72	9.67	0.86	74.95	196.18	22.55	123.69	30,383.23
1.A.1. Energy industries	**18,927.03**	**0.42**	**0.16**	**35.07**	**6.41**	**0.55**	**90.52**	**18,980.28**
1.A.1.a. Public electricity and heat production	18,927.03	0.42	0.16	35.07	6.41	0.55	90.52	18,980.28
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**1,269.19**	**0.05**	**0.01**	**6.48**	**1.74**	**0.55**	**1.22**	**1,273.22**
1.A.2.a. Iron and steel	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.d. Pulp, paper and print	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.e. Food processing, beverages and tobacco	166.65	0.01	0.00	0.80	0.71	0.12	0.61	167.58
1.A.2.f. Non-metallic minerals	1,022.11	0.03	0.01	5.46	0.80	0.35	0.49	1,024.79
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	63.54	0.00	0.00	0.14	0.15	0.03	0.12	63.69
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	7.40	0.00	0.00	0.04	0.07	0.04	0.00	7.64
1.A.2.k. Construction	9.49	0.00	0.00	0.05	0.01	0.00	0.00	9.52
1.A.2.l. Textile and leather	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.m. Other industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3. Transport	**3,656.10**	**1.03**	**0.29**	**16.79**	**53.95**	**6.92**	**0.61**	**3,762.74**
1.A.3.a. Domestic aviation	54.75	0.00	0.00	0.00	0.02	0.00	0.00	55.17
1.A.3.b. Road transportation	3,168.46	1.01	0.15	10.82	52.69	6.41	0.53	3,237.56
1.A.3.c. Railways	356.63	0.02	0.14	5.74	1.17	0.51	0.09	393.66
1.A.3.d. Domestic navigation	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.29
1.A.3.e. Other transportation	75.98	0.00	0.00	0.24	0.06	0.00	0.00	76.06
1.A.4. Other sectors	**5,925.02**	**8.15**	**0.40**	**15.96**	**133.47**	**14.45**	**31.04**	**6,259.50**
1.A.4.a. Commercial/institutional	1,001.82	0.18	0.01	1.93	8.16	0.89	7.71	1,010.72
1.A.4.b. Residential	3,871.51	7.75	0.05	3.88	116.66	12.38	22.59	4,101.06
1.A.4.c. Agriculture/forestry/fishing	1,051.70	0.22	0.34	10.15	8.65	1.18	0.73	1,147.72
1.A.4.ci. Stationary	158.51	0.15	0.00	0.55	0.54	0.08	0.51	163.02
1.A.4.cii. Mobile	893.18	0.07	0.34	9.60	8.11	1.10	0.22	984.70
1.A.5. Other	**106.37**	**0.01**	**0.00**	**0.66**	**0.62**	**0.09**	**0.29**	**107.48**
1.A.5.a. Stationary	51.51	0.00	0.00	0.14	0.29	0.03	0.28	51.70
1.A.5.b. Mobile	54.86	0.01	0.00	0.52	0.33	0.05	0.01	55.78
1.B. Fugitive emissions from fuels	**0.64**	**34.46**	**0.00**	**NO**	**NO**	**0.62**	**NO**	**965.59**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.64**	**34.46**	**0.00**	**NO**	**NO**	**0.62**	**NO**	**965.59**
1.B.2.a. Oil	0.09	0.00	0.00	NO	NO	0.00	NO	0.09
1.B.2.b. Natural gas	0.55	34.46			NO	0.62	NO	965.49
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**145.99**	**0.01**	**0.00**	**0.58**	**0.44**	**0.21**	**0.05**	**147.55**
1.D.1.a. Aviation	145.99	0.01	0.00	0.58	0.44	0.21	0.05	147.55
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**201.20**							**201.20**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**23,300.20**	**37.18**	**0.60**	**56.59**	**124.61**	**15.07**	**91.50**	**24,501.07**
1.A. Fuel combustion activities (sectoral approach)	23,299.66	6.06	0.60	56.59	124.61	14.51	91.50	23,629.03
1.A.1. Energy industries	**15,660.99**	**0.36**	**0.12**	**28.75**	**5.58**	**0.48**	**71.24**	**15,703.31**
1.A.1.a. Public electricity and heat production	15,660.99	0.36	0.12	28.75	5.58	0.48	71.24	15,703.31
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**921.55**	**0.04**	**0.01**	**4.56**	**1.32**	**0.41**	**0.93**	**924.48**
1.A.2.a. Iron and steel	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.d. Pulp, paper and print	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.e. Food processing, beverages and tobacco	129.05	0.01	0.00	0.59	0.58	0.10	0.49	129.79
1.A.2.f. Non-metallic minerals	727.52	0.02	0.00	3.72	0.57	0.25	0.34	729.37
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	50.02	0.00	0.00	0.16	0.11	0.02	0.09	50.15
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	5.99	0.00	0.00	0.03	0.06	0.03	0.00	6.18
1.A.2.k. Construction	8.97	0.00	0.00	0.05	0.01	0.00	0.00	8.99
1.A.2.l. Textile and leather	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.m. Other industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3. Transport	**2,615.22**	**0.72**	**0.22**	**12.61**	**37.27**	**4.84**	**0.45**	**2,694.66**
1.A.3.a. Domestic aviation	37.16	0.00	0.00	0.00	0.01	0.00	0.00	37.45
1.A.3.b. Road transportation	2,224.56	0.70	0.11	7.67	36.23	4.42	0.37	2,272.88
1.A.3.c. Railways	296.27	0.02	0.11	4.76	0.97	0.42	0.07	327.04
1.A.3.d. Domestic navigation	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.25
1.A.3.e. Other transportation	56.99	0.00	0.00	0.18	0.05	0.00	0.00	57.04
1.A.4. Other sectors	**4,024.16**	**4.93**	**0.25**	**10.19**	**80.11**	**8.74**	**18.71**	**4,228.10**
1.A.4.a. Commercial/institutional	663.33	0.12	0.01	1.30	5.14	0.57	4.84	669.25
1.A.4.b. Residential	2,702.08	4.67	0.03	2.62	69.74	7.44	13.41	2,841.10
1.A.4.c. Agriculture/forestry/fishing	658.75	0.14	0.21	6.28	5.23	0.73	0.47	717.76
1.A.4.ci. Stationary	111.05	0.09	0.00	0.39	0.35	0.05	0.33	113.91
1.A.4.cii. Mobile	547.70	0.04	0.21	5.89	4.88	0.67	0.14	603.85
1.A.5. Other	**77.75**	**0.00**	**0.00**	**0.48**	**0.34**	**0.05**	**0.17**	**78.47**
1.A.5.a. Stationary	42.59	0.00	0.00	0.13	0.17	0.02	0.16	42.74
1.A.5.b. Mobile	35.16	0.00	0.00	0.34	0.18	0.03	0.01	35.74
1.B. Fugitive emissions from fuels	**0.54**	**31.13**	**0.00**	**NO**	**NO**	**0.56**	**NO**	**872.04**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.54**	**31.13**	**0.00**	**NO**	**NO**	**0.56**	**NO**	**872.04**
1.B.2.a. Oil	0.06	0.00	0.00	NO	NO	0.00	NO	0.06
1.B.2.b. Natural gas	0.48	31.13			NO	0.56	NO	871.99
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**107.51**	**0.01**	**0.00**	**0.42**	**0.32**	**0.21**	**0.03**	**108.66**
1.D.1.a. Aviation	107.51	0.01	0.00	0.42	0.32	0.21	0.03	108.66
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**169.59**							**169.59**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**17,333.44**	**30.57**	**0.50**	**44.67**	**60.89**	**8.21**	**72.01**	**18,321.97**
1.A. Fuel combustion activities (sectoral approach)	17,332.99	2.60	0.50	44.67	60.89	7.71	72.01	17,538.26
1.A.1. Energy industries	**12,640.60**	**0.28**	**0.11**	**23.64**	**4.24**	**0.37**	**62.27**	**12,676.53**
1.A.1.a. Public electricity and heat production	12,640.60	0.28	0.11	23.64	4.24	0.37	62.27	12,676.53
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**610.17**	**0.03**	**0.00**	**2.86**	**0.95**	**0.28**	**0.67**	**612.12**
1.A.2.a. Iron and steel	0.96	0.00	0.00	0.00	0.01	0.00	0.01	0.97
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.d. Pulp, paper and print	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.e. Food processing, beverages and tobacco	92.14	0.01	0.00	0.39	0.44	0.07	0.38	92.68
1.A.2.f. Non-metallic minerals	432.93	0.01	0.00	1.99	0.34	0.16	0.19	433.95
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	36.90	0.00	0.00	0.18	0.08	0.02	0.06	37.02
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	4.58	0.00	0.00	0.03	0.04	0.02	0.00	4.72
1.A.2.k. Construction	9.85	0.00	0.00	0.06	0.01	0.00	0.01	9.88
1.A.2.l. Textile and leather	0.59	0.00	0.00	0.00	0.01	0.00	0.01	0.59
1.A.2.m. Other industries	32.21	0.00	0.00	0.20	0.03	0.01	0.02	32.31
1.A.3. Transport	**1,854.84**	**0.49**	**0.18**	**9.92**	**24.46**	**3.29**	**0.32**	**1,916.56**
1.A.3.a. Domestic aviation	19.58	0.00	0.00	0.00	0.01	0.00	0.00	19.73
1.A.3.b. Road transportation	1,538.52	0.48	0.07	5.29	23.51	2.88	0.25	1,571.60
1.A.3.c. Railways	274.07	0.02	0.11	4.56	0.93	0.40	0.07	302.53
1.A.3.d. Domestic navigation	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.28
1.A.3.e. Other transportation	22.38	0.00	0.00	0.07	0.02	0.00	0.00	22.40
1.A.4. Other sectors	**2,133.92**	**1.79**	**0.21**	**7.79**	**30.61**	**3.69**	**8.37**	**2,238.79**
1.A.4.a. Commercial/institutional	589.84	0.10	0.01	1.21	4.46	0.49	4.22	594.69
1.A.4.b. Residential	979.33	1.57	0.01	1.02	23.06	2.58	3.76	1,026.26
1.A.4.c. Agriculture/forestry/fishing	564.75	0.12	0.19	5.56	3.10	0.62	0.40	617.83
1.A.4.ci. Stationary	76.75	0.09	0.00	0.26	0.30	0.05	0.27	79.49
1.A.4.cii. Mobile	488.00	0.03	0.19	5.30	2.80	0.57	0.12	538.34
1.A.5. Other	**93.45**	**0.01**	**0.00**	**0.46**	**0.63**	**0.09**	**0.37**	**94.26**
1.A.5.a. Stationary	62.13	0.00	0.00	0.16	0.39	0.05	0.36	62.41
1.A.5.b. Mobile	31.32	0.00	0.00	0.30	0.24	0.04	0.01	31.85
1.B. Fugitive emissions from fuels	**0.46**	**27.97**	**0.00**	**NO**	**NO**	**0.50**	**NO**	**783.70**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.46**	**27.97**	**0.00**	**NO**	**NO**	**0.50**	**NO**	**783.70**
1.B.2.a. Oil	0.03	0.00	0.00	NO	NO	0.00	NO	0.03
1.B.2.b. Natural gas	0.43	27.97				0.50	NO	783.67
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**54.71**	**0.00**	**0.00**	**0.22**	**0.16**	**0.21**	**0.02**	**55.30**
1.D.1.a. Aviation	54.71	0.00	0.00	0.22	0.16	0.21	0.02	55.30
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**143.24**							**143.24**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**14,492.41**	**30.05**	**0.45**	**35.25**	**68.52**	**8.83**	**57.04**	**15,453.99**
1.A. Fuel combustion activities (sectoral approach)	14,491.98	3.09	0.45	35.25	68.52	8.35	57.04	14,698.72
1.A.1. Energy industries	**9,961.85**	**0.19**	**0.09**	**18.81**	**3.56**	**0.28**	**47.12**	**9,990.25**
1.A.1.a. Public electricity and heat production	9,961.85	0.19	0.09	18.81	3.56	0.28	47.12	9,990.25
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**738.06**	**0.02**	**0.00**	**1.25**	**0.72**	**0.32**	**0.36**	**739.14**
1.A.2.a. Iron and steel	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.d. Pulp, paper and print	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.e. Food processing, beverages and tobacco	163.78	0.01	0.00	0.36	0.38	0.08	0.31	164.18
1.A.2.f. Non-metallic minerals	141.48	0.00	0.00	0.26	0.10	0.06	0.04	141.66
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	79.10	0.00	0.00	0.14	0.04	0.03	0.00	79.19
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	7.32	0.00	0.00	0.01	0.02	0.01	0.00	7.38
1.A.2.k. Construction	35.98	0.00	0.00	0.07	0.02	0.01	0.00	36.02
1.A.2.l. Textile and leather	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.m. Other industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.3. Transport	**1,612.96**	**0.44**	**0.11**	**6.25**	**22.38**	**2.83**	**0.22**	**1,654.26**
1.A.3.a. Domestic aviation	19.77	0.00	0.00	0.00	0.01	0.00	0.00	19.92
1.A.3.b. Road transportation	1,380.09	0.43	0.07	4.11	21.91	2.66	0.19	1,409.82
1.A.3.c. Railways	108.86	0.01	0.04	1.81	0.37	0.16	0.03	120.17
1.A.3.d. Domestic navigation	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.22
1.A.3.e. Other transportation	104.02	0.00	0.00	0.32	0.08	0.00	0.00	104.13
1.A.4. Other sectors	**2,090.75**	**2.44**	**0.25**	**8.60**	**41.25**	**4.83**	**9.08**	**2,226.08**
1.A.4.a. Commercial/institutional	386.95	0.08	0.01	0.76	3.21	0.35	3.03	390.60
1.A.4.b. Residential	1,062.68	2.26	0.01	1.15	33.60	3.71	5.75	1,129.73
1.A.4.c. Agriculture/forestry/fishing	641.11	0.11	0.23	6.68	4.44	0.76	0.30	705.75
1.A.4.ci. Stationary	32.33	0.06	0.00	0.09	0.19	0.04	0.15	34.26
1.A.4.cii. Mobile	608.78	0.04	0.23	6.59	4.25	0.73	0.15	671.49
1.A.5. Other	**88.36**	**0.01**	**0.00**	**0.33**	**0.61**	**0.09**	**0.27**	**88.99**
1.A.5.a. Stationary	71.33	0.00	0.00	0.19	0.31	0.05	0.27	71.60
1.A.5.b. Mobile	17.04	0.00	0.00	0.15	0.30	0.04	0.00	17.38
1.B. Fugitive emissions from fuels	**0.43**	**26.96**	**0.00**	**NO**	**NO**	**0.49**	**NO**	**755.27**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.43**	**26.96**	**0.00**	**NO**	**NO**	**0.49**	**NO**	**755.27**
1.B.2.a. Oil	0.01	0.00	0.00	NO	NO	0.00	NO	0.01
1.B.2.b. Natural gas	0.41	26.96			NO	0.49	NO	755.26
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**30.55**	**0.00**	**0.00**	**0.12**	**0.09**	**0.21**	**0.01**	**30.88**
1.D.1.a. Aviation	30.55	0.00	0.00	0.12	0.09	0.21	0.01	30.88
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**157.46**							**157.46**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**11,471.70**	**31.47**	**0.43**	**29.65**	**58.20**	**7.27**	**31.51**	**12,467.03**
1.A. Fuel combustion activities (sectoral approach)	11,471.26	1.94	0.43	29.65	58.20	6.73	31.51	11,639.59
1.A.1. Energy industries	**7,174.03**	**0.14**	**0.05**	**12.99**	**3.15**	**0.24**	**25.59**	**7,191.16**
1.A.1.a. Public electricity and heat production	7,174.03	0.14	0.05	12.99	3.15	0.24	25.59	7,191.16
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**381.51**	**0.01**	**0.00**	**0.69**	**0.56**	**0.18**	**0.37**	**382.22**
1.A.2.a. Iron and steel	37.33	0.00	0.00	0.05	0.02	0.02	0.00	37.36
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.14
1.A.2.d. Pulp, paper and print	3.68	0.00	0.00	0.00	0.00	0.00	0.00	3.68
1.A.2.e. Food processing, beverages and tobacco	93.65	0.01	0.00	0.26	0.38	0.06	0.33	94.05
1.A.2.f. Non-metallic minerals	159.90	0.00	0.00	0.24	0.11	0.07	0.03	160.08
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	31.17	0.00	0.00	0.04	0.02	0.01	0.00	31.20
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	1.91	0.00	0.00	0.00	0.00	0.00	0.00	1.91
1.A.2.k. Construction	13.96	0.00	0.00	0.04	0.01	0.01	0.00	13.98
1.A.2.l. Textile and leather	20.16	0.00	0.00	0.03	0.01	0.01	0.00	20.18
1.A.2.m. Other industries	19.62	0.00	0.00	0.03	0.01	0.01	0.00	19.64
1.A.3. Transport	**1,617.92**	**0.44**	**0.11**	**6.32**	**23.35**	**2.93**	**0.23**	**1,658.41**
1.A.3.a. Domestic aviation	19.92	0.00	0.00	0.00	0.01	0.00	0.00	20.07
1.A.3.b. Road transportation	1,401.75	0.44	0.07	4.42	22.93	2.78	0.21	1,432.02
1.A.3.c. Railways	95.96	0.01	0.04	1.60	0.33	0.14	0.02	105.92
1.A.3.d. Domestic navigation	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.22
1.A.3.e. Other transportation	100.08	0.00	0.00	0.31	0.08	0.00	0.00	100.17
1.A.4. Other sectors	**2,172.16**	**1.33**	**0.27**	**9.15**	**30.52**	**3.29**	**5.04**	**2,281.29**
1.A.4.a. Commercial/institutional	395.42	0.08	0.01	0.78	3.32	0.36	3.13	399.13
1.A.4.b. Residential	1,068.76	1.14	0.01	1.09	15.70	1.95	1.66	1,103.77
1.A.4.c. Agriculture/forestry/fishing	707.99	0.11	0.25	7.28	11.50	0.98	0.25	778.39
1.A.4.ci. Stationary	18.76	0.04	0.00	0.04	0.11	0.02	0.08	19.85
1.A.4.cii. Mobile	689.23	0.08	0.25	7.24	11.39	0.96	0.17	758.54
1.A.5. Other	**125.64**	**0.01**	**0.00**	**0.51**	**0.63**	**0.10**	**0.28**	**126.51**
1.A.5.a. Stationary	104.41	0.00	0.00	0.34	0.32	0.06	0.27	104.84
1.A.5.b. Mobile	21.24	0.01	0.00	0.18	0.31	0.04	0.00	21.67
1.B. Fugitive emissions from fuels	**0.44**	**29.54**	**0.00**	**NO**	**NO**	**0.53**	**NO**	**827.44**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.44**	**29.54**	**0.00**	**NO**	**NO**	**0.53**	**NO**	**827.44**
1.B.2.a. Oil	0.01	0.00	0.00	NO	NO	0.00	NO	0.01
1.B.2.b. Natural gas	0.43	29.54			NO	0.53	NO	827.42
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**34.67**	**0.00**	**0.00**	**0.13**	**0.11**	**0.21**	**0.01**	**35.05**
1.D.1.a. Aviation	34.67	0.00	0.00	0.13	0.11	0.21	0.01	35.05
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**230.05**							**230.05**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**11,375.14**	**35.31**	**0.37**	**27.92**	**71.30**	**8.71**	**31.73**	**12,462.93**
1.A. Fuel combustion activities (sectoral approach)	11,374.65	2.97	0.37	27.92	71.30	8.13	31.73	11,557.14
1.A.1. Energy industries	**7,107.05**	**0.14**	**0.05**	**12.75**	**3.26**	**0.24**	**23.44**	**7,123.27**
1.A.1.a. Public electricity and heat production	7,107.05	0.14	0.05	12.75	3.26	0.24	23.44	7,123.27
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**321.29**	**0.01**	**0.00**	**0.65**	**0.63**	**0.16**	**0.47**	**322.02**
1.A.2.a. Iron and steel	27.91	0.00	0.00	0.04	0.01	0.01	0.00	27.94
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.10
1.A.2.d. Pulp, paper and print	1.98	0.00	0.00	0.00	0.00	0.00	0.00	1.98
1.A.2.e. Food processing, beverages and tobacco	97.24	0.01	0.00	0.29	0.41	0.06	0.36	97.66
1.A.2.f. Non-metallic minerals	126.99	0.00	0.00	0.20	0.17	0.06	0.11	127.19
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	17.55	0.00	0.00	0.02	0.01	0.01	0.00	17.57
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	0.89	0.00	0.00	0.00	0.00	0.00	0.00	0.89
1.A.2.k. Construction	13.39	0.00	0.00	0.05	0.01	0.00	0.00	13.42
1.A.2.l. Textile and leather	19.80	0.00	0.00	0.03	0.01	0.01	0.00	19.82
1.A.2.m. Other industries	15.44	0.00	0.00	0.02	0.01	0.01	0.00	15.46
1.A.3. Transport	**1,578.77**	**0.43**	**0.10**	**6.19**	**22.27**	**2.79**	**0.22**	**1,617.58**
1.A.3.a. Domestic aviation	20.03	0.00	0.00	0.00	0.01	0.00	0.00	20.19
1.A.3.b. Road transportation	1,324.42	0.42	0.06	4.20	21.83	2.65	0.19	1,353.26
1.A.3.c. Railways	93.11	0.01	0.04	1.55	0.32	0.14	0.02	102.77
1.A.3.d. Domestic navigation	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.23
1.A.3.e. Other transportation	140.98	0.00	0.00	0.44	0.11	0.00	0.00	141.11
1.A.4. Other sectors	**2,285.70**	**2.39**	**0.22**	**7.90**	**44.68**	**4.84**	**7.39**	**2,411.51**
1.A.4.a. Commercial/institutional	362.44	0.09	0.01	0.70	2.99	0.35	2.78	366.45
1.A.4.b. Residential	1,349.81	2.18	0.02	1.44	31.36	3.68	4.39	1,415.56
1.A.4.c. Agriculture/forestry/fishing	573.45	0.11	0.20	5.75	10.32	0.81	0.22	629.51
1.A.4.ci. Stationary	26.98	0.05	0.00	0.07	0.13	0.03	0.09	28.38
1.A.4.cii. Mobile	546.47	0.07	0.20	5.68	10.19	0.78	0.13	601.13
1.A.5. Other	**81.84**	**0.01**	**0.00**	**0.44**	**0.47**	**0.10**	**0.21**	**82.76**
1.A.5.a. Stationary	58.79	0.01	0.00	0.20	0.30	0.07	0.21	59.27
1.A.5.b. Mobile	23.05	0.00	0.00	0.24	0.17	0.03	0.01	23.49
1.B. Fugitive emissions from fuels	**0.50**	**32.33**	**0.00**	**NO**	**NO**	**0.58**	**NO**	**905.78**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.50**	**32.33**	**0.00**	**NO**	**NO**	**0.58**	**NO**	**905.78**
1.B.2.a. Oil	0.02	0.00	0.00	NO	NO	0.00	NO	0.02
1.B.2.b. Natural gas	0.48	32.33			NO	0.58	NO	905.77
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**56.73**	**0.00**	**0.00**	**0.22**	**0.15**	**0.07**	**0.02**	**57.31**
1.D.1.a. Aviation	56.73	0.00	0.00	0.22	0.15	0.07	0.02	57.31
1.D.1.b.Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**294.03**							**294.03**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**10,258.32**	**29.73**	**0.34**	**24.66**	**64.80**	**7.96**	**16.40**	**11,181.69**
1.A. Fuel combustion activities (sectoral approach)	10,257.83	2.32	0.34	24.66	64.80	7.47	16.40	10,413.70
1.A.1. Energy industries	**5,615.61**	**0.11**	**0.02**	**9.52**	**3.14**	**0.22**	**10.53**	**5,625.19**
1.A.1.a. Public electricity and heat production	5,615.61	0.11	0.02	9.52	3.14	0.22	10.53	5,625.19
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**546.90**	**0.02**	**0.00**	**0.92**	**0.74**	**0.28**	**0.40**	**548.02**
1.A.2.a. Iron and steel	101.59	0.00	0.00	0.13	0.05	0.04	0.00	101.69
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	0.29	0.00	0.00	0.00	0.00	0.00	0.00	0.29
1.A.2.d. Pulp, paper and print	5.18	0.00	0.00	0.01	0.00	0.00	0.00	5.19
1.A.2.e. Food processing, beverages and tobacco	117.62	0.01	0.00	0.29	0.43	0.10	0.31	118.24
1.A.2.f. Non-metallic minerals	173.12	0.00	0.00	0.26	0.17	0.07	0.08	173.35
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	41.39	0.00	0.00	0.05	0.02	0.02	0.00	41.43
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	1.44	0.00	0.00	0.00	0.00	0.00	0.00	1.44
1.A.2.k. Construction	22.54	0.00	0.00	0.07	0.01	0.01	0.00	22.58
1.A.2.l. Textile and leather	45.76	0.00	0.00	0.06	0.02	0.02	0.00	45.80
1.A.2.m. Other industries	37.99	0.00	0.00	0.05	0.02	0.02	0.00	38.02
1.A.3. Transport	**1,516.13**	**0.40**	**0.10**	**6.05**	**24.65**	**3.07**	**0.23**	**1,553.23**
1.A.3.a. Domestic aviation	20.13	0.00	0.00	0.00	0.01	0.00	0.00	20.29
1.A.3.b. Road transportation	1,357.16	0.40	0.07	4.54	24.32	2.95	0.21	1,385.74
1.A.3.c. Railways	80.01	0.00	0.03	1.33	0.27	0.12	0.02	88.32
1.A.3.d. Domestic navigation	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.25
1.A.3.e. Other transportation	58.58	0.00	0.00	0.18	0.05	0.00	0.00	58.63
1.A.4. Other sectors	**2,502.53**	**1.78**	**0.22**	**7.89**	**35.78**	**3.82**	**5.02**	**2,609.85**
1.A.4.a. Commercial/institutional	307.24	0.07	0.00	0.57	2.56	0.29	2.39	310.33
1.A.4.b. Residential	1,621.95	1.59	0.02	1.64	21.84	2.67	2.46	1,670.52
1.A.4.c. Agriculture/forestry/fishing	573.34	0.13	0.20	5.68	11.38	0.85	0.17	629.01
1.A.4.ci. Stationary	31.36	0.06	0.00	0.08	0.13	0.06	0.04	33.11
1.A.4.cii. Mobile	541.98	0.07	0.20	5.60	11.25	0.80	0.13	595.90
1.A.5. Other	**76.66**	**0.01**	**0.00**	**0.29**	**0.50**	**0.08**	**0.22**	**77.41**
1.A.5.a. Stationary	51.79	0.00	0.00	0.14	0.26	0.05	0.21	52.08
1.A.5.b. Mobile	24.87	0.00	0.00	0.14	0.24	0.03	0.00	25.34
1.B. Fugitive emissions from fuels	**0.49**	**27.41**	**0.00**	**NO**	**NO**	**0.49**	**NO**	**767.99**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.49**	**27.41**	**0.00**	**NO**	**NO**	**0.49**	**NO**	**767.99**
1.B.2.a. Oil	0.02	0.00	0.00	NO	NO	0.00	NO	0.02
1.B.2.b. Natural gas	0.47	27.41			NO	0.49	NO	767.97
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**66.19**	**0.00**	**0.00**	**0.26**	**0.17**	**0.08**	**0.02**	**66.85**
1.D.1.a. Aviation	66.19	0.00	0.00	0.26	0.17	0.08	0.02	66.85
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**304.23**							**304.23**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,874.91**	**27.25**	**0.27**	**20.61**	**49.10**	**6.33**	**12.18**	**9,708.68**
1.A. Fuel combustion activities (sectoral approach)	8,874.46	1.71	0.27	20.61	49.10	5.88	12.18	8,993.08
1.A.1. Energy industries	**4,836.61**	**0.10**	**0.02**	**8.11**	**2.78**	**0.20**	**7.93**	**4,844.34**
1.A.1.a. Public electricity and heat production	4,836.61	0.10	0.02	8.11	2.78	0.20	7.93	4,844.34
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**523.10**	**0.01**	**0.00**	**0.88**	**0.60**	**0.24**	**0.32**	**523.97**
1.A.2.a. Iron and steel	91.56	0.00	0.00	0.12	0.05	0.04	0.00	91.64
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	5.57	0.00	0.00	0.01	0.00	0.00	0.00	5.57
1.A.2.d. Pulp, paper and print	4.17	0.00	0.00	0.01	0.00	0.00	0.00	4.18
1.A.2.e. Food processing, beverages and tobacco	109.90	0.01	0.00	0.28	0.35	0.07	0.28	110.34
1.A.2.f. Non-metallic minerals	161.35	0.00	0.00	0.24	0.11	0.07	0.03	161.53
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	28.03	0.00	0.00	0.04	0.01	0.01	0.00	28.06
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	1.39	0.00	0.00	0.00	0.00	0.00	0.00	1.39
1.A.2.k. Construction	19.27	0.00	0.00	0.05	0.01	0.01	0.00	19.30
1.A.2.l. Textile and leather	63.17	0.00	0.00	0.08	0.03	0.03	0.00	63.23
1.A.2.m. Other industries	38.68	0.00	0.00	0.05	0.02	0.02	0.00	38.72
1.A.3. Transport	**1,363.25**	**0.40**	**0.08**	**5.07**	**21.35**	**2.64**	**0.19**	**1,396.45**
1.A.3.a. Domestic aviation	20.51	0.00	0.00	0.00	0.01	0.00	0.00	20.67
1.A.3.b. Road transportation	1,226.88	0.40	0.06	3.91	21.09	2.55	0.18	1,253.72
1.A.3.c. Railways	59.20	0.00	0.02	0.98	0.20	0.09	0.02	65.34
1.A.3.d. Domestic navigation	0.16	0.00	0.00	0.00	0.00	0.00	0.00	0.16
1.A.3.e. Other transportation	56.50	0.00	0.00	0.18	0.05	0.00	0.00	56.56
1.A.4. Other sectors	**2,078.68**	**1.19**	**0.16**	**6.16**	**23.79**	**2.69**	**3.53**	**2,154.67**
1.A.4.a. Commercial/institutional	305.54	0.07	0.00	0.58	2.61	0.29	2.45	308.65
1.A.4.b. Residential	1,339.79	1.05	0.01	1.34	13.73	1.81	0.93	1,372.52
1.A.4.c. Agriculture/forestry/fishing	433.34	0.07	0.14	4.25	7.45	0.59	0.15	473.51
1.A.4.ci. Stationary	38.74	0.02	0.00	0.11	0.08	0.02	0.05	39.44
1.A.4.cii. Mobile	394.60	0.05	0.14	4.14	7.37	0.57	0.10	434.07
1.A.5. Other	**72.83**	**0.01**	**0.00**	**0.39**	**0.59**	**0.10**	**0.22**	**73.64**
1.A.5.a. Stationary	50.44	0.00	0.00	0.15	0.29	0.06	0.22	50.83
1.A.5.b. Mobile	22.39	0.00	0.00	0.24	0.30	0.04	0.01	22.80
1.B. Fugitive emissions from fuels	**0.45**	**25.54**	**0.00**	**NO**	**NO**	**0.46**	**NO**	**715.61**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.45**	**25.54**	**0.00**	**NO**	**NO**	**0.46**	**NO**	**715.61**
1.B.2.a. Oil	0.02	0.00	0.00	NO	NO	0.00	NO	0.02
1.B.2.b. Natural gas	0.43	25.54			NO	0.46	NO	715.59
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**53.59**	**0.00**	**0.00**	**0.21**	**0.14**	**0.07**	**0.02**	**54.15**
1.D.1.a. Aviation	53.59	0.00	0.00	0.21	0.14	0.07	0.02	54.15
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**275.62**							**275.62**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**6,903.73**	**26.89**	**0.18**	**14.92**	**36.98**	**5.01**	**5.59**	**7,704.88**
1.A. Fuel combustion activities (sectoral approach)	6,903.32	1.55	0.18	14.92	36.98	4.55	5.59	6,995.16
1.A.1. Energy industries	**3,660.25**	**0.07**	**0.01**	**5.89**	**2.38**	**0.16**	**2.13**	**3,664.61**
1.A.1.a. Public electricity and heat production	3,660.25	0.07	0.01	5.89	2.38	0.16	2.13	3,664.61
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**473.83**	**0.01**	**0.00**	**0.73**	**0.49**	**0.22**	**0.23**	**474.57**
1.A.2.a. Iron and steel	94.62	0.00	0.00	0.12	0.05	0.04	0.00	94.71
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	4.91	0.00	0.00	0.01	0.00	0.00	0.00	4.92
1.A.2.d. Pulp, paper and print	3.10	0.00	0.00	0.00	0.00	0.00	0.00	3.11
1.A.2.e. Food processing, beverages and tobacco	85.91	0.01	0.00	0.21	0.26	0.06	0.20	86.26
1.A.2.f. Non-metallic minerals	153.15	0.00	0.00	0.20	0.10	0.06	0.03	153.32
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	21.74	0.00	0.00	0.03	0.01	0.01	0.00	21.76
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	1.03	0.00	0.00	0.00	0.00	0.00	0.00	1.04
1.A.2.k. Construction	16.28	0.00	0.00	0.03	0.01	0.01	0.00	16.30
1.A.2.l. Textile and leather	57.65	0.00	0.00	0.08	0.03	0.02	0.00	57.71
1.A.2.m. Other industries	35.42	0.00	0.00	0.05	0.02	0.01	0.00	35.45
1.A.3. Transport	**910.68**	**0.25**	**0.05**	**3.44**	**12.53**	**1.55**	**0.14**	**931.24**
1.A.3.a. Domestic aviation	2.03	0.00	0.00	0.00	0.00	0.00	0.00	2.05
1.A.3.b. Road transportation	815.26	0.24	0.04	2.74	12.37	1.51	0.13	832.54
1.A.3.c. Railways	30.84	0.00	0.01	0.51	0.10	0.05	0.01	34.04
1.A.3.d. Domestic navigation	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.26
1.A.3.e. Other transportation	62.29	0.00	0.00	0.19	0.05	0.00	0.00	62.35
1.A.4. Other sectors	**1,809.40**	**1.22**	**0.12**	**4.71**	**21.22**	**2.55**	**2.93**	**1,874.96**
1.A.4.a. Commercial/institutional	228.39	0.05	0.00	0.43	1.81	0.21	1.68	230.66
1.A.4.b. Residential	1,283.21	1.13	0.01	1.29	15.02	1.95	1.17	1,318.28
1.A.4.c. Agriculture/forestry/fishing	297.80	0.03	0.10	2.99	4.39	0.39	0.08	326.02
1.A.4.ci. Stationary	18.54	0.00	0.00	0.05	0.02	0.01	0.01	18.62
1.A.4.cii. Mobile	279.26	0.03	0.10	2.94	4.37	0.38	0.07	307.40
1.A.5. Other	**49.16**	**0.01**	**0.00**	**0.15**	**0.36**	**0.06**	**0.17**	**49.77**
1.A.5.a. Stationary	30.99	0.00	0.00	0.08	0.23	0.05	0.17	31.27
1.A.5.b. Mobile	18.17	0.00	0.00	0.06	0.13	0.02	0.00	18.50
1.B. Fugitive emissions from fuels	**0.41**	**25.33**	**0.00**	**NO**	**NO**	**0.46**	**NO**	**709.73**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.41**	**25.33**	**0.00**	**NO**	**NO**	**0.46**	**NO**	**709.73**
1.B.2.a. Oil	0.02	0.00	0.00	NO	NO	0.00	NO	0.02
1.B.2.b. Natural gas	0.39	25.33			NO	0.46	NO	709.71
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**63.04**	**0.00**	**0.00**	**0.25**	**0.16**	**0.08**	**0.02**	**63.68**
1.D.1.a. Aviation	63.04	0.00	0.00	0.25	0.16	0.08	0.02	63.68
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**272.72**							**272.72**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**6,188.57**	**28.10**	**0.16**	**13.57**	**34.60**	**4.90**	**4.06**	**7,018.53**
1.A. Fuel combustion activities (sectoral approach)	6,188.18	1.54	0.16	13.57	34.60	4.42	4.06	6,274.33
1.A.1. Energy industries	**3,155.75**	**0.06**	**0.01**	**5.04**	**2.12**	**0.14**	**0.97**	**3,159.28**
1.A.1.a. Public electricity and heat production	3,155.75	0.06	0.01	5.04	2.12	0.14	0.97	3,159.28
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**519.59**	**0.01**	**0.00**	**0.79**	**0.48**	**0.22**	**0.23**	**520.27**
1.A.2.a. Iron and steel	97.58	0.00	0.00	0.13	0.05	0.04	0.00	97.68
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	5.19	0.00	0.00	0.01	0.00	0.00	0.00	5.20
1.A.2.d. Pulp, paper and print	4.92	0.00	0.00	0.01	0.00	0.00	0.00	4.92
1.A.2.e. Food processing, beverages and tobacco	80.43	0.00	0.00	0.20	0.23	0.04	0.19	80.66
1.A.2.f. Non-metallic minerals	184.87	0.00	0.00	0.25	0.12	0.08	0.03	185.07
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	25.72	0.00	0.00	0.03	0.01	0.01	0.00	25.75
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	1.64	0.00	0.00	0.00	0.00	0.00	0.00	1.64
1.A.2.k. Construction	9.61	0.00	0.00	0.02	0.01	0.00	0.00	9.63
1.A.2.l. Textile and leather	80.64	0.00	0.00	0.11	0.04	0.03	0.00	80.72
1.A.2.m. Other industries	28.97	0.00	0.00	0.04	0.01	0.01	0.00	29.00
1.A.3. Transport	**982.33**	**0.25**	**0.06**	**3.78**	**12.43**	**1.55**	**0.16**	**1,004.59**
1.A.3.a. Domestic aviation	2.03	0.00	0.00	0.00	0.00	0.00	0.00	2.05
1.A.3.b. Road transportation	911.85	0.25	0.04	3.11	12.29	1.50	0.15	930.59
1.A.3.c. Railways	33.35	0.00	0.01	0.55	0.11	0.05	0.01	36.81
1.A.3.d. Domestic navigation	0.12	0.00	0.00	0.00	0.00	0.00	0.00	0.12
1.A.3.e. Other transportation	34.99	0.00	0.00	0.11	0.03	0.00	0.00	35.02
1.A.4. Other sectors	**1,494.12**	**1.21**	**0.10**	**3.82**	**19.34**	**2.46**	**2.54**	**1,553.40**
1.A.4.a. Commercial/institutional	205.23	0.05	0.00	0.39	1.44	0.18	1.32	207.28
1.A.4.b. Residential	1,052.52	1.14	0.01	1.09	15.27	2.00	1.17	1,087.74
1.A.4.c. Agriculture/forestry/fishing	236.37	0.02	0.08	2.34	2.64	0.29	0.05	258.39
1.A.4.ci. Stationary	20.77	0.00	0.00	0.06	0.02	0.01	0.01	20.86
1.A.4.cii. Mobile	215.60	0.02	0.08	2.29	2.62	0.28	0.04	237.53
1.A.5. Other	**36.39**	**0.00**	**0.00**	**0.13**	**0.23**	**0.04**	**0.16**	**36.78**
1.A.5.a. Stationary	26.59	0.00	0.00	0.05	0.20	0.04	0.16	26.78
1.A.5.b. Mobile	9.80	0.00	0.00	0.08	0.03	0.01	0.00	10.00
1.B. Fugitive emissions from fuels	**0.39**	**26.56**	**0.00**	**NO**	**NO**	**0.48**	**NO**	**744.21**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.39**	**26.56**	**0.00**	**NO**	**NO**	**0.48**	**NO**	**744.21**
1.B.2.a. Oil	0.03	0.00	0.00	NO	NO	0.00	NO	0.03
1.B.2.b. Natural gas	0.37	26.56			NO	0.48	NO	744.18
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**63.08**	**0.00**	**0.00**	**0.26**	**0.17**	**0.07**	**0.02**	**63.73**
1.D.1.a. Aviation	63.08	0.00	0.00	0.26	0.17	0.07	0.02	63.73
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**272.37**							**272.37**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**6,818.02**	**28.03**	**0.17**	**14.70**	**33.43**	**4.82**	**3.58**	**7,647.24**
1.A. Fuel combustion activities (sectoral approach)	6,817.59	1.41	0.17	14.70	33.43	4.34	3.58	6,901.41
1.A.1. Energy industries	**3,677.72**	**0.07**	**0.01**	**5.88**	**2.50**	**0.17**	**0.88**	**3,681.88**
1.A.1.a. Public electricity and heat production	3,677.72	0.07	0.01	5.88	2.50	0.17	0.88	3,681.88
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**600.55**	**0.01**	**0.00**	**0.90**	**0.55**	**0.25**	**0.26**	**601.33**
1.A.2.a. Iron and steel	117.67	0.00	0.00	0.16	0.06	0.05	0.00	117.79
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	4.31	0.00	0.00	0.01	0.00	0.00	0.00	4.31
1.A.2.d. Pulp, paper and print	7.96	0.00	0.00	0.01	0.00	0.00	0.00	7.96
1.A.2.e. Food processing, beverages and tobacco	85.69	0.00	0.00	0.22	0.28	0.05	0.25	85.97
1.A.2.f. Non-metallic minerals	201.07	0.00	0.00	0.26	0.10	0.08	0.00	201.26
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	29.83	0.00	0.00	0.04	0.02	0.01	0.00	29.86
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	3.65	0.00	0.00	0.00	0.00	0.00	0.00	3.65
1.A.2.k. Construction	11.16	0.00	0.00	0.03	0.01	0.00	0.00	11.18
1.A.2.l. Textile and leather	98.45	0.00	0.00	0.13	0.05	0.04	0.00	98.54
1.A.2.m. Other industries	40.77	0.00	0.00	0.05	0.02	0.02	0.00	40.81
1.A.3. Transport	**1,061.82**	**0.27**	**0.06**	**4.02**	**13.29**	**1.66**	**0.13**	**1,086.09**
1.A.3.a. Domestic aviation	0.10	0.00	0.00	0.00	0.00	0.00	0.00	0.10
1.A.3.b. Road transportation	1,008.22	0.26	0.05	3.37	13.15	1.61	0.13	1,028.75
1.A.3.c. Railways	35.85	0.00	0.01	0.60	0.12	0.05	0.01	39.57
1.A.3.d. Domestic navigation	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.21
1.A.3.e. Other transportation	17.45	0.00	0.00	0.05	0.01	0.00	0.00	17.46
1.A.4. Other sectors	**1,434.10**	**1.06**	**0.09**	**3.74**	**16.74**	**2.19**	**2.20**	**1,488.25**
1.A.4.a. Commercial/institutional	236.43	0.07	0.00	0.46	1.57	0.21	1.40	239.18
1.A.4.b. Residential	967.00	0.96	0.01	0.99	12.58	1.69	0.74	996.79
1.A.4.c. Agriculture/forestry/fishing	230.66	0.03	0.08	2.29	2.59	0.29	0.06	252.29
1.A.4.ci. Stationary	21.75	0.01	0.00	0.07	0.04	0.02	0.02	22.14
1.A.4.cii. Mobile	208.91	0.02	0.08	2.22	2.55	0.27	0.04	230.15
1.A.5. Other	**43.40**	**0.01**	**0.00**	**0.16**	**0.36**	**0.06**	**0.11**	**43.86**
1.A.5.a. Stationary	28.78	0.00	0.00	0.06	0.15	0.03	0.11	28.96
1.A.5.b. Mobile	14.62	0.00	0.00	0.10	0.20	0.03	0.00	14.89
1.B. Fugitive emissions from fuels	**0.43**	**26.62**	**0.00**	**NO**	**NO**	**0.48**	**NO**	**745.82**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.43**	**26.62**	**0.00**	**NO**	**NO**	**0.48**	**NO**	**745.82**
1.B.2.a. Oil	0.03	0.00	0.00	NO	NO	0.00	NO	0.03
1.B.2.b. Natural gas	0.39	26.62			NO	0.48	NO	745.79
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**50.49**	**0.00**	**0.00**	**0.19**	**0.15**	**0.06**	**0.02**	**51.03**
1.D.1.a. Aviation	50.49	0.00	0.00	0.19	0.15	0.06	0.02	51.03
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**282.23**							**282.23**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**6,537.00**	**30.14**	**0.21**	**15.59**	**40.70**	**5.89**	**4.39**	**7,437.76**
1.A. Fuel combustion activities (sectoral approach)	6,536.60	1.78	0.21	15.59	40.70	5.38	4.39	6,643.20
1.A.1. Energy industries	**2,933.21**	**0.06**	**0.01**	**4.70**	**2.01**	**0.14**	**0.69**	**2,936.75**
1.A.1.a. Public electricity and heat production	2,933.21	0.06	0.01	4.70	2.01	0.14	0.69	2,936.75
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**410.40**	**0.01**	**0.00**	**0.60**	**0.40**	**0.18**	**0.20**	**410.94**
1.A.2.a. Iron and steel	27.25	0.00	0.00	0.04	0.01	0.01	0.00	27.28
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	1.67	0.00	0.00	0.00	0.00	0.00	0.00	1.67
1.A.2.d. Pulp, paper and print	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.56
1.A.2.e. Food processing, beverages and tobacco	60.31	0.00	0.00	0.12	0.22	0.03	0.20	60.51
1.A.2.f. Non-metallic minerals	219.00	0.00	0.00	0.29	0.11	0.09	0.00	219.22
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	11.22	0.00	0.00	0.01	0.01	0.00	0.00	11.23
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	1.81	0.00	0.00	0.00	0.00	0.00	0.00	1.81
1.A.2.k. Construction	8.49	0.00	0.00	0.03	0.01	0.00	0.00	8.50
1.A.2.l. Textile and leather	41.44	0.00	0.00	0.05	0.02	0.02	0.00	41.48
1.A.2.m. Other industries	38.66	0.00	0.00	0.05	0.02	0.02	0.00	38.69
1.A.3. Transport	**1,405.71**	**0.34**	**0.09**	**5.68**	**17.26**	**2.19**	**0.18**	**1,440.38**
1.A.3.a. Domestic aviation	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.09
1.A.3.b. Road transportation	1,285.48	0.34	0.06	4.20	16.96	2.07	0.16	1,311.63
1.A.3.c. Railways	81.63	0.00	0.03	1.36	0.28	0.12	0.02	90.11
1.A.3.d. Domestic navigation	0.48	0.00	0.00	0.00	0.00	0.00	0.00	0.49
1.A.3.e. Other transportation	38.04	0.00	0.00	0.12	0.03	0.00	0.00	38.07
1.A.4. Other sectors	**1,747.82**	**1.36**	**0.11**	**4.48**	**20.74**	**2.81**	**3.16**	**1,815.02**
1.A.4.a. Commercial/institutional	426.81	0.09	0.00	0.69	1.97	0.31	1.71	430.23
1.A.4.b. Residential	1,065.72	1.25	0.01	1.11	16.95	2.20	1.40	1,104.30
1.A.4.c. Agriculture/forestry/fishing	255.30	0.02	0.09	2.68	1.83	0.30	0.05	280.49
1.A.4.ci. Stationary	10.94	0.00	0.00	0.03	0.01	0.00	0.01	10.98
1.A.4.cii. Mobile	244.37	0.02	0.09	2.66	1.82	0.30	0.05	269.51
1.A.5. Other	**39.45**	**0.01**	**0.00**	**0.14**	**0.29**	**0.07**	**0.16**	**40.10**
1.A.5.a. Stationary	25.37	0.00	0.00	0.06	0.25	0.06	0.16	25.73
1.A.5.b. Mobile	14.08	0.00	0.00	0.08	0.03	0.01	0.00	14.37
1.B. Fugitive emissions from fuels	**0.41**	**28.36**	**0.00**	**NO**	**NO**	**0.52**	**NO**	**794.56**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**0.41**	**28.36**	**0.00**	**NO**	**NO**	**0.52**	**NO**	**794.56**
1.B.2.a. Oil	0.04	0.00	0.00	NO	NO	0.00	NO	0.04
1.B.2.b. Natural gas	0.37	28.36			NO	0.52	NO	794.53
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**59.95**	**0.00**	**0.00**	**0.24**	**0.16**	**0.06**	**0.02**	**60.57**
1.D.1.a. Aviation	59.95	0.00	0.00	0.24	0.16	0.06	0.02	60.57
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**322.08**							**322.08**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**7,178.52**	**32.01**	**0.21**	**16.53**	**49.75**	**7.05**	**5.93**	**8,130.01**
1.A. Fuel combustion activities (sectoral approach)	7,177.44	2.27	0.21	16.53	49.75	6.47	5.93	7,296.25
1.A.1. Energy industries	**3,036.74**	**0.06**	**0.01**	**4.85**	**2.09**	**0.14**	**0.52**	**3,040.33**
1.A.1.a. Public electricity and heat production	3,036.74	0.06	0.01	4.85	2.09	0.14	0.52	3,040.33
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**438.86**	**0.01**	**0.00**	**0.66**	**0.39**	**0.19**	**0.17**	**439.42**
1.A.2.a. Iron and steel	46.97	0.00	0.00	0.06	0.02	0.02	0.00	47.02
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	1.80	0.00	0.00	0.00	0.00	0.00	0.00	1.80
1.A.2.d. Pulp, paper and print	2.28	0.00	0.00	0.00	0.00	0.00	0.00	2.29
1.A.2.e. Food processing, beverages and tobacco	87.16	0.00	0.00	0.18	0.20	0.04	0.17	87.37
1.A.2.f. Non-metallic minerals	216.66	0.00	0.00	0.30	0.11	0.09	0.00	216.88
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	13.63	0.00	0.00	0.02	0.01	0.01	0.00	13.65
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	1.80	0.00	0.00	0.00	0.00	0.00	0.00	1.80
1.A.2.k. Construction	5.83	0.00	0.00	0.01	0.00	0.00	0.00	5.83
1.A.2.l. Textile and leather	26.41	0.00	0.00	0.03	0.01	0.01	0.00	26.44
1.A.2.m. Other industries	36.32	0.00	0.00	0.05	0.02	0.01	0.00	36.35
1.A.3. Transport	**1,588.76**	**0.40**	**0.09**	**6.15**	**20.61**	**2.58**	**0.21**	**1,624.14**
1.A.3.a. Domestic aviation	0.66	0.00	0.00	0.00	0.00	0.00	0.00	0.66
1.A.3.b. Road transportation	1,517.27	0.40	0.07	5.34	20.44	2.52	0.20	1,548.11
1.A.3.c. Railways	43.36	0.00	0.02	0.72	0.15	0.06	0.01	47.87
1.A.3.d. Domestic navigation	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.44
1.A.3.e. Other transportation	27.03	0.00	0.00	0.08	0.02	0.00	0.00	27.06
1.A.4. Other sectors	**2,084.65**	**1.79**	**0.11**	**4.73**	**26.38**	**3.51**	**4.90**	**2,163.57**
1.A.4.a. Commercial/institutional	580.52	0.21	0.01	0.98	3.24	0.54	2.71	588.42
1.A.4.b. Residential	1,266.42	1.55	0.02	1.31	21.34	2.68	2.14	1,313.93
1.A.4.c. Agriculture/forestry/fishing	237.72	0.03	0.09	2.44	1.79	0.28	0.05	261.22
1.A.4.ci. Stationary	12.10	0.01	0.00	0.02	0.02	0.01	0.00	12.42
1.A.4.cii. Mobile	225.62	0.02	0.09	2.42	1.77	0.27	0.04	248.80
1.A.5. Other	**28.42**	**0.00**	**0.00**	**0.14**	**0.28**	**0.05**	**0.12**	**28.79**
1.A.5.a. Stationary	20.41	0.00	0.00	0.06	0.16	0.04	0.11	20.63
1.A.5.b. Mobile	8.01	0.00	0.00	0.09	0.12	0.02	0.00	8.16
1.B. Fugitive emissions from fuels	**1.08**	**29.74**	**0.00**	**NO**	**NO**	**0.58**	**NO**	**833.76**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.08**	**29.74**	**0.00**	**NO**	**NO**	**0.58**	**NO**	**833.76**
1.B.2.a. Oil	0.68	0.04	0.00	NO	NO	0.04	NO	1.90
1.B.2.b. Natural gas	0.39	29.69			NO	0.54	NO	831.85
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**34.77**	**0.00**	**0.00**	**0.13**	**0.12**	**0.04**	**0.01**	**35.17**
1.D.1.a. Aviation	34.77	0.00	0.00	0.13	0.12	0.04	0.01	35.17
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**373.58**							**373.58**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**7,626.66**	**34.10**	**0.21**	**17.69**	**46.42**	**7.07**	**4.98**	**8,637.54**
1.A. Fuel combustion activities (sectoral approach)	7,625.53	1.98	0.21	17.69	46.42	6.17	4.98	7,736.94
1.A.1. Energy industries	**3,107.08**	**0.06**	**0.01**	**4.96**	**2.14**	**0.14**	**0.48**	**3,110.75**
1.A.1.a. Public electricity and heat production	3,107.08	0.06	0.01	4.96	2.14	0.14	0.48	3,110.75
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**443.90**	**0.01**	**0.00**	**0.70**	**0.45**	**0.20**	**0.20**	**444.58**
1.A.2.a. Iron and steel	45.94	0.00	0.00	0.06	0.03	0.02	0.00	45.98
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	2.47	0.00	0.00	0.00	0.00	0.00	0.00	2.47
1.A.2.d. Pulp, paper and print	2.53	0.00	0.00	0.00	0.00	0.00	0.00	2.54
1.A.2.e. Food processing, beverages and tobacco	68.18	0.00	0.00	0.17	0.22	0.05	0.17	68.46
1.A.2.f. Non-metallic minerals	241.54	0.00	0.00	0.33	0.14	0.10	0.02	241.79
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	13.63	0.00	0.00	0.02	0.01	0.01	0.00	13.64
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	1.54	0.00	0.00	0.00	0.00	0.00	0.00	1.56
1.A.2.k. Construction	9.35	0.00	0.00	0.03	0.01	0.00	0.00	9.37
1.A.2.l. Textile and leather	25.71	0.00	0.00	0.04	0.01	0.01	0.00	25.73
1.A.2.m. Other industries	33.00	0.00	0.00	0.04	0.02	0.01	0.00	33.04
1.A.3. Transport	**1,786.89**	**0.43**	**0.11**	**7.11**	**22.06**	**2.78**	**0.25**	**1,827.10**
1.A.3.a. Domestic aviation	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.35
1.A.3.b. Road transportation	1,682.50	0.43	0.08	5.98	21.82	2.69	0.23	1,716.44
1.A.3.c. Railways	59.97	0.00	0.02	1.00	0.20	0.09	0.02	66.20
1.A.3.d. Domestic navigation	0.44	0.00	0.00	0.00	0.00	0.00	0.00	0.44
1.A.3.e. Other transportation	43.63	0.00	0.00	0.14	0.03	0.00	0.00	43.67
1.A.4. Other sectors	**2,260.03**	**1.47**	**0.10**	**4.70**	**21.48**	**2.99**	**4.01**	**2,326.51**
1.A.4.a. Commercial/institutional	822.79	0.18	0.01	1.26	2.86	0.56	2.31	829.41
1.A.4.b. Residential	1,220.25	1.27	0.01	1.24	17.28	2.18	1.65	1,259.28
1.A.4.c. Agriculture/forestry/fishing	216.99	0.02	0.08	2.20	1.35	0.25	0.05	237.83
1.A.4.ci. Stationary	17.03	0.01	0.00	0.03	0.02	0.01	0.01	17.27
1.A.4.cii. Mobile	199.96	0.01	0.08	2.17	1.32	0.24	0.04	220.56
1.A.5. Other	**27.64**	**0.00**	**0.00**	**0.22**	**0.29**	**0.05**	**0.04**	**28.00**
1.A.5.a. Stationary	11.40	0.00	0.00	0.02	0.06	0.01	0.04	11.48
1.A.5.b. Mobile	16.24	0.00	0.00	0.20	0.23	0.03	0.00	16.52
1.B. Fugitive emissions from fuels	**1.12**	**32.12**	**0.00**	**NO**	**NO**	**0.91**	**NO**	**900.60**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.12**	**32.12**	**0.00**	**NO**	**NO**	**0.91**	**NO**	**900.60**
1.B.2.a. Oil	0.70	0.27	0.00	NO	NO	0.33	NO	8.36
1.B.2.b. Natural gas	0.42	31.85			NO	0.58	NO	892.24
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**34.79**	**0.00**	**0.00**	**0.13**	**0.13**	**0.03**	**0.01**	**35.20**
1.D.1.a. Aviation	34.79	0.00	0.00	0.13	0.13	0.03	0.01	35.20
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**307.68**							**307.68**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**7,871.74**	**35.98**	**0.21**	**18.14**	**48.37**	**7.21**	**4.57**	**8,935.27**
1.A. Fuel combustion activities (sectoral approach)	7,870.60	2.08	0.21	18.14	48.37	6.39	4.57	7,984.74
1.A.1. Energy industries	**3,229.45**	**0.07**	**0.01**	**5.16**	**2.23**	**0.15**	**0.44**	**3,233.22**
1.A.1.a. Public electricity and heat production	3,229.45	0.07	0.01	5.16	2.23	0.15	0.44	3,233.22
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**574.40**	**0.01**	**0.00**	**0.85**	**0.49**	**0.25**	**0.19**	**575.18**
1.A.2.a. Iron and steel	67.12	0.00	0.00	0.09	0.04	0.03	0.01	67.19
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	3.36	0.00	0.00	0.01	0.00	0.00	0.00	3.37
1.A.2.d. Pulp, paper and print	3.16	0.00	0.00	0.00	0.00	0.00	0.00	3.16
1.A.2.e. Food processing, beverages and tobacco	76.05	0.00	0.00	0.17	0.21	0.05	0.16	76.30
1.A.2.f. Non-metallic minerals	311.17	0.01	0.00	0.42	0.17	0.13	0.02	311.49
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	18.81	0.00	0.00	0.02	0.01	0.01	0.00	18.83
1.A.2.i. Mining and quarrying	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.22
1.A.2.j. Wood and wood production	2.10	0.00	0.00	0.00	0.00	0.00	0.00	2.11
1.A.2.k. Construction	7.95	0.00	0.00	0.02	0.01	0.00	0.00	7.96
1.A.2.l. Textile and leather	38.66	0.00	0.00	0.05	0.02	0.02	0.00	38.70
1.A.2.m. Other industries	45.80	0.00	0.00	0.06	0.02	0.02	0.00	45.84
1.A.3. Transport	**1,821.73**	**0.44**	**0.12**	**7.56**	**22.79**	**2.89**	**0.06**	**1,864.52**
1.A.3.a. Domestic aviation	1.68	0.00	0.00	0.00	0.00	0.00	0.00	1.69
1.A.3.b. Road transportation	1,698.08	0.43	0.08	6.09	22.48	2.77	0.04	1,732.41
1.A.3.c. Railways	81.01	0.00	0.03	1.35	0.27	0.12	0.02	89.43
1.A.3.d. Domestic navigation	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.26
1.A.3.e. Other transportation	40.69	0.00	0.00	0.13	0.03	0.00	0.00	40.73
1.A.4. Other sectors	**2,219.08**	**1.56**	**0.09**	**4.34**	**22.73**	**3.07**	**3.83**	**2,285.56**
1.A.4.a. Commercial/institutional	702.39	0.14	0.01	1.06	2.35	0.46	1.90	707.63
1.A.4.b. Residential	1,331.63	1.39	0.01	1.35	19.04	2.38	1.92	1,374.36
1.A.4.c. Agriculture/forestry/fishing	185.06	0.02	0.07	1.93	1.34	0.22	0.01	203.57
1.A.4.ci. Stationary	7.82	0.01	0.00	0.02	0.02	0.01	0.01	8.10
1.A.4.cii. Mobile	177.24	0.01	0.07	1.91	1.32	0.21	0.00	195.46
1.A.5. Other	**25.94**	**0.00**	**0.00**	**0.23**	**0.13**	**0.03**	**0.04**	**26.26**
1.A.5.a. Stationary	11.70	0.00	0.00	0.02	0.07	0.02	0.04	11.79
1.A.5.b. Mobile	14.24	0.00	0.00	0.21	0.06	0.01	0.00	14.47
1.B. Fugitive emissions from fuels	**1.14**	**33.91**	**0.00**	**NO**	**NO**	**0.82**	**NO**	**950.54**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.14**	**33.91**	**0.00**	**NO**	**NO**	**0.82**	**NO**	**950.54**
1.B.2.a. Oil	0.69	0.17	0.00	NO	NO	0.20	NO	5.59
1.B.2.b. Natural gas	0.45	33.73			NO	0.61	NO	944.94
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**37.93**	**0.00**	**0.00**	**0.14**	**0.14**	**0.04**	**0.01**	**38.36**
1.D.1.a. Aviation	37.93	0.00	0.00	0.14	0.14	0.04	0.01	38.36
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**307.39**							**307.39**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**7,113.56**	**32.14**	**0.22**	**17.00**	**49.26**	**7.33**	**4.70**	**8,070.72**
1.A. Fuel combustion activities (sectoral approach)	7,112.32	2.27	0.22	17.00	49.26	6.62	4.70	7,233.28
1.A.1. Energy industries	**2,492.93**	**0.05**	**0.01**	**3.98**	**1.73**	**0.12**	**0.33**	**2,495.89**
1.A.1.a. Public electricity and heat production	2,492.93	0.05	0.01	3.98	1.73	0.12	0.33	2,495.89
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**634.67**	**0.01**	**0.00**	**0.94**	**0.49**	**0.27**	**0.17**	**635.44**
1.A.2.a. Iron and steel	76.18	0.00	0.00	0.10	0.04	0.03	0.01	76.26
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	4.75	0.00	0.00	0.01	0.00	0.00	0.00	4.75
1.A.2.d. Pulp, paper and print	3.99	0.00	0.00	0.01	0.00	0.00	0.00	4.00
1.A.2.e. Food processing, beverages and tobacco	90.41	0.00	0.00	0.18	0.19	0.05	0.15	90.62
1.A.2.f. Non-metallic minerals	308.99	0.01	0.00	0.42	0.16	0.13	0.01	309.30
1.A.2.g. Transport equipment	0.50	0.00	0.00	0.00	0.00	0.00	0.00	0.50
1.A.2.h. Machinery	25.89	0.00	0.00	0.03	0.02	0.01	0.00	25.92
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	1.94	0.00	0.00	0.00	0.00	0.00	0.00	1.95
1.A.2.k. Construction	16.68	0.00	0.00	0.04	0.01	0.01	0.00	16.71
1.A.2.l. Textile and leather	59.78	0.00	0.00	0.08	0.03	0.02	0.00	59.84
1.A.2.m. Other industries	45.54	0.00	0.00	0.06	0.02	0.02	0.00	45.59
1.A.3. Transport	**1,742.01**	**0.41**	**0.12**	**7.45**	**20.89**	**2.69**	**0.07**	**1,785.12**
1.A.3.a. Domestic aviation	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20
1.A.3.b. Road transportation	1,632.42	0.40	0.08	5.74	20.54	2.54	0.04	1,665.00
1.A.3.c. Railways	101.28	0.01	0.04	1.68	0.34	0.15	0.03	111.79
1.A.3.d. Domestic navigation	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.52
1.A.3.e. Other transportation	7.60	0.00	0.00	0.02	0.01	0.00	0.00	7.61
1.A.4. Other sectors	**2,203.66**	**1.80**	**0.09**	**4.29**	**25.75**	**3.48**	**4.01**	**2,277.37**
1.A.4.a. Commercial/institutional	644.51	0.14	0.00	0.98	2.25	0.45	1.81	649.88
1.A.4.b. Residential	1,380.16	1.63	0.02	1.43	22.35	2.82	2.19	1,430.16
1.A.4.c. Agriculture/forestry/fishing	179.00	0.02	0.07	1.89	1.14	0.22	0.01	197.34
1.A.4.ci. Stationary	4.46	0.01	0.00	0.01	0.02	0.01	0.01	4.80
1.A.4.cii. Mobile	174.55	0.01	0.07	1.88	1.12	0.21	0.00	192.54
1.A.5. Other	**39.04**	**0.00**	**0.00**	**0.33**	**0.40**	**0.06**	**0.13**	**39.46**
1.A.5.a. Stationary	21.48	0.00	0.00	0.04	0.15	0.03	0.13	21.61
1.A.5.b. Mobile	17.56	0.00	0.00	0.29	0.25	0.04	0.00	17.84
1.B. Fugitive emissions from fuels	**1.24**	**29.86**	**0.00**	**NO**	**NO**	**0.71**	**NO**	**837.45**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.24**	**29.86**	**0.00**	**NO**	**NO**	**0.71**	**NO**	**837.45**
1.B.2.a. Oil	0.85	0.15	0.00	NO	NO	0.17	NO	5.01
1.B.2.b. Natural gas	0.39	29.72				0.54	NO	832.44
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**37.92**	**0.00**	**0.00**	**0.14**	**0.14**	**0.04**	**0.01**	**38.38**
1.D.1.a. Aviation	37.92	0.00	0.00	0.14	0.14	0.04	0.01	38.38
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**361.44**							**361.44**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**7,250.36**	**33.64**	**0.21**	**17.39**	**42.76**	**6.73**	**3.23**	**8,247.81**
1.A. Fuel combustion activities (sectoral approach)	7,249.08	1.81	0.21	17.39	42.76	5.83	3.23	7,355.12
1.A.1. Energy industries	**2,890.45**	**0.06**	**0.01**	**4.61**	**2.02**	**0.14**	**0.21**	**2,893.79**
1.A.1.a. Public electricity and heat production	2,890.45	0.06	0.01	4.61	2.02	0.14	0.21	2,893.79
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**800.81**	**0.02**	**0.00**	**1.12**	**0.50**	**0.33**	**0.10**	**801.69**
1.A.2.a. Iron and steel	205.99	0.00	0.00	0.27	0.11	0.08	0.01	206.19
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	4.87	0.00	0.00	0.01	0.00	0.00	0.00	4.88
1.A.2.d. Pulp, paper and print	3.73	0.00	0.00	0.00	0.00	0.00	0.00	3.73
1.A.2.e. Food processing, beverages and tobacco	86.05	0.00	0.00	0.14	0.12	0.04	0.07	86.20
1.A.2.f. Non-metallic minerals	304.06	0.01	0.00	0.41	0.16	0.12	0.01	304.36
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	32.79	0.00	0.00	0.04	0.02	0.01	0.00	32.83
1.A.2.i. Mining and quarrying	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.11
1.A.2.j. Wood and wood production	1.26	0.00	0.00	0.00	0.00	0.00	0.00	1.27
1.A.2.k. Construction	46.30	0.00	0.00	0.08	0.03	0.02	0.00	46.35
1.A.2.l. Textile and leather	60.18	0.00	0.00	0.08	0.03	0.02	0.00	60.24
1.A.2.m. Other industries	55.46	0.00	0.00	0.07	0.03	0.02	0.00	55.52
1.A.3. Transport	**1,846.56**	**0.43**	**0.13**	**7.88**	**21.55**	**2.78**	**0.07**	**1,891.74**
1.A.3.a. Domestic aviation	1.05	0.00	0.00	0.00	0.00	0.00	0.00	1.06
1.A.3.b. Road transportation	1,739.74	0.42	0.09	6.17	21.20	2.63	0.04	1,774.32
1.A.3.c. Railways	101.92	0.01	0.04	1.69	0.35	0.15	0.03	112.50
1.A.3.d. Domestic navigation	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.34
1.A.3.e. Other transportation	3.51	0.00	0.00	0.01	0.00	0.00	0.00	3.52
1.A.4. Other sectors	**1,666.75**	**1.30**	**0.07**	**3.39**	**18.39**	**2.52**	**2.74**	**1,722.83**
1.A.4.a. Commercial/institutional	361.92	0.12	0.00	0.59	1.75	0.31	1.44	366.30
1.A.4.b. Residential	1,152.43	1.17	0.01	1.17	15.67	2.03	1.30	1,188.44
1.A.4.c. Agriculture/forestry/fishing	152.40	0.02	0.06	1.63	0.96	0.18	0.01	168.09
1.A.4.ci. Stationary	1.82	0.01	0.00	0.00	0.01	0.01	0.00	1.98
1.A.4.cii. Mobile	150.58	0.01	0.06	1.63	0.95	0.18	0.00	166.11
1.A.5. Other	**44.51**	**0.00**	**0.00**	**0.39**	**0.31**	**0.06**	**0.11**	**45.08**
1.A.5.a. Stationary	17.80	0.00	0.00	0.03	0.13	0.02	0.10	17.92
1.A.5.b. Mobile	26.71	0.00	0.00	0.35	0.18	0.03	0.00	27.15
1.B. Fugitive emissions from fuels	**1.28**	**31.84**	**0.00**	**NO**	**NO**	**0.90**	**NO**	**892.70**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.28**	**31.84**	**0.00**	**NO**	**NO**	**0.90**	**NO**	**892.70**
1.B.2.a. Oil	0.86	0.28	0.00	NO	NO	0.33	NO	8.70
1.B.2.b. Natural gas	0.41	31.56			NO	0.58	NO	884.00
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**44.21**	**0.00**	**0.00**	**0.18**	**0.13**	**0.04**	**0.01**	**44.67**
1.D.1.a. Aviation	44.21	0.00	0.00	0.18	0.13	0.04	0.01	44.67
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**304.66**							**304.66**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**7,547.68**	**33.57**	**0.21**	**18.05**	**45.40**	**7.32**	**4.79**	**8,544.04**
1.A. Fuel combustion activities (sectoral approach)	7,546.38	1.88	0.21	18.05	45.40	6.14	4.79	7,655.37
1.A.1. Energy industries	**2,990.84**	**0.07**	**0.01**	**4.79**	**2.09**	**0.14**	**0.30**	**2,994.57**
1.A.1.a. Public electricity and heat production	2,990.84	0.07	0.01	4.79	2.09	0.14	0.30	2,994.57
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**884.97**	**0.03**	**0.00**	**1.35**	**2.27**	**0.47**	**1.85**	**887.09**
1.A.2.a. Iron and steel	215.08	0.00	0.00	0.29	0.11	0.09	0.01	215.29
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	5.53	0.00	0.00	0.01	0.00	0.00	0.00	5.54
1.A.2.d. Pulp, paper and print	4.24	0.00	0.00	0.01	0.00	0.00	0.00	4.24
1.A.2.e. Food processing, beverages and tobacco	98.01	0.00	0.00	0.18	0.13	0.04	0.08	98.18
1.A.2.f. Non-metallic minerals	337.28	0.02	0.00	0.55	1.89	0.24	1.75	338.75
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	31.75	0.00	0.00	0.04	0.02	0.01	0.00	31.78
1.A.2.i. Mining and quarrying	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06
1.A.2.j. Wood and wood production	0.76	0.00	0.00	0.00	0.01	0.00	0.00	0.78
1.A.2.k. Construction	58.01	0.00	0.00	0.09	0.03	0.02	0.00	58.08
1.A.2.l. Textile and leather	59.22	0.00	0.00	0.08	0.03	0.02	0.00	59.28
1.A.2.m. Other industries	75.04	0.00	0.00	0.10	0.04	0.03	0.00	75.11
1.A.3. Transport	**1,949.57**	**0.45**	**0.13**	**8.22**	**22.47**	**2.91**	**0.07**	**1,995.91**
1.A.3.a. Domestic aviation	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.15
1.A.3.b. Road transportation	1,850.70	0.45	0.09	6.65	22.15	2.77	0.05	1,887.29
1.A.3.c. Railways	93.69	0.01	0.04	1.56	0.32	0.14	0.02	103.42
1.A.3.d. Domestic navigation	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.34
1.A.3.e. Other transportation	4.69	0.00	0.00	0.01	0.00	0.00	0.00	4.69
1.A.4. Other sectors	**1,677.37**	**1.33**	**0.07**	**3.37**	**18.27**	**2.57**	**2.44**	**1,733.67**
1.A.4.a. Commercial/institutional	370.72	0.13	0.00	0.62	1.68	0.32	1.35	375.40
1.A.4.b. Residential	1,156.84	1.18	0.01	1.19	15.72	2.08	1.08	1,193.51
1.A.4.c. Agriculture/forestry/fishing	149.81	0.01	0.05	1.56	0.87	0.17	0.01	164.77
1.A.4.ci. Stationary	6.19	0.00	0.00	0.01	0.01	0.01	0.00	6.34
1.A.4.cii. Mobile	143.62	0.01	0.05	1.55	0.86	0.17	0.00	158.43
1.A.5. Other	**43.63**	**0.00**	**0.00**	**0.32**	**0.31**	**0.05**	**0.12**	**44.13**
1.A.5.a. Stationary	20.36	0.00	0.00	0.04	0.14	0.02	0.12	20.48
1.A.5.b. Mobile	23.27	0.00	0.00	0.28	0.16	0.03	0.00	23.66
1.B. Fugitive emissions from fuels	**1.29**	**31.69**	**0.00**	**NO**	**NO**	**1.18**	**NO**	**888.68**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.29**	**31.69**	**0.00**	**NO**	**NO**	**1.18**	**NO**	**888.68**
1.B.2.a. Oil	0.88	0.51	0.00	NO	NO	0.61	NO	15.15
1.B.2.b. Natural gas	0.41	31.18				0.57	NO	873.53
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**44.17**	**0.00**	**0.00**	**0.19**	**0.11**	**0.04**	**0.01**	**44.60**
1.D.1.a. Aviation	44.17	0.00	0.00	0.19	0.11	0.04	0.01	44.60
1.D.1.b. Navigation	NO	NO	NO	NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**352.45**							**352.45**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,093.50**	**28.97**	**0.19**	**17.96**	**45.68**	**7.18**	**4.80**	**8,955.84**
1.A. Fuel combustion activities (sectoral approach)	8,092.21	2.00	0.19	17.96	45.68	6.01	4.80	8,199.36
1.A.1. Energy industries	**3,835.58**	**0.08**	**0.01**	**6.14**	**2.66**	**0.18**	**0.61**	**3,840.36**
1.A.1.a. Public electricity and heat production	3,835.58	0.08	0.01	6.14	2.66	0.18	0.61	3,840.36
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**501.95**	**0.02**	**0.00**	**0.77**	**1.66**	**0.29**	**1.44**	**503.39**
1.A.2.a. Iron and steel	74.78	0.00	0.00	0.10	0.04	0.03	0.00	74.85
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	3.77	0.00	0.00	0.01	0.00	0.00	0.00	3.77
1.A.2.d. Pulp, paper and print	2.83	0.00	0.00	0.00	0.00	0.00	0.00	2.84
1.A.2.e. Food processing, beverages and tobacco	54.51	0.00	0.00	0.08	0.08	0.03	0.05	54.60
1.A.2.f. Non-metallic minerals	226.95	0.02	0.00	0.39	1.47	0.17	1.38	228.07
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	13.58	0.00	0.00	0.02	0.01	0.01	0.00	13.60
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.24
1.A.2.k. Construction	9.35	0.00	0.00	0.02	0.01	0.00	0.00	9.37
1.A.2.l. Textile and leather	38.82	0.00	0.00	0.05	0.02	0.02	0.00	38.86
1.A.2.m. Other industries	77.12	0.00	0.00	0.10	0.04	0.03	0.00	77.19
1.A.3. Transport	**1,919.24**	**0.46**	**0.11**	**7.44**	**22.29**	**2.83**	**0.02**	**1,961.51**
1.A.3.a. Domestic aviation	0.08	0.00	0.00	0.00	0.00	0.00	0.00	0.08
1.A.3.b. Road transportation	1,855.83	0.45	0.09	6.55	22.11	2.76	0.00	1,892.75
1.A.3.c. Railways	51.32	0.00	0.02	0.85	0.17	0.08	0.01	56.65
1.A.3.d. Domestic navigation	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.34
1.A.3.e. Other transportation	11.68	0.00	0.00	0.04	0.01	0.00	0.00	11.69
1.A.4. Other sectors	**1,824.94**	**1.43**	**0.07**	**3.50**	**18.91**	**2.69**	**2.71**	**1,883.51**
1.A.4.a. Commercial/institutional	476.56	0.22	0.01	0.80	1.92	0.44	1.39	484.06
1.A.4.b. Residential	1,209.20	1.20	0.01	1.23	16.06	2.08	1.31	1,246.21
1.A.4.c. Agriculture/forestry/fishing	139.17	0.02	0.05	1.47	0.93	0.17	0.00	153.24
1.A.4.ci. Stationary	4.61	0.01	0.00	0.01	0.02	0.01	0.00	4.84
1.A.4.cii. Mobile	134.56	0.01	0.05	1.46	0.92	0.16	0.00	148.40
1.A.5. Other	**10.49**	**0.00**	**0.00**	**0.10**	**0.15**	**0.03**	**0.02**	**10.59**
1.A.5.a. Stationary	7.47	0.00	0.00	0.02	0.03	0.01	0.02	7.52
1.A.5.b. Mobile	3.02	0.00	0.00	0.09	0.12	0.02	0.00	3.07
1.B. Fugitive emissions from fuels	**1.29**	**26.97**	**0.00**	**NO**	**NO**	**1.17**	**NO**	**756.49**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.29**	**26.97**	**0.00**	**NO**	**NO**	**1.17**	**NO**	**756.49**
1.B.2.a. Oil	0.89	0.58	0.00	NO	NO	0.69	NO	17.00
1.B.2.b. Natural gas	0.40	26.40			NO	0.48	NO	739.49
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**44.17**	**0.00**	**0.00**	**0.19**	**0.11**	**0.04**	**0.01**	**44.60**
1.D.1.a. Aviation	44.17	0.00	0.00	0.19	0.11	0.04	0.01	44.60
1.D.1.b. Navigation	NE	NE	NE	NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**362.10**							**362.10**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,718.00**	**28.60**	**0.21**	**19.82**	**48.31**	**7.21**	**4.88**	**9,574.49**
1.A. Fuel combustion activities (sectoral approach)	8,716.70	2.15	0.21	19.82	48.31	6.29	4.88	8,832.63
1.A.1. Energy industries	**4,047.95**	**0.09**	**0.01**	**6.48**	**2.82**	**0.19**	**0.53**	**4,053.06**
1.A.1.a. Public electricity and heat production	4,047.95	0.09	0.01	6.48	2.82	0.19	0.53	4,053.06
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**515.62**	**0.02**	**0.00**	**0.79**	**1.50**	**0.29**	**1.25**	**517.00**
1.A.2.a. Iron and steel	40.87	0.00	0.00	0.06	0.02	0.02	0.00	40.92
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	3.91	0.00	0.00	0.01	0.00	0.00	0.00	3.91
1.A.2.d. Pulp, paper and print	3.01	0.00	0.00	0.00	0.00	0.00	0.00	3.01
1.A.2.e. Food processing, beverages and tobacco	68.97	0.00	0.00	0.10	0.10	0.03	0.06	69.09
1.A.2.f. Non-metallic minerals	240.50	0.02	0.00	0.39	1.28	0.16	1.18	241.50
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	17.74	0.00	0.00	0.02	0.01	0.01	0.00	17.76
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	0.61	0.00	0.00	0.00	0.01	0.01	0.00	0.65
1.A.2.k. Construction	16.95	0.00	0.00	0.04	0.01	0.01	0.00	16.98
1.A.2.l. Textile and leather	48.79	0.00	0.00	0.07	0.03	0.02	0.00	48.84
1.A.2.m. Other industries	74.26	0.00	0.00	0.10	0.04	0.03	0.00	74.33
1.A.3. Transport	**2,139.84**	**0.47**	**0.12**	**8.66**	**21.91**	**2.83**	**0.02**	**2,185.47**
1.A.3.a. Domestic aviation	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.35
1.A.3.b. Road transportation	2,069.29	0.47	0.10	7.74	21.72	2.75	0.00	2,109.47
1.A.3.c. Railways	52.23	0.00	0.02	0.87	0.18	0.08	0.01	57.66
1.A.3.d. Domestic navigation	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.26
1.A.3.e. Other transportation	17.71	0.00	0.00	0.06	0.01	0.00	0.00	17.73
1.A.4. Other sectors	**1,985.99**	**1.57**	**0.07**	**3.76**	**21.82**	**2.94**	**2.98**	**2,049.60**
1.A.4.a. Commercial/institutional	477.20	0.13	0.00	0.75	1.37	0.33	1.00	481.79
1.A.4.b. Residential	1,353.05	1.41	0.01	1.37	19.33	2.41	1.98	1,396.35
1.A.4.c. Agriculture/forestry/fishing	155.75	0.02	0.06	1.64	1.13	0.19	0.00	171.46
1.A.4.ci. Stationary	5.80	0.01	0.00	0.01	0.02	0.01	0.00	6.13
1.A.4.cii. Mobile	149.94	0.01	0.06	1.63	1.11	0.18	0.00	165.33
1.A.5. Other	**27.30**	**0.00**	**0.00**	**0.12**	**0.25**	**0.04**	**0.11**	**27.51**
1.A.5.a. Stationary	23.80	0.00	0.00	0.04	0.14	0.03	0.11	23.94
1.A.5.b. Mobile	3.50	0.00	0.00	0.08	0.11	0.02	0.00	3.57
1.B. Fugitive emissions from fuels	**1.30**	**26.45**	**0.00**	**NO**	**NO**	**0.92**	**NO**	**741.85**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.30**	**26.45**	**0.00**	**NO**	**NO**	**0.92**	**NO**	**741.85**
1.B.2.a. Oil	0.88	0.38	0.00	NO	NO	0.45	NO	11.47
1.B.2.b. Natural gas	0.42	26.07			NO	0.47	NO	730.38
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**41.06**	**0.00**	**0.00**	**0.17**	**0.12**	**0.04**	**0.01**	**41.49**
1.D.1.a. Aviation	41.06	0.00	0.00	0.17	0.12	0.04	0.01	41.49
1.D.1.b. Navigation	NE	NE	NE	NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**341.05**							**341.05**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,926.20**	**31.86**	**0.22**	**20.17**	**50.69**	**7.81**	**4.89**	**9,875.71**
1.A. Fuel combustion activities (sectoral approach)	8,924.86	2.27	0.22	20.17	50.69	6.75	4.89	9,045.77
1.A.1. Energy industries	**3,746.14**	**0.08**	**0.01**	**5.99**	**2.61**	**0.18**	**0.40**	**3,750.68**
1.A.1.a. Public electricity and heat production	3,746.14	0.08	0.01	5.99	2.61	0.18	0.40	3,750.68
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2. Manufacturing industries and construction	**575.45**	**0.03**	**0.00**	**0.88**	**1.86**	**0.33**	**1.58**	**577.13**
1.A.2.a. Iron and steel	53.48	0.00	0.00	0.07	0.03	0.02	0.01	53.54
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	5.85	0.00	0.00	0.02	0.00	0.00	0.00	5.86
1.A.2.d. Pulp, paper and print	5.62	0.00	0.00	0.01	0.00	0.00	0.00	5.62
1.A.2.e. Food processing, beverages and tobacco	73.35	0.00	0.00	0.11	0.11	0.04	0.07	73.48
1.A.2.f. Non-metallic minerals	276.16	0.02	0.00	0.45	1.60	0.19	1.49	277.40
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	19.49	0.00	0.00	0.03	0.01	0.01	0.00	19.52
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	0.57	0.00	0.00	0.00	0.02	0.01	0.00	0.64
1.A.2.k. Construction	16.14	0.00	0.00	0.03	0.01	0.01	0.00	16.16
1.A.2.l. Textile and leather	48.39	0.00	0.00	0.07	0.03	0.02	0.00	48.44
1.A.2.m. Other industries	76.39	0.00	0.00	0.10	0.04	0.03	0.00	76.47
1.A.3. Transport	**2,272.70**	**0.47**	**0.13**	**9.01**	**22.52**	**2.90**	**0.02**	**2,319.77**
1.A.3.a. Domestic aviation	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.07
1.A.3.b. Road transportation	2,197.59	0.47	0.11	8.12	22.33	2.83	0.01	2,239.62
1.A.3.c. Railways	48.19	0.00	0.02	0.80	0.16	0.07	0.01	53.20
1.A.3.d. Domestic navigation	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.26
1.A.3.e. Other transportation	26.59	0.00	0.00	0.08	0.02	0.00	0.00	26.62
1.A.4. Other sectors	**2,310.78**	**1.69**	**0.08**	**4.14**	**23.36**	**3.30**	**2.81**	**2,378.26**
1.A.4.a. Commercial/institutional	806.00	0.15	0.00	1.17	1.53	0.46	1.00	811.38
1.A.4.b. Residential	1,352.56	1.52	0.02	1.39	20.64	2.65	1.80	1,399.45
1.A.4.c. Agriculture/forestry/fishing	152.21	0.02	0.06	1.58	1.18	0.18	0.01	167.43
1.A.4.ci. Stationary	5.82	0.01	0.00	0.01	0.02	0.01	0.01	6.03
1.A.4.cii. Mobile	146.40	0.01	0.06	1.57	1.16	0.18	0.00	161.40
1.A.5. Other	**19.79**	**0.00**	**0.00**	**0.15**	**0.35**	**0.04**	**0.09**	**19.94**
1.A.5.a. Stationary	15.93	0.00	0.00	0.03	0.11	0.02	0.09	16.01
1.A.5.b. Mobile	3.86	0.00	0.00	0.13	0.24	0.03	0.00	3.93
1.B. Fugitive emissions from fuels	**1.33**	**29.59**	**0.00**	**NO**	**NO**	**1.06**	**NO**	**829.95**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.33**	**29.59**	**0.00**	**NO**	**NO**	**1.06**	**NO**	**829.95**
1.B.2.a. Oil	0.89	0.44	0.00	NO	NO	0.53	NO	13.32
1.B.2.b. Natural gas	0.45	29.15			NO	0.53	NO	816.63
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**41.01**	**0.00**	**0.00**	**0.16**	**0.12**	**0.05**	**0.01**	**41.43**
1.D.1.a. Aviation	41.01	0.00	0.00	0.16	0.12	0.05	0.01	41.43
1.D.1.b. Navigation	NE	NE	NE	NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**384.64**							**384.64**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,613.94**	**31.63**	**0.20**	**19.08**	**49.57**	**7.62**	**5.04**	**9,553.17**
1.A. Fuel combustion activities (sectoral approach)	8,612.61	2.44	0.20	19.08	49.57	6.65	5.04	8,734.47
1.A.1. Energy industries	**3,803.41**	**0.09**	**0.01**	**6.09**	**2.71**	**0.20**	**0.66**	**3,808.15**
1.A.1.a. Public electricity and heat production	3,803.41	0.08	0.01	6.09	2.62	0.18	0.66	3,807.79
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	0.00	0.01	0.00	0.00	0.09	0.02	0.00	0.36
1.A.2. Manufacturing industries and construction	**538.21**	**0.02**	**0.00**	**0.80**	**1.45**	**0.30**	**1.17**	**539.60**
1.A.2.a. Iron and steel	65.11	0.00	0.00	0.09	0.03	0.03	0.00	65.17
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	5.88	0.00	0.00	0.01	0.00	0.00	0.00	5.88
1.A.2.d. Pulp, paper and print	3.52	0.00	0.00	0.00	0.00	0.00	0.00	3.52
1.A.2.e. Food processing, beverages and tobacco	80.75	0.00	0.00	0.12	0.13	0.04	0.09	80.90
1.A.2.f. Non-metallic minerals	216.68	0.01	0.00	0.35	1.16	0.15	1.07	217.59
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	18.84	0.00	0.00	0.03	0.01	0.01	0.00	18.86
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	1.17	0.00	0.00	0.01	0.03	0.01	0.00	1.26
1.A.2.k. Construction	18.85	0.00	0.00	0.04	0.01	0.01	0.00	18.87
1.A.2.l. Textile and leather	46.86	0.00	0.00	0.06	0.03	0.02	0.00	46.91
1.A.2.m. Other industries	80.55	0.00	0.00	0.11	0.04	0.03	0.00	80.63
1.A.3. Transport	**1,992.59**	**0.40**	**0.12**	**8.11**	**18.90**	**2.47**	**0.02**	**2,034.45**
1.A.3.a. Domestic aviation	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.14
1.A.3.b. Road transportation	1,916.42	0.40	0.10	7.17	18.70	2.39	0.00	1,952.86
1.A.3.c. Railways	51.94	0.00	0.02	0.86	0.18	0.08	0.01	57.33
1.A.3.d. Domestic navigation	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.26
1.A.3.e. Other transportation	23.83	0.00	0.00	0.07	0.02	0.00	0.00	23.85
1.A.4. Other sectors	**2,271.47**	**1.93**	**0.07**	**4.03**	**26.39**	**3.67**	**3.18**	**2,345.27**
1.A.4.a. Commercial/institutional	777.01	0.18	0.00	1.11	1.49	0.47	0.92	783.02
1.A.4.b. Residential	1,345.60	1.73	0.02	1.41	23.74	3.02	2.26	1,398.59
1.A.4.c. Agriculture/forestry/fishing	148.86	0.02	0.05	1.52	1.16	0.18	0.01	163.66
1.A.4.ci. Stationary	8.42	0.01	0.00	0.01	0.03	0.01	0.01	8.81
1.A.4.cii. Mobile	140.44	0.01	0.05	1.51	1.13	0.17	0.00	154.85
1.A.5. Other	**6.93**	**0.00**	**0.00**	**0.05**	**0.13**	**0.02**	**0.00**	**7.00**
1.A.5.a. Stationary	3.59	0.00	0.00	0.01	0.01	0.00	0.00	3.59
1.A.5.b. Mobile	3.35	0.00	0.00	0.05	0.13	0.01	0.00	3.41
1.B. Fugitive emissions from fuels	**1.33**	**29.19**	**0.00**	**NO**	**NO**	**0.97**	**NO**	**818.70**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.33**	**29.19**	**0.00**	**NO**	**NO**	**0.97**	**NO**	**818.70**
1.B.2.a. Oil	0.89	0.38	0.00	NO	NO	0.45	NO	11.48
1.B.2.b. Natural gas	0.44	28.81			NO	0.52	NO	807.22
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**47.31**	**0.00**	**0.00**	**0.18**	**0.13**	**0.06**	**0.02**	**47.79**
1.D.1.a. Aviation	47.31	0.00	0.00	0.18	0.13	0.06	0.02	47.79
1.D.1.b. Navigation	NE	NE	NE	NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**406.30**							**406.30**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,224.92**	**29.75**	**0.22**	**19.17**	**50.58**	**7.56**	**12.54**	**9,116.08**
1.A. Fuel combustion activities (sectoral approach)	8,223.26	2.51	0.22	19.17	50.58	6.66	12.54	8,351.58
1.A.1. Energy industries	**3,598.61**	**0.08**	**0.02**	**6.23**	**2.14**	**0.17**	**7.14**	**3,605.95**
1.A.1.a. Public electricity and heat production	3,598.61	0.07	0.02	6.23	2.03	0.14	7.14	3,605.50
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	0.00	0.02	0.00	0.00	0.11	0.03	0.00	0.45
1.A.2. Manufacturing industries and construction	**573.06**	**0.03**	**0.00**	**0.87**	**2.30**	**0.35**	**2.03**	**575.00**
1.A.2.a. Iron and steel	31.77	0.00	0.00	0.04	0.02	0.01	0.00	31.80
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	7.44	0.00	0.00	0.02	0.01	0.01	0.00	7.46
1.A.2.d. Pulp, paper and print	0.64	0.00	0.00	0.00	0.00	0.00	0.00	0.64
1.A.2.e. Food processing, beverages and tobacco	82.33	0.00	0.00	0.11	0.12	0.04	0.07	82.49
1.A.2.f. Non-metallic minerals	302.75	0.02	0.00	0.49	2.07	0.23	1.96	304.31
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	17.74	0.00	0.00	0.02	0.01	0.01	0.00	17.75
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	4.61	0.00	0.00	0.01	0.01	0.01	0.00	4.64
1.A.2.k. Construction	14.87	0.00	0.00	0.02	0.01	0.01	0.00	14.89
1.A.2.l. Textile and leather	51.62	0.00	0.00	0.07	0.03	0.02	0.00	51.67
1.A.2.m. Other industries	59.30	0.00	0.00	0.08	0.03	0.02	0.00	59.36
1.A.3. Transport	**2,101.30**	**0.41**	**0.12**	**8.25**	**18.35**	**2.40**	**0.01**	**2,143.31**
1.A.3.a. Domestic aviation	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.20
1.A.3.b. Road transportation	2,052.75	0.41	0.10	7.65	18.23	2.35	0.00	2,091.28
1.A.3.c. Railways	33.29	0.00	0.01	0.55	0.11	0.05	0.01	36.75
1.A.3.d. Domestic navigation	0.25	0.00	0.00	0.00	0.00	0.00	0.00	0.26
1.A.3.e. Other transportation	14.81	0.00	0.00	0.05	0.01	0.00	0.00	14.82
1.A.4. Other sectors	**1,947.94**	**1.98**	**0.08**	**3.78**	**27.76**	**3.74**	**3.35**	**2,024.94**
1.A.4.a. Commercial/institutional	471.01	0.13	0.00	0.70	1.38	0.33	1.00	475.58
1.A.4.b. Residential	1,311.51	1.83	0.02	1.39	25.13	3.21	2.33	1,367.54
1.A.4.c. Agriculture/forestry/fishing	165.42	0.03	0.06	1.69	1.25	0.20	0.02	181.82
1.A.4.ci. Stationary	10.54	0.02	0.00	0.02	0.04	0.01	0.02	11.05
1.A.4.cii. Mobile	154.88	0.01	0.06	1.67	1.21	0.19	0.00	170.77
1.A.5. Other	**2.35**	**0.00**	**0.00**	**0.04**	**0.03**	**0.00**	**0.00**	**2.39**
1.A.5.a. Stationary	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.21
1.A.5.b. Mobile	2.14	0.00	0.00	0.04	0.03	0.00	0.00	2.18
1.B. Fugitive emissions from fuels	**1.66**	**27.24**	**0.00**	**NO**	**NO**	**0.90**	**NO**	**764.49**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.66**	**27.24**	**0.00**	**NO**	**NO**	**0.90**	**NO**	**764.49**
1.B.2.a. Oil	1.29	0.35	0.00	NO	NO	0.41	NO	11.20
1.B.2.b. Natural gas	0.37	26.89			NO	0.49	NO	753.29
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**41.07**	**0.00**	**0.00**	**0.16**	**0.16**	**0.06**	**0.01**	**41.55**
1.D.1.a. Aviation	41.07	0.00	0.00	0.16	0.16	0.06	0.01	41.55
1.D.1.b. Navigation	NE	NE	NE	NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**432.75**							**432.75**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,190.75**	**31.31**	**0.24**	**19.11**	**77.65**	**11.71**	**4.53**	**9,131.98**
1.A. Fuel combustion activities (sectoral approach)	8,189.06	4.60	0.24	19.11	77.65	10.91	4.53	8,382.49
1.A.1. Energy industries	**3,555.98**	**0.08**	**0.01**	**5.71**	**2.55**	**0.18**	**0.41**	**3,560.48**
1.A.1.a. Public electricity and heat production	3,555.98	0.07	0.01	5.71	2.49	0.17	0.41	3,560.26
1.A.1.b. Petroleum refining	NO	NO	NO	NO	NO	NO	NO	NO
1.A.1.c. Manufacture of solid fuels and other energy industries	0.00	0.01	0.00	0.00	0.06	0.01	0.00	0.22
1.A.2. Manufacturing industries and construction	**562.39**	**0.03**	**0.00**	**0.86**	**1.93**	**0.33**	**1.67**	**564.08**
1.A.2.a. Iron and steel	67.40	0.00	0.00	0.09	0.04	0.03	0.00	67.46
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	6.58	0.00	0.00	0.01	0.00	0.00	0.00	6.59
1.A.2.d. Pulp, paper and print	3.81	0.00	0.00	0.01	0.00	0.00	0.00	3.81
1.A.2.e. Food processing, beverages and tobacco	92.19	0.00	0.00	0.14	0.16	0.05	0.11	92.37
1.A.2.f. Non-metallic minerals	240.79	0.02	0.00	0.40	1.64	0.18	1.55	242.03
1.A.2.g. Transport equipment	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.h. Machinery	10.90	0.00	0.00	0.01	0.01	0.00	0.00	10.91
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	2.37	0.00	0.00	0.00	0.01	0.01	0.00	2.40
1.A.2.k. Construction	23.75	0.00	0.00	0.04	0.01	0.01	0.00	23.78
1.A.2.l. Textile and leather	34.83	0.00	0.00	0.05	0.02	0.01	0.00	34.86
1.A.2.m. Other industries	79.79	0.00	0.00	0.11	0.04	0.03	0.00	79.87
1.A.3. Transport	**2,140.57**	**0.41**	**0.11**	**8.04**	**18.55**	**2.39**	**0.01**	**2,180.29**
1.A.3.a. Domestic aviation	0.14	0.00	0.00	0.00	0.00	0.00	0.00	0.14
1.A.3.b. Road transportation	2,115.96	0.40	0.11	7.93	18.53	2.39	0.00	2,155.35
1.A.3.c. Railways	2.79	0.00	0.00	0.05	0.01	0.00	0.00	3.08
1.A.3.d. Domestic navigation	2.35	0.00	0.00	0.00	0.00	0.00	0.00	2.37
1.A.3.e. Other transportation	19.33	0.00	0.00	0.06	0.02	0.00	0.00	19.35
1.A.4. Other sectors	**1,927.74**	**4.09**	**0.12**	**4.49**	**54.58**	**8.00**	**2.45**	**2,075.21**
1.A.4.a. Commercial/institutional	482.98	0.19	0.00	0.72	1.22	0.38	0.72	489.28
1.A.4.b. Residential	1,246.54	3.86	0.05	1.69	51.81	7.37	1.71	1,367.37
1.A.4.c. Agriculture/forestry/fishing	198.22	0.03	0.07	2.08	1.55	0.25	0.02	218.56
1.A.4.ci. Stationary	5.73	0.02	0.00	0.01	0.04	0.02	0.02	6.32
1.A.4.cii. Mobile	192.48	0.01	0.07	2.07	1.51	0.23	0.00	212.24
1.A.5. Other	**2.38**	**0.00**	**0.00**	**0.01**	**0.03**	**0.00**	**0.00**	**2.42**
1.A.5.a. Stationary	0.18	0.00	0.00	0.00	0.00	0.00	0.00	0.18
1.A.5.b. Mobile	2.20	0.00	0.00	0.01	0.03	0.00	0.00	2.24
1.B. Fugitive emissions from fuels	**1.69**	**26.71**	**0.00**	**NO**	**NO**	**0.81**	**NO**	**749.49**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.69**	**26.71**	**0.00**	**NO**	**NO**	**0.81**	**NO**	**749.49**
1.B.2.a. Oil	1.28	0.29	0.00	NO	NO	0.33	NO	9.36
1.B.2.b. Natural gas	0.41	26.42			NO	0.48	NO	740.13
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**53.69**	**0.00**	**0.00**	**0.21**	**0.16**	**0.06**	**0.02**	**54.25**
1.D.1.a. Aviation	53.69	0.00	0.00	0.21	0.16	0.06	0.02	54.25
1.D.1.b. Navigation	NE	NE	NE	NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**1,318.30**							**1,318.30**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,391.24**	**30.55**	**0.27**	**20.39**	**82.09**	**12.44**	**4.17**	**9,317.70**
1.A. Fuel combustion activities (sectoral approach)	8,389.56	4.89	0.27	20.39	82.09	11.70	4.17	8,597.45
1.A.1. Energy industries	**3,684.45**	**0.08**	**0.01**	**5.85**	**2.65**	**0.19**	**0.10**	**3,688.43**
1.A.1.a. Public electricity and heat production	3,680.50	0.07	0.01	5.85	2.56	0.17	0.08	3,684.10
1.A.1.b. Petroleum refining	3.95	0.00	0.00	0.01	0.00	0.00	0.02	3.96
1.A.1.c. Manufacture of solid fuels and other energy industries	0.00	0.01	0.00	0.00	0.09	0.02	0.00	0.36
1.A.2. Manufacturing industries and construction	**651.53**	**0.04**	**0.01**	**1.15**	**2.18**	**0.50**	**1.63**	**654.13**
1.A.2.a. Iron and steel	49.77	0.00	0.00	0.07	0.03	0.02	0.00	49.82
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	4.51	0.00	0.00	0.01	0.00	0.00	0.00	4.52
1.A.2.d. Pulp, paper and print	4.12	0.00	0.00	0.01	0.00	0.00	0.00	4.12
1.A.2.e. Food processing, beverages and tobacco	81.42	0.00	0.00	0.12	0.12	0.05	0.05	81.61
1.A.2.f. Non-metallic minerals	239.33	0.02	0.00	0.40	1.58	0.18	1.48	240.53
1.A.2.g. Transport equipment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.2.h. Machinery	9.39	0.00	0.00	0.01	0.01	0.00	0.00	9.40
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	0.21	0.00	0.00	0.00	0.01	0.00	0.00	0.23
1.A.2.k. Construction	13.59	0.00	0.00	0.02	0.01	0.01	0.00	13.61
1.A.2.l. Textile and leather	26.99	0.00	0.00	0.04	0.01	0.01	0.00	27.02
1.A.2.m. Other industries	222.21	0.02	0.00	0.47	0.42	0.22	0.08	223.28
1.A.3. Transport	**2,261.58**	**0.43**	**0.12**	**8.81**	**19.05**	**2.48**	**0.01**	**2,305.29**
1.A.3.a. Domestic aviation	0.31	0.00	0.00	0.00	0.00	0.00	0.00	0.31
1.A.3.b. Road transportation	2,216.77	0.43	0.11	8.38	18.96	2.44	0.00	2,258.11
1.A.3.c. Railways	22.48	0.00	0.01	0.37	0.08	0.03	0.01	24.82
1.A.3.d. Domestic navigation	2.42	0.00	0.00	0.00	0.00	0.00	0.00	2.44
1.A.3.e. Other transportation	19.59	0.00	0.00	0.06	0.02	0.00	0.00	19.61
1.A.4. Other sectors	**1,790.21**	**4.34**	**0.14**	**4.56**	**58.19**	**8.53**	**2.43**	**1,947.77**
1.A.4.a. Commercial/institutional	340.03	0.15	0.00	0.55	1.06	0.29	0.70	344.93
1.A.4.b. Residential	1,231.39	4.17	0.05	1.73	55.83	7.98	1.70	1,361.74
1.A.4.c. Agriculture/forestry/fishing	218.80	0.03	0.08	2.28	1.29	0.26	0.03	241.09
1.A.4.ci. Stationary	7.97	0.02	0.00	0.01	0.05	0.01	0.03	8.52
1.A.4.cii. Mobile	210.82	0.01	0.08	2.27	1.25	0.24	0.00	232.57
1.A.5. Other	**1.80**	**0.00**	**0.00**	**0.01**	**0.02**	**0.00**	**0.00**	**1.83**
1.A.5.a. Stationary	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.16
1.A.5.b. Mobile	1.64	0.00	0.00	0.01	0.02	0.00	0.00	1.67
1.B. Fugitive emissions from fuels	**1.68**	**25.66**	**0.00**	**NO**	**NO**	**0.75**	**NO**	**720.25**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.68**	**25.66**	**0.00**	**NO**	**NO**	**0.75**	**NO**	**720.25**
1.B.2.a. Oil	1.28	0.26	0.00	NO	NO	0.29	NO	8.43
1.B.2.b. Natural gas	0.40	25.41			NO	0.46	NO	711.82
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**58.20**	**0.01**	**0.00**	**0.23**	**0.18**	**0.08**	**0.02**	**58.86**
1.D.1.a. Aviation	56.81	0.01	0.00	0.23	0.18	0.08	0.02	57.45
1.D.1.b. Navigation	1.39	0.00	0.00	0.00	0.00	0.00	0.00	1.41
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**1,436.50**							**1,436.50**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,484.95**	**32.75**	**0.29**	**21.41**	**86.00**	**13.18**	**3.43**	**9,478.03**
1.A. Fuel combustion activities (sectoral approach)	8,483.26	5.28	0.29	21.41	86.00	12.44	3.43	8,707.08
1.A.1. Energy industries	**3,644.88**	**0.08**	**0.01**	**5.80**	**2.63**	**0.20**	**0.23**	**3,648.99**
1.A.1.a. Public electricity and heat production	3,640.85	0.07	0.01	5.79	2.52	0.17	0.21	3,644.51
1.A.1.b. Petroleum refining	4.03	0.00	0.00	0.01	0.00	0.00	0.02	4.04
1.A.1.c. Manufacture of solid fuels and other energy industries	0.00	0.02	0.00	0.00	0.11	0.03	0.00	0.45
1.A.2. Manufacturing industries and construction	**641.34**	**0.03**	**0.00**	**1.22**	**1.68**	**0.45**	**1.15**	**643.57**
1.A.2.a. Iron and steel	41.73	0.00	0.00	0.06	0.02	0.02	0.00	41.78
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	6.17	0.00	0.00	0.01	0.00	0.00	0.00	6.18
1.A.2.d. Pulp, paper and print	3.44	0.00	0.00	0.00	0.00	0.00	0.00	3.44
1.A.2.e. Food processing, beverages and tobacco	93.84	0.00	0.00	0.16	0.12	0.05	0.06	94.03
1.A.2.f. Non-metallic minerals	179.89	0.01	0.00	0.29	1.02	0.13	0.95	180.69
1.A.2.g. Transport equipment	0.62	0.00	0.00	0.00	0.00	0.00	0.00	0.62
1.A.2.h. Machinery	11.32	0.00	0.00	0.02	0.01	0.01	0.00	11.33
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.24
1.A.2.k. Construction	15.70	0.00	0.00	0.03	0.01	0.01	0.00	15.72
1.A.2.l. Textile and leather	33.62	0.00	0.00	0.05	0.02	0.01	0.00	33.66
1.A.2.m. Other industries	254.77	0.02	0.00	0.62	0.47	0.23	0.14	255.89
1.A.3. Transport	**2,428.36**	**0.50**	**0.14**	**9.85**	**19.62**	**2.57**	**0.02**	**2,478.57**
1.A.3.a. Domestic aviation	0.23	0.00	0.00	0.00	0.00	0.00	0.00	0.23
1.A.3.b. Road transportation	2,362.59	0.49	0.12	9.02	19.45	2.50	0.01	2,407.89
1.A.3.c. Railways	46.91	0.00	0.02	0.78	0.16	0.07	0.01	51.78
1.A.3.d. Domestic navigation	1.82	0.00	0.00	0.00	0.00	0.00	0.00	1.83
1.A.3.e. Other transportation	16.82	0.00	0.00	0.05	0.01	0.00	0.00	16.84
1.A.4. Other sectors	**1,767.49**	**4.66**	**0.14**	**4.53**	**62.05**	**9.22**	**2.03**	**1,934.72**
1.A.4.a. Commercial/institutional	338.36	0.13	0.00	0.52	1.03	0.27	0.70	342.66
1.A.4.b. Residential	1,218.49	4.50	0.06	1.79	60.00	8.70	1.31	1,359.71
1.A.4.c. Agriculture/forestry/fishing	210.64	0.04	0.08	2.22	1.02	0.25	0.03	232.35
1.A.4.ci. Stationary	7.81	0.02	0.00	0.02	0.06	0.02	0.03	8.54
1.A.4.cii. Mobile	202.82	0.01	0.08	2.21	0.96	0.23	0.00	223.81
1.A.5. Other	**1.20**	**0.00**	**0.00**	**0.01**	**0.01**	**0.00**	**0.00**	**1.22**
1.A.5.a. Stationary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b. Mobile	1.20	0.00	0.00	0.01	0.01	0.00	0.00	1.22
1.B. Fugitive emissions from fuels	**1.69**	**27.47**	**0.00**	**NO**	**NO**	**0.74**	**NO**	**770.95**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.69**	**27.47**	**0.00**	**NO**	**NO**	**0.74**	**NO**	**770.95**
1.B.2.a. Oil	1.28	0.22	0.00	NO	NO	0.25	NO	7.51
1.B.2.b. Natural gas	0.41	27.25			NO	0.49	NO	763.44
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**102.91**	**0.01**	**0.00**	**0.41**	**0.27**	**0.11**	**0.03**	**103.98**
1.D.1.a. Aviation	100.97	0.01	0.00	0.41	0.27	0.11	0.03	102.02
1.D.1.b. Navigation	1.94	0.00	0.00	0.00	0.00	0.00	0.00	1.96
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**1,609.80**							**1,609.80**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,070.00**	**35.71**	**0.33**	**21.69**	**108.10**	**16.39**	**4.31**	**9,158.19**
1.A. Fuel combustion activities (sectoral approach)	8,068.33	6.97	0.33	21.69	108.10	15.67	4.31	8,351.62
1.A.1. Energy industries	**2,996.52**	**0.07**	**0.01**	**4.77**	**2.19**	**0.16**	**0.05**	**2,999.89**
1.A.1.a. Public electricity and heat production	2,992.67	0.05	0.01	4.77	2.09	0.14	0.03	2,995.63
1.A.1.b. Petroleum refining	3.85	0.00	0.00	0.01	0.00	0.00	0.01	3.87
1.A.1.c. Manufacture of solid fuels and other energy industries	0.00	0.01	0.00	0.00	0.10	0.02	0.00	0.39
1.A.2. Manufacturing industries and construction	**658.71**	**0.04**	**0.01**	**1.38**	**1.79**	**0.46**	**1.27**	**661.07**
1.A.2.a. Iron and steel	60.45	0.00	0.00	0.08	0.03	0.02	0.00	60.51
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	4.89	0.00	0.00	0.01	0.00	0.00	0.00	4.90
1.A.2.d. Pulp, paper and print	1.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00
1.A.2.e. Food processing, beverages and tobacco	91.65	0.00	0.00	0.14	0.11	0.05	0.05	91.83
1.A.2.f. Non-metallic minerals	230.43	0.01	0.00	0.54	1.15	0.15	1.07	231.41
1.A.2.g. Transport equipment	0.11	0.00	0.00	0.00	0.00	0.00	0.00	0.11
1.A.2.h. Machinery	10.10	0.00	0.00	0.01	0.01	0.00	0.00	10.12
1.A.2.i. Mining and quarrying	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.j. Wood and wood production	0.26	0.00	0.00	0.00	0.00	0.00	0.00	0.26
1.A.2.k. Construction	14.31	0.00	0.00	0.03	0.01	0.01	0.00	14.33
1.A.2.l. Textile and leather	25.02	0.00	0.00	0.03	0.01	0.01	0.00	25.05
1.A.2.m. Other industries	220.49	0.02	0.00	0.53	0.46	0.21	0.14	221.55
1.A.3. Transport	**2,451.25**	**0.48**	**0.14**	**9.82**	**19.04**	**2.50**	**0.01**	**2,500.58**
1.A.3.a. Domestic aviation	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.59
1.A.3.b. Road transportation	2,390.48	0.48	0.12	9.13	18.90	2.44	0.01	2,435.84
1.A.3.c. Railways	37.86	0.00	0.01	0.63	0.13	0.06	0.01	41.80
1.A.3.d. Domestic navigation	1.73	0.00	0.00	0.00	0.00	0.00	0.00	1.75
1.A.3.e. Other transportation	20.59	0.00	0.00	0.06	0.02	0.00	0.00	20.61
1.A.4. Other sectors	**1,960.70**	**6.38**	**0.19**	**5.71**	**85.07**	**12.55**	**2.99**	**2,188.91**
1.A.4.a. Commercial/institutional	335.09	0.18	0.00	0.53	1.14	0.32	0.71	341.04
1.A.4.b. Residential	1,338.52	6.15	0.08	2.14	82.59	11.88	2.23	1,531.20
1.A.4.c. Agriculture/forestry/fishing	287.08	0.05	0.11	3.03	1.34	0.34	0.05	316.67
1.A.4.ci. Stationary	9.97	0.03	0.00	0.02	0.08	0.02	0.04	10.87
1.A.4.cii. Mobile	277.11	0.02	0.11	3.01	1.27	0.32	0.00	305.80
1.A.5. Other	**1.15**	**0.00**	**0.00**	**0.01**	**0.01**	**0.00**	**0.00**	**1.17**
1.A.5.a. Stationary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b. Mobile	1.15	0.00	0.00	0.01	0.01	0.00	0.00	1.17
1.B. Fugitive emissions from fuels	**1.68**	**28.75**	**0.00**	**NO**	**NO**	**0.73**	**NO**	**806.57**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.68**	**28.75**	**0.00**	**NO**	**NO**	**0.73**	**NO**	**806.57**
1.B.2.a. Oil	1.27	0.19	0.00	NO	NO	0.21	NO	6.59
1.B.2.b. Natural gas	0.40	28.56			NO	0.52	NO	799.98
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**151.25**	**0.01**	**0.00**	**0.58**	**0.35**	**0.14**	**0.05**	**152.71**
1.D.1.a. Aviation	148.28	0.01	0.00	0.58	0.35	0.14	0.05	149.71
1.D.1.b. Navigation	2.97	0.00	0.00	0.00	0.00	0.00	0.00	3.00
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**2,129.55**							**2,129.55**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,482.65**	**37.76**	**0.38**	**23.03**	**157.08**	**23.91**	**3.54**	**9,641.29**
1.A. Fuel combustion activities (sectoral approach)	8,480.96	10.65	0.38	23.03	157.08	23.22	3.54	8,880.51
1.A.1. Energy industries	**3,255.38**	**0.07**	**0.01**	**5.20**	**2.37**	**0.17**	**0.06**	**3,258.96**
1.A.1.a. Public electricity and heat production	3,252.31	0.06	0.01	5.19	2.28	0.15	0.04	3,255.55
1.A.1.b. Petroleum refining	3.06	0.00	0.00	0.00	0.00	0.00	0.01	3.07
1.A.1.c. Manufacture of solid fuels and other energy industries	0.00	0.01	0.00	0.00	0.08	0.02	0.00	0.34
1.A.2. Manufacturing industries and construction	**748.59**	**0.04**	**0.01**	**1.66**	**1.73**	**0.53**	**1.08**	**751.30**
1.A.2.a. Iron and steel	65.70	0.00	0.00	0.09	0.04	0.03	0.00	65.76
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	6.28	0.00	0.00	0.01	0.01	0.00	0.00	6.29
1.A.2.d. Pulp, paper and print	3.07	0.00	0.00	0.00	0.00	0.00	0.00	3.08
1.A.2.e. Food processing, beverages and tobacco	103.45	0.00	0.00	0.15	0.14	0.06	0.06	103.68
1.A.2.f. Non-metallic minerals	292.01	0.01	0.00	0.84	0.99	0.15	0.89	293.00
1.A.2.g. Transport equipment	0.39	0.00	0.00	0.00	0.00	0.00	0.00	0.39
1.A.2.h. Machinery	11.38	0.00	0.00	0.02	0.01	0.00	0.00	11.39
1.A.2.i. Mining and quarrying	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.06
1.A.2.j. Wood and wood production	0.27	0.00	0.00	0.00	0.00	0.00	0.00	0.28
1.A.2.k. Construction	16.05	0.00	0.00	0.03	0.01	0.01	0.00	16.07
1.A.2.l. Textile and leather	27.31	0.00	0.00	0.04	0.02	0.01	0.00	27.34
1.A.2.m. Other industries	222.63	0.02	0.00	0.49	0.53	0.26	0.12	223.96
1.A.3. Transport	**2,529.58**	**0.50**	**0.13**	**9.81**	**19.87**	**2.58**	**0.01**	**2,579.00**
1.A.3.a. Domestic aviation	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.15
1.A.3.b. Road transportation	2,489.25	0.50	0.13	9.41	19.79	2.55	0.01	2,536.51
1.A.3.c. Railways	20.49	0.00	0.01	0.34	0.07	0.03	0.01	22.62
1.A.3.d. Domestic navigation	1.56	0.00	0.00	0.00	0.00	0.00	0.00	1.58
1.A.3.e. Other transportation	18.12	0.00	0.00	0.06	0.01	0.00	0.00	18.14
1.A.4. Other sectors	**1,946.25**	**10.03**	**0.24**	**6.35**	**133.09**	**19.94**	**2.40**	**2,290.05**
1.A.4.a. Commercial/institutional	343.46	0.18	0.00	0.54	1.13	0.33	0.69	349.48
1.A.4.b. Residential	1,316.60	9.81	0.13	2.75	130.79	19.27	1.67	1,624.99
1.A.4.c. Agriculture/forestry/fishing	286.19	0.04	0.11	3.06	1.17	0.34	0.04	315.58
1.A.4.ci. Stationary	10.96	0.03	0.00	0.02	0.07	0.02	0.04	11.80
1.A.4.cii. Mobile	275.23	0.02	0.11	3.04	1.10	0.32	0.00	303.78
1.A.5. Other	**1.17**	**0.00**	**0.00**	**0.01**	**0.02**	**0.00**	**0.00**	**1.19**
1.A.5.a. Stationary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b. Mobile	1.17	0.00	0.00	0.01	0.02	0.00	0.00	1.19
1.B. Fugitive emissions from fuels	**1.69**	**27.11**	**0.00**	**NO**	**NO**	**0.69**	**NO**	**760.78**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.69**	**27.11**	**0.00**	**NO**	**NO**	**0.69**	**NO**	**760.78**
1.B.2.a. Oil	1.27	0.19	0.00	NO	NO	0.21	NO	6.59
1.B.2.b. Natural gas	0.41	26.92			NO	0.49	NO	754.19
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**171.99**	**0.01**	**0.01**	**0.65**	**0.51**	**0.15**	**0.05**	**173.73**
1.D.1.a. Aviation	170.41	0.01	0.01	0.65	0.51	0.15	0.05	172.13
1.D.1.b. Navigation	1.58	0.00	0.00	0.00	0.00	0.00	0.00	1.60
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**3,588.77**							**3,588.77**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,560.27**	**28.17**	**0.38**	**23.30**	**141.58**	**21.18**	**4.30**	**9,450.40**
1.A. Fuel combustion activities (sectoral approach)	8,558.64	9.37	0.38	23.30	141.58	20.65	4.30	8,922.30
1.A.1. Energy industries	**3,124.41**	**0.07**	**0.01**	**4.98**	**2.29**	**0.17**	**0.05**	**3,127.91**
1.A.1.a. Public electricity and heat production	3,123.09	0.06	0.01	4.98	2.19	0.15	0.04	3,126.16
1.A.1.b. Petroleum refining	1.33	0.00	0.00	0.00	0.00	0.00	0.01	1.33
1.A.1.c. Manufacture of solid fuels and other energy industries	0.00	0.02	0.00	0.00	0.11	0.03	0.00	0.42
1.A.2. Manufacturing industries and construction	**715.94**	**0.04**	**0.01**	**1.56**	**1.53**	**0.48**	**0.92**	**718.39**
1.A.2.a. Iron and steel	54.50	0.00	0.00	0.07	0.03	0.02	0.00	54.55
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	7.05	0.00	0.00	0.01	0.00	0.00	0.00	7.06
1.A.2.d. Pulp, paper and print	3.16	0.00	0.00	0.00	0.00	0.00	0.00	3.17
1.A.2.e. Food processing, beverages and tobacco	92.25	0.00	0.00	0.13	0.09	0.04	0.04	92.39
1.A.2.f. Non-metallic minerals	281.48	0.01	0.00	0.85	0.95	0.14	0.86	282.45
1.A.2.g. Transport equipment	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.79
1.A.2.h. Machinery	14.27	0.00	0.00	0.02	0.01	0.01	0.00	14.28
1.A.2.i. Mining and quarrying	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.28
1.A.2.j. Wood and wood production	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.28
1.A.2.k. Construction	16.95	0.00	0.00	0.04	0.01	0.01	0.00	16.97
1.A.2.l. Textile and leather	35.07	0.00	0.00	0.05	0.02	0.01	0.00	35.10
1.A.2.m. Other industries	209.89	0.02	0.00	0.39	0.41	0.24	0.02	211.08
1.A.3. Transport	**2,611.55**	**0.50**	**0.14**	**10.17**	**20.57**	**2.68**	**0.01**	**2,662.34**
1.A.3.a. Domestic aviation	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.29
1.A.3.b. Road transportation	2,567.74	0.50	0.13	9.69	20.47	2.64	0.01	2,615.94
1.A.3.c. Railways	24.53	0.00	0.01	0.43	0.09	0.04	0.01	27.07
1.A.3.d. Domestic navigation	1.83	0.00	0.00	0.00	0.00	0.00	0.00	1.84
1.A.3.e. Other transportation	17.18	0.00	0.00	0.05	0.01	0.00	0.00	17.20
1.A.4. Other sectors	**2,105.50**	**8.76**	**0.23**	**6.58**	**117.16**	**17.31**	**3.32**	**2,412.41**
1.A.4.a. Commercial/institutional	331.32	0.16	0.00	0.51	1.03	0.31	0.62	336.74
1.A.4.b. Residential	1,448.82	8.55	0.11	2.63	114.78	16.63	2.66	1,716.96
1.A.4.c. Agriculture/forestry/fishing	325.35	0.05	0.12	3.44	1.35	0.37	0.04	358.70
1.A.4.ci. Stationary	11.83	0.03	0.00	0.02	0.07	0.02	0.04	12.67
1.A.4.cii. Mobile	313.52	0.02	0.12	3.41	1.28	0.35	0.00	346.03
1.A.5. Other	**1.23**	**0.00**	**0.00**	**0.01**	**0.02**	**0.00**	**0.00**	**1.25**
1.A.5.a. Stationary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b. Mobile	1.23	0.00	0.00	0.01	0.02	0.00	0.00	1.25
1.B. Fugitive emissions from fuels	**1.63**	**18.80**	**0.00**	**NO**	**NO**	**0.54**	**NO**	**528.10**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.63**	**18.80**	**0.00**	**NO**	**NO**	**0.54**	**NO**	**528.10**
1.B.2.a. Oil	1.27	0.19	0.00	NO	NO	0.21	NO	6.58
1.B.2.b. Natural gas	0.36	18.61			NO	0.33	NO	521.52
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**153.18**	**0.01**	**0.01**	**0.62**	**0.42**	**0.12**	**0.05**	**154.71**
1.D.1.a. Aviation	151.50	0.01	0.01	0.62	0.42	0.12	0.05	153.02
1.D.1.b. Navigation	1.67	0.00	0.00	0.00	0.00	0.00	0.00	1.69
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**2,984.40**							**2,984.40**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,842.15**	**18.80**	**0.37**	**23.44**	**136.21**	**20.43**	**3.33**	**9,466.98**
1.A. Fuel combustion activities (sectoral approach)	8,840.57	9.09	0.37	23.44	136.21	20.02	3.33	9,193.48
1.A.1. Energy industries	**3,634.38**	**0.08**	**0.01**	**5.80**	**2.65**	**0.20**	**0.04**	**3,638.38**
1.A.1.a. Public electricity and heat production	3,632.82	0.07	0.01	5.79	2.55	0.17	0.03	3,636.39
1.A.1.b. Petroleum refining	1.56	0.00	0.00	0.00	0.00	0.00	0.00	1.57
1.A.1.c. Manufacture of solid fuels and other energy industries	0.00	0.02	0.00	0.00	0.11	0.03	0.00	0.42
1.A.2. Manufacturing industries and construction	**692.66**	**0.04**	**0.00**	**1.38**	**1.37**	**0.46**	**0.78**	**694.91**
1.A.2.a. Iron and steel	62.88	0.00	0.00	0.08	0.03	0.03	0.00	62.94
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	10.50	0.00	0.00	0.01	0.01	0.00	0.00	10.52
1.A.2.d. Pulp, paper and print	3.24	0.00	0.00	0.00	0.00	0.00	0.00	3.24
1.A.2.e. Food processing, beverages and tobacco	83.54	0.00	0.00	0.11	0.07	0.04	0.03	83.66
1.A.2.f. Non-metallic minerals	260.65	0.01	0.00	0.73	0.82	0.13	0.73	261.49
1.A.2.g. Transport equipment	0.79	0.00	0.00	0.00	0.00	0.00	0.00	0.79
1.A.2.h. Machinery	11.69	0.00	0.00	0.02	0.01	0.00	0.00	11.70
1.A.2.i. Mining and quarrying	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.22
1.A.2.j. Wood and wood production	0.06	0.00	0.00	0.00	0.00	0.00	0.00	0.08
1.A.2.k. Construction	13.69	0.00	0.00	0.03	0.01	0.01	0.00	13.71
1.A.2.l. Textile and leather	31.99	0.00	0.00	0.04	0.02	0.01	0.00	32.02
1.A.2.m. Other industries	213.40	0.02	0.00	0.35	0.39	0.23	0.02	214.53
1.A.3. Transport	**2,462.27**	**0.44**	**0.13**	**9.75**	**18.40**	**2.41**	**0.01**	**2,508.94**
1.A.3.a. Domestic aviation	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.07
1.A.3.b. Road transportation	2,431.00	0.43	0.12	9.41	18.33	2.39	0.01	2,475.68
1.A.3.c. Railways	19.04	0.00	0.01	0.30	0.06	0.03	0.00	21.02
1.A.3.d. Domestic navigation	0.61	0.00	0.00	0.00	0.00	0.00	0.00	0.62
1.A.3.e. Other transportation	11.55	0.00	0.00	0.04	0.01	0.00	0.00	11.56
1.A.4. Other sectors	**2,050.09**	**8.53**	**0.23**	**6.50**	**113.77**	**16.95**	**2.51**	**2,350.07**
1.A.4.a. Commercial/institutional	296.71	0.14	0.00	0.46	0.92	0.27	0.57	301.35
1.A.4.b. Residential	1,429.86	8.34	0.11	2.61	111.43	16.30	1.90	1,691.95
1.A.4.c. Agriculture/forestry/fishing	323.53	0.05	0.12	3.44	1.42	0.38	0.05	356.78
1.A.4.ci. Stationary	12.80	0.03	0.00	0.03	0.09	0.03	0.05	13.85
1.A.4.cii. Mobile	310.72	0.02	0.12	3.42	1.33	0.36	0.00	342.92
1.A.5. Other	**1.16**	**0.00**	**0.00**	**0.01**	**0.02**	**0.00**	**0.00**	**1.19**
1.A.5.a. Stationary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b. Mobile	1.16	0.00	0.00	0.01	0.02	0.00	0.00	1.19
1.B. Fugitive emissions from fuels	**1.58**	**9.71**	**0.00**	**NO**	**NO**	**0.40**	**NO**	**273.49**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.58**	**9.71**	**0.00**	**NO**	**NO**	**0.40**	**NO**	**273.49**
1.B.2.a. Oil	1.27	0.22	0.00	NO	NO	0.25	NO	7.50
1.B.2.b. Natural gas	0.31	9.49			NO	0.16	NO	265.99
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**41.40**	**0.00**	**0.00**	**0.12**	**0.05**	**0.02**	**0.02**	**41.73**
1.D.1.a. Aviation	35.25	0.00	0.00	0.12	0.05	0.02	0.02	35.52
1.D.1.b. Navigation	6.15	0.00	0.00	0.00	0.00	0.00	0.00	6.21
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**2,992.97**							**2,992.97**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**9,817.04**	**18.99**	**0.42**	**26.56**	**138.38**	**20.67**	**5.90**	**10,460.91**
1.A. Fuel combustion activities (sectoral approach)	9,815.46	9.11	0.42	26.56	138.38	20.31	5.90	10,182.87
1.A.1. Energy industries	**3,931.09**	**0.09**	**0.01**	**6.40**	**2.72**	**0.20**	**2.08**	**3,936.22**
1.A.1.a. Public electricity and heat production	3,930.30	0.07	0.01	6.40	2.61	0.18	2.08	3,934.97
1.A.1.b. Petroleum refining	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.80
1.A.1.c. Manufacture of solid fuels and other energy industries	0.00	0.02	0.00	0.00	0.11	0.03	0.00	0.45
1.A.2. Manufacturing industries and construction	**755.19**	**0.04**	**0.01**	**1.48**	**1.84**	**0.55**	**1.14**	**757.79**
1.A.2.a. Iron and steel	71.78	0.00	0.00	0.10	0.04	0.03	0.00	71.85
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	9.50	0.00	0.00	0.01	0.01	0.00	0.00	9.51
1.A.2.d. Pulp, paper and print	3.10	0.00	0.00	0.00	0.00	0.00	0.00	3.10
1.A.2.e. Food processing, beverages and tobacco	90.41	0.00	0.00	0.13	0.15	0.07	0.04	90.54
1.A.2.f. Non-metallic minerals	280.72	0.02	0.00	0.68	1.17	0.16	1.07	281.77
1.A.2.g. Transport equipment	0.45	0.00	0.00	0.00	0.00	0.00	0.00	0.45
1.A.2.h. Machinery	13.70	0.00	0.00	0.02	0.01	0.01	0.00	13.72
1.A.2.i. Mining and quarrying	0.34	0.00	0.00	0.00	0.00	0.00	0.00	0.34
1.A.2.j. Wood and wood production	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.21
1.A.2.k. Construction	13.53	0.00	0.00	0.03	0.01	0.01	0.00	13.55
1.A.2.l. Textile and leather	34.98	0.00	0.00	0.05	0.02	0.01	0.00	35.02
1.A.2.m. Other industries	236.49	0.02	0.00	0.46	0.43	0.25	0.03	237.74
1.A.3. Transport	**2,721.37**	**0.58**	**0.14**	**10.93**	**21.79**	**2.81**	**0.01**	**2,775.47**
1.A.3.a. Domestic aviation	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.07
1.A.3.b. Road transportation	2,702.84	0.58	0.14	10.62	21.72	2.79	0.01	2,755.24
1.A.3.c. Railways	16.39	0.00	0.01	0.30	0.06	0.03	0.00	18.09
1.A.3.d. Domestic navigation	0.35	0.00	0.00	0.00	0.00	0.00	0.00	0.35
1.A.3.e. Other transportation	1.72	0.00	0.00	0.01	0.00	0.00	0.00	1.72
1.A.4. Other sectors	**2,406.24**	**8.41**	**0.26**	**7.73**	**112.01**	**16.74**	**2.66**	**2,711.79**
1.A.4.a. Commercial/institutional	342.15	0.15	0.00	0.52	1.00	0.30	0.61	347.26
1.A.4.b. Residential	1,638.20	8.19	0.11	2.76	109.27	15.95	1.98	1,895.34
1.A.4.c. Agriculture/forestry/fishing	425.89	0.07	0.16	4.44	1.74	0.49	0.07	469.18
1.A.4.ci. Stationary	20.61	0.04	0.00	0.04	0.11	0.03	0.07	21.88
1.A.4.cii. Mobile	405.28	0.02	0.16	4.41	1.62	0.46	0.00	447.30
1.A.5. Other	**1.57**	**0.00**	**0.00**	**0.01**	**0.02**	**0.00**	**0.00**	**1.60**
1.A.5.a. Stationary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b. Mobile	1.57	0.00	0.00	0.01	0.02	0.00	0.00	1.60
1.B. Fugitive emissions from fuels	**1.58**	**9.87**	**0.00**	**NO**	**NO**	**0.36**	**NO**	**278.04**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.58**	**9.87**	**0.00**	**NO**	**NO**	**0.36**	**NO**	**278.04**
1.B.2.a. Oil	1.26	0.19	0.00	NO	NO	0.21	NO	6.58
1.B.2.b. Natural gas	0.31	9.68			NO	0.16	NO	271.46
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**160.01**	**0.01**	**0.01**	**0.62**	**0.42**	**0.12**	**0.05**	**161.61**
1.D.1.a. Aviation	151.50	0.01	0.01	0.62	0.42	0.12	0.05	153.02
1.D.1.b. Navigation	8.51	0.00	0.00	0.00	0.00	0.00	0.00	8.60
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**2,904.28**							**2,904.28**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
Total Energy	**8,705.13**	**15.88**	**0.38**	**24.22**	**116.11**	**17.50**	**4.16**	**9,249.65**
1.A. Fuel combustion activities (sectoral approach)	8,703.60	7.56	0.38	24.22	116.11	17.16	4.16	9,014.96
1.A.1. Energy industries	**3,341.56**	**0.09**	**0.01**	**5.38**	**2.39**	**0.19**	**1.38**	**3,345.93**
1.A.1.a. Public electricity and heat production	3,340.76	0.06	0.01	5.38	2.24	0.15	1.38	3,344.52
1.A.1.b. Petroleum refining	0.80	0.00	0.00	0.00	0.00	0.00	0.00	0.80
1.A.1.c. Manufacture of solid fuels and other energy industries	0.00	0.02	0.00	0.00	0.15	0.04	0.00	0.62
1.A.2. Manufacturing industries and construction	**669.56**	**0.04**	**0.01**	**1.57**	**1.23**	**0.53**	**0.46**	**672.30**
1.A.2.a. Iron and steel	75.21	0.00	0.00	0.10	0.04	0.03	0.00	75.28
1.A.2.b. Non-ferrous metals	NO	NO	NO	NO	NO	NO	NO	NO
1.A.2.c. Chemicals	7.96	0.00	0.00	0.01	0.00	0.00	0.00	7.97
1.A.2.d. Pulp, paper and print	3.19	0.00	0.00	0.00	0.00	0.00	0.00	3.19
1.A.2.e. Food processing, beverages and tobacco	77.16	0.00	0.00	0.11	0.08	0.04	0.04	77.28
1.A.2.f. Non-metallic minerals	227.21	0.01	0.00	0.69	0.45	0.10	0.37	227.79
1.A.2.g. Transport equipment	0.56	0.00	0.00	0.00	0.00	0.00	0.00	0.56
1.A.2.h. Machinery	13.08	0.00	0.00	0.02	0.01	0.01	0.00	13.10
1.A.2.i. Mining and quarrying	0.28	0.00	0.00	0.00	0.00	0.00	0.00	0.28
1.A.2.j. Wood and wood production	0.21	0.00	0.00	0.00	0.00	0.00	0.00	0.21
1.A.2.k. Construction	12.86	0.00	0.00	0.02	0.01	0.01	0.00	12.88
1.A.2.l. Textile and leather	36.29	0.00	0.00	0.05	0.02	0.01	0.00	36.32
1.A.2.m. Other industries	215.54	0.03	0.00	0.57	0.61	0.34	0.05	217.43
1.A.3. Transport	**2,724.89**	**0.49**	**0.14**	**10.82**	**20.28**	**2.65**	**0.01**	**2,776.78**
1.A.3.a. Domestic aviation	0.07	0.00	0.00	0.00	0.00	0.00	0.00	0.07
1.A.3.b. Road transportation	2,705.33	0.49	0.14	10.51	20.22	2.62	0.01	2,755.25
1.A.3.c. Railways	18.92	0.00	0.01	0.31	0.06	0.03	0.00	20.88
1.A.3.d. Domestic navigation	0.17	0.00	0.00	0.00	0.00	0.00	0.00	0.18
1.A.3.e. Other transportation	0.40	0.00	0.00	0.00	0.00	0.00	0.00	0.40
1.A.4. Other sectors	**1,964.95**	**6.93**	**0.22**	**6.43**	**92.18**	**13.78**	**2.31**	**2,217.25**
1.A.4.a. Commercial/institutional	299.05	0.15	0.00	0.47	0.94	0.28	0.56	304.12
1.A.4.b. Residential	1,305.36	6.72	0.09	2.23	89.72	13.09	1.66	1,516.27
1.A.4.c. Agriculture/forestry/fishing	360.55	0.06	0.13	3.74	1.53	0.41	0.09	396.86
1.A.4.ci. Stationary	22.57	0.04	0.00	0.04	0.12	0.03	0.09	23.87
1.A.4.cii. Mobile	337.98	0.02	0.13	3.70	1.41	0.39	0.00	372.98
1.A.5. Other	**2.64**	**0.00**	**0.00**	**0.02**	**0.03**	**0.00**	**0.00**	**2.70**
1.A.5.a. Stationary	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1.A.5.b. Mobile	2.64	0.00	0.00	0.02	0.03	0.00	0.00	2.70
1.B. Fugitive emissions from fuels	**1.52**	**8.33**	**0.00**	**NO**	**NO**	**0.34**	**NO**	**234.70**
1.B.1. Solid fuels	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.B.1.a. Coal mining and handling	NO	NO	NO	NO	NO	NO		NO
1.B.1.b. Fuel transformation	NO	NO	NO	NO	NO	NO	NO	NO
1.B.1.c. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	**1.52**	**8.33**	**0.00**	**NO**	**NO**	**0.34**	**NO**	**234.70**
1.B.2.a. Oil	1.26	0.19	0.00	NO	NO	0.21	NO	6.58
1.B.2.b. Natural gas	0.26	8.14			NO	0.13	NO	228.12
1.B.2.c. Venting and flaring	NO	NO	NO	NO	NO	NO	NO	NO
1.B.2.d. Other	NO	NO	NO	NO	NO	NO	NO	NO
1.C. CO_2 Transport and storage	**NO**							**NO**
1.C.1. Transport of CO_2	NO							NO
1.C.2. Injection and storage	NO							NO
1.C.3. Other	NO							NO
1.D. Memo items: [3]								
1.D.1. International bunkers	**145.60**	**0.00**	**0.00**	**0.59**	**0.33**	**0.09**	**0.05**	**146.96**
1.D.1.a. Aviation	142.05	0.00	0.00	0.59	0.33	0.09	0.05	143.37
1.D.1.b. Navigation	3.56	0.00	0.00	0.00	0.00	0.00	0.00	3.59
1.D.2. Multilateral operations	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**
1.D.3. CO_2 emissions from biomass	**2,429.50**							**2,429.50**
1.D.4. CO_2 captured	**NO**							**NO**
1.D.4.a. For domestic storage	NO							NO
1.D.4.b. For storage in other countries	NO							NO

Annex 6-2. Sectoral Report for Sector 2 'Industrial Processes and Product Use', 1990-2022

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	1,605.22	NO	0.00	NO	NO	NO	NO	NO	3.76	5.49	106.55	1.38	1,605.24
2.A. Mineral industry	1,338.96								3.60	3.44	0.03	1.32	1,338.96
2.A.1. Cement production	971.70								2.24	2.62	0.03	0.67	971.70
2.A.2. Lime production	264.31								0.49	0.69		0.11	264.31
2.A.3. Glass production	27.49								0.76		0.00	0.51	27.49
2.A.4. Other process uses of carbonates	75.46								0.12	0.13		0.03	75.46
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.06	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.06	NO	NO
2.C. Metal industry	28.50	NO	NO	NO	NO	NO	NO	NO	0.09	1.21	0.04	0.04	28.50
2.C.1. Iron and steel production	28.50	NO							0.09	1.21	0.04	0.04	28.50
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	234.36	NO	NO						0.04	0.24	92.79	0.02	234.36
2.D.1. Lubricant use	24.80	NO	NO						NO	NO	NO	NO	24.80
2.D.2. Paraffin wax use	0.11	NO	NO						NO	NO	NO	NO	0.11
2.D.3. Solvent use	204.15	NO	NO						0.04	0.24	92.79	0.02	204.15
2.D.4. Other	5.30	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.30
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO

2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO					NO
2.F.1. Refrigeration and air conditioning				NO	NO	NO	NO	NO					NO
2.F.2. Foam blowing agents				NO	NO	NO	NO	NO					NO
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	3.40	NO	0.00	NO	NO	NO	NO	NO	0.02	0.60	1.55	NO	3.42
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.02
2.G.4. Other	3.40	NO	NO	NO	NO	NO	NO	NO	0.02	0.60	1.55	NO	3.40
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	12.08	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	12.08	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	1,411.27	NO	0.00	NO	NO	NO	NO	NO	3.44	4.90	87.89	1.30	1,411.29
2.A. Mineral industry	1,190.16								3.30	3.04	0.03	1.24	1,190.16
2.A.1. Cement production	900.79								2.07	2.42	0.03	0.62	900.79
2.A.2. Lime production	192.23								0.35	0.50		0.08	192.23
2.A.3. Glass production	27.19								0.77		0.00	0.51	27.19
2.A.4. Other process uses of carbonates	69.96								0.11	0.12		0.02	69.96
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.05	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO

2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.05	NO	NO
2.C. Metal industry	24.73	NO	NO	NO	NO	NO	NO	NO	0.08	1.05	0.03	0.04	24.73
2.C.1. Iron and steel production	24.73	NO							0.08	1.05	0.03	0.04	24.73
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	193.32	NO	NO						0.04	0.20	76.26	0.02	193.32
2.D.1. Lubricant use	20.76	NO	NO						NO	NO	NO	NO	20.76
2.D.2. Paraffin wax use	0.10	NO	NO						NO	NO	NO	NO	0.10
2.D.3. Solvent use	167.78	NO	NO						0.04	0.20	76.26	0.02	167.78
2.D.4. Other	4.68	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.68
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO					NO
2.F.1. Refrigeration and air conditioning				NO	NO	NO	NO	NO					NO
2.F.2. Foam blowing agents				NO	NO	NO	NO	NO					NO
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	3.06	NO	0.00	NO	NO	NO	NO	NO	0.02	0.61	1.39	NO	3.08
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.01
2.G.4. Other	3.06	NO	NO	NO	NO	NO	NO	NO	0.02	0.61	1.39	NO	3.06
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	10.11	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	10.11	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	822.46	NO	0.00	NO	NO	NO	NO	NO	1.85	3.40	72.18	0.68	822.47
2.A. Mineral industry	641.79								1.73	1.65	0.02	0.63	641.79
2.A.1. Cement production	474.31								1.09	1.28	0.02	0.33	474.31
2.A.2. Lime production	116.16								0.21	0.30		0.05	116.16
2.A.3. Glass production	13.53								0.36		0.00	0.24	13.53
2.A.4. Other process uses of carbonates	37.79								0.06	0.06		0.01	37.79
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	23.99	NO	NO	NO	NO	NO	NO	NO	0.08	1.02	0.03	0.04	23.99
2.C.1. Iron and steel production	23.99	NO							0.08	1.02	0.03	0.04	23.99
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	154.26	NO	NO						0.03	0.17	62.97	0.02	154.26
2.D.1. Lubricant use	12.11	NO	NO						NO	NO	NO	NO	12.11
2.D.2. Paraffin wax use	0.06	NO	NO						NO	NO	NO	NO	0.06
2.D.3. Solvent use	138.52	NO	NO						0.03	0.17	62.97	0.02	138.52
2.D.4. Other	3.57	NO	NO						NO	NO	NO	NO	3.57
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO					NO
2.F.1. Refrigeration and air conditioning				NO	NO	NO	NO	NO					NO
2.F.2. Foam blowing agents				NO	NO	NO	NO	NO					NO
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	2.41	NO	0.00	NO	NO	NO	NO	NO	0.02	0.57	1.10	NO	2.43
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.01
2.G.4. Other	2.41	NO	NO	NO	NO	NO	NO	NO	0.02	0.57	1.10	NO	2.41
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	8.05	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	8.05	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
2. Total industrial processes	737.86	NO	0.00	NO	NO	NO	NO	NO	1.76	3.24	60.28	0.67	737.88
2.A. Mineral industry	587.58								1.64	1.49	0.01	0.62	587.58
2.A.1. Cement production	405.72								0.93	1.09	0.01	0.28	405.72
2.A.2. Lime production	112.79								0.21	0.29		0.05	112.79
2.A.3. Glass production	12.20								0.40		0.00	0.27	12.20
2.A.4. Other process uses of carbonates	56.88								0.09	0.10		0.02	56.88
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	24.42	NO	NO	NO	NO	NO	NO	NO	0.08	1.04	0.03	0.04	24.42
2.C.1. Iron and steel production	24.42	NO							0.08	1.04	0.03	0.04	24.42
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	123.88	NO	NO						0.02	0.14	50.10	0.01	123.88
2.D.1. Lubricant use	10.96	NO	NO						NO	NO	NO	NO	10.96
2.D.2. Paraffin wax use	0.05	NO	NO						NO	NO	NO	NO	0.05
2.D.3. Solvent use	110.22	NO	NO						0.02	0.14	50.10	0.01	110.22
2.D.4. Other	2.65	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2.65
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO					NO
2.F.1. Refrigeration and air conditioning				NO	NO	NO	NO	NO					NO
2.F.2. Foam blowing agents				NO	NO	NO	NO	NO					NO
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.98	NO	0.00	NO	NO	NO	NO	NO	0.02	0.58	0.90	NO	2.00
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.02
2.G.4. Other	1.98	NO	NO	NO	NO	NO	NO	NO	0.02	0.58	0.90	NO	1.98
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	9.22	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	9.22	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	556.59	NO	0.00	NO	NO	NO	NO	NO	1.39	2.84	40.93	0.53	556.60
2.A. Mineral industry	445.34								1.28	1.15	0.01	0.49	445.34
2.A.1. Cement production	328.44								0.76	0.89	0.01	0.23	328.44
2.A.2. Lime production	83.84								0.15	0.22		0.04	83.84
2.A.3. Glass production	4.33								0.32		0.00	0.21	4.33
2.A.4. Other process uses of carbonates	28.74								0.05	0.05		0.01	28.74
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	25.33	NO	NO	NO	NO	NO	NO	NO	0.08	1.08	0.03	0.04	25.33
2.C.1. Iron and steel production	25.33	NO							0.08	1.08	0.03	0.04	25.33
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	84.47	NO	NO						0.01	0.08	32.80	0.01	84.47
2.D.1. Lubricant use	10.10	NO	NO						NO	NO	NO	NO	10.10
2.D.2. Paraffin wax use	0.05	NO	NO						NO	NO	NO	NO	0.05
2.D.3. Solvent use	72.15	NO	NO						0.01	0.08	32.80	0.01	72.15
2.D.4. Other	2.17	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2.17
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO					NO
2.F.1. Refrigeration and air conditioning				NO	NO	NO	NO	NO					NO
2.F.2. Foam blowing agents				NO	NO	NO	NO	NO					NO
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.44	NO	0.00	NO	NO	NO	NO	NO	0.02	0.53	0.66	NO	1.46
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.01
2.G.4. Other	1.44	NO	NO	NO	NO	NO	NO	NO	0.02	0.53	0.66	NO	1.44
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	7.42	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	7.42	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	455.63	NO	0.00	0.94	NO	NO	NO	NO	1.21	2.56	39.13	0.49	456.56
2.A. Mineral industry	351.66								1.09	0.90	0.01	0.44	351.66
2.A.1. Cement production	248.53								0.57	0.67	0.01	0.17	248.53
2.A.2. Lime production	78.02								0.14	0.20		0.03	78.02
2.A.3. Glass production	5.53								0.35		0.00	0.23	5.53
2.A.4. Other process uses of carbonates	19.58								0.03	0.03		0.01	19.58
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	26.24	NO	NO	NO	NO	NO	NO	NO	0.09	1.12	0.03	0.04	26.24
2.C.1. Iron and steel production	26.24	NO							0.09	1.12	0.03	0.04	26.24
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	76.56	NO	NO						0.01	0.07	29.22	0.01	76.56
2.D.1. Lubricant use	10.13	NO	NO						NO	NO	NO	NO	10.13
2.D.2. Paraffin wax use	0.05	NO	NO						NO	NO	NO	NO	0.05
2.D.3. Solvent use	64.28	NO	NO						0.01	0.07	29.22	0.01	64.28
2.D.4. Other	2.10	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2.10
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				0.94	NO	NO	NO	NO					0.94
2.F.1. Refrigeration and air conditioning				0.69	NO	NO	NO	NO					0.69
2.F.2. Foam blowing agents				0.25	NO	NO	NO	NO					0.25
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.17	NO	0.00	NO	NO	NO	NO	NO	0.02	0.47	0.53	NO	1.17
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.00
2.G.4. Other	1.17	NO	NO	NO	NO	NO	NO	NO	0.02	0.47	0.53	NO	1.17
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	9.34	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	9.34	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_X	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	415.26	NO	0.00	1.51	NO	NO	NO	NO	1.05	2.65	36.16	0.42	416.77
2.A. Mineral industry	316.36								0.93	0.80	0.01	0.37	316.36
2.A.1. Cement production	193.12								0.44	0.52	0.01	0.13	193.12
2.A.2. Lime production	97.77								0.18	0.26		0.04	97.77
2.A.3. Glass production	8.21								0.28		0.00	0.19	8.21
2.A.4. Other process uses of carbonates	17.26								0.03	0.03		0.01	17.26
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	26.73	NO	NO	NO	NO	NO	NO	NO	0.09	1.14	0.03	0.04	26.73
2.C.1. Iron and steel production	26.73	NO							0.09	1.14	0.03	0.04	26.73
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	71.07	NO	NO						0.01	0.07	27.03	0.01	71.07
2.D.1. Lubricant use	9.77	NO	NO						NO	NO	NO	NO	9.77
2.D.2. Paraffin wax use	0.04	NO	NO						NO	NO	NO	NO	0.04
2.D.3. Solvent use	59.46	NO	NO						0.01	0.07	27.03	0.01	59.46
2.D.4. Other	1.80	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.80
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				1.51	NO	NO	NO	NO					1.51
2.F.1. Refrigeration and air conditioning				1.13	NO	NO	NO	NO					1.13
2.F.2. Foam blowing agents				0.38	NO	NO	NO	NO					0.38
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.10	NO	0.00	NO	NO	NO	NO	NO	0.02	0.64	0.50	NO	1.11
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.00
2.G.4. Other	1.10	NO	NO	NO	NO	NO	NO	NO	0.02	0.64	0.50	NO	1.10
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	8.58	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	8.58	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	452.49	NO	0.00	2.10	NO	NO	NO	NO	1.26	3.00	22.34	0.50	454.60
2.A. Mineral industry	377.06								1.13	0.97	0.01	0.45	377.06
2.A.1. Cement production	270.13								0.62	0.73	0.01	0.19	270.13
2.A.2. Lime production	81.30								0.15	0.21		0.03	81.30
2.A.3. Glass production	5.46								0.33		0.00	0.22	5.46
2.A.4. Other process uses of carbonates	20.18								0.03	0.03		0.01	20.18
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	32.38	NO	NO	NO	NO	NO	NO	NO	0.11	1.38	0.04	0.05	32.38
2.C.1. Iron and steel production	32.38	NO							0.11	1.38	0.04	0.05	32.38
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	42.05	NO	NO						0.00	0.02	14.13	0.00	42.05
2.D.1. Lubricant use	9.22	NO	NO						NO	NO	NO	NO	9.22
2.D.2. Paraffin wax use	0.04	NO	NO						NO	NO	NO	NO	0.04
2.D.3. Solvent use	31.09	NO	NO						0.00	0.02	14.13	0.00	31.09
2.D.4. Other	1.70	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.70
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				2.10	NO	NO	NO	NO					2.10
2.F.1. Refrigeration and air conditioning				1.63	NO	NO	NO	NO					1.63
2.F.2. Foam blowing agents				0.47	NO	NO	NO	NO					0.47
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.00	NO	0.00	NO	NO	NO	NO	NO	0.02	0.63	0.45	NO	1.00
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.00
2.G.4. Other	1.00	NO	NO	NO	NO	NO	NO	NO	0.02	0.63	0.45	NO	1.00
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	7.70	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	7.70	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_X	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	375.52	NO	0.00	2.85	NO	NO	NO	NO	1.11	2.52	19.96	0.46	378.37
2.A. Mineral industry	308.48								1.00	0.79	0.01	0.42	308.48
2.A.1. Cement production	215.06								0.49	0.58	0.01	0.15	215.06
2.A.2. Lime production	68.59								0.13	0.18		0.03	68.59
2.A.3. Glass production	5.86								0.35		0.00	0.24	5.86
2.A.4. Other process uses of carbonates	18.97								0.03	0.03		0.01	18.97
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	28.68	NO	NO	NO	NO	NO	NO	NO	0.09	1.22	0.04	0.04	28.68
2.C.1. Iron and steel production	28.68	NO							0.09	1.22	0.04	0.04	28.68
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	37.61	NO	NO						0.00	0.02	13.27	0.00	37.61
2.D.1. Lubricant use	7.01	NO	NO						NO	NO	NO	NO	7.01
2.D.2. Paraffin wax use	0.03	NO	NO						NO	NO	NO	NO	0.03
2.D.3. Solvent use	29.19	NO	NO						0.00	0.02	13.27	0.00	29.19
2.D.4. Other	1.38	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.38
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				2.85	NO	NO	NO	NO					2.85
2.F.1. Refrigeration and air conditioning				2.19	NO	NO	NO	NO					2.19
2.F.2. Foam blowing agents				0.66	NO	NO	NO	NO					0.66
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	0.75	NO	0.00	NO	NO	NO	NO	NO	0.02	0.50	0.34	NO	0.75
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.00
2.G.4. Other	0.75	NO	NO	NO	NO	NO	NO	NO	0.02	0.50	0.34	NO	0.75
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	6.30	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	6.30	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	338.23	NO	0.00	3.64	NO	NO	NO	NO	0.98	2.65	17.05	0.40	341.88
2.A. Mineral industry	271.71								0.85	0.70	0.01	0.35	271.71
2.A.1. Cement production	210.81								0.48	0.57	0.01	0.15	210.81
2.A.2. Lime production	37.89								0.07	0.10		0.02	37.89
2.A.3. Glass production	3.94								0.27		0.00	0.18	3.94
2.A.4. Other process uses of carbonates	19.07								0.03	0.03		0.01	19.07
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	31.79	NO	NO	NO	NO	NO	NO	NO	0.10	1.35	0.04	0.05	31.79
2.C.1. Iron and steel production	31.79	NO							0.10	1.35	0.04	0.05	31.79
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	34.08	NO	NO						0.00	0.02	12.76	0.00	34.08
2.D.1. Lubricant use	5.00	NO	NO						NO	NO	NO	NO	5.00
2.D.2. Paraffin wax use	0.02	NO	NO						NO	NO	NO	NO	0.02
2.D.3. Solvent use	28.07	NO	NO						0.00	0.02	12.76	0.00	28.07
2.D.4. Other	0.99	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.99
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				3.64	NO	NO	NO	NO					3.64
2.F.1. Refrigeration and air conditioning				2.80	NO	NO	NO	NO					2.80
2.F.2. Foam blowing agents				0.84	NO	NO	NO	NO					0.84
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	0.64	NO	0.00	NO	NO	NO	NO	NO	0.02	0.58	0.29	NO	0.65
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.01
2.G.4. Other	0.64	NO	NO	NO	NO	NO	NO	NO	0.02	0.58	0.29	NO	0.64
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.95	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	3.95	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_X	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	310.64	NO	0.00	4.66	NO	NO	NO	NO	1.14	2.75	16.67	0.54	315.31
2.A. Mineral industry	240.78								1.00	0.58	0.01	0.48	240.78
2.A.1. Cement production	172.76								0.40	0.47	0.01	0.12	172.76
2.A.2. Lime production	31.40								0.06	0.08		0.01	31.40
2.A.3. Glass production	18.03								0.52		0.00	0.35	18.03
2.A.4. Other process uses of carbonates	18.59								0.03	0.03		0.01	18.59
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	36.27	NO	NO	NO	NO	NO	NO	NO	0.12	1.54	0.05	0.05	36.27
2.C.1. Iron and steel production	36.27	NO							0.12	1.54	0.05	0.05	36.27
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	32.64	NO	NO						0.00	0.01	12.56	0.00	32.64
2.D.1. Lubricant use	3.91	NO	NO						NO	NO	NO	NO	3.91
2.D.2. Paraffin wax use	0.02	NO	NO						NO	NO	NO	NO	0.02
2.D.3. Solvent use	27.64	NO	NO						0.00	0.01	12.56	0.00	27.64
2.D.4. Other	1.07	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.07
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				4.66	NO	NO	NO	NO					4.66
2.F.1. Refrigeration and air conditioning				3.47	NO	NO	NO	NO					3.47
2.F.2. Foam blowing agents				1.18	NO	NO	NO	NO					1.18
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	0.96	NO	0.00	NO	NO	NO	NO	NO	0.02	0.61	0.43	NO	0.97
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.01
2.G.4. Other	0.96	NO	NO	NO	NO	NO	NO	NO	0.02	0.61	0.43	NO	0.96
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.61	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	3.61	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
2. Total industrial processes	312.94	NO	0.00	6.25	NO	NO	NO	NO	1.09	2.86	18.45	0.51	319.20
2.A. Mineral industry	237.07								0.94	0.57	0.01	0.45	237.07
2.A.1. Cement production	173.88								0.40	0.47	0.01	0.12	173.88
2.A.2. Lime production	28.45								0.05	0.07		0.01	28.45
2.A.3. Glass production	16.32								0.46		0.00	0.31	16.32
2.A.4. Other process uses of carbonates	18.42								0.03	0.03		0.01	18.42
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	38.63	NO	NO	NO	NO	NO	NO	NO	0.13	1.64	0.05	0.06	38.63
2.C.1. Iron and steel production	38.63	NO							0.13	1.64	0.05	0.06	38.63
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	36.42	NO	NO						0.00	0.02	14.02	0.00	36.42
2.D.1. Lubricant use	4.39	NO	NO						NO	NO	NO	NO	4.39
2.D.2. Paraffin wax use	0.02	NO	NO						NO	NO	NO	NO	0.02
2.D.3. Solvent use	30.84	NO	NO						0.00	0.02	14.02	0.00	30.84
2.D.4. Other	1.17	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.17
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				6.25	NO	NO	NO	NO					6.25
2.F.1. Refrigeration and air conditioning				4.55	NO	NO	NO	NO					4.55
2.F.2. Foam blowing agents				1.70	NO	NO	NO	NO					1.70
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	0.82	NO	0.00	NO	NO	NO	NO	NO	0.02	0.62	0.37	NO	0.83
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.01
2.G.4. Other	0.82	NO	NO	NO	NO	NO	NO	NO	0.02	0.62	0.37	NO	0.82
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.99	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	3.99	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_X	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	361.15	NO	0.00	8.30	NO	NO	NO	NO	1.25	2.06	19.77	0.58	369.46
2.A. Mineral industry	301.49								1.16	0.73	0.01	0.55	301.49
2.A.1. Cement production	219.19								0.50	0.59	0.01	0.15	219.19
2.A.2. Lime production	38.25								0.07	0.10		0.02	38.25
2.A.3. Glass production	22.01								0.56		0.00	0.37	22.01
2.A.4. Other process uses of carbonates	22.03								0.03	0.03		0.01	22.03
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	20.50	NO	NO	NO	NO	NO	NO	NO	0.07	0.87	0.03	0.03	20.50
2.C.1. Iron and steel production	20.50	NO							0.07	0.87	0.03	0.03	20.50
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	38.37	NO	NO						0.00	0.02	14.82	0.00	38.37
2.D.1. Lubricant use	4.32	NO	NO						NO	NO	NO	NO	4.32
2.D.2. Paraffin wax use	0.02	NO	NO						NO	NO	NO	NO	0.02
2.D.3. Solvent use	32.61	NO	NO						0.00	0.02	14.82	0.00	32.61
2.D.4. Other	1.43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.43
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				8.30	NO	NO	NO	NO					8.30
2.F.1. Refrigeration and air conditioning				5.61	NO	NO	NO	NO					5.61
2.F.2. Foam blowing agents				2.69	NO	NO	NO	NO					2.69
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				NO	NO	NO	NO	NO					NO
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	0.78	NO	0.00	NO	NO	NO	NO	NO	0.01	0.45	0.36	NO	0.80
2.G.1. Electrical equipment				NO	NO	NO	NO	NO					NO
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.01
2.G.4. Other	0.78	NO	NO	NO	NO	NO	NO	NO	0.01	0.45	0.36	NO	0.78
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.55	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	4.55	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
2. Total industrial processes	386.39	NO	0.00	10.95	NO	NO	0.00	NO	1.28	2.83	19.65	0.58	397.36
2.A. Mineral industry	309.07								1.15	0.75	0.01	0.53	309.07
2.A.1. Cement production	245.63								0.56	0.66	0.01	0.17	245.63
2.A.2. Lime production	20.52								0.04	0.05		0.01	20.52
2.A.3. Glass production	20.32								0.51		0.00	0.34	20.32
2.A.4. Other process uses of carbonates	22.61								0.04	0.04		0.01	22.61
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	35.43	NO	NO	NO	NO	NO	NO	NO	0.12	1.51	0.05	0.05	35.43
2.C.1. Iron and steel production	35.43	NO							0.12	1.51	0.05	0.05	35.43
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	40.93	NO	NO						0.00	0.01	14.87	0.00	40.93
2.D.1. Lubricant use	6.58	NO	NO						NO	NO	NO	NO	6.58
2.D.2. Paraffin wax use	0.03	NO	NO						NO	NO	NO	NO	0.03
2.D.3. Solvent use	32.72	NO	NO						0.00	0.01	14.87	0.00	32.72
2.D.4. Other	1.59	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.59
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				10.95	NO	NO	NO	NO					10.95
2.F.1. Refrigeration and air conditioning				6.59	NO	NO	NO	NO					6.59
2.F.2. Foam blowing agents				4.36	NO	NO	NO	NO					4.36
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	0.96	NO	0.00	NO	NO	NO	0.00	NO	0.02	0.55	0.44	NO	0.98
2.G.1. Electrical equipment				NO	NO	NO	0.00	NO					0.01
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.01
2.G.4. Other	0.96	NO	NO	NO	NO	NO	NO	NO	0.02	0.55	0.44	NO	0.96
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.27	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	4.27	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_X	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	456.15	NO	0.00	14.40	NO	NO	0.00	NO	1.44	3.21	31.18	0.64	470.56
2.A. Mineral industry	350.46								1.28	0.86	0.01	0.58	350.46
2.A.1. Cement production	282.58								0.65	0.76	0.01	0.20	282.58
2.A.2. Lime production	20.58								0.04	0.05		0.01	20.58
2.A.3. Glass production	21.07								0.54		0.00	0.36	21.07
2.A.4. Other process uses of carbonates	26.23								0.04	0.04		0.01	26.23
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	40.51	NO	NO	NO	NO	NO	NO	NO	0.13	1.72	0.05	0.06	40.51
2.C.1. Iron and steel production	40.51	NO							0.13	1.72	0.05	0.06	40.51
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	64.13	NO	NO						0.01	0.05	25.33	0.00	64.13
2.D.1. Lubricant use	6.56	NO	NO						NO	NO	NO	NO	6.56
2.D.2. Paraffin wax use	0.03	NO	NO						NO	NO	NO	NO	0.03
2.D.3. Solvent use	55.73	NO	NO						0.01	0.05	25.33	0.00	55.73
2.D.4. Other	1.81	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.81
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				14.40	NO	NO	NO	NO					14.40
2.F.1. Refrigeration and air conditioning				7.60	NO	NO	NO	NO					7.60
2.F.2. Foam blowing agents				6.80	NO	NO	NO	NO					6.80
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.05	NO	0.00	NO	NO	NO	0.00	NO	0.02	0.58	0.48	NO	1.07
2.G.1. Electrical equipment				NO	NO	NO	0.00	NO					0.01
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.01
2.G.4. Other	1.05	NO	NO	NO	NO	NO	NO	NO	0.02	0.58	0.48	NO	1.05
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.30	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	5.30	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
2. Total industrial processes	550.48	NO	0.00	20.20	NO	NO	0.00	NO	1.72	3.50	33.62	0.76	570.74
2.A. Mineral industry	439.19								1.56	1.10	0.01	0.69	439.19
2.A.1. Cement production	365.08								0.84	0.99	0.01	0.25	365.08
2.A.2. Lime production	27.84								0.05	0.07		0.01	27.84
2.A.3. Glass production	24.23								0.62		0.00	0.41	24.23
2.A.4. Other process uses of carbonates	22.04								0.04	0.04		0.01	22.04
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	41.94	NO	NO	NO	NO	NO	NO	NO	0.14	1.78	0.05	0.06	41.94
2.C.1. Iron and steel production	41.94	NO							0.14	1.78	0.05	0.06	41.94
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	68.19	NO	NO						0.01	0.04	27.23	0.00	68.19
2.D.1. Lubricant use	6.47	NO	NO						NO	NO	NO	NO	6.47
2.D.2. Paraffin wax use	0.01	NO	NO						NO	NO	NO	NO	0.01
2.D.3. Solvent use	59.90	NO	NO						0.01	0.04	27.23	0.00	59.90
2.D.4. Other	1.81	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.81
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				20.20	NO	NO	NO	NO					20.20
2.F.1. Refrigeration and air conditioning				8.98	NO	NO	NO	NO					8.98
2.F.2. Foam blowing agents				11.22	NO	NO	NO	NO					11.22
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.16	NO	0.00	NO	NO	NO	0.00	NO	0.02	0.57	0.53	NO	1.22
2.G.1. Electrical equipment				NO	NO	NO	0.00	NO					0.04
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.02
2.G.4. Other	1.16	NO	NO	NO	NO	NO	NO	NO	0.02	0.57	0.53	NO	1.16
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.78	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	5.78	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_X	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	645.49	NO	0.00	29.92	0.02	NO	0.00	NO	1.85	3.13	38.81	0.77	675.77
2.A. Mineral industry	535.42								1.73	1.36	0.02	0.73	535.42
2.A.1. Cement production	457.08								1.06	1.24	0.02	0.32	457.08
2.A.2. Lime production	30.10								0.06	0.08		0.01	30.10
2.A.3. Glass production	24.95								0.58		0.00	0.39	24.95
2.A.4. Other process uses of carbonates	23.29								0.04	0.04		0.01	23.29
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	27.02	NO	NO	NO	NO	NO	NO	NO	0.09	1.15	0.04	0.04	27.02
2.C.1. Iron and steel production	27.02	NO							0.09	1.15	0.04	0.04	27.02
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	81.98	NO	NO						0.01	0.07	33.23	0.01	81.98
2.D.1. Lubricant use	6.99	NO	NO						NO	NO	NO	NO	6.99
2.D.2. Paraffin wax use	0.06	NO	NO						NO	NO	NO	NO	0.06
2.D.3. Solvent use	73.10	NO	NO						0.01	0.07	33.23	0.01	73.10
2.D.4. Other	1.84	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.84
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				29.92	NO	NO	NO	NO					29.92
2.F.1. Refrigeration and air conditioning				13.02	NO	NO	NO	NO					13.02
2.F.2. Foam blowing agents				16.90	NO	NO	NO	NO					16.90
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.07	NO	0.00	NO	0.02	NO	0.00	NO	0.02	0.55	0.48	NO	1.42
2.G.1. Electrical equipment				NO	0.02	NO	0.00	NO					0.34
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			0.00										0.02
2.G.4. Other	1.07	NO	NO	NO	NO	NO	NO	NO	0.02	0.55	0.48	NO	1.07
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.03	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	5.03	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
2. Total industrial processes	892.11	NO	NO	40.32	0.02	NO	0.00	NO	2.39	4.32	39.16	0.92	932.87
2.A. Mineral industry	767.69								2.23	2.00	0.02	0.86	767.69
2.A.1. Cement production	702.67								1.62	1.89	0.02	0.49	702.67
2.A.2. Lime production	21.94								0.04	0.06		0.01	21.94
2.A.3. Glass production	21.57								0.53		0.00	0.35	21.57
2.A.4. Other process uses of carbonates	21.51								0.04	0.05		0.01	21.51
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	38.61	NO	NO	NO	NO	NO	NO	NO	0.13	1.64	0.05	0.06	38.61
2.C.1. Iron and steel production	38.61	NO							0.13	1.64	0.05	0.06	38.61
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	84.75	NO	NO						0.01	0.07	34.99	0.01	84.75
2.D.1. Lubricant use	5.77	NO	NO						NO	NO	NO	NO	5.77
2.D.2. Paraffin wax use	0.06	NO	NO						NO	NO	NO	NO	0.06
2.D.3. Solvent use	76.99	NO	NO						0.01	0.07	34.99	0.01	76.99
2.D.4. Other	1.93	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.93
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				40.32	NO	NO	NO	NO					40.32
2.F.1. Refrigeration and air conditioning				15.17	NO	NO	NO	NO					15.17
2.F.2. Foam blowing agents				25.15	NO	NO	NO	NO					25.15
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.07	NO	NO	NO	0.02	NO	0.00	NO	0.02	0.61	0.48	NO	1.51
2.G.1. Electrical equipment				NO	0.02	NO	0.00	NO					0.44
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.07	NO	NO	NO	NO	NO	NO	NO	0.02	0.61	0.48	NO	1.07
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.59	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	3.59	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_X	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	967.70	NO	NO	51.77	0.03	NO	0.00	NO	2.57	4.35	32.04	0.96	1,020.01
2.A. Mineral industry	864.47								2.43	2.28	0.03	0.90	864.47
2.A.1. Cement production	789.92								1.84	2.16	0.03	0.56	789.92
2.A.2. Lime production	29.14								0.05	0.08		0.01	29.14
2.A.3. Glass production	24.18								0.49		0.00	0.33	24.18
2.A.4. Other process uses of carbonates	21.24								0.04	0.04		0.01	21.24
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	35.41	NO	NO	NO	NO	NO	NO	NO	0.12	1.51	0.05	0.05	35.41
2.C.1. Iron and steel production	35.41	NO							0.12	1.51	0.05	0.05	35.41
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	66.72	NO	NO						0.01	0.04	26.60	0.00	66.72
2.D.1. Lubricant use	6.15	NO	NO						NO	NO	NO	NO	6.15
2.D.2. Paraffin wax use	0.03	NO	NO						NO	NO	NO	NO	0.03
2.D.3. Solvent use	58.51	NO	NO						0.01	0.04	26.60	0.00	58.51
2.D.4. Other	2.03	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2.03
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				51.77	NO	NO	NO	NO					51.77
2.F.1. Refrigeration and air conditioning				17.34	NO	NO	NO	NO					17.34
2.F.2. Foam blowing agents				34.43	NO	NO	NO	NO					34.43
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.10	NO	NO	NO	0.03	NO	0.00	NO	0.02	0.52	0.50	NO	1.64
2.G.1. Electrical equipment				NO	0.03	NO	0.00	NO					0.54
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.10	NO	NO	NO	NO	NO	NO	NO	0.02	0.52	0.50	NO	1.10
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.85	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	4.85	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
2. Total industrial processes	462.34	NO	NO	61.02	0.03	NO	0.00	NO	1.29	2.37	26.67	0.52	523.95
2.A. Mineral industry	386.85								1.21	0.99	0.01	0.50	386.85
2.A.1. Cement production	340.57								0.80	0.93	0.01	0.24	340.57
2.A.2. Lime production	8.46								0.02	0.02		0.00	8.46
2.A.3. Glass production	18.07								0.37		0.00	0.25	18.07
2.A.4. Other process uses of carbonates	19.74								0.03	0.03		0.01	19.74
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	17.06	NO	NO	NO	NO	NO	NO	NO	0.06	0.73	0.02	0.03	17.06
2.C.1. Iron and steel production	17.06	NO							0.06	0.73	0.02	0.03	17.06
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	57.63	NO	NO						0.01	0.03	23.00	0.00	57.63
2.D.1. Lubricant use	5.09	NO	NO						NO	NO	NO	NO	5.09
2.D.2. Paraffin wax use	0.07	NO	NO						NO	NO	NO	NO	0.07
2.D.3. Solvent use	50.60	NO	NO						0.01	0.03	23.00	0.00	50.60
2.D.4. Other	1.86	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	1.86
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				61.02	NO	NO	NO	NO					61.02
2.F.1. Refrigeration and air conditioning				18.86	NO	NO	NO	NO					18.86
2.F.2. Foam blowing agents				42.16	NO	NO	NO	NO					42.16
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	0.80	NO	NO	NO	0.03	NO	0.00	NO	0.02	0.63	0.37	NO	1.39
2.G.1. Electrical equipment				NO	0.03	NO	0.00	NO					0.58
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	0.80	NO	NO	NO	NO	NO	NO	NO	0.02	0.63	0.37	NO	0.80
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.25	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	3.25	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_X	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	482.43	NO	NO	70.54	0.04	NO	0.00	NO	1.37	2.20	31.23	0.57	553.69
2.A. Mineral industry	405.39								1.31	1.02	0.01	0.55	405.39
2.A.1. Cement production	349.83								0.81	0.95	0.01	0.25	349.83
2.A.2. Lime production	15.36								0.03	0.04		0.01	15.36
2.A.3. Glass production	21.27								0.44		0.00	0.29	21.27
2.A.4. Other process uses of carbonates	18.92								0.03	0.03		0.01	18.92
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	9.70	NO	NO	NO	NO	NO	NO	NO	0.03	0.41	0.01	0.01	9.70
2.C.1. Iron and steel production	9.70	NO							0.03	0.41	0.01	0.01	9.70
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	66.32	NO	NO						0.01	0.04	26.53	0.00	66.32
2.D.1. Lubricant use	5.46	NO	NO						NO	NO	NO	NO	5.46
2.D.2. Paraffin wax use	0.18	NO	NO						NO	NO	NO	NO	0.18
2.D.3. Solvent use	58.36	NO	NO						0.01	0.04	26.53	0.00	58.36
2.D.4. Other	2.32	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2.32
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				70.54	NO	NO	NO	NO					70.54
2.F.1. Refrigeration and air conditioning				20.55	NO	NO	NO	NO					20.55
2.F.2. Foam blowing agents				49.99	NO	NO	NO	NO					49.99
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.02	NO	NO	NO	0.04	NO	0.00	NO	0.02	0.72	0.47	NO	1.74
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					0.72
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.02	NO	NO	NO	NO	NO	NO	NO	0.02	0.72	0.47	NO	1.02
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.20	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	4.20	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
2. Total industrial processes	573.63	NO	NO	80.58	0.04	NO	0.00	NO	1.66	2.56	33.53	0.69	654.97
2.A. Mineral industry	488.20								1.59	1.25	0.02	0.67	488.20
2.A.1. Cement production	427.26								1.00	1.17	0.01	0.30	427.26
2.A.2. Lime production	16.62								0.03	0.04		0.01	16.62
2.A.3. Glass production	25.95								0.53		0.00	0.35	25.95
2.A.4. Other process uses of carbonates	18.37								0.03	0.03		0.01	18.37
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	12.86	NO	NO	NO	NO	NO	NO	NO	0.04	0.55	0.02	0.02	12.86
2.C.1. Iron and steel production	12.86	NO							0.04	0.55	0.02	0.02	12.86
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	71.34	NO	NO						0.01	0.04	28.65	0.00	71.34
2.D.1. Lubricant use	5.78	NO	NO						NO	NO	NO	NO	5.78
2.D.2. Paraffin wax use	0.07	NO	NO						NO	NO	NO	NO	0.07
2.D.3. Solvent use	63.03	NO	NO						0.01	0.04	28.65	0.00	63.03
2.D.4. Other	2.47	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2.47
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				80.58	NO	NO	NO	NO					80.58
2.F.1. Refrigeration and air conditioning				24.11	NO	NO	NO	NO					24.11
2.F.2. Foam blowing agents				56.47	NO	NO	NO	NO					56.47
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.23	NO	NO	NO	0.04	NO	0.00	NO	0.02	0.72	0.56	NO	1.99
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					0.76
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.23	NO	NO	NO	NO	NO	NO	NO	0.02	0.72	0.56	NO	1.23
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.28	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	4.28	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	581.67	NO	NO	88.14	0.04	NO	0.00	NO	1.57	2.40	35.19	0.62	670.64
2.A. Mineral industry	493.16								1.50	1.28	0.02	0.60	493.16
2.A.1. Cement production	442.16								1.03	1.21	0.01	0.31	442.16
2.A.2. Lime production	15.53								0.03	0.04		0.01	15.53
2.A.3. Glass production	20.86								0.41		0.00	0.28	20.86
2.A.4. Other process uses of carbonates	14.61								0.03	0.03		0.01	14.61
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	12.70	NO	NO	NO	NO	NO	NO	NO	0.04	0.54	0.02	0.02	12.70
2.C.1. Iron and steel production	12.70	NO							0.04	0.54	0.02	0.02	12.70
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	74.66	NO	NO						0.01	0.05	30.62	0.00	74.66
2.D.1. Lubricant use	4.94	NO	NO						NO	NO	NO	NO	4.94
2.D.2. Paraffin wax use	0.14	NO	NO						NO	NO	NO	NO	0.14
2.D.3. Solvent use	67.37	NO	NO						0.01	0.05	30.62	0.00	67.37
2.D.4. Other	2.21	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2.21
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				88.14	NO	NO	NO	NO					88.14
2.F.1. Refrigeration and air conditioning				26.86	NO	NO	NO	NO					26.86
2.F.2. Foam blowing agents				61.28	NO	NO	NO	NO					61.28
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.16	NO	NO	NO	0.04	NO	0.00	NO	0.02	0.53	0.53	NO	1.98
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					0.82
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.16	NO	NO	NO	NO	NO	NO	NO	0.02	0.53	0.53	NO	1.16
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.99	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	3.99	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
2. Total industrial processes	623.12	NO	NO	95.76	0.04	NO	0.00	NO	1.74	2.17	34.25	0.71	719.91
2.A. Mineral industry	544.87								1.69	1.39	0.02	0.69	544.87
2.A.1. Cement production	476.91								1.11	1.31	0.02	0.34	476.91
2.A.2. Lime production	20.77								0.04	0.05		0.01	20.77
2.A.3. Glass production	27.72								0.51		0.00	0.34	27.72
2.A.4. Other process uses of carbonates	19.47								0.03	0.03		0.01	19.47
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	7.66	NO	NO	NO	NO	NO	NO	NO	0.02	0.32	0.01	0.01	7.66
2.C.1. Iron and steel production	7.66	NO							0.02	0.32	0.01	0.01	7.66
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	69.49	NO	NO						0.01	0.05	28.24	0.00	69.49
2.D.1. Lubricant use	4.85	NO	NO						NO	NO	NO	NO	4.85
2.D.2. Paraffin wax use	0.08	NO	NO						NO	NO	NO	NO	0.08
2.D.3. Solvent use	62.14	NO	NO						0.01	0.05	28.24	0.00	62.14
2.D.4. Other	2.43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2.43
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				95.76	NO	NO	NO	NO					95.76
2.F.1. Refrigeration and air conditioning				30.03	NO	NO	NO	NO					30.03
2.F.2. Foam blowing agents				65.73	NO	NO	NO	NO					65.73
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.10	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.41	0.50	0.00	2.13
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					1.03
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.10	NO	NO	NO	NO	NO	NO	NO	0.01	0.41	0.50	0.00	1.10
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.47	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	5.47	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_X	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	636.28	NO	NO	107.94	0.04	NO	0.00	NO	1.70	2.38	42.62	0.69	745.35
2.A. Mineral industry	533.99								1.63	1.36	0.02	0.66	533.99
2.A.1. Cement production	464.61								1.08	1.27	0.02	0.33	464.61
2.A.2. Lime production	23.82								0.04	0.06		0.01	23.82
2.A.3. Glass production	26.38								0.48		0.00	0.32	26.38
2.A.4. Other process uses of carbonates	19.19								0.03	0.03		0.01	19.19
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	13.85	NO	NO	NO	NO	NO	NO	NO	0.04	0.59	0.02	0.02	13.85
2.C.1. Iron and steel production	13.85	NO							0.04	0.59	0.02	0.02	13.85
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	87.24	NO	NO						0.01	0.07	36.30	0.01	87.24
2.D.1. Lubricant use	4.78	NO	NO						NO	NO	NO	NO	4.78
2.D.2. Paraffin wax use	0.03	NO	NO						NO	NO	NO	NO	0.03
2.D.3. Solvent use	79.86	NO	NO						0.01	0.07	36.30	0.01	79.86
2.D.4. Other	2.56	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2.56
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				107.94	NO	NO	NO	NO					107.94
2.F.1. Refrigeration and air conditioning				39.05	NO	NO	NO	NO					39.05
2.F.2. Foam blowing agents				68.88	NO	NO	NO	NO					68.88
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.21	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.36	0.55	0.00	2.33
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					1.12
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.21	NO	NO	NO	NO	NO	NO	NO	0.01	0.36	0.55	0.00	1.21
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.72	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	5.72	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
2. Total industrial processes	610.79	NO	NO	137.88	0.04	NO	0.00	NO	1.68	2.42	39.68	0.70	749.79
2.A. Mineral industry	507.99								1.61	1.28	0.02	0.67	507.99
2.A.1. Cement production	443.24								1.03	1.21	0.01	0.31	443.24
2.A.2. Lime production	15.74								0.03	0.04		0.01	15.74
2.A.3. Glass production	31.25								0.52		0.00	0.35	31.25
2.A.4. Other process uses of carbonates	17.76								0.03	0.03		0.01	17.76
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	17.28	NO	NO	NO	NO	NO	NO	NO	0.06	0.73	0.02	0.03	17.28
2.C.1. Iron and steel production	17.28	NO							0.06	0.73	0.02	0.03	17.28
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	84.58	NO	NO						0.01	0.05	34.97	0.00	84.58
2.D.1. Lubricant use	4.82	NO	NO						NO	NO	NO	NO	4.82
2.D.2. Paraffin wax use	0.06	NO	NO						NO	NO	NO	NO	0.06
2.D.3. Solvent use	76.94	NO	NO						0.01	0.05	34.97	0.00	76.94
2.D.4. Other	2.76	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2.76
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				137.88	NO	NO	NO	NO					137.88
2.F.1. Refrigeration and air conditioning				64.48	NO	NO	NO	NO					64.48
2.F.2. Foam blowing agents				73.40	NO	NO	NO	NO					73.40
2.F.3. Fire protection				NO	NO	NO	NO	NO					NO
2.F.4. Aerosols				0.00	NO	NO	NO	NO					0.00
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	0.94	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.36	0.43	0.00	2.06
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					1.12
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	0.94	NO	NO	NO	NO	NO	NO	NO	0.01	0.36	0.43	0.00	0.94
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.23	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	4.23	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	583.41	NO	NO	146.79	0.04	NO	0.00	NO	1.57	1.82	40.15	0.65	731.35
2.A. Mineral industry	492.25								1.53	1.24	0.02	0.63	492.25
2.A.1. Cement production	433.90								1.00	1.18	0.01	0.30	433.90
2.A.2. Lime production	13.65								0.03	0.04		0.01	13.65
2.A.3. Glass production	28.09								0.48		0.00	0.32	28.09
2.A.4. Other process uses of carbonates	16.61								0.02	0.02		0.01	16.61
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	5.22	NO	NO	NO	NO	NO	NO	NO	0.02	0.22	0.01	0.01	5.22
2.C.1. Iron and steel production	5.22	NO							0.02	0.22	0.01	0.01	5.22
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	84.87	NO	NO						0.01	0.04	34.96	0.00	84.87
2.D.1. Lubricant use	4.92	NO	NO						NO	NO	NO	NO	4.92
2.D.2. Paraffin wax use	0.04	NO	NO						NO	NO	NO	NO	0.04
2.D.3. Solvent use	76.92	NO	NO						0.01	0.04	34.96	0.00	76.92
2.D.4. Other	2.99	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	2.99
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				146.79	NO	NO	NO	NO					146.79
2.F.1. Refrigeration and air conditioning				72.27	NO	NO	NO	NO					72.27
2.F.2. Foam blowing agents				74.38	NO	NO	NO	NO					74.38
2.F.3. Fire protection				0.13	NO	NO	NO	NO					0.13
2.F.4. Aerosols				0.01	NO	NO	NO	NO					0.01
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.06	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.32	0.48	0.00	2.22
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					1.15
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.06	NO	NO	NO	NO	NO	NO	NO	0.01	0.32	0.48	0.00	1.06
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.66	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	4.66	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	587.60	NO	NO	162.10	0.04	NO	0.00	NO	1.54	2.30	46.38	0.63	750.89
2.A. Mineral industry	470.20								1.46	1.20	0.01	0.60	470.20
2.A.1. Cement production	404.93								0.94	1.10	0.01	0.28	404.93
2.A.2. Lime production	28.80								0.05	0.08		0.01	28.80
2.A.3. Glass production	21.39								0.44		0.00	0.30	21.39
2.A.4. Other process uses of carbonates	15.07								0.02	0.02		0.00	15.07
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	18.88	NO	NO	NO	NO	NO	NO	NO	0.06	0.80	0.02	0.03	18.88
2.C.1. Iron and steel production	18.88	NO							0.06	0.80	0.02	0.03	18.88
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	97.34	NO	NO						0.01	0.05	40.59	0.00	97.34
2.D.1. Lubricant use	4.81	NO	NO						NO	NO	NO	NO	4.81
2.D.2. Paraffin wax use	0.06	NO	NO						NO	NO	NO	NO	0.06
2.D.3. Solvent use	89.29	NO	NO						0.01	0.05	40.59	0.00	89.29
2.D.4. Other	3.18	NO	NO						NO	NO	NO	NO	3.18
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				162.10	NO	NO	NO	NO					162.10
2.F.1. Refrigeration and air conditioning				86.22	NO	NO	NO	NO					86.22
2.F.2. Foam blowing agents				75.48	NO	NO	NO	NO					75.48
2.F.3. Fire protection				0.39	NO	NO	NO	NO					0.39
2.F.4. Aerosols				0.01	NO	NO	NO	NO					0.01
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.18	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.24	0.53	0.00	2.36
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					1.19
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.18	NO	NO	NO	NO	NO	NO	NO	0.01	0.24	0.53	0.00	1.18
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.21	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	5.21	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	755.82	NO	NO	174.41	0.04	NO	0.00	NO	1.92	2.76	70.22	0.79	931.64
2.A. Mineral industry	583.18								1.82	1.49	0.02	0.75	583.18
2.A.1. Cement production	511.12								1.19	1.39	0.02	0.36	511.12
2.A.2. Lime production	27.79								0.05	0.07		0.01	27.79
2.A.3. Glass production	28.60								0.56		0.00	0.37	28.60
2.A.4. Other process uses of carbonates	15.66								0.02	0.02		0.00	15.66
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	20.21	NO	NO	NO	NO	NO	NO	NO	0.07	0.86	0.03	0.03	20.21
2.C.1. Iron and steel production	20.21	NO							0.07	0.86	0.03	0.03	20.21
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	151.37	NO	NO						0.03	0.15	64.99	0.01	151.37
2.D.1. Lubricant use	5.01	NO	NO						NO	NO	NO	NO	5.01
2.D.2. Paraffin wax use	0.12	NO	NO						NO	NO	NO	NO	0.12
2.D.3. Solvent use	142.99	NO	NO						0.03	0.15	64.99	0.01	142.99
2.D.4. Other	3.25	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.25
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO

2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				174.41	NO	NO	NO	NO					174.41
2.F.1. Refrigeration and air conditioning				95.61	NO	NO	NO	NO					95.61
2.F.2. Foam blowing agents				76.25	NO	NO	NO	NO					76.25
2.F.3. Fire protection				2.54	NO	NO	NO	NO					2.54
2.F.4. Aerosols				0.01	NO	NO	NO	NO					0.01
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.06	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.26	0.48	0.00	2.47
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					1.41
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.06	NO	NO	NO	NO	NO	NO	NO	0.01	0.26	0.48	0.00	1.06
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.69	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	4.69	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
2. Total industrial processes	754.51	NO	NO	196.40	0.04	NO	0.00	NO	1.86	2.54	66.78	0.75	952.43
2.A. Mineral industry	593.82								1.79	1.53	0.02	0.71	593.82
2.A.1. Cement production	523.88								1.22	1.43	0.02	0.37	523.88
2.A.2. Lime production	27.59								0.05	0.07		0.01	27.59
2.A.3. Glass production	25.93								0.49		0.00	0.33	25.93
2.A.4. Other process uses of carbonates	16.43								0.02	0.03		0.01	16.43
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO

2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	15.79	NO	NO	NO	NO	NO	NO	NO	0.05	0.67	0.02	0.02	15.79
2.C.1. Iron and steel production	15.79	NO							0.05	0.67	0.02	0.02	15.79
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	143.77	NO	NO						0.02	0.10	61.43	0.01	143.77
2.D.1. Lubricant use	4.95	NO	NO						NO	NO	NO	NO	4.95
2.D.2. Paraffin wax use	0.25	NO	NO						NO	NO	NO	NO	0.25
2.D.3. Solvent use	135.14	NO	NO						0.02	0.10	61.43	0.01	135.14
2.D.4. Other	3.43	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.43
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				196.40	NO	NO	NO	NO					196.40
2.F.1. Refrigeration and air conditioning				114.76	NO	NO	NO	NO					114.76
2.F.2. Foam blowing agents				76.66	NO	NO	NO	NO					76.66
2.F.3. Fire protection				4.97	NO	NO	NO	NO					4.97
2.F.4. Aerosols				0.01	NO	NO	NO	NO					0.01
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.13	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.24	0.51	0.00	2.65
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					1.52
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.13	NO	NO	NO	NO	NO	NO	NO	0.01	0.24	0.51	0.00	1.13
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.78	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	4.78	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	762.25	NO	NO	206.62	0.04	NO	0.00	NO	1.90	2.63	92.84	0.82	970.54
2.A. Mineral industry	538.63								1.80	1.35	0.02	0.77	538.63
2.A.1. Cement production	467.52								1.09	1.28	0.02	0.33	467.52
2.A.2. Lime production	21.06								0.04	0.06		0.01	21.06
2.A.3. Glass production	34.64								0.65		0.00	0.43	34.64
2.A.4. Other process uses of carbonates	15.41								0.02	0.02		0.00	15.41
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	18.70	NO	NO	NO	NO	NO	NO	NO	0.06	0.79	0.02	0.03	18.70
2.C.1. Iron and steel production	18.70	NO							0.06	0.79	0.02	0.03	18.70
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	203.98	NO	NO						0.03	0.18	88.84	0.02	203.98
2.D.1. Lubricant use	5.08	NO	NO						NO	NO	NO	NO	5.08
2.D.2. Paraffin wax use	0.12	NO	NO						NO	NO	NO	NO	0.12
2.D.3. Solvent use	195.44	NO	NO						0.03	0.18	88.84	0.02	195.44
2.D.4. Other	3.34	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.34
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO

2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				206.62	NO	NO	NO	NO					206.62
2.F.1. Refrigeration and air conditioning				126.21	NO	NO	NO	NO					126.21
2.F.2. Foam blowing agents				76.45	NO	NO	NO	NO					76.45
2.F.3. Fire protection				3.94	NO	NO	NO	NO					3.94
2.F.4. Aerosols				0.01	NO	NO	NO	NO					0.01
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	0.94	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.30	0.43	0.00	2.61
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					1.67
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	0.94	NO	NO	NO	NO	NO	NO	NO	0.01	0.30	0.43	0.00	0.94
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.51	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	3.51	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

2021

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
2. Total industrial processes	781.81	NO	NO	213.27	0.04	NO	0.00	NO	1.98	2.80	81.97	0.84	996.76
2.A. Mineral industry	582.07								1.88	1.47	0.02	0.79	582.07
2.A.1. Cement production	509.57								1.19	1.39	0.02	0.36	509.57
2.A.2. Lime production	20.82								0.04	0.05		0.01	20.82
2.A.3. Glass production	33.58								0.63		0.00	0.42	33.58
2.A.4. Other process uses of carbonates	18.11								0.03	0.03		0.01	18.11
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO

2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	22.26	NO	NO	NO	NO	NO	NO	NO	0.07	0.95	0.03	0.03	22.26
2.C.1. Iron and steel production	22.26	NO							0.07	0.95	0.03	0.03	22.26
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	176.31	NO	NO						0.03	0.14	75.91	0.01	176.31
2.D.1. Lubricant use	5.43	NO	NO						NO	NO	NO	NO	5.43
2.D.2. Paraffin wax use	0.21	NO	NO						NO	NO	NO	NO	0.21
2.D.3. Solvent use	167.01	NO	NO						0.03	0.14	75.91	0.01	167.01
2.D.4. Other	3.66	NO	NO						NO	NO	NO	NO	3.66
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO
2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				213.27	NO	NO	NO	NO					213.27
2.F.1. Refrigeration and air conditioning				133.98	NO	NO	NO	NO					133.98
2.F.2. Foam blowing agents				75.95	NO	NO	NO	NO					75.95
2.F.3. Fire protection				3.34	NO	NO	NO	NO					3.34
2.F.4. Aerosols				0.01	NO	NO	NO	NO					0.01
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.16	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.24	0.53	0.00	2.84
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					1.68
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	1.16	NO	NO	NO	NO	NO	NO	NO	0.01	0.24	0.53	0.00	1.16
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.46	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	5.46	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions [2]
	(kt)			CO_2 equivalent (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
2. Total industrial processes	663.47	NO	NO	234.84	0.04	NO	0.00	NO	1.80	2.03	72.59	0.80	900.00
2.A. Mineral industry	491.38								1.73	1.21	0.02	0.77	491.38
2.A.1. Cement production	408.47								0.95	1.11	0.01	0.28	408.47
2.A.2. Lime production	28.00								0.05	0.07		0.01	28.00
2.A.3. Glass production	37.34								0.70		0.00	0.47	37.34
2.A.4. Other process uses of carbonates	17.57								0.03	0.03		0.01	17.57
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.B.1. Ammonia production	NO	NO	NO						NO	NO	NO	NO	NO
2.B.2. Nitric acid production			NO						NO				NO
2.B.3. Adipic acid production	NO		NO						NO	NO	NO		NO
2.B.4. Caprolactam, glyoxal and glyoxylic acid production	NO		NO								NO	NO	NO
2.B.5. Carbide production	NO	NO							NO	NO	NO	NO	NO
2.B.6. Titanium dioxide production	NO												NO
2.B.7. Soda ash production	NO												NO
2.B.8. Petrochemical and carbon black production	NO	NO							NO	NO	NO	NO	NO
2.B.9. Fluorochemical production				NO	NO	NO	NO	NO					NO
2.B.10. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	12.20	NO	NO	NO	NO	NO	NO	NO	0.04	0.52	0.02	0.02	12.20
2.C.1. Iron and steel production	12.20	NO							0.04	0.52	0.02	0.02	12.20
2.C.2. Ferroalloys production	NO	NO							NO	NO	NO	NO	NO
2.C.3. Aluminium production	NO				NO		NO		NO	NO	NO	NO	NO
2.C.4. Magnesium production	NO			NO	NO	NO	NO		NO	NO	NO	NO	NO
2.C.5. Lead production	NO								NO	NO	NO	NO	NO
2.C.6. Zinc production	NO								NO	NO	NO	NO	NO
2.C.7. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.D. Non-energy products from fuels and solvent use [4]	159.11	NO	NO						0.02	0.14	68.41	0.01	159.11
2.D.1. Lubricant use	4.77	NO	NO						NO	NO	NO	NO	4.77
2.D.2. Paraffin wax use	0.16	NO	NO						NO	NO	NO	NO	0.16
2.D.3. Solvent use	150.49	NO	NO						0.02	0.14	68.41	0.01	150.49
2.D.4. Other	3.69	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.69
2.E. Electronics industry			NO	NO	NO	NO	NO	NO					NO
2.E.1. Integrated circuit or semiconductor			NO	NO	NO	NO	NO	NO					NO
2.E.2. TFT flat panel display			NO	NO	NO	NO	NO	NO					NO

2.E.3. Photovoltaics				NO	NO	NO	NO	NO					NO
2.E.4. Heat transfer fluid				NO	NO	NO	NO	NO					NO
2.E.5. Other			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				234.84	NO	NO	NO	NO					234.84
2.F.1. Refrigeration and air conditioning				156.03	NO	NO	NO	NO					156.03
2.F.2. Foam blowing agents				74.97	NO	NO	NO	NO					74.97
2.F.3. Fire protection				3.84	NO	NO	NO	NO					3.84
2.F.4. Aerosols				0.01	NO	NO	NO	NO					0.01
2.F.5. Solvents				NO	NO	NO	NO	NO					NO
2.F.6. Other applications				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	0.78	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.16	0.36	0.00	2.47
2.G.1. Electrical equipment				NO	0.04	NO	0.00	NO					1.69
2.G.2. SF_6 and PFCs from other product use					NO	NO	NO						NO
2.G.3. N_2O from product uses			NO										NO
2.G.4. Other	0.78	NO	NO	NO	NO	NO	NO	NO	0.01	0.16	0.36	0.00	0.78
2.H. Other [5]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.78	NO	NO
2.H.1. Pulp and Paper Industry									NO	NO	NO	NO	NO
2.H.2. Food and Beverages Industry									NO	NO	3.78	NO	NO
2.H.3. Other									NO	NO	NO	NO	NO

Annex 6-3. Sectoral Report for Sector 3 'Agriculture', 1990-2022

1990

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.58	107.38	7.90	NO	NO	NE, NO	NO, IE	5,101.04
I. Livestock		107.38	2.90			NE		3,775.93
3.A. Enteric fermentation		87.58						2,452.16
3.A.1. Cattle		74.99						2,099.82
3.A.1.a. Dairy cattle		41.41						1,159.49
3.A.1.b. Non-dairy cattle		33.58						940.32
3.A.2. Sheep		8.59						240.48
3.A.3. Swine		2.78						77.70
3.A.4. Other livestock		1.22						34.15
Goats		0.19						5.19
Horses		0.85						23.81
Mules and asses		0.02						0.47
Other (rabbits)		0.17						4.67
3.B. Manure management		19.80	2.90			NE		1,323.77
3.B.1. Cattle[3]		9.21	0.70			NE		444.58
3.B.1.a. Dairy cattle		5.33	0.32			NE		233.85
3.B.1.b. Non-dairy cattle		3.88	0.39			NE		210.73
3.B.2. Sheep		0.24	0.22			NE		64.91
3.B.3. Swine		9.49	0.38			NE		366.26
3.B.4. Other livestock		0.86	0.27			NE		96.93
Goats		0.00	0.01			NE		2.29
Horses		0.07	0.03			NE		10.50
Mules and asses		0.00	0.00			NE		0.15
Poultry		0.76	0.21			NE		75.98
Other (rabbits)		0.02	0.03			NE		8.01
3.B.5. Indirect N_2O emissions			1.32					351.09
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			5.00					1,324.53
3.D.1. Direct N_2O emissions from managed soils			3.81					1,010.70
3.D.1.a. Inorganic N fertilizers			1.45					383.53
3.D.1.b. Organic N fertilizers			0.86					227.14
Animal manure applied to soils			0.86					227.14
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.17					46.10
3.D.1.d. Crop residues			0.55					144.91
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.79					209.02
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			1.18					313.83
Atmospheric deposition			0.34					89.90
Nitrogen leaching and run-off			0.85					223.93
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.58							0.58
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.52	97.76	7.52	NO	NO	NE, NO	NO, IE	4,729.89
I. Livestock		97.76	2.71			NE		3,456.15
3.A. Enteric fermentation		81.15						2,272.33
3.A.1. Cattle		68.63						1,921.57
3.A.1.a. Dairy cattle		38.76						1,085.26
3.A.1.b. Non-dairy cattle		29.87						836.31
3.A.2. Sheep		8.61						241.15
3.A.3. Swine		2.63						73.63
3.A.4. Other livestock		1.29						35.98
Goats		0.25						6.93
Horses		0.87						24.41
Mules and asses		0.02						0.50
Other (rabbits)		0.15						4.14
3.B. Manure management		16.60	2.71			NE		1,183.82
3.B.1. Cattle[3]		7.47	0.64			NE		378.86
3.B.1.a. Dairy cattle		4.54	0.30			NE		205.55
3.B.1.b. Non-dairy cattle		2.93	0.34			NE		173.31
3.B.2. Sheep		0.24	0.22			NE		65.88
3.B.3. Swine		8.07	0.37			NE		325.12
3.B.4. Other livestock		0.83	0.26			NE		92.57
Goats		0.01	0.01			NE		3.12
Horses		0.08	0.03			NE		9.92
Mules and asses		0.00	0.00			NE		0.15
Poultry		0.73	0.20			NE		72.33
Other (rabbits)		0.02	0.02			NE		7.04
3.B.5. Indirect N_2O emissions			1.21					321.40
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			4.80					1,273.21
3.D.1. Direct N_2O emissions from managed soils			3.68					976.46
3.D.1.a. Inorganic N fertilizers			1.30					344.39
3.D.1.b. Organic N fertilizers			0.76					200.55
Animal manure applied to soils			0.76					200.55
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.23					61.31
3.D.1.d. Crop residues			0.62					163.13
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.78					207.08
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			1.12					296.76
Atmospheric deposition			0.31					82.22
Nitrogen leaching and run-off			0.81					214.54
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.52							0.52
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.39	94.80	6.44	NO	NO	NE, NO	NO, IE	4,360.93
I. Livestock		94.80	2.41			NE		3,291.72
3.A. Enteric fermentation		79.87						2,236.40
3.A.1. Cattle		67.49						1,889.59
3.A.1.a. Dairy cattle		39.18						1,097.04
3.A.1.b. Non-dairy cattle		28.31						792.54
3.A.2. Sheep		8.72						244.12
3.A.3. Swine		2.23						62.47
3.A.4. Other livestock		1.44						40.22
Goats		0.31						8.81
Horses		0.92						25.90
Mules and asses		0.02						0.59
Other (rabbits)		0.18						4.93
3.B. Manure management		14.92	2.41			NE		1,055.31
3.B.1. Cattle[3]		7.34	0.62			NE		368.75
3.B.1.a. Dairy cattle		4.58	0.29			NE		206.16
3.B.1.b. Non-dairy cattle		2.77	0.32			NE		162.59
3.B.2. Sheep		0.25	0.23			NE		67.65
3.B.3. Swine		6.69	0.29			NE		263.02
3.B.4. Other livestock		0.65	0.22			NE		76.32
Goats		0.01	0.01			NE		3.89
Horses		0.08	0.03			NE		10.81
Mules and asses		0.00	0.00			NE		0.18
Poultry		0.53	0.14			NE		53.12
Other (rabbits)		0.02	0.03			NE		8.33
3.B.5. Indirect N_2O emissions			1.06					279.58
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			4.03					1,068.82
3.D.1. Direct N_2O emissions from managed soils			3.09					818.78
3.D.1.a. Inorganic N fertilizers			0.97					257.35
3.D.1.b. Organic N fertilizers			0.71					187.01
Animal manure applied to soils			0.71					187.01
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.22					58.54
3.D.1.d. Crop residues			0.41					109.51
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.78					206.37
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.94					250.04
Atmospheric deposition			0.27					70.60
Nitrogen leaching and run-off			0.68					179.45
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.39							0.39
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.13	85.91	5.40	NO	NO	NE, NO	NO, IE	3,837.53
I. Livestock		85.91	2.03			NE		2,944.13
3.A. Enteric fermentation		74.92						2,097.65
3.A.1. Cattle		62.75						1,757.03
3.A.1.a. Dairy cattle		37.65						1,054.21
3.A.1.b. Non-dairy cattle		25.10						702.83
3.A.2. Sheep		9.01						252.27
3.A.3. Swine		1.62						45.46
3.A.4. Other livestock		1.53						42.89
Goats		0.37						10.48
Horses		0.98						27.44
Mules and asses		0.02						0.63
Other (rabbits)		0.15						4.33
3.B. Manure management		11.00	2.03			NE		846.48
3.B.1. Cattle[3]		5.50	0.55			NE		298.58
3.B.1.a. Dairy cattle		3.46	0.28			NE		170.47
3.B.1.b. Non-dairy cattle		2.04	0.27			NE		128.12
3.B.2. Sheep		0.26	0.23			NE		69.49
3.B.3. Swine		4.72	0.21			NE		187.93
3.B.4. Other livestock		0.52	0.18			NE		63.35
Goats		0.01	0.02			NE		4.51
Horses		0.08	0.03			NE		11.27
Mules and asses		0.00	0.00			NE		0.19
Poultry		0.40	0.11			NE		40.11
Other (rabbits)		0.02	0.03			NE		7.28
3.B.5. Indirect N_2O emissions			0.86					227.12
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			3.37					893.26
3.D.1. Direct N_2O emissions from managed soils			2.61					691.48
3.D.1.a. Inorganic N fertilizers			0.41					109.84
3.D.1.b. Organic N fertilizers			0.61					160.69
Animal manure applied to soils			0.61					160.69
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.28					74.97
3.D.1.d. Crop residues			0.50					131.36
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.81					214.62
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.76					201.78
Atmospheric deposition			0.20					52.51
Nitrogen leaching and run-off			0.56					149.27
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.13							0.13
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.05	83.52	4.69	NO	NO	NE, NO	NO, IE	3,581.43
I. Livestock		83.52	1.96			NE		2,858.39
3.A. Enteric fermentation		72.91						2,041.57
3.A.1. Cattle		60.43						1,692.14
3.A.1.a. Dairy cattle		37.38						1,046.55
3.A.1.b. Non-dairy cattle		23.06						645.60
3.A.2. Sheep		9.23						258.50
3.A.3. Swine		1.57						43.97
3.A.4. Other livestock		1.68						46.96
Goats		0.46						12.90
Horses		1.05						29.32
Mules and asses		0.03						0.82
Other (rabbits)		0.14						3.92
3.B. Manure management		10.61	1.96			NE		816.82
3.B.1. Cattle[3]		5.45	0.51			NE		286.92
3.B.1.a. Dairy cattle		3.52	0.28			NE		172.17
3.B.1.b. Non-dairy cattle		1.93	0.23			NE		114.76
3.B.2. Sheep		0.27	0.25			NE		73.29
3.B.3. Swine		4.35	0.20			NE		173.38
3.B.4. Other livestock		0.54	0.19			NE		65.48
Goats		0.01	0.02			NE		5.55
Horses		0.09	0.04			NE		12.54
Mules and asses		0.00	0.00			NE		0.24
Poultry		0.42	0.11			NE		40.51
Other (rabbits)		0.02	0.02			NE		6.63
3.B.5. Indirect N_2O emissions			0.82					217.75
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.73					722.98
3.D.1. Direct N_2O emissions from managed soils			2.10					557.17
3.D.1.a. Inorganic N fertilizers			0.22					58.75
3.D.1.b. Organic N fertilizers			0.59					155.90
Animal manure applied to soils			0.59					155.90
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.28					73.25
3.D.1.d. Crop residues			0.24					62.37
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.78					206.90
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.63					165.82
Atmospheric deposition			0.18					46.41
Nitrogen leaching and run-off			0.45					119.41
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.05							0.05
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.06	72.97	4.44	NO	NO	NE, NO	NO, IE	3,220.29
I. Livestock		72.97	1.73			NE		2,502.83
3.A. Enteric fermentation		64.72						1,812.26
3.A.1. Cattle		52.95						1,482.71
3.A.1.a. Dairy cattle		34.61						969.02
3.A.1.b. Non-dairy cattle		18.35						513.69
3.A.2. Sheep		8.50						237.96
3.A.3. Swine		1.52						42.69
3.A.4. Other livestock		1.75						48.90
Goats		0.48						13.50
Horses		1.11						31.04
Mules and asses		0.03						0.90
Other (rabbits)		0.12						3.46
3.B. Manure management		8.25	1.73			NE		690.57
3.B.1. Cattle[3]		3.67	0.43			NE		218.09
3.B.1.a. Dairy cattle		2.55	0.26			NE		139.59
3.B.1.b. Non-dairy cattle		1.12	0.18			NE		78.51
3.B.2. Sheep		0.25	0.21			NE		62.43
3.B.3. Swine		3.77	0.19			NE		155.16
3.B.4. Other livestock		0.56	0.18			NE		64.52
Goats		0.01	0.02			NE		5.26
Horses		0.10	0.04			NE		13.00
Mules and asses		0.00	0.00			NE		0.26
Poultry		0.43	0.11			NE		40.12
Other (rabbits)		0.02	0.02			NE		5.88
3.B.5. Indirect N_2O emissions			0.72					190.37
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.71					717.39
3.D.1. Direct N_2O emissions from managed soils			2.10					557.25
3.D.1.a. Inorganic N fertilizers			0.17					43.77
3.D.1.b. Organic N fertilizers			0.52					137.97
Animal manure applied to soils			0.52					137.97
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.29					77.29
3.D.1.d. Crop residues			0.34					90.12
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.79					208.10
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.60					160.15
Atmospheric deposition			0.16					41.47
Nitrogen leaching and run-off			0.45					118.68
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.06							0.06
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.09	67.17	3.93	NO	NO	NE, NO	NO, IE	2,921.62
I. Livestock		67.17	1.49			NE		2,276.88
3.A. Enteric fermentation		59.67						1,670.90
3.A.1. Cattle		48.28						1,351.71
3.A.1.a. Dairy cattle		32.18						901.00
3.A.1.b. Non-dairy cattle		16.10						450.71
3.A.2. Sheep		8.19						229.18
3.A.3. Swine		1.43						39.90
3.A.4. Other livestock		1.79						50.10
Goats		0.51						14.18
Horses		1.14						31.93
Mules and asses		0.03						0.86
Other (rabbits)		0.11						3.14
3.B. Manure management		7.49	1.49			NE		605.98
3.B.1. Cattle[3]		3.35	0.38			NE		195.01
3.B.1.a. Dairy cattle		2.37	0.24			NE		129.87
3.B.1.b. Non-dairy cattle		0.98	0.14			NE		65.14
3.B.2. Sheep		0.24	0.17			NE		52.42
3.B.3. Swine		3.39	0.15			NE		134.33
3.B.4. Other livestock		0.52	0.18			NE		60.99
Goats		0.01	0.02			NE		5.54
Horses		0.10	0.04			NE		13.05
Mules and asses		0.00	0.00			NE		0.25
Poultry		0.39	0.10			NE		36.94
Other (rabbits)		0.02	0.02			NE		5.21
3.B.5. Indirect N_2O emissions			0.62					163.22
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.43					644.66
3.D.1. Direct N_2O emissions from managed soils			1.89					500.12
3.D.1.a. Inorganic N fertilizers			0.21					55.04
3.D.1.b. Organic N fertilizers			0.45					120.49
Animal manure applied to soils			0.45					120.49
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.26					68.38
3.D.1.d. Crop residues			0.19					49.08
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.78					207.13
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.55					144.53
Atmospheric deposition			0.14					37.97
Nitrogen leaching and run-off			0.40					106.56
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.09							0.09
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	1.10	57.39	3.84	NO	NO	NE, NO	NO, IE	2,626.87
I. Livestock		57.39	1.35			NE		1,964.44
3.A. Enteric fermentation		51.30						1,436.51
3.A.1. Cattle		41.19						1,153.25
3.A.1.a. Dairy cattle		29.17						816.87
3.A.1.b. Non-dairy cattle		12.01						336.37
3.A.2. Sheep		7.11						199.19
3.A.3. Swine		1.20						33.50
3.A.4. Other livestock		1.81						50.57
Goats		0.49						13.86
Horses		1.18						32.97
Mules and asses		0.03						0.83
Other (rabbits)		0.10						2.92
3.B. Manure management		6.09	1.35			NE		527.93
3.B.1. Cattle[3]		2.81	0.36			NE		173.87
3.B.1.a. Dairy cattle		2.10	0.23			NE		120.83
3.B.1.b. Non-dairy cattle		0.71	0.12			NE		53.04
3.B.2. Sheep		0.22	0.16			NE		49.00
3.B.3. Swine		2.54	0.11			NE		100.97
3.B.4. Other livestock		0.52	0.17			NE		58.46
Goats		0.01	0.02			NE		4.85
Horses		0.10	0.03			NE		12.03
Mules and asses		0.00	0.00			NE		0.24
Poultry		0.39	0.10			NE		36.36
Other (rabbits)		0.01	0.02			NE		4.98
3.B.5. Indirect N_2O emissions			0.55					145.63
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.50					661.33
3.D.1. Direct N_2O emissions from managed soils			1.95					516.39
3.D.1.a. Inorganic N fertilizers			0.18					47.56
3.D.1.b. Organic N fertilizers			0.41					108.95
Animal manure applied to soils			0.41					108.95
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.24					64.49
3.D.1.d. Crop residues			0.33					87.19
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.79					208.20
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.55					144.94
Atmospheric deposition			0.13					34.41
Nitrogen leaching and run-off			0.42					110.53
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	1.10							1.10
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.27	55.43	3.75	NO	NO	NE, NO	NO, IE	2,546.35
I. Livestock		55.43	1.33			NE		1,903.10
3.A. Enteric fermentation		49.81						1,394.62
3.A.1. Cattle		40.03						1,120.85
3.A.1.a. Dairy cattle		28.78						805.92
3.A.1.b. Non-dairy cattle		11.25						314.93
3.A.2. Sheep		6.51						182.19
3.A.3. Swine		1.39						38.98
3.A.4. Other livestock		1.88						52.60
Goats		0.50						14.11
Horses		1.23						34.52
Mules and asses		0.03						0.90
Other (rabbits)		0.11						3.07
3.B. Manure management		5.62	1.33			NE		508.48
3.B.1. Cattle[3]		2.09	0.34			NE		148.91
3.B.1.a. Dairy cattle		1.61	0.22			NE		104.48
3.B.1.b. Non-dairy cattle		0.48	0.12			NE		44.43
3.B.2. Sheep		0.20	0.15			NE		44.14
3.B.3. Swine		2.78	0.13			NE		111.18
3.B.4. Other livestock		0.55	0.17			NE		61.49
Goats		0.01	0.02			NE		4.82
Horses		0.11	0.04			NE		12.50
Mules and asses		0.00	0.00			NE		0.25
Poultry		0.41	0.10			NE		38.72
Other (rabbits)		0.01	0.02			NE		5.20
3.B.5. Indirect N_2O emissions			0.54					142.76
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.43					642.97
3.D.1. Direct N_2O emissions from managed soils			1.90					502.20
3.D.1.a. Inorganic N fertilizers			0.16					42.40
3.D.1.b. Organic N fertilizers			0.40					106.37
Animal manure applied to soils			0.40					106.37
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.27					71.65
3.D.1.d. Crop residues			0.28					74.62
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.78					207.15
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.53					140.77
Atmospheric deposition			0.13					34.17
Nitrogen leaching and run-off			0.40					106.61
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.27							0.27
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.00	50.97	3.43	NO	NO	NE, NO	NO, IE	2,335.46
I. Livestock		50.97	1.20			NE		1,745.55
3.A. Enteric fermentation		46.07						1,290.04
3.A.1. Cattle		37.05						1,037.38
3.A.1.a. Dairy cattle		27.80						778.34
3.A.1.b. Non-dairy cattle		9.25						259.05
3.A.2. Sheep		5.92						165.90
3.A.3. Swine		1.13						31.56
3.A.4. Other livestock		1.97						55.20
Goats		0.53						14.93
Horses		1.30						36.30
Mules and asses		0.03						0.96
Other (rabbits)		0.11						3.02
3.B. Manure management		4.89	1.20			NE		455.51
3.B.1. Cattle[3]		1.95	0.31			NE		136.54
3.B.1.a. Dairy cattle		1.56	0.21			NE		100.41
3.B.1.b. Non-dairy cattle		0.39	0.09			NE		36.13
3.B.2. Sheep		0.18	0.13			NE		40.02
3.B.3. Swine		2.19	0.09			NE		86.01
3.B.4. Other livestock		0.57	0.18			NE		64.77
Goats		0.01	0.02			NE		5.10
Horses		0.11	0.04			NE		13.07
Mules and asses		0.00	0.00			NE		0.26
Poultry		0.43	0.11			NE		41.30
Other (rabbits)		0.01	0.02			NE		5.05
3.B.5. Indirect N_2O emissions			0.48					128.17
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.23					589.91
3.D.1. Direct N_2O emissions from managed soils			1.74					461.90
3.D.1.a. Inorganic N fertilizers			0.09					24.62
3.D.1.b. Organic N fertilizers			0.37					97.34
Animal manure applied to soils			0.37					97.34
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.25					66.60
3.D.1.d. Crop residues			0.27					72.68
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.76					200.66
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.48					128.01
Atmospheric deposition			0.11					29.99
Nitrogen leaching and run-off			0.37					98.01
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.00							0.00
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.44	47.28	3.22	NO	NO	NE, NO	NO, IE	2,178.48
I. Livestock		47.28	1.09			NE		1,613.21
3.A. Enteric fermentation		43.43						1,216.08
3.A.1. Cattle		35.34						989.63
3.A.1.a. Dairy cattle		27.25						762.93
3.A.1.b. Non-dairy cattle		8.10						226.69
3.A.2. Sheep		5.27						147.49
3.A.3. Swine		0.74						20.69
3.A.4. Other livestock		2.08						58.27
Goats		0.58						16.21
Horses		1.37						38.32
Mules and asses		0.04						1.07
Other (rabbits)		0.10						2.66
3.B. Manure management		3.84	1.09			NE		397.14
3.B.1. Cattle[3]		1.65	0.28			NE		121.22
3.B.1.a. Dairy cattle		1.31	0.21			NE		91.65
3.B.1.b. Non-dairy cattle		0.34	0.08			NE		29.57
3.B.2. Sheep		0.16	0.12			NE		35.77
3.B.3. Swine		1.45	0.07			NE		60.27
3.B.4. Other livestock		0.58	0.18			NE		64.82
Goats		0.02	0.02			NE		5.55
Horses		0.12	0.04			NE		13.97
Mules and asses		0.00	0.00			NE		0.29
Poultry		0.43	0.11			NE		40.56
Other (rabbits)		0.01	0.02			NE		4.45
3.B.5. Indirect N_2O emissions			0.43					115.05
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.13					564.83
3.D.1. Direct N_2O emissions from managed soils			1.67					441.42
3.D.1.a. Inorganic N fertilizers			0.16					42.65
3.D.1.b. Organic N fertilizers			0.34					88.98
Animal manure applied to soils			0.34					88.98
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.24					64.84
3.D.1.d. Crop residues			0.15					39.76
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.77					205.20
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.47					123.40
Atmospheric deposition			0.11					29.88
Nitrogen leaching and run-off			0.35					93.53
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.44							0.44
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.15	47.99	3.46	NO	NO	NE, NO	NO, IE	2,260.91
I. Livestock		47.99	1.10			NE		1,635.83
3.A. Enteric fermentation		44.13						1,235.66
3.A.1. Cattle		35.83						1,003.25
3.A.1.a. Dairy cattle		27.66						774.59
3.A.1.b. Non-dairy cattle		8.17						228.66
3.A.2. Sheep		5.34						149.52
3.A.3. Swine		0.74						20.61
3.A.4. Other livestock		2.22						62.29
Goats		0.60						16.82
Horses		1.47						41.11
Mules and asses		0.04						1.20
Other (rabbits)		0.11						3.16
3.B. Manure management		3.86	1.10			NE		400.17
3.B.1. Cattle[3]		1.68	0.29			NE		123.13
3.B.1.a. Dairy cattle		1.33	0.21			NE		92.39
3.B.1.b. Non-dairy cattle		0.35	0.08			NE		30.73
3.B.2. Sheep		0.16	0.11			NE		34.29
3.B.3. Swine		1.40	0.07			NE		56.55
3.B.4. Other livestock		0.62	0.20			NE		70.51
Goats		0.02	0.02			NE		5.42
Horses		0.13	0.04			NE		14.91
Mules and asses		0.00	0.00			NE		0.32
Poultry		0.46	0.12			NE		44.48
Other (rabbits)		0.02	0.02			NE		5.37
3.B.5. Indirect N_2O emissions			0.44					115.70
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.36					624.93
3.D.1. Direct N_2O emissions from managed soils			1.85					489.52
3.D.1.a. Inorganic N fertilizers			0.20					52.83
3.D.1.b. Organic N fertilizers			0.34					90.18
Animal manure applied to soils			0.34					90.18
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.25					65.75
3.D.1.d. Crop residues			0.27					71.69
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.79					209.06
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.51					135.42
Atmospheric deposition			0.12					31.20
Nitrogen leaching and run-off			0.39					104.21
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.15							0.15
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.05	49.04	3.60	NO	NO	NE, NO	NO, IE	2,328.42
I. Livestock		49.04	1.11			NE		1,667.95
3.A. Enteric fermentation		45.02						1,260.68
3.A.1. Cattle		36.58						1,024.20
3.A.1.a. Dairy cattle		28.44						796.27
3.A.1.b. Non-dairy cattle		8.14						227.93
3.A.2. Sheep		5.31						148.61
3.A.3. Swine		0.83						23.11
3.A.4. Other livestock		2.31						64.76
Goats		0.67						18.85
Horses		1.49						41.65
Mules and asses		0.04						1.11
Other (rabbits)		0.11						3.15
3.B. Manure management		4.02	1.11			NE		407.27
3.B.1. Cattle[3]		1.72	0.29			NE		124.31
3.B.1.a. Dairy cattle		1.37	0.21			NE		94.30
3.B.1.b. Non-dairy cattle		0.34	0.08			NE		30.01
3.B.2. Sheep		0.16	0.11			NE		33.21
3.B.3. Swine		1.49	0.07			NE		60.90
3.B.4. Other livestock		0.65	0.20			NE		71.72
Goats		0.02	0.02			NE		5.93
Horses		0.13	0.04			NE		14.65
Mules and asses		0.00	0.00			NE		0.30
Poultry		0.49	0.12			NE		45.52
Other (rabbits)		0.02	0.02			NE		5.33
3.B.5. Indirect N_2O emissions			0.44					117.12
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.49					660.42
3.D.1. Direct N_2O emissions from managed soils			1.95					516.38
3.D.1.a. Inorganic N fertilizers			0.28					74.80
3.D.1.b. Organic N fertilizers			0.34					90.92
Animal manure applied to soils			0.34					90.92
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.26					68.00
3.D.1.d. Crop residues			0.28					73.26
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.79					209.39
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.54					144.05
Atmospheric deposition			0.13					33.90
Nitrogen leaching and run-off			0.42					110.15
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.05							0.05
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.24	44.87	3.18	NO	NO	NE, NO	NO, IE	2,100.30
I. Livestock		44.87	1.07			NE		1,538.83
3.A. Enteric fermentation		41.14						1,151.96
3.A.1. Cattle		33.06						925.55
3.A.1.a. Dairy cattle		25.97						727.27
3.A.1.b. Non-dairy cattle		7.08						198.27
3.A.2. Sheep		5.10						142.69
3.A.3. Swine		0.71						20.01
3.A.4. Other livestock		2.28						63.72
Goats		0.65						18.09
Horses		1.47						41.04
Mules and asses		0.04						1.20
Other (rabbits)		0.12						3.39
3.B. Manure management		3.73	1.07			NE		386.87
3.B.1. Cattle[3]		1.55	0.26			NE		111.78
3.B.1.a. Dairy cattle		1.25	0.19			NE		85.73
3.B.1.b. Non-dairy cattle		0.30	0.07			NE		26.05
3.B.2. Sheep		0.16	0.11			NE		32.64
3.B.3. Swine		1.36	0.07			NE		56.53
3.B.4. Other livestock		0.66	0.21			NE		73.42
Goats		0.02	0.02			NE		5.69
Horses		0.13	0.04			NE		14.43
Mules and asses		0.00	0.00			NE		0.32
Poultry		0.50	0.13			NE		47.34
Other (rabbits)		0.02	0.02			NE		5.63
3.B.5. Indirect N_2O emissions			0.42					112.49
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.12					561.24
3.D.1. Direct N_2O emissions from managed soils			1.65					437.23
3.D.1.a. Inorganic N fertilizers			0.23					60.89
3.D.1.b. Organic N fertilizers			0.33					86.73
Animal manure applied to soils			0.33					86.73
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.24					63.11
3.D.1.d. Crop residues			0.13					34.36
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.73					192.14
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.47					124.01
Atmospheric deposition			0.12					31.15
Nitrogen leaching and run-off			0.35					92.86
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.24							0.24
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.37	41.96	3.42	NO	NO	NE, NO	NO, IE	2,080.37
I. Livestock		41.96	1.03			NE		1,446.92
3.A. Enteric fermentation		38.46						1,076.79
3.A.1. Cattle		30.40						851.13
3.A.1.a. Dairy cattle		24.18						677.03
3.A.1.b. Non-dairy cattle		6.22						174.10
3.A.2. Sheep		5.24						146.85
3.A.3. Swine		0.63						17.74
3.A.4. Other livestock		2.18						61.08
Goats		0.64						17.80
Horses		1.36						38.21
Mules and asses		0.04						1.12
Other (rabbits)		0.14						3.95
3.B. Manure management		3.50	1.03			NE		370.13
3.B.1. Cattle[3]		1.50	0.23			NE		102.50
3.B.1.a. Dairy cattle		1.20	0.17			NE		79.14
3.B.1.b. Non-dairy cattle		0.30	0.06			NE		23.36
3.B.2. Sheep		0.16	0.11			NE		32.85
3.B.3. Swine		1.13	0.06			NE		47.61
3.B.4. Other livestock		0.71	0.22			NE		78.96
Goats		0.02	0.02			NE		5.62
Horses		0.12	0.04			NE		13.58
Mules and asses		0.00	0.00			NE		0.30
Poultry		0.56	0.14			NE		52.80
Other (rabbits)		0.02	0.02			NE		6.67
3.B.5. Indirect N_2O emissions			0.41					108.21
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.39					633.08
3.D.1. Direct N_2O emissions from managed soils			1.87					495.98
3.D.1.a. Inorganic N fertilizers			0.25					66.89
3.D.1.b. Organic N fertilizers			0.31					83.07
Animal manure applied to soils			0.31					83.07
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.23					59.89
3.D.1.d. Crop residues			0.31					83.22
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.77					202.92
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.52					137.10
Atmospheric deposition			0.12					30.68
Nitrogen leaching and run-off			0.40					106.42
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.37							0.37
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.17	40.66	3.52	NO	NO	NE, NO	NO, IE	2,070.93
I. Livestock		40.66	1.10			NE		1,429.73
3.A. Enteric fermentation		36.96						1,034.91
3.A.1. Cattle		28.72						804.27
3.A.1.a. Dairy cattle		22.84						639.42
3.A.1.b. Non-dairy cattle		5.89						164.85
3.A.2. Sheep		5.36						150.17
3.A.3. Swine		0.74						20.70
3.A.4. Other livestock		2.13						59.77
Goats		0.64						17.83
Horses		1.30						36.29
Mules and asses		0.04						1.05
Other (rabbits)		0.16						4.61
3.B. Manure management		3.70	1.10			NE		394.82
3.B.1. Cattle[3]		1.38	0.21			NE		94.99
3.B.1.a. Dairy cattle		1.11	0.16			NE		73.08
3.B.1.b. Non-dairy cattle		0.27	0.05			NE		21.91
3.B.2. Sheep		0.16	0.11			NE		32.55
3.B.3. Swine		1.30	0.07			NE		54.57
3.B.4. Other livestock		0.86	0.27			NE		95.33
Goats		0.02	0.02			NE		5.61
Horses		0.11	0.04			NE		12.72
Mules and asses		0.00	0.00			NE		0.28
Poultry		0.70	0.19			NE		68.92
Other (rabbits)		0.02	0.03			NE		7.80
3.B.5. Indirect N_2O emissions			0.44					117.38
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.42					641.03
3.D.1. Direct N_2O emissions from managed soils			1.89					501.82
3.D.1.a. Inorganic N fertilizers			0.25					67.05
3.D.1.b. Organic N fertilizers			0.33					87.24
Animal manure applied to soils			0.33					87.24
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.22					59.23
3.D.1.d. Crop residues			0.32					83.49
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.77					204.80
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.53					139.21
Atmospheric deposition			0.12					31.44
Nitrogen leaching and run-off			0.41					107.78
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.17							0.17
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.15	39.94	3.45	NO	NO	NE, NO	NO, IE	2,033.09
I. Livestock		39.94	1.15			NE		1,423.94
3.A. Enteric fermentation		36.14						1,012.00
3.A.1. Cattle		27.47						769.03
3.A.1.a. Dairy cattle		21.64						606.02
3.A.1.b. Non-dairy cattle		5.82						163.01
3.A.2. Sheep		5.75						161.00
3.A.3. Swine		0.85						23.87
3.A.4. Other livestock		2.07						58.10
Goats		0.60						16.78
Horses		1.25						34.91
Mules and asses		0.04						1.02
Other (rabbits)		0.19						5.39
3.B. Manure management		3.80	1.15			NE		411.94
3.B.1. Cattle[3]		1.32	0.20			NE		91.06
3.B.1.a. Dairy cattle		1.05	0.15			NE		69.32
3.B.1.b. Non-dairy cattle		0.27	0.05			NE		21.74
3.B.2. Sheep		0.16	0.12			NE		37.11
3.B.3. Swine		1.46	0.08			NE		62.38
3.B.4. Other livestock		0.86	0.28			NE		98.18
Goats		0.02	0.02			NE		6.08
Horses		0.11	0.04			NE		12.72
Mules and asses		0.00	0.00			NE		0.28
Poultry		0.71	0.19			NE		69.95
Other (rabbits)		0.03	0.03			NE		9.15
3.B.5. Indirect N_2O emissions			0.46					123.20
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.30					609.01
3.D.1. Direct N_2O emissions from managed soils			1.79					475.60
3.D.1.a. Inorganic N fertilizers			0.22					57.50
3.D.1.b. Organic N fertilizers			0.34					90.78
Animal manure applied to soils			0.34					90.78
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.22					59.57
3.D.1.d. Crop residues			0.31					81.18
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.70					186.56
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.50					133.41
Atmospheric deposition			0.12					31.39
Nitrogen leaching and run-off			0.38					102.02
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.15							0.15
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.26	31.86	2.85	NO	NO	NE, NO	NO, IE	1,646.52
I. Livestock		31.86	0.88			NE		1,125.75
3.A. Enteric fermentation		29.20						817.65
3.A.1. Cattle		21.72						608.13
3.A.1.a. Dairy cattle		17.77						497.49
3.A.1.b. Non-dairy cattle		3.95						110.64
3.A.2. Sheep		5.19						145.40
3.A.3. Swine		0.48						13.47
3.A.4. Other livestock		1.81						50.65
Goats		0.53						14.91
Horses		1.09						30.51
Mules and asses		0.03						0.87
Other (rabbits)		0.16						4.35
3.B. Manure management		2.66	0.88			NE		308.10
3.B.1. Cattle[3]		1.05	0.16			NE		71.18
3.B.1.a. Dairy cattle		0.86	0.12			NE		56.58
3.B.1.b. Non-dairy cattle		0.18	0.04			NE		14.60
3.B.2. Sheep		0.14	0.11			NE		32.75
3.B.3. Swine		0.80	0.05			NE		34.60
3.B.4. Other livestock		0.67	0.22			NE		76.89
Goats		0.01	0.02			NE		5.40
Horses		0.09	0.03			NE		11.12
Mules and asses		0.00	0.00			NE		0.24
Poultry		0.53	0.14			NE		52.94
Other (rabbits)		0.02	0.02			NE		7.19
3.B.5. Indirect N_2O emissions			0.35					92.68
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			1.96					520.51
3.D.1. Direct N_2O emissions from managed soils			1.53					405.15
3.D.1.a. Inorganic N fertilizers			0.30					78.41
3.D.1.b. Organic N fertilizers			0.27					70.53
Animal manure applied to soils			0.27					70.53
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.18					47.67
3.D.1.d. Crop residues			0.08					21.32
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.71					187.23
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.44					115.35
Atmospheric deposition			0.11					28.05
Nitrogen leaching and run-off			0.33					87.30
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.26							0.26
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.85	30.66	3.22	NO	NO	NE, NO	NO, IE	1,712.97
I. Livestock		30.66	0.88			NE		1,092.43
3.A. Enteric fermentation		28.08						786.37
3.A.1. Cattle		20.42						571.83
3.A.1.a. Dairy cattle		16.96						474.92
3.A.1.b. Non-dairy cattle		3.46						96.90
3.A.2. Sheep		5.44						152.23
3.A.3. Swine		0.45						12.72
3.A.4. Other livestock		1.77						49.59
Goats		0.56						15.67
Horses		1.03						28.92
Mules and asses		0.03						0.89
Other (rabbits)		0.15						4.10
3.B. Manure management		2.58	0.88			NE		306.06
3.B.1. Cattle[3]		0.98	0.15			NE		65.97
3.B.1.a. Dairy cattle		0.82	0.11			NE		52.74
3.B.1.b. Non-dairy cattle		0.16	0.03			NE		13.23
3.B.2. Sheep		0.15	0.11			NE		33.80
3.B.3. Swine		0.75	0.05			NE		33.62
3.B.4. Other livestock		0.70	0.23			NE		79.74
Goats		0.01	0.02			NE		5.84
Horses		0.09	0.03			NE		10.54
Mules and asses		0.00	0.00			NE		0.24
Poultry		0.57	0.15			NE		56.15
Other (rabbits)		0.02	0.02			NE		6.96
3.B.5. Indirect N_2O emissions			0.35					92.94
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.34					619.68
3.D.1. Direct N_2O emissions from managed soils			1.83					484.84
3.D.1.a. Inorganic N fertilizers			0.34					91.33
3.D.1.b. Organic N fertilizers			0.26					70.00
Animal manure applied to soils			0.26					70.00
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.18					48.75
3.D.1.d. Crop residues			0.33					87.58
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.71					187.18
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.51					134.85
Atmospheric deposition			0.11					29.53
Nitrogen leaching and run-off			0.40					105.32
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.85							0.85
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	0.59	31.82	3.19	NO	NO	NE, NO	NO, IE	1,738.07
I. Livestock		31.82	0.99			NE		1,152.62
3.A. Enteric fermentation		28.90						809.31
3.A.1. Cattle		20.73						580.55
3.A.1.a. Dairy cattle		17.14						479.97
3.A.1.b. Non-dairy cattle		3.59						100.57
3.A.2. Sheep		5.76						161.36
3.A.3. Swine		0.61						16.95
3.A.4. Other livestock		1.80						50.45
Goats		0.60						16.84
Horses		1.01						28.26
Mules and asses		0.03						0.82
Other (rabbits)		0.16						4.53
3.B. Manure management		2.92	0.99			NE		343.31
3.B.1. Cattle[3]		0.97	0.15			NE		66.57
3.B.1.a. Dairy cattle		0.81	0.11			NE		52.80
3.B.1.b. Non-dairy cattle		0.16	0.03			NE		13.77
3.B.2. Sheep		0.15	0.12			NE		35.56
3.B.3. Swine		0.97	0.06			NE		43.94
3.B.4. Other livestock		0.82	0.26			NE		92.09
Goats		0.02	0.02			NE		6.26
Horses		0.09	0.03			NE		10.18
Mules and asses		0.00	0.00			NE		0.22
Poultry		0.70	0.18			NE		67.69
Other (rabbits)		0.02	0.03			NE		7.74
3.B.5. Indirect N_2O emissions			0.40					105.15
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.21					584.86
3.D.1. Direct N_2O emissions from managed soils			1.72					456.85
3.D.1.a. Inorganic N fertilizers			0.27					70.75
3.D.1.b. Organic N fertilizers			0.29					77.19
Animal manure applied to soils			0.29					77.19
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.19					51.65
3.D.1.d. Crop residues			0.25					65.13
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.72					192.12
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.48					128.02
Atmospheric deposition			0.11					29.26
Nitrogen leaching and run-off			0.37					98.76
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	0.59							0.59
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	1.74	31.81	3.44	NO	NO	NE, NO	NO, IE	1,804.19
I. Livestock		31.81	1.02			NE		1,161.80
3.A. Enteric fermentation		28.67						802.68
3.A.1. Cattle		20.46						572.83
3.A.1.a. Dairy cattle		16.80						470.31
3.A.1.b. Non-dairy cattle		3.66						102.52
3.A.2. Sheep		5.65						158.16
3.A.3. Swine		0.77						21.49
3.A.4. Other livestock		1.79						50.20
Goats		0.64						17.84
Horses		0.96						27.01
Mules and asses		0.03						0.77
Other (rabbits)		0.16						4.58
3.B. Manure management		3.14	1.02			NE		359.11
3.B.1. Cattle[3]		0.93	0.15			NE		64.91
3.B.1.a. Dairy cattle		0.77	0.11			NE		51.03
3.B.1.b. Non-dairy cattle		0.16	0.04			NE		13.88
3.B.2. Sheep		0.15	0.11			NE		34.12
3.B.3. Swine		1.21	0.08			NE		55.21
3.B.4. Other livestock		0.84	0.27			NE		94.86
Goats		0.02	0.02			NE		6.31
Horses		0.08	0.03			NE		9.82
Mules and asses		0.00	0.00			NE		0.21
Poultry		0.72	0.19			NE		70.69
Other (rabbits)		0.02	0.03			NE		7.84
3.B.5. Indirect N_2O emissions			0.42					110.02
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.42					640.65
3.D.1. Direct N_2O emissions from managed soils			1.89					500.96
3.D.1.a. Inorganic N fertilizers			0.32					85.70
3.D.1.b. Organic N fertilizers			0.30					79.05
Animal manure applied to soils			0.30					79.05
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.19					51.23
3.D.1.d. Crop residues			0.33					88.60
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.74					196.36
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.53					139.69
Atmospheric deposition			0.12					31.03
Nitrogen leaching and run-off			0.41					108.67
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	1.74							1.74
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	3.68	29.90	3.37	NO	NO	NE, NO	NO, IE	1,734.96
I. Livestock		29.90	0.93			NE		1,084.91
3.A. Enteric fermentation		26.93						754.04
3.A.1. Cattle		19.48						545.46
3.A.1.a. Dairy cattle		15.86						444.15
3.A.1.b. Non-dairy cattle		3.62						101.31
3.A.2. Sheep		4.98						139.36
3.A.3. Swine		0.71						19.81
3.A.4. Other livestock		1.76						49.41
Goats		0.66						18.48
Horses		0.92						25.65
Mules and asses		0.03						0.70
Other (rabbits)		0.16						4.58
3.B. Manure management		2.97	0.93			NE		330.87
3.B.1. Cattle[3]		0.89	0.14			NE		62.45
3.B.1.a. Dairy cattle		0.73	0.10			NE		48.10
3.B.1.b. Non-dairy cattle		0.16	0.04			NE		14.35
3.B.2. Sheep		0.14	0.10			NE		30.98
3.B.3. Swine		1.23	0.08			NE		54.62
3.B.4. Other livestock		0.72	0.24			NE		82.64
Goats		0.02	0.02			NE		6.53
Horses		0.08	0.03			NE		9.27
Mules and asses		0.00	0.00			NE		0.19
Poultry		0.60	0.16			NE		58.86
Other (rabbits)		0.02	0.03			NE		7.79
3.B.5. Indirect N_2O emissions			0.38					100.17
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.44					646.37
3.D.1. Direct N_2O emissions from managed soils			1.91					505.33
3.D.1.a. Inorganic N fertilizers			0.39					104.10
3.D.1.b. Organic N fertilizers			0.27					72.57
Animal manure applied to soils			0.27					72.57
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.18					47.50
3.D.1.d. Crop residues			0.33					88.51
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.73					192.65
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.53					141.05
Atmospheric deposition			0.12					31.09
Nitrogen leaching and run-off			0.41					109.95
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	3.68							3.68
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	5.59	28.31	3.19	NO	NO	NE, NO	NO, IE	1,644.45
I. Livestock		28.31	0.86			NE		1,020.79
3.A. Enteric fermentation		25.55						715.30
3.A.1. Cattle		18.31						512.56
3.A.1.a. Dairy cattle		14.83						415.13
3.A.1.b. Non-dairy cattle		3.48						97.43
3.A.2. Sheep		4.86						136.02
3.A.3. Swine		0.66						18.41
3.A.4. Other livestock		1.73						48.31
Goats		0.69						19.30
Horses		0.85						23.93
Mules and asses		0.02						0.68
Other (rabbits)		0.16						4.41
3.B. Manure management		2.76	0.86			NE		305.49
3.B.1. Cattle[3]		0.83	0.13			NE		58.64
3.B.1.a. Dairy cattle		0.68	0.10			NE		44.91
3.B.1.b. Non-dairy cattle		0.15	0.04			NE		13.73
3.B.2. Sheep		0.13	0.10			NE		31.21
3.B.3. Swine		1.20	0.07			NE		53.15
3.B.4. Other livestock		0.60	0.20			NE		70.85
Goats		0.02	0.03			NE		7.19
Horses		0.07	0.03			NE		8.90
Mules and asses		0.00	0.00			NE		0.18
Poultry		0.48	0.13			NE		47.27
Other (rabbits)		0.02	0.03			NE		7.30
3.B.5. Indirect N_2O emissions			0.35					91.65
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.33					618.06
3.D.1. Direct N_2O emissions from managed soils			1.81					479.93
3.D.1.a. Inorganic N fertilizers			0.54					141.90
3.D.1.b. Organic N fertilizers			0.25					67.24
Animal manure applied to soils			0.25					67.24
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.17					44.78
3.D.1.d. Crop residues			0.10					26.59
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.75					199.42
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.52					138.13
Atmospheric deposition			0.13					33.56
Nitrogen leaching and run-off			0.39					104.57
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	5.59							5.59
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	4.18	28.46	3.63	NO	NO	NE, NO	NO, IE	1,761.71
I. Livestock		28.46	0.81			NE		1,010.27
3.A. Enteric fermentation		25.76						721.38
3.A.1. Cattle		18.07						505.92
3.A.1.a. Dairy cattle		14.60						408.76
3.A.1.b. Non-dairy cattle		3.47						97.16
3.A.2. Sheep		5.28						147.88
3.A.3. Swine		0.67						18.68
3.A.4. Other livestock		1.75						48.91
Goats		0.72						20.24
Horses		0.83						23.17
Mules and asses		0.02						0.60
Other (rabbits)		0.17						4.89
3.B. Manure management		2.69	0.81			NE		288.89
3.B.1. Cattle[3]		0.80	0.13			NE		57.12
3.B.1.a. Dairy cattle		0.65	0.10			NE		43.55
3.B.1.b. Non-dairy cattle		0.15	0.04			NE		13.57
3.B.2. Sheep		0.14	0.11			NE		33.48
3.B.3. Swine		1.28	0.07			NE		54.15
3.B.4. Other livestock		0.48	0.17			NE		59.49
Goats		0.02	0.03			NE		8.09
Horses		0.07	0.03			NE		8.69
Mules and asses		0.00	0.00			NE		0.17
Poultry		0.36	0.09			NE		34.48
Other (rabbits)		0.02	0.03			NE		8.05
3.B.5. Indirect N_2O emissions			0.32					84.66
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.82					747.25
3.D.1. Direct N_2O emissions from managed soils			2.20					582.97
3.D.1.a. Inorganic N fertilizers			0.66					175.35
3.D.1.b. Organic N fertilizers			0.24					64.13
Animal manure applied to soils			0.24					64.13
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.16					43.29
3.D.1.d. Crop residues			0.37					96.83
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.77					203.38
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.62					164.28
Atmospheric deposition			0.14					36.24
Nitrogen leaching and run-off			0.48					128.04
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	4.18							4.18
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	10.21	29.20	4.20	NO	NO	NE, NO	NO, IE	1,940.10
I. Livestock		29.20	0.88			NE		1,051.21
3.A. Enteric fermentation		26.36						737.98
3.A.1. Cattle		18.28						511.78
3.A.1.a. Dairy cattle		14.74						412.65
3.A.1.b. Non-dairy cattle		3.54						99.13
3.A.2. Sheep		5.57						155.96
3.A.3. Swine		0.76						21.20
3.A.4. Other livestock		1.75						49.04
Goats		0.77						21.48
Horses		0.77						21.56
Mules and asses		0.02						0.61
Other (rabbits)		0.19						5.39
3.B. Manure management		2.84	0.88			NE		313.23
3.B.1. Cattle[3]		0.81	0.14			NE		59.50
3.B.1.a. Dairy cattle		0.66	0.10			NE		44.48
3.B.1.b. Non-dairy cattle		0.15	0.04			NE		15.02
3.B.2. Sheep		0.14	0.12			NE		36.90
3.B.3. Swine		1.40	0.08			NE		61.06
3.B.4. Other livestock		0.49	0.19			NE		62.82
Goats		0.02	0.03			NE		9.18
Horses		0.07	0.02			NE		7.98
Mules and asses		0.00	0.00			NE		0.17
Poultry		0.38	0.10			NE		36.37
Other (rabbits)		0.03	0.03			NE		9.12
3.B.5. Indirect N_2O emissions			0.35					92.96
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			3.32					878.68
3.D.1. Direct N_2O emissions from managed soils			2.58					682.76
3.D.1.a. Inorganic N fertilizers			0.96					254.48
3.D.1.b. Organic N fertilizers			0.26					69.30
Animal manure applied to soils			0.26					69.30
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.17					46.24
3.D.1.d. Crop residues			0.41					108.40
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.77					204.34
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.74					195.92
Atmospheric deposition			0.17					45.61
Nitrogen leaching and run-off			0.57					150.31
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	10.21							10.21
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	11.24	27.56	3.29	NO	NO	NE, NO	NO, IE	1,655.97
I. Livestock		27.56	0.81			NE		987.41
3.A. Enteric fermentation		24.80						694.45
3.A.1. Cattle		17.70						495.53
3.A.1.a. Dairy cattle		14.42						403.90
3.A.1.b. Non-dairy cattle		3.27						91.63
3.A.2. Sheep		4.64						129.79
3.A.3. Swine		0.73						20.35
3.A.4. Other livestock		1.74						48.78
Goats		0.79						22.21
Horses		0.72						20.24
Mules and asses		0.02						0.55
Other (rabbits)		0.21						5.78
3.B. Manure management		2.76	0.81			NE		292.96
3.B.1. Cattle[3]		0.79	0.14			NE		58.82
3.B.1.a. Dairy cattle		0.65	0.10			NE		44.57
3.B.1.b. Non-dairy cattle		0.14	0.04			NE		14.25
3.B.2. Sheep		0.14	0.10			NE		29.40
3.B.3. Swine		1.34	0.08			NE		57.63
3.B.4. Other livestock		0.49	0.18			NE		60.88
Goats		0.02	0.03			NE		7.55
Horses		0.06	0.02			NE		7.39
Mules and asses		0.00	0.00			NE		0.15
Poultry		0.38	0.10			NE		36.05
Other (rabbits)		0.03	0.03			NE		9.75
3.B.5. Indirect N_2O emissions			0.33					86.22
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.48					657.32
3.D.1. Direct N_2O emissions from managed soils			1.93					510.87
3.D.1.a. Inorganic N fertilizers			0.61					161.07
3.D.1.b. Organic N fertilizers			0.24					64.56
Animal manure applied to soils			0.24					64.56
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.16					42.59
3.D.1.d. Crop residues			0.14					38.37
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.77					204.28
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.55					146.44
Atmospheric deposition			0.13					34.69
Nitrogen leaching and run-off			0.42					111.75
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	11.24							11.24
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	12.27	26.68	3.71	NO	NO	NE, NO	NO, IE	1,742.64
I. Livestock		26.68	0.82			NE		963.67
3.A. Enteric fermentation		24.14						675.89
3.A.1. Cattle		17.32						485.06
3.A.1.a. Dairy cattle		13.77						385.56
3.A.1.b. Non-dairy cattle		3.55						99.51
3.A.2. Sheep		4.36						121.96
3.A.3. Swine		0.70						19.73
3.A.4. Other livestock		1.76						49.14
Goats		0.84						23.38
Horses		0.67						18.84
Mules and asses		0.03						0.86
Other (rabbits)		0.22						6.06
3.B. Manure management		2.54	0.82			NE		287.78
3.B.1. Cattle[3]		0.75	0.14			NE		56.95
3.B.1.a. Dairy cattle		0.62	0.10			NE		42.46
3.B.1.b. Non-dairy cattle		0.14	0.04			NE		14.49
3.B.2. Sheep		0.14	0.09			NE		26.54
3.B.3. Swine		1.14	0.09			NE		54.82
3.B.4. Other livestock		0.51	0.18			NE		61.66
Goats		0.02	0.03			NE		7.31
Horses		0.06	0.02			NE		6.87
Mules and asses		0.00	0.00			NE		0.23
Poultry		0.40	0.10			NE		36.96
Other (rabbits)		0.03	0.04			NE		10.30
3.B.5. Indirect N_2O emissions			0.33					87.82
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.89					766.69
3.D.1. Direct N_2O emissions from managed soils			2.26					598.91
3.D.1.a. Inorganic N fertilizers			0.68					180.77
3.D.1.b. Organic N fertilizers			0.24					63.58
Animal manure applied to soils			0.24					63.58
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.15					40.24
3.D.1.d. Crop residues			0.41					107.47
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.78					206.84
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.63					167.78
Atmospheric deposition			0.14					36.11
Nitrogen leaching and run-off			0.50					131.68
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	12.27							12.27
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	26.39	25.81	4.09	NO	NO	NE, NO	NO, IE	1,834.24
I. Livestock		25.81	0.83			NE		941.93
3.A. Enteric fermentation		23.38						654.60
3.A.1. Cattle		16.00						447.97
3.A.1.a. Dairy cattle		12.85						359.87
3.A.1.b. Non-dairy cattle		3.15						88.10
3.A.2. Sheep		4.98						139.50
3.A.3. Swine		0.66						18.47
3.A.4. Other livestock		1.74						48.66
Goats		0.85						23.84
Horses		0.61						17.20
Mules and asses		0.05						1.40
Other (rabbits)		0.22						6.22
3.B. Manure management		2.43	0.83			NE		287.33
3.B.1. Cattle[3]		0.71	0.13			NE		54.44
3.B.1.a. Dairy cattle		0.58	0.09			NE		39.61
3.B.1.b. Non-dairy cattle		0.13	0.04			NE		14.83
3.B.2. Sheep		0.13	0.11			NE		32.75
3.B.3. Swine		1.08	0.06			NE		46.89
3.B.4. Other livestock		0.52	0.20			NE		66.24
Goats		0.02	0.03			NE		9.63
Horses		0.05	0.02			NE		6.80
Mules and asses		0.00	0.00			NE		0.40
Poultry		0.41	0.10			NE		38.77
Other (rabbits)		0.03	0.04			NE		10.65
3.B.5. Indirect N_2O emissions			0.33					87.01
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			3.27					865.92
3.D.1. Direct N_2O emissions from managed soils			2.55					675.04
3.D.1.a. Inorganic N fertilizers			0.88					231.99
3.D.1.b. Organic N fertilizers			0.24					64.49
Animal manure applied to soils			0.24					64.49
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.16					42.63
3.D.1.d. Crop residues			0.48					126.59
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.79					209.34
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.72					190.88
Atmospheric deposition			0.16					41.98
Nitrogen leaching and run-off			0.56					148.91
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	26.39							26.39
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	44.16	23.04	4.21	NO	NO	NE, NO	NO, IE	1,805.17
I. Livestock		23.04	0.80			NE		856.40
3.A. Enteric fermentation		20.88						584.64
3.A.1. Cattle		14.04						393.02
3.A.1.a. Dairy cattle		11.21						313.87
3.A.1.b. Non-dairy cattle		2.83						79.16
3.A.2. Sheep		4.59						128.49
3.A.3. Swine		0.65						18.13
3.A.4. Other livestock		1.61						45.01
Goats		0.81						22.80
Horses		0.55						15.34
Mules and asses		0.04						1.06
Other (rabbits)		0.21						5.81
3.B. Manure management		2.16	0.80			NE		271.76
3.B.1. Cattle[3]		0.60	0.11			NE		46.59
3.B.1.a. Dairy cattle		0.48	0.07			NE		33.06
3.B.1.b. Non-dairy cattle		0.12	0.04			NE		13.54
3.B.2. Sheep		0.12	0.10			NE		29.62
3.B.3. Swine		1.00	0.09			NE		51.65
3.B.4. Other livestock		0.45	0.17			NE		57.45
Goats		0.02	0.03			NE		9.00
Horses		0.05	0.02			NE		5.74
Mules and asses		0.00	0.00			NE		0.29
Poultry		0.35	0.09			NE		32.52
Other (rabbits)		0.03	0.03			NE		9.91
3.B.5. Indirect N_2O emissions			0.33					86.44
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			3.41					904.61
3.D.1. Direct N_2O emissions from managed soils			2.66					704.70
3.D.1.a. Inorganic N fertilizers			1.01					267.79
3.D.1.b. Organic N fertilizers			0.23					59.79
Animal manure applied to soils			0.23					59.79
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.14					38.17
3.D.1.d. Crop residues			0.48					127.97
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.80					210.96
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.75					199.91
Atmospheric deposition			0.17					44.01
Nitrogen leaching and run-off			0.59					155.90
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	44.16							44.16
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	39.12	19.53	4.22	NO	NO	NE, NO	NO, IE	1,705.25
I. Livestock		19.53	0.63			NE		714.88
3.A. Enteric fermentation		17.48						489.47
3.A.1. Cattle		11.80						330.33
3.A.1.a. Dairy cattle		9.30						260.28
3.A.1.b. Non-dairy cattle		2.50						70.05
3.A.2. Sheep		3.59						100.58
3.A.3. Swine		0.64						18.00
3.A.4. Other livestock		1.45						40.57
Goats		0.76						21.40
Horses		0.48						13.32
Mules and asses		0.01						0.40
Other (rabbits)		0.19						5.45
3.B. Manure management		2.05	0.63			NE		225.41
3.B.1. Cattle[3]		0.52	0.10			NE		40.55
3.B.1.a. Dairy cattle		0.40	0.06			NE		27.63
3.B.1.b. Non-dairy cattle		0.11	0.04			NE		12.91
3.B.2. Sheep		0.10	0.08			NE		22.78
3.B.3. Swine		1.01	0.05			NE		41.28
3.B.4. Other livestock		0.42	0.16			NE		53.20
Goats		0.02	0.03			NE		7.47
Horses		0.04	0.01			NE		5.12
Mules and asses		0.00	0.00			NE		0.11
Poultry		0.34	0.08			NE		31.25
Other (rabbits)		0.03	0.03			NE		9.26
3.B.5. Indirect N_2O emissions			0.26					67.60
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			3.59					951.25
3.D.1. Direct N_2O emissions from managed soils			2.79					740.59
3.D.1.a. Inorganic N fertilizers			1.21					321.56
3.D.1.b. Organic N fertilizers			0.19					49.17
Animal manure applied to soils			0.19					49.17
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.12					31.84
3.D.1.d. Crop residues			0.49					130.10
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.78					207.92
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.79					210.65
Atmospheric deposition			0.17					46.32
Nitrogen leaching and run-off			0.62					164.34
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	39.12							39.12
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	42.50	17.35	3.59	NO	NO	NE, NO	NO, IE	1,479.01
I. Livestock		17.35	0.56			NE		633.38
3.A. Enteric fermentation		15.50						434.00
3.A.1. Cattle		10.23						286.36
3.A.1.a. Dairy cattle		7.89						220.93
3.A.1.b. Non-dairy cattle		2.34						65.44
3.A.2. Sheep		3.36						94.06
3.A.3. Swine		0.55						15.41
3.A.4. Other livestock		1.36						38.16
Goats		0.75						20.96
Horses		0.41						11.59
Mules and asses		0.01						0.34
Other (rabbits)		0.19						5.27
3.B. Manure management		1.85	0.56			NE		199.38
3.B.1. Cattle[3]		0.46	0.08			NE		34.77
3.B.1.a. Dairy cattle		0.35	0.05			NE		23.66
3.B.1.b. Non-dairy cattle		0.11	0.03			NE		11.10
3.B.2. Sheep		0.09	0.07			NE		21.29
3.B.3. Swine		0.93	0.04			NE		36.69
3.B.4. Other livestock		0.37	0.14			NE		47.73
Goats		0.02	0.03			NE		7.72
Horses		0.04	0.01			NE		4.47
Mules and asses		0.00	0.00			NE		0.09
Poultry		0.29	0.07			NE		26.51
Other (rabbits)		0.03	0.03			NE		8.94
3.B.5. Indirect N_2O emissions			0.22					58.90
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			3.03					803.13
3.D.1. Direct N_2O emissions from managed soils			2.34					621.39
3.D.1.a. Inorganic N fertilizers			1.18					312.22
3.D.1.b. Organic N fertilizers			0.16					43.66
Animal manure applied to soils			0.16					43.66
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.10					27.66
3.D.1.d. Crop residues			0.12					31.65
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.78					206.20
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.69					181.74
Atmospheric deposition			0.17					43.81
Nitrogen leaching and run-off			0.52					137.93
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	42.50							42.50
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	18.61	17.00	4.47	NO	NO	NE, NO	NO, IE	1,679.02
I. Livestock		17.00	0.56			NE		623.42
3.A. Enteric fermentation		15.32						429.07
3.A.1. Cattle		10.09						282.60
3.A.1.a. Dairy cattle		7.83						219.16
3.A.1.b. Non-dairy cattle		2.27						63.44
3.A.2. Sheep		3.34						93.45
3.A.3. Swine		0.56						15.61
3.A.4. Other livestock		1.34						37.40
Goats		0.74						20.58
Horses		0.36						10.03
Mules and asses		0.02						0.43
Other (rabbits)		0.23						6.36
3.B. Manure management		1.68	0.56			NE		194.35
3.B.1. Cattle[3]		0.48	0.08			NE		35.24
3.B.1.a. Dairy cattle		0.37	0.05			NE		24.80
3.B.1.b. Non-dairy cattle		0.11	0.03			NE		10.45
3.B.2. Sheep		0.08	0.07			NE		21.00
3.B.3. Swine		0.74	0.04			NE		29.96
3.B.4. Other livestock		0.38	0.15			NE		49.64
Goats		0.02	0.03			NE		8.31
Horses		0.03	0.01			NE		3.55
Mules and asses		0.00	0.00			NE		0.12
Poultry		0.29	0.07			NE		26.78
Other (rabbits)		0.03	0.04			NE		10.89
3.B.5. Indirect N_2O emissions			0.22					58.50
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			3.91					1,036.99
3.D.1. Direct N_2O emissions from managed soils			3.06					811.11
3.D.1.a. Inorganic N fertilizers			1.23					326.34
3.D.1.b. Organic N fertilizers			0.17					43.90
Animal manure applied to soils			0.17					43.90
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.10					26.73
3.D.1.d. Crop residues			0.76					200.93
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.80					213.21
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.85					225.88
Atmospheric deposition			0.17					45.17
Nitrogen leaching and run-off			0.68					180.71
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	18.61							18.61
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

GREENHOUSE GAS SOURCE AND	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SOx	Total GHG emissions [1]
SINK CATEGORIES	(kt)							CO_2 equivalents (kt) [2]
3. Total agriculture	22.66	16.47	3.30	NO	NO	NE, NO	NO, IE	1,357.09
I. Livestock		16.47	0.51			NE		596.22
3.A. Enteric fermentation		14.82						414.83
3.A.1. Cattle		9.90						277.13
3.A.1.a. Dairy cattle		7.73						216.44
3.A.1.b. Non-dairy cattle		2.17						60.69
3.A.2. Sheep		3.13						87.76
3.A.3. Swine		0.55						15.26
3.A.4. Other livestock		1.24						34.67
Goats		0.72						20.14
Horses		0.32						9.08
Mules and asses		0.02						0.44
Other (rabbits)		0.18						5.01
3.B. Manure management		1.65	0.51			NE		181.39
3.B.1. Cattle[3]		0.50	0.08			NE		35.98
3.B.1.a. Dairy cattle		0.39	0.05			NE		25.15
3.B.1.b. Non-dairy cattle		0.11	0.03			NE		10.83
3.B.2. Sheep		0.08	0.06			NE		17.63
3.B.3. Swine		0.72	0.03			NE		29.06
3.B.4. Other livestock		0.35	0.13			NE		44.59
Goats		0.02	0.02			NE		6.85
Horses		0.03	0.01			NE		3.27
Mules and asses		0.00	0.00			NE		0.12
Poultry		0.28	0.07			NE		25.78
Other (rabbits)		0.02	0.03			NE		8.58
3.B.5. Indirect N_2O emissions			0.20					54.12
3.C. Rice cultivation		NO				NO		NO
3.D. Agricultural soils[4,5]			2.79					738.21
3.D.1. Direct N_2O emissions from managed soils			2.18					578.63
3.D.1.a. Inorganic N fertilizers			0.75					197.77
3.D.1.b. Organic N fertilizers			0.15					40.01
Animal manure applied to soils			0.15					40.01
Sewage sludge applied to soils			NO, NE					NO, NE
Other organic fertilizers applied to soils			NO, NE					NO, NE
3.D.1.c. Urine and dung deposited by grazing animals			0.09					23.98
3.D.1.d. Crop residues			0.38					100.50
3.D.1.e. Mineralization/immobilization associated with loss/gain of soil organic matter			0.82					216.37
3.D.1.f. Cultivation of organic soils (i.e. histosols)			NO					NO
3.D.1.g. Other			NO					NO
3.D.2. Indirect N_2O Emissions from managed soils			0.60					159.58
Atmospheric deposition			0.12					31.07
Nitrogen leaching and run-off			0.48					128.50
3.E. Prescribed burning of savannahs		NO	NO				NO	NO
3.F. Field burning of agricultural residues		IE	IE				IE	IE
3.G. Liming	NO							NO
3.H. Urea application	22.66							22.66
3.I. Other carbon-containing fertilizers	NO, NE							NO, NE
3.J. Other	NO	NO	NO	NO	NO	NO	NO	NO

Annex 6-4. Sectoral Reports for Sector 4 'LULUCF', 1990-2022

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,830.49**	**0.11**	**0.57**	**0.10**	**3.52**	**NE**	**-1,676.01**
4.A. Forest land	**-2,563.43**	**0.01**	**0.00**	**0.01**	**0.19**	**NE**	**-2,563.08**
4.A.1. Forest land remaining forest land	-1,579.04	NE	NE	NE	NE	NE	-1,579.04
4.A.2. Land converted to forest land	-984.39	0.01	0.00	0.01	0.19	NE	-984.04
4.B. Cropland	**2,379.09**	**0.10**	**0.00**	**0.09**	**3.33**	**NE**	**2,382.50**
4.B.1. Cropland remaining cropland	2,333.34	0.10	0.00	0.09	3.33	NE	2,336.75
4.B.2. Land converted to cropland	45.75	NE	NE	NE	NE	NE	45.75
4.C. Grassland	**-1,205.69**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,205.69**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,205.69	NE	NE	NE	NE	NE	-1,205.69
4.D. Wetlands [5]	**-555.38**	**NE**	**NE**	**NE**	**NE**	**NE**	**-555.38**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-555.38	NE	NE	NE	NE	NE	-555.38
4.E. Settlements	**84.75**	**NO, NE**	**0.57**	**NE**	**NE**	**NE**	**235.46**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	84.75	NO	0.57	NE	NE	NE	235.46
4.F. Other land [6]	**152.36**	**NE**	**NE**	**NE**	**NE**	**NE**	**152.36**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	152.36	NE	NE	NE	NE	NE	152.36
4.G. Harvested wood products [7]	-122.18						-122.18
4.H. Other	NE	NE	NE	NE	NE	NE	NE

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,907.84**	**0.10**	**0.62**	**0.09**	**3.26**	**NE**	**-2,741.63**
4.A. Forest land	**-2,343.31**	**0.00**	**0.00**	**0.00**	**0.03**	**NE**	**-2,343.25**
4.A.1. Forest land remaining forest land	-1,352.65	NE	NE	NE	NE	NE	-1,352.65
4.A.2. Land converted to forest land	-990.66	0.00	0.00	0.00	0.03	NE	-990.60
4.B. Cropland	**1,248.78**	**0.09**	**0.00**	**0.09**	**3.22**	**NE**	**1,252.08**
4.B.1. Cropland remaining cropland	1,221.40	0.09	0.00	0.09	3.22	NE	1,224.70
4.B.2. Land converted to cropland	27.39	NE	NE	NE	NE	NE	27.39
4.C. Grassland	**-1,414.32**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,414.32**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,414.32	NE	NE	NE	NE	NE	-1,414.32
4.D. Wetlands [5]	**-526.46**	**NE**	**NE**	**NE**	**NE**	**NE**	**-526.46**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-526.46	NE	NE	NE	NE	NE	-526.46
4.E. Settlements	**88.71**	**NO, NE**	**0.61**	**NE**	**NE**	**NE**	**251.56**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	88.71	NO	0.61	NE	NE	NE	251.56
4.F. Other land [6]	**152.36**	**NE**	**NE**	**NE**	**NE**	**NE**	**152.36**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	152.36	NE	NE	NE	NE	NE	152.36
4.G. Harvested wood products [7]	-113.61						-113.61
4.H. Other	NE	NE	NE	NE	NE	NE	NE

1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,322.98**	**0.09**	**0.69**	**0.08**	**2.98**	**NE**	**-2,138.53**
4.A. Forest land	**-2,184.24**	**0.00**	**0.00**	**0.00**	**0.03**	**NE**	**-2,184.18**
4.A.1. Forest land remaining forest land	-1,290.42	NE	NE	NE	NE	NE	-1,290.42
4.A.2. Land converted to forest land	-893.82	0.00	0.00	0.00	0.03	NE	-893.75
4.B. Cropland	**1,174.19**	**0.09**	**0.00**	**0.08**	**2.94**	**NE**	**1,177.20**
4.B.1. Cropland remaining cropland	1,301.63	0.09	0.00	0.08	2.94	NE	1,304.64
4.B.2. Land converted to cropland	-127.44	NE	NE	NE	NE	NE	-127.44
4.C. Grassland	**-1,428.48**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,428.48**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,428.48	NE	NE	NE	NE	NE	-1,428.48
4.D. Wetlands [5]	**-595.55**	**NE**	**NE**	**NE**	**NE**	**NE**	**-595.55**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-595.55	NE	NE	NE	NE	NE	-595.55
4.E. Settlements	**386.62**	**NO, NE**	**0.68**	**NE**	**NE**	**NE**	**567.99**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	386.62	NO	0.68	NE	NE	NE	567.99
4.F. Other land [6]	**418.78**	**NE**	**NE**	**NE**	**NE**	**NE**	**418.78**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	418.78	NE	NE	NE	NE	NE	418.78
4.G. Harvested wood products [7]	-94.30						-94.30
4.H. Other	NE	NE	NE	NE	NE	NE	NE

1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,364.70**	**0.12**	**0.75**	**0.11**	**4.02**	**NE**	**-2,163.47**
4.A. Forest land	**-2,193.51**	**0.00**	**0.00**	**0.00**	**0.00**	**NE**	**-2,193.51**
4.A.1. Forest land remaining forest land	-1,367.44	NE	NE	NE	NE	NE	-1,367.44
4.A.2. Land converted to forest land	-826.08	0.00	0.00	0.00	0.00	NE	-826.07
4.B. Cropland	**1,443.00**	**0.12**	**0.00**	**0.11**	**4.01**	**NE**	**1,447.10**
4.B.1. Cropland remaining cropland	1,437.81	0.12	0.00	0.11	4.01	NE	1,441.91
4.B.2. Land converted to cropland	5.19	NE	NE	NE	NE	NE	5.19
4.C. Grassland	**-1,303.52**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,303.52**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,303.52	NE	NE	NE	NE	NE	-1,303.52
4.D. Wetlands [5]	**-525.84**	**NE**	**NE**	**NE**	**NE**	**NE**	**-525.84**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-525.84	NE	NE	NE	NE	NE	-525.84
4.E. Settlements	**114.62**	**NO, NE**	**0.74**	**NE**	**NE**	**NE**	**311.73**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	114.62	NO	0.74	NE	NE	NE	311.73
4.F. Other land [6]	**164.02**	**NE**	**NE**	**NE**	**NE**	**NE**	**164.02**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	164.02	NE	NE	NE	NE	NE	164.02
4.G. Harvested wood products [7]	-63.45						-63.45
4.H. Other	NE	NE	NE	NE	NE	NE	NE

1994

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,311.29**	**0.07**	**0.79**	**0.06**	**2.23**	**NE**	**-2,099.09**
4.A. Forest land	**-2,108.00**	**0.00**	**0.00**	**0.00**	**0.05**	**NE**	**-2,107.90**
4.A.1. Forest land remaining forest land	-1,355.18	NE	NE	NE	NE	NE	-1,355.18
4.A.2. Land converted to forest land	-752.83	0.00	0.00	0.00	0.05	NE	-752.73
4.B. Cropland	**1,206.39**	**0.06**	**0.00**	**0.06**	**2.18**	**NE**	**1,208.61**
4.B.1. Cropland remaining cropland	1,209.79	0.06	0.00	0.06	2.18	NE	1,212.02
4.B.2. Land converted to cropland	-3.40	NE	NE	NE	NE	NE	-3.40
4.C. Grassland	**-1,577.33**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,577.33**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,577.33	NE	NE	NE	NE	NE	-1,577.33
4.D. Wetlands [5]	**-497.64**	**NE**	**NE**	**NE**	**NE**	**NE**	**-497.64**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-497.64	NE	NE	NE	NE	NE	-497.64
4.E. Settlements	**130.49**	**NO, NE**	**0.79**	**NE**	**NE**	**NE**	**340.36**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	130.49	NO	0.79	NE	NE	NE	340.36
4.F. Other land [6]	**549.46**	**NE**	**NE**	**NE**	**NE**	**NE**	**549.46**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	549.46	NE	NE	NE	NE	NE	549.46
4.G. Harvested wood products [7]	-14.65						-14.65
4.H. Other	NE	NE	NE	NE	NE	NE	NE

1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,284.87**	**0.09**	**0.84**	**0.08**	**3.05**	**NE**	**-2,058.69**
4.A. Forest land	**-2,045.07**	**0.00**	**0.00**	**0.00**	**0.00**	**NE**	**-2,045.06**
4.A.1. Forest land remaining forest land	-1,350.20	NE	NE	NE	NE	NE	-1,350.20
4.A.2. Land converted to forest land	-694.87	0.00	0.00	0.00	0.00	NE	-694.86
4.B. Cropland	**1,316.72**	**0.09**	**0.00**	**0.08**	**3.05**	**NE**	**1,319.84**
4.B.1. Cropland remaining cropland	1,383.08	0.09	0.00	0.08	3.05	NE	1,386.19
4.B.2. Land converted to cropland	-66.35	NE	NE	NE	NE	NE	-66.35
4.C. Grassland	**-1,601.10**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,601.10**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,601.10	NE	NE	NE	NE	NE	-1,601.10
4.D. Wetlands [5]	**-469.44**	**NE**	**NE**	**NE**	**NE**	**NE**	**-469.44**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-469.44	NE	NE	NE	NE	NE	-469.44
4.E. Settlements	**106.92**	**NO, NE**	**0.84**	**NE**	**NE**	**NE**	**329.96**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	106.92	NO	0.84	NE	NE	NE	329.96
4.F. Other land [6]	**401.13**	**NE**	**NE**	**NE**	**NE**	**NE**	**401.13**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	401.13	NE	NE	NE	NE	NE	401.13
4.G. Harvested wood products [7]	5.97						5.97
4.H. Other	NE	NE	NE	NE	NE	NE	NE

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,740.53**	**0.06**	**0.88**	**0.06**	**2.09**	**NE**	**-2,505.59**
4.A. Forest land	**-2,190.43**	**0.00**	**0.00**	**0.00**	**0.02**	**NE**	**-2,190.40**
4.A.1. Forest land remaining forest land	-1,559.05	NE	NE	NE	NE	NE	-1,559.05
4.A.2. Land converted to forest land	-631.39	0.00	0.00	0.00	0.02	NE	-631.35
4.B. Cropland	**1,118.52**	**0.06**	**0.00**	**0.06**	**2.07**	**NE**	**1,120.65**
4.B.1. Cropland remaining cropland	1,219.68	0.06	0.00	0.06	2.07	NE	1,221.80
4.B.2. Land converted to cropland	-101.15	NE	NE	NE	NE	NE	-101.15
4.C. Grassland	**-1,548.08**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,548.08**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,548.08	NE	NE	NE	NE	NE	-1,548.08
4.D. Wetlands [5]	**-441.24**	**NE**	**NE**	**NE**	**NE**	**NE**	**-441.24**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-441.24	NE	NE	NE	NE	NE	-441.24
4.E. Settlements	**101.59**	**NO, NE**	**0.88**	**NE**	**NE**	**NE**	**334.38**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	101.59	NO	0.88	NE	NE	NE	334.38
4.F. Other land [6]	**217.33**	**NE**	**NE**	**NE**	**NE**	**NE**	**217.33**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	217.33	NE	NE	NE	NE	NE	217.33
4.G. Harvested wood products [7]	1.78						1.78
4.H. Other	NE	NE	NE	NE	NE	NE	NE

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,390.60**	**0.11**	**0.91**	**0.10**	**3.66**	**NE**	**-2,145.55**
4.A. Forest land	**-2,232.29**	**0.00**	**0.00**	**0.00**	**0.01**	**NE**	**-2,232.28**
4.A.1. Forest land remaining forest land	-1,639.49	NE	NE	NE	NE	NE	-1,639.49
4.A.2. Land converted to forest land	-592.79	0.00	0.00	0.00	0.01	NE	-592.78
4.B. Cropland	**1,385.79**	**0.11**	**0.00**	**0.10**	**3.66**	**NE**	**1,389.53**
4.B.1. Cropland remaining cropland	1,531.81	0.11	0.00	0.10	3.66	NE	1,535.55
4.B.2. Land converted to cropland	-146.02	NE	NE	NE	NE	NE	-146.02
4.C. Grassland	**-1,400.86**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,400.86**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,400.86	NE	NE	NE	NE	NE	-1,400.86
4.D. Wetlands [5]	**-413.03**	**NE**	**NE**	**NE**	**NE**	**NE**	**-413.03**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-413.03	NE	NE	NE	NE	NE	-413.03
4.E. Settlements	**100.80**	**NO, NE**	**0.91**	**NE**	**NE**	**NE**	**100.80**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	100.80	NO	0.91	NE	NE	NE	342.10
4.F. Other land [6]	**188.24**	**NE**	**NE**	**NE**	**NE**	**NE**	**188.24**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	188.24	NE	NE	NE	NE	NE	188.24
4.G. Harvested wood products [7]	-19.24						-19.24
4.H. Other	NE	NE	NE	NE	NE	NE	NE

1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,422.61**	**0.10**	**0.95**	**0.09**	**3.34**	**NE**	**-2,166.97**
4.A. Forest land	**-2,288.49**	**0.00**	**0.00**	**0.00**	**0.05**	**NE**	**-2,288.39**
4.A.1. Forest land remaining forest land	-1,732.32	NE	NE	NE	NE	NE	-1,732.32
4.A.2. Land converted to forest land	-556.17	0.00	0.00	0.00	0.05	NE	-556.07
4.B. Cropland	**1,412.06**	**0.10**	**0.00**	**0.09**	**3.29**	**NE**	**1,415.42**
4.B.1. Cropland remaining cropland	1,566.68	0.10	0.00	0.09	3.29	NE	1,570.05
4.B.2. Land converted to cropland	-154.62	NE	NE	NE	NE	NE	-154.62
4.C. Grassland	**-1,436.27**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,436.27**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,436.27	NE	NE	NE	NE	NE	-1,436.27
4.D. Wetlands [5]	**-384.83**	**NE**	**NE**	**NE**	**NE**	**NE**	**-384.83**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-384.83	NE	NE	NE	NE	NE	-384.83
4.E. Settlements	**99.04**	**NO, NE**	**0.95**	**NE**	**NE**	**NE**	**351.21**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	99.04	NO	0.95	NE	NE	NE	351.21
4.F. Other land [6]	**185.01**	**NE**	**NE**	**NE**	**NE**	**NE**	**185.01**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	185.01	NE	NE	NE	NE	NE	185.01
4.G. Harvested wood products [7]	-9.13						-9.13
4.H. Other	NE	NE	NE	NE	NE	NE	NE

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,140.44**	**0.10**	**0.99**	**0.09**	**3.24**	**NE**	**-1,876.44**
4.A. Forest land	**-2,336.85**	**0.00**	**0.00**	**0.00**	**0.04**	**NE**	**-2,336.77**
4.A.1. Forest land remaining forest land	-1,840.91	NE	NE	NE	NE	NE	-1,840.91
4.A.2. Land converted to forest land	-495.94	0.00	0.00	0.00	0.04	NE	-495.87
4.B. Cropland	**1,430.80**	**0.09**	**0.00**	**0.09**	**3.20**	**NE**	**1,434.07**
4.B.1. Cropland remaining cropland	1,543.24	0.09	0.00	0.09	3.20	NE	1,546.51
4.B.2. Land converted to cropland	-112.44	NE	NE	NE	NE	NE	-112.44
4.C. Grassland	**-1,433.29**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,433.29**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,433.29	NE	NE	NE	NE	NE	-1,433.29
4.D. Wetlands [5]	**-356.63**	**NE**	**NE**	**NE**	**NE**	**NE**	**-356.63**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-356.63	NE	NE	NE	NE	NE	-356.63
4.E. Settlements	**111.83**	**NO, NE**	**0.98**	**NE**	**NE**	**NE**	**372.47**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	111.83	NO	0.98	NE	NE	NE	372.47
4.F. Other land [6]	**425.16**	**NE**	**NE**	**NE**	**NE**	**NE**	**425.16**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	425.16	NE	NE	NE	NE	NE	425.16
4.G. Harvested wood products [7]	18.54						18.54
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,420.58**	**0.04**	**0.99**	**0.03**	**1.24**	**NE**	**-2,156.04**
4.A. Forest land	**-2,307.44**	**0.00**	**0.00**	**0.00**	**0.00**	**NE**	**-2,307.44**
4.A.1. Forest land remaining forest land	-1,881.45	NE	NE	NE	NE	NE	-1,881.45
4.A.2. Land converted to forest land	-425.98	0.00	0.00	0.00	0.00	NE	-425.98
4.B. Cropland	**1,222.73**	**0.04**	**0.00**	**0.03**	**1.24**	**NE**	**1,224.00**
4.B.1. Cropland remaining cropland	1,349.37	0.04	0.00	0.03	1.24	NE	1,350.64
4.B.2. Land converted to cropland	-126.64	NE	NE	NE	NE	NE	-126.64
4.C. Grassland	**-1,291.95**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,291.95**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,291.95	NE	NE	NE	NE	NE	-1,291.95
4.D. Wetlands [5]	**-328.42**	**NE**	**NE**	**NE**	**NE**	**NE**	**-328.42**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-328.42	NE	NE	NE	NE	NE	-328.42
4.E. Settlements	**100.18**	**NO, NE**	**0.99**	**NE**	**NE**	**NE**	**363.44**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	100.18	NO	0.99	NE	NE	NE	363.44
4.F. Other land [6]	**178.52**	**NE**	**NE**	**NE**	**NE**	**NE**	**178.52**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	178.52	NE	NE	NE	NE	NE	178.52
4.G. Harvested wood products [7]	5.81						5.81
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,064.79**	**0.05**	**1.00**	**0.05**	**1.69**	**NE**	**-1,799.66**
4.A. Forest land	**-2,273.70**	**0.00**	**0.00**	**0.00**	**0.09**	**NE**	**-2,273.53**
4.A.1. Forest land remaining forest land	-1,873.56	NE	NE	NE	NE	NE	-1,873.56
4.A.2. Land converted to forest land	-400.15	0.00	0.00	0.00	0.09	NE	-399.98
4.B. Cropland	**1,560.44**	**0.05**	**0.00**	**0.04**	**1.60**	**NE**	**1,562.07**
4.B.1. Cropland remaining cropland	1,731.69	0.05	0.00	0.04	1.60	NE	1,733.32
4.B.2. Land converted to cropland	-171.25	NE	NE	NE	NE	NE	-171.25
4.C. Grassland	**-1,290.65**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,290.65**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,290.65	NE	NE	NE	NE	NE	-1,290.65
4.D. Wetlands [5]	**-300.22**	**NE**	**NE**	**NE**	**NE**	**NE**	**-300.22**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-300.22	NE	NE	NE	NE	NE	-300.22
4.E. Settlements	**67.09**	**NO, NE**	**0.99**	**NE**	**NE**	**NE**	**330.42**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	67.09	NO	0.99	NE	NE	NE	330.42
4.F. Other land [6]	**178.52**	**NE**	**NE**	**NE**	**NE**	**NE**	**178.52**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	178.52	NE	NE	NE	NE	NE	178.52
4.G. Harvested wood products [7]	-6.26						-6.26
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,151.54**	**0.01**	**1.00**	**0.01**	**0.34**	**NE**	**-1,887.18**
4.A. Forest land	**-2,267.62**	**0.00**	**0.00**	**0.00**	**0.05**	**NE**	**-2,267.53**
4.A.1. Forest land remaining forest land	-1,913.58	NE	NE	NE	NE	NE	-1,913.58
4.A.2. Land converted to forest land	-354.04	0.00	0.00	0.00	0.05	NE	-353.95
4.B. Cropland	**1,156.59**	**0.01**	**0.00**	**0.01**	**0.29**	**NE**	**1,156.88**
4.B.1. Cropland remaining cropland	1,300.69	0.01	0.00	0.01	0.29	NE	1,300.99
4.B.2. Land converted to cropland	-144.11	NE	NE	NE	NE	NE	-144.11
4.C. Grassland	**-1,235.14**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,235.14**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,235.14	NE	NE	NE	NE	NE	-1,235.14
4.D. Wetlands [5]	**-272.02**	**NE**	**NE**	**NE**	**NE**	**NE**	**-272.02**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-272.02	NE	NE	NE	NE	NE	-272.02
4.E. Settlements	**67.09**	**NO, NE**	**1.00**	**NE**	**NE**	**NE**	**331.07**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	67.09	NO	1.00	NE	NE	NE	331.07
4.F. Other land [6]	**456.24**	**NE**	**NE**	**NE**	**NE**	**NE**	**456.24**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	456.24	NE	NE	NE	NE	NE	456.24
4.G. Harvested wood products [7]	-56.69						-56.69
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,079.15**	**0.00**	**0.99**	**0.00**	**0.06**	**NE**	**-1,817.34**
4.A. Forest land	**-2,270.12**	**0.00**	**0.00**	**0.00**	**0.05**	**NE**	**-2,270.02**
4.A.1. Forest land remaining forest land	-1,863.87	NE	NE	NE	NE	NE	-1,863.87
4.A.2. Land converted to forest land	-406.25	0.00	0.00	0.00	0.05	NE	-406.15
4.B. Cropland	**1,237.55**	**0.00**	**0.00**	**0.00**	**0.00**	**NE**	**1,237.56**
4.B.1. Cropland remaining cropland	1,376.95	0.00	0.00	0.00	0.00	NE	1,376.96
4.B.2. Land converted to cropland	-139.40	NE	NE	NE	NE	NE	-139.40
4.C. Grassland	**-1,007.18**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,007.18**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,007.18	NE	NE	NE	NE	NE	-1,007.18
4.D. Wetlands [5]	**-243.82**	**NE**	**NE**	**NE**	**NE**	**NE**	**-243.82**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-243.82	NE	NE	NE	NE	NE	-243.82
4.E. Settlements	**67.86**	**NO, NE**	**0.99**	**NE**	**NE**	**NE**	**67.86**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	67.86	NO	0.99	NE	NE	NE	329.57
4.F. Other land [6]	**201.66**	**NE**	**NE**	**NE**	**NE**	**NE**	**201.66**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	201.66	NE	NE	NE	NE	NE	201.66
4.G. Harvested wood products [7]	-65.11						-65.11
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,248.26**	**0.01**	**0.97**	**0.01**	**0.21**	**NE**	**-1,990.04**
4.A. Forest land	**-2,334.78**	**0.01**	**0.00**	**0.00**	**0.14**	**NE**	**-2,334.52**
4.A.1. Forest land remaining forest land	-1,904.34	NE	NE	NE	NE	NE	-1,904.34
4.A.2. Land converted to forest land	-430.44	0.01	0.00	0.00	0.14	NE	-430.18
4.B. Cropland	**1,198.59**	**0.00**	**0.00**	**0.00**	**0.07**	**NE**	**1,198.66**
4.B.1. Cropland remaining cropland	1,321.99	0.00	0.00	0.00	0.07	NE	1,322.06
4.B.2. Land converted to cropland	-123.40	NE	NE	NE	NE	NE	-123.40
4.C. Grassland	**-1,120.48**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,120.48**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,120.48	NE	NE	NE	NE	NE	-1,120.48
4.D. Wetlands [5]	**-215.61**	**NE**	**NE**	**NE**	**NE**	**NE**	**-215.61**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-215.61	NE	NE	NE	NE	NE	-215.61
4.E. Settlements	**53.67**	**NO, NE**	**0.97**	**NE**	**NE**	**NE**	**311.57**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	53.67	NO	0.97	NE	NE	NE	311.57
4.F. Other land [6]	**223.82**	**NE**	**NE**	**NE**	**NE**	**NE**	**223.82**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	223.82	NE	NE	NE	NE	NE	223.82
4.G. Harvested wood products [7]	-53.47						-53.47
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,954.31**	**0.01**	**0.96**	**0.01**	**0.33**	**NE**	**-1,699.22**
4.A. Forest land	**-2,409.52**	**0.00**	**0.00**	**0.00**	**0.01**	**NE**	**-2,409.49**
4.A.1. Forest land remaining forest land	-1,966.00	NE	NE	NE	NE	NE	-1,966.00
4.A.2. Land converted to forest land	-443.52	0.00	0.00	0.00	0.01	NE	-443.50
4.B. Cropland	**1,271.68**	**0.01**	**0.00**	**0.01**	**0.32**	**NE**	**1,272.01**
4.B.1. Cropland remaining cropland	1,359.37	0.01	0.00	0.01	0.32	NE	1,359.69
4.B.2. Land converted to cropland	-87.69	NE	NE	NE	NE	NE	-87.69
4.C. Grassland	**-1,058.12**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,058.12**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,058.12	NE	NE	NE	NE	NE	-1,058.12
4.D. Wetlands [5]	**-187.41**	**NE**	**NE**	**NE**	**NE**	**NE**	**-187.41**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-187.41	NE	NE	NE	NE	NE	-187.41
4.E. Settlements	**53.67**	**NO, NE**	**0.96**	**NE**	**NE**	**NE**	**308.41**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	53.67	NO	0.96	NE	NE	NE	308.41
4.F. Other land [6]	**416.50**	**NE**	**NE**	**NE**	**NE**	**NE**	**416.50**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	416.50	NE	NE	NE	NE	NE	416.50
4.G. Harvested wood products [7]	-41.11						-41.11
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,076.24**	**0.01**	**0.95**	**0.01**	**0.27**	**NE**	**-1,824.65**
4.A. Forest land	**-2,366.52**	**0.01**	**0.00**	**0.00**	**0.14**	**NE**	**-2,366.25**
4.A.1. Forest land remaining forest land	-1,882.93	NE	NE	NE	NE	NE	-1,882.93
4.A.2. Land converted to forest land	-483.58	0.01	0.00	0.00	0.14	NE	-483.32
4.B. Cropland	**1,303.27**	**0.00**	**0.00**	**0.00**	**0.13**	**NE**	**1,303.40**
4.B.1. Cropland remaining cropland	1,391.96	0.00	0.00	0.00	0.13	NE	1,392.09
4.B.2. Land converted to cropland	-88.69	NE	NE	NE	NE	NE	-88.69
4.C. Grassland	**-1,056.37**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,056.37**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,056.37	NE	NE	NE	NE	NE	-1,056.37
4.D. Wetlands [5]	**-159.21**	**NE**	**NE**	**NE**	**NE**	**NE**	**-159.21**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-159.21	NE	NE	NE	NE	NE	-159.21
4.E. Settlements	**53.67**	**NO, NE**	**0.95**	**NE**	**NE**	**NE**	**304.86**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	53.67	NO	0.95	NE	NE	NE	304.86
4.F. Other land [6]	**189.50**	**NE**	**NE**	**NE**	**NE**	**NE**	**189.50**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	189.50	NE	NE	NE	NE	NE	189.50
4.G. Harvested wood products [7]	-40.59						-40.59
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-2,268.71**	**0.06**	**0.93**	**0.04**	**1.45**	**NE**	**-2,019.78**
4.A. Forest land	**-2,460.39**	**0.05**	**0.00**	**0.03**	**1.24**	**NE**	**-2,458.06**
4.A.1. Forest land remaining forest land	-1,985.96	NE	NE	NE	NE	NE	-1,985.96
4.A.2. Land converted to forest land	-474.43	0.05	0.00	0.03	1.24	NE	-472.10
4.B. Cropland	**1,266.13**	**0.01**	**0.00**	**0.01**	**0.21**	**NE**	**1,266.34**
4.B.1. Cropland remaining cropland	1,346.90	0.01	0.00	0.01	0.21	NE	1,347.11
4.B.2. Land converted to cropland	-80.78	NE	NE	NE	NE	NE	-80.78
4.C. Grassland	**-1,031.24**	**NE**	**NE**	**NE**	**NE**	**NE**	**-1,031.24**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-1,031.24	NE	NE	NE	NE	NE	-1,031.24
4.D. Wetlands [5]	**-131.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**-131.00**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-131.00	NE	NE	NE	NE	NE	-131.00
4.E. Settlements	**49.27**	**NO, NE**	**0.93**	**NE**	**NE**	**NE**	**295.66**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	49.27	NO	0.93	NE	NE	NE	295.66
4.F. Other land [6]	**83.11**	**NE**	**NE**	**NE**	**NE**	**NE**	**83.11**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	83.11	NE	NE	NE	NE	NE	83.11
4.G. Harvested wood products [7]	-44.59						-44.59
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2008

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,956.39**	**0.03**	**0.91**	**0.03**	**1.01**	**NE**	**-1,713.63**
4.A. Forest land	**-2,462.79**	**0.00**	**0.00**	**0.00**	**0.09**	**NE**	**-2,462.63**
4.A.1. Forest land remaining forest land	-1,985.38	NE	NE	NE	NE	NE	-1,985.38
4.A.2. Land converted to forest land	-477.41	0.00	0.00	0.00	0.09	NE	-477.24
4.B. Cropland	**1,236.67**	**0.03**	**0.00**	**0.03**	**0.92**	**NE**	**1,237.62**
4.B.1. Cropland remaining cropland	1,329.19	0.03	0.00	0.03	0.92	NE	1,330.13
4.B.2. Land converted to cropland	-92.51	NE	NE	NE	NE	NE	-92.51
4.C. Grassland	**-932.15**	**NE**	**NE**	**NE**	**NE**	**NE**	**-932.15**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-932.15	NE	NE	NE	NE	NE	-932.15
4.D. Wetlands [5]	**-102.80**	**NE**	**NE**	**NE**	**NE**	**NE**	**-102.80**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-102.80	NE	NE	NE	NE	NE	-102.80
4.E. Settlements	**49.27**	**NO, NE**	**0.91**	**NE**	**NE**	**NE**	**290.94**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	49.27	NO	0.91	NE	NE	NE	290.94
4.F. Other land [6]	**291.00**	**NE**	**NE**	**NE**	**NE**	**NE**	**291.00**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	291.00	NE	NE	NE	NE	NE	291.00
4.G. Harvested wood products [7]	-35.61						-35.61
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2009

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,560.64**	**0.01**	**0.89**	**0.01**	**0.32**	**NE**	**-1,324.34**
4.A. Forest land	**-2,526.07**	**0.01**	**0.00**	**0.01**	**0.21**	**NE**	**-2,525.67**
4.A.1. Forest land remaining forest land	-2,008.95	NE	NE	NE	NE	NE	-2,008.95
4.A.2. Land converted to forest land	-517.12	0.01	0.00	0.01	0.21	NE	-516.73
4.B. Cropland	**1,390.69**	**0.00**	**0.00**	**0.00**	**0.11**	**NE**	**1,390.80**
4.B.1. Cropland remaining cropland	1,469.75	0.00	0.00	0.00	0.11	NE	1,469.87
4.B.2. Land converted to cropland	-79.07	NE	NE	NE	NE	NE	-79.07
4.C. Grassland	**-447.69**	**NE**	**NE**	**NE**	**NE**	**NE**	**-447.69**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-447.69	NE	NE	NE	NE	NE	-447.69
4.D. Wetlands [5]	**-74.60**	**NE**	**NE**	**NE**	**NE**	**NE**	**-74.60**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-74.60	NE	NE	NE	NE	NE	-74.60
4.E. Settlements	**45.57**	**NO, NE**	**0.89**	**NE**	**NE**	**NE**	**281.36**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	45.57	NO	0.89	NE	NE	NE	281.36
4.F. Other land [6]	**79.94**	**NE**	**NE**	**NE**	**NE**	**NE**	**79.94**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	79.94	NE	NE	NE	NE	NE	79.94
4.G. Harvested wood products [7]	-28.47						-28.47
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2010

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,486.52**	**0.01**	**0.87**	**0.00**	**0.15**	**NE**	**-1,256.74**
4.A. Forest land	**-2,484.16**	**0.00**	**0.00**	**0.00**	**0.07**	**NE**	**-2,484.02**
4.A.1. Forest land remaining forest land	-1,964.09	NE	NE	NE	NE	NE	-1,964.09
4.A.2. Land converted to forest land	-520.08	0.00	0.00	0.00	0.07	NE	-519.94
4.B. Cropland	**1,271.78**	**0.00**	**0.00**	**0.00**	**0.08**	**NE**	**1,271.86**
4.B.1. Cropland remaining cropland	1,344.75	0.00	0.00	0.00	0.08	NE	1,344.83
4.B.2. Land converted to cropland	-72.97	NE	NE	NE	NE	NE	-72.97
4.C. Grassland	**-691.99**	**NE**	**NE**	**NE**	**NE**	**NE**	**-691.99**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-691.99	NE	NE	NE	NE	NE	-691.99
4.D. Wetlands [5]	**-46.40**	**NE**	**NE**	**NE**	**NE**	**NE**	**-46.40**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-46.40	NE	NE	NE	NE	NE	-46.40
4.E. Settlements	**45.57**	**NO, NE**	**0.87**	**NE**	**NE**	**NE**	**275.13**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	45.57	NO	0.87	NE	NE	NE	275.13
4.F. Other land [6]	**441.48**	**NE**	**NE**	**NE**	**NE**	**NE**	**441.48**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	441.48	NE	NE	NE	NE	NE	441.48
4.G. Harvested wood products [7]	-22.80						-22.80
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2011

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,421.98**	**0.01**	**0.85**	**0.00**	**0.17**	**NE**	**-1,197.75**
4.A. Forest land	**-2,390.57**	**0.00**	**0.00**	**0.00**	**0.10**	**NE**	**-2,390.39**
4.A.1. Forest land remaining forest land	-1,871.43	NE	NE	NE	NE	NE	-1,871.43
4.A.2. Land converted to forest land	-519.14	0.00	0.00	0.00	0.10	NE	-518.96
4.B. Cropland	**1,230.68**	**0.00**	**0.00**	**0.00**	**0.07**	**NE**	**1,230.76**
4.B.1. Cropland remaining cropland	1,336.69	0.00	0.00	0.00	0.07	NE	1,336.76
4.B.2. Land converted to cropland	-106.00	NE	NE	NE	NE	NE	-106.00
4.C. Grassland	**-638.17**	**NE**	**NE**	**NE**	**NE**	**NE**	**-638.17**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-638.17	NE	NE	NE	NE	NE	-638.17
4.D. Wetlands [5]	**-75.31**	**NE**	**NE**	**NE**	**NE**	**NE**	**-75.31**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-75.31	NE	NE	NE	NE	NE	-75.31
4.E. Settlements	**62.04**	**NO, NE**	**0.85**	**NE**	**NE**	**NE**	**286.02**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	62.04	NO	0.85	NE	NE	NE	286.02
4.F. Other land [6]	**393.73**	**NE**	**NE**	**NE**	**NE**	**NE**	**393.73**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	393.73	NE	NE	NE	NE	NE	393.73
4.G. Harvested wood products [7]	-4.38						-4.38
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,433.66**	**0.05**	**0.78**	**0.03**	**1.07**	**NE**	**-1,224.78**
4.A. Forest land	**-2,294.82**	**0.05**	**0.00**	**0.03**	**1.06**	**NE**	**-2,292.84**
4.A.1. Forest land remaining forest land	-1,702.27	NE	NE	NE	NE	NE	-1,702.27
4.A.2. Land converted to forest land	-592.56	0.05	0.00	0.03	1.06	NE	-590.58
4.B. Cropland	**1,236.50**	**0.00**	**0.00**	**0.00**	**0.01**	**NE**	**1,236.51**
4.B.1. Cropland remaining cropland	1,321.32	0.00	0.00	0.00	0.01	NE	1,321.33
4.B.2. Land converted to cropland	-84.81	NE	NE	NE	NE	NE	-84.81
4.C. Grassland	**-562.75**	**NE**	**NE**	**NE**	**NE**	**NE**	**-562.75**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-562.75	NE	NE	NE	NE	NE	-562.75
4.D. Wetlands [5]	**-15.47**	**NE**	**NE**	**NE**	**NE**	**NE**	**-15.47**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-15.47	NE	NE	NE	NE	NE	-15.47
4.E. Settlements	**11.89**	**NO, NE**	**0.78**	**NE**	**NE**	**NE**	**218.78**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	11.89	NO	0.78	NE	NE	NE	218.78
4.F. Other land [6]	**114.14**	**NE**	**NE**	**NE**	**NE**	**NE**	**114.14**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	114.14	NE	NE	NE	NE	NE	114.14
4.G. Harvested wood products [7]	76.84						76.84
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2013

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,289.15**	**0.03**	**0.73**	**0.02**	**0.82**	**NE**	**-1,094.98**
4.A. Forest land	**-2,141.87**	**0.03**	**0.00**	**0.02**	**0.73**	**NE**	**-2,140.50**
4.A.1. Forest land remaining forest land	-1,531.88	NE	NE	NE	NE	NE	-1,531.88
4.A.2. Land converted to forest land	-609.99	0.03	0.00	0.02	0.73	NE	-608.61
4.B. Cropland	**1,139.91**	**0.00**	**0.00**	**0.00**	**0.09**	**NE**	**1,140.01**
4.B.1. Cropland remaining cropland	1,416.02	0.00	0.00	0.00	0.09	NE	1,416.11
4.B.2. Land converted to cropland	-276.10	NE	NE	NE	NE	NE	-276.10
4.C. Grassland	**-360.17**	**NE**	**NE**	**NE**	**NE**	**NE**	**-360.17**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-360.17	NE	NE	NE	NE	NE	-360.17
4.D. Wetlands [5]	**-106.10**	**NE**	**NE**	**NE**	**NE**	**NE**	**-106.10**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-106.10	NE	NE	NE	NE	NE	-106.10
4.E. Settlements	**13.75**	**NO, NE**	**0.73**	**NE**	**NE**	**NE**	**206.45**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	13.75	NO	0.73	NE	NE	NE	206.45
4.F. Other land [6]	**103.45**	**NE**	**NE**	**NE**	**NE**	**NE**	**103.45**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	103.45	NE	NE	NE	NE	NE	103.45
4.G. Harvested wood products [7]	61.88						61.88
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2014

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-927.33**	**0.00**	**0.68**	**0.00**	**0.13**	**NE**	**-747.16**
4.A. Forest land	**-2,134.74**	**0.00**	**0.00**	**0.00**	**0.06**	**NE**	**-2,134.63**
4.A.1. Forest land remaining forest land	-1,484.67	NE	NE	NE	NE	NE	-1,484.67
4.A.2. Land converted to forest land	-650.06	0.00	0.00	0.00	0.06	NE	-649.95
4.B. Cropland	**1,174.61**	**0.00**	**0.00**	**0.00**	**0.07**	**NE**	**1,174.69**
4.B.1. Cropland remaining cropland	1,420.30	0.00	0.00	0.00	0.07	NE	1,420.37
4.B.2. Land converted to cropland	-245.69	NE	NE	NE	NE	NE	-245.69
4.C. Grassland	**-341.11**	**NE**	**NE**	**NE**	**NE**	**NE**	**-341.11**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-341.11	NE	NE	NE	NE	NE	-341.11
4.D. Wetlands [5]	**-139.75**	**NE**	**NE**	**NE**	**NE**	**NE**	**-139.75**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-139.75	NE	NE	NE	NE	NE	-139.75
4.E. Settlements	**18.98**	**NO, NE**	**0.68**	**NE**	**NE**	**NE**	**198.98**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	18.98	NO	0.68	NE	NE	NE	198.98
4.F. Other land [6]	**436.65**	**NE**	**NE**	**NE**	**NE**	**NE**	**436.65**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	436.65	NE	NE	NE	NE	NE	436.65
4.G. Harvested wood products [7]	58.02						58.02
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2015

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,372.85**	**0.03**	**0.64**	**0.02**	**0.61**	**NE**	**-1,202.92**
4.A. Forest land	**-2,159.44**	**0.02**	**0.00**	**0.02**	**0.56**	**NE**	**-2,158.40**
4.A.1. Forest land remaining forest land	-1,496.39	NE	NE	NE	NE	NE	-1,496.39
4.A.2. Land converted to forest land	-663.05	0.02	0.00	0.02	0.56	NE	-662.00
4.B. Cropland	**1,112.63**	**0.00**	**0.00**	**0.00**	**0.05**	**NE**	**1,112.68**
4.B.1. Cropland remaining cropland	1,421.96	0.00	0.00	0.00	0.05	NE	1,422.01
4.B.2. Land converted to cropland	-309.33	NE	NE	NE	NE	NE	-309.33
4.C. Grassland	**-418.46**	**NE**	**NE**	**NE**	**NE**	**NE**	**-418.46**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-418.46	NE	NE	NE	NE	NE	-418.46
4.D. Wetlands [5]	**-82.79**	**NE**	**NE**	**NE**	**NE**	**NE**	**-82.79**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-82.79	NE	NE	NE	NE	NE	-82.79
4.E. Settlements	**39.16**	**NO, NE**	**0.64**	**NE**	**NE**	**NE**	**207.99**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	39.16	NO	0.64	NE	NE	NE	207.99
4.F. Other land [6]	**86.82**	**NE**	**NE**	**NE**	**NE**	**NE**	**86.82**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	86.82	NE	NE	NE	NE	NE	86.82
4.G. Harvested wood products [7]	49.24						49.24
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2016

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,117.11**	**0.01**	**0.60**	**0.01**	**0.35**	**NE**	**-957.29**
4.A. Forest land	**-2,115.76**	**0.01**	**0.00**	**0.01**	**0.28**	**NE**	**-2,115.24**
4.A.1. Forest land remaining forest land	-1,433.25	NE	NE	NE	NE	NE	-1,433.25
4.A.2. Land converted to forest land	-682.52	0.01	0.00	0.01	0.28	NE	-681.99
4.B. Cropland	**1,111.99**	**0.00**	**0.00**	**0.00**	**0.07**	**NE**	**1,112.06**
4.B.1. Cropland remaining cropland	1,495.48	0.00	0.00	0.00	0.07	NE	1,495.55
4.B.2. Land converted to cropland	-383.49	NE	NE	NE	NE	NE	-383.49
4.C. Grassland	**-402.37**	**NE**	**NE**	**NE**	**NE**	**NE**	**-402.37**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-402.37	NE	NE	NE	NE	NE	-402.37
4.D. Wetlands [5]	**-82.79**	**NE**	**NE**	**NE**	**NE**	**NE**	**-82.79**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-82.79	NE	NE	NE	NE	NE	-82.79
4.E. Settlements	**19.31**	**NO, NE**	**0.60**	**NE**	**NE**	**NE**	**178.53**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	19.31	NO	0.60	NE	NE	NE	178.53
4.F. Other land [6]	**351.63**	**NE**	**NE**	**NE**	**NE**	**NE**	**351.63**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	351.63	NE	NE	NE	NE	NE	351.63
4.G. Harvested wood products [7]	0.88						0.88
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2017

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,165.66**	**0.02**	**0.58**	**0.01**	**0.49**	**NE**	**-1,012.29**
4.A. Forest land	**-2,016.44**	**0.02**	**0.00**	**0.01**	**0.39**	**NE**	**-2,015.71**
4.A.1. Forest land remaining forest land	-1,324.56	NE	NE	NE	NE	NE	-1,324.56
4.A.2. Land converted to forest land	-691.87	0.02	0.00	0.01	0.39	NE	-691.15
4.B. Cropland	**1,089.56**	**0.00**	**0.00**	**0.00**	**0.10**	**NE**	**1,089.66**
4.B.1. Cropland remaining cropland	1,502.19	0.00	0.00	0.00	0.10	NE	1,502.29
4.B.2. Land converted to cropland	-412.63	NE	NE	NE	NE	NE	-412.63
4.C. Grassland	**-384.04**	**NE**	**NE**	**NE**	**NE**	**NE**	**-384.04**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-384.04	NE	NE	NE	NE	NE	-384.04
4.D. Wetlands [5]	**-82.82**	**NE**	**NE**	**NE**	**NE**	**NE**	**-82.82**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-82.82	NE	NE	NE	NE	NE	-82.82
4.E. Settlements	**77.31**	**NO, NE**	**0.58**	**NE**	**NE**	**NE**	**229.86**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	77.31	NO	0.58	NE	NE	NE	229.86
4.F. Other land [6]	**218.21**	**NE**	**NE**	**NE**	**NE**	**NE**	**218.21**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	218.21	NE	NE	NE	NE	NE	218.21
4.G. Harvested wood products [7]	-67.45						-67.45
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2018

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-1,006.61**	**0.01**	**0.55**	**0.00**	**0.17**	**NE**	**-859.35**
4.A. Forest land	**-1,969.36**	**0.01**	**0.00**	**0.00**	**0.13**	**NE**	**-1,969.11**
4.A.1. Forest land remaining forest land	-1,281.36	NE	NE	NE	NE	NE	-1,281.36
4.A.2. Land converted to forest land	-687.99	0.01	0.00	0.00	0.13	NE	-687.74
4.B. Cropland	**1,206.39**	**0.00**	**0.00**	**0.00**	**0.03**	**NE**	**1,206.43**
4.B.1. Cropland remaining cropland	1,505.41	0.00	0.00	0.00	0.03	NE	1,505.44
4.B.2. Land converted to cropland	-299.01	NE	NE	NE	NE	NE	-299.01
4.C. Grassland	**-440.15**	**NE**	**NE**	**NE**	**NE**	**NE**	**-440.15**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-440.15	NE	NE	NE	NE	NE	-440.15
4.D. Wetlands [5]	**-82.83**	**NE**	**NE**	**NE**	**NE**	**NE**	**-82.83**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-82.83	NE	NE	NE	NE	NE	-82.83
4.E. Settlements	**21.62**	**NO, NE**	**0.55**	**NE**	**NE**	**NE**	**168.60**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	21.62	NO	0.55	NE	NE	NE	168.60
4.F. Other land [6]	**321.21**	**NE**	**NE**	**NE**	**NE**	**NE**	**321.21**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	321.21	NE	NE	NE	NE	NE	321.21
4.G. Harvested wood products [7]	-63.50						-63.50
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2019

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-148.61**	**0.02**	**0.54**	**0.01**	**0.38**	**NE**	**-4.52**
4.A. Forest land	**-1,950.65**	**0.01**	**0.00**	**0.01**	**0.33**	**NE**	**-1,950.04**
4.A.1. Forest land remaining forest land	-1,231.10	NE	NE	NE	NE	NE	-1,231.10
4.A.2. Land converted to forest land	-719.55	0.01	0.00	0.01	0.33	NE	-718.94
4.B. Cropland	**1,507.41**	**0.00**	**0.00**	**0.00**	**0.06**	**NE**	**1,507.47**
4.B.1. Cropland remaining cropland	1,516.68	0.00	0.00	0.00	0.06	NE	1,516.74
4.B.2. Land converted to cropland	-9.27	NE	NE	NE	NE	NE	-9.27
4.C. Grassland	**-293.29**	**NE**	**NE**	**NE**	**NE**	**NE**	**-293.29**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-293.29	NE	NE	NE	NE	NE	-293.29
4.D. Wetlands [5]	**-82.81**	**NE**	**NE**	**NE**	**NE**	**NE**	**-82.81**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-82.81	NE	NE	NE	NE	NE	-82.81
4.E. Settlements	**116.50**	**NO, NE**	**0.54**	**NE**	**NE**	**NE**	**259.93**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	116.50	NO	0.54	NE	NE	NE	259.93
4.F. Other land [6]	**611.79**	**NE**	**NE**	**NE**	**NE**	**NE**	**611.79**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	611.79	NE	NE	NE	NE	NE	611.79
4.G. Harvested wood products [7]	-57.56						-57.56
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2020

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-172.36**	**0.03**	**0.56**	**0.02**	**0.77**	**NE**	**-22.06**
4.A. Forest land	**-1,887.32**	**0.03**	**0.00**	**0.02**	**0.66**	**NE**	**-1,886.09**
4.A.1. Forest land remaining forest land	-1,159.88	NE	NE	NE	NE	NE	-1,159.88
4.A.2. Land converted to forest land	-727.44	0.03	0.00	0.02	0.66	NE	-726.21
4.B. Cropland	**1,629.90**	**0.00**	**0.00**	**0.00**	**0.11**	**NE**	**1,630.01**
4.B.1. Cropland remaining cropland	1,558.08	0.00	0.00	0.00	0.11	NE	1,558.19
4.B.2. Land converted to cropland	71.82	NE	NE	NE	NE	NE	71.82
4.C. Grassland	**-223.15**	**NE**	**NE**	**NE**	**NE**	**NE**	**-223.15**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-223.15	NE	NE	NE	NE	NE	-223.15
4.D. Wetlands [5]	**-82.81**	**NE**	**NE**	**NE**	**NE**	**NE**	**-82.81**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-82.81	NE	NE	NE	NE	NE	-82.81
4.E. Settlements	**27.21**	**NO, NE**	**0.56**	**NE**	**NE**	**NE**	**176.16**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	27.21	NO	0.56	NE	NE	NE	176.16
4.F. Other land [6]	**329.13**	**NE**	**NE**	**NE**	**NE**	**NE**	**329.13**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	329.13	NE	NE	NE	NE	NE	329.13
4.G. Harvested wood products [7]	34.69						34.69
4.H. Other	NE	NE	NE	NE	NE	NE	NE

2021

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**-105.16**	**0.01**	**0.58**	**0.01**	**0.33**	**NE**	**49.11**
4.A. Forest land	**-1,919.59**	**0.00**	**0.00**	**0.00**	**0.07**	**NE**	**-1,919.47**
4.A.1. Forest land remaining forest land	-1,198.20	NE	NE	NE	NE	NE	-1,198.20
4.A.2. Land converted to forest land	-721.39	0.00	0.00	0.00	0.07	NE	-721.27
4.B. Cropland	**1,713.54**	**0.01**	**0.00**	**0.01**	**0.27**	**NE**	**1,713.81**
4.B.1. Cropland remaining cropland	1,573.00	0.01	0.00	0.01	0.27	NE	1,573.28
4.B.2. Land converted to cropland	140.53	NE	NE	NE	NE	NE	140.53
4.C. Grassland	**-138.64**	**NE**	**NE**	**NE**	**NE**	**NE**	**-138.64**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-138.64	NE	NE	NE	NE	NE	-138.64
4.D. Wetlands [5]	**-83.05**	**NE**	**NE**	**NE**	**NE**	**NE**	**-83.05**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-83.05	NE	NE	NE	NE	NE	-83.05
4.E. Settlements	**29.73**	**NO, NE**	**0.58**	**NE**	**NE**	**NE**	**183.61**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	29.73	NO	0.58	NE	NE	NE	183.61
4.F. Other land [6]	**285.13**	**NE**	**NE**	**NE**	**NE**	**NE**	**285.13**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	285.13	NE	NE	NE	NE	NE	285.13
4.G. Harvested wood products [7]	7.73						7.73
4.H. Other	NE	NE	NE	NE	NE	NE	NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals [1,2]	CH_4 [2]	N_2O [2]	NO_x	CO	NMVOC	Total GHG emissions/removals [3]
	(kt)						CO_2 equivalents (kt) [4]
4. Total LULUCF	**258.39**	**0.05**	**0.61**	**0.04**	**1.38**	**NE**	**420.66**
4.A. Forest land	**-1,592.42**	**0.04**	**0.00**	**0.03**	**0.94**	**NE**	**-1,590.66**
4.A.1. Forest land remaining forest land	-912.82	NE	NE	NE	NE	NE	-912.82
4.A.2. Land converted to forest land	-679.60	0.04	0.00	0.03	0.94	NE	-677.84
4.B. Cropland	**1,730.18**	**0.01**	**0.00**	**0.01**	**0.44**	**NE**	**1,730.63**
4.B.1. Cropland remaining cropland	1,589.32	0.01	0.00	0.01	0.44	NE	1,589.77
4.B.2. Land converted to cropland	140.86	NE	NE	NE	NE	NE	140.86
4.C. Grassland	**-123.13**	**NE**	**NE**	**NE**	**NE**	**NE**	**-123.13**
4.C.1. Grassland remaining grassland	NO	NE	NE	NE	NE	NE	NO, NE
4.C.2. Land converted to grassland	-123.13	NE	NE	NE	NE	NE	-123.13
4.D. Wetlands [5]	**-84.25**	**NE**	**NE**	**NE**	**NE**	**NE**	**-84.25**
4.D.1. Wetlands remaining wetlands	NO	NE	NE	NE	NE	NE	NO, NE
4.D.2. Land converted to wetlands	-84.25	NE	NE	NE	NE	NE	-84.25
4.E. Settlements	**27.50**	**NO, NE**	**0.60**	**NE**	**NE**	**NE**	**187.56**
4.E.1. Settlements remaining settlements	NO	NE	NE	NE	NE	NE	NO, NE
4.E.2. Land converted to settlements	27.50	NO	0.60	NE	NE	NE	187.56
4.F. Other land [6]	**304.27**	**NE**	**NE**	**NE**	**NE**	**NE**	**304.27**
4.F.1. Other land remaining other land							
4.F.2. Land converted to other land	304.27	NE	NE	NE	NE	NE	304.27
4.G. Harvested wood products [7]	-3.78						-3.78
4.H. Other	NE	NE	NE	NE	NE	NE	NE

Annex 6-5. Sectoral Report for Sector 5 'Waste' 1990-2022

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	14.97	56.96	0.30	0.15	2.64	3.12	0.01	1,690.28
5.A. Solid waste disposal		43.86		NA, NO	NA, NO	3.02		1,228.09
5.A.1. Managed waste disposal sites		NO		NA, NO	NA	NO		NO
5.A.2. Unmanaged waste disposal sites		43.86		NA, NO	NA	3.02		1,228.09
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.05	0.00	NO, NE	0.01	NO, NE		2.39
5.B.1. Composting		0.05	0.00	NO	0.01	NO		2.39
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	14.97	0.31	0.01	0.15	2.64	0.06	0.01	25.01
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	14.97	0.31	0.01	0.15	2.64	0.06	0.01	25.01
5.D. Wastewater treatment and discharge		12.74	0.30	NA, IE	NA, IE	0.04		434.80
5.D.1. Domestic wastewater		12.74	0.30	NA	NA	0.04		434.80
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

1991

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
		(kt)						CO_2 equivalents (kt) [2]
5. Total waste	15.00	58.34	0.28	0.15	2.65	3.26	0.01	1,723.07
5.A. Solid waste disposal		45.62		NA, NO	NA, NO	3.16		1,277.50
5.A.1. Managed waste disposal sites		NO		NA, NO	NA	NO		NO
5.A.2. Unmanaged waste disposal sites		45.62		NA, NO	NA	3.16		1,277.50
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.06	0.00	NO, NE	0.01	NO, NE		2.42
5.B.1. Composting		0.06	0.00	NO	0.01	NO		2.42
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	15.00	0.31	0.01	0.15	2.64	0.06	0.01	25.06
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	15.00	0.31	0.01	0.15	2.64	0.06	0.01	25.06
5.D. Wastewater treatment and discharge		12.35	0.27	NA, IE	NA, IE	0.04		418.10
5.D.1. Domestic wastewater		12.35	0.27	NA	NA	0.04		418.10
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	15.05	59.62	0.26	0.15	2.65	3.08	0.01	1,753.00
5.A. Solid waste disposal		47.56		NA, NO	NA, NO	2.99		1,331.63
5.A.1. Managed waste disposal sites		7.76		NA, NO	NA	0.49		217.23
5.A.2. Unmanaged waste disposal sites		39.80		NA, NO	NA	2.50		1,114.40
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.06	0.00	NO, NE	0.01	NO, NE		2.52
5.B.1. Composting		0.06	0.00	NO	0.01	NO		2.52
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	15.05	0.31	0.01	0.15	2.64	0.06	0.01	25.13
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	15.05	0.31	0.01	0.15	2.64	0.06	0.01	25.13
5.D. Wastewater treatment and discharge		11.70	0.25	NA, IE	NA, IE	0.03		393.70
5.D.1. Domestic wastewater		11.70	0.25	NA	NA	0.03		393.70
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	15.04	61.50	0.24	0.15	2.64	2.90	0.01	1,801.08
5.A. Solid waste disposal		49.45		NA, NO	NA, NO	2.82		1,384.63
5.A.1. Managed waste disposal sites		13.44		NA, NO	NA	0.77		376.35
5.A.2. Unmanaged waste disposal sites		36.01		NA, NO	NA	2.05		1,008.28
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.03	0.00	NO, NE	0.00	NO, NE		1.26
5.B.1. Composting		0.03	0.00	NO	0.00	NO		1.26
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	15.04	0.31	0.01	0.15	2.64	0.06	0.01	25.13
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	15.04	0.31	0.01	0.15	2.64	0.06	0.01	25.13
5.D. Wastewater treatment and discharge		11.72	0.23	NA, IE	NA, IE	0.03		390.06
5.D.1. Domestic wastewater		11.72	0.23	NA	NA	0.03		390.06
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

1994

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	15.09	61.19	0.23	0.15	2.65	2.80	0.01	1,790.62
5.A. Solid waste disposal		49.67		NA, NO	NA, NO	2.71		1,390.84
5.A.1. Managed waste disposal sites		14.20		NA, NO	NA	0.78		397.50
5.A.2. Unmanaged waste disposal sites		35.48		NA, NO	NA	1.94		993.34
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.03	0.00	NO, NE	0.00	NO, NE		1.18
5.B.1. Composting		0.03	0.00	NO	0.00	NO		1.18
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	15.09	0.31	0.01	0.15	2.64	0.06	0.01	25.21
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	15.09	0.31	0.01	0.15	2.64	0.06	0.01	25.21
5.D. Wastewater treatment and discharge		11.18	0.23	NA, IE	NA, IE	0.03		373.39
5.D.1. Domestic wastewater		11.18	0.23	NA	NA	0.03		373.39
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	15.10	61.19	0.24	0.15	2.65	1.75	0.01	1,791.14
5.A. Solid waste disposal		49.57		NA, NO	NA, NO	1.67		1,388.07
5.A.1. Managed waste disposal sites		15.43		NA, NO	NA	0.52		431.91
5.A.2. Unmanaged waste disposal sites		34.15		NA, NO	NA	1.15		956.16
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.03	0.00	NO, NE	0.00	NO, NE		1.11
5.B.1. Composting		0.03	0.00	NO	0.00	NO		1.11
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	15.10	0.31	0.01	0.15	2.64	0.06	0.01	25.21
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	15.10	0.31	0.01	0.15	2.64	0.06	0.01	25.21
5.D. Wastewater treatment and discharge		11.28	0.23	NA, IE	NA, IE	0.02		376.76
5.D.1. Domestic wastewater		11.28	0.23	NA	NA	0.02		376.76
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	15.10	61.02	0.23	0.15	2.64	1.59	0.01	1,785.66
5.A. Solid waste disposal		49.49		NA, NO	NA, NO	1.51		1,385.67
5.A.1. Managed waste disposal sites		14.87		NA, NO	NA	0.45		416.29
5.A.2. Unmanaged waste disposal sites		34.62		NA, NO	NA	1.06		969.38
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.03	0.00	NO, NE	0.00	NO, NE		1.14
5.B.1. Composting		0.03	0.00	NO	0.00	NO		1.14
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	15.10	0.31	0.01	0.15	2.64	0.06	0.01	25.20
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	15.10	0.31	0.01	0.15	2.64	0.06	0.01	25.20
5.D. Wastewater treatment and discharge		11.20	0.23	NA, IE	NA, IE	0.02		373.65
5.D.1. Domestic wastewater		11.20	0.23	NA	NA	0.02		373.65
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	15.05	60.78	0.24	0.15	2.63	1.46	0.01	1,779.74
5.A. Solid waste disposal		49.07		NA, NO	NA, NO	1.38		1,373.84
5.A.1. Managed waste disposal sites		16.09		NA, NO	NA	0.45		450.47
5.A.2. Unmanaged waste disposal sites		32.98		NA, NO	NA	0.93		923.37
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.02	0.00	NO, NE	0.00	NO, NE		1.08
5.B.1. Composting		0.02	0.00	NO	0.00	NO		1.08
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	15.05	0.31	0.01	0.15	2.63	0.06	0.01	25.11
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	15.05	0.31	0.01	0.15	2.63	0.06	0.01	25.11
5.D. Wastewater treatment and discharge		11.38	0.23	NA, IE	NA, IE	0.02		379.72
5.D.1. Domestic wastewater		11.38	0.23	NA	NA	0.02		379.72
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	15.08	59.87	0.24	0.15	2.63	1.42	0.01	1,755.22
5.A. Solid waste disposal		48.48		NA, NO	NA, NO	1.35		1,357.44
5.A.1. Managed waste disposal sites		15.76		NA, NO	NA	0.44		441.33
5.A.2. Unmanaged waste disposal sites		32.72		NA, NO	NA	0.91		916.11
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.02	0.00	NO, NE	0.00	NO, NE		1.09
5.B.1. Composting		0.02	0.00	NO	0.00	NO		1.09
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	15.08	0.31	0.01	0.15	2.63	0.06	0.01	25.17
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	15.08	0.31	0.01	0.15	2.63	0.06	0.01	25.17
5.D. Wastewater treatment and discharge		11.05	0.23	NA, IE	NA, IE	0.02		371.52
5.D.1. Domestic wastewater		11.05	0.23	NA	NA	0.02		371.52
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	15.01	59.28	0.24	0.15	2.63	1.33	0.01	1,737.47
5.A. Solid waste disposal		48.20		NA, NO	NA, NO	1.26		1,349.68
5.A.1. Managed waste disposal sites		15.88		NA, NO	NA	0.41		444.57
5.A.2. Unmanaged waste disposal sites		32.33		NA, NO	NA	0.85		905.11
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.02	0.00	NO, NE	0.00	NO, NE		1.02
5.B.1. Composting		0.02	0.00	NO	0.00	NO		1.02
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	15.01	0.31	0.01	0.15	2.62	0.06	0.01	25.05
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	15.01	0.31	0.01	0.15	2.62	0.06	0.01	25.05
5.D. Wastewater treatment and discharge		10.75	0.23	NA, IE	NA, IE	0.01		361.71
5.D.1. Domestic wastewater		10.75	0.23	NA	NA	0.01		361.71
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2000

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	15.00	58.19	0.24	0.15	2.62	1.33	0.01	1,708.15
5.A. Solid waste disposal		47.08		NA, NO	NA, NO	1.26		1,318.27
5.A.1. Managed waste disposal sites		15.73		NA, NO	NA	0.40		440.56
5.A.2. Unmanaged waste disposal sites		31.35		NA, NO	NA	0.86		877.71
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.02	0.00	NO, NE	0.00	NO, NE		0.92
5.B.1. Composting		0.02	0.00	NO	0.00	NO		0.92
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	15.00	0.31	0.01	0.15	2.62	0.06	0.01	25.03
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	15.00	0.31	0.01	0.15	2.62	0.06	0.01	25.03
5.D. Wastewater treatment and discharge		10.78	0.23	NA, IE	NA, IE	0.01		363.93
5.D.1. Domestic wastewater		10.78	0.23	NA	NA	0.01		363.93
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2001

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	14.97	56.99	0.24	0.15	2.62	1.20	0.01	1,675.27
5.A. Solid waste disposal		45.73		NA, NO	NA, NO	1.13		1,280.40
5.A.1. Managed waste disposal sites		15.35		NA, NO	NA	0.36		429.92
5.A.2. Unmanaged waste disposal sites		30.37		NA, NO	NA	0.77		850.48
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.02	0.00	NO, NE	0.00	NO, NE		0.83
5.B.1. Composting		0.02	0.00	NO	0.00	NO		0.83
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	14.97	0.31	0.01	0.15	2.61	0.06	0.01	24.99
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	14.97	0.31	0.01	0.15	2.61	0.06	0.01	24.99
5.D. Wastewater treatment and discharge		10.93	0.24	NA, IE	NA, IE	0.01		369.05
5.D.1. Domestic wastewater		10.93	0.24	NA	NA	0.01		369.05
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	14.94	56.41	0.25	0.15	2.61	1.13	0.01	1,660.76
5.A. Solid waste disposal		44.37		NA, NO	NA, NO	1.06		1,242.34
5.A.1. Managed waste disposal sites		14.94		NA, NO	NA	0.34		418.28
5.A.2. Unmanaged waste disposal sites		29.43		NA, NO	NA	0.72		824.06
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.02	0.00	NO, NE	0.00	NO, NE		0.92
5.B.1. Composting		0.02	0.00	NO	0.00	NO		0.92
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	14.94	0.31	0.01	0.15	2.60	0.06	0.01	24.93
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	14.94	0.31	0.01	0.15	2.60	0.06	0.01	24.93
5.D. Wastewater treatment and discharge		11.72	0.24	NA, IE	NA, IE	0.01		392.58
5.D.1. Domestic wastewater		11.72	0.24	NA	NA	0.01		392.58
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	14.91	55.25	0.24	0.15	2.59	1.02	0.01	1,625.93
5.A. Solid waste disposal		43.01		NA, NO	NA, NO	0.95		1,204.29
5.A.1. Managed waste disposal sites		13.80		NA, NO	NA	0.29		386.28
5.A.2. Unmanaged waste disposal sites		29.21		NA, NO	NA	0.66		818.01
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.02	0.00	NO, NE	0.00	NO, NE		0.96
5.B.1. Composting		0.02	0.00	NO	0.00	NO		0.96
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	14.91	0.31	0.01	0.15	2.59	0.06	0.01	24.87
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	14.91	0.31	0.01	0.15	2.59	0.06	0.01	24.87
5.D. Wastewater treatment and discharge		11.91	0.24	NA, IE	NA, IE	0.01		395.80
5.D.1. Domestic wastewater		11.91	0.24	NA	NA	0.01		395.80
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2004

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	14.86	54.91	0.23	0.15	2.58	1.07	0.01	1,613.47
5.A. Solid waste disposal		42.54		NA, NO	NA, NO	1.01		1,191.18
5.A.1. Managed waste disposal sites		13.13		NA, NO	NA	0.30		367.74
5.A.2. Unmanaged waste disposal sites		29.41		NA, NO	NA	0.71		823.44
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.02	0.00	NO, NE	0.00	NO, NE		1.01
5.B.1. Composting		0.02	0.00	NO	0.00	NO		1.01
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	14.86	0.30	0.01	0.15	2.58	0.06	0.01	24.79
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	14.86	0.30	0.01	0.15	2.58	0.06	0.01	24.79
5.D. Wastewater treatment and discharge		12.04	0.22	NA, IE	NA, IE	0.01		396.49
5.D.1. Domestic wastewater		12.04	0.22	NA	NA	0.01		396.49
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	14.33	54.89	0.21	0.14	2.49	1.23	0.01	1,607.45
5.A. Solid waste disposal		42.71		NA, NO	NA, NO	1.16		1,195.79
5.A.1. Managed waste disposal sites		13.33		NA, NO	NA	0.33		373.23
5.A.2. Unmanaged waste disposal sites		29.38		NA, NO	NA	0.83		822.56
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.02	0.00	NO, NE	0.00	NO, NE		1.06
5.B.1. Composting		0.02	0.00	NO	0.00	NO		1.06
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	14.33	0.29	0.01	0.14	2.48	0.06	0.01	23.90
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	14.33	0.29	0.01	0.14	2.48	0.06	0.01	23.90
5.D. Wastewater treatment and discharge		11.87	0.21	NA, IE	NA, IE	0.01		386.70
5.D.1. Domestic wastewater		11.87	0.21	NA	NA	0.01		386.70
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2006

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	14.02	54.07	0.22	0.14	2.43	1.31	0.01	1,585.82
5.A. Solid waste disposal		42.36		NA, NO	NA, NO	1.24		1,185.99
5.A.1. Managed waste disposal sites		12.68		NA, NO	NA	0.34		355.00
5.A.2. Unmanaged waste disposal sites		29.68		NA, NO	NA	0.91		830.99
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.03	0.00	NO, NE	0.00	NO, NE		1.14
5.B.1. Composting		0.03	0.00	NO	0.00	NO		1.14
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	14.02	0.29	0.01	0.14	2.43	0.05	0.01	23.38
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	14.02	0.29	0.01	0.14	2.43	0.05	0.01	23.38
5.D. Wastewater treatment and discharge		11.40	0.21	NA, IE	NA, IE	0.01		375.31
5.D.1. Domestic wastewater		11.40	0.21	NA	NA	0.01		375.31
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2007

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	13.71	53.48	0.20	0.14	2.38	1.38	0.00	1,565.00
5.A. Solid waste disposal		42.17		NA, NO	NA, NO	1.32		1,180.68
5.A.1. Managed waste disposal sites		13.82		NA, NO	NA	0.41		387.00
5.A.2. Unmanaged waste disposal sites		28.35		NA, NO	NA	0.91		793.68
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.03	0.00	NO, NE	0.00	NO, NE		1.33
5.B.1. Composting		0.03	0.00	NO	0.00	NO		1.33
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	13.71	0.28	0.00	0.14	2.37	0.05	0.00	22.86
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	13.71	0.28	0.00	0.14	2.37	0.05	0.00	22.86
5.D. Wastewater treatment and discharge		11.01	0.20	NA, IE	NA, IE	0.01		360.14
5.D.1. Domestic wastewater		11.01	0.20	NA	NA	0.01		360.14
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2008

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	13.40	53.57	0.19	0.13	2.32	1.50	0.00	1,562.97
5.A. Solid waste disposal		42.21		NA, NO	NA, NO	1.43		1,182.01
5.A.1. Managed waste disposal sites		15.35		NA, NO	NA	0.48		429.73
5.A.2. Unmanaged waste disposal sites		26.87		NA, NO	NA	0.95		752.29
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.04	0.00	NO, NE	0.00	NO, NE		1.57
5.B.1. Composting		0.04	0.00	NO	0.00	NO		1.57
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	13.40	0.27	0.00	0.13	2.32	0.05	0.00	22.35
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	13.40	0.27	0.00	0.13	2.32	0.05	0.00	22.35
5.D. Wastewater treatment and discharge		11.05	0.18	NA, IE	NA, IE	0.01		357.05
5.D.1. Domestic wastewater		11.05	0.18	NA	NA	0.01		357.05
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2009

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	13.12	53.27	0.19	0.13	2.27	1.67	0.00	1,555.04
5.A. Solid waste disposal		42.55		NA, NO	NA, NO	1.61		1,191.41
5.A.1. Managed waste disposal sites		15.53		NA, NO	NA	0.57		434.93
5.A.2. Unmanaged waste disposal sites		27.02		NA, NO	NA	1.03		756.48
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.04	0.00	NO, NE	0.01	NO, NE		1.63
5.B.1. Composting		0.04	0.00	NO	0.01	NO		1.63
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	13.12	0.27	0.00	0.13	2.26	0.05	0.00	21.87
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	13.12	0.27	0.00	0.13	2.26	0.05	0.00	21.87
5.D. Wastewater treatment and discharge		10.41	0.18	NA, IE	NA, IE	0.01		340.12
5.D.1. Domestic wastewater		10.41	0.18	NA	NA	0.01		340.12
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2010

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	12.84	53.64	0.18	0.13	2.21	1.88	0.00	1,563.54
5.A. Solid waste disposal		42.72		NA, NO	NA, NO	1.82		1,196.05
5.A.1. Managed waste disposal sites		17.18		NA, NO	NA	0.71		480.97
5.A.2. Unmanaged waste disposal sites		25.54		NA, NO	NA	1.11		715.07
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.04	0.00	NO, NE	0.01	NO, NE		1.72
5.B.1. Composting		0.04	0.00	NO	0.01	NO		1.72
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	12.84	0.26	0.00	0.13	2.21	0.05	0.00	21.39
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	12.84	0.26	0.00	0.13	2.21	0.05	0.00	21.39
5.D. Wastewater treatment and discharge		10.62	0.18	NA, IE	NA, IE	0.01		344.38
5.D.1. Domestic wastewater		10.62	0.18	NA	NA	0.01		344.38
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2011

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	12.57	53.31	0.19	0.12	2.16	1.81	0.00	1,554.43
5.A. Solid waste disposal		42.65		NA, NO	NA, NO	1.75		1,194.27
5.A.1. Managed waste disposal sites		17.30		NA, NO	NA	0.70		484.37
5.A.2. Unmanaged waste disposal sites		25.35		NA, NO	NA	1.05		709.90
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.04	0.00	NO, NE	0.01	NO, NE		1.82
5.B.1. Composting		0.04	0.00	NO	0.01	NO		1.82
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	12.57	0.26	0.00	0.12	2.15	0.05	0.00	20.93
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	12.57	0.26	0.00	0.12	2.15	0.05	0.00	20.93
5.D. Wastewater treatment and discharge		10.36	0.18	NA, IE	NA, IE	0.01		337.41
5.D.1. Domestic wastewater		10.36	0.18	NA	NA	0.01		337.41
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2012

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	12.27	52.64	0.19	0.12	2.10	1.64	0.00	1,535.82
5.A. Solid waste disposal		42.13		NA, NO	NA, NO	1.59		1,179.54
5.A.1. Managed waste disposal sites		17.42		NA, NO	NA	0.63		487.82
5.A.2. Unmanaged waste disposal sites		24.70		NA, NO	NA	0.95		691.72
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.04	0.00	NO, NE	0.01	NO, NE		1.79
5.B.1. Composting		0.04	0.00	NO	0.01	NO		1.79
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	12.27	0.25	0.00	0.12	2.10	0.05	0.00	20.44
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	12.27	0.25	0.00	0.12	2.10	0.05	0.00	20.44
5.D. Wastewater treatment and discharge		10.23	0.18	NA, IE	NA, IE	0.01		334.05
5.D.1. Domestic wastewater		10.23	0.18	NA	NA	0.01		334.05
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2013

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	11.93	50.18	0.19	0.12	2.05	1.73	0.00	1,466.78
5.A. Solid waste disposal		39.62		NA, NO	NA, NO	1.67		1,109.40
5.A.1. Managed waste disposal sites		15.56		NA, NO	NA	0.66		435.57
5.A.2. Unmanaged waste disposal sites		24.07		NA, NO	NA	1.02		673.83
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.04	0.00	NO, NE	0.01	NO, NE		1.93
5.B.1. Composting		0.04	0.00	NO	0.01	NO		1.93
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	11.93	0.24	0.00	0.12	2.04	0.05	0.00	19.86
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	11.93	0.24	0.00	0.12	2.04	0.05	0.00	19.86
5.D. Wastewater treatment and discharge		10.27	0.18	NA, IE	NA, IE	0.01		335.59
5.D.1. Domestic wastewater		10.27	0.18	NA	NA	0.01		335.59
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2014

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	11.58	49.54	0.19	0.11	1.99	1.63	0.00	1,447.92
5.A. Solid waste disposal		39.32		NA, NO	NA, NO	1.58		1,101.07
5.A.1. Managed waste disposal sites		14.55		NA, NO	NA	0.58		407.39
5.A.2. Unmanaged waste disposal sites		24.77		NA, NO	NA	0.99		693.69
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.05	0.00	NO, NE	0.01	NO, NE		2.10
5.B.1. Composting		0.05	0.00	NO	0.01	NO		2.10
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	11.58	0.24	0.00	0.11	1.99	0.04	0.00	19.28
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	11.58	0.24	0.00	0.11	1.99	0.04	0.00	19.28
5.D. Wastewater treatment and discharge		9.93	0.18	NA, IE	NA, IE	0.01		325.46
5.D.1. Domestic wastewater		9.93	0.18	NA	NA	0.01		325.46
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2015

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	11.38	49.22	0.19	0.11	1.97	1.76	0.00	1,439.62
5.A. Solid waste disposal		39.23		NA, NO	NA, NO	1.70		1,098.55
5.A.1. Managed waste disposal sites		15.61		NA, NO	NA	0.68		437.19
5.A.2. Unmanaged waste disposal sites		23.62		NA, NO	NA	1.02		661.36
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.05	0.00	NO, NE	0.01	NO, NE		2.11
5.B.1. Composting		0.05	0.00	NO	0.01	NO		2.11
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	11.38	0.23	0.00	0.11	1.96	0.04	0.00	18.97
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	11.38	0.23	0.00	0.11	1.96	0.04	0.00	18.97
5.D. Wastewater treatment and discharge		9.71	0.18	NA, IE	NA, IE	0.01		319.99
5.D.1. Domestic wastewater		9.71	0.18	NA	NA	0.01		319.99
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2016

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	11.14	49.47	0.19	0.11	1.94	1.91	0.00	1,446.85
5.A. Solid waste disposal		39.52		NA, NO	NA, NO	1.85		1,106.59
5.A.1. Managed waste disposal sites		17.07		NA, NO	NA	0.80		477.91
5.A.2. Unmanaged waste disposal sites		22.45		NA, NO	NA	1.05		628.68
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.05	0.00	NO, NE	0.01	NO, NE		2.09
5.B.1. Composting		0.05	0.00	NO	0.01	NO		2.09
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	11.14	0.23	0.00	0.11	1.93	0.04	0.00	18.58
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	11.14	0.23	0.00	0.11	1.93	0.04	0.00	18.58
5.D. Wastewater treatment and discharge		9.67	0.18	NA, IE	NA, IE	0.01		319.59
5.D.1. Domestic wastewater		9.67	0.18	NA	NA	0.01		319.59
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2017

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	10.87	52.31	0.20	0.11	1.90	1.91	0.00	1,527.52
5.A. Solid waste disposal		42.56		NA, NO	NA, NO	1.86		1,191.54
5.A.1. Managed waste disposal sites		17.11		NA, NO	NA	0.75		478.96
5.A.2. Unmanaged waste disposal sites		25.45		NA, NO	NA	1.11		712.58
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.05	0.00	NO, NE	0.01	NO, NE		2.02
5.B.1. Composting		0.05	0.00	NO	0.01	NO		2.02
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	10.87	0.22	0.00	0.11	1.89	0.04	0.00	18.13
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	10.87	0.22	0.00	0.11	1.89	0.04	0.00	18.13
5.D. Wastewater treatment and discharge		9.48	0.19	NA, IE	NA, IE	0.01		315.82
5.D.1. Domestic wastewater		9.48	0.19	NA	NA	0.01		315.82
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2018

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	10.58	51.93	0.20	0.11	1.86	1.54	0.00	1,518.24
5.A. Solid waste disposal		42.15		NA, NO	NA, NO	1.49		1,180.17
5.A.1. Managed waste disposal sites		17.81		NA, NO	NA	0.63		498.62
5.A.2. Unmanaged waste disposal sites		24.34		NA, NO	NA	0.86		681.56
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.04	0.00	NO, NE	0.01	NO, NE		1.96
5.B.1. Composting		0.04	0.00	NO	0.01	NO		1.96
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	10.58	0.22	0.00	0.11	1.85	0.04	0.00	17.66
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	10.58	0.22	0.00	0.11	1.85	0.04	0.00	17.66
5.D. Wastewater treatment and discharge		9.52	0.20	NA, IE	NA, IE	0.01		318.45
5.D.1. Domestic wastewater		9.52	0.20	NA	NA	0.01		318.45
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2019

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	10.28	51.14	0.20	0.10	1.81	1.53	0.00	1,495.93
5.A. Solid waste disposal		41.72		NA, NO	NA, NO	1.48		1,168.09
5.A.1. Managed waste disposal sites		17.25		NA, NO	NA	0.61		482.96
5.A.2. Unmanaged waste disposal sites		24.47		NA, NO	NA	0.87		685.13
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.05	0.00	NO, NE	0.01	NO, NE		2.01
5.B.1. Composting		0.05	0.00	NO	0.01	NO		2.01
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	10.28	0.21	0.00	0.10	1.81	0.04	0.00	17.18
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	10.28	0.21	0.00	0.10	1.81	0.04	0.00	17.18
5.D. Wastewater treatment and discharge		9.17	0.20	NA, IE	NA, IE	0.01		308.64
5.D.1. Domestic wastewater		9.17	0.20	NA	NA	0.01		308.64
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2020

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	10.47	50.40	0.20	0.10	1.84	1.49	0.00	1,475.44
5.A. Solid waste disposal		41.31		NA, NO	NA, NO	1.44		1,156.70
5.A.1. Managed waste disposal sites		17.44		NA, NO	NA	0.61		488.18
5.A.2. Unmanaged waste disposal sites		23.88		NA, NO	NA	0.83		668.52
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.05	0.00	NO, NE	0.01	NO, NE		2.19
5.B.1. Composting		0.05	0.00	NO	0.01	NO		2.19
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	10.47	0.21	0.00	0.10	1.83	0.04	0.00	17.48
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	10.47	0.21	0.00	0.10	1.83	0.04	0.00	17.48
5.D. Wastewater treatment and discharge		8.82	0.20	NA, IE	NA, IE	0.01		299.06
5.D.1. Domestic wastewater		8.82	0.20	NA	NA	0.01		299.06
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

2021

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	10.06	50.31	0.20	0.10	1.76	1.52	0.00	1,471.47
5.A. Solid waste disposal		40.88		NA, NO	NA, NO	1.47		1,144.56
5.A.1. Managed waste disposal sites		17.21		NA, NO	NA	0.62		482.00
5.A.2. Unmanaged waste disposal sites		23.66		NA, NO	NA	0.85		662.56
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.05	0.00	NO, NE	0.01	NO, NE		2.08
5.B.1. Composting		0.05	0.00	NO	0.01	NO		2.08
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	10.06	0.21	0.00	0.10	1.76	0.04	0.00	16.79
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	10.06	0.21	0.00	0.10	1.76	0.04	0.00	16.79
5.D. Wastewater treatment and discharge		9.18	0.19	NA, IE	NA, IE	0.01		308.05
5.D.1. Domestic wastewater		9.18	0.19	NA	NA	0.01		308.05
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2	CH_4	N_2O	NO_x	CO	NMVOC	SO_x	Total GHG emissions [1]
	(kt)							CO_2 equivalents (kt) [2]
5. Total waste	9.89	49.43	0.19	0.10	1.74	1.49	0.00	1,445.09
5.A. Solid waste disposal		40.37		NA, NO	NA, NO	1.44		1,130.39
5.A.1. Managed waste disposal sites		17.13		NA, NO	NA	0.61		479.59
5.A.2. Unmanaged waste disposal sites		23.24		NA, NO	NA	0.83		650.79
5.A.3. Uncategorized waste disposal sites		NO		NO	NO	NO		NO
5.B. Biological treatment of solid waste		0.05	0.00	NO, NE	0.01	NO, NE		2.16
5.B.1. Composting		0.05	0.00	NO	0.01	NO		2.16
5.B.2. Anaerobic digestion at biogas facilities		NE	NE	NE	NE	NE		NE
5.C. Incineration and open burning of waste	9.89	0.20	0.00	0.10	1.73	0.04	0.00	16.51
5.C.1. Waste incineration	NO	NO	NO	NO	NO	NO	NO	NO
5.C.2. Open burning of waste	9.89	0.20	0.00	0.10	1.73	0.04	0.00	16.51
5.D. Wastewater treatment and discharge		8.81	0.19	NA, IE	NA, IE	0.01		296.03
5.D.1. Domestic wastewater		8.81	0.19	NA	NA	0.01		296.03
5.D.2. Industrial wastewater		IE	IE	IE	IE	IE		IE
5.D.3. Other		NA	NA	NA	NA	NA		NA
5.E. Other	NO	NO	NO	NO	NO	NO	NO	NO
Memo item: [3]								
5.F.1. Long-term storage of C in waste disposal sites	NE							NE
5.F.1.a. Annual change in total long-term C storage	NE							NE
5.F.1.b. Annual change in total long-term C storage in HWP waste [4]	NE							NE

Annex 6-6. Summary Reports on GHG Emissions in the Republic of Moldova within 1990-2022

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
Total national emissions and removals	**35,174.33**	**214.31**	**9.94**	**NO**	**NO**	**NO**	**NO**	**NO**	**95.73**	**282.33**	**141.54**	**150.86**	**43,808.10**
1. Energy	**35,384.04**	**49.86**	**1.16**						**91.72**	**270.67**	**31.87**	**149.47**	**37,087.56**
1.A. Fuel combustion	35,383.38	13.43	1.16						91.72	270.67	31.21	149.47	36,066.86
1.A.1. Energy industries	21,300.29	0.49	0.17						39.47	7.21	0.63	102.36	21,359.99
1.A.2. Manufacturing industries and construction	1,898.61	0.09	0.01						8.86	3.45	0.87	2.67	1,904.84
1.A.3. Transport	4,698.24	1.35	0.36						21.04	70.89	9.04	0.78	4,830.86
1.A.4. Other sectors	7,372.26	11.50	0.61						21.60	188.29	20.55	43.34	7,855.70
1.A.5. Other	113.97	0.01	0.00						0.76	0.83	0.12	0.33	115.46
1.B. Fugitive emissions from fuels	0.66	36.43	0.00						NO	NO	0.66	NO	1,020.70
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.66	36.43	0.00						NO	NO	0.66	NO	1,020.70
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**1,605.22**	**NO**	**0.00**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.76**	**5.49**	**106.55**	**1.38**	**1,605.24**
2.A. Mineral industry	1,338.96								3.60	3.44	0.03	1.32	1,338.96
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.06	NO	NO
2.C. Metal industry	28.50	NO	NO	NO	NO	NO	NO	NO	0.09	1.21	0.04	0.04	28.50
2.D. Non-energy products from fuels and solvent use	234.36	NO	NO						0.04	0.24	92.79	0.02	234.36
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	3.40	NO	0.00	NO	NO	NO	NO	NO	0.02	0.60	1.55	NO	3.42
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	12.08	NO	NO
3. Agriculture	**0.58**	**107.38**	**7.90**						**NO**	**NO**	**NE, NO**	**NO**	**5,101.04**
3.A. Enteric fermentation		87.58											2,452.16
3.B. Manure management		19.80	2.90								NO		1,323.77
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	5.00						NO	NO	NO		1,324.53
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE

3.G. Liming	NO												NO
3.H. Urea application	0.58												0.58
3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,830.49**	**0.11**	**0.57**						**0.10**	**3.52**	**NE**		**-1,676.01**
4.A. Forest land [5]	-2,563.43	0.01	0.00						0.01	0.19	NE		-2,563.08
4.B. Cropland [5]	2,379.09	0.10	0.00						0.09	3.33	NE		2,382.50
4.C. Grassland [5]	-1,205.69	NE	NE						NE	NE	NE		-1,205.69
4.D. Wetlands [5]	-555.38	NE	NE						NE	NE	NE		-555.38
4.E. Settlements [5]	84.75	NO, NE	0.57						NE	NE	NE		235.46
4.F. Other land [5]	152.36	NE	NE						NE	NE	NE		152.36
4.G. Harvested wood products [5]	-122.18												-122.18
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**14.97**	**56.96**	**0.30**						**0.15**	**2.64**	**3.12**	**0.01**	**1,690.28**
5.A. Solid waste disposal [6]		43.86							NA, NO	NA, NO	3.02	0.00	1,228.09
5.B. Biological treatment of solid waste		0.05	0.00						NO, NE	0.01	NO, NE		2.39
5.C. Incineration and open burning of waste [6]	14.97	0.31	0.01						0.15	2.64	0.06	0.01	25.01
5.D. Wastewater treatment and discharge		12.74	0.30						NA, IE	NA, IE	0.04	0.00	434.80
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**191.63**	**0.01**	**0.01**						**0.76**	**0.57**	**0.21**	**0.06**	**193.68**
1.D.1.a. Aviation	191.63	0.01	0.01						0.76	0.57	0.21	0.06	193.68
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**232.81**												**232.81**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**2.51**										**664.92**

Indirect CO_2	**207.55**												**207.55**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**28,403.31**	**200.32**	**9.28**	**NO**	**NO**	**NO**	**NO**	**NO**	**78.63**	**206.99**	**114.31**	**124.99**	**36,471.43**
1. Energy	**29,884.36**	**44.13**	**0.86**						**74.95**	**196.18**	**23.17**	**123.69**	**31,348.82**
1.A. Fuel combustion	29,883.72	9.67	0.86						74.95	196.18	22.55	123.69	30,383.23
1.A.1. Energy industries	18,927.03	0.42	0.16						35.07	6.41	0.55	90.52	18,980.28
1.A.2. Manufacturing industries and construction	1,269.19	0.05	0.01						6.48	1.74	0.55	1.22	1,273.22
1.A.3. Transport	3,656.10	1.03	0.29						16.79	53.95	6.92	0.61	3,762.74
1.A.4. Other sectors	5,925.02	8.15	0.40						15.96	133.47	14.45	31.04	6,259.50
1.A.5. Other	106.37	0.01	0.00						0.66	0.62	0.09	0.29	107.48
1.B. Fugitive emissions from fuels	0.64	34.46	0.00						NO	NO	0.62	NO	965.59
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.64	34.46	0.00						NO	NO	0.62	NO	965.59
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**1,411.27**	**NO**	**0.00**	**NO**	**NO**	**NO**	**NO**	**NO**	**3.44**	**4.90**	**87.89**	**1.30**	**1,411.29**
2.A. Mineral industry	1,190.16								3.30	3.04	0.03	1.24	1,190.16
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.05	NO	NO
2.C. Metal industry	24.73	NO	NO	NO	NO	NO	NO	NO	0.08	1.05	0.03	0.04	24.73
2.D. Non-energy products from fuels and solvent use	193.32	NO	NO						0.04	0.20	76.26	0.02	193.32
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	3.06	NO	0.00	NO	NO	NO	NO	NO	0.02	0.61	1.39	NO	3.08
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	10.11	NO	NO
3. Agriculture	**0.52**	**97.76**	**7.52**						**NO**	**NO**	**NE, NO**	**NO**	**4,729.89**
3.A. Enteric fermentation		81.15											2,272.33
3.B. Manure management		16.60	2.71								NO		1,183.82
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	4.80						NO	NO	NO		1,273.21
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.52												0.52

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,907.84**	**0.10**	**0.62**						**0.09**	**3.26**	**NE**		**-2,741.63**
4.A. Forest land [5]	-2,343.31	0.00	0.00						0.00	0.03	NE		-2,343.25
4.B. Cropland [5]	1,248.78	0.09	0.00						0.09	3.22	NE		1,252.08
4.C. Grassland [5]	-1,414.32	NE	NE						NE	NE	NE		-1,414.32
4.D. Wetlands [5]	-526.46	NE	NE						NE	NE	NE		-526.46
4.E. Settlements [5]	88.71	NO, NE	0.61						NE	NE	NE		251.56
4.F. Other land [5]	152.36	NE	NE						NE	NE	NE		152.36
4.G. Harvested wood products [5]	-113.61												-113.61
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**15.00**	**58.34**	**0.28**						**0.15**	**2.65**	**3.26**	**0.01**	**1,723.07**
5.A. Solid waste disposal [6]		45.62							NA, NO	NA, NO	3.16	0.00	1,277.50
5.B. Biological treatment of solid waste		0.06	0.00						NO, NE	0.01	NO, NE		2.42
5.C. Incineration and open burning of waste [6]	15.00	0.31	0.01						0.15	2.64	0.06	0.01	25.06
5.D. Wastewater treatment and discharge		12.35	0.27						NA, IE	NA, IE	0.04	0.00	418.10
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**145.99**	**0.01**	**0.00**						**0.58**	**0.44**	**0.21**	**0.05**	**147.55**
1.D.1.a. Aviation	145.99	0.01	0.00						0.58	0.44	0.21	0.05	147.55
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**201.20**												**201.20**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**2.33**										**618.15**

Indirect CO_2	**170.84**												**170.84**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**21,815.12**	**191.69**	**7.99**	**NO**	**NO**	**NO**	**NO**	**NO**	**58.68**	**133.65**	**90.34**	**92.19**	**29,298.94**
1. Energy	**23,300.20**	**37.18**	**0.60**						**56.59**	**124.61**	**15.07**	**91.50**	**24,501.07**
1.A. Fuel combustion	23,299.66	6.06	0.60						56.59	124.61	14.51	91.50	23,629.03
1.A.1. Energy industries	15,660.99	0.36	0.12						28.75	5.58	0.48	71.24	15,703.31
1.A.2. Manufacturing industries and construction	921.55	0.04	0.01						4.56	1.32	0.41	0.93	924.48
1.A.3. Transport	2,615.22	0.72	0.22						12.61	37.27	4.84	0.45	2,694.66
1.A.4. Other sectors	4,024.16	4.93	0.25						10.19	80.11	8.74	18.71	4,228.10
1.A.5. Other	77.75	0.00	0.00						0.48	0.34	0.05	0.17	78.47
1.B. Fugitive emissions from fuels	0.54	31.13	0.00						NO	NO	0.56	NO	872.04
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.54	31.13	0.00						NO	NO	0.56	NO	872.04
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**822.46**	**NO**	**0.00**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.85**	**3.40**	**72.18**	**0.68**	**822.47**
2.A. Mineral industry	641.79								1.73	1.65	0.02	0.63	641.79
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	23.99	NO	NO	NO	NO	NO	NO	NO	0.08	1.02	0.03	0.04	23.99
2.D. Non-energy products from fuels and solvent use	154.26	NO	NO						0.03	0.17	62.97	0.02	154.26
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	2.41	NO	0.00	NO	NO	NO	NO	NO	0.02	0.57	1.10	NO	2.43
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	8.05	NO	NO
3. Agriculture	**0.39**	**94.80**	**6.44**						**NO**	**NO**	**NE, NO**	**NO**	**4,360.93**
3.A. Enteric fermentation		79.87											2,236.40
3.B. Manure management		14.92	2.41								NO		1,055.31
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	4.03						NO	NO	NO		1,068.82
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.39												0.39

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,322.98**	**0.09**	**0.69**						**0.08**	**2.98**	**NE**		**-2,138.53**
4.A. Forest land [5]	-2,184.24	0.00	0.00						0.00	0.03	NE		-2,184.18
4.B. Cropland [5]	1,174.19	0.09	0.00						0.08	2.94	NE		1,177.20
4.C. Grassland [5]	-1,428.48	NE	NE						NE	NE	NE		-1,428.48
4.D. Wetlands [5]	-595.55	NE	NE						NE	NE	NE		-595.55
4.E. Settlements [5]	386.62	NO, NE	0.68						NE	NE	NE		567.99
4.F. Other land [5]	418.78	NE	NE						NE	NE	NE		418.78
4.G. Harvested wood products [5]	-94.30												-94.30
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**15.05**	**59.62**	**0.26**						**0.15**	**2.65**	**3.08**	**0.01**	**1,753.00**
5.A. Solid waste disposal [6]		47.56							NA, NO	NA, NO	2.99	0.00	1,331.63
5.B. Biological treatment of solid waste		0.06	0.00						NO, NE	0.01	NO, NE		2.52
5.C. Incineration and open burning of waste [6]	15.05	0.31	0.01						0.15	2.64	0.06	0.01	25.13
5.D. Wastewater treatment and discharge		11.70	0.25						NA, IE	NA, IE	0.03	0.00	393.70
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**107.51**	**0.01**	**0.00**						**0.42**	**0.32**	**0.21**	**0.03**	**108.66**
1.D.1.a. Aviation	107.51	0.01	0.00						0.42	0.32	0.21	0.03	108.66
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**169.59**												**169.59**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**2.00**										**529.63**

Indirect CO_2	**140.94**												**140.94**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**15,721.78**	**178.11**	**6.89**	**NO**	**NO**	**NO**	**NO**	**NO**	**46.68**	**70.79**	**71.40**	**72.68**	**22,534.98**
1. Energy	**17,333.44**	**30.57**	**0.50**						**44.67**	**60.89**	**8.21**	**72.01**	**18,321.97**
1.A. Fuel combustion	17,332.99	2.60	0.50						44.67	60.89	7.71	72.01	17,538.26
1.A.1. Energy industries	12,640.60	0.28	0.11						23.64	4.24	0.37	62.27	12,676.53
1.A.2. Manufacturing industries and construction	610.17	0.03	0.00						2.86	0.95	0.28	0.67	612.12
1.A.3. Transport	1,854.84	0.49	0.18						9.92	24.46	3.29	0.32	1,916.56
1.A.4. Other sectors	2,133.92	1.79	0.21						7.79	30.61	3.69	8.37	2,238.79
1.A.5. Other	93.45	0.01	0.00						0.46	0.63	0.09	0.37	94.26
1.B. Fugitive emissions from fuels	0.46	27.97	0.00						NO	NO	0.50	NO	783.70
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.46	27.97	0.00						NO	NO	0.50	NO	783.70
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**737.86**	**NO**	**0.00**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.76**	**3.24**	**60.28**	**0.67**	**737.88**
2.A. Mineral industry	587.58								1.64	1.49	0.01	0.62	587.58
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	24.42	NO	NO	NO	NO	NO	NO	NO	0.08	1.04	0.03	0.04	24.42
2.D. Non-energy products from fuels and solvent use	123.88	NO	NO						0.02	0.14	50.10	0.01	123.88
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.98	NO	0.00	NO	NO	NO	NO	NO	0.02	0.58	0.90	NO	2.00
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	9.22	NO	NO
3. Agriculture	**0.13**	**85.91**	**5.40**						**NO**	**NO**	**NE, NO**	**NO**	**3,837.53**
3.A. Enteric fermentation		74.92											2,097.65
3.B. Manure management		11.00	2.03								NO		846.48
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	3.37						NO	NO	NO		893.26
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.13												0.13

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,364.70**	**0.12**	**0.75**						**0.11**	**4.02**	**NE**		**-2,163.47**
4.A. Forest land [5]	-2,193.51	0.00	0.00						0.00	0.00	NE		-2,193.51
4.B. Cropland [5]	1,443.00	0.12	0.00						0.11	4.01	NE		1,447.10
4.C. Grassland [5]	-1,303.52	NE	NE						NE	NE	NE		-1,303.52
4.D. Wetlands [5]	-525.84	NE	NE						NE	NE	NE		-525.84
4.E. Settlements [5]	114.62	NO, NE	0.74						NE	NE	NE		311.73
4.F. Other land [5]	164.02	NE	NE						NE	NE	NE		164.02
4.G. Harvested wood products [5]	-63.45												-63.45
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**15.04**	**61.50**	**0.24**						**0.15**	**2.64**	**2.90**	**0.01**	**1,801.08**
5.A. Solid waste disposal [6]		49.45							NA, NO	NA, NO	2.82	0.00	1,384.63
5.B. Biological treatment of solid waste		0.03	0.00						NO, NE	0.00	NO, NE		1.26
5.C. Incineration and open burning of waste [6]	15.04	0.31	0.01						0.15	2.64	0.06	0.01	25.13
5.D. Wastewater treatment and discharge		11.72	0.23						NA, IE	NA, IE	0.03	0.00	390.06
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**54.71**	**0.00**	**0.00**						**0.22**	**0.16**	**0.21**	**0.02**	**55.30**
1.D.1.a. Aviation	54.71	0.00	0.00						0.22	0.16	0.21	0.02	55.30
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**143.24**												**143.24**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**1.62**										**428.90**

Indirect CO_2	**112.20**												**112.20**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**12,752.85**	**174.83**	**6.17**	**NO**	**NO**	**NO**	**NO**	**NO**	**36.85**	**76.23**	**52.56**	**57.58**	**19,283.55**
1. Energy	**14,492.41**	**30.05**	**0.45**						**35.25**	**68.52**	**8.83**	**57.04**	**15,453.99**
1.A. Fuel combustion	14,491.98	3.09	0.45						35.25	68.52	8.35	57.04	14,698.72
1.A.1. Energy industries	9,961.85	0.19	0.09						18.81	3.56	0.28	47.12	9,990.25
1.A.2. Manufacturing industries and construction	738.06	0.02	0.00						1.25	0.72	0.32	0.36	739.14
1.A.3. Transport	1,612.96	0.44	0.11						6.25	22.38	2.83	0.22	1,654.26
1.A.4. Other sectors	2,090.75	2.44	0.25						8.60	41.25	4.83	9.08	2,226.08
1.A.5. Other	88.36	0.01	0.00						0.33	0.61	0.09	0.27	88.99
1.B. Fugitive emissions from fuels	0.43	26.96	0.00						NO	NO	0.49	NO	755.27
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.43	26.96	0.00						NO	NO	0.49	NO	755.27
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**556.59**	**NO**	**0.00**	**NO**	**NO**	**NO**	**NO**	**NO**	**1.39**	**2.84**	**40.93**	**0.53**	**556.60**
2.A. Mineral industry	445.34								1.28	1.15	0.01	0.49	445.34
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	25.33	NO	NO	NO	NO	NO	NO	NO	0.08	1.08	0.03	0.04	25.33
2.D. Non-energy products from fuels and solvent use	84.47	NO	NO						0.01	0.08	32.80	0.01	84.47
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				NO	NO	NO	NO	NO					NO
2.G. Other product manufacture and use	1.44	NO	0.00	NO	NO	NO	NO	NO	0.02	0.53	0.66	NO	1.46
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	7.42	NO	NO
3. Agriculture	**0.05**	**83.52**	**4.69**						**NO**	**NO**	**NE, NO**	**NO**	**3,581.43**
3.A. Enteric fermentation		72.91											2,041.57
3.B. Manure management		10.61	1.96								NO		816.82
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.73						NO	NO	NO		722.98
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.05												0.05

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,311.29**	**0.07**	**0.79**						**0.06**	**2.23**	**NE**		**-2,099.09**
4.A. Forest land [5]	-2,108.00	0.00	0.00						0.00	0.05	NE		-2,107.90
4.B. Cropland [5]	1,206.39	0.06	0.00						0.06	2.18	NE		1,208.61
4.C. Grassland [5]	-1,577.33	NE	NE						NE	NE	NE		-1,577.33
4.D. Wetlands [5]	-497.64	NE	NE						NE	NE	NE		-497.64
4.E. Settlements [5]	130.49	NO, NE	0.79						NE	NE	NE		340.36
4.F. Other land [5]	549.46	NE	NE						NE	NE	NE		549.46
4.G. Harvested wood products [5]	-14.65												-14.65
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**15.09**	**61.19**	**0.23**						**0.15**	**2.65**	**2.80**	**0.01**	**1,790.62**
5.A. Solid waste disposal [6]		49.67							NA, NO	NA, NO	2.71	0.00	1,390.84
5.B. Biological treatment of solid waste		0.03	0.00						NO, NE	0.00	NO, NE		1.18
5.C. Incineration and open burning of waste [6]	15.09	0.31	0.01						0.15	2.64	0.06	0.01	25.21
5.D. Wastewater treatment and discharge		11.18	0.23						NA, IE	NA, IE	0.03	0.00	373.39
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**30.55**	**0.00**	**0.00**						**0.12**	**0.09**	**0.21**	**0.01**	**30.88**
1.D.1.a. Aviation	30.55	0.00	0.00						0.12	0.09	0.21	0.01	30.88
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**157.46**												**157.46**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**1.45**										**383.57**

Indirect CO_2	**73.60**												**73.60**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**9,657.62**	**165.72**	**5.95**	**0.94**	**NO**	**NO**	**NO**	**NO**	**31.09**	**66.46**	**48.15**	**32.01**	**15,876.32**
1. Energy	**11,471.70**	**31.47**	**0.43**						**29.65**	**58.20**	**7.27**	**31.51**	**12,467.03**
1.A. Fuel combustion	11,471.26	1.94	0.43						29.65	58.20	6.73	31.51	11,639.59
1.A.1. Energy industries	7,174.03	0.14	0.05						12.99	3.15	0.24	25.59	7,191.16
1.A.2. Manufacturing industries and construction	381.51	0.01	0.00						0.69	0.56	0.18	0.37	382.22
1.A.3. Transport	1,617.92	0.44	0.11						6.32	23.35	2.93	0.23	1,658.41
1.A.4. Other sectors	2,172.16	1.33	0.27						9.15	30.52	3.29	5.04	2,281.29
1.A.5. Other	125.64	0.01	0.00						0.51	0.63	0.10	0.28	126.51
1.B. Fugitive emissions from fuels	0.44	29.54	0.00						NO	NO	0.53	NO	827.44
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.44	29.54	0.00						NO	NO	0.53	NO	827.44
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**455.63**	**NO**	**0.00**	**0.94**	**NO**	**NO**	**NO**	**NO**	**1.21**	**2.56**	**39.13**	**0.49**	**456.56**
2.A. Mineral industry	351.66								1.09	0.90	0.01	0.44	351.66
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	26.24	NO	NO	NO	NO	NO	NO	NO	0.09	1.12	0.03	0.04	26.24
2.D. Non-energy products from fuels and solvent use	76.56	NO	NO						0.01	0.07	29.22	0.01	76.56
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				0.94	NO	NO	NO	NO					0.94
2.G. Other product manufacture and use	1.17	NO	0.00	NO	NO	NO	NO	NO	0.02	0.47	0.53	NO	1.17
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	9.34	NO	NO
3. Agriculture	**0.06**	**72.97**	**4.44**						**NO**	**NO**	**NE, NO**	**NO**	**3,220.29**
3.A. Enteric fermentation		64.72											1,812.26
3.B. Manure management		8.25	1.73								NO		690.57
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.71						NO	NO	NO		717.39
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.06												0.06

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,284.87**	**0.09**	**0.84**						**0.08**	**3.05**	**NE**		**-2,058.69**
4.A. Forest land [5]	-2,045.07	0.00	0.00						0.00	0.00	NE		-2,045.06
4.B. Cropland [5]	1,316.72	0.09	0.00						0.08	3.05	NE		1,319.84
4.C. Grassland [5]	-1,601.10	NE	NE						NE	NE	NE		-1,601.10
4.D. Wetlands [5]	-469.44	NE	NE						NE	NE	NE		-469.44
4.E. Settlements [5]	106.92	NO, NE	0.84						NE	NE	NE		329.96
4.F. Other land [5]	401.13	NE	NE						NE	NE	NE		401.13
4.G. Harvested wood products [5]	5.97												5.97
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**15.10**	**61.19**	**0.24**						**0.15**	**2.65**	**1.75**	**0.01**	**1,791.14**
5.A. Solid waste disposal [6]		49.57							NA, NO	NA, NO	1.67	0.00	1,388.07
5.B. Biological treatment of solid waste		0.03	0.00						NO, NE	0.00	NO, NE		1.11
5.C. Incineration and open burning of waste [6]	15.10	0.31	0.01						0.15	2.64	0.06	0.01	25.21
5.D. Wastewater treatment and discharge		11.28	0.23						NA, IE	NA, IE	0.02	0.00	376.76
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**34.67**	**0.00**	**0.00**						**0.13**	**0.11**	**0.21**	**0.01**	**35.05**
1.D.1.a. Aviation	34.67	0.00	0.00						0.13	0.11	0.21	0.01	35.05
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**230.05**												**230.05**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**1.32**										**350.51**

Indirect CO_2	**65.45**												**65.45**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**9,065.06**	**163.56**	**5.42**	**1.51**	**NO**	**NO**	**NO**	**NO**	**29.18**	**78.69**	**46.45**	**32.16**	**15,081.39**
1. Energy	**11,375.14**	**35.31**	**0.37**						**27.92**	**71.30**	**8.71**	**31.73**	**12,462.93**
1.A. Fuel combustion	11,374.65	2.97	0.37						27.92	71.30	8.13	31.73	11,557.14
1.A.1. Energy industries	7,107.05	0.14	0.05						12.75	3.26	0.24	23.44	7,123.27
1.A.2. Manufacturing industries and construction	321.29	0.01	0.00						0.65	0.63	0.16	0.47	322.02
1.A.3. Transport	1,578.77	0.43	0.10						6.19	22.27	2.79	0.22	1,617.58
1.A.4. Other sectors	2,285.70	2.39	0.22						7.90	44.68	4.84	7.39	2,411.51
1.A.5. Other	81.84	0.01	0.00						0.44	0.47	0.10	0.21	82.76
1.B. Fugitive emissions from fuels	0.50	32.33	0.00						NO	NO	0.58	NO	905.78
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.50	32.33	0.00						NO	NO	0.58	NO	905.78
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**415.26**	**NO**	**0.00**	**1.51**	**NO**	**NO**	**NO**	**NO**	**1.05**	**2.65**	**36.16**	**0.42**	**416.77**
2.A. Mineral industry	316.36								0.93	0.80	0.01	0.37	316.36
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	26.73	NO	NO	NO	NO	NO	NO	NO	0.09	1.14	0.03	0.04	26.73
2.D. Non-energy products from fuels and solvent use	71.07	NO	NO						0.01	0.07	27.03	0.01	71.07
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				1.51	NO	NO	NO	NO					1.51
2.G. Other product manufacture and use	1.10	NO	0.00	NO	NO	NO	NO	NO	0.02	0.64	0.50	NO	1.11
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	8.58	NO	NO
3. Agriculture	**0.09**	**67.17**	**3.93**						**NO**	**NO**	**NE, NO**	**NO**	**2,921.62**
3.A. Enteric fermentation		59.67											1,670.90
3.B. Manure management		7.49	1.49								NO		605.98
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.43						NO	NO	NO		644.66
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.09												0.09

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,740.53**	**0.06**	**0.88**						**0.06**	**2.09**	**NE**		**-2,505.59**
4.A. Forest land [5]	-2,190.43	0.00	0.00						0.00	0.02	NE		-2,190.40
4.B. Cropland [5]	1,118.52	0.06	0.00						0.06	2.07	NE		1,120.65
4.C. Grassland [5]	-1,548.08	NE	NE						NE	NE	NE		-1,548.08
4.D. Wetlands [5]	-441.24	NE	NE						NE	NE	NE		-441.24
4.E. Settlements [5]	101.59	NO, NE	0.88						NE	NE	NE		334.38
4.F. Other land [5]	217.33	NE	NE						NE	NE	NE		217.33
4.G. Harvested wood products [5]	1.78												1.78
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**15.10**	**61.02**	**0.23**						**0.15**	**2.64**	**1.59**	**0.01**	**1,785.66**
5.A. Solid waste disposal [6]		49.49							NA, NO	NA, NO	1.51	0.00	1,385.67
5.B. Biological treatment of solid waste		0.03	0.00						NO, NE	0.00	NO, NE		1.14
5.C. Incineration and open burning of waste [6]	15.10	0.31	0.01						0.15	2.64	0.06	0.01	25.20
5.D. Wastewater treatment and discharge		11.20	0.23						NA, IE	NA, IE	0.02	0.00	373.65
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**56.73**	**0.00**	**0.00**						**0.22**	**0.15**	**0.07**	**0.02**	**57.31**
1.D.1.a. Aviation	56.73	0.00	0.00						0.22	0.15	0.07	0.02	57.31
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**294.03**												**294.03**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**1.16**										**307.75**

Indirect CO_2	**60.57**	**60.57**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**8,336.36**	**148.01**	**5.34**	**2.10**	**NO**	**NO**	**NO**	**NO**	**26.17**	**74.10**	**31.76**	**16.90**	**13,897.35**
1. Energy	**10,258.32**	**29.73**	**0.34**						**24.66**	**64.80**	**7.96**	**16.40**	**11,181.69**
1.A. Fuel combustion	10,257.83	2.32	0.34						24.66	64.80	7.47	16.40	10,413.70
1.A.1. Energy industries	5,615.61	0.11	0.02						9.52	3.14	0.22	10.53	5,625.19
1.A.2. Manufacturing industries and construction	546.90	0.02	0.00						0.92	0.74	0.28	0.40	548.02
1.A.3. Transport	1,516.13	0.40	0.10						6.05	24.65	3.07	0.23	1,553.23
1.A.4. Other sectors	2,502.53	1.78	0.22						7.89	35.78	3.82	5.02	2,609.85
1.A.5. Other	76.66	0.01	0.00						0.29	0.50	0.08	0.22	77.41
1.B. Fugitive emissions from fuels	0.49	27.41	0.00						NO	NO	0.49	NO	767.99
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.49	27.41	0.00						NO	NO	0.49	NO	767.99
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**452.49**	**NO**	**0.00**	**2.10**	**NO**	**NO**	**NO**	**NO**	**1.26**	**3.00**	**22.34**	**0.50**	**454.60**
2.A. Mineral industry	377.06								1.13	0.97	0.01	0.45	377.06
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	32.38	NO	NO	NO	NO	NO	NO	NO	0.11	1.38	0.04	0.05	32.38
2.D. Non-energy products from fuels and solvent use	42.05	NO	NO						0.00	0.02	14.13	0.00	42.05
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				2.10	NO	NO	NO	NO					2.10
2.G. Other product manufacture and use	1.00	NO	0.00	NO	NO	NO	NO	NO	0.02	0.63	0.45	NO	1.00
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	7.70	NO	NO
3. Agriculture	**1.10**	**57.39**	**3.84**						**NO**	**NO**	**NE, NO**	**NO**	**2,626.87**
3.A. Enteric fermentation		51.30											1,436.51
3.B. Manure management		6.09	1.35								NO		527.93
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.50						NO	NO	NO		661.33
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	1.10												1.10

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,390.60**	**0.11**	**0.91**						**0.10**	**3.66**	**NE**		**-2,145.55**
4.A. Forest land [5]	-2,232.29	0.00	0.00						0.00	0.01	NE		-2,232.28
4.B. Cropland [5]	1,385.79	0.11	0.00						0.10	3.66	NE		1,389.53
4.C. Grassland [5]	-1,400.86	NE	NE						NE	NE	NE		-1,400.86
4.D. Wetlands [5]	-413.03	NE	NE						NE	NE	NE		-413.03
4.E. Settlements [5]	100.80	NO, NE	0.91						NE	NE	NE		342.10
4.F. Other land [5]	188.24	NE	NE						NE	NE	NE		188.24
4.G. Harvested wood products [5]	-19.24												-19.24
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**15.05**	**60.78**	**0.24**						**0.15**	**2.63**	**1.46**	**0.01**	**1,779.74**
5.A. Solid waste disposal [6]		49.07							NA, NO	NA, NO	1.38	0.00	1,373.84
5.B. Biological treatment of solid waste		0.02	0.00						NO, NE	0.00	NO, NE		1.08
5.C. Incineration and open burning of waste [6]	15.05	0.31	0.01						0.15	2.63	0.06	0.01	25.11
5.D. Wastewater treatment and discharge		11.38	0.23						NA, IE	NA, IE	0.02	0.00	379.72
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**66.19**	**0.00**	**0.00**						**0.26**	**0.17**	**0.08**	**0.02**	**66.85**
1.D.1.a. Aviation	66.19	0.00	0.00						0.26	0.17	0.08	0.02	66.85
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**304.23**												**304.23**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**1.10**										**290.58**

Indirect CO_2	**32.09**												**32.09**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**6,843.18**	**142.64**	**5.21**	**2.85**	**NO**	**NO**	**NO**	**NO**	**21.96**	**57.60**	**27.72**	**12.65**	**12,221.65**
1. Energy	**8,874.91**	**27.25**	**0.27**						**20.61**	**49.10**	**6.33**	**12.18**	**9,708.68**
1.A. Fuel combustion	8,874.46	1.71	0.27						20.61	49.10	5.88	12.18	8,993.08
1.A.1. Energy industries	4,836.61	0.10	0.02						8.11	2.78	0.20	7.93	4,844.34
1.A.2. Manufacturing industries and construction	523.10	0.01	0.00						0.88	0.60	0.24	0.32	523.97
1.A.3. Transport	1,363.25	0.40	0.08						5.07	21.35	2.64	0.19	1,396.45
1.A.4. Other sectors	2,078.68	1.19	0.16						6.16	23.79	2.69	3.53	2,154.67
1.A.5. Other	72.83	0.01	0.00						0.39	0.59	0.10	0.22	73.64
1.B. Fugitive emissions from fuels	0.45	25.54	0.00						NO	NO	0.46	NO	715.61
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.45	25.54	0.00						NO	NO	0.46	NO	715.61
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**375.52**	**NO**	**0.00**	**2.85**	**NO**	**NO**	**NO**	**NO**	**1.11**	**2.52**	**19.96**	**0.46**	**378.37**
2.A. Mineral industry	308.48								1.00	0.79	0.01	0.42	308.48
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	28.68	NO	NO	NO	NO	NO	NO	NO	0.09	1.22	0.04	0.04	28.68
2.D. Non-energy products from fuels and solvent use	37.61	NO	NO						0.00	0.02	13.27	0.00	37.61
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				2.85	NO	NO	NO	NO					2.85
2.G. Other product manufacture and use	0.75	NO	0.00	NO	NO	NO	NO	NO	0.02	0.50	0.34	NO	0.75
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	6.30	NO	NO
3. Agriculture	**0.27**	**55.43**	**3.75**						**NO**	**NO**	**NE, NO**	**NO**	**2,546.35**
3.A. Enteric fermentation		49.81											1,394.62
3.B. Manure management		5.62	1.33								NO		508.48
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.43						NO	NO	NO		642.97
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.27												0.27

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,422.61**	**0.10**	**0.95**						**0.09**	**3.34**	**NE**		**-2,166.97**
4.A. Forest land [5]	-2,288.49	0.00	0.00						0.00	0.05	NE		-2,288.39
4.B. Cropland [5]	1,412.06	0.10	0.00						0.09	3.29	NE		1,415.42
4.C. Grassland [5]	-1,436.27	NE	NE						NE	NE	NE		-1,436.27
4.D. Wetlands [5]	-384.83	NE	NE						NE	NE	NE		-384.83
4.E. Settlements [5]	99.04	NO, NE	0.95						NE	NE	NE		351.21
4.F. Other land [5]	185.01	NE	NE						NE	NE	NE		185.01
4.G. Harvested wood products [5]	-9.13												-9.13
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**15.08**	**59.87**	**0.24**						**0.15**	**2.63**	**1.42**	**0.01**	**1,755.22**
5.A. Solid waste disposal [6]		48.48							NA, NO	NA, NO	1.35	0.00	1,357.44
5.B. Biological treatment of solid waste		0.02	0.00						NO, NE	0.00	NO, NE		1.09
5.C. Incineration and open burning of waste [6]	15.08	0.31	0.01						0.15	2.63	0.06	0.01	25.17
5.D. Wastewater treatment and discharge		11.05	0.23						NA, IE	NA, IE	0.02	0.00	371.52
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**53.59**	**0.00**	**0.00**						**0.21**	**0.14**	**0.07**	**0.02**	**54.15**
1.D.1.a. Aviation	53.59	0.00	0.00						0.21	0.14	0.07	0.02	54.15
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**275.62**												**275.62**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**1.07**										**283.53**

Indirect CO_2	**29.94**												**29.94**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**5,116.53**	**137.23**	**4.83**	**3.64**	**NO**	**NO**	**NO**	**NO**	**16.13**	**45.49**	**23.39**	**5.99**	**10,243.24**
1. Energy	**6,903.73**	**26.89**	**0.18**						**14.92**	**36.98**	**5.01**	**5.59**	**7,704.88**
1.A. Fuel combustion	6,903.32	1.55	0.18						14.92	36.98	4.55	5.59	6,995.16
1.A.1. Energy industries	3,660.25	0.07	0.01						5.89	2.38	0.16	2.13	3,664.61
1.A.2. Manufacturing industries and construction	473.83	0.01	0.00						0.73	0.49	0.22	0.23	474.57
1.A.3. Transport	910.68	0.25	0.05						3.44	12.53	1.55	0.14	931.24
1.A.4. Other sectors	1,809.40	1.22	0.12						4.71	21.22	2.55	2.93	1,874.96
1.A.5. Other	49.16	0.01	0.00						0.15	0.36	0.06	0.17	49.77
1.B. Fugitive emissions from fuels	0.41	25.33	0.00						NO	NO	0.46	NO	709.73
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.41	25.33	0.00						NO	NO	0.46	NO	709.73
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**338.23**	**NO**	**0.00**	**3.64**	**NO**	**NO**	**NO**	**NO**	**0.98**	**2.65**	**17.05**	**0.40**	**341.88**
2.A. Mineral industry	271.71								0.85	0.70	0.01	0.35	271.71
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	31.79	NO	NO	NO	NO	NO	NO	NO	0.10	1.35	0.04	0.05	31.79
2.D. Non-energy products from fuels and solvent use	34.08	NO	NO						0.00	0.02	12.76	0.00	34.08
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				3.64	NO	NO	NO	NO					3.64
2.G. Other product manufacture and use	0.64	NO	0.00	NO	NO	NO	NO	NO	0.02	0.58	0.29	NO	0.65
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.95	NO	NO
3. Agriculture	**0.00**	**50.97**	**3.43**						**NO**	**NO**	**NE, NO**	**NO**	**2,335.46**
3.A. Enteric fermentation		46.07											1,290.04
3.B. Manure management		4.89	1.20								NO		455.51
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.23						NO	NO	NO		589.91
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.00												0.00

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,140.44**	**0.10**	**0.99**						**0.09**	**3.24**	**NE**		**-1,876.44**
4.A. Forest land [5]	-2,336.85	0.00	0.00						0.00	0.04	NE		-2,336.77
4.B. Cropland [5]	1,430.80	0.09	0.00						0.09	3.20	NE		1,434.07
4.C. Grassland [5]	-1,433.29	NE	NE						NE	NE	NE		-1,433.29
4.D. Wetlands [5]	-356.63	NE	NE						NE	NE	NE		-356.63
4.E. Settlements [5]	111.83	NO, NE	0.98						NE	NE	NE		372.47
4.F. Other land [5]	425.16	NE	NE						NE	NE	NE		425.16
4.G. Harvested wood products [5]	18.54												18.54
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**15.01**	**59.28**	**0.24**						**0.15**	**2.63**	**1.33**	**0.01**	**1,737.47**
5.A. Solid waste disposal [6]		48.20							NA, NO	NA, NO	1.26	0.00	1,349.68
5.B. Biological treatment of solid waste		0.02	0.00						NO, NE	0.00	NO, NE		1.02
5.C. Incineration and open burning of waste [6]	15.01	0.31	0.01						0.15	2.62	0.06	0.01	25.05
5.D. Wastewater treatment and discharge		10.75	0.23						NA, IE	NA, IE	0.01	0.00	361.71
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**63.04**	**0.00**	**0.00**						**0.25**	**0.16**	**0.08**	**0.02**	**63.68**
1.D.1.a. Aviation	63.04	0.00	0.00						0.25	0.16	0.08	0.02	63.68
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**272.72**												**272.72**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.97**										**256.18**

Indirect CO_2	**28.71**												**28.71**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**4,094.07**	**133.60**	**4.62**	**4.66**	**NO**	**NO**	**NO**	**NO**	**14.89**	**41.21**	**22.90**	**4.61**	**9,064.43**
1. Energy	**6,188.57**	**28.10**	**0.16**						**13.57**	**34.60**	**4.90**	**4.06**	**7,018.53**
1.A. Fuel combustion	6,188.18	1.54	0.16						13.57	34.60	4.42	4.06	6,274.33
1.A.1. Energy industries	3,155.75	0.06	0.01						5.04	2.12	0.14	0.97	3,159.28
1.A.2. Manufacturing industries and construction	519.59	0.01	0.00						0.79	0.48	0.22	0.23	520.27
1.A.3. Transport	982.33	0.25	0.06						3.78	12.43	1.55	0.16	1,004.59
1.A.4. Other sectors	1,494.12	1.21	0.10						3.82	19.34	2.46	2.54	1,553.40
1.A.5. Other	36.39	0.00	0.00						0.13	0.23	0.04	0.16	36.78
1.B. Fugitive emissions from fuels	0.39	26.56	0.00						NO	NO	0.48	NO	744.21
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.39	26.56	0.00						NO	NO	0.48	NO	744.21
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**310.64**	**NO**	**0.00**	**4.66**	**NO**	**NO**	**NO**	**NO**	**1.14**	**2.75**	**16.67**	**0.54**	**315.31**
2.A. Mineral industry	240.78								1.00	0.58	0.01	0.48	240.78
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	36.27	NO	NO	NO	NO	NO	NO	NO	0.12	1.54	0.05	0.05	36.27
2.D. Non-energy products from fuels and solvent use	32.64	NO	NO						0.00	0.01	12.56	0.00	32.64
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				4.66	NO	NO	NO	NO					4.66
2.G. Other product manufacture and use	0.96	NO	0.00	NO	NO	NO	NO	NO	0.02	0.61	0.43	NO	0.97
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.61	NO	NO
3. Agriculture	**0.44**	**47.28**	**3.22**						**NO**	**NO**	**NE, NO**	**NO**	**2,178.48**
3.A. Enteric fermentation		43.43											1,216.08
3.B. Manure management		3.84	1.09								NO		397.14
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.13						NO	NO	NO		564.83
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.44												0.44

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,420.58**	**0.04**	**0.99**						**0.03**	**1.24**	**NE**		**-2,156.04**
4.A. Forest land [5]	-2,307.44	0.00	0.00						0.00	0.00	NE		-2,307.44
4.B. Cropland [5]	1,222.73	0.04	0.00						0.03	1.24	NE		1,224.00
4.C. Grassland [5]	-1,291.95	NE	NE						NE	NE	NE		-1,291.95
4.D. Wetlands [5]	-328.42	NE	NE						NE	NE	NE		-328.42
4.E. Settlements [5]	100.18	NO, NE	0.99						NE	NE	NE		363.44
4.F. Other land [5]	178.52	NE	NE						NE	NE	NE		178.52
4.G. Harvested wood products [5]	5.81												5.81
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**15.00**	**58.19**	**0.24**						**0.15**	**2.62**	**1.33**	**0.01**	**1,708.15**
5.A. Solid waste disposal [6]		47.08							NA, NO	NA, NO	1.26	0.00	1,318.27
5.B. Biological treatment of solid waste		0.02	0.00						NO, NE	0.00	NO, NE		0.92
5.C. Incineration and open burning of waste [6]	15.00	0.31	0.01						0.15	2.62	0.06	0.01	25.03
5.D. Wastewater treatment and discharge		10.78	0.23						NA, IE	NA, IE	0.01	0.00	363.93
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other ***(please specify)*** [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**63.08**	**0.00**	**0.00**						**0.26**	**0.17**	**0.07**	**0.02**	**63.73**
1.D.1.a. Aviation	63.08	0.00	0.00						0.26	0.17	0.07	0.02	63.73
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**272.37**												**272.37**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.90**										**238.46**

Indirect CO_2	**28.60**												**28.60**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**5,081.29**	**133.07**	**4.87**	**6.25**	**NO**	**NO**	**NO**	**NO**	**15.99**	**40.59**	**24.47**	**4.09**	**10,102.97**
1. Energy	**6,818.02**	**28.03**	**0.17**						**14.70**	**33.43**	**4.82**	**3.58**	**7,647.24**
1.A. Fuel combustion	6,817.59	1.41	0.17						14.70	33.43	4.34	3.58	6,901.41
1.A.1. Energy industries	3,677.72	0.07	0.01						5.88	2.50	0.17	0.88	3,681.88
1.A.2. Manufacturing industries and construction	600.55	0.01	0.00						0.90	0.55	0.25	0.26	601.33
1.A.3. Transport	1,061.82	0.27	0.06						4.02	13.29	1.66	0.13	1,086.09
1.A.4. Other sectors	1,434.10	1.06	0.09						3.74	16.74	2.19	2.20	1,488.25
1.A.5. Other	43.40	0.01	0.00						0.16	0.36	0.06	0.11	43.86
1.B. Fugitive emissions from fuels	0.43	26.62	0.00						NO	NO	0.48	NO	745.82
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.43	26.62	0.00						NO	NO	0.48	NO	745.82
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**312.94**	**NO**	**0.00**	**6.25**	**NO**	**NO**	**NO**	**NO**	**1.09**	**2.86**	**18.45**	**0.51**	**319.20**
2.A. Mineral industry	237.07								0.94	0.57	0.01	0.45	237.07
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	38.63	NO	NO	NO	NO	NO	NO	NO	0.13	1.64	0.05	0.06	38.63
2.D. Non-energy products from fuels and solvent use	36.42	NO	NO						0.00	0.02	14.02	0.00	36.42
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				6.25	NO	NO	NO	NO					6.25
2.G. Other product manufacture and use	0.82	NO	0.00	NO	NO	NO	NO	NO	0.02	0.62	0.37	NO	0.83
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.99	NO	NO
3. Agriculture	**0.15**	**47.99**	**3.46**						**NO**	**NO**	**NE, NO**	**NO**	**2,260.91**
3.A. Enteric fermentation		44.13											1,235.66
3.B. Manure management		3.86	1.10								NO		400.17
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.36						NO	NO	NO		624.93
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.15												0.15

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,064.79**	**0.05**	**1.00**						**0.05**	**1.69**	**NE**		**-1,799.66**
4.A. Forest land [5]	-2,273.70	0.00	0.00						0.00	0.09	NE		-2,273.53
4.B. Cropland [5]	1,560.44	0.05	0.00						0.04	1.60	NE		1,562.07
4.C. Grassland [5]	-1,290.65	NE	NE						NE	NE	NE		-1,290.65
4.D. Wetlands [5]	-300.22	NE	NE						NE	NE	NE		-300.22
4.E. Settlements [5]	67.09	NO, NE	0.99						NE	NE	NE		330.42
4.F. Other land [5]	178.52	NE	NE						NE	NE	NE		178.52
4.G. Harvested wood products [5]	-6.26												-6.26
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**14.97**	**56.99**	**0.24**						**0.15**	**2.62**	**1.20**	**0.01**	**1,675.27**
5.A. Solid waste disposal [6]		45.73							NA, NO	NA, NO	1.13	0.00	1,280.40
5.B. Biological treatment of solid waste		0.02	0.00						NO, NE	0.00	NO, NE		0.83
5.C. Incineration and open burning of waste [6]	14.97	0.31	0.01						0.15	2.61	0.06	0.01	24.99
5.D. Wastewater treatment and discharge		10.93	0.24						NA, IE	NA, IE	0.01	0.00	369.05
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other ***(please specify)*** [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**50.49**	**0.00**	**0.00**						**0.19**	**0.15**	**0.06**	**0.02**	**51.03**
1.D.1.a. Aviation	50.49	0.00	0.00						0.19	0.15	0.06	0.02	51.03
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**282.23**												**282.23**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.95**										**251.11**

Indirect CO_2	**31.66**												**31.66**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**4,761.60**	**135.61**	**5.07**	**8.30**	**NO**	**NO**	**NO**	**NO**	**17.00**	**45.71**	**26.79**	**4.98**	**9,909.23**
1. Energy	**6,537.00**	**30.14**	**0.21**						**15.59**	**40.70**	**5.89**	**4.39**	**7,437.76**
1.A. Fuel combustion	6,536.60	1.78	0.21						15.59	40.70	5.38	4.39	6,643.20
1.A.1. Energy industries	2,933.21	0.06	0.01						4.70	2.01	0.14	0.69	2,936.75
1.A.2. Manufacturing industries and construction	410.40	0.01	0.00						0.60	0.40	0.18	0.20	410.94
1.A.3. Transport	1,405.71	0.34	0.09						5.68	17.26	2.19	0.18	1,440.38
1.A.4. Other sectors	1,747.82	1.36	0.11						4.48	20.74	2.81	3.16	1,815.02
1.A.5. Other	39.45	0.01	0.00						0.14	0.29	0.07	0.16	40.10
1.B. Fugitive emissions from fuels	0.41	28.36	0.00						NO	NO	0.52	NO	794.56
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	0.41	28.36	0.00						NO	NO	0.52	NO	794.56
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**361.15**	**NO**	**0.00**	**8.30**	**NO**	**NO**	**NO**	**NO**	**1.25**	**2.06**	**19.77**	**0.58**	**369.46**
2.A. Mineral industry	301.49								1.16	0.73	0.01	0.55	301.49
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	20.50	NO	NO	NO	NO	NO	NO	NO	0.07	0.87	0.03	0.03	20.50
2.D. Non-energy products from fuels and solvent use	38.37	NO	NO						0.00	0.02	14.82	0.00	38.37
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				8.30	NO	NO	NO	NO					8.30
2.G. Other product manufacture and use	0.78	NO	0.00	NO	NO	NO	NO	NO	0.01	0.45	0.36	NO	0.80
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.55	NO	NO
3. Agriculture	**0.05**	**49.04**	**3.60**						**NO**	**NO**	**NE, NO**	**NO**	**2,328.42**
3.A. Enteric fermentation		45.02											1,260.68
3.B. Manure management		4.02	1.11								NO		407.27
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.49						NO	NO	NO		660.42
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.05												0.05

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,151.54**	**0.01**	**1.00**						**0.01**	**0.34**	**NE**		**-1,887.18**
4.A. Forest land [5]	-2,267.62	0.00	0.00						0.00	0.05	NE		-2,267.53
4.B. Cropland [5]	1,156.59	0.01	0.00						0.01	0.29	NE		1,156.88
4.C. Grassland [5]	-1,235.14	NE	NE						NE	NE	NE		-1,235.14
4.D. Wetlands [5]	-272.02	NE	NE						NE	NE	NE		-272.02
4.E. Settlements [5]	67.09	NO, NE	1.00						NE	NE	NE		331.07
4.F. Other land [5]	456.24	NE	NE						NE	NE	NE		456.24
4.G. Harvested wood products [5]	-56.69												-56.69
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**14.94**	**56.41**	**0.25**						**0.15**	**2.61**	**1.13**	**0.01**	**1,660.76**
5.A. Solid waste disposal [6]		44.37							NA, NO	NA, NO	1.06	0.00	1,242.34
5.B. Biological treatment of solid waste		0.02	0.00						NO, NE	0.00	NO, NE		0.92
5.C. Incineration and open burning of waste [6]	14.94	0.31	0.01						0.15	2.60	0.06	0.01	24.93
5.D. Wastewater treatment and discharge		11.72	0.24						NA, IE	NA, IE	0.01	0.00	392.58
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**59.95**	**0.00**	**0.00**						**0.24**	**0.16**	**0.06**	**0.02**	**60.57**
1.D.1.a. Aviation	59.95	0.00	0.00						0.24	0.16	0.06	0.02	60.57
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**322.08**												**322.08**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.99**										**261.17**

Indirect CO_2	**33.39**												**33.39**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**5,500.90**	**132.13**	**4.62**	**10.95**	**NO**	**NO**	**0.00**	**NO**	**17.96**	**55.23**	**27.72**	**6.51**	**10,436.26**
1. Energy	**7,178.52**	**32.01**	**0.21**						**16.53**	**49.75**	**7.05**	**5.93**	**8,130.01**
1.A. Fuel combustion	7,177.44	2.27	0.21						16.53	49.75	6.47	5.93	7,296.25
1.A.1. Energy industries	3,036.74	0.06	0.01						4.85	2.09	0.14	0.52	3,040.33
1.A.2. Manufacturing industries and construction	438.86	0.01	0.00						0.66	0.39	0.19	0.17	439.42
1.A.3. Transport	1,588.76	0.40	0.09						6.15	20.61	2.58	0.21	1,624.14
1.A.4. Other sectors	2,084.65	1.79	0.11						4.73	26.38	3.51	4.90	2,163.57
1.A.5. Other	28.42	0.00	0.00						0.14	0.28	0.05	0.12	28.79
1.B. Fugitive emissions from fuels	1.08	29.74	0.00						NO	NO	0.58	NO	833.76
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.08	29.74	0.00						NO	NO	0.58	NO	833.76
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**386.39**	**NO**	**0.00**	**10.95**	**NO**	**NO**	**0.00**	**NO**	**1.28**	**2.83**	**19.65**	**0.58**	**397.36**
2.A. Mineral industry	309.07								1.15	0.75	0.01	0.53	309.07
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	35.43	NO	NO	NO	NO	NO	NO	NO	0.12	1.51	0.05	0.05	35.43
2.D. Non-energy products from fuels and solvent use	40.93	NO	NO						0.00	0.01	14.87	0.00	40.93
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				10.95	NO	NO	NO	NO					10.95
2.G. Other product manufacture and use	0.96	NO	0.00	NO	NO	NO	0.00	NO	0.02	0.55	0.44	NO	0.98
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.27	NO	NO
3. Agriculture	**0.24**	**44.87**	**3.18**						**NO**	**NO**	**NE, NO**	**NO**	**2,100.30**
3.A. Enteric fermentation		41.14											1,151.96
3.B. Manure management		3.73	1.07								NO		386.87
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils			2.12						NO	NO	NO		561.24
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.24												0.24

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,079.15**	**0.00**	**0.99**						**0.00**	**0.06**	**NE**		**-1,817.34**
4.A. Forest land [5]	-2,270.12	0.00	0.00						0.00	0.05	NE		-2,270.02
4.B. Cropland [5]	1,237.55	0.00	0.00						0.00	0.00	NE		1,237.56
4.C. Grassland [5]	-1,007.18	NE	NE						NE	NE	NE		-1,007.18
4.D. Wetlands [5]	-243.82	NE	NE						NE	NE	NE		-243.82
4.E. Settlements [5]	67.86	NO, NE	0.99						NE	NE	NE		329.57
4.F. Other land [5]	201.66	NE	NE						NE	NE	NE		201.66
4.G. Harvested wood products [5]	-65.11												-65.11
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**14.91**	**55.25**	**0.24**						**0.15**	**2.59**	**1.02**	**0.01**	**1,625.93**
5.A. Solid waste disposal [6]		43.01							NA, NO	NA, NO	0.95	0.00	1,204.29
5.B. Biological treatment of solid waste		0.02	0.00						NO, NE	0.00	NO, NE		0.96
5.C. Incineration and open burning of waste [6]	14.91	0.31	0.01						0.15	2.59	0.06	0.01	24.87
5.D. Wastewater treatment and discharge		11.91	0.24						NA, IE	NA, IE	0.01	0.00	395.80
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**34.77**	**0.00**	**0.00**						**0.13**	**0.12**	**0.04**	**0.01**	**35.17**
1.D.1.a. Aviation	34.77	0.00	0.00						0.13	0.12	0.04	0.01	35.17
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**373.58**												**373.58**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.89**										**236.50**

Indirect CO_2	**33.68**												**33.68**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions/removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**5,849.77**	**130.98**	**4.83**	**14.40**	**NO**	**NO**	**0.00**	**NO**	**19.28**	**52.41**	**39.33**	**5.63**	**10,811.90**
1. Energy	**7,626.66**	**34.10**	**0.21**						**17.69**	**46.42**	**7.07**	**4.98**	**8,637.54**
1.A. Fuel combustion	7,625.53	1.98	0.21						17.69	46.42	6.17	4.98	7,736.94
1.A.1. Energy industries	3,107.08	0.06	0.01						4.96	2.14	0.14	0.48	3,110.75
1.A.2. Manufacturing industries and construction	443.90	0.01	0.00						0.70	0.45	0.20	0.20	444.58
1.A.3. Transport	1,786.89	0.43	0.11						7.11	22.06	2.78	0.25	1,827.10
1.A.4. Other sectors	2,260.03	1.47	0.10						4.70	21.48	2.99	4.01	2,326.51
1.A.5. Other	27.64	0.00	0.00						4.70	21.48	2.99	4.01	28.00
1.B. Fugitive emissions from fuels	1.12	32.12	0.00						NO	NO	0.91	NO	900.60
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.12	32.12	0.00						NO	NO	0.91	NO	900.60
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**456.15**	**NO**	**0.00**	**14.40**	**NO**	**NO**	**0.00**	**NO**	**1.44**	**3.21**	**31.18**	**0.64**	**470.56**
2.A. Mineral industry	350.46								1.28	0.86	0.01	0.58	350.46
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	40.51	NO	NO	NO	NO	NO	NO	NO	0.13	1.72	0.05	0.06	40.51
2.D. Non-energy products from fuels and solvent use	64.13	NO	NO						0.01	0.05	25.33	0.00	64.13
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				14.40	NO	NO	NO	NO					14.40
2.G. Other product manufacture and use	1.05	NO	0.00	NO	NO	NO	0.00	NO	0.02	0.58	0.48	NO	1.07
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.30	NO	NO
3. Agriculture	**0.37**	**41.96**	**3.42**						**NO**	**NO**	**NE, NO**	**NO**	**2,080.37**
3.A. Enteric fermentation		38.46											1,076.79
3.B. Manure management		3.50	1.03								NO		370.13
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.39						NO	NO	NO		633.08
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.37												0.37

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,248.26**	**0.01**	**0.97**						**0.01**	**0.21**	**NE**		**-1,990.04**
4.A. Forest land [5]	-2,334.78	0.01	0.00						0.00	0.14	NE		-2,334.52
4.B. Cropland [5]	1,198.59	0.00	0.00						0.00	0.07	NE		1,198.66
4.C. Grassland [5]	-1,120.48	NE	NE						NE	NE	NE		-1,120.48
4.D. Wetlands [5]	-215.61	NE	NE						NE	NE	NE		-215.61
4.E. Settlements [5]	53.67	NO, NE	0.97						NE	NE	NE		311.57
4.F. Other land [5]	223.82	NE	NE						NE	NE	NE		223.82
4.G. Harvested wood products [5]	-53.47												-53.47
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**14.86**	**54.91**	**0.23**						**0.15**	**2.58**	**1.07**	**0.01**	**1,613.47**
5.A. Solid waste disposal [6]		42.54							NA, NO	NA, NO	1.01	0.00	1,191.18
5.B. Biological treatment of solid waste		0.02	0.00						NO, NE	0.00	NO, NE		1.01
5.C. Incineration and open burning of waste [6]	14.86	0.30	0.01						0.15	2.58	0.06	0.01	24.79
5.D. Wastewater treatment and discharge		12.04	0.22						NA, IE	NA, IE	0.01	0.00	396.49
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**34.79**	**0.00**	**0.00**						**0.13**	**0.13**	**0.03**	**0.01**	**35.20**
1.D.1.a. Aviation	34.79	0.00	0.00						0.13	0.13	0.03	0.01	35.20
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**307.68**												**307.68**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.93**										**245.31**

Indirect CO_2	**56.78**												**56.78**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**6,482.41**	**131.54**	**4.90**	**20.20**	**NO**	**NO**	**0.00**	**NO**	**20.01**	**54.68**	**42.06**	**5.33**	**11,485.17**
1. Energy	**7,871.74**	**35.98**	**0.21**						**18.14**	**48.37**	**7.21**	**4.57**	**8,935.27**
1.A. Fuel combustion	7,870.60	2.08	0.21						18.14	48.37	6.39	4.57	7,984.74
1.A.1. Energy industries	3,229.45	0.07	0.01						5.16	2.23	0.15	0.44	3,233.22
1.A.2. Manufacturing industries and construction	574.40	0.01	0.00						0.85	0.49	0.25	0.19	575.18
1.A.3. Transport	1,821.73	0.44	0.12						7.56	22.79	2.89	0.06	1,864.52
1.A.4. Other sectors	2,219.08	1.56	0.09						4.34	22.73	3.07	3.83	2,285.56
1.A.5. Other	25.94	0.00	0.00						0.23	0.13	0.03	0.04	26.26
1.B. Fugitive emissions from fuels	1.14	33.91	0.00						NO	NO	0.82	NO	950.54
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.14	33.91	0.00						NO	NO	0.82	NO	950.54
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**550.48**	**NO**	**0.00**	**20.20**	**NO**	**NO**	**0.00**	**NO**	**1.72**	**3.50**	**33.62**	**0.76**	**570.74**
2.A. Mineral industry	439.19								1.56	1.10	0.01	0.69	439.19
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	41.94	NO	NO	NO	NO	NO	NO	NO	0.14	1.78	0.05	0.06	41.94
2.D. Non-energy products from fuels and solvent use	68.19	NO	NO						0.01	0.04	27.23	0.00	68.19
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				20.20	NO	NO	NO	NO					20.20
2.G. Other product manufacture and use	1.16	NO	0.00	NO	NO	NO	0.00	NO	0.02	0.57	0.53	NO	1.22
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.78	NO	NO
3. Agriculture	**0.17**	**40.66**	**3.52**						**NO**	**NO**	**NE, NO**	**NO**	**2,070.93**
3.A. Enteric fermentation		36.96											1,034.91
3.B. Manure management		3.70	1.10								NO		394.82
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.42						NO	NO	NO		641.03
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.17												0.17

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,954.31**	**0.01**	**0.96**						**0.01**	**0.33**	**NE**		**-1,699.22**
4.A. Forest land [5]	-2,409.52	0.00	0.00						0.00	0.01	NE		-2,409.49
4.B. Cropland [5]	1,271.68	0.01	0.00						0.01	0.32	NE		1,272.01
4.C. Grassland [5]	-1,058.12	NE	NE						NE	NE	NE		-1,058.12
4.D. Wetlands [5]	-187.41	NE	NE						NE	NE	NE		-187.41
4.E. Settlements [5]	53.67	NO, NE	0.96						NE	NE	NE		308.41
4.F. Other land [5]	416.50	NE	NE						NE	NE	NE		416.50
4.G. Harvested wood products [5]	-41.11												-41.11
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**14.33**	**54.89**	**0.21**						**0.14**	**2.49**	**1.23**	**0.01**	**1,607.45**
5.A. Solid waste disposal [6]		42.71							NA, NO	NA, NO	1.16	0.00	1,195.79
5.B. Biological treatment of solid waste		0.02	0.00						NO, NE	0.00	NO, NE		1.06
5.C. Incineration and open burning of waste [6]	14.33	0.29	0.01						0.14	2.48	0.06	0.01	23.90
5.D. Wastewater treatment and discharge		11.87	0.21						NA, IE	NA, IE	0.01	0.00	386.70
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**37.93**	**0.00**	**0.00**						**0.14**	**0.14**	**0.04**	**0.01**	**38.36**
1.D.1.a. Aviation	37.93	0.00	0.00						0.14	0.14	0.04	0.01	38.36
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**307.39**												**307.39**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.97**										**256.59**

Indirect CO_2	**61.06**												**61.06**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**5,696.97**	**126.16**	**4.83**	**29.92**	**0.02**	**NO**	**0.00**	**NO**	**19.00**	**55.09**	**47.45**	**5.48**	**10,540.75**
1. Energy	**7,113.56**	**32.14**	**0.22**						**17.00**	**49.26**	**7.33**	**4.70**	**8,070.72**
1.A. Fuel combustion	7,112.32	2.27	0.22						17.00	49.26	6.62	4.70	7,233.28
1.A.1. Energy industries	2,492.93	0.05	0.01						3.98	1.73	0.12	0.33	2,495.89
1.A.2. Manufacturing industries and construction	634.67	0.01	0.00						0.94	0.49	0.27	0.17	635.44
1.A.3. Transport	1,742.01	0.41	0.12						7.45	20.89	2.69	0.07	1,785.12
1.A.4. Other sectors	2,203.66	1.80	0.09						4.29	25.75	3.48	4.01	2,277.37
1.A.5. Other	39.04	0.00	0.00						0.33	0.40	0.06	0.13	39.46
1.B. Fugitive emissions from fuels	1.24	29.86	0.00						NO	NO	0.71	NO	837.45
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.24	29.86	0.00						NO	NO	0.71	NO	837.45
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**645.49**	**NO**	**0.00**	**29.92**	**0.02**	**NO**	**0.00**	**NO**	**1.85**	**3.13**	**38.81**	**0.77**	**675.77**
2.A. Mineral industry	535.42								1.73	1.36	0.02	0.73	535.42
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	27.02	NO	NO	NO	NO	NO	NO	NO	0.09	1.15	0.04	0.04	27.02
2.D. Non-energy products from fuels and solvent use	81.98	NO	NO						0.01	0.07	33.23	0.01	81.98
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				29.92	NO	NO	NO	NO					29.92
2.G. Other product manufacture and use	1.07	NO	0.00	NO	0.02	NO	0.00	NO	0.02	0.55	0.48	NO	1.42
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.03	NO	NO
3. Agriculture	**0.15**	**39.94**	**3.45**						**NO**	**NO**	**NE, NO**	**NO**	**2,033.09**
3.A. Enteric fermentation		36.14											1,012.00
3.B. Manure management		3.80	1.15								NO		411.94
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.30						NO	NO	NO		609.01
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.15												0.15

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,076.24**	**0.01**	**0.95**						**0.01**	**0.27**	**NE**		**-1,824.65**
4.A. Forest land [5]	-2,366.52	0.01	0.00						0.00	0.14	NE		-2,366.25
4.B. Cropland [5]	1,303.27	0.00	0.00						0.00	0.13	NE		1,303.40
4.C. Grassland [5]	-1,056.37	NE	NE						NE	NE	NE		-1,056.37
4.D. Wetlands [5]	-159.21	NE	NE						NE	NE	NE		-159.21
4.E. Settlements [5]	53.67	NO, NE	0.95						NE	NE	NE		304.86
4.F. Other land [5]	189.50	NE	NE						NE	NE	NE		189.50
4.G. Harvested wood products [5]	-40.59												-40.59
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**14.02**	**54.07**	**0.22**						**0.14**	**2.43**	**1.31**	**0.01**	**1,585.82**
5.A. Solid waste disposal [6]		42.36							NA, NO	NA, NO	1.24	0.00	1,185.99
5.B. Biological treatment of solid waste		0.03	0.00						NO, NE	0.00	NO, NE		1.14
5.C. Incineration and open burning of waste [6]	14.02	0.29	0.01						0.14	2.43	0.05	0.01	23.38
5.D. Wastewater treatment and discharge		11.40	0.21						NA, IE	NA, IE	0.01	0.00	375.31
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other ***(please specify)*** [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**37.92**	**0.00**	**0.00**						**0.14**	**0.14**	**0.04**	**0.01**	**38.38**
1.D.1.a. Aviation	37.92	0.00	0.00						0.14	0.14	0.04	0.01	38.38
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**361.44**												**361.44**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.97**										**256.61**

Indirect CO_2	**74.16**												**74.16**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**5,887.73**	**119.05**	**4.19**	**40.32**	**0.02**	**NO**	**0.00**	**NO**	**19.96**	**50.91**	**47.26**	**4.16**	**10,372.43**
1. Energy	**7,250.36**	**33.64**	**0.21**						**17.39**	**42.76**	**6.73**	**3.23**	**8,247.81**
1.A. Fuel combustion	7,249.08	1.81	0.21						17.39	42.76	5.83	3.23	7,355.12
1.A.1. Energy industries	2,890.45	0.06	0.01						4.61	2.02	0.14	0.21	2,893.79
1.A.2. Manufacturing industries and construction	800.81	0.02	0.00						1.12	0.50	0.33	0.10	801.69
1.A.3. Transport	1,846.56	0.43	0.13						7.88	21.55	2.78	0.07	1,891.74
1.A.4. Other sectors	1,666.75	1.30	0.07						3.39	18.39	2.52	2.74	1,722.83
1.A.5. Other	44.51	0.00	0.00						0.39	0.31	0.06	0.11	45.08
1.B. Fugitive emissions from fuels	1.28	31.84	0.00						NO	NO	0.90	NO	892.70
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.28	31.84	0.00						NO	NO	0.90	NO	892.70
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**892.11**	**NO**	**NO**	**40.32**	**0.02**	**NO**	**0.00**	**NO**	**2.39**	**4.32**	**39.16**	**0.92**	**932.87**
2.A. Mineral industry	767.69								2.23	2.00	0.02	0.86	767.69
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	38.61	NO	NO	NO	NO	NO	NO	NO	0.13	1.64	0.05	0.06	38.61
2.D. Non-energy products from fuels and solvent use	84.75	NO	NO						0.01	0.07	34.99	0.01	84.75
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				40.32	NO	NO	NO	NO					40.32
2.G. Other product manufacture and use	1.07	NO	NO	NO	0.02	NO	0.00	NO	0.02	0.61	0.48	NO	1.51
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.59	NO	NO
3. Agriculture	**0.26**	**31.86**	**2.85**						**NO**	**NO**	**NE, NO**	**NO**	**1,646.52**
3.A. Enteric fermentation		29.20											817.65
3.B. Manure management		2.66	0.88								NO		308.10
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	1.96						NO	NO	NO		520.51
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.26												0.26

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-2,268.71**	**0.06**	**0.93**						**0.04**	**1.45**	**NE**		**-2,019.78**
4.A. Forest land [5]	-2,460.39	0.05	0.00						0.03	1.24	NE		-2,458.06
4.B. Cropland [5]	1,266.13	0.01	0.00						0.01	0.21	NE		1,266.34
4.C. Grassland [5]	-1,031.24	NE	NE						NE	NE	NE		-1,031.24
4.D. Wetlands [5]	-131.00	NE	NE						NE	NE	NE		-131.00
4.E. Settlements [5]	49.27	NO, NE	0.93						NE	NE	NE		295.66
4.F. Other land [5]	83.11	NE	NE						NE	NE	NE		83.11
4.G. Harvested wood products [5]	-44.59												-44.59
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**13.71**	**53.48**	**0.20**						**0.14**	**2.38**	**1.38**	**0.00**	**1,565.00**
5.A. Solid waste disposal [6]		42.17							NA, NO	NA, NO	1.32	0.00	1,180.68
5.B. Biological treatment of solid waste		0.03	0.00						NO, NE	0.00	NO, NE		1.33
5.C. Incineration and open burning of waste [6]	13.71	0.28	0.00						0.14	2.37	0.05	0.00	22.86
5.D. Wastewater treatment and discharge		11.01	0.20						NA, IE	NA, IE	0.01	0.00	360.14
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**44.21**	**0.00**	**0.00**						**0.18**	**0.13**	**0.04**	**0.01**	**44.67**
1.D.1.a. Aviation	44.21	0.00	0.00						0.18	0.13	0.04	0.01	44.67
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**304.66**												**304.66**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.79**										**208.03**

Indirect CO_2	**78.05**												**78.05**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**6,573.24**	**117.84**	**4.53**	**51.77**	**0.03**	**NO**	**0.00**	**NO**	**20.78**	**53.09**	**40.85**	**5.75**	**11,126.37**
1. Energy	**7,547.68**	**33.57**	**0.21**						**18.05**	**45.40**	**7.32**	**4.79**	**8,544.04**
1.A. Fuel combustion	7,546.38	1.88	0.21						18.05	45.40	6.14	4.79	7,655.37
1.A.1. Energy industries	2,990.84	0.07	0.01						4.79	2.09	0.14	0.30	2,994.57
1.A.2. Manufacturing industries and construction	884.97	0.03	0.00						1.35	2.27	0.47	1.85	887.09
1.A.3. Transport	1,949.57	0.45	0.13						8.22	22.47	2.91	0.07	1,995.91
1.A.4. Other sectors	1,677.37	1.33	0.07						3.37	18.27	2.57	2.44	1,733.67
1.A.5. Other	43.63	0.00	0.00						0.32	0.31	0.05	0.12	44.13
1.B. Fugitive emissions from fuels	1.29	31.69	0.00						NO	NO	1.18	NO	888.68
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.29	31.69	0.00						NO	NO	1.18	NO	888.68
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**967.70**	**NO**	**NO**	**51.77**	**0.03**	**NO**	**0.00**	**NO**	**2.57**	**4.35**	**32.04**	**0.96**	**1,020.01**
2.A. Mineral industry	864.47								2.43	2.28	0.03	0.90	864.47
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	35.41	NO	NO	NO	NO	NO	NO	NO	0.12	1.51	0.05	0.05	35.41
2.D. Non-energy products from fuels and solvent use	66.72	NO	NO						0.01	0.04	26.60	0.00	66.72
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				51.77	NO	NO	NO	NO					51.77
2.G. Other product manufacture and use	1.10	NO	NO	NO	0.03	NO	0.00	NO	0.02	0.52	0.50	NO	1.64
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.85	NO	NO
3. Agriculture	**0.85**	**30.66**	**3.22**						**NO**	**NO**	**NE, NO**	**NO**	**1,712.97**
3.A. Enteric fermentation		28.08											786.37
3.B. Manure management		2.58	0.88								NO		306.06
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.34						NO	NO	NO		619.68
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.85												0.85

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,956.39**	**0.03**	**0.91**						**0.03**	**1.01**	**NE**		**-1,713.63**
4.A. Forest land [5]	-2,462.79	0.00	0.00						0.00	0.09	NE		-2,462.63
4.B. Cropland [5]	1,236.67	0.03	0.00						0.03	0.92	NE		1,237.62
4.C. Grassland [5]	-932.15	NE	NE						NE	NE	NE		-932.15
4.D. Wetlands [5]	-102.80	NE	NE						NE	NE	NE		-102.80
4.E. Settlements [5]	49.27	NO, NE	0.91						NE	NE	NE		290.94
4.F. Other land [5]	291.00	NE	NE						NE	NE	NE		291.00
4.G. Harvested wood products [5]	-35.61												-35.61
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**13.40**	**53.57**	**0.19**						**0.13**	**2.32**	**1.50**	**0.00**	**1,562.97**
5.A. Solid waste disposal [6]		42.21							NA, NO	NA, NO	1.43	0.00	1,182.01
5.B. Biological treatment of solid waste		0.04	0.00						NO, NE	0.00	NO, NE		1.57
5.C. Incineration and open burning of waste [6]	13.40	0.27	0.00						0.13	2.32	0.05	0.00	22.35
5.D. Wastewater treatment and discharge		11.05	0.18						NA, IE	NA, IE	0.01	0.00	357.05
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**44.17**	**0.00**	**0.00**						**0.19**	**0.11**	**0.04**	**0.01**	**44.60**
1.D.1.a. Aviation	44.17	0.00	0.00						0.19	0.11	0.04	0.01	44.60
1.D.1.b. Navigation	NO	NO	NO						NO	NO	NO	NO	NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**352.45**												**352.45**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.86**										**227.79**

Indirect CO_2	**59.61**												**59.61**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**7,008.92**	**114.07**	**4.47**	**61.02**	**0.03**	**NO**	**0.00**	**NO**	**19.39**	**50.65**	**35.51**	**5.32**	**11,448.57**
1. Energy	**8,093.50**	**28.97**	**0.19**						**17.96**	**45.68**	**7.18**	**4.80**	**8,955.84**
1.A. Fuel combustion	8,092.21	2.00	0.19						17.96	45.68	6.01	4.80	8,199.36
1.A.1. Energy industries	3,835.58	0.08	0.01						6.14	2.66	0.18	0.61	3,840.36
1.A.2. Manufacturing industries and construction	501.95	0.02	0.00						0.77	1.66	0.29	1.44	503.39
1.A.3. Transport	1,919.24	0.46	0.11						7.44	22.29	2.83	0.02	1,961.51
1.A.4. Other sectors	1,824.94	1.43	0.07						3.50	18.91	2.69	2.71	1,883.51
1.A.5. Other	10.49	0.00	0.00						0.10	0.15	0.03	0.02	10.59
1.B. Fugitive emissions from fuels	1.29	26.97	0.00						NO	NO	1.17	NO	756.49
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.29	26.97	0.00						NO	NO	1.17	NO	756.49
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**462.34**	**NO**	**NO**	**61.02**	**0.03**	**NO**	**0.00**	**NO**	**1.29**	**2.37**	**26.67**	**0.52**	**523.95**
2.A. Mineral industry	386.85								1.21	0.99	0.01	0.50	386.85
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	17.06	NO	NO	NO	NO	NO	NO	NO	0.06	0.73	0.02	0.03	17.06
2.D. Non-energy products from fuels and solvent use	57.63	NO	NO						0.01	0.03	23.00	0.00	57.63
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				61.02	NO	NO	NO	NO					61.02
2.G. Other product manufacture and use	0.80	NO	NO	NO	0.03	NO	0.00	NO	0.02	0.63	0.37	NO	1.39
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.25	NO	NO
3. Agriculture	**0.59**	**31.82**	**3.19**						**NO**	**NO**	**NE, NO**	**NO**	**1,738.07**
3.A. Enteric fermentation		28.90											809.31
3.B. Manure management		2.92	0.99								NO		343.31
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.21						NO	NO	NO		584.86
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	0.59												0.59

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,560.64**	**0.01**	**0.89**						**0.01**	**0.32**	**NE**		**-1,324.34**
4.A. Forest land [5]	-2,526.07	0.01	0.00						0.01	0.21	NE		-2,525.67
4.B. Cropland [5]	1,390.69	0.00	0.00						0.00	0.11	NE		1,390.80
4.C. Grassland [5]	-447.69	NE	NE						NE	NE	NE		-447.69
4.D. Wetlands [5]	-74.60	NE	NE						NE	NE	NE		-74.60
4.E. Settlements [5]	45.57	NO, NE	0.89						NE	NE	NE		281.36
4.F. Other land [5]	79.94	NE	NE						NE	NE	NE		79.94
4.G. Harvested wood products [5]	-28.47												-28.47
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**13.12**	**53.27**	**0.19**						**0.13**	**2.27**	**1.67**	**0.00**	**1,555.04**
5.A. Solid waste disposal [6]		42.55							NA, NO	NA, NO	1.61	0.00	1,191.41
5.B. Biological treatment of solid waste		0.04	0.00						NO, NE	0.01	NO, NE		1.63
5.C. Incineration and open burning of waste [6]	13.12	0.27	0.00						0.13	2.26	0.05	0.00	21.87
5.D. Wastewater treatment and discharge		10.41	0.18						NA, IE	NA, IE	0.01	0.00	340.12
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**44.17**	**0.00**	**0.00**						**0.19**	**0.11**	**0.04**	**0.01**	**44.60**
1.D.1.a. Aviation	44.17	0.00	0.00						0.19	0.11	0.04	0.01	44.60
1.D.1.b. Navigation	NE	NE	NE						NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**362.10**												**362.10**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.88**										**233.17**

Indirect CO_2	**51.41**												**51.41**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**7,728.50**	**114.05**	**4.70**	**70.54**	**0.04**	**NO**	**0.00**	**NO**	**21.33**	**52.88**	**40.31**	**5.46**	**12,239.16**
1. Energy	**8,718.00**	**28.60**	**0.21**						**19.82**	**48.31**	**7.21**	**4.88**	**9,574.49**
1.A. Fuel combustion	8,716.70	2.15	0.21						19.82	48.31	6.29	4.88	8,832.63
1.A.1. Energy industries	4,047.95	0.09	0.01						6.48	2.82	0.19	0.53	4,053.06
1.A.2. Manufacturing industries and construction	515.62	0.02	0.00						0.79	1.50	0.29	1.25	517.00
1.A.3. Transport	2,139.84	0.47	0.12						8.66	21.91	2.83	0.02	2,185.47
1.A.4. Other sectors	1,985.99	1.57	0.07						3.76	21.82	2.94	2.98	2,049.60
1.A.5. Other	27.30	0.00	0.00						0.12	0.25	0.04	0.11	27.51
1.B. Fugitive emissions from fuels	1.30	26.45	0.00						NO	NO	0.92	NO	741.85
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.30	26.45	0.00						NO	NO	0.92	NO	741.85
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**482.43**	**NO**	**NO**	**70.54**	**0.04**	**NO**	**0.00**	**NO**	**1.37**	**2.20**	**31.23**	**0.57**	**553.69**
2.A. Mineral industry	405.39								1.31	1.02	0.01	0.55	405.39
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	9.70	NO	NO	NO	NO	NO	NO	NO	0.03	0.41	0.01	0.01	9.70
2.D. Non-energy products from fuels and solvent use	66.32	NO	NO						0.01	0.04	26.53	0.00	66.32
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				70.54	NO	NO	NO	NO					70.54
2.G. Other product manufacture and use	1.02	NO	NO	NO	0.04	NO	0.00	NO	0.02	0.72	0.47	NO	1.74
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.20	NO	NO
3. Agriculture	**1.74**	**31.81**	**3.44**						**NO**	**NO**	**NE, NO**	**NO**	**1,804.19**
3.A. Enteric fermentation		28.67											802.68
3.B. Manure management		3.14	1.02								NO		359.11
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.42						NO	NO	NO		640.65
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	1.74												1.74

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,486.52**	**0.01**	**0.87**						**0.00**	**0.15**	**NE**		**-1,256.74**
4.A. Forest land [5]	-2,484.16	0.00	0.00						0.00	0.07	NE		-2,484.02
4.B. Cropland [5]	1,271.78	0.00	0.00						0.00	0.08	NE		1,271.86
4.C. Grassland [5]	-691.99	NE	NE						NE	NE	NE		-691.99
4.D. Wetlands [5]	-46.40	NE	NE						NE	NE	NE		-46.40
4.E. Settlements [5]	45.57	NO, NE	0.87						NE	NE	NE		275.13
4.F. Other land [5]	441.48	NE	NE						NE	NE	NE		441.48
4.G. Harvested wood products [5]	-22.80												-22.80
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**12.84**	**53.64**	**0.18**						**0.13**	**2.21**	**1.88**	**0.00**	**1,563.54**
5.A. Solid waste disposal [6]		42.72							NA, NO	NA, NO	1.82	0.00	1,196.05
5.B. Biological treatment of solid waste		0.04	0.00						NO, NE	0.01	NO, NE		1.72
5.C. Incineration and open burning of waste [6]	12.84	0.26	0.00						0.13	2.21	0.05	0.00	21.39
5.D. Wastewater treatment and discharge		10.62	0.18						NA, IE	NA, IE	0.01	0.00	344.38
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**41.06**	**0.00**	**0.00**						**0.17**	**0.12**	**0.04**	**0.01**	**41.49**
1.D.1.a. Aviation	41.06	0.00	0.00						0.17	0.12	0.04	0.01	41.49
1.D.1.b. Navigation	NE	NE	NE						NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**341.05**												**341.05**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.94**										**249.71**

Indirect CO_2	**59.38**												**59.38**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**8,094.08**	**115.08**	**4.62**	**80.58**	**0.04**	**NO**	**0.00**	**NO**	**21.96**	**55.58**	**43.15**	**5.59**	**12,622.33**
1. Energy	**8,926.20**	**31.86**	**0.22**						**20.17**	**50.69**	**7.81**	**4.89**	**9,875.71**
1.A. Fuel combustion	8,924.86	2.27	0.22						20.17	50.69	6.75	4.89	9,045.77
1.A.1. Energy industries	3,746.14	0.08	0.01						5.99	2.61	0.18	0.40	3,750.68
1.A.2. Manufacturing industries and construction	575.45	0.03	0.00						0.88	1.86	0.33	1.58	577.13
1.A.3. Transport	2,272.70	0.47	0.13						9.01	22.52	2.90	0.02	2,319.77
1.A.4. Other sectors	2,310.78	1.69	0.08						4.14	23.36	3.30	2.81	2,378.26
1.A.5. Other	19.79	0.00	0.00						0.15	0.35	0.04	0.09	19.94
1.B. Fugitive emissions from fuels	1.33	29.59	0.00						NO	NO	1.06	NO	829.95
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.33	29.59	0.00						NO	NO	1.06	NO	829.95
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**573.63**	**NO**	**NO**	**80.58**	**0.04**	**NO**	**0.00**	**NO**	**1.66**	**2.56**	**33.53**	**0.69**	**654.97**
2.A. Mineral industry	488.20								1.59	1.25	0.02	0.67	488.20
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	12.86	NO	NO	NO	NO	NO	NO	NO	0.04	0.55	0.02	0.02	12.86
2.D. Non-energy products from fuels and solvent use	71.34	NO	NO						0.01	0.04	28.65	0.00	71.34
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				80.58	NO	NO	NO	NO					80.58
2.G. Other product manufacture and use	1.23	NO	NO	NO	0.04	NO	0.00	NO	0.02	0.72	0.56	NO	1.99
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.28	NO	NO
3. Agriculture	**3.68**	**29.90**	**3.37**						**NO**	**NO**	**NE, NO**	**NO**	**1,734.96**
3.A. Enteric fermentation		26.93											754.04
3.B. Manure management		2.97	0.93								NO		330.87
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.44						NO	NO	NO		646.37
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	3.68												3.68

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,421.98**	**0.01**	**0.85**						**0.00**	**0.17**	**NE**		**-1,197.75**
4.A. Forest land [5]	-2,390.57	0.00	0.00						0.00	0.10	NE		-2,390.39
4.B. Cropland [5]	1,230.68	0.00	0.00						0.00	0.07	NE		1,230.76
4.C. Grassland [5]	-638.17	NE	NE						NE	NE	NE		-638.17
4.D. Wetlands [5]	-75.31	NE	NE						NE	NE	NE		-75.31
4.E. Settlements [5]	62.04	NO, NE	0.85						NE	NE	NE		286.02
4.F. Other land [5]	393.73	NE	NE						NE	NE	NE		393.73
4.G. Harvested wood products [5]	-4.38												-4.38
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**12.57**	**53.31**	**0.19**						**0.12**	**2.16**	**1.81**	**0.00**	**1,554.43**
5.A. Solid waste disposal [6]		42.65							NA, NO	NA, NO	1.75	0.00	1,194.27
5.B. Biological treatment of solid waste		0.04	0.00						NO, NE	0.01	NO, NE		1.82
5.C. Incineration and open burning of waste [6]	12.57	0.26	0.00						0.12	2.15	0.05	0.00	20.93
5.D. Wastewater treatment and discharge		10.36	0.18						NA, IE	NA, IE	0.01	0.00	337.41
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**41.01**	**0.00**	**0.00**						**0.16**	**0.12**	**0.05**	**0.01**	**41.43**
1.D.1.a. Aviation	41.01	0.00	0.00						0.16	0.12	0.05	0.01	41.43
1.D.1.b. Navigation	NE	NE	NE						NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**384.64**												**384.64**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.91**										**241.22**

Indirect CO_2	**64.25**												**64.25**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**7,779.81**	**112.64**	**4.36**	**88.14**	**0.04**	**NO**	**0.00**	**NO**	**20.80**	**55.14**	**44.45**	**5.67**	**12,179.29**
1. Energy	**8,613.94**	**31.63**	**0.20**						**19.08**	**49.57**	**7.62**	**5.04**	**9,553.17**
1.A. Fuel combustion	8,612.61	2.44	0.20						19.08	49.57	6.65	5.04	8,734.47
1.A.1. Energy industries	3,803.41	0.09	0.01						6.09	2.71	0.20	0.66	3,808.15
1.A.2. Manufacturing industries and construction	538.21	0.02	0.00						0.80	1.45	0.30	1.17	539.60
1.A.3. Transport	1,992.59	0.40	0.12						8.11	18.90	2.47	0.02	2,034.45
1.A.4. Other sectors	2,271.47	1.93	0.07						4.03	26.39	3.67	3.18	2,345.27
1.A.5. Other	6.93	0.00	0.00						0.05	0.13	0.02	0.00	7.00
1.B. Fugitive emissions from fuels	1.33	29.19	0.00						NO	NO	0.97	NO	818.70
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.33	29.19	0.00						NO	NO	0.97	NO	818.70
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**581.67**	**NO**	**NO**	**88.14**	**0.04**	**NO**	**0.00**	**NO**	**1.57**	**2.40**	**35.19**	**0.62**	**670.64**
2.A. Mineral industry	493.16								1.50	1.28	0.02	0.60	493.16
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	12.70	NO	NO	NO	NO	NO	NO	NO	0.04	0.54	0.02	0.02	12.70
2.D. Non-energy products from fuels and solvent use	74.66	NO	NO						0.01	0.05	30.62	0.00	74.66
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				88.14	NO	NO	NO	NO					88.14
2.G. Other product manufacture and use	1.16	NO	NO	NO	0.04	NO	0.00	NO	0.02	0.53	0.53	NO	1.98
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.99	NO	NO
3. Agriculture	**5.59**	**28.31**	**3.19**						**NO**	**NO**	**NE, NO**	**NO**	**1,644.45**
3.A. Enteric fermentation		25.55											715.30
3.B. Manure management		2.76	0.86								NO		305.49
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.33						NO	NO	NO		618.06
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	5.59												5.59

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,433.66**	**0.05**	**0.78**						**0.03**	**1.07**	**NE**		**-1,224.78**
4.A. Forest land [5]	-2,294.82	0.05	0.00						0.03	1.06	NE		-2,292.84
4.B. Cropland [5]	1,236.50	0.00	0.00						0.00	0.01	NE		1,236.51
4.C. Grassland [5]	-562.75	NE	NE						NE	NE	NE		-562.75
4.D. Wetlands [5]	-15.47	NE	NE						NE	NE	NE		-15.47
4.E. Settlements [5]	11.89	NO, NE	0.78						NE	NE	NE		218.78
4.F. Other land [5]	114.14	NE	NE						NE	NE	NE		114.14
4.G. Harvested wood products [5]	76.84												76.84
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**12.27**	**52.64**	**0.19**						**0.12**	**2.10**	**1.64**	**0.00**	**1,535.82**
5.A. Solid waste disposal [6]		42.13							NA, NO	NA, NO	1.59	0.00	1,179.54
5.B. Biological treatment of solid waste		0.04	0.00						NO, NE	0.01	NO, NE		1.79
5.C. Incineration and open burning of waste [6]	12.27	0.25	0.00						0.12	2.10	0.05	0.00	20.44
5.D. Wastewater treatment and discharge		10.23	0.18						NA, IE	NA, IE	0.01	0.00	334.05
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**47.31**	**0.00**	**0.00**						**0.18**	**0.13**	**0.06**	**0.02**	**47.79**
1.D.1.a. Aviation	47.31	0.00	0.00						0.18	0.13	0.06	0.02	47.79
1.D.1.b. Navigation	NE	NE	NE						NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**406.30**												**406.30**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.87**										**229.78**

Indirect CO_2	**68.53**												**68.53**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**7,575.00**	**108.43**	**4.76**	**95.76**	**0.04**	**NO**	**0.00**	**NO**	**21.05**	**55.62**	**43.55**	**13.26**	**11,969.50**
1. Energy	**8,224.92**	**29.75**	**0.22**						**19.17**	**50.58**	**7.56**	**12.54**	**9,116.08**
1.A. Fuel combustion	8,223.26	2.51	0.22						19.17	50.58	6.66	12.54	8,351.58
1.A.1. Energy industries	3,598.61	0.08	0.02						6.23	2.14	0.17	7.14	3,605.95
1.A.2. Manufacturing industries and construction	573.06	0.03	0.00						0.87	2.30	0.35	2.03	575.00
1.A.3. Transport	2,101.30	0.41	0.12						8.25	18.35	2.40	0.01	2,143.31
1.A.4. Other sectors	1,947.94	1.98	0.08						3.78	27.76	3.74	3.35	2,024.94
1.A.5. Other	2.35	0.00	0.00						0.04	0.03	0.00	0.00	2.39
1.B. Fugitive emissions from fuels	1.66	27.24	0.00						NO	NO	0.90	NO	764.49
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.66	27.24	0.00						NO	NO	0.90	NO	764.49
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**623.12**	**NO**	**NO**	**95.76**	**0.04**	**NO**	**0.00**	**NO**	**1.74**	**2.17**	**34.25**	**0.71**	**719.91**
2.A. Mineral industry	544.87								1.69	1.39	0.02	0.69	544.87
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	7.66	NO	NO	NO	NO	NO	NO	NO	0.02	0.32	0.01	0.01	7.66
2.D. Non-energy products from fuels and solvent use	69.49	NO	NO						0.01	0.05	28.24	0.00	69.49
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				95.76	NO	NO	NO	NO					95.76
2.G. Other product manufacture and use	1.10	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.41	0.50	0.00	2.13
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.47	NO	NO
3. Agriculture	**4.18**	**28.46**	**3.63**						**NO**	**NO**	**NE, NO**	**NO**	**1,761.71**
3.A. Enteric fermentation		25.76											721.38
3.B. Manure management		2.69	0.81								NO		288.89
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.82						NO	NO	NO		747.25
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	4.18												4.18

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,289.15**	**0.03**	**0.73**						**0.02**	**0.82**	**NE**		**-1,094.98**
4.A. Forest land [5]	-2,141.87	0.03	0.00						0.02	0.73	NE		-2,140.50
4.B. Cropland [5]	1,139.91	0.00	0.00						0.00	0.09	NE		1,140.01
4.C. Grassland [5]	-360.17	NE	NE						NE	NE	NE		-360.17
4.D. Wetlands [5]	-106.10	NE	NE						NE	NE	NE		-106.10
4.E. Settlements [5]	13.75	NO, NE	0.73						NE	NE	NE		206.45
4.F. Other land [5]	103.45	NE	NE						NE	NE	NE		103.45
4.G. Harvested wood products [5]	61.88												61.88
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**11.93**	**50.18**	**0.19**						**0.12**	**2.05**	**1.73**	**0.00**	**1,466.78**
5.A. Solid waste disposal [6]		39.62							NA, NO	NA, NO	1.67	0.00	1,109.40
5.B. Biological treatment of solid waste		0.04	0.00						NO, NE	0.01	NO, NE		1.93
5.C. Incineration and open burning of waste [6]	11.93	0.24	0.00						0.12	2.04	0.05	0.00	19.86
5.D. Wastewater treatment and discharge		10.27	0.18						NA, IE	NA, IE	0.01	0.00	335.59
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**41.07**	**0.00**	**0.00**						**0.16**	**0.16**	**0.06**	**0.01**	**41.55**
1.D.1.a. Aviation	41.07	0.00	0.00						0.16	0.16	0.06	0.01	41.55
1.D.1.b. Navigation	NE	NE	NE						NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**432.75**												**432.75**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.94**										**248.93**

Indirect CO_2	**63.23**	**63.23**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions/ removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**7,921.48**	**110.05**	**5.31**	**107.94**	**0.04**	**NO**	**0.00**	**NO**	**20.93**	**82.15**	**55.96**	**5.22**	**12,518.19**
1. Energy	**8,190.75**	**31.31**	**0.24**						**19.11**	**77.65**	**11.71**	**4.53**	**9,131.98**
1.A. Fuel combustion	8,189.06	4.60	0.24						19.11	77.65	10.91	4.53	8,382.49
1.A.1. Energy industries	3,555.98	0.08	0.01						5.71	2.55	0.18	0.41	3,560.48
1.A.2. Manufacturing industries and construction	562.39	0.03	0.00						0.86	1.93	0.33	1.67	564.08
1.A.3. Transport	2,140.57	0.41	0.11						8.04	18.55	2.39	0.01	2,180.29
1.A.4. Other sectors	1,927.74	4.09	0.12						4.49	54.58	8.00	2.45	2,075.21
1.A.5. Other	2.38	0.00	0.00						0.01	0.03	0.00	0.00	2.42
1.B. Fugitive emissions from fuels	1.69	26.71	0.00						NO	NO	0.81	NO	749.49
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.69	26.71	0.00						NO	NO	0.81	NO	749.49
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**636.28**	**NO**	**NO**	**107.94**	**0.04**	**NO**	**0.00**	**NO**	**1.70**	**2.38**	**42.62**	**0.69**	**745.35**
2.A. Mineral industry	533.99								1.63	1.36	0.02	0.66	533.99
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	13.85	NO	NO	NO	NO	NO	NO	NO	0.04	0.59	0.02	0.02	13.85
2.D. Non-energy products from fuels and solvent use	87.24	NO	NO						0.01	0.07	36.30	0.01	87.24
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				107.94	NO	NO	NO	NO					107.94
2.G. Other product manufacture and use	1.21	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.36	0.55	0.00	2.33
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.72	NO	NO
3. Agriculture	**10.21**	**29.20**	**4.20**						**NO**	**NO**	**NE, NO**	**NO**	**1,940.10**
3.A. Enteric fermentation		26.36											737.98
3.B. Manure management		2.84	0.88								NO		313.23
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	3.32						NO	NO	NO		878.68
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	10.21												10.21

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-927.33**	**0.00**	**0.68**						**0.00**	**0.13**	**NE**		**-747.16**
4.A. Forest land [5]	-2,134.74	0.00	0.00						0.00	0.06	NE		-2,134.63
4.B. Cropland [5]	1,174.61	0.00	0.00						0.00	0.07	NE		1,174.69
4.C. Grassland [5]	-341.11	NE	NE						NE	NE	NE		-341.11
4.D. Wetlands [5]	-139.75	NE	NE						NE	NE	NE		-139.75
4.E. Settlements [5]	18.98	NO, NE	0.68						NE	NE	NE		198.98
4.F. Other land [5]	436.65	NE	NE						NE	NE	NE		436.65
4.G. Harvested wood products [5]	58.02												58.02
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**11.58**	**49.54**	**0.19**						**0.11**	**1.99**	**1.63**	**0.00**	**1,447.92**
5.A. Solid waste disposal [6]		39.32							NA, NO	NA, NO	1.58	0.00	1,101.07
5.B. Biological treatment of solid waste		0.05	0.00						NO, NE	0.01	NO, NE		2.10
5.C. Incineration and open burning of waste [6]	11.58	0.24	0.00						0.11	1.99	0.04	0.00	19.28
5.D. Wastewater treatment and discharge		9.93	0.18						NA, IE	NA, IE	0.01	0.00	325.46
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**53.69**	**0.00**	**0.00**						**0.21**	**0.16**	**0.06**	**0.02**	**54.25**
1.D.1.a. Aviation	53.69	0.00	0.00						0.21	0.16	0.06	0.02	54.25
1.D.1.b. Navigation	NE	NE	NE						NE	NE	NE	NE	NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**1,318.30**												**1,318.30**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**1.09**										**288.88**

Indirect CO_2	**81.07**												**81.07**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**7,651.81**	**107.36**	**4.39**	**137.88**	**0.04**	**NO**	**0.00**	**NO**	**22.20**	**87.09**	**53.88**	**4.87**	**11,960.16**
1. Energy	**8,391.24**	**30.55**	**0.27**						**20.39**	**82.09**	**12.44**	**4.17**	**9,317.70**
1.A. Fuel combustion	8,389.56	4.89	0.27						20.39	82.09	11.70	4.17	8,597.45
1.A.1. Energy industries	3,684.45	0.08	0.01						5.85	2.65	0.19	0.10	3,688.43
1.A.2. Manufacturing industries and construction	651.53	0.04	0.01						1.15	2.18	0.50	1.63	654.13
1.A.3. Transport	2,261.58	0.43	0.12						8.81	19.05	2.48	0.01	2,305.29
1.A.4. Other sectors	1,790.21	4.34	0.14						4.56	58.19	8.53	2.43	1,947.77
1.A.5. Other	1.80	0.00	0.00						0.01	0.02	0.00	0.00	1.83
1.B. Fugitive emissions from fuels	1.68	25.66	0.00						NO	NO	0.75	NO	720.25
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.68	25.66	0.00						NO	NO	0.75	NO	720.25
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**610.79**	**NO**	**NO**	**137.88**	**0.04**	**NO**	**0.00**	**NO**	**1.68**	**2.42**	**39.68**	**0.70**	**749.79**
2.A. Mineral industry	507.99								1.61	1.28	0.02	0.67	507.99
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	17.28	NO	NO	NO	NO	NO	NO	NO	0.06	0.73	0.02	0.03	17.28
2.D. Non-energy products from fuels and solvent use	84.58	NO	NO						0.01	0.05	34.97	0.00	84.58
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				137.88	NO	NO	NO	NO					137.88
2.G. Other product manufacture and use	0.94	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.36	0.43	0.00	2.06
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.23	NO	NO
3. Agriculture	**11.24**	**27.56**	**3.29**						**NO**	**NO**	**NE, NO**	**NO**	**1,655.97**
3.A. Enteric fermentation		24.80											694.45
3.B. Manure management		2.76	0.81								NO		292.96
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.48						NO	NO	NO		657.32
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	11.24												11.24

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,372.85**	**0.03**	**0.64**						**0.02**	**0.61**	**NE**		**-1,202.92**
4.A. Forest land [5]	-2,159.44	0.02	0.00						0.02	0.56	NE		-2,158.40
4.B. Cropland [5]	1,112.63	0.00	0.00						0.00	0.05	NE		1,112.68
4.C. Grassland [5]	-418.46	NE	NE						NE	NE	NE		-418.46
4.D. Wetlands [5]	-82.79	NE	NE						NE	NE	NE		-82.79
4.E. Settlements [5]	39.16	NO, NE	0.64						NE	NE	NE		207.99
4.F. Other land [5]	86.82	NE	NE						NE	NE	NE		86.82
4.G. Harvested wood products [5]	49.24												49.24
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**11.38**	**49.22**	**0.19**						**0.11**	**1.97**	**1.76**	**0.00**	**1,439.62**
5.A. Solid waste disposal [6]		39.23							NA, NO	NA, NO	1.70	0.00	1,098.55
5.B. Biological treatment of solid waste		0.05	0.00						NO, NE	0.01	NO, NE		2.11
5.C. Incineration and open burning of waste [6]	11.38	0.23	0.00						0.11	1.96	0.04	0.00	18.97
5.D. Wastewater treatment and discharge		9.71	0.18						NA, IE	NA, IE	0.01	0.00	319.99
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**58.20**	**0.01**	**0.00**						**0.23**	**0.18**	**0.08**	**0.02**	**58.86**
1.D.1.a. Aviation	56.81	0.01	0.00						0.23	0.18	0.08	0.02	57.45
1.D.1.b. Navigation	1.39	0.00	0.00						0.00	0.00	0.00	0.00	1.41
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**1,436.50**												**1,436.50**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.88**										**232.67**

Indirect CO_2	**77.88**												**77.88**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**7,974.67**	**108.91**	**4.79**	**146.79**	**0.04**	**NO**	**0.00**	**NO**	**23.09**	**90.10**	**55.23**	**4.08**	**12,441.57**
1. Energy	**8,484.95**	**32.75**	**0.29**						**21.41**	**86.00**	**13.18**	**3.43**	**9,478.03**
1.A. Fuel combustion	8,483.26	5.28	0.29						21.41	86.00	12.44	3.43	8,707.08
1.A.1. Energy industries	3,644.88	0.08	0.01						5.80	2.63	0.20	0.23	3,648.99
1.A.2. Manufacturing industries and construction	641.34	0.03	0.00						1.22	1.68	0.45	1.15	643.57
1.A.3. Transport	2,428.36	0.50	0.14						9.85	19.62	2.57	0.02	2,478.57
1.A.4. Other sectors	1,767.49	4.66	0.14						4.53	62.05	9.22	2.03	1,934.72
1.A.5. Other	1.20	0.00	0.00						0.01	0.01	0.00	0.00	1.22
1.B. Fugitive emissions from fuels	1.69	27.47	0.00						NO	NO	0.74	NO	770.95
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.69	27.47	0.00						NO	NO	0.74	NO	770.95
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**583.41**	**NO**	**NO**	**146.79**	**0.04**	**NO**	**0.00**	**NO**	**1.57**	**1.82**	**40.15**	**0.65**	**731.35**
2.A. Mineral industry	492.25								1.53	1.24	0.02	0.63	492.25
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	5.22	NO	NO	NO	NO	NO	NO	NO	0.02	0.22	0.01	0.01	5.22
2.D. Non-energy products from fuels and solvent use	84.87	NO	NO						0.01	0.04	34.96	0.00	84.87
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				146.79	NO	NO	NO	NO					146.79
2.G. Other product manufacture and use	1.06	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.32	0.48	0.00	2.22
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.66	NO	NO
3. Agriculture	**12.27**	**26.68**	**3.71**						**NO**	**NO**	**NE, NO**	**NO**	**1,742.64**
3.A. Enteric fermentation		24.14											675.89
3.B. Manure management		2.54	0.82								NO		287.78
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.89						NO	NO	NO		766.69
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	12.27												12.27

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,117.11**	**0.01**	**0.60**						**0.01**	**0.35**	**NE**		**-957.29**
4.A. Forest land [5]	-2,115.76	0.01	0.00						0.01	0.28	NE		-2,115.24
4.B. Cropland [5]	1,111.99	0.00	0.00						0.00	0.07	NE		1,112.06
4.C. Grassland [5]	-402.37	NE	NE						NE	NE	NE		-402.37
4.D. Wetlands [5]	-82.79	NE	NE						NE	NE	NE		-82.79
4.E. Settlements [5]	19.31	NO, NE	0.60						NE	NE	NE		178.53
4.F. Other land [5]	351.63	NE	NE						NE	NE	NE		351.63
4.G. Harvested wood products [5]	0.88												0.88
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**11.14**	**49.47**	**0.19**						**0.11**	**1.94**	**1.91**	**0.00**	**1,446.85**
5.A. Solid waste disposal [6]		39.52							NA, NO	NA, NO	1.85	0.00	1,106.59
5.B. Biological treatment of solid waste		0.05	0.00						NO, NE	0.01	NO, NE		2.09
5.C. Incineration and open burning of waste [6]	11.14	0.23	0.00						0.11	1.93	0.04	0.00	18.58
5.D. Wastewater treatment and discharge		9.67	0.18						NA, IE	NA, IE	0.01	0.00	319.59
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**102.91**	**0.01**	**0.00**						**0.41**	**0.27**	**0.11**	**0.03**	**103.98**
1.D.1.a. Aviation	100.97	0.01	0.00						0.41	0.27	0.11	0.03	102.02
1.D.1.b. Navigation	1.94	0.00	0.00						0.00	0.00	0.00	0.00	1.96
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**1,609.80**												**1,609.80**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.96**										**255.60**

Indirect CO_2	**77.98**												**77.98**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**7,529.19**	**113.85**	**5.20**	**162.10**	**0.04**	**NO**	**0.00**	**NO**	**23.35**	**112.79**	**64.68**	**4.95**	**12,258.55**
1. Energy	**8,070.00**	**35.71**	**0.33**						**21.69**	**108.10**	**16.39**	**4.31**	**9,158.19**
1.A. Fuel combustion	8,068.33	6.97	0.33						21.69	108.10	15.67	4.31	8,351.62
1.A.1. Energy industries	2,996.52	0.07	0.01						4.77	2.19	0.16	0.05	2,999.89
1.A.2. Manufacturing industries and construction	658.71	0.04	0.01						1.38	1.79	0.46	1.27	661.07
1.A.3. Transport	2,451.25	0.48	0.14						9.82	19.04	2.50	0.01	2,500.58
1.A.4. Other sectors	1,960.70	6.38	0.19						5.71	85.07	12.55	2.99	2,188.91
1.A.5. Other	1.15	0.00	0.00						0.01	0.01	0.00	0.00	1.17
1.B. Fugitive emissions from fuels	1.68	28.75	0.00						NO	NO	0.73	NO	806.57
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.68	28.75	0.00						NO	NO	0.73	NO	806.57
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**587.60**	**NO**	**NO**	**162.10**	**0.04**	**NO**	**0.00**	**NO**	**1.54**	**2.30**	**46.38**	**0.63**	**750.89**
2.A. Mineral industry	470.20								1.46	1.20	0.01	0.60	470.20
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.01	NO	NO
2.C. Metal industry	18.88	NO	NO	NO	NO	NO	NO	NO	0.06	0.80	0.02	0.03	18.88
2.D. Non-energy products from fuels and solvent use	97.34	NO	NO						0.01	0.05	40.59	0.00	97.34
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				162.10	NO	NO	NO	NO					162.10
2.G. Other product manufacture and use	1.18	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.24	0.53	0.00	2.36
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.21	NO	NO
3. Agriculture	**26.39**	**25.81**	**4.09**						**NO**	**NO**	**NE, NO**	**NO**	**1,834.24**
3.A. Enteric fermentation		23.38											654.60
3.B. Manure management		2.43	0.83								NO		287.33
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils			3.27						NO	NO	NO		865.92
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	26.39												26.39

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,165.66**	**0.02**	**0.58**						**0.01**	**0.49**	**NE**		**-1,012.29**
4.A. Forest land [5]	-2,016.44	0.02	0.00						0.01	0.39	NE		-2,015.71
4.B. Cropland [5]	1,089.56	0.00	0.00						0.00	0.10	NE		1,089.66
4.C. Grassland [5]	-384.04	NE	NE						NE	NE	NE		-384.04
4.D. Wetlands [5]	-82.82	NE	NE						NE	NE	NE		-82.82
4.E. Settlements [5]	77.31	NO, NE	0.58						NE	NE	NE		229.86
4.F. Other land [5]	218.21	NE	NE						NE	NE	NE		218.21
4.G. Harvested wood products [5]	-67.45												-67.45
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**10.87**	**52.31**	**0.20**						**0.11**	**1.90**	**1.91**	**0.00**	**1,527.52**
5.A. Solid waste disposal [6]		42.56							NA, NO	NA, NO	1.86		1,191.54
5.B. Biological treatment of solid waste		0.05	0.00						NO, NE	0.01	NO, NE		2.02
5.C. Incineration and open burning of waste [6]	10.87	0.22	0.00						0.11	1.89	0.04	0.00	18.13
5.D. Wastewater treatment and discharge		9.48	0.19						NA, IE	NA, IE	0.01		315.82
5.E. Other [6]	NO	NO	NO						NO	NO	NO		NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**151.25**	**0.01**	**0.00**						**0.58**	**0.35**	**0.14**	**0.05**	**152.71**
1.D.1.a. Aviation	148.28	0.01	0.00						0.58	0.35	0.14	0.05	149.71
1.D.1.b. Navigation	2.97	0.00	0.00						0.00	0.00	0.00	0.00	3.00
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**2,129.55**												**2,129.55**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**1.05**										**277.90**

Indirect CO_2	**90.47**												**90.47**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
Total national emissions and removals	**8,286.60**	**112.74**	**5.35**	**174.41**	**0.04**	**NO**	**0.00**	**NO**	**25.06**	**161.86**	**95.67**	**4.34**	**13,036.99**
1. Energy	**8,482.65**	**37.76**	**0.38**						**23.03**	**157.08**	**23.91**	**3.54**	**9,641.29**
1.A. Fuel combustion	8,480.96	10.65	0.38						23.03	157.08	23.22	3.54	8,880.51
1.A.1. Energy industries	3,255.38	0.07	0.01						5.20	2.37	0.17	0.06	3,258.96
1.A.2. Manufacturing industries and construction	748.59	0.04	0.01						1.66	1.73	0.53	1.08	751.30
1.A.3. Transport	2,529.58	0.50	0.13						9.81	19.87	2.58	0.01	2,579.00
1.A.4. Other sectors	1,946.25	10.03	0.24						6.35	133.09	19.94	2.40	2,290.05
1.A.5. Other	1.17	0.00	0.00						0.01	0.02	0.00	0.00	1.19
1.B. Fugitive emissions from fuels	1.69	27.11	0.00						NO	NO	0.69	NO	760.78
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.69	27.11	0.00						NO	NO	0.69	NO	760.78
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**755.82**	**NO**	**NO**	**174.41**	**0.04**	**NO**	**0.00**	**NO**	**1.92**	**2.76**	**70.22**	**0.79**	**931.64**
2.A. Mineral industry	583.18								1.82	1.49	0.02	0.75	583.18
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	20.21	NO	NO	NO	NO	NO	NO	NO	0.07	0.86	0.03	0.03	20.21
2.D. Non-energy products from fuels and solvent use	151.37	NO	NO						0.03	0.15	64.99	0.01	151.37
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				174.41	NO	NO	NO	NO					174.41
2.G. Other product manufacture and use	1.06	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.26	0.48	0.00	2.47
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.69	NO	NO
3. Agriculture	**44.16**	**23.04**	**4.21**						**NO**	**NO**	**NE, NO**	**NO**	**1,805.17**
3.A. Enteric fermentation		20.88											584.64
3.B. Manure management		2.16	0.80								NO		271.76
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	3.41						NO	NO	NO		904.61
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	44.16												44.16

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-1,006.61**	**0.01**	**0.55**						**0.00**	**0.17**	**NE**		**-859.35**
4.A. Forest land [5]	-1,969.36	0.01	0.00						0.00	0.13	NE		-1,969.11
4.B. Cropland [5]	1,206.39	0.00	0.00						0.00	0.03	NE		1,206.43
4.C. Grassland [5]	-440.15	NE	NE						NE	NE	NE		-440.15
4.D. Wetlands [5]	-82.83	NE	NE						NE	NE	NE		-82.83
4.E. Settlements [5]	21.62	NO, NE	0.55						NE	NE	NE		168.60
4.F. Other land [5]	321.21	NE	NE						NE	NE	NE		321.21
4.G. Harvested wood products [5]	-63.50												-63.50
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**10.58**	**51.93**	**0.20**						**0.11**	**1.86**	**1.54**	**0.00**	**1,518.24**
5.A. Solid waste disposal [6]		42.15							NA, NO	NA, NO	1.49	0.00	1,180.17
5.B. Biological treatment of solid waste		0.04	0.00						NO, NE	0.01	NO, NE		1.96
5.C. Incineration and open burning of waste [6]	10.58	0.22	0.00						0.11	1.85	0.04	0.00	17.66
5.D. Wastewater treatment and discharge		9.52	0.20						NA, IE	NA, IE	0.01	0.00	318.45
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other ***(please specify)*** [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**171.99**	**0.01**	**0.01**						**0.65**	**0.51**	**0.15**	**0.05**	**173.73**
1.D.1.a. Aviation	170.41	0.01	0.01						0.65	0.51	0.15	0.05	172.13
1.D.1.b. Navigation	1.58	0.00	0.00						0.00	0.00	0.00	0.00	1.60
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**3,588.77**												**3,588.77**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**1.08**										**286.35**

Indirect CO_2	**144.05**												**144.05**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_X	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]					(kt)				CO_2 equivalents (kt) [3]
Total national emissions and removals	**9,215.58**	**98.86**	**5.35**	**196.40**	**0.04**	**NO**	**0.00**	**NO**	**25.28**	**146.31**	**89.49**	**5.05**	**13,599.49**
1. Energy	**8,560.27**	**28.17**	**0.38**						**23.30**	**141.58**	**21.18**	**4.30**	**9,450.40**
1.A. Fuel combustion	8,558.64	9.37	0.38						23.30	141.58	20.65	4.30	8,922.30
1.A.1. Energy industries	3,124.41	0.07	0.01						4.98	2.29	0.17	0.05	3,127.91
1.A.2. Manufacturing industries and construction	715.94	0.04	0.01						1.56	1.53	0.48	0.92	718.39
1.A.3. Transport	2,611.55	0.50	0.14						10.17	20.57	2.68	0.01	2,662.34
1.A.4. Other sectors	2,105.50	8.76	0.23						6.58	117.16	17.31	3.32	2,412.41
1.A.5. Other	1.23	0.00	0.00						0.01	0.02	0.00	0.00	1.25
1.B. Fugitive emissions from fuels	1.63	18.80	0.00						NO	NO	0.54	NO	528.10
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.63	18.80	0.00						NO	NO	0.54	NO	528.10
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**754.51**	**NO**	**NO**	**196.40**	**0.04**	**NO**	**0.00**	**NO**	**1.86**	**2.54**	**66.78**	**0.75**	**952.43**
2.A. Mineral industry	593.82								1.79	1.53	0.02	0.71	593.82
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	15.79	NO	NO	NO	NO	NO	NO	NO	0.05	0.67	0.02	0.02	15.79
2.D. Non-energy products from fuels and solvent use	143.77	NO	NO						0.02	0.10	61.43	0.01	143.77
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				196.40	NO	NO	NO	NO					196.40
2.G. Other product manufacture and use	1.13	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.24	0.51	0.00	2.65
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	4.78	NO	NO
3. Agriculture	**39.12**	**19.53**	**4.22**						**NO**	**NO**	**NE, NO**	**NO**	**1,705.25**
3.A. Enteric fermentation		17.48											489.47
3.B. Manure management		2.05	0.63								NO		225.41
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	3.59						NO	NO	NO		951.25
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	39.12												39.12

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-148.61**	**0.02**	**0.54**						**0.01**	**0.38**	**NE**		**-4.52**
4.A. Forest land [5]	-1,950.65	0.01	0.00						0.01	0.33	NE		-1,950.04
4.B. Cropland [5]	1,507.41	0.00	0.00						0.00	0.06	NE		1,507.47
4.C. Grassland [5]	-293.29	NE	NE						NE	NE	NE		-293.29
4.D. Wetlands [5]	-82.81	NE	NE						NE	NE	NE		-82.81
4.E. Settlements [5]	116.50	NO, NE	0.54						NE	NE	NE		259.93
4.F. Other land [5]	611.79	NE	NE						NE	NE	NE		611.79
4.G. Harvested wood products [5]	-57.56												-57.56
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**10.28**	**51.14**	**0.20**						**0.10**	**1.81**	**1.53**	**0.00**	**1,495.93**
5.A. Solid waste disposal [6]		41.72							NA, NO	NA, NO	1.48	0.00	1,168.09
5.B. Biological treatment of solid waste		0.05	0.00						NO, NE	0.01	NO, NE		2.01
5.C. Incineration and open burning of waste [6]	10.28	0.21	0.00						0.10	1.81	0.04	0.00	17.18
5.D. Wastewater treatment and discharge		9.17	0.20						NA, IE	NA, IE	0.01	0.00	308.64
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**153.18**	**0.01**	**0.01**						**0.62**	**0.42**	**0.12**	**0.05**	**154.71**
1.D.1.a. Aviation	151.50	0.01	0.01						0.62	0.42	0.12	0.05	153.02
1.D.1.b. Navigation	1.67	0.00	0.00						0.00	0.00	0.00	0.00	1.69
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**2,984.40**												**2,984.40**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**1.05**										**278.25**

Indirect CO_2	**136.27**												**136.27**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_X	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**9,485.02**	**86.58**	**4.73**	**206.62**	**0.04**	**NO**	**0.00**	**NO**	**25.46**	**141.45**	**114.76**	**4.16**	**13,369.90**
1. Energy	**8,842.15**	**18.80**	**0.37**						**23.44**	**136.21**	**20.43**	**3.33**	**9,466.98**
1.A. Fuel combustion	8,840.57	9.09	0.37						23.44	136.21	20.02	3.33	9,193.48
1.A.1. Energy industries	3,634.38	0.08	0.01						5.80	2.65	0.20	0.04	3,638.38
1.A.2. Manufacturing industries and construction	692.66	0.04	0.00						1.38	1.37	0.46	0.78	694.91
1.A.3. Transport	2,462.27	0.44	0.13						9.75	18.40	2.41	0.01	2,508.94
1.A.4. Other sectors	2,050.09	8.53	0.23						6.50	113.77	16.95	2.51	2,350.07
1.A.5. Other	1.16	0.00	0.00						0.01	0.02	0.00	0.00	1.19
1.B. Fugitive emissions from fuels	1.58	9.71	0.00						NO	NO	0.40	NO	273.49
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.58	9.71	0.00						NO	NO	0.40	NO	273.49
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**762.25**	**NO**	**NO**	**206.62**	**0.04**	**NO**	**0.00**	**NO**	**1.90**	**2.63**	**92.84**	**0.82**	**970.54**
2.A. Mineral industry	538.63								1.80	1.35	0.02	0.77	538.63
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	18.70	NO	NO	NO	NO	NO	NO	NO	0.06	0.79	0.02	0.03	18.70
2.D. Non-energy products from fuels and solvent use	203.98	NO	NO						0.03	0.18	88.84	0.02	203.98
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				206.62	NO	NO	NO	NO					206.62
2.G. Other product manufacture and use	0.94	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.30	0.43	0.00	2.61
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.51	NO	NO
3. Agriculture	**42.50**	**17.35**	**3.59**						**NO**	**NO**	**NE, NO**	**NO**	**1,479.01**
3.A. Enteric fermentation		15.50											434.00
3.B. Manure management		1.85	0.56								NO		199.38
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	3.03						NO	NO	NO		803.13
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	42.50												42.50

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-172.36**	**0.03**	**0.56**						**0.02**	**0.77**	**NE**		**-22.06**
4.A. Forest land [5]	-1,887.32	0.03	0.00						0.02	0.66	NE		-1,886.09
4.B. Cropland [5]	1,629.90	0.00	0.00						0.00	0.11	NE		1,630.01
4.C. Grassland [5]	-223.15	NE	NE						NE	NE	NE		-223.15
4.D. Wetlands [5]	-82.81	NE	NE						NE	NE	NE		-82.81
4.E. Settlements [5]	27.21	NO, NE	0.56						NE	NE	NE		176.16
4.F. Other land [5]	329.13	NE	NE						NE	NE	NE		329.13
4.G. Harvested wood products [5]	34.69												34.69
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**10.47**	**50.40**	**0.20**						**0.10**	**1.84**	**1.49**	**0.00**	**1,475.44**
5.A. Solid waste disposal [6]		41.31							NA, NO	NA, NO	1.44	0.00	1,156.70
5.B. Biological treatment of solid waste		0.05	0.00						NO, NE	0.01	NO, NE		2.19
5.C. Incineration and open burning of waste [6]	10.47	0.21	0.00						0.10	1.83	0.04	0.00	17.48
5.D. Wastewater treatment and discharge		8.82	0.20						NA, IE	NA, IE	0.01	0.00	299.06
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**41.40**	**0.00**	**0.00**						**0.12**	**0.05**	**0.02**	**0.02**	**41.73**
1.D.1.a. Aviation	35.25	0.00	0.00						0.12	0.05	0.02	0.02	35.52
1.D.1.b. Navigation	6.15	0.00	0.00						0.00	0.00	0.00	0.00	6.21
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**2,992.97**												**2,992.97**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**0.91**										**240.64**

Indirect CO_2	**196.38**												**196.38**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**10,522.35**	**86.31**	**5.67**	**213.27**	**0.04**	**NO**	**0.00**	**NO**	**28.65**	**143.27**	**104.17**	**6.73**	**14,657.27**
1. Energy	**9,817.04**	**18.99**	**0.42**						**26.56**	**138.38**	**20.67**	**5.90**	**10,460.91**
1.A. Fuel combustion	9,815.46	9.11	0.42						26.56	138.38	20.31	5.90	10,182.87
1.A.1. Energy industries	3,931.09	0.09	0.01						6.40	2.72	0.20	2.08	3,936.22
1.A.2. Manufacturing industries and construction	755.19	0.04	0.01						1.48	1.84	0.55	1.14	757.79
1.A.3. Transport	2,721.37	0.58	0.14						10.93	21.79	2.81	0.01	2,775.47
1.A.4. Other sectors	2,406.24	8.41	0.26						7.73	112.01	16.74	2.66	2,711.79
1.A.5. Other	1.57	0.00	0.00						0.01	0.02	0.00	0.00	1.60
1.B. Fugitive emissions from fuels	1.58	9.87	0.00						NO	NO	0.36	NO	278.04
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.58	9.87	0.00						NO	NO	0.36	NO	278.04
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**781.81**	**NO**	**NO**	**213.27**	**0.04**	**NO**	**0.00**	**NO**	**1.98**	**2.80**	**81.97**	**0.84**	**996.76**
2.A. Mineral industry	582.07								1.88	1.47	0.02	0.79	582.07
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	22.26	NO	NO	NO	NO	NO	NO	NO	0.07	0.95	0.03	0.03	22.26
2.D. Non-energy products from fuels and solvent use	176.31	NO	NO						0.03	0.14	75.91	0.01	176.31
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				213.27	NO	NO	NO	NO					213.27
2.G. Other product manufacture and use	1.16	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.24	0.53	0.00	2.84
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	5.46	NO	NO
3. Agriculture	**18.61**	**17.00**	**4.47**						**NO**	**NO**	**NE, NO**	**NO**	**1,679.02**
3.A. Enteric fermentation		15.32											429.07
3.B. Manure management		1.68	0.56								NO		194.35
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	3.91						NO	NO	NO		1,036.99
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	18.61												18.61

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**-105.16**	**0.01**	**0.58**						**0.01**	**0.33**	**NE**		**49.11**
4.A. Forest land [5]	-1,919.59	0.00	0.00						0.00	0.07	NE		-1,919.47
4.B. Cropland [5]	1,713.54	0.01	0.00						0.01	0.27	NE		1,713.81
4.C. Grassland [5]	-138.64	NE	NE						NE	NE	NE		-138.64
4.D. Wetlands [5]	-83.05	NE	NE						NE	NE	NE		-83.05
4.E. Settlements [5]	29.73	NO, NE	0.58						NE	NE	NE		183.61
4.F. Other land [5]	285.13	NE	NE						NE	NE	NE		285.13
4.G. Harvested wood products [5]	7.73												7.73
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**10.06**	**50.31**	**0.20**						**0.10**	**1.76**	**1.52**	**0.00**	**1,471.47**
5.A. Solid waste disposal [6]		40.88							NA, NO	NA, NO	1.47		1,144.56
5.B. Biological treatment of solid waste		0.05	0.00						NO, NE	0.01	NO, NE		2.08
5.C. Incineration and open burning of waste [6]	10.06	0.21	0.00						0.10	1.76	0.04	0.00	16.79
5.D. Wastewater treatment and discharge		9.18	0.19						NA, IE	NA, IE	0.01		308.05
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other *(please specify)* [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**160.01**	**0.01**	**0.01**						**0.62**	**0.42**	**0.12**	**0.05**	**161.61**
1.D.1.a. Aviation	151.50	0.01	0.01						0.62	0.42	0.12	0.05	153.02
1.D.1.b. Navigation	8.51	0.00	0.00						0.00	0.00	0.00	0.00	8.60
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**2,904.28**												**2,904.28**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**												**NE**
Indirect N_2O			**1.07**										**284.38**

Indirect CO_2	**168.17**												**168.17**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	Net CO_2 emissions / removals	CH_4	N_2O	HFCs [1]	PFCs [1]	Unspecified mix of HFCs and PFCs [1]	SF_6	NF_3	NO_x	CO	NMVOC	SO_x	Total GHG emissions / removals [2]
	(kt)			CO_2 equivalents (kt) [3]			(kt)						CO_2 equivalents (kt) [3]
Total national emissions and removals	**9,659.53**	**81.84**	**4.47**	**234.84**	**0.04**	**NO**	**0.00**	**NO**	**26.16**	**121.26**	**91.58**	**4.96**	**13,372.49**
1. Energy	**8,705.13**	**15.88**	**0.38**						**24.22**	**116.11**	**17.50**	**4.16**	**9,249.65**
1.A. Fuel combustion	8,703.60	7.56	0.38						24.22	116.11	17.16	4.16	9,014.96
1.A.1. Energy industries	3,341.56	0.09	0.01						5.38	2.39	0.19	1.38	3,345.93
1.A.2. Manufacturing industries and construction	669.56	0.04	0.01						1.57	1.23	0.53	0.46	672.30
1.A.3. Transport	2,724.89	0.49	0.14						10.82	20.28	2.65	0.01	2,776.78
1.A.4. Other sectors	1,964.95	6.93	0.22						6.43	92.18	13.78	2.31	2,217.25
1.A.5. Other	2.64	0.00	0.00						0.02	0.03	0.00	0.00	2.70
1.B. Fugitive emissions from fuels	1.52	8.33	0.00						NO	NO	0.34	NO	234.70
1.B.1. Solid fuels	NO	NO	NO						NO	NO	NO	NO	NO
1.B.2. Oil and natural gas and other emissions from energy production	1.52	8.33	0.00						NO	NO	0.34	NO	234.70
1.C. CO_2 Transport and storage	NO												NO
2. Industrial processes and product use	**663.47**	**NO**	**NO**	**234.84**	**0.04**	**NO**	**0.00**	**NO**	**1.80**	**2.03**	**72.59**	**0.80**	**900.00**
2.A. Mineral industry	491.38								1.73	1.21	0.02	0.77	491.38
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	0.02	NO	NO
2.C. Metal industry	12.20	NO	NO	NO	NO	NO	NO	NO	0.04	0.52	0.02	0.02	12.20
2.D. Non-energy products from fuels and solvent use	159.11	NO	NO						0.02	0.14	68.41	0.01	159.11
2.E. Electronic industry			NO	NO	NO	NO	NO	NO					NO
2.F. Product uses as substitutes for ODS				234.84	NO	NO	NO	NO					234.84
2.G. Other product manufacture and use	0.78	NO	NO	NO	0.04	NO	0.00	NO	0.01	0.16	0.36	0.00	2.47
2.H. Other [4]	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	3.78	NO	NO
3. Agriculture	**22.66**	**16.47**	**3.30**						**NO**	**NO**	**NE, NO**	**NO**	**1,357.09**
3.A. Enteric fermentation		14.82											414.83
3.B. Manure management		1.65	0.51								NO		181.39
3.C. Rice cultivation		NO									NE		NO
3.D. Agricultural soils		NO	2.79						NO	NO	NO		738.21
3.E. Prescribed burning of savannahs		NO	NO						NO	NO	NO		NO
3.F. Field burning of agricultural residues		IE	IE						IE	IE	IE		IE
3.G. Liming	NO												NO
3.H. Urea application	22.66												22.66

3.I. Other carbon-containing fertilizers	NO, NE												NO, NE
3.J. Other	NO	NO	NO						NO	NO	NO	NO	NO
4. Land use, land-use change and forestry [5]	**258.39**	**0.05**	**0.61**						**0.04**	**1.38**	**NE**		**420.66**
4.A. Forest land [5]	-1,592.42	0.04	0.00						0.03	0.94	NE		-1,590.66
4.B. Cropland [5]	1,730.18	0.01	0.00						0.01	0.44	NE		1,730.63
4.C. Grassland [5]	-123.13	NE	NE						NE	NE	NE		-123.13
4.D. Wetlands [5]	-84.25	NE	NE						NE	NE	NE		-84.25
4.E. Settlements [5]	27.50	NO, NE	0.60						NE	NE	NE		187.56
4.F. Other land [5]	304.27	NE	NE						NE	NE	NE		304.27
4.G. Harvested wood products [5]	-3.78												-3.78
4.H. Other [5]	NE	NE	NE						NE	NE	NE		NE
5. Waste	**9.89**	**49.43**	**0.19**						**0.10**	**1.74**	**1.49**	**0.00**	**1,445.09**
5.A. Solid waste disposal [6]		40.37							NA, NO	NA, NO	1.44		1,130.39
5.B. Biological treatment of solid waste		0.05	0.00						NO, NE	0.01	NO, NE		2.16
5.C. Incineration and open burning of waste [6]	9.89	0.20	0.00						0.10	1.73	0.04	0.00	16.51
5.D. Wastewater treatment and discharge		8.81	0.19						NA, IE	NA, IE	0.01	0.00	296.03
5.E. Other [6]	NO	NO	NO						NO	NO	NO	NO	NO
6. Other ***(please specify)*** [7]	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [8]													
1.D.1. International bunkers	**145.60**	**0.00**	**0.00**						**0.59**	**0.33**	**0.09**	**0.05**	**146.96**
1.D.1.a. Aviation	142.05	0.00	0.00						0.59	0.33	0.09	0.05	143.37
1.D.1.b. Navigation	3.56	0.00	0.00						0.00	0.00	0.00	0.00	3.59
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**	**NO**	**NO**	**NO**	NO
1.D.3. CO_2 emissions from biomass	**2,429.50**												**2,429.50**
1.D.4. CO_2 captured	**NO**												**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NO**												**NO**
Indirect N_2O			**0.81**										**213.70**

Indirect CO_2	**151.27**												**151.27**

Annex 6-7. Summary Reports for GHG Emissions in CO_2 equivalent in the Republic of Moldova within 1990-2022

1990

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**35,384.04**	**1,396.21**	**307.30**						**37,087.56**
1.A. Fuel combustion	35,383.38	376.17	307.30						36,066.86
1.A.1. Energy industries	21,300.29	13.76	45.95						21,359.99
1.A.2. Manufacturing industries and construction	1,898.61	2.39	3.84						1,904.84
1.A.3. Transport	4,698.24	37.71	94.91						4,830.86
1.A.4. Other sectors	7,372.26	322.01	161.43						7,855.70
1.A.5. Other	113.97	0.31	1.18						115.46
1.B. Fugitive emissions from fuels	0.66	1,020.03	0.00						1,020.70
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.66	1,020.03	0.00						1,020.70
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**1,605.22**	**NO**	**0.02**	**NO**	**NO**	**NO**	**NO**	**NO**	**1,605.24**
2.A. Mineral industry	1,338.96								1,338.96
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	28.50	NO	NO	NO	NO	NO	NO	NO	28.50
2.D. Non-energy products from fuels and solvent use	234.36	NO	NO						234.36
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				NO	NO	NO	NO	NO	NO
2.G. Other product manufacture and use	3.40	NO	0.02	NO	NO	NO	NO	NO	3.42
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.58**	**3,006.67**	**2,093.79**						**5,101.04**
3.A. Enteric fermentation		2,452.16							2,452.16
3.B. Manure management		554.51	769.26						1,323.77
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	1,324.53						1,324.53
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO

3.H. Urea application	0.58								0.58
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE
3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,830.49**	**2.97**	**151.51**						**-1,676.01**
4.A. Forest land	-2,563.43	0.23	0.12						-2,563.08
4.B. Cropland	2,379.09	2.74	0.67						2,382.50
4.C. Grassland	-1,205.69	NE	NE						-1,205.69
4.D. Wetlands	-555.38	NE	NE						-555.38
4.E. Settlements	84.75	NO, NE	150.71						235.46
4.F. Other land	152.36	NE	NE						152.36
4.G. Harvested wood products	-122.18								-122.18
4.H. Other	NE	NE	NE						NE
5. Waste	**14.97**	**1,594.81**	**80.51**						**1,690.28**
5.A. Solid waste disposal-		1,228.09							1,228.09
5.B. Biological treatment of solid waste		1.52	0.86						2.39
5.C. Incineration and open burning of waste	14.97	8.61	1.43						25.01
5.D. Waste water treatment and discharge		356.58	78.21						434.80
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**191.63**	**0.38**	**1.67**						**193.68**
1.D.1.a. Aviation	191.63	0.38	1.67						193.68
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**232.81**								**232.81**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**664.92**						**664.92**

Indirect CO_2 [4]	**207.55**								**207.55**

Total CO_2 equivalent emissions without LULUCF	**45,484.11**
Total CO_2 equivalent emissions with LULUCF	**43,808.10**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**29,884.36**	**1,235.57**	**228.88**						**31,348.82**
1.A. Fuel combustion	29,883.72	270.63	228.88						30,383.23
1.A.1. Energy industries	18,927.03	11.84	41.41						18,980.28
1.A.2. Manufacturing industries and construction	1,269.19	1.52	2.52						1,273.22
1.A.3. Transport	3,656.10	28.96	77.68						3,762.74
1.A.4. Other sectors	5,925.02	228.10	106.37						6,259.50
1.A.5. Other	106.37	0.20	0.91						107.48
1.B. Fugitive emissions from fuels	0.64	964.95	0.00						965.59
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.64	964.95	0.00						965.59
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**1,411.27**	**NO**	**0.01**	**NO**	**NO**	**NO**	**NO**	**NO**	**1,411.29**
2.A. Mineral industry	1,190.16								1,190.16
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	24.73	NO	NO	NO	NO	NO	NO	NO	24.73
2.D. Non-energy products from fuels and solvent use	193.32	NO	NO						193.32
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				NO	NO	NO	NO	NO	NO
2.G. Other product manufacture and use	3.06	NO	0.01	NO	NO	NO	NO	NO	3.08
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.52**	**2,737.22**	**1,992.14**						**4,729.89**
3.A. Enteric fermentation		2,272.33							2,272.33
3.B. Manure management		464.89	718.93						1,183.82
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	1,273.21						1,273.21
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.52								0.52
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,907.84**	**2.69**	**163.52**						**-2,741.63**
4.A. Forest land	-2,343.31	0.04	0.02						-2,343.25
4.B. Cropland	1,248.78	2.65	0.65						1,252.08
4.C. Grassland	-1,414.32	NE	NE						-1,414.32
4.D. Wetlands	-526.46	NE	NE						-526.46
4.E. Settlements	88.71	NO, NE	162.85						251.56
4.F. Other land	152.36	NE	NE						152.36
4.G. Harvested wood products	-113.61								-113.61
4.H. Other	NE	NE	NE						NE
5. Waste	**15.00**	**1,633.58**	**74.49**						**1,723.07**
5.A. Solid waste disposal		1,277.50							1,277.50
5.B. Biological treatment of solid waste		1.54	0.88						2.42
5.C. Incineration and open burning of waste	15.00	8.63	1.43						25.06
5.D. Waste water treatment and discharge		345.92	72.18						418.10
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**145.99**	**0.29**	**1.27**						**147.55**
1.D.1.a. Aviation	145.99	0.29	1.27						147.55
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**201.20**								**201.20**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**618.15**						**618.15**

Indirect CO_2 [4]	**170.84**								**170.84**

Total CO_2 equivalent emissions without LULUCF	**39,213.06**
Total CO_2 equivalent emissions with LULUCF	**36,471.43**

1992

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**23,300.20**	**1,041.06**	**159.81**						**24,501.07**
1.A. Fuel combustion	23,299.66	169.56	159.81						23,629.03
1.A.1. Energy industries	15,660.99	10.02	32.30						15,703.31
1.A.2. Manufacturing industries and construction	921.55	1.11	1.82						924.48
1.A.3. Transport	2,615.22	20.24	59.20						2,694.66
1.A.4. Other sectors	4,024.16	138.06	65.89						4,228.10
1.A.5. Other	77.75	0.13	0.60						78.47
1.B. Fugitive emissions from fuels	0.54	871.50	0.00						872.04
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.54	871.50	0.00						872.04
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**822.46**	**NO**	**0.01**	**NO**	**NO**	**NO**	**NO**	**NO**	**822.47**
2.A. Mineral industry	641.79								641.79
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	23.99	NO	NO	NO	NO	NO	NO	NO	23.99
2.D. Non-energy products from fuels and solvent use	154.26	NO	NO						154.26
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				NO	NO	NO	NO	NO	NO
2.G. Other product manufacture and use	2.41	NO	0.01	NO	NO	NO	NO	NO	2.43
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.39**	**2,654.29**	**1,706.25**						**4,360.93**
3.A. Enteric fermentation		2,236.40							2,236.40
3.B. Manure management		417.89	637.42						1,055.31
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	1,068.82						1,068.82
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.39								0.39
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,322.98**	**2.46**	**181.99**						**-2,138.53**
4.A. Forest land	-2,184.24	0.04	0.02						-2,184.18
4.B. Cropland	1,174.19	2.42	0.59						1,177.20
4.C. Grassland	-1,428.48	NE	NE						-1,428.48
4.D. Wetlands	-595.55	NE	NE						-595.55
4.E. Settlements	386.62	NO, NE	181.37						567.99
4.F. Other land	418.78	NE	NE						418.78
4.G. Harvested wood products	-94.30								-94.30
4.H. Other	NE	NE	NE						NE
5. Waste	**15.05**	**1,669.46**	**68.49**						**1,753.00**
5.A. Solid waste disposal-		1,331.63							1,331.63
5.B. Biological treatment of solid waste		1.61	0.91						2.52
5.C. Incineration and open burning of waste	15.05	8.65	1.44						25.13
5.D. Waste water treatment and discharge		327.56	66.14						393.70
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**107.51**	**0.21**	**0.94**						**108.66**
1.D.1.a. Aviation	107.51	0.21	0.94						108.66
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**169.59**								**169.59**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**529.63**						**529.63**

Indirect CO_2 [4]	**140.94**								**140.94**

Total CO_2 equivalent emissions without LULUCF	**31,437.47**
Total CO_2 equivalent emissions with LULUCF	**29,298.94**

1993

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**17,333.44**	**856.01**	**132.51**						**18,321.97**
1.A. Fuel combustion	17,332.99	72.77	132.51						17,538.26
1.A.1. Energy industries	12,640.60	7.91	28.03						12,676.53
1.A.2. Manufacturing industries and construction	610.17	0.75	1.20						612.12
1.A.3. Transport	1,854.84	13.80	47.92						1,916.56
1.A.4. Other sectors	2,133.92	50.16	54.71						2,238.79
1.A.5. Other	93.45	0.16	0.65						94.26
1.B. Fugitive emissions from fuels	0.46	783.24	0.00						783.70
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.46	783.24	0.00						783.70
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**737.86**	**NO**	**0.02**	**NO**	**NO**	**NO**	**NO**	**NO**	**737.88**
2.A. Mineral industry	587.58								587.58
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	24.42	NO	NO	NO	NO	NO	NO	NO	24.42
2.D. Non-energy products from fuels and solvent use	123.88	NO	NO						123.88
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				NO	NO	NO	NO	NO	NO
2.G. Other product manufacture and use	1.98	NO	0.02	NO	NO	NO	NO	NO	2.00
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.13**	**2,405.59**	**1,431.81**						**3,837.53**
3.A. Enteric fermentation		2,097.65							2,097.65
3.B. Manure management		307.94	538.54						846.48
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	893.26						893.26
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.13								0.13
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,364.70**	**3.30**	**197.92**						**-2,163.47**
4.A. Forest land	-2,193.51	0.00	0.00						-2,193.51
4.B. Cropland	1,443.00	3.30	0.81						1,447.10
4.C. Grassland	-1,303.52	NE	NE						-1,303.52
4.D. Wetlands	-525.84	NE	NE						-525.84
4.E. Settlements	114.62	NO, NE	197.11						311.73
4.F. Other land	164.02	NE	NE						164.02
4.G. Harvested wood products	-63.45								-63.45
4.H. Other	NE	NE	NE						NE
5. Waste	**15.04**	**1,722.10**	**63.93**						**1,801.08**
5.A. Solid waste disposal		1,384.63							1,384.63
5.B. Biological treatment of solid waste		0.81	0.46						1.26
5.C. Incineration and open burning of waste	15.04	8.64	1.44						25.13
5.D. Waste water treatment and discharge		328.02	62.04						390.06
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**54.71**	**0.11**	**0.48**						**55.30**
1.D.1.a. Aviation	54.71	0.11	0.48						55.30
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**143.24**								**143.24**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**428.90**						**428.90**

Indirect CO_2 [4]	**112.20**								**112.20**

Total CO_2 equivalent emissions without LULUCF	**24,698.45**
Total CO_2 equivalent emissions with LULUCF	**22,534.98**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**14,492.41**	**841.40**	**120.18**						**15,453.99**
1.A. Fuel combustion	14,491.98	86.55	120.18						14,698.72
1.A.1. Energy industries	9,961.85	5.29	23.11						9,990.25
1.A.2. Manufacturing industries and construction	738.06	0.50	0.58						739.14
1.A.3. Transport	1,612.96	12.24	29.05						1,654.26
1.A.4. Other sectors	2,090.75	68.33	67.01						2,226.08
1.A.5. Other	88.36	0.19	0.43						88.99
1.B. Fugitive emissions from fuels	0.43	754.84	0.00						755.27
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.43	754.84	0.00						755.27
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**556.59**	**NO**	**0.01**	**NO**	**NO**	**NO**	**NO**	**NO**	**556.60**
2.A. Mineral industry	445.34								445.34
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	25.33	NO	NO	NO	NO	NO	NO	NO	25.33
2.D. Non-energy products from fuels and solvent use	84.47	NO	NO						84.47
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				NO	NO	NO	NO	NO	NO
2.G. Other product manufacture and use	1.44	NO	0.01	NO	NO	NO	NO	NO	1.46
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.05**	**2,338.63**	**1,242.75**						**3,581.43**
3.A. Enteric fermentation		2,041.57							2,041.57
3.B. Manure management		297.06	519.76						816.82
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	722.98						722.98
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.05								0.05
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,311.29**	**1.85**	**210.35**						**-2,099.09**
4.A. Forest land	-2,108.00	0.06	0.03						-2,107.90
4.B. Cropland	1,206.39	1.79	0.44						1,208.61
4.C. Grassland	-1,577.33	NE	NE						-1,577.33
4.D. Wetlands	-497.64	NE	NE						-497.64
4.E. Settlements	130.49	NO, NE	209.87						340.36
4.F. Other land	549.46	NE	NE						549.46
4.G. Harvested wood products	-14.65								-14.65
4.H. Other	NE	NE	NE						NE
5. Waste	**15.09**	**1,713.44**	**62.09**						**1,790.62**
5.A. Solid waste disposal		1,390.84							1,390.84
5.B. Biological treatment of solid waste		0.75	0.43						1.18
5.C. Incineration and open burning of waste	15.09	8.67	1.44						25.21
5.D. Waste water treatment and discharge		313.17	60.22						373.39
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**30.55**	**0.06**	**0.27**						**30.88**
1.D.1.a. Aviation	30.55	0.06	0.27						30.88
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**157.46**								**157.46**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**383.57**						**383.57**

Indirect CO_2 [4]	**73.60**								**73.60**

Total CO_2 equivalent emissions without LULUCF	**21,382.64**
Total CO_2 equivalent emissions with LULUCF	**19,283.55**

1995

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**11,471.70**	**881.26**	**114.07**						**12,467.03**
1.A. Fuel combustion	11,471.26	54.26	114.07						11,639.59
1.A.1. Energy industries	7,174.03	3.84	13.30						7,191.16
1.A.2. Manufacturing industries and construction	381.51	0.32	0.39						382.22
1.A.3. Transport	1,617.92	12.45	28.04						1,658.41
1.A.4. Other sectors	2,172.16	37.36	71.76						2,281.29
1.A.5. Other	125.64	0.29	0.58						126.51
1.B. Fugitive emissions from fuels	0.44	827.00	0.00						827.44
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.44	827.00	0.00						827.44
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**455.63**	**NO**	**0.00**	**0.94**	**NO**	**NO**	**NO**	**NO**	**456.56**
2.A. Mineral industry	351.66								351.66
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	26.24	NO	NO	NO	NO	NO	NO	NO	26.24
2.D. Non-energy products from fuels and solvent use	76.56	NO	NO						76.56
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				0.94	NO	NO	NO	NO	0.94
2.G. Other product manufacture and use	1.17	NO	0.00	NO	NO	NO	NO	NO	1.17
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.06**	**2,043.29**	**1,176.94**						**3,220.29**
3.A. Enteric fermentation		1,812.26							1,812.26
3.B. Manure management		231.03	459.54						690.57
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	717.39						717.39
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.06								0.06
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,284.87**	**2.51**	**223.66**						**-2,058.69**
4.A. Forest land	-2,045.07	0.00	0.00						-2,045.06
4.B. Cropland	1,316.72	2.50	0.61						1,319.84
4.C. Grassland	-1,601.10	NE	NE						-1,601.10
4.D. Wetlands	-469.44	NE	NE						-469.44
4.E. Settlements	106.92	NO, NE	223.05						329.96
4.F. Other land	401.13	NE	NE						401.13
4.G. Harvested wood products	5.97								5.97
4.H. Other	NE	NE	NE						NO
5. Waste	**15.10**	**1,713.24**	**62.81**						**1,791.14**
5.A. Solid waste disposal		1,388.07							1,388.07
5.B. Biological treatment of solid waste		0.71	0.40						1.11
5.C. Incineration and open burning of waste	15.10	8.67	1.44						25.21
5.D. Waste water treatment and discharge		315.79	60.97						376.76
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**34.67**	**0.08**	**0.30**						**35.05**
1.D.1.a. Aviation	34.67	0.08	0.30						35.05
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**230.05**								**230.05**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**350.51**						**350.51**

Indirect CO_2 [4]	**65.45**								**65.45**

Total CO_2 equivalent emissions without LULUCF	**17,935.02**
Total CO_2 equivalent emissions with LULUCF	**15,876.32**

1996

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**11,375.14**	**988.56**	**99.23**						**12,462.93**
1.A. Fuel combustion	11,374.65	83.27	99.23						11,557.14
1.A.1. Energy industries	7,107.05	3.79	12.43						7,123.27
1.A.2. Manufacturing industries and construction	321.29	0.32	0.42						322.02
1.A.3. Transport	1,578.77	12.07	26.73						1,617.58
1.A.4. Other sectors	2,285.70	66.78	59.03						2,411.51
1.A.5. Other	81.84	0.31	0.62						82.76
1.B. Fugitive emissions from fuels	0.50	905.29	0.00						905.78
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.50	905.29	0.00						905.78
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**415.26**	**NO**	**0.00**	**1.51**	**NO**	**NO**	**NO**	**NO**	**416.77**
2.A. Mineral industry	316.36								316.36
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	26.73	NO	NO	NO	NO	NO	NO	NO	26.73
2.D. Non-energy products from fuels and solvent use	71.07	NO	NO						71.07
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				1.51	NO	NO	NO	NO	1.51
2.G. Other product manufacture and use	1.10	NO	0.00	NO	NO	NO	NO	NO	1.11
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.09**	**1,880.74**	**1,040.79**						**2,921.62**
3.A. Enteric fermentation		1,670.90							1,670.90
3.B. Manure management		209.84	396.13						605.98
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	644.66						644.66
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.09								0.09
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,740.53**	**1.73**	**233.22**						**-2,505.59**
4.A. Forest land	-2,190.43	0.02	0.01						-2,190.40
4.B. Cropland	1,118.52	1.70	0.42						1,120.65
4.C. Grassland	-1,548.08	NE	NE						-1,548.08
4.D. Wetlands	-441.24	NE	NE						-441.24
4.E. Settlements	101.59	NO, NE	232.79						334.38
4.F. Other land	217.33	NE	NE						217.33
4.G. Harvested wood products	1.78								1.78
4.H. Other	NE	NE	NE						NE
5. Waste	**15.10**	**1,708.66**	**61.90**						**1,785.66**
5.A. Solid waste disposal-		1,385.67							1,385.67
5.B. Biological treatment of solid waste		0.73	0.41						1.14
5.C. Incineration and open burning of waste	15.10	8.66	1.44						25.20
5.D. Waste water treatment and discharge		313.60	60.05						373.65
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**56.73**	**0.10**	**0.48**						**57.31**
1.D.1.a. Aviation	56.73	0.10	0.48						57.31
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**294.03**								**294.03**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**346.07**						**346.07**

Indirect CO_2 [4]	**60.57**								**60.57**

Total CO_2 equivalent emissions without LULUCF	**17,586.98**
Total CO_2 equivalent emissions with LULUCF	**15,081.39**

1997

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**10,258.32**	**832.50**	**90.87**						**11,181.69**
1.A. Fuel combustion	10,257.83	65.00	90.87						10,413.70
1.A.1. Energy industries	5,615.61	3.10	6.48						5,625.19
1.A.2. Manufacturing industries and construction	546.90	0.51	0.61						548.02
1.A.3. Transport	1,516.13	11.23	25.87						1,553.23
1.A.4. Other sectors	2,502.53	49.94	57.39						2,609.85
1.A.5. Other	76.66	0.23	0.53						77.41
1.B. Fugitive emissions from fuels	0.49	767.50	0.00						767.99
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.49	767.50	0.00						767.99
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**452.49**	**NO**	**0.00**	**2.10**	**NO**	**NO**	**NO**	**NO**	**454.60**
2.A. Mineral industry	377.06								377.06
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	32.38	NO	NO	NO	NO	NO	NO	NO	32.38
2.D. Non-energy products from fuels and solvent use	42.05	NO	NO						42.05
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				2.10	NO	NO	NO	NO	2.10
2.G. Other product manufacture and use	1.00	NO	0.00	NO	NO	NO	NO	NO	1.00
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**1.10**	**1,606.93**	**1,018.84**						**2,626.87**
3.A. Enteric fermentation		1,436.51							1,436.51
3.B. Manure management		170.42	357.51						527.93
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	661.33						661.33
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	1.10								1.10
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,390.60**	**3.01**	**242.04**						**-2,145.55**
4.A. Forest land	-2,232.29	0.01	0.00						-2,232.28
4.B. Cropland	1,385.79	3.00	0.74						1,389.53
4.C. Grassland	-1,400.86	NE	NE						-1,400.86
4.D. Wetlands	-413.03	NE	NE						-413.03
4.E. Settlements	100.80	NO, NE	241.30						342.10
4.F. Other land	188.24	NE	NE						188.24
4.G. Harvested wood products	-19.24								-19.24
4.H. Other	NE	NE	NE						NE
5. Waste	**15.05**	**1,701.73**	**62.97**						**1,779.74**
5.A. Solid waste disposal		1,373.84							1,373.84
5.B. Biological treatment of solid waste		0.69	0.39						1.08
5.C. Incineration and open burning of waste	15.05	8.63	1.44						25.11
5.D. Waste water treatment and discharge		318.57	61.15						379.72
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**66.19**	**0.09**	**0.57**						**66.85**
1.D.1.a. Aviation	66.19	0.09	0.57						66.85
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**304.23**								**304.23**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**290.58**						**290.58**

Indirect CO_2 [4]	**32.09**								**32.09**

Total CO_2 equivalent emissions without LULUCF	**16,042.90**
Total CO_2 equivalent emissions with LULUCF	**13,897.35**

1998

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,874.91**	**763.08**	**70.69**						**9,708.68**
1.A. Fuel combustion	8,874.46	47.93	70.69						8,993.08
1.A.1. Energy industries	4,836.61	2.69	5.04						4,844.34
1.A.2. Manufacturing industries and construction	523.10	0.40	0.47						523.97
1.A.3. Transport	1,363.25	11.30	21.91						1,396.45
1.A.4. Other sectors	2,078.68	33.29	42.71						2,154.67
1.A.5. Other	72.83	0.25	0.56						73.64
1.B. Fugitive emissions from fuels	0.45	715.16	0.00						715.61
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.45	715.16	0.00						715.61
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**375.52**	**NO**	**0.00**	**2.85**	**NO**	**NO**	**NO**	**NO**	**378.37**
2.A. Mineral industry	308.48								308.48
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	28.68	NO	NO	NO	NO	NO	NO	NO	28.68
2.D. Non-energy products from fuels and solvent use	37.61	NO	NO						37.61
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				2.85	NO	NO	NO	NO	2.85
2.G. Other product manufacture and use	0.75	NO	0.00	NO	NO	NO	NO	NO	0.75
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.27**	**1,551.96**	**994.11**						**2,546.35**
3.A. Enteric fermentation		1,394.62							1,394.62
3.B. Manure management		157.34	351.14						508.48
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	642.97						642.97
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.27								0.27
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,422.61**	**2.77**	**252.87**						**-2,166.97**
4.A. Forest land	-2,288.49	0.07	0.03						-2,288.39
4.B. Cropland	1,412.06	2.70	0.66						1,415.42
4.C. Grassland	-1,436.27	NE	NE						-1,436.27
4.D. Wetlands	-384.83	NE	NE						-384.83
4.E. Settlements	99.04	NO, NE	252.17						351.21
4.F. Other land	185.01	NE	NE						185.01
4.G. Harvested wood products	-9.13								-9.13
4.H. Other	NE	NE	NE						NE
5. Waste	**15.08**	**1,676.23**	**63.91**						**1,755.22**
5.A. Solid waste disposal-		1,357.44							1,357.44
5.B. Biological treatment of solid waste		0.69	0.39						1.09
5.C. Incineration and open burning of waste	15.08	8.65	1.44						25.17
5.D. Waste water treatment and discharge		309.45	62.07						371.52
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**53.59**	**0.10**	**0.46**						**54.15**
1.D.1.a. Aviation	53.59	0.10	0.46						54.15
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**275.62**								**275.62**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**283.53**						**283.53**

Indirect CO_2 [4]	**29.94**								**29.94**

Total CO_2 equivalent emissions without LULUCF	**14,388.62**
Total CO_2 equivalent emissions with LULUCF	**12,221.65**

1999

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**6,903.73**	**752.83**	**48.32**						**7,704.88**
1.A. Fuel combustion	6,903.32	43.52	48.32						6,995.16
1.A.1. Energy industries	3,660.25	2.03	2.33						3,664.61
1.A.2. Manufacturing industries and construction	473.83	0.35	0.40						474.57
1.A.3. Transport	910.68	6.93	13.63						931.24
1.A.4. Other sectors	1,809.40	34.02	31.54						1,874.96
1.A.5. Other	49.16	0.18	0.43						49.77
1.B. Fugitive emissions from fuels	0.41	709.32	0.00						709.73
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.41	709.32	0.00						709.73
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**338.23**	**NO**	**0.01**	**3.64**	**NO**	**NO**	**NO**	**NO**	**341.88**
2.A. Mineral industry	271.71								271.71
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	31.79	NO	NO	NO	NO	NO	NO	NO	31.79
2.D. Non-energy products from fuels and solvent use	34.08	NO	NO						34.08
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				3.64	NO	NO	NO	NO	3.64
2.G. Other product manufacture and use	0.64	NO	0.01	NO	NO	NO	NO	NO	0.65
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.00**	**1,427.06**	**908.39**						**2,335.46**
3.A. Enteric fermentation		1,290.04							1,290.04
3.B. Manure management		137.03	318.49						455.51
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	589.91						589.91
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.00								0.00
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,140.44**	**2.68**	**261.32**						**-1,876.44**
4.A. Forest land	-2,336.85	0.05	0.03						-2,336.77
4.B. Cropland	1,430.80	2.63	0.64						1,434.07
4.C. Grassland	-1,433.29	NE	NE						-1,433.29
4.D. Wetlands	-356.63	NE	NE						-356.63
4.E. Settlements	111.83	NO, NE	260.65						372.47
4.F. Other land	425.16	NE	NE						425.16
4.G. Harvested wood products	18.54								18.54
4.H. Other	NE	NE	NE						NE
5. Waste	**15.01**	**1,659.92**	**62.54**						**1,737.47**
5.A. Solid waste disposal-		1,349.68							1,349.68
5.B. Biological treatment of solid waste		0.65	0.37						1.02
5.C. Incineration and open burning of waste	15.01	8.62	1.43						25.05
5.D. Waste water treatment and discharge		300.98	60.73						361.71
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**63.04**	**0.10**	**0.54**						**63.68**
1.D.1.a. Aviation	63.04	0.10	0.54						63.68
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**272.72**								**272.72**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**256.18**						**256.18**

Indirect CO_2 [4]	**28.71**								**28.71**

Total CO_2 equivalent emissions without LULUCF	**12,119.69**
Total CO_2 equivalent emissions with LULUCF	**10,243.24**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**6,188.57**	**786.86**	**43.10**						**7,018.53**
1.A. Fuel combustion	6,188.18	43.05	43.10						6,274.33
1.A.1. Energy industries	3,155.75	1.71	1.82						3,159.28
1.A.2. Manufacturing industries and construction	519.59	0.32	0.36						520.27
1.A.3. Transport	982.33	7.05	15.20						1,004.59
1.A.4. Other sectors	1,494.12	33.84	25.45						1,553.40
1.A.5. Other	36.39	0.13	0.27						36.78
1.B. Fugitive emissions from fuels	0.39	743.81	0.00						744.21
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.39	743.81	0.00						744.21
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**310.64**	**NO**	**0.01**	**4.66**	**NO**	**NO**	**NO**	**NO**	**315.31**
2.A. Mineral industry	240.78								240.78
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	36.27	NO	NO	NO	NO	NO	NO	NO	36.27
2.D. Non-energy products from fuels and solvent use	32.64	NO	NO						32.64
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				4.66	NO	NO	NO	NO	4.66
2.G. Other product manufacture and use	0.96	NO	0.01	NO	NO	NO	NO	NO	0.97
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.44**	**1,323.70**	**854.34**						**2,178.48**
3.A. Enteric fermentation		1,216.08							1,216.08
3.B. Manure management		107.63	289.51						397.14
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	564.83						564.83
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.44								0.44
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,420.58**	**1.02**	**263.51**						**-2,156.04**
4.A. Forest land	-2,307.44	0.00	0.00						-2,307.44
4.B. Cropland	1,222.73	1.02	0.25						1,224.00
4.C. Grassland	-1,291.95	NE	NE						-1,291.95
4.D. Wetlands	-328.42	NE	NE						-328.42
4.E. Settlements	100.18	NO, NE	263.26						363.44
4.F. Other land	178.52	NE	NE						178.52
4.G. Harvested wood products	5.81								5.81
4.H. Other	NE	NE	NE						NE
5. Waste	**15.00**	**1,629.21**	**63.94**						**1,708.15**
5.A. Solid waste disposal-		1,318.27							1,318.27
5.B. Biological treatment of solid waste		0.59	0.33						0.92
5.C. Incineration and open burning of waste	15.00	8.60	1.43						25.03
5.D. Waste water treatment and discharge		301.75	62.18						363.93
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**63.08**	**0.11**	**0.54**						**63.73**
1.D.1.a. Aviation	63.08	0.11	0.54						63.73
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**272.37**								**272.37**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**238.46**						**238.46**

Indirect CO_2 [4]	**28.60**								**28.60**

Total CO_2 equivalent emissions without LULUCF	**11,220.47**
Total CO_2 equivalent emissions with LULUCF	**9,064.43**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**6,818.02**	**784.96**	**44.26**						**7,647.24**
1.A. Fuel combustion	6,817.59	39.56	44.26						6,901.41
1.A.1. Energy industries	3,677.72	2.03	2.13						3,681.88
1.A.2. Manufacturing industries and construction	600.55	0.37	0.41						601.33
1.A.3. Transport	1,061.82	7.47	16.80						1,086.09
1.A.4. Other sectors	1,434.10	29.55	24.60						1,488.25
1.A.5. Other	43.40	0.14	0.32						43.86
1.B. Fugitive emissions from fuels	0.43	745.39	0.00						745.82
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.43	745.39	0.00						745.82
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**312.94**	**NO**	**0.01**	**6.25**	**NO**	**NO**	**NO**	**NO**	**319.20**
2.A. Mineral industry	237.07								237.07
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	38.63	NO	NO	NO	NO	NO	NO	NO	38.63
2.D. Non-energy products from fuels and solvent use	36.42	NO	NO						36.42
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				6.25	NO	NO	NO	NO	6.25
2.G. Other product manufacture and use	0.82	NO	0.01	NO	NO	NO	NO	NO	0.83
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.15**	**1,343.83**	**916.94**						**2,260.91**
3.A. Enteric fermentation		1,235.66							1,235.66
3.B. Manure management		108.16	292.00						400.17
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	624.93						624.93
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.15								0.15
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,064.79**	**1.42**	**263.71**						**-1,799.66**
4.A. Forest land	-2,273.70	0.11	0.06						-2,273.53
4.B. Cropland	1,560.44	1.31	0.32						1,562.07
4.C. Grassland	-1,290.65	NE	NE						-1,290.65
4.D. Wetlands	-300.22	NE	NE						-300.22
4.E. Settlements	67.09	NO, NE	263.33						330.42
4.F. Other land	178.52	NE	NE						178.52
4.G. Harvested wood products	-6.26								-6.26
4.H. Other	NE	NE	NE						NE
5. Waste	**14.97**	**1,595.70**	**64.61**						**1,675.27**
5.A. Solid waste disposal		1,280.40							1,280.40
5.B. Biological treatment of solid waste		0.53	0.30						0.83
5.C. Incineration and open burning of waste	14.97	8.59	1.43						24.99
5.D. Waste water treatment and discharge		306.18	62.88						369.05
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**50.49**	**0.10**	**0.44**						**51.03**
1.D.1.a. Aviation	50.49	0.10	0.44						51.03
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**282.23**								**282.23**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**251.11**						**251.11**

Indirect CO_2 [4]	**31.66**								**31.66**

Total CO_2 equivalent emissions without LULUCF	**11,902.62**
Total CO_2 equivalent emissions with LULUCF	**10,102.97**

2002

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**6,537.00**	**843.89**	**56.87**						**7,437.76**
1.A. Fuel combustion	6,536.60	49.73	56.87						6,643.20
1.A.1. Energy industries	2,933.21	1.72	1.82						2,936.75
1.A.2. Manufacturing industries and construction	410.40	0.26	0.28						410.94
1.A.3. Transport	1,405.71	9.57	25.10						1,440.38
1.A.4. Other sectors	1,747.82	37.95	29.24						1,815.02
1.A.5. Other	39.45	0.23	0.42						40.10
1.B. Fugitive emissions from fuels	0.41	794.16	0.00						794.56
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	0.41	794.16	0.00						794.56
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**361.15**	**NO**	**0.01**	**8.30**	**NO**	**NO**	**NO**	**NO**	**369.46**
2.A. Mineral industry	301.49								301.49
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	20.50	NO	NO	NO	NO	NO	NO	NO	20.50
2.D. Non-energy products from fuels and solvent use	38.37	NO	NO						38.37
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				8.30	NO	NO	NO	NO	8.30
2.G. Other product manufacture and use	0.78	NO	0.01	NO	NO	NO	NO	NO	0.80
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.05**	**1,373.21**	**955.16**						**2,328.42**
3.A. Enteric fermentation		1,260.68							1,260.68
3.B. Manure management		112.53	294.74						407.27
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	660.42						660.42
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.05								0.05
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,151.54**	**0.30**	**264.07**						**-1,887.18**
4.A. Forest land	-2,267.62	0.06	0.03						-2,267.53
4.B. Cropland	1,156.59	0.24	0.06						1,156.88
4.C. Grassland	-1,235.14	NE	NE						-1,235.14
4.D. Wetlands	-272.02	NE	NE						-272.02
4.E. Settlements	67.09	NO, NE	263.98						331.07
4.F. Other land	456.24	NE	NE						456.24
4.G. Harvested wood products	-56.69								-56.69
4.H. Other	NE	NE	NE						NE
5. Waste	**14.94**	**1,579.56**	**66.26**						**1,660.76**
5.A. Solid waste disposal		1,242.34							1,242.34
5.B. Biological treatment of solid waste		0.58	0.33						0.92
5.C. Incineration and open burning of waste	14.94	8.57	1.42						24.93
5.D. Waste water treatment and discharge		328.07	64.50						392.58
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**59.95**	**0.10**	**0.52**						**60.57**
1.D.1.a. Aviation	59.95	0.10	0.52						60.57
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**322.08**								**322.08**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**261.17**						**261.17**

Indirect CO_2 [4]	**33.39**								**33.39**

Total CO_2 equivalent emissions without LULUCF	**11,796.40**
Total CO_2 equivalent emissions with LULUCF	**9,909.23**

2003

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**7,178.52**	**896.20**	**55.29**						**8,130.01**
1.A. Fuel combustion	7,177.44	63.52	55.29						7,296.25
1.A.1. Energy industries	3,036.74	1.75	1.84						3,040.33
1.A.2. Manufacturing industries and construction	438.86	0.27	0.29						439.42
1.A.3. Transport	1,588.76	11.21	24.17						1,624.14
1.A.4. Other sectors	2,084.65	50.18	28.75						2,163.57
1.A.5. Other	28.42	0.12	0.25						28.79
1.B. Fugitive emissions from fuels	1.08	832.68	0.00						833.76
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.08	832.68	0.00						833.76
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**386.39**	**NO**	**0.01**	**10.95**	**NO**	**NO**	**0.01**	**NO**	**397.36**
2.A. Mineral industry	309.07								309.07
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	35.43	NO	NO	NO	NO	NO	NO	NO	35.43
2.D. Non-energy products from fuels and solvent use	40.93	NO	NO						40.93
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				10.95	NO	NO	NO	NO	10.95
2.G. Other product manufacture and use	0.96	NO	0.01	NO	NO	NO	0.01	NO	0.98
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.24**	**1,256.38**	**843.68**						**2,100.30**
3.A. Enteric fermentation		1,151.96							1,151.96
3.B. Manure management		104.42	282.44						386.87
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		0.00	561.24						561.24
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.24								0.24
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,079.15**	**0.07**	**261.74**						**-1,817.34**
4.A. Forest land	-2,270.12	0.06	0.03						-2,270.02
4.B. Cropland	1,237.55	0.00	0.00						1,237.56
4.C. Grassland	-1,007.18	NE	NE						-1,007.18
4.D. Wetlands	-243.82	NE	NE						-243.82
4.E. Settlements	67.86	NO, NE	261.71						329.57
4.F. Other land	201.66	NE	NE						201.66
4.G. Harvested wood products	-65.11								-65.11
4.H. Other	NE	NE	NE						NE
5. Waste	**14.91**	**1,546.95**	**64.07**						**1,625.93**
5.A. Solid waste disposal-		1,204.29							1,204.29
5.B. Biological treatment of solid waste		0.61	0.35						0.96
5.C. Incineration and open burning of waste	14.91	8.54	1.42						24.87
5.D. Waste water treatment and discharge		333.50	62.30						395.80
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**34.77**	**0.10**	**0.31**						**35.17**
1.D.1.a. Aviation	34.77	0.10	0.31						35.17
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**373.58**								**373.58**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**236.50**						**236.50**

Indirect CO_2 [4]	**33.68**								**33.68**

Total CO_2 equivalent emissions without LULUCF	**12,253.60**
Total CO_2 equivalent emissions with LULUCF	**10,436.26**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**7,626.66**	**954.89**	**55.99**						**8,637.54**
1.A. Fuel combustion	7,625.53	55.41	55.99						7,736.94
1.A.1. Energy industries	3,107.08	1.79	1.87						3,110.75
1.A.2. Manufacturing industries and construction	443.90	0.32	0.36						444.58
1.A.3. Transport	1,786.89	12.07	28.14						1,827.10
1.A.4. Other sectors	2,260.03	41.14	25.35						2,326.51
1.A.5. Other	27.64	0.09	0.27						28.00
1.B. Fugitive emissions from fuels	1.12	899.48	0.00						900.60
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.12	899.48	0.00						900.60
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**456.15**	**NO**	**0.01**	**14.40**	**NO**	**NO**	**0.01**	**NO**	**470.56**
2.A. Mineral industry	350.46								350.46
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	40.51	NO	NO	NO	NO	NO	NO	NO	40.51
2.D. Non-energy products from fuels and solvent use	64.13	NO	NO						64.13
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				14.40	NO	NO	NO	NO	14.40
2.G. Other product manufacture and use	1.05	NO	0.01	NO	NO	NO	0.01	NO	1.07
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.37**	**1,174.91**	**905.09**						**2,080.37**
3.A. Enteric fermentation		1,076.79							1,076.79
3.B. Manure management		98.12	272.01						370.13
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	633.08						633.08
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.37								0.37
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,248.26**	**0.22**	**257.99**						**-1,990.04**
4.A. Forest land	-2,334.78	0.17	0.09						-2,334.52
4.B. Cropland	1,198.59	0.05	0.01						1,198.66
4.C. Grassland	-1,120.48	NE	NE						-1,120.48
4.D. Wetlands	-215.61	NE	NE						-215.61
4.E. Settlements	53.67	NO, NE	257.89						311.57
4.F. Other land	223.82	NE	NE						223.82
4.G. Harvested wood products	-53.47								-53.47
4.H. Other	NE	NE	NE						NE
5. Waste	**14.86**	**1,537.52**	**61.09**						**1,613.47**
5.A. Solid waste disposal		1,191.18							1,191.18
5.B. Biological treatment of solid waste		0.64	0.37						1.01
5.C. Incineration and open burning of waste	14.86	8.51	1.42						24.79
5.D. Waste water treatment and discharge		337.19	59.30						396.49
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**34.79**	**0.09**	**0.32**						**35.20**
1.D.1.a. Aviation	34.79	0.09	0.32						35.20
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**307.68**								**307.68**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**245.31**						**245.31**

Indirect CO_2 [4]	**56.78**								**56.78**

Total CO_2 equivalent emissions without LULUCF	**12,801.94**
Total CO_2 equivalent emissions with LULUCF	**10,811.90**

2005

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**7,871.74**	**1,007.54**	**55.99**						**8,935.27**
1.A. Fuel combustion	7,870.60	58.15	55.99						7,984.74
1.A.1. Energy industries	3,229.45	1.85	1.92						3,233.22
1.A.2. Manufacturing industries and construction	574.40	0.37	0.40						575.18
1.A.3. Transport	1,821.73	12.31	30.48						1,864.52
1.A.4. Other sectors	2,219.08	43.55	22.94						2,285.56
1.A.5. Other	25.94	0.07	0.25						26.26
1.B. Fugitive emissions from fuels	1.14	949.40	0.00						950.54
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.14	949.40	0.00						950.54
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**550.48**	**NO**	**0.02**	**20.20**	**NO**	**NO**	**0.04**	**NO**	**570.74**
2.A. Mineral industry	439.19								439.19
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	41.94	NO	NO	NO	NO	NO	NO	NO	41.94
2.D. Non-energy products from fuels and solvent use	68.19	NO	NO						68.19
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				20.20	NO	NO	NO	NO	20.20
2.G. Other product manufacture and use	1.16	NO	0.02	NO	NO	NO	0.04	NO	1.22
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.17**	**1,138.38**	**932.38**						**2,070.93**
3.A. Enteric fermentation		1,034.91							1,034.91
3.B. Manure management		103.47	291.35						394.82
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	641.03						641.03
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.17								0.17
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,954.31**	**0.28**	**254.81**						**-1,699.22**
4.A. Forest land	-2,409.52	0.02	0.01						-2,409.49
4.B. Cropland	1,271.68	0.26	0.06						1,272.01
4.C. Grassland	-1,058.12	NE	NE						-1,058.12
4.D. Wetlands	-187.41	NE	NE						-187.41
4.E. Settlements	53.67	NO, NE	254.74						308.41
4.F. Other land	416.50	NE	NE						416.50
4.G. Harvested wood products	-41.11								-41.11
4.H. Other	NE	NE	NE						NE
5. Waste	**14.33**	**1,537.01**	**56.11**						**1,607.45**
5.A. Solid waste disposal		1,195.79							1,195.79
5.B. Biological treatment of solid waste		0.67	0.38						1.06
5.C. Incineration and open burning of waste	14.33	8.20	1.36						23.90
5.D. Waste water treatment and discharge		332.34	54.36						386.70
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**37.93**	**0.09**	**0.34**						**38.36**
1.D.1.a. Aviation	37.93	0.09	0.34						38.36
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**307.39**								**307.39**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**256.59**						**256.59**

Indirect CO_2 [4]	**61.06**								**61.06**

Total CO_2 equivalent emissions without LULUCF	**13,184.39**
Total CO_2 equivalent emissions with LULUCF	**11,485.17**

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GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**7,113.56**	**899.82**	**57.35**						**8,070.72**
1.A. Fuel combustion	7,112.32	63.61	57.35						7,233.28
1.A.1. Energy industries	2,492.93	1.45	1.51						2,495.89
1.A.2. Manufacturing industries and construction	634.67	0.37	0.39						635.44
1.A.3. Transport	1,742.01	11.36	31.75						1,785.12
1.A.4. Other sectors	2,203.66	50.35	23.36						2,277.37
1.A.5. Other	39.04	0.08	0.34						39.46
1.B. Fugitive emissions from fuels	1.24	836.20	0.00						837.45
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.24	836.20	0.00						837.45
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**645.49**	**NO**	**0.02**	**29.92**	**0.02**	**NO**	**0.32**	**NO**	**675.77**
2.A. Mineral industry	535.42								535.42
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	27.02	NO	NO	NO	NO	NO	NO	NO	27.02
2.D. Non-energy products from fuels and solvent use	81.98	NO	NO						81.98
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				29.92	NO	NO	NO	NO	29.92
2.G. Other product manufacture and use	1.07	NO	0.02	NO	0.02	NO	0.32	NO	1.42
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.15**	**1,118.32**	**914.63**						**2,033.09**
3.A. Enteric fermentation		1,012.00							1,012.00
3.B. Manure management		106.32	305.62						411.94
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	609.01						609.01
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.15								0.15
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,076.24**	**0.28**	**251.31**						**-1,824.65**
4.A. Forest land	-2,366.52	0.18	0.09						-2,366.25
4.B. Cropland	1,303.27	0.11	0.03						1,303.40
4.C. Grassland	-1,056.37	NE	NE						-1,056.37
4.D. Wetlands	-159.21	NE	NE						-159.21
4.E. Settlements	53.67	NO, NE	251.19						304.86
4.F. Other land	189.50	NE	NE						189.50
4.G. Harvested wood products	-40.59								-40.59
4.H. Other	NE	NE	NE						NE
5. Waste	**14.02**	**1,514.03**	**57.76**						**1,585.82**
5.A. Solid waste disposal-		1,185.99							1,185.99
5.B. Biological treatment of solid waste		0.73	0.41						1.14
5.C. Incineration and open burning of waste	14.02	8.02	1.34						23.38
5.D. Waste water treatment and discharge		319.29	56.01						375.31
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items: [3]									
1.D.1. International bunkers	**37.92**	**0.11**	**0.34**						**38.38**
1.D.1.a. Aviation	37.92	0.11	0.34						38.38
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**361.44**								**361.44**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**256.61**						**256.61**

Indirect CO_2 [4]	**74.16**								**74.16**

Total CO_2 equivalent emissions without LULUCF	**12,365.40**
Total CO_2 equivalent emissions with LULUCF	**10,540.75**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**7,250.36**	**942.02**	**55.44**						**8,247.81**
1.A. Fuel combustion	7,249.08	50.60	55.44						7,355.12
1.A.1. Energy industries	2,890.45	1.66	1.68						2,893.79
1.A.2. Manufacturing industries and construction	800.81	0.44	0.44						801.69
1.A.3. Transport	1,846.56	11.96	33.21						1,891.74
1.A.4. Other sectors	1,666.75	36.43	19.65						1,722.83
1.A.5. Other	44.51	0.11	0.46						45.08
1.B. Fugitive emissions from fuels	1.28	891.42	0.00						892.70
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.28	891.42	0.00						892.70
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**892.11**	**NO**	**NO**	**40.32**	**0.02**	**NO**	**0.42**	**NO**	**932.87**
2.A. Mineral industry	767.69								767.69
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	38.61	NO	NO	NO	NO	NO	NO	NO	38.61
2.D. Non-energy products from fuels and solvent use	84.75	NO	NO						84.75
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				40.32	NO	NO	NO	NO	40.32
2.G. Other product manufacture and use	1.07	NO	NO	NO	0.02	NO	0.42	NO	1.51
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.26**	**892.08**	**754.18**						**1,646.52**
3.A. Enteric fermentation		817.65							817.65
3.B. Manure management		74.43	233.67						308.10
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	520.51						520.51
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.26								0.26
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-2,268.71**	**1.70**	**247.23**						**-2,019.78**
4.A. Forest land	-2,460.39	1.53	0.80						-2,458.06
4.B. Cropland	1,266.13	0.17	0.04						1,266.34
4.C. Grassland	-1,031.24	NE	NE						-1,031.24
4.D. Wetlands	-131.00	NE	NE						-131.00
4.E. Settlements	49.27	NO, NE	246.39						295.66
4.F. Other land	83.11	NE	NE						83.11
4.G. Harvested wood products	-44.59								-44.59
4.H. Other	NE	NE	NE						NE
5. Waste	**13.71**	**1,497.55**	**53.75**						**1,565.00**
5.A. Solid waste disposal-		1,180.68							1,180.68
5.B. Biological treatment of solid waste		0.85	0.48						1.33
5.C. Incineration and open burning of waste	13.71	7.84	1.31						22.86
5.D. Waste water treatment and discharge		308.17	51.96						360.14
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**44.21**	**0.08**	**0.39**						**44.67**
1.D.1.a. Aviation	44.21	0.08	0.39						44.67
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**304.66**								**304.66**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**208.03**						**208.03**

Indirect CO_2 [4]	**78.05**								**78.05**

Total CO_2 equivalent emissions without LULUCF	**12,392.21**
Total CO_2 equivalent emissions with LULUCF	**10,372.43**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**7,547.68**	**940.00**	**56.37**						**8,544.04**
1.A. Fuel combustion	7,546.38	52.61	56.37						7,655.37
1.A.1. Energy industries	2,990.84	1.83	1.90						2,994.57
1.A.2. Manufacturing industries and construction	884.97	0.94	1.18						887.09
1.A.3. Transport	1,949.57	12.62	33.71						1,995.91
1.A.4. Other sectors	1,677.37	37.13	19.17						1,733.67
1.A.5. Other	43.63	0.10	0.41						44.13
1.B. Fugitive emissions from fuels	1.29	887.38	0.00						888.68
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.29	887.38	0.00						888.68
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**967.70**	**NO**	**NO**	**51.77**	**0.03**	**NO**	**0.51**	**NO**	**1,020.01**
2.A. Mineral industry	864.47								864.47
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	35.41	NO	NO	NO	NO	NO	NO	NO	35.41
2.D. Non-energy products from fuels and solvent use	66.72	NO	NO						66.72
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				51.77	NO	NO	NO	NO	51.77
2.G. Other product manufacture and use	1.10	NO	NO	NO	0.03	NO	0.51	NO	1.64
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.85**	**858.51**	**853.61**						**1,712.97**
3.A. Enteric fermentation		786.37							786.37
3.B. Manure management		72.14	233.93						306.06
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	619.68						619.68
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.85								0.85
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,956.39**	**0.86**	**241.90**						**-1,713.63**
4.A. Forest land	-2,462.79	0.11	0.06						-2,462.63
4.B. Cropland	1,236.67	0.76	0.19						1,237.62
4.C. Grassland	-932.15	NE	NE						-932.15
4.D. Wetlands	-102.80	NE	NE						-102.80
4.E. Settlements	49.27	NO, NE	241.66						290.94
4.F. Other land	291.00	NE	NE						291.00
4.G. Harvested wood products	-35.61								-35.61
4.H. Other	NE	NE	NE						NE
5. Waste	**13.40**	**1,500.06**	**49.51**						**1,562.97**
5.A. Solid waste disposal		1,182.01							1,182.01
5.B. Biological treatment of solid waste		1.00	0.57						1.57
5.C. Incineration and open burning of waste	13.40	7.67	1.28						22.35
5.D. Waste water treatment and discharge		309.38	47.67						357.05
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**44.17**	**0.05**	**0.38**						**44.60**
1.D.1.a. Aviation	44.17	0.05	0.38						44.60
1.D.1.b. Navigation	NO	NO	NO						NO
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**352.45**								**352.45**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**227.79**						**227.79**

Indirect CO_2 [4]	**59.61**								**59.61**

Total CO_2 equivalent emissions without LULUCF	**12,839.99**
Total CO_2 equivalent emissions with LULUCF	**11,126.37**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,093.50**	**811.10**	**51.24**						**8,955.84**
1.A. Fuel combustion	8,092.21	55.91	51.24						8,199.36
1.A.1. Energy industries	3,835.58	2.33	2.45						3,840.36
1.A.2. Manufacturing industries and construction	501.95	0.63	0.81						503.39
1.A.3. Transport	1,919.24	12.80	29.47						1,961.51
1.A.4. Other sectors	1,824.94	40.13	18.44						1,883.51
1.A.5. Other	10.49	0.03	0.07						10.59
1.B. Fugitive emissions from fuels	1.29	755.19	0.00						756.49
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.29	755.19	0.00						756.49
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**462.34**	**NO**	**NO**	**61.02**	**0.03**	**NO**	**0.56**	**NO**	**523.95**
2.A. Mineral industry	386.85								386.85
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO		NO
2.C. Metal industry	17.06	NO	NO	NO	NO	NO	NO	NO	17.06
2.D. Non-energy products from fuels and solvent use	57.63	NO	NO						57.63
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				61.02	NO	NO	NO	NO	61.02
2.G. Other product manufacture and use	0.80	NO	NO	NO	0.03	NO	0.56	NO	1.39
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**0.59**	**891.02**	**846.46**						**1,738.07**
3.A. Enteric fermentation		809.31							809.31
3.B. Manure management		81.71	261.60						343.31
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	584.86						584.86
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	0.59								0.59
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,560.64**	**0.35**	**235.95**						**-1,324.34**
4.A. Forest land	-2,526.07	0.26	0.14						-2,525.67
4.B. Cropland	1,390.69	0.09	0.02						1,390.80
4.C. Grassland	-447.69	NE	NE						-447.69
4.D. Wetlands	-74.60	NE	NE						-74.60
4.E. Settlements	45.57	NO, NE	235.79						281.36
4.F. Other land	79.94	NE	NE						79.94
4.G. Harvested wood products	-28.47								-28.47
4.H. Other	NE	NE	NE						NE
5. Waste	**13.12**	**1,491.44**	**50.47**						**1,555.04**
5.A. Solid waste disposal-		1,191.41							1,191.41
5.B. Biological treatment of solid waste		1.04	0.59						1.63
5.C. Incineration and open burning of waste	13.12	7.50	1.25						21.87
5.D. Waste water treatment and discharge		291.49	48.63						340.12
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**44.17**	**0.05**	**0.38**						**44.60**
1.D.1.a. Aviation	44.17	0.05	0.38						44.60
1.D.1.b. Navigation	NE	NE	NE						NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**362.10**								**362.10**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**233.17**						**233.17**

Indirect CO_2 [4]	**51.41**								**51.41**

Total CO_2 equivalent emissions without LULUCF	**12,772.90**
Total CO_2 equivalent emissions with LULUCF	**11,448.57**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,718.00**	**800.72**	**55.77**						**9,574.49**
1.A. Fuel combustion	8,716.70	60.16	55.77						8,832.63
1.A.1. Energy industries	4,047.95	2.50	2.61						4,053.06
1.A.2. Manufacturing industries and construction	515.62	0.60	0.77						517.00
1.A.3. Transport	2,139.84	13.16	32.47						2,185.47
1.A.4. Other sectors	1,985.99	43.83	19.77						2,049.60
1.A.5. Other	27.30	0.06	0.15						27.51
1.B. Fugitive emissions from fuels	1.30	740.56	0.00						741.85
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.30	740.56	0.00						741.85
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**482.43**	**NO**	**NO**	**70.54**	**0.04**	**NO**	**0.68**	**NO**	**553.69**
2.A. Mineral industry	405.39								405.39
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	9.70	NO	NO	NO	NO	NO	NO	NO	9.70
2.D. Non-energy products from fuels and solvent use	66.32	NO	NO						66.32
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				70.54	NO	NO	NO	NO	70.54
2.G. Other product manufacture and use	1.02	NO	NO	NO	0.04	NO	0.68	NO	1.74
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**1.74**	**890.65**	**911.80**						**1,804.19**
3.A. Enteric fermentation		802.68							802.68
3.B. Manure management		87.96	271.15						359.11
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	640.65						640.65
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	1.74								1.74
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,486.52**	**0.16**	**229.62**						**-1,256.74**
4.A. Forest land	-2,484.16	0.09	0.05						-2,484.02
4.B. Cropland	1,271.78	0.07	0.02						1,271.86
4.C. Grassland	-691.99	NE	NE						-691.99
4.D. Wetlands	-46.40	NE	NE						-46.40
4.E. Settlements	45.57	NO, NE	229.56						275.13
4.F. Other land	441.48	NE	NE						441.48
4.G. Harvested wood products	-22.80								-22.80
4.H. Other	NE	NE	NE						NE
5. Waste	**12.84**	**1,501.79**	**48.91**						**1,563.54**
5.A. Solid waste disposal-		1,196.05							1,196.05
5.B. Biological treatment of solid waste		1.09	0.62						1.72
5.C. Incineration and open burning of waste	12.84	7.33	1.22						21.39
5.D. Waste water treatment and discharge		297.31	47.07						344.38
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**41.06**	**0.07**	**0.36**						**41.49**
1.D.1.a. Aviation	41.06	0.07	0.36						41.49
1.D.1.b. Navigation	NE	NE	NE						NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**341.05**								**341.05**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**249.71**						**249.71**

Indirect CO_2 [4]	**59.38**								**59.38**

Total CO_2 equivalent emissions without LULUCF	**13,495.90**
Total CO_2 equivalent emissions with LULUCF	**12,239.16**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,926.20**	**892.18**	**57.34**						**9,875.71**
1.A. Fuel combustion	8,924.86	63.57	57.33						9,045.77
1.A.1. Energy industries	3,746.14	2.24	2.30						3,750.68
1.A.2. Manufacturing industries and construction	575.45	0.73	0.94						577.13
1.A.3. Transport	2,272.70	13.12	33.94						2,319.77
1.A.4. Other sectors	2,310.78	47.44	20.03						2,378.26
1.A.5. Other	19.79	0.04	0.11						19.94
1.B. Fugitive emissions from fuels	1.33	828.61	0.00						829.95
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.33	828.61	0.00						829.95
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**573.63**	**NO**	**NO**	**80.58**	**0.04**	**NO**	**0.73**	**NO**	**654.97**
2.A. Mineral industry	488.20								488.20
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	12.86	NO	NO	NO	NO	NO	NO	NO	12.86
2.D. Non-energy products from fuels and solvent use	71.34	NO	NO						71.34
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				80.58	NO	NO	NO	NO	80.58
2.G. Other product manufacture and use	1.23	NO	NO	NO	0.04	NO	0.73	NO	1.99
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**3.68**	**837.30**	**893.98**						**1,734.96**
3.A. Enteric fermentation		754.04							754.04
3.B. Manure management		83.26	247.61						330.87
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	646.37						646.37
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	3.68								3.68
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,421.98**	**0.18**	**224.06**						**-1,197.75**
4.A. Forest land	-2,390.57	0.12	0.06						-2,390.39
4.B. Cropland	1,230.68	0.06	0.01						1,230.76
4.C. Grassland	-638.17	NE	NE						-638.17
4.D. Wetlands	-75.31	NE	NE						-75.31
4.E. Settlements	62.04	NO, NE	223.98						286.02
4.F. Other land	393.73	NE	NE						393.73
4.G. Harvested wood products	-4.38								-4.38
4.H. Other	NE	NE	NE						NE
5. Waste	**12.57**	**1,492.72**	**49.15**						**1,554.43**
5.A. Solid waste disposal		1,194.27							1,194.27
5.B. Biological treatment of solid waste		1.16	0.66						1.82
5.C. Incineration and open burning of waste	12.57	7.17	1.19						20.93
5.D. Waste water treatment and discharge		290.11	47.30						337.41
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items: [3]									
1.D.1. International bunkers	**41.01**	**0.08**	**0.35**						**41.43**
1.D.1.a. Aviation	41.01	0.08	0.35						41.43
1.D.1.b. Navigation	NE	NE	NE						NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**384.64**								**384.64**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**241.22**						**241.22**

Indirect CO_2 [4]	**64.25**								**64.25**

Total CO_2 equivalent emissions without LULUCF	**13,820.07**
Total CO_2 equivalent emissions with LULUCF	**12,622.33**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,613.94**	**885.74**	**53.49**						**9,553.17**
1.A. Fuel combustion	8,612.61	68.38	53.48						8,734.47
1.A.1. Energy industries	3,803.41	2.48	2.27						3,808.15
1.A.2. Manufacturing industries and construction	538.21	0.62	0.77						539.60
1.A.3. Transport	1,992.59	11.34	30.53						2,034.45
1.A.4. Other sectors	2,271.47	53.93	19.87						2,345.27
1.A.5. Other	6.93	0.02	0.05						7.00
1.B. Fugitive emissions from fuels	1.33	817.36	0.00						818.70
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.33	817.36	0.00						818.70
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**581.67**	**NO**	**NO**	**88.14**	**0.04**	**NO**	**0.79**	**NO**	**670.64**
2.A. Mineral industry	493.16								493.16
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	12.70	NO	NO	NO	NO	NO	NO	NO	12.70
2.D. Non-energy products from fuels and solvent use	74.66	NO	NO						74.66
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				88.14	NO	NO	NO	NO	88.14
2.G. Other product manufacture and use	1.16	NO	NO	NO	0.04	NO	0.79	NO	1.98
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**5.59**	**792.71**	**846.15**						**1,644.45**
3.A. Enteric fermentation		715.30							715.30
3.B. Manure management		77.41	228.08						305.49
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	618.06						618.06
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	5.59								5.59
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,433.66**	**1.31**	**207.57**						**-1,224.78**
4.A. Forest land	-2,294.82	1.30	0.68						-2,292.84
4.B. Cropland	1,236.50	0.01	0.00						1,236.51
4.C. Grassland	-562.75	NE	NE						-562.75
4.D. Wetlands	-15.47	NE	NE						-15.47
4.E. Settlements	11.89	NO, NE	206.89						218.78
4.F. Other land	114.14	NE	NE						114.14
4.G. Harvested wood products	76.84								76.84
4.H. Other	NE	NE	NE						NE
5. Waste	**12.27**	**1,474.05**	**49.49**						**1,535.82**
5.A. Solid waste disposal-		1,179.54							1,179.54
5.B. Biological treatment of solid waste		1.14	0.65						1.79
5.C. Incineration and open burning of waste	12.27	7.00	1.17						20.44
5.D. Waste water treatment and discharge		286.37	47.68						334.05
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**47.31**	**0.08**	**0.40**						**47.79**
1.D.1.a. Aviation	47.31	0.08	0.40						47.79
1.D.1.b. Navigation	NE	NE	NE						NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**406.30**								**406.30**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**229.78**						**229.78**

Indirect CO_2 [4]	**68.53**								**68.53**

Total CO_2 equivalent emissions without LULUCF	**13,404.07**
Total CO_2 equivalent emissions with LULUCF	**12,179.29**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,224.92**	**833.02**	**58.14**						**9,116.08**
1.A. Fuel combustion	8,223.26	70.19	58.14						8,351.58
1.A.1. Energy industries	3,598.61	2.34	5.00						3,605.95
1.A.2. Manufacturing industries and construction	573.06	0.84	1.10						575.00
1.A.3. Transport	2,101.30	11.44	30.56						2,143.31
1.A.4. Other sectors	1,947.94	55.56	21.44						2,024.94
1.A.5. Other	2.35	0.01	0.03						2.39
1.B. Fugitive emissions from fuels	1.66	762.83	0.00						764.49
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.66	762.83	0.00						764.49
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**623.12**	**NO**	**NO**	**95.76**	**0.04**	**NO**	**0.99**	**NO**	**719.91**
2.A. Mineral industry	544.87								544.87
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	7.66	NO	NO	NO	NO	NO	NO	NO	7.66
2.D. Non-energy products from fuels and solvent use	69.49	NO	NO						69.49
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				95.76	NO	NO	NO	NO	95.76
2.G. Other product manufacture and use	1.10	NO	NO	NO	0.04	NO	0.99	NO	2.13
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**4.18**	**796.80**	**960.72**						**1,761.71**
3.A. Enteric fermentation		721.38							721.38
3.B. Manure management		75.42	213.47						288.89
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	747.25						747.25
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	4.18								4.18
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,289.15**	**0.98**	**193.19**						**-1,094.98**
4.A. Forest land	-2,141.87	0.90	0.47						-2,140.50
4.B. Cropland	1,139.91	0.07	0.02						1,140.01
4.C. Grassland	-360.17	NE	NE						-360.17
4.D. Wetlands	-106.10	NE	NE						-106.10
4.E. Settlements	13.75	NO, NE	192.70						206.45
4.F. Other land	103.45	NE	NE						103.45
4.G. Harvested wood products	61.88								61.88
4.H. Other	NE	NE	NE						NE
5. Waste	**11.93**	**1,405.13**	**49.73**						**1,466.78**
5.A. Solid waste disposal-		1,109.40							1,109.40
5.B. Biological treatment of solid waste		1.23	0.70						1.93
5.C. Incineration and open burning of waste	11.93	6.80	1.13						19.86
5.D. Waste water treatment and discharge		287.69	47.90						335.59
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**41.07**	**0.13**	**0.35**						**41.55**
1.D.1.a. Aviation	41.07	0.13	0.35						41.55
1.D.1.b. Navigation	NE	NE	NE						NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**432.75**								**432.75**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**248.93**						**248.93**

Indirect CO_2 [4]	**63.23**								**63.23**

Total CO_2 equivalent emissions without LULUCF	**13,064.47**
Total CO_2 equivalent emissions with LULUCF	**11,969.50**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,190.75**	**876.65**	**64.58**						**9,131.98**
1.A. Fuel combustion	8,189.06	128.85	64.57						8,382.49
1.A.1. Energy industries	3,555.98	2.32	2.18						3,560.48
1.A.2. Manufacturing industries and construction	562.39	0.74	0.95						564.08
1.A.3. Transport	2,140.57	11.36	28.36						2,180.29
1.A.4. Other sectors	1,927.74	114.43	33.05						2,075.21
1.A.5. Other	2.38	0.01	0.03						2.42
1.B. Fugitive emissions from fuels	1.69	747.80	0.00						749.49
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.69	747.80	0.00						749.49
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**636.28**	**NO**	**NO**	**107.94**	**0.04**	**NO**	**1.09**	**NO**	**745.35**
2.A. Mineral industry	533.99								533.99
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	13.85	NO	NO	NO	NO	NO	NO	NO	13.85
2.D. Non-energy products from fuels and solvent use	87.24	NO	NO						87.24
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				107.94	NO	NO	NO	NO	107.94
2.G. Other product manufacture and use	1.21	NO	NO	NO	0.04	NO	1.09	NO	2.33
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**10.21**	**817.62**	**1,112.27**						**1,940.10**
3.A. Enteric fermentation		737.98							737.98
3.B. Manure management		79.65	233.59						313.23
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	878.68						878.68
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	10.21								10.21
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-927.33**	**0.13**	**180.05**						**-747.16**
4.A. Forest land	-2,134.74	0.07	0.04						-2,134.63
4.B. Cropland	1,174.61	0.06	0.01						1,174.69
4.C. Grassland	-341.11	NE	NE						-341.11
4.D. Wetlands	-139.75	NE	NE						-139.75
4.E. Settlements	18.98	NO, NE	179.99						198.98
4.F. Other land	436.65	NE	NE						436.65
4.G. Harvested wood products	58.02								58.02
4.H. Other	NE	NE	NE						NE
5. Waste	**11.58**	**1,387.09**	**49.25**						**1,447.92**
5.A. Solid waste disposal-		1,101.07							1,101.07
5.B. Biological treatment of solid waste		1.34	0.76						2.10
5.C. Incineration and open burning of waste	11.58	6.61	1.10						19.28
5.D. Waste water treatment and discharge		278.07	47.39						325.46
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	NO	NO	NO	NO	NO	NO	NO	NO	NO

Memo items: [3]									
1.D.1. International bunkers	**53.69**	**0.10**	**0.47**						**54.25**
1.D.1.a. Aviation	53.69	0.10	0.47						54.25
1.D.1.b. Navigation	NE	NE	NE						NE
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**1,318.30**								**1,318.30**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**288.88**						**288.88**

Indirect CO_2 [4]	**81.07**								**81.07**

Total CO_2 equivalent emissions without LULUCF	**13,265.34**
Total CO_2 equivalent emissions with LULUCF	**12,518.19**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,391.24**	**855.52**	**70.94**						**9,317.70**
1.A. Fuel combustion	8,389.56	136.95	70.93						8,597.45
1.A.1. Energy industries	3,684.45	2.21	1.77						3,688.43
1.A.2. Manufacturing industries and construction	651.53	1.14	1.46						654.13
1.A.3. Transport	2,261.58	12.00	31.72						2,305.29
1.A.4. Other sectors	1,790.21	121.60	35.96						1,947.77
1.A.5. Other	1.80	0.01	0.02						1.83
1.B. Fugitive emissions from fuels	1.68	718.57	0.00						720.25
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.68	718.57	0.00						720.25
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**610.79**	**NO**	**NO**	**137.88**	**0.04**	**NO**	**1.09**	NO	**749.79**
2.A. Mineral industry	507.99								507.99
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	17.28	NO	NO	NO	NO	NO	NO	NO	17.28
2.D. Non-energy products from fuels and solvent use	84.58	NO	NO						84.58
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				137.88	NO	NO	NO	NO	137.88
2.G. Other product manufacture and use	0.94	NO	NO	NO	0.04	NO	1.09	NO	2.06
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**11.24**	**771.64**	**873.09**						**1,655.97**
3.A. Enteric fermentation		694.45							694.45
3.B. Manure management		77.19	215.77						292.96
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	657.32						657.32
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	11.24								11.24
3.I. Other carbon-containing fertilizers	NO, NE								NO,NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,372.85**	**0.73**	**169.19**						**-1,202.92**
4.A. Forest land	-2,159.44	0.69	0.36						-2,158.40
4.B. Cropland	1,112.63	0.04	0.01						1,112.68
4.C. Grassland	-418.46	NE	NE						-418.46
4.D. Wetlands	-82.79	NE	NE						-82.79
4.E. Settlements	39.16	NO, NE	168.82						207.99
4.F. Other land	86.82	NE	NE						86.82
4.G. Harvested wood products	49.24								49.24
4.H. Other	NE	NE	NE						NE
5. Waste	**11.38**	**1,378.18**	**50.06**						**1,439.62**
5.A. Solid waste disposal-		1,098.55							1,098.55
5.B. Biological treatment of solid waste		1.34	0.76						2.11
5.C. Incineration and open burning of waste	11.38	6.51	1.08						18.97
5.D. Waste water treatment and discharge		271.78	48.21						319.99
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**58.20**	**0.16**	**0.50**						**58.86**
1.D.1.a. Aviation	56.81	0.16	0.49						57.45
1.D.1.b. Navigation	1.39	0.00	0.01						1.41
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**1,436.50**								**1,436.50**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**232.67**						**232.67**

Indirect CO_2 [4]	**77.88**								**77.88**

Total CO_2 equivalent emissions without LULUCF	**13,163.08**
Total CO_2 equivalent emissions with LULUCF	**11,960.16**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,484.95**	**916.98**	**76.10**						**9,478.03**
1.A. Fuel combustion	8,483.26	147.72	76.09						8,707.08
1.A.1. Energy industries	3,644.88	2.29	1.83						3,648.99
1.A.2. Manufacturing industries and construction	641.34	0.98	1.26						643.57
1.A.3. Transport	2,428.36	13.90	36.31						2,478.57
1.A.4. Other sectors	1,767.49	130.55	36.68						1,934.72
1.A.5. Other	1.20	0.01	0.02						1.22
1.B. Fugitive emissions from fuels	1.69	769.26	0.00						770.95
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.69	769.26	0.00						770.95
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**583.41**	**NO**	**NO**	**146.79**	**0.04**	**NO**	**1.12**	NO	**731.35**
2.A. Mineral industry	492.25								492.25
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	5.22	NO	NO	NO	NO	NO	NO	NO	5.22
2.D. Non-energy products from fuels and solvent use	84.87	NO	NO						84.87
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				146.79	NO	NO	NO	NO	146.79
2.G. Other product manufacture and use	1.06	NO	NO	NO	0.04	NO	1.12	NO	2.22
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**12.27**	**747.03**	**983.33**						**1,742.64**
3.A. Enteric fermentation		675.89							675.89
3.B. Manure management		71.14	216.64						287.78
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	766.69						766.69
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	12.27								12.27
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,117.11**	**0.40**	**159.42**						**-957.29**
4.A. Forest land	-2,115.76	0.35	0.18						-2,115.24
4.B. Cropland	1,111.99	0.05	0.01						1,112.06
4.C. Grassland	-402.37	NE	NE						-402.37
4.D. Wetlands	-82.79	NE	NE						-82.79
4.E. Settlements	19.31	NO, NE	159.22						178.53
4.F. Other land	351.63	NE	NE						351.63
4.G. Harvested wood products	0.88								0.88
4.H. Other	NE	NE	NE						NE
5. Waste	**11.14**	**1,385.10**	**50.61**						**1,446.85**
5.A. Solid waste disposal-		1,106.59							1,106.59
5.B. Biological treatment of solid waste		1.34	0.76						2.09
5.C. Incineration and open burning of waste	11.14	6.38	1.06						18.58
5.D. Waste water treatment and discharge		270.79	48.80						319.59
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**102.91**	**0.18**	**0.89**						**103.98**
1.D.1.a. Aviation	100.97	0.17	0.87						102.02
1.D.1.b. Navigation	1.94	0.01	0.01						1.96
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**1,609.80**								**1,609.80**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**255.60**						**255.60**

Indirect CO_2 [4]	**77.98**								**77.98**

Total CO_2 equivalent emissions without LULUCF	**13,398.86**
Total CO_2 equivalent emissions with LULUCF	**12,441.57**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,070.00**	**999.94**	**88.25**						**9,158.19**
1.A. Fuel combustion	8,068.33	195.05	88.25						8,351.62
1.A.1. Energy industries	2,996.52	1.91	1.46						2,999.89
1.A.2. Manufacturing industries and construction	658.71	1.02	1.34						661.07
1.A.3. Transport	2,451.25	13.55	35.79						2,500.58
1.A.4. Other sectors	1,960.70	178.56	49.65						2,188.91
1.A.5. Other	1.15	0.01	0.02						1.17
1.B. Fugitive emissions from fuels	1.68	804.89	0.00						806.57
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.68	804.89	0.00						806.57
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**587.60**	**NO**	**NO**	**162.10**	**0.04**	**NO**	**1.15**	**NO**	**750.89**
2.A. Mineral industry	470.20								470.20
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	18.88	NO	NO	NO	NO	NO	NO	NO	18.88
2.D. Non-energy products from fuels and solvent use	97.34	NO	NO						97.34
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				162.10	NO	NO	NO	NO	162.10
2.G. Other product manufacture and use	1.18	NO	NO	NO	0.04	NO	1.15	NO	2.36
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**26.39**	**722.77**	**1,085.09**						**1,834.24**
3.A. Enteric fermentation		654.60							654.60
3.B. Manure management		68.17	219.17						287.33
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		0.00	865.92						865.92
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	26.39								26.39
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,165.66**	**0.56**	**152.82**						**-1,012.29**
4.A. Forest land	-2,016.44	0.48	0.25						-2,015.71
4.B. Cropland	1,089.56	0.08	0.02						1,089.66
4.C. Grassland	-384.04	NE	NE						-384.04
4.D. Wetlands	-82.82	NE	NE						-82.82
4.E. Settlements	77.31	NO, NE	152.55						229.86
4.F. Other land	218.21	NE	NE						218.21
4.G. Harvested wood products	-67.45								-67.45
4.H. Other	NE	NE	NE						NE
5. Waste	**10.87**	**1,464.59**	**52.06**						**1,527.52**
5.A. Solid waste disposal		1,191.54							1,191.54
5.B. Biological treatment of solid waste		1.29	0.73						2.02
5.C. Incineration and open burning of waste	10.87	6.23	1.04						18.13
5.D. Waste water treatment and discharge		265.53	50.30						315.82
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**151.25**	**0.17**	**1.29**						**152.71**
1.D.1.a. Aviation	148.28	0.16	1.27						149.71
1.D.1.b. Navigation	2.97	0.01	0.02						3.00
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**2,129.55**								**2,129.55**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**277.90**						**277.90**

Indirect CO_2 [4]	**90.47**								**90.47**

Total CO_2 equivalent emissions without LULUCF	**13,270.84**
Total CO_2 equivalent emissions with LULUCF	**12,258.55**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,482.65**	**1,057.18**	**101.46**						**9,641.29**
1.A. Fuel combustion	8,480.96	298.09	101.46						8,880.51
1.A.1. Energy industries	3,255.38	2.00	1.59						3,258.96
1.A.2. Manufacturing industries and construction	748.59	1.18	1.54						751.30
1.A.3. Transport	2,529.58	14.07	35.35						2,579.00
1.A.4. Other sectors	1,946.25	280.84	62.96						2,290.05
1.A.5. Other	1.17	0.01	0.02						1.19
1.B. Fugitive emissions from fuels	1.69	759.09	0.00						760.78
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.69	759.09	0.00						760.78
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**755.82**	**NO**	**NO**	**174.41**	**0.04**	**NO**	**1.38**	**NO**	**931.64**
2.A. Mineral industry	583.18								583.18
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	20.21	NO	NO	NO	NO	NO	NO	NO	20.21
2.D. Non-energy products from fuels and solvent use	151.37	NO	NO						151.37
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				174.41	NO	NO	NO	NO	174.41
2.G. Other product manufacture and use	1.06	NO	NO	NO	0.04	NO	1.38	NO	2.47
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**44.16**	**645.09**	**1,115.92**						**1,805.17**
3.A. Enteric fermentation		584.64							584.64
3.B. Manure management		60.45	211.31						271.76
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	904.61						904.61
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	44.16								44.16
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-1,006.61**	**0.19**	**147.07**						**-859.35**
4.A. Forest land	-1,969.36	0.16	0.09						-1,969.11
4.B. Cropland	1,206.39	0.03	0.01						1,206.43
4.C. Grassland	-440.15	NE	NE						-440.15
4.D. Wetlands	-82.83	NE	NE						-82.83
4.E. Settlements	21.62	NO, NE	146.98						168.60
4.F. Other land	321.21	NE	NE						321.21
4.G. Harvested wood products	-63.50								-63.50
4.H. Other	NE	NE	NE						NE
5. Waste	**10.58**	**1,454.15**	**53.51**						**1,518.24**
5.A. Solid waste disposal		1,180.17							1,180.17
5.B. Biological treatment of solid waste		1.25	0.71						1.96
5.C. Incineration and open burning of waste	10.58	6.07	1.01						17.66
5.D. Waste water treatment and discharge		266.65	51.79						318.45
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**171.99**	**0.20**	**1.54**						**173.73**
1.D.1.a. Aviation	170.41	0.20	1.53						172.13
1.D.1.b. Navigation	1.58	0.00	0.01						1.60
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**3,588.77**								**3,588.77**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**286.35**						**286.35**

Indirect CO_2 [4]	**144.05**								**144.05**

Total CO_2 equivalent emissions without LULUCF	**13,896.34**
Total CO_2 equivalent emissions with LULUCF	**13,036.99**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,560.27**	**788.83**	**101.30**						**9,450.40**
1.A. Fuel combustion	8,558.64	262.36	101.30						8,922.30
1.A.1. Energy industries	3,124.41	1.99	1.50						3,127.91
1.A.2. Manufacturing industries and construction	715.94	1.07	1.38						718.39
1.A.3. Transport	2,611.55	13.95	36.83						2,662.34
1.A.4. Other sectors	2,105.50	245.34	61.57						2,412.41
1.A.5. Other	1.23	0.01	0.02						1.25
1.B. Fugitive emissions from fuels	1.63	526.47	0.00						528.10
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.63	526.47	0.00						528.10
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**754.51**	**NO**	**NO**	**196.40**	**0.04**	**NO**	**1.48**	**NO**	**952.43**
2.A. Mineral industry	593.82								593.82
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	15.79	NO	NO	NO	NO	NO	NO	NO	15.79
2.D. Non-energy products from fuels and solvent use	143.77	NO	NO						143.77
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				196.40	NO	NO	NO	NO	196.40
2.G. Other product manufacture and use	1.13	NO	NO	NO	0.04	NO	1.48	NO	2.65
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**39.12**	**546.79**	**1,119.34**						**1,705.25**
3.A. Enteric fermentation		489.47							489.47
3.B. Manure management		57.32	168.09						225.41
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	951.25						951.25
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	39.12								39.12
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-148.61**	**0.45**	**143.64**						**-4.52**
4.A. Forest land	-1,950.65	0.40	0.21						-1,950.04
4.B. Cropland	1,507.41	0.05	0.01						1,507.47
4.C. Grassland	-293.29	NE	NE						-293.29
4.D. Wetlands	-82.81	NE	NE						-82.81
4.E. Settlements	116.50	NO, NE	143.42						259.93
4.F. Other land	611.79	NE	NE						611.79
4.G. Harvested wood products	-57.56								-57.56
4.H. Other	NE	NE	NE						NE
5. Waste	**10.28**	**1,431.92**	**53.72**						**1,495.93**
5.A. Solid waste disposal-		1,168.09							1,168.09
5.B. Biological treatment of solid waste		1.28	0.73						2.01
5.C. Incineration and open burning of waste	10.28	5.91	0.98						17.18
5.D. Waste water treatment and discharge		256.63	52.01						308.64
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**153.18**	**0.16**	**1.38**						**154.71**
1.D.1.a. Aviation	151.50	0.15	1.36						153.02
1.D.1.b. Navigation	1.67	0.00	0.01						1.69
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**2,984.40**								**2,984.40**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**278.25**						**278.25**

Indirect CO_2 [4]	**136.27**								**136.27**

Total CO_2 equivalent emissions without LULUCF	**13,604.00**
Total CO_2 equivalent emissions with LULUCF	**13,599.49**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,842.15**	**526.32**	**98.50**						**9,466.98**
1.A. Fuel combustion	8,840.57	254.41	98.50						9,193.48
1.A.1. Energy industries	3,634.38	2.25	1.74						3,638.38
1.A.2. Manufacturing industries and construction	692.66	0.99	1.25						694.91
1.A.3. Transport	2,462.27	12.18	34.49						2,508.94
1.A.4. Other sectors	2,050.09	238.98	61.00						2,350.07
1.A.5. Other	1.16	0.01	0.02						1.19
1.B. Fugitive emissions from fuels	1.58	271.91	0.00						273.49
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.58	271.91	0.00						273.49
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**762.25**	**NO**	**NO**	**206.62**	**0.04**	**NO**	**1.63**	**NO**	**970.54**
2.A. Mineral industry	538.63								538.63
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	18.70	NO	NO	NO	NO	NO	NO	NO	18.70
2.D. Non-energy products from fuels and solvent use	203.98	NO	NO						203.98
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				206.62	NO	NO	NO	NO	206.62
2.G. Other product manufacture and use	0.94	NO	NO	NO	0.04	NO	1.63	NO	2.61
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**42.50**	**485.77**	**950.74**						**1,479.01**
3.A. Enteric fermentation		434.00							434.00
3.B. Manure management		51.77	147.61						199.38
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		IE	803.13						803.13
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	42.50								42.50
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-172.36**	**0.90**	**149.40**						**-22.06**
4.A. Forest land	-1,887.32	0.81	0.42						-1,886.09
4.B. Cropland	1,629.90	0.09	0.02						1,630.01
4.C. Grassland	-223.15	NE	NE						-223.15
4.D. Wetlands	-82.81	NE	NE						-82.81
4.E. Settlements	27.21	NO, NE	148.95						176.16
4.F. Other land	329.13	NE	NE						329.13
4.G. Harvested wood products	34.69								34.69
4.H. Other	NE	NE	NE						NE
5. Waste	**10.47**	**1,411.18**	**53.79**						**1,475.44**
5.A. Solid waste disposal-		1,156.70							1,156.70
5.B. Biological treatment of solid waste		1.40	0.79						2.19
5.C. Incineration and open burning of waste	10.47	6.01	1.00						17.48
5.D. Waste water treatment and discharge		247.06	51.99						299.06
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**41.40**	**0.02**	**0.31**						**41.73**
1.D.1.a. Aviation	35.25	0.01	0.26						35.52
1.D.1.b. Navigation	6.15	0.02	0.04						6.21
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**2,992.97**								**2,992.97**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**240.64**						**240.64**

Indirect CO_2 [4]	**196.38**								**196.38**

Total CO_2 equivalent emissions without LULUCF	**13,391.96**
Total CO_2 equivalent emissions with LULUCF	**13,369.90**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**9,817.04**	**531.66**	**112.21**						**10,460.91**
1.A. Fuel combustion	9,815.46	255.20	112.20						10,182.87
1.A.1. Energy industries	3,931.09	2.41	2.72						3,936.22
1.A.2. Manufacturing industries and construction	755.19	1.14	1.46						757.79
1.A.3. Transport	2,721.37	16.27	37.83						2,775.47
1.A.4. Other sectors	2,406.24	235.37	70.17						2,711.79
1.A.5. Other	1.57	0.01	0.02						1.60
1.B. Fugitive emissions from fuels	1.58	276.46	0.00						278.04
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.58	276.46	0.00						278.04
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**781.81**	**NO**	**NO**	**213.27**	**0.04**	**NO**	**1.64**	**NO**	**996.76**
2.A. Mineral industry	582.07								582.07
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	22.26	NO	NO	NO	NO	NO	NO	NO	22.26
2.D. Non-energy products from fuels and solvent use	176.31	NO	NO						176.31
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				213.27	NO	NO	NO	NO	213.27
2.G. Other product manufacture and use	1.16	NO	NO	NO	0.04	NO	1.64	NO	2.84
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**18.61**	**476.06**	**1,184.35**						**1,679.02**
3.A. Enteric fermentation		429.07							429.07
3.B. Manure management		46.99	147.36						194.35
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	1,036.99						1,036.99
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	18.61								18.61
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NO	NO						NO
4. Land use, land-use change and forestry [1]	**-105.16**	**0.30**	**153.97**						**49.11**
4.A. Forest land	-1,919.59	0.08	0.04						-1,919.47
4.B. Cropland	1,713.54	0.22	0.05						1,713.81
4.C. Grassland	-138.64	NE	NE						-138.64
4.D. Wetlands	-83.05	NE	NE						-83.05
4.E. Settlements	29.73	NO, NE	153.88						183.61
4.F. Other land	285.13	NE	NE						285.13
4.G. Harvested wood products	7.73								7.73
4.H. Other	NE	NE	NE						NE
5. Waste	**10.06**	**1,408.64**	**52.77**						**1,471.47**
5.A. Solid waste disposal-		1,144.56							1,144.56
5.B. Biological treatment of solid waste		1.33	0.75						2.08
5.C. Incineration and open burning of waste	10.06	5.77	0.96						16.79
5.D. Waste water treatment and discharge		256.99	51.06						308.05
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**160.01**	**0.18**	**1.42**						**161.61**
1.D.1.a. Aviation	151.50	0.15	1.36						153.02
1.D.1.b. Navigation	8.51	0.02	0.06						8.60
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**2,904.28**								**2,904.28**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NE**								**NE**
Indirect N_2O			**284.38**						**284.38**

Indirect CO_2 [4]	**168.17**								**168.17**

Total CO_2 equivalent emissions without LULUCF	**14,608.16**
Total CO_2 equivalent emissions with LULUCF	**14,657.27**

GREENHOUSE GAS SOURCE AND SINK CATEGORIES	CO_2 [1]	CH_4	N_2O	HFCs	PFCs	Unspecified mix of HFCs and PFCs	SF_6	NF_3	Total
	CO_2 equivalents (kt) [2]								
1. Energy	**8,705.13**	**444.76**	**99.77**						**9,249.65**
1.A. Fuel combustion	8,703.60	211.59	99.77						9,014.96
1.A.1. Energy industries	3,341.56	2.43	1.94						3,345.93
1.A.2. Manufacturing industries and construction	669.56	1.20	1.53						672.30
1.A.3. Transport	2,724.89	13.78	38.11						2,776.78
1.A.4. Other sectors	1,964.95	194.13	58.16						2,217.25
1.A.5. Other	2.64	0.04	0.03						2.70
1.B. Fugitive emissions from fuels	1.52	233.17	0.00						234.70
1.B.1. Solid fuels	NO	NO	NO						NO
1.B.2. Oil and natural gas and other emissions from energy production	1.52	233.17	0.00						234.70
1.C. CO_2 transport and storage	NO								NO
2. Industrial processes and product use	**663.47**	**NO**	**NO**	**234.84**	**0.04**	**NO**	**1.65**	**NO**	**900.00**
2.A. Mineral industry	491.38								491.38
2.B. Chemical industry	NO	NO	NO	NO	NO	NO	NO	NO	NO
2.C. Metal industry	12.20	NO	NO	NO	NO	NO	NO	NO	12.20
2.D. Non-energy products from fuels and solvent use	159.11	NO	NO						159.11
2.E. Electronic Industry			NO	NO	NO	NO	NO	NO	NO
2.F. Product uses as ODS substitutes				234.84	NO	NO	NO	NO	234.84
2.G. Other product manufacture and use	0.78	NO	NO	NO	0.04	NO	1.65	NO	2.47
2.H. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO
3. Agriculture	**22.66**	**461.17**	**873.26**						**1,357.09**
3.A. Enteric fermentation		414.83							414.83
3.B. Manure management		46.34	135.05						181.39
3.C. Rice cultivation		NO							NO
3.D. Agricultural soils		NO	738.21						738.21
3.E. Prescribed burning of savannahs		NO	NO						NO
3.F. Field burning of agricultural residues		IE	IE						IE
3.G. Liming	NO								NO
3.H. Urea application	22.66								22.66
3.I. Other carbon-containing fertilizers	NO, NE								NO, NE

3.J. Other	NO	NE	NE						NO
4. Land use, land-use change and forestry [1]	**258.39**	**1.52**	**160.76**						**420.66**
4.A. Forest land	-1,592.42	1.16	0.61						-1,590.66
4.B. Cropland	1,730.18	0.36	0.09						1,730.63
4.C. Grassland	-123.13	NE	NE						-123.13
4.D. Wetlands	-84.25	NE	NE						-84.25
4.E. Settlements	27.50	NO, NE	160.06						187.56
4.F. Other land	304.27	NE	NE						304.27
4.G. Harvested wood products	-3.78								-3.78
4.H. Other	NE	NE	NE						NE
5. Waste	**9.89**	**1,384.13**	**51.07**						**1,445.09**
5.A. Solid waste disposal-		1,130.39							1,130.39
5.B. Biological treatment of solid waste		1.38	0.78						2.16
5.C. Incineration and open burning of waste	9.89	5.68	0.94						16.51
5.D. Waste water treatment and discharge		246.68	49.34						296.03
5.E. Other	NO	NO	NO						NO
6. Other *(as specified in summary 1)*	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**	**NO**

Memo items: [3]									
1.D.1. International bunkers	**145.60**	**0.09**	**1.26**						**146.96**
1.D.1.a. Aviation	142.05	0.08	1.24						143.37
1.D.1.b. Navigation	3.56	0.01	0.03						3.59
1.D.2. Multilateral operations	**NO**	**NO**	**NO**						**NO**
1.D.3. CO_2 emissions from biomass	**2,429.50**								**2,429.50**
1.D.4. CO_2 captured	**NO**								**NO**
5.F.1. Long-term storage of C in waste disposal sites	**NO**								**NE**
Indirect N_2O			**213.70**						**213.70**

Indirect CO_2 [4]	**151.27**								**151.27**

Total CO_2 equivalent emissions without LULUCF	**12,951.83**
Total CO_2 equivalent emissions with LULUCF	**13,372.49**