THE FIRST BIENNIAL TRANSPARENCY REPORT OF THE REPUBLIC OF KAZAKHSTAN

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Introduction

Since gaining its independence, Kazakhstan has been actively engaged in global efforts to combat climate change, demonstrating its commitment through participation in key international climate agreements. As a Party to the *United Nations Framework Convention on Climate Change (UNFCCC)* since 1995, the country reinforced its dedication by ratifying the *Kyoto Protocol* in 2009 and the *Paris Agreement* in 2016.

Recognizing the urgent need for transformative actions to mitigate climate change and build a resilient future, Kazakhstan has adopted the *Strategy for Achieving Carbon Neutrality by 2060*. This strategy integrates measures to decarbonize key sectors and promotes sustainable development in line with the country's updated *Nationally Determined Contribution (NDC)*. Kazakhstan has also implemented a national *Emissions Trading System (ETS)*, the first of its kind in Central Asia, to deliver reductions in carbon emissions across key sectors and to attract clean technologies.

Kazakhstan's efforts are further bolstered by significant investments in renewable energy sources (RES), energy efficiency, and sustainable land and water management. The country strives to achieve the set targets of expanding the share of RES in its energy mix, improving energy efficiency in buildings and industries, and enhancing climate-resilient agricultural practices. These initiatives are supported by national policies, including the *Environmental Code* and *the Concept for Transition to a Green Economy*, which provide a robust legislative and policy framework.

Despite these efforts, Kazakhstan faces considerable challenges stemming from its reliance on fossil fuels, the energy intensity of its economy, and the need for large-scale investments in low-carbon infrastructure and decarbonization. Kazakhstan emphasizes the importance of *financial, technological, and capacity-building support from the international community and donor organizations* to address these challenges.

This document highlights Kazakhstan's progress, achievements, challenges, and future priorities in combating climate change. It underscores the country's commitment to meeting its NDC targets, transitioning to a sustainable, low-carbon economy, and contributing to global efforts to achieve the goals of the Paris Agreement.

Yerlan Nyssanbayev
Minister of Ecology
and Natural Resources

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Abbreviations and Acronyms

ABS	Acrylonitrile Butadiene Styrene
ADB	Asian Development Bank
AFOLU	Agriculture, Forestry and Other Land Use
ALA	Almaty International Airport
ARDFM	Agency of Kazakhstan for Regulation and Development of Financial Markets
BAT	Best Available Techniques
BioPP	Bioelectric power plants
BNS ASPR RK	Bureau of National Statistics Agency for Strategic Planning and Reforms of the Republic of Kazakh-stan
BR	Biennial Reports
CAMP4ASB	Climate Adaptation for the Central Asian Countries
CAREC	Central Asia Regional Environmental Center
CASPCOM	Coordination Committee for Hydrometeorology of the Caspian Sea
CBIT	Capacity-Building Initiative for Transparency
CCS	Carbon Capture and Storage
CCUS	Carbon Capture, Utilization, and Storage
CEPs	Comprehensive Environmental Permits
CHPP	Combined Heat and Power Plant
CIS	Commonwealth of Independent States
CMA	Conference of the Parties Serving as the Meeting of the Parties to the Paris Agreement
CNNC	China National Nuclear Corporation
CO2e	Carbon Dioxide Equivalent
COP28	UN Framework Convention nn Climate Change In 2023
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
COVID-19	Coronavirus Disease 2019
CRTs	Common Reporting Tables
CRVA	Climate Risk And Vulnerability Assessment
CTF	Common Tabular Formats
CzDA	Czech International Development Agency
DRI	Direct Reduction Iron
EIB	European Investment Bank
EBRD	European Bank for Reconstruction and Development
ECMWF	European Centre for Medium-Range Weather Forecasts
EDF	Électricité De France
EIS OOS	Unified Information System for Environmental Protection
ENRC	Eurasian Natural Resources Corporation

EPO	Extended Producer Obligations
EPR	Extended Producer Responsibility
ETS	Emissions Trading System
ETSAP	Energy Technology Systems Analysis Program
EUMETSAT	European Meteorological Satellite Agency
FAO	Food and Agriculture Organization
F-gases	Fluorinated Gases
GBFF	Global Biodiversity Framework Fund
GCA	Green Central Asia
Gcal	Gigacalorie
Gcal/h	Gigacalorie/Hour
GCF	Green Climate Fund
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gases
GIZ	German International Cooperation Society
GOS	Global Observing System
GW	Gigawatt
GWPs	Global Warming Potentials
HDPE	High-Density Polyethylene
HFCs	Hydrofluorocarbons
HPP	Hydroelectric power plants
IATA	International Air Transport Association
IBRD	International Bank for Reconstruction and Development
ICAO	International Civil Aviation Organization
IDF	Industrial Development Fund
IEA	International Energy Agency
IEP	Integrated Environmental Permits
IFAS	International Fund for Aral Sea Saving
IMO	International Maritime Organization
IPCC	Intergovernmental Panel on Climate Change
IPPU	Industrial Processes and Product Use
I-REC	International Renewable Energy Certificates
IWRM	Integrated Water Resources Management
JCM	Joint Crediting Mechanism
JICA	Japan International Cooperation Agency
JSC	Joint-Stock Company
KEGOC	Kazakhstan Electricity Grid Operating Company
KHNP	Korea Hydro Nuclear Power

KOICA	Korean International Cooperation Agency
kt	Kiloton
KTK	Caspian Pipeline Consortium
kWh	Kilowatthour
KZT	Kazakhstani Tenge
LDCF	Least Developed Countries Fund
LDPE	Low-Density Polyethylene
LRT	Light Rail Transport
LULUCF	Land Use, Land-Use Change and Forestry
M&E	Monitoring and Evaluation
MCI	Monthly Calculation Indices
MEGNR	Ministry of Ecology, Geology and Natural Resources
MENR	Ministry of Ecology and Natural Resources
MoA	Ministry of Agriculture
MPGs	Modalities, Procedures and Guidelines
MRV	Monitoring, Reporting and Verification
MSW	Municipal Solid Waste
Mt	Megaton
MW	Megawatt
NAP	National Adaptation Plan
NbS	Nature-Based Solutions
NC	National Communication
NDC	Nationally Determined Contribution
ND-GAIN	Notre Dame-Global Adaptation Index
NGOs	Non-Governmental Organizations
NID	National Inventory Document
NIR	National Inventory Report
NMVOCs	Non-Methane Volatile Organic Compounds
NPIF	Nagoya Protocol Implementation Fund
NPP	Nuclear Power Plant
OECD	Organization for Economic Cooperation and Development
ODS	Ozone-depleting substances
PFCs	Perfluorocarbons
PP	Polypropylene
PRTR	Pollutant Release and Transfer Register
PS	Polystyrene
R&D	Research and Development
RA II	Regional Association for Asia
RA VI	Regional Association for Europe

RCCAS	Regional Climate Change Adaptation Strategy
RCP	Representative Concentration Pathways
RES	Renewable Energy Sources
RSE	Republican State Enterprise
SCADA	Supervisory Control and Data Acquisition
SCCF	Special Climate Change Fund
SECCA	Sustainable Energy Connectivity in Central Asia
SF6	Sulfur Hexafluoride
SlovakAID	Slovak Agency for International Development
SME	Small and Medium-Sized Enterprises
SPP	Solar power plants
TJ	TeraJoule
TOE	Tonne(s) of Oil Equivalent
TPP	Thermal Power Plants
UIS OOS	Unified Information System of Environmental Protection
UNDP	United Nations Development Programme
UNECE	United Nations Economic Commission for Europe
UNEP	United Nations Environmental Programme
UNFCCC	United Nations Framework Convention on Climate Change
USAID	United States Agency for International Development
USD	United States Dollar
WAM	With Additional Measures
WB	World Bank
WMO	World Meteorological Organization
WPP	Wind power plants

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EXECUTIVE SUMMARY

Chapter I

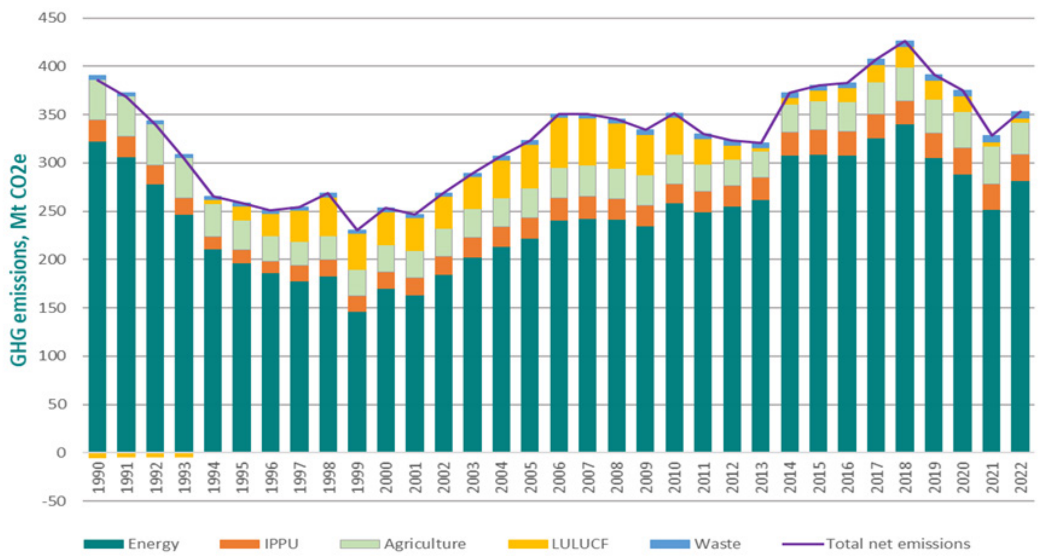
Chapter I provides a brief summary of Kazakhstan's National Inventory Report (NIR), detailing greenhouse gas (GHG) emissions and removals from 1990 to 2022. The report covers six key GHGs (CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6) across the energy, industrial processes and product use (IPPU), agriculture, land use, land-use change, and forestry (LULUCF) and waste sectors. This comprehensive assessment of GHG emissions and removals that is provided in the NIR forms the foundation for tracking progress toward Kazakhstan's climate commitments under the Paris Agreement.

In 2022, Kazakhstan's gross GHG emissions (excluding LULUCF) reached 348.8 Mt CO_2e, a 10.7% reduction from 1990 levels but a 7.8% increase compared to 2021, driven by post-pandemic economic recovery. Net emissions (including LULUCF) stood at 353 Mt CO_2e, marking an 8.5% decrease from 1990 levels. The energy sector, the largest contributor of 79.9% to the total GHG emissions, achieved a 12.5% reduction since 1990. Yet it continues to dominate in the total GHG emissions due to the combustion of fossil fuels that account for the bulk of energy supply in the country.

Other sectors showed varying trends. The agriculture sector that was the second largest emissions source contributing 9.3% of total GHG emissions, reduced emissions by 21% since 1990 due to improved agricultural practices. The IPPU sector, with a 7.7% share, recorded an 18.8% increase, driven by industrial growth. The waste sector, responsible for 2% of total GHG emissions, experienced a significant 74.2% rise since 1990, mainly due to the population growth and limited waste management actions. The LULUCF sector, once a carbon sink in the early 1990s, became a net source in 2022, with net emissions amounting 4.13 Mt CO_2e; however due to improved land management emissions declined by 11.9% compared to 2021.

By gas, CO_2 dominated by far the emission profile of the country, accounting for 78.8% of the total GHG emissions, followed by CH_4 (16.1%), N_2O (4.3%) and fluorinated gases (8%).

The GHG emissions inventory underscores Kazakhstan's continued reliance on fossil fuels while highlighting progress in emission reduction in certain sectors.



Chapter II

Chapter II provides a comprehensive overview of Kazakhstan's efforts to implement and achieve its Nationally Determined Contribution (NDC) under Article 4 of the Paris Agreement. It includes information on national circumstances, institutional arrangements, mitigation policies and measures, GHG emissions projections, and tracking progress in NDCs through established indicators.

Kazakhstan's geographic, climatic, and economic conditions significantly shape the approach to its climate policies and relevant mitigation strategies and adaptation plans. As a landlocked country with a sharply continental climate, Kazakhstan faces challenges such as rising temperatures, low precipitation, water scarcity, and desertification. Its resource-based, energy-intensive economy, heavily reliant on fossil fuels, particularly coal, results in high per capita GHG emissions. Nevertheless, the country's abundant renewable energy potential in solar, wind, and hydropower offers substantial opportunities for transitioning to a low-carbon economy harnessing the power of technology innovation and international cooperation.

Kazakhstan's NDC includes a commitment to reduce in 2030 total GHG emissions from all gases and all sectors by 15% unconditionally and 25% conditionally compared to 1990 levels. These ambitious targets are supported by the Strategy on Achieving Carbon Neutrality by 2060 and the Concept for Transition to a Green Economy. The updated NDC, adopted in April 2023, consolidates these commitments and provides a roadmap for achieving an economy-wide absolute emission reduction targets for 2030 and towards carbon neutrality in 2060.

According to the 2024 NIR, the total GHG emissions, including LULUCF, amounted to 328,422.27 ktCO2e in 2021 and 352,973.03 kt CO2e in 2022. Compared to the levels of the 1990 base year, GHG emissions in the first two years of the NDC implementation period were by 14.86% and 8.49% lower, respectively. Therefore, Kazakhstan is making progress towards its NDC as it has been reducing emissions during the years covered by NDC below 1990 levels. Yet, the country plans to intensify its efforts to further reduce emissions and enhance removals to achieve its target of 15% emission reduction in 2030 compared to 1990 levels.

The chapter underscores the pivotal role of institutional arrangements in tracking and achieving NDC progress. The Ministry of Ecology and Natural Resources (MENR) leads climate policy efforts, with Zhasyl Damu JSC managing the national GHG inventory and the Emissions Trading System (ETS).

Kazakhstan's ETS, the first market-based mechanism in Central Asia, represents its flagship policy that is designed to deliver sizable GHG emission reductions across key sectors and support the achievement of the country's climate targets while encouraging investments in cleaner technologies. Environmental Code (2021) and the Strategy on Achieving Carbon Neutrality by 2060 provide key policy frameworks for mitigation and adaptation efforts.

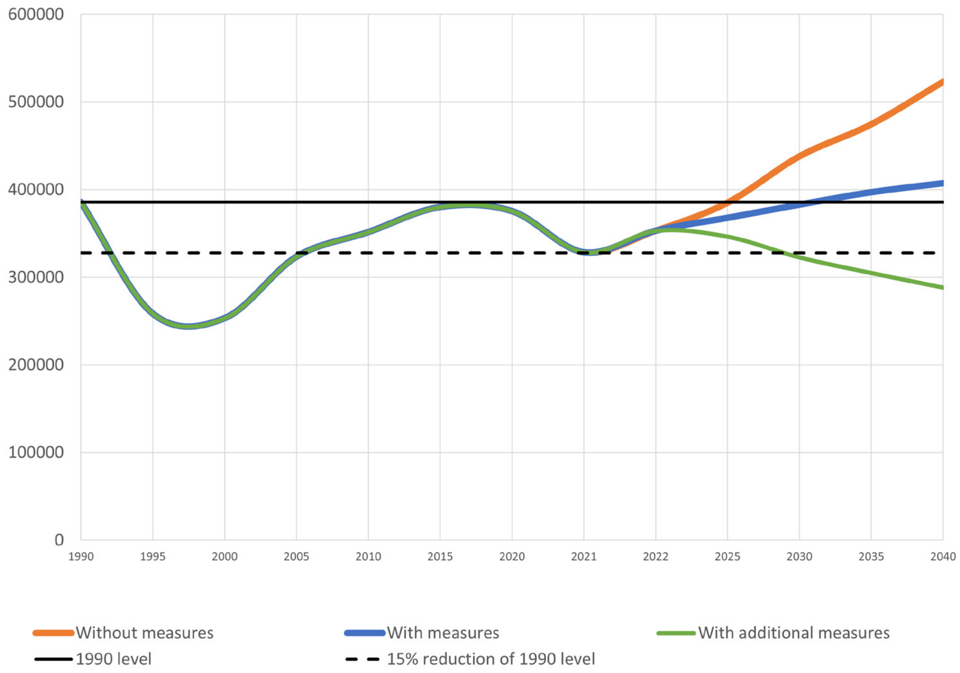
Building on these institutional and policy efforts, GHG emissions and removals projections offer a forward-looking perspective on Kazakhstan's GHG emission trends and opportunities to achieve its emission reduction targets. These projections, which cover CO_2, CH_4, N_2O, HFCs, PFCs, and SF_6, are prepared for the years 2025, 2030, 2035, and 2040 under three scenarios: "with measures," "with additional measures," and "without measures."

- Under the "with measures" scenario, total net GHG emissions in 2040 are projected to reach 407.3 Mt CO_2e, representing a modest 6% increase compared to 1990 levels.
- The "without measures" scenario envisages a significant 36% rise in emissions.
- The "with additional measures" scenario anticipates a 25% reduction relative to 1990 levels.

Key findings from projections by sectors under the "with measures" scenario include:

- The projected emissions for the energy sector (including transport) in 2040 are expected to decrease slightly by 1% compared to 1990 levels, or by 2.1 Mt CO_2e.

- In the IPPU sector, emissions are anticipated to nearly double by 2040 due to expected growth in industry activities, representing an increase of 91% compared to 1990 levels, or by 20.6 Mt CO_2e.
- Agriculture sector emissions are projected to decrease marginally by 1% compared to 1990 levels, or by 0.5 Mt CO_2e.
- The LULUCF sector is expected to experience a significant decrease in emissions, declining by 24% by 2040 compared to 1990 levels, or by 1.2 Mt CO_2e.
- Emissions in the waste sector are projected to double, driven by anticipated population and GDP growth and increased waste volumes. The sector is expected to grow by 118%, or by 4.7 Mt CO_2e, though its overall share of total emissions remains relatively small.



Chapter III

Chapter III outlines Kazakhstan's adaptation efforts to address the impacts of climate change and build resilience, in accordance with provisions of Article 7 of the Paris Agreement. The country faces significant vulnerabilities due to its geographical location as a land-locked country, its continental climate, arid landscapes, and its reliance on transboundary water resources. Rising temperatures, irregular precipitation, and extreme weather events are already causing economic and ecological losses, with impacts on key sectors such as agriculture, water resources, forestry, disaster risks, public health and tourism.

Since 2020, Kazakhstan has prioritized adaptation alongside mitigation, integrating measures into national development plans and programs. Key frameworks include the Environmental Code (2021), the Strategy on Achieving Carbon Neutrality by 2060, and the updated NDC. The MENR coordinates adaptation efforts, supported by climate monitoring from Kazhydromet. Strategic measures for adaptation focus on improving water resource management, adopting drought-resistant agricultural practices, enhancing disaster risk reduction mechanisms, and expanding forest cover. These measures are part of the ongoing development of a National Adaptation Plan (NAP) to guide implementation and enhance monitoring and evaluation of adaptation actions.

Challenges include limited institutional capacity, data gaps, insufficient funding, and the need for infrastructure modernization. International support, particularly from organizations like UNDP and the Green Climate Fund, plays a vital role in addressing these barriers.

The chapter emphasizes the importance of a systematic and inclusive approach to adaptation, highlighting co-benefits such as reduced GHG emissions, enhanced ecosystem services, and increased resilience to future climate impacts. It also emphasizes importance to frame adaptation actions and actions to increase resilience in the light of the best available science and taking into account gender considerations and local contexts.

Chapter IV

This chapter provides an overview of Kazakhstan's efforts to meet its commitments under the Paris Agreement, as outlined in key documents, including the updated NDC and the Strategy on Achieving Carbon Neutrality by 2060. The key focus of this effort is on the financial, technological, and capacity-building support needed and received to achieve these goals, particularly the GHG emission reduction target enshrined in the updated NDC. The estimated investment required to achieve carbon neutrality by 2060 is USD 610 billion, with 96.2% expected to come from the private sector.

The chapter highlights significant challenges in mobilizing financial resources, particularly in sectors with high investment risks and low returns. Blended financing instruments, which combine grants, concessional loans, and equity investments, are identified as critical tools to address these barriers. International financial institutions, such as the World Bank and the EBRD, have provided substantial support, although concessional loans and guarantees remain underutilized. Bilateral financial assistance also played a key role, in particular with regards to capacity and institutional building, and upgrading the legal framework to create certainty and attract foreign investments.

Technology transfer is recognized as essential for facilitating the transition to a low-carbon economy. Key areas include the deployment of renewable energy, carbon capture and storage, smart grids, and water-saving technologies. Also, capacity-building efforts are deemed essential to develop local expertise, enhance policy implementation, and improve project readiness in key sectors such as energy, industry, and agriculture.

The chapter also features examples of projects that align with Kazakhstan's NDC and national strategies, showcasing innovative approaches to both mitigation and adaptation. These projects include initiatives in renewable energy expansion, industrial modernization, waste management, and climate adaptation.

Lastly, the chapter underscores the critical importance of international cooperation and private sector engagement in overcoming financial and technological barriers and achieving Kazakhstan's ambitious climate goals.

EXECUTIVE SUMMARY OF THE NATIONAL INVENTORY REPORT OF ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES

1

CHAPTER I:

Executive Summary of the National Inventory Report of anthropogenic emissions by sources and removals by sinks of greenhouse gases

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement, Kazakhstan has a commitment to annually develop, update, and make available national inventory of anthropogenic emissions by sources and removals by sinks of all greenhouse gases (GHGs) not controlled by the Montreal Protocol. The national GHG inventory is provided as a national inventory report (NIR) that comprises a national inventory document (NID) and common reporting tables (CRTs).

The 2024 NIR of Kazakhstan has been prepared in response to these commitments and in accordance with the Modalities, Procedures and Guidelines (MPGs) for the transparency framework under Article 13 of the Paris Agreement, as adopted at the first session of the Conference of the Parties, serving as the meeting of the Parties to the Paris Agreement (CMA) (decision 18/CMA.1). The NIR also adheres to the Guidance for operationalizing the modalities, procedures and guidelines for the enhanced transparency framework referred to in Article 13 of the Paris Agreement (decision 5/CMA.3).

Consistent with decision 18/CMA.1 and decision 5/CMA.3, emissions estimates in the 2024 NIR have been compiled in accordance with the 2006 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC 2006 Guidelines). Detailed information on the 2024 GHG inventory submission is contained in the CRTs that are submitted electronically in conjunction with the NIR.

This chapter presents a summary of Kazakhstan's NIR for the period 1990–2022, providing comprehensive accounts of emissions and removals from the following key sectors:

- Energy
- Industrial Processes and Product Use (IPPU)
- Agriculture
- Land Use, Land Use Change and Forestry (LULUCF)
- Waste

The NIR includes data on six GHGs with direct effects: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Additionally, emissions of four pollutants classified as indirect GHGs were assessed for certain source categories: carbon monoxide (CO), nitrogen oxides (NOx), non-methane volatile organic compounds (NMVOCs), and sulfur dioxide (SO_2).

The NIR presents emissions' estimates for each of the major GHGs that are provided as carbon dioxide equivalents (CO_2e) using 100-year global warming potentials (GWPs). As GHGs vary in their radiative activity, and in their atmospheric residence time, converting emissions into CO_2e allows the aggregated effect of emissions of the various gases to be compared. In accordance with the MPG requirements the NIR applies 100-year time horizon GWPs contained in Table 8.A.1 of Chapter 8: Anthropogenic and Natural Radiative Forcing of the 2014 IPCC Fifth Assessment Report.

The summary of the GHG emissions inventory that is provided in this chapter sets the context for the other chapters of the BTR and presents relevant information in a concise format. Detailed summary and full and comprehensive information on this GHG inventory are presented in Kazakhstan's NID, submitted to the UNFCCC in 2024 and relevant CRTs. Summary table of GHG emissions and removals from the same submission is presented in section E, of Chapter II of the BTR.

1.A. Institutional arrangements for preparation of greenhouse gas inventory

Since 2023, the Ministry of Ecology and Natural Resources of the Republic of Kazakhstan (MENR) has been coordinating and implementing the provisions of the Convention and the Paris Agreement, succeeding previous government bodies and structures responsible for developing climate policy, transitioning to a green economy, and managing the national GHG inventory.

Since 2009, Joint Stock Company Zhasyl Damu (Zhasyl Damu) has been responsible for the annual preparation of the National Inventory Report on GHG emissions and removals and the corresponding reporting tables as the institution implementing the relevant provisions of the UNFCCC. This task is carried out under state contracts between Zhasyl Damu and MENR. Within the structure of Zhasyl Damu, there is a Greenhouse Gas Inventory Department, which is responsible for collecting, processing, and storing data, as well as preparing assessments of GHG emissions and removals for inclusion in the National Inventory Report and corresponding reporting tables.

1.B. Overall national GHG emissions trend

Kazakhstan's total GHG emissions have shown significant variation over the years, primarily due to changes in the energy sector. In 2022, gross GHG emissions (excluding LULUCF) amounted to 348.8 Mt CO_2e, which was 10.7% below the 1990 level, however this was by 7.8% (or 25.1 Mt CO_2e) higher than in 2021. Net emissions (including LULUCF) totaled 353 Mt CO_2e in 2022, representing an 8.5% decrease compared to 1990 but a 7.5% increase compared to the previous year.

Table 1. Total Greenhouse gas emissions of Kazakhstan by Sector, 1990–2022 , Mt CO_2e

IPCC Sectors	1990	1995	2000	2005	2010	2015	2020	2021	2022	Emissions trend	
										2021/22	1990/22
Energy	322,0	196,1	170,1	222,4	258,5	309,0	288,5	251,4	281,9	12,1%	-12,5%
IPPU	22,7	14	17,3	20,8	20	25,4	26,8	26,9	27	0,5%	18,8%
Agriculture	41,8	30,9	28,1	31,0	30,3	29,8	37,5	38,6	33,0	-14,5%	-21,0%
LULUCF	-4,79	14,1	34,0	45,2	37,9	10,6	16,1	4,7	4,13	-11,9%	n/a
Waste	4,0	3,5	3,6	3,9	4,8	5,3	6,5	6,8	6,9	1,0%	74,2%
Total gross emissions	390,5	244,5	219,1	278,1	313,5	369,5	359,3	323,7	348,8	7,8%	-10,7%
Total net emissions	385,7	258,5	253,2	323,3	351,4	380,1	375,4	328,4	353,0	7,5%	-8,5%

In 2022, the *energy* sector remained the largest source of GHG emissions in Kazakhstan, reaching 281.9 Mt CO_2e, which accounted for 79.9% of the total emissions. This sector defines by far the overall GHG emissions profile of the country, contributing the largest share of the CO_2 emissions. In 1990, total emissions were high due to Kazakhstan's significant reliance on fossil fuels and high energy intensity of its economy, inherited from the Soviet period. Following independence in 1991, emissions sharply declined in the early 1990s as a result of economic downturns. However, starting in 2000, emissions regained, driven by factors such as economic growth and urbanization, and resulting increase in energy demand. In 2022, emissions in the energy sector were 12.5% lower than in 1990 but 12.1% higher compared to 2021.

This recent increase was attributed to the lifting of COVID-19 restrictions and the subsequent economic recovery.

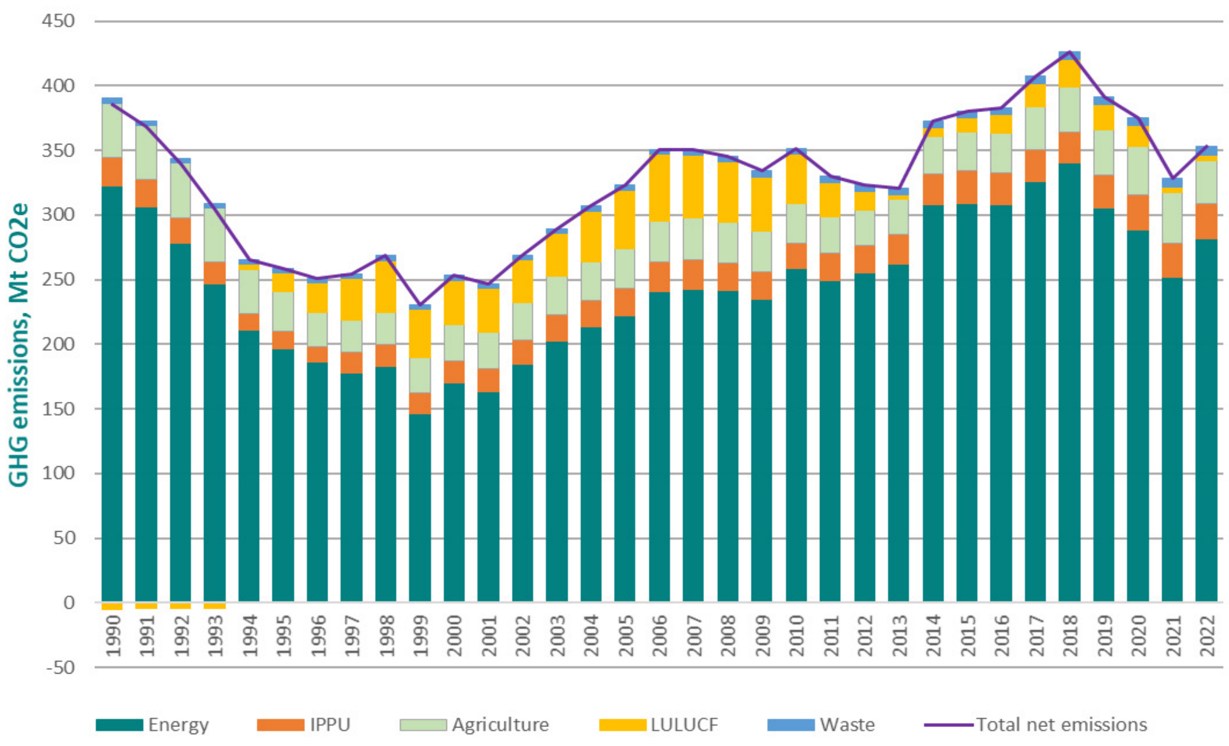
Agriculture became the second-largest source of GHG emissions in Kazakhstan, reaching 33 Mt CO_2e, which accounted for 9.3% of total emissions in 2022. Emissions in the agriculture sector have fluctuated over the years, primarily depending on livestock population trends. In recent years, emissions from this sector have significantly decreased compared to the baseline year. In 2022, they were 21% lower than the 1990 level and 14.5% lower than in 2021.

The industrial processes and product use (IPPU) sector accounted for 7.7% of total national emissions in 2022, reaching 27 Mt CO_2e. GHG emissions in this sector increased by 18.8% compared to 1990, reflecting the long-term growth of industry since 2000. Compared to 2021, emissions in the IPPU sector increased by 0.5% in 2022.

In the *waste* sector, after some decline in the early 1990s, emissions have steadily grown since 2000, driven by population growth, changes in lifestyle and higher waste volumes. In 2022, emissions in this sector reached 6.9 Mt CO_2e, an increase of 74.2% compared to 1990. However, this sector accounted for only 2% of total national emissions.

Although the *land use, land-use change and forestry (LULUCF)* sector was a net sink in the base year, it has now become a net source of GHG emissions, amounting to 4.13 Mt CO_2e. Despite this change, emissions from the LULUCF sector in 2022 decreased by 11.9% compared to 2021, indicating positive changes in land management practices that have mitigated the sector's impact on the overall emission level of the country.

Figure 1.1. Total greenhouse gas emissions of Kazakhstan for 1990–2022, Mt CO_2e

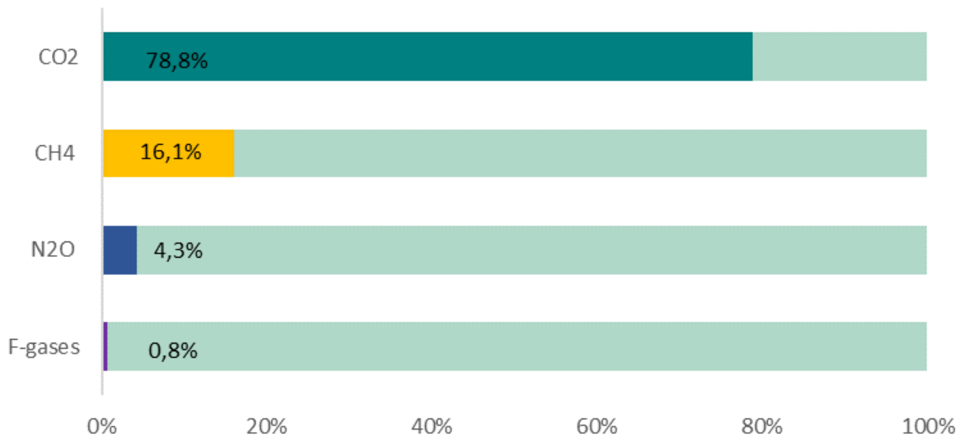


Overall, Kazakhstan's total national GHG emissions increased in 2022 compared to 2021. This increase was primarily due to the lifting of COVID-19 restrictions, which facilitated the recovery of economic activity and growth in energy consumption. However, total net emissions remained 8.5% lower compared to 1990 levels.

1.C. Greenhouse gas emissions trend by gas

The main GHG associated with anthropogenic activity in Kazakhstan in 2022 was CO_2, which accounted for 78.8% of total GHG emissions. The largest source of CO_2 and total GHG emissions was the combustion of fossil fuels, primarily for electricity and heat production. Methane (CH_4) accounted for 16.1% of total emissions, mainly due to the energy and agriculture sectors. Nitrous oxide (N_2O), primarily produced from agricultural activities, accounted for 4.3% of total emissions. Fluorinated gases (F-gases, including HFCs, PFCs, and SF_6), originating from the industrial sector, accounted for 0.8% of total emissions.

Figure 1.2. Share of the total greenhouse gas emissions by gas in 2022, percentages

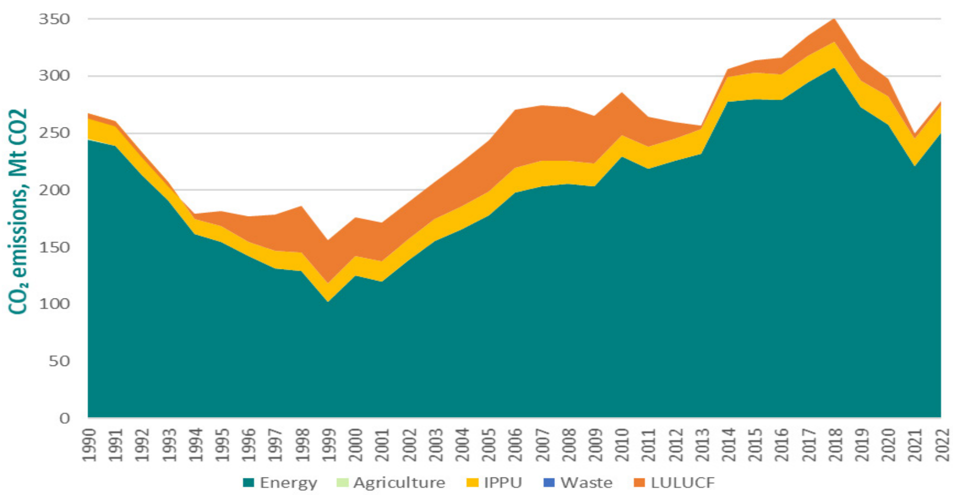


1.C.1. Carbon dioxide (CO_2)

In 1990, net CO_2 emissions, defined as emissions from all anthropogenic sources minus removals, were estimated at 262.6 Mt, accounting for approximately 68% of total net GHG emissions in Kazakhstan. By 2022, CO_2 emissions had increased by 6% from the base year, reaching 278.3 Mt or 78.8% of total GHG emissions.

The energy sector was the primary source of CO_2 emissions in 2022, contributing 89.9% of the total, primarily due to fossil fuel combustion for electricity and heat production. This was followed by the industrial sector at 8.7% and LULUCF at 1.4%. The waste and agriculture sectors had negligible contributions to CO_2 emissions, collectively accounting for less than 0.1%, as indicated in the NID figures. This highlights the dominant role of the energy and industrial sectors in the country's CO_2 emissions profile.

Figure 1.3. Carbon dioxide emissions of Kazakhstan for 1990–2022, Mt CO_2



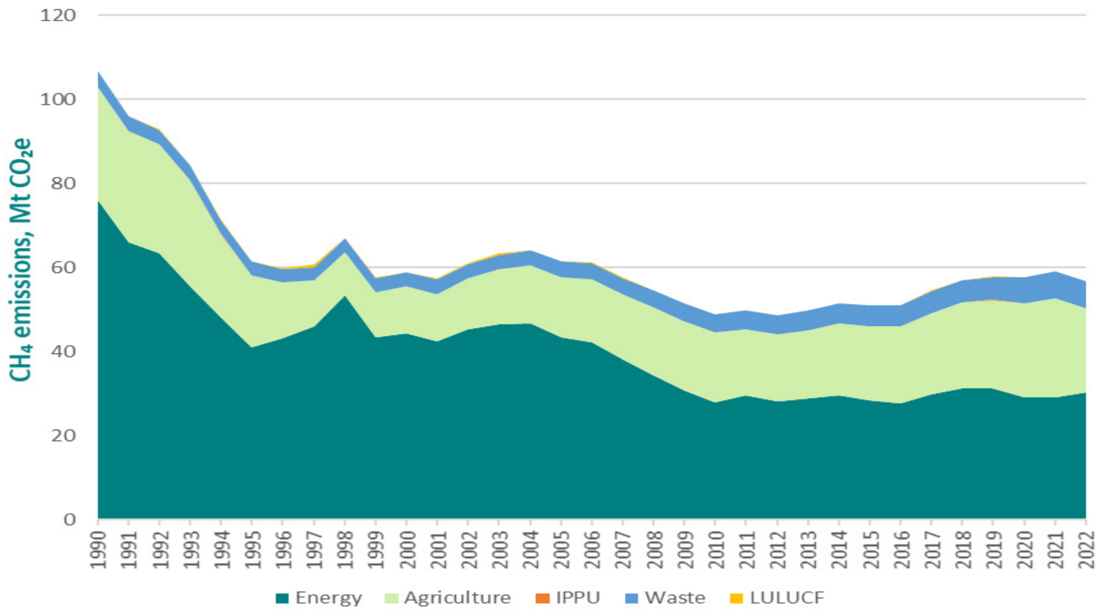
1.C.2. Methane (CH_4)

In 2022, methane (CH_4) emissions in Kazakhstan amounted to 56.9 Mt CO_2e. The main source of emissions was the energy sector, which contributed 53.3% of methane emissions, primarily due to fugitive emissions during the extraction, processing, and transportation of fossil fuels. Fugitive methane emissions occur at all stages of oil and gas production, as well as during coal mining, transportation and storage. It is worth noting that, compared to 1990, methane emissions in the energy sector decreased by 60%.

The agricultural sector accounted for 35.1% of total methane emissions, mainly due to enteric fermentation in ruminants such as cattle and sheep. The waste sector was responsible for about 11.4% of methane emissions, primarily from unmanaged solid waste disposal on landfills and wastewater discharge.

Overall, methane emissions in 2022 were slightly more than half of the 1990 level. This reduction can be explained by a combination of economic changes, modernization efforts, and improvements in management practices in the relevant sectors of Kazakhstan.

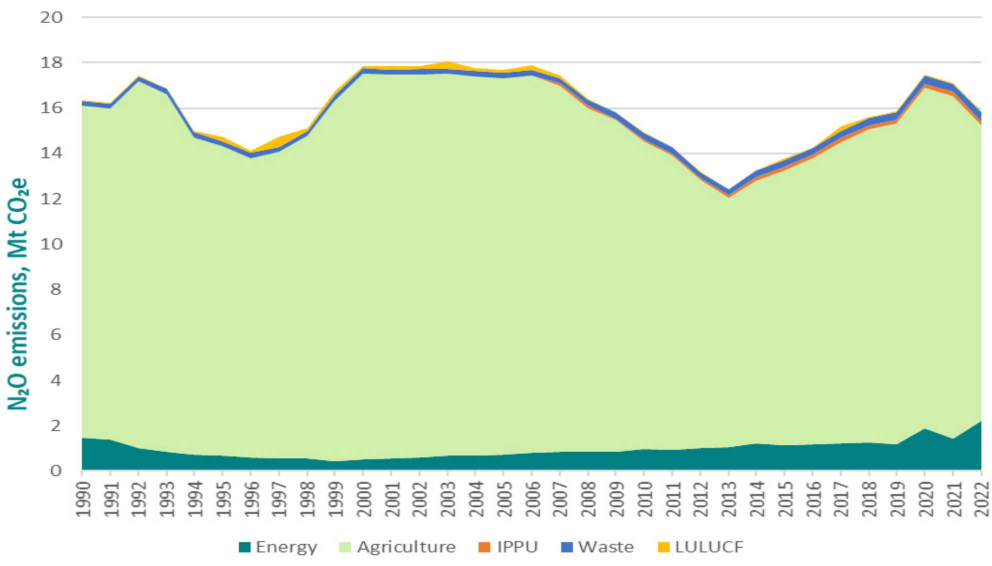
Figure 1.4. Methane emissions of Kazakhstan for 1990–2022, Mt CO_2e



1.C.3. Nitrous Oxide (N_2O)

In 2022, nitrous oxide (N_2O) emissions in Kazakhstan amounted to 15.2 Mt CO_2e, representing 4.3% of the country's total GHG emissions. Agriculture was the primary contributor to N_2O emissions, accounting for 13.05 Mt CO_2e, or 86.1% of the total. Key sources of N_2O emissions in agriculture include soil management practices such as fertilizer application and manure use. The energy sector also contributed to N_2O emissions, totaling 1.5 Mt CO_2e, or 9.6% of the total, primarily due to the combustion of fossil fuels.

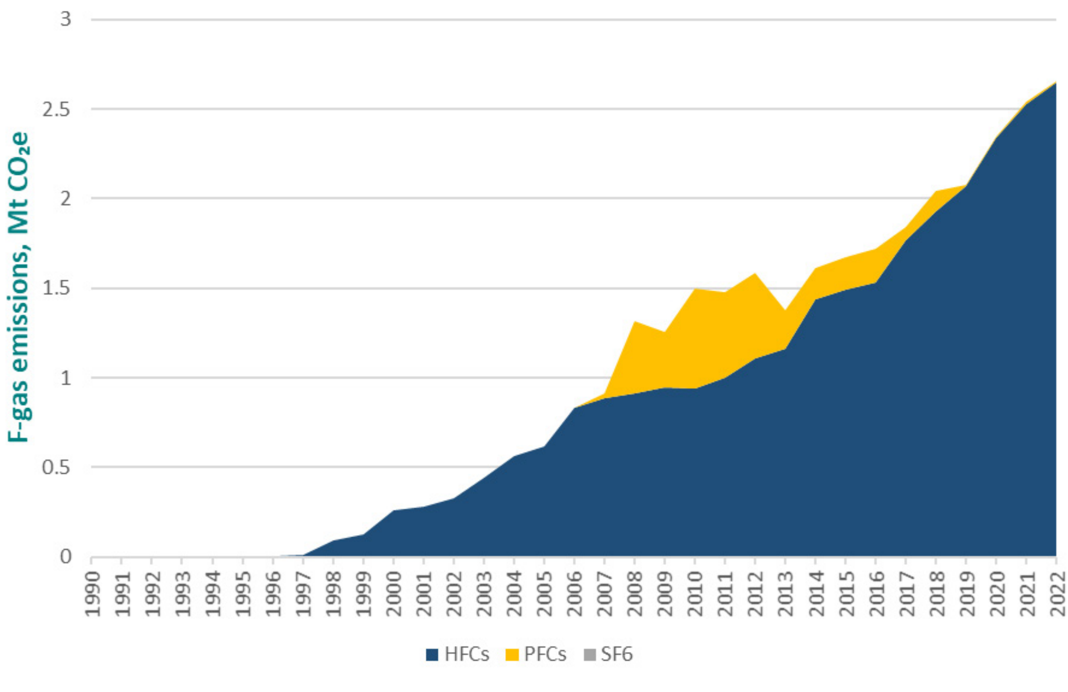
Figure 1.5. Nitrogen oxide emissions of Kazakhstan for 1990–2022, Mt CO_2e



1.C.4. Fluorinated gases (F gases)

Fluorinated gases (F-gases) in Kazakhstan, including hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6), are primarily emitted as a result of industrial activities. In 2022, total F-gas emissions amounted to approximately 2.7 Mt CO_2e. These gases are used in refrigeration systems, air conditioning, foam production, and certain industrial processes. Although F-gases account for only about 0.8% of Kazakhstan's total GHG emissions, their high global warming potential significantly amplifies their impact on climate change. The increase in F-gas emissions is closely associated with industrial growth and the rising demand for refrigeration and air conditioning systems.

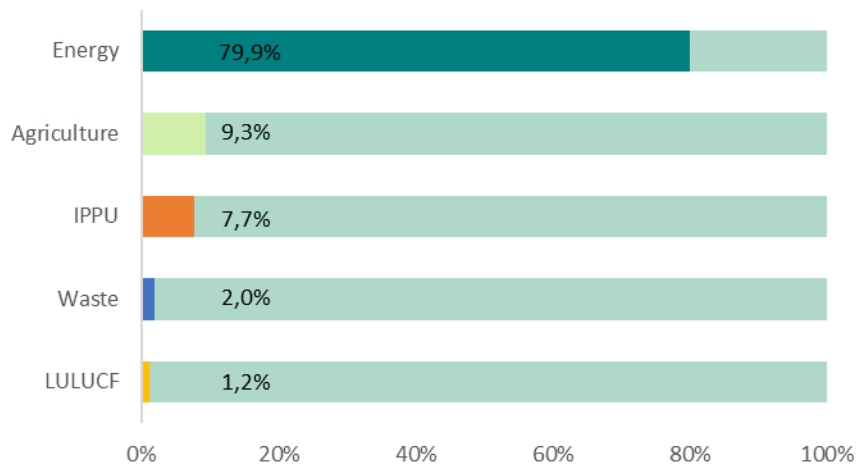
Figure 1.6. Fluorinated gases emissions of Kazakhstan for 1990–2022, Mt CO_2e



1.D. Greenhouse gas emissions trend by sector

In 2022, Kazakhstan's energy sector dominated GHG emissions, accounting for 79.9% of the total. This reflects the country's heavy reliance on fossil fuels for electricity generation, transportation, and other energy needs. Agriculture ranked second, contributing 9.3%, primarily due to emissions from livestock and fertilizer use. Industrial processes accounted for 7.7%, while the waste sector contributed only 2%, mainly due to emissions from landfills and wastewater management. The smallest share of net emissions came from the LULUCF sector, at 1.2%. The sectoral breakdown is illustrated in Figure 1.7.

Figure 1.7. Share of total greenhouse gas emissions by sector in 2022, percentages



1.D.1. Energy

Kazakhstan's energy sector is the primary source of GHG emissions due to its heavy reliance on fossil fuels such as coal, oil, and gas for electricity generation, energy use in industry processes, and transportation. In 2022, the energy sector produced approximately 281.9 Mt CO_2e, representing the largest share of the country's total GHG emissions. This figure was 12.1% higher than in 2021, reflecting economic recovery and increased demand for energy resources following the downturn during COVID-19. However, emissions remained 12.5% below the 1990 levels, indicating some progress in long-term emission reductions.

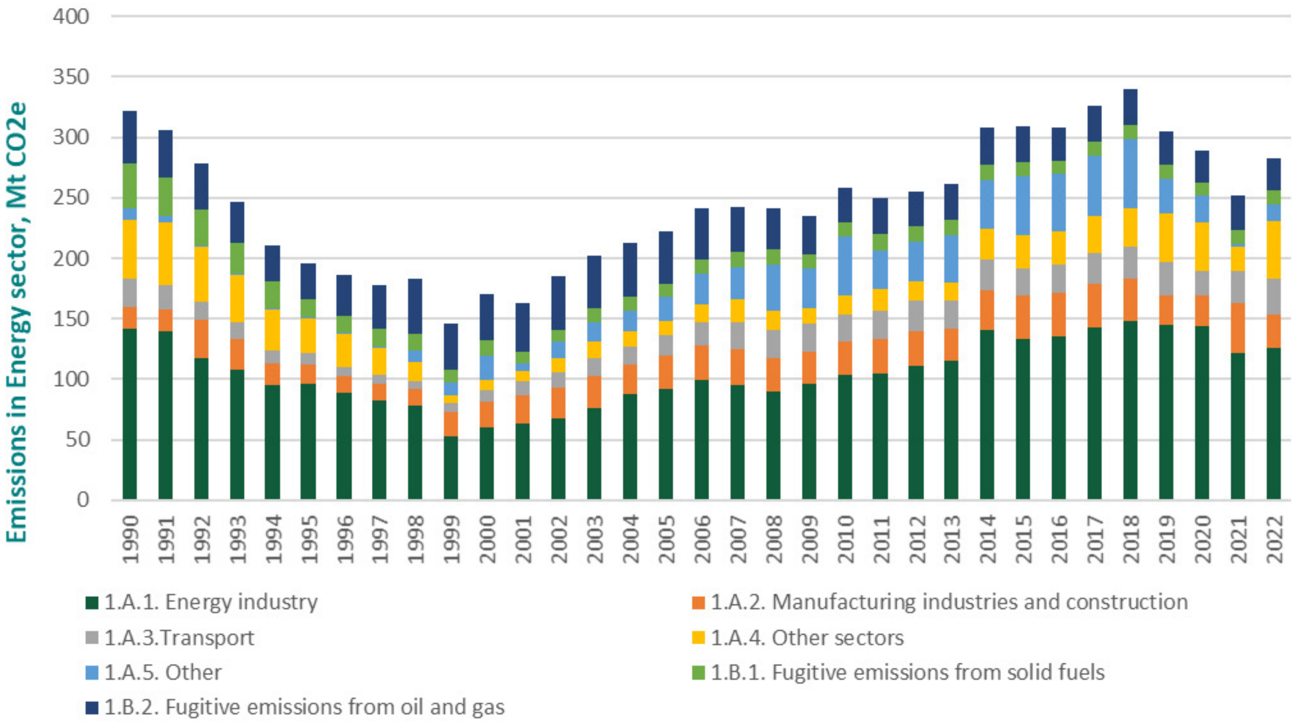
Within the energy sector:

- Energy industries (electricity and heat generation) is the largest source, contributing around 44.7% of the sector's emissions, equivalent to 126 Mt CO_2e in 2022. This represents an 11.4% reduction from 1990 levels and a 4% increase compared to 2021.
- Manufacturing industries and construction accounted for 9.9% of the sector's emissions in 2022, equivalent to 27.8 Mt CO_2e. This represents a 59.7% increase compared to 1990, reflecting the growth of industrial and construction activities following the dissolution of the Soviet Union. However, emissions decreased sharply by 33.1% compared to the previous year, primarily due to the normalization of economic activity following a spike in 2021 as the economy rebounded from the COVID-19 pandemic.
- Transport emissions have shown consistent growth, amounting to 28 Mt CO_2e or 9.92% of total emissions in 2022. This increase is attributed to the steady rise in the number of vehicles and fuel consumption that is in turn is largely due to the shift from use of public transport to cars.
- Fugitive emissions from the extraction and transportation of solid fuels were 11.6 Mt CO_2e in 2022, a 68.9% reduction compared to 1990 levels. Similarly, leaks from the production,

storage, and transportation of oil and natural gas decreased by 38.3% compared to 1990, amounting to 26.9 Mt CO_2e. These reductions are due to advancements in extraction and transportation technologies and improved measures for monitoring and preventing leaks.

Overall, the energy sector's emissions reflect Kazakhstan's economic structure and energy profile, with improvements over the years but persistent challenges in reducing reliance on fossil fuels.

Figure 1.8. Emissions in the Energy sector by categories, 1990–2022



1.D.2. Industrial Processes and Product Use

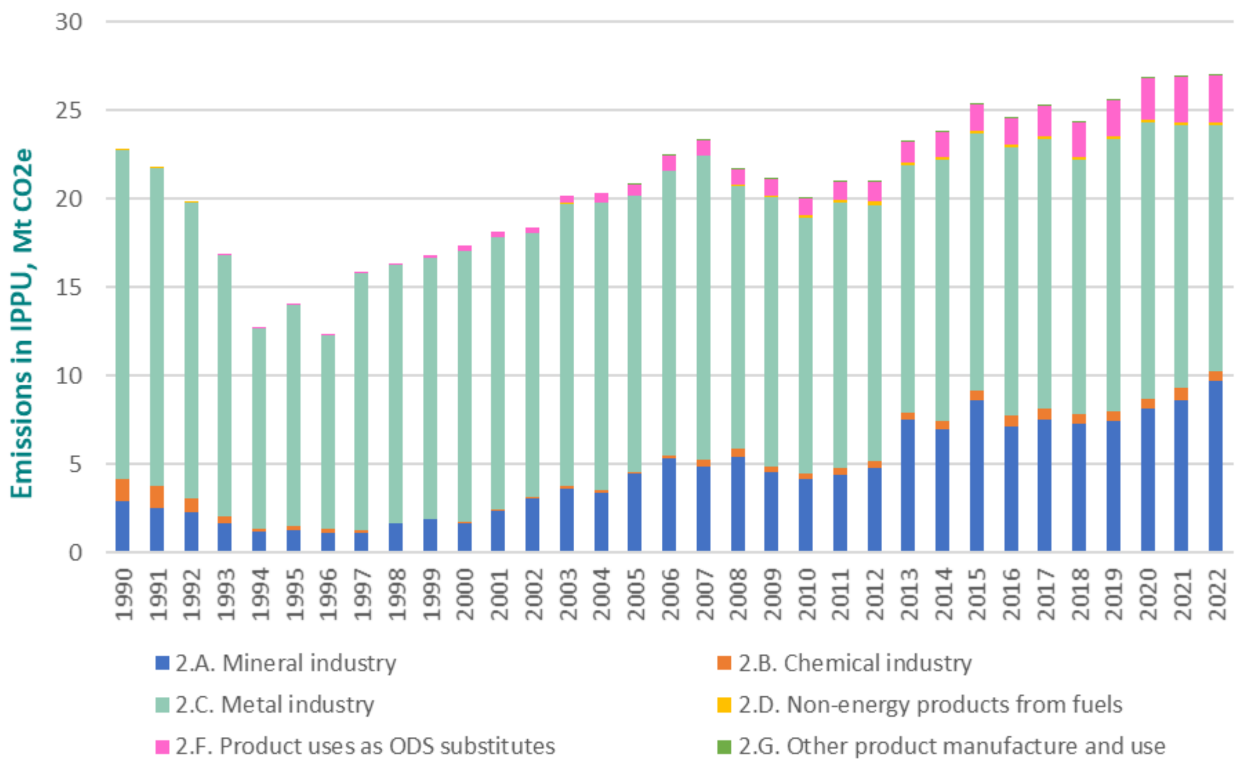
The IPPU sector in Kazakhstan is a significant source of GHG emissions, particularly in industries such as metal and mineral industries. In 2022, total emissions from the IPPU sector reached 27 Mt CO_2e, representing a 0.5% increase compared to 2021. Compared to 1990 levels, emissions have risen by 18.8%, reflecting the steady growth of industrial activity.

Key sources of emissions within the sector include:

- Metal industry (notably iron, steel, and ferroalloy production) contributed approximately 14 Mt CO_2e, accounting for 51.7% of the sector's total emissions.
- Mineral industry was the second-largest contributor, with emissions of 9.7 Mt CO_2e, representing around 35.9% of sectoral emissions.
- Product use as substitutes for ozone-depleting substances (ODS) resulted in emissions of 2.7 Mt CO_2e, making up roughly 9.8% of the sector's total emissions.

Overall, the IPPU sector in Kazakhstan is an increasingly significant source of emissions, driven primarily by the metal and mineral industries, despite some advancements in efficiency.

Figure 1.9. Emissions in the Industry sector by categories, 1990–2022



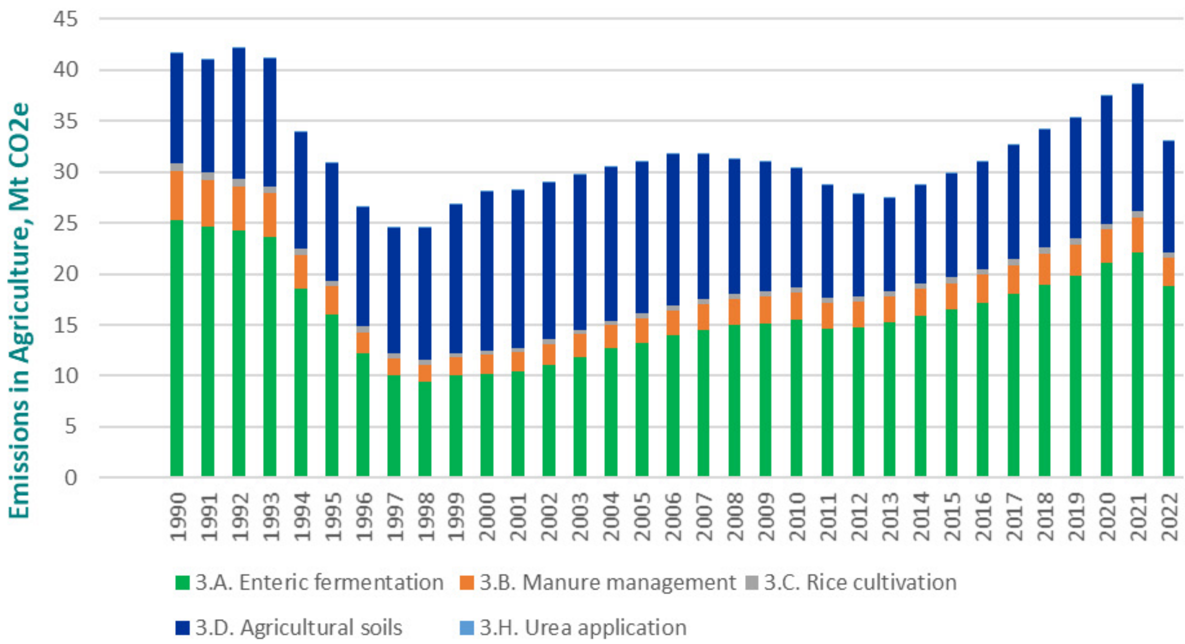
1.D.3. Agriculture

In Kazakhstan's agriculture sector, the main GHGs are methane (CH_4) and nitrous oxide (N_2O). In 2022, total emissions from this sector amounted to 33 Mt CO_2e, a decrease of 14.5% compared to the previous year and a 21% reduction compared to 1990 levels. In 2022, CH_4 emissions totaled 19.95 Mt CO_2e (60.4%), while N_2O emissions reached 13.05 Mt CO_2e (39.5%). CO_2 emissions from urea application were negligible, accounting for approximately 0.01%.

The primary source of CH_4 emissions is enteric fermentation in livestock, which accounted for 56.8% of the sector's emissions. N_2O emissions are mainly related to soil management, including the use of fertilizers and agronomic practices, constituting 33.1% of total emissions in the sector.

Emission variations were driven by changes in livestock numbers and the expansion of agricultural activities, which were linked to improved economic conditions after 2000. The apparent sharp reduction in emissions by 5.6 Mt CO_2e in 2022 compared to the previous year resulted from a revision of livestock data conducted by the ASPR of Kazakhstan. This revision led to a recalculation of the livestock population for nearly all animal species. Nonetheless, agriculture remains the second-largest source of greenhouse gas emissions in the country, following the energy sector.

Figure 1.10. Emissions in the Agriculture sector by categories, 1990–2022



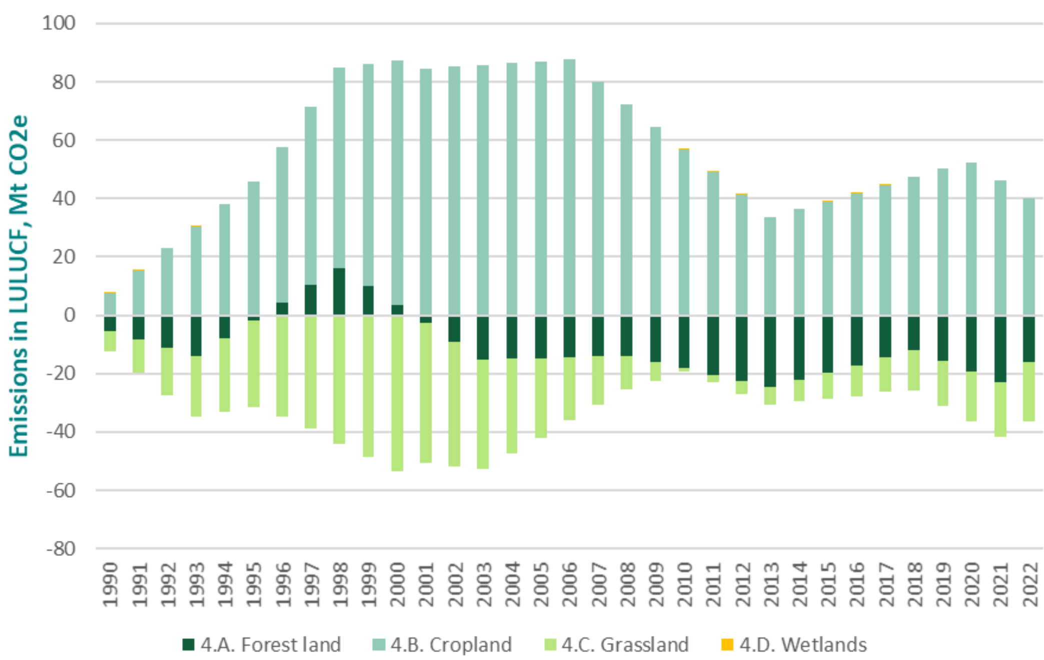
1.D.4. Land Use, Land Use Change and Forestry

The LULUCF sector in Kazakhstan contributed both to carbon sequestration and to GHG emissions. In 2022, total net emissions from this sector amounted to 4.1 Mt CO_2e, representing a 11.9% decrease compared to 2021. The main categories within the LULUCF sector for 2022 include:

- Croplands — the primary source of emissions, contributing around 40.3 Mt CO_2e in 2022.
- Agricultural lands and pastures sequestered a significant amount of emissions, amounting to 20.3 Mt CO_2e.
- Forests also contributed to carbon sequestration, absorbing 15.9 Mt CO_2e.

The LULUCF sector involves both carbon capture through sequestration in forests and pastures, as well as emissions from activities such as biomass burning and land-use changes.

Figure 1.11. Emissions in the LULUCF sector by categories, 1990–2022



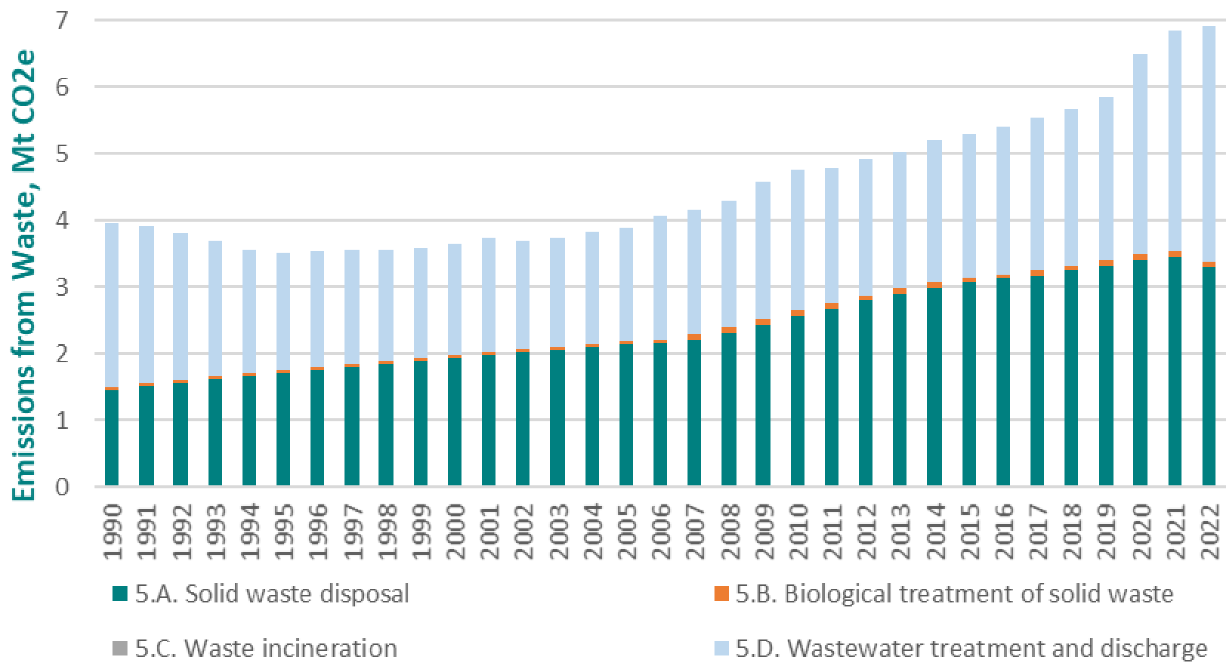
1.D.5. Waste Sector

The waste sector in Kazakhstan contributes to GHG emissions primarily through the disposal of solid waste, wastewater treatment and discharge. In 2022, total GHG emissions from this sector amounted to 6.9 Mt CO_2e, reflecting a 1% increase compared to 2021 and a 74.2% rise compared to 1990 levels. Methane (CH_4) is the predominant GHG, accounting for 94% of the sector's emissions.

The main sources of emissions in the waste sector remain unmanaged landfills and wastewater discharge. In 2022, wastewater treatment and effluent discharge contributed 3.5 Mt CO_2e, or 51% of the sector's total emissions. Solid waste landfills accounted for the remaining 3.3 Mt CO_2e, or 48% of emissions.

There has been a gradual increase in methane emissions, particularly from unmanaged landfills, which presents a significant challenge for reducing GHG emissions in the sector. This rise is closely tied to population growth and the increasing generation of waste.

Figure 1.12. Emissions in the Waste sector by categories, 1990–2022



INFORMATION NECESSARY TO TRACK PROGRESS MADE IN IMPLEMENTING AND ACHIEVING NATIONALLY DETERMINED CONTRIBUTIONS UNDER ARTICLE 4 OF THE PARIS AGREEMENT

2

CHAPTER II:

Information necessary to track progress made in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement

This chapter provides information on a broad range of issues related to tracking progress in NDC of Kazakhstan, covering relevant national circumstances and institutional arrangements, description of NDCs, NDC progress that is manifested through a selected indicator, mitigation policies and measures and GHG emission projections. Further information is presented in the common tabular formats for the electronic reporting of the information (CTF) tables II.1-11 on tracking progress of NDCs and an appendix contained therein.

2.A. National circumstances and institutional arrangements

This section provides information on the national circumstances of Kazakhstan that are relevant to understanding and tracking the progress towards implementation and achievement of its NDC under Article 4 of the Paris Agreement and on understanding of how national circumstances affect GHG emissions and removals over time. This includes information on government structure and population, geographical, economic, climate and sectors' profiles. This also includes information on legal, institutional, administrative and procedural arrangements for domestic implementation, monitoring, reporting and archiving of information, and stakeholders engagement relevant to tracking the NDC.

Further information on national circumstances is provided in Chapter III Information related to climate change impacts and adaptation under Article 7 of the Paris Agreement and Chapter IV Information on financial, technology development and transfer and capacity building support needed and received under Articles 9–11 of the Paris Agreement.

2.A.1. National circumstances

2.A.1.1. Government structure

Kazakhstan is a unitary, secular state with a presidential form of government[1]. Power in Kazakhstan is distributed among three independent branches of government. Legislative power is vested in the Parliament, which consists of two chambers: the Senate (upper house) and the Mazhilis (lower house). Executive power is exercised by the President and the Cabinet of Ministers, which oversees the system of executive bodies. Judicial power is administered by the judicial system, which includes the Supreme Court, regional, city, and district courts and as well as specialized courts (military, juvenile, economic).

As of early 2023, Kazakhstan's administrative-territorial structure included 17 regions, 3 cities of republican significance, 188 administrative districts, 89 towns, 29 settlements, and 6,295 rural settlements[2].

Strategic decisions on climate policy are made by the President, Parliament and Government of Kazakhstan. The planning and implementation of climate strategies and policies are coordinated by the Presidential Administration, through the designated Advisor to the President and Special Representative for International Environmental Cooperation, in close collaboration with the Ministry of Foreign Affairs of Kazakhstan.

The Ministry of Ecology and Natural Resources (MENR) is responsible for implementing and achieving the NDC objectives in cooperation with other relevant ministries. Table 2.1 provides details on the key ministries and agencies directly and indirectly involved in implementation of the NDC by 2030 and related Strategy for Achieving Carbon Neutrality by 2060.

Table 2.1. Ministries and agencies of the Republic of Kazakhstan responsible for climate change policies and measures included in the NDC and their respective roles

No.	Ministry and Agency	Role
Responsible for implementation and achievement of NDC		
1	Ministry of Ecology and Natural Resources	Regulates greenhouse gas emissions and removals; formulates state policy for green economy development and climate change.
1.1.	Department of Climate Policy	Formulates and implements coordinated state policy on climate and ozone layer protection; implements provisions of the UNFCCC and other international agreements; oversees state policy on international cooperation.
1.2	Forestry and Wildlife Committee	Carries out implementation, control and supervisory functions related to forestry, wildlife protection, and use of specially protected natural areas
1.3	Zhasyl Damu JSC	Acts as the national operator of the Carbon Units Trading System; collects, processes and stores baseline information; assesses GHG emissions and removals; Prepares and submits the national GHG Inventory[3]
Responsible for implementation of the Strategy for Achieving Carbon Neutrality by 2060		
2	Ministry of National Economy	Developed the Strategy for Achieving Carbon Neutrality by 2060 and supervises the Roadmap of the Strategy
2.1	Economic Research Institute	Develops and coordinates policies and measures to implement the Strategy for Achieving Carbon Neutrality by 2060, including the Roadmap

[1] Constitution of the Republic of Kazakhstan
[2] Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, Demographic Yearbook of Kazakhstan, 2021
[3] National Operator Zhasyl Damu JSC https://recycle.kz/ru

No.	Ministry and Agency	Role
Supporting sectoral policies		
3	Ministry of Energy	Develops and coordinates policies for Kazakhstan's fuel and energy complex, considering low-carbon development and green economy principles to meet present and future needs[4]
4	Ministry of Agriculture	Develops and coordinates policies for the agro-industrial complex, focusing on green technologies, sustainable production, effective resource management, and improved infrastructure, welfare, and environmental quality[5]
5	Ministry of Water Resources and Irrigation	Develops and coordinates policies for the national water strategy and policy, integrating green economy principles
6	Ministry of Transport	Develops and coordinates policies for transport sector development, emphasizing accessibility, efficiency, safety, and minimizing environmental impact[6]
7	Ministry of Industry and Construction	Develops and coordinates policies related to technical, industrial, mining, and smelting enterprises, integrating green economy and low-carbon development indicators[7]
8	Agency for Strategic Planning and Reforms	Collects key statistical data for GHG inventory and tracking progress towards achieving NDC
8.1	Bureau of National Statistics	
9	Ministry of Digital Development, Innovations and Aerospace Industry	Collects key data that is used to track progress towards achieving NDC (aerography, cartography, geodesy)

Additionally, the Council on Transition to Green Economy, under the President of Kazakhstan and chaired by the Prime Minister, acts as the coordinating body for sustainable development issues, including climate change. One of the Council's key functions is to monitor and assess the implementation of the Concept for the Transition to a Green Economy by relevant state bodies and provide recommendations based on these assessments.

The MENR serves as the working body of the Council. Its tasks include overseeing the implementation of the Council's decisions and collection of information necessary for the fulfillment of the Council's tasks.

[4] https://www.gov.kz/memleket/entities/energo/documents/details/100787?lang=ru Strategic Plan of the Ministry of Energy for 2020–2024

[5] Concept for Development of AIC RK for 2021–2030, Resolution of the Government of the RK dated 30.12.2021, No. 960.

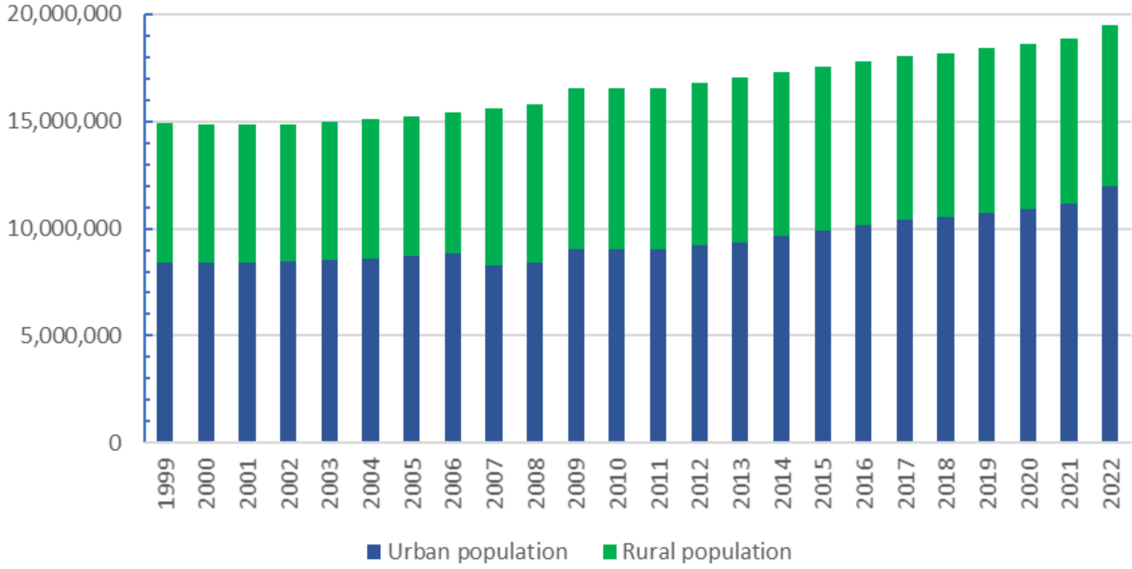
[6] On approval of "Nurly Zhol" State Infrastructure Development Program for 2020–2025; Concept of Transport and Logistics Potential Development, Resolution of the Government of the Republic of Kazakhstan dated 30.12.2022, No. 1116.

[7] On approval of "Nurly Zher" State Infrastructure Development Program for 2020–2025. On approval of the Concept of Industrial and Innovative Development of the Republic of Kazakhstan for 2021–2025

2.A.1.2. Population profile

As of the beginning of 2023, the population of Kazakhstan reached 19,8 million people, of which 10 million (51.19%) were women and 9,6 million (48.81%) were men. The urban population was 12,3 million people and the rural population was 7,5 million people. (Figure 2.1)[8]

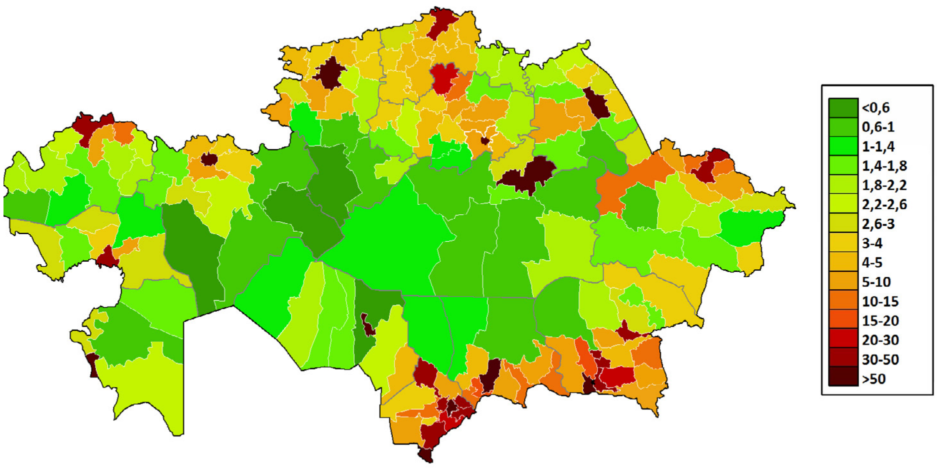
Figure 2.1. Population distribution



Source: Demographic statistics. Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan.

Net migration changed from minus 22,130 people in 2017 to minus 6,722 in 2022. National average population density in 2022 was 7.2 people per square kilometer. However, population density is highly uneven, with the majority of population concentrated in the southern part of the country, particularly in Turkestan and Almaty regions, the cities of Shymkent and Almaty. (Figure 2.2).

Figure 2.2. Population density by region/district



Source: Demographic statistics. Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan.

[8] Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, Demographic Yearbook of Kazakhstan, 2022

The country's population is projected to reach 24.5 million by 2050. If the current trend continues, the population in the northern regions will decrease by 0.9 million, while the number of people living in the southern regions will increase by 5.3 million.

Urban population growth, which drives higher energy consumption, may lead to a rising demand for energy. Since Kazakhstan's energy supply remains largely fossil fuel-based, this demographic shift to urbanization, without mitigation policies, could result in increased GHG emissions.

2.A.1.3. Geographical profile

Kazakhstan is located at the junction of two continents – Europe and Asia. Its vast territory spreads over 2,724,902 km^2 and a state border stretching 13,398 km[9].

The country ranks ninth in the world by land area and is the largest landlocked nation, without access to the World Ocean. The topography of the territory is predominantly flat, with more than 90% of the territory occupied by plains. High mountains occupy only the Southeast and East of the country.

Most of the country consists of arid natural zones: desert, semi-desert and dry-steppe. More favorable moisture conditions, such as steppes and forest-steppes, are found only in the northern regions.

The trend of land use in Kazakhstan is presented in Table 2.2 and Figure 2.3. Between 2017 and 2022, agricultural land experienced a significant expansion, increasing by over 11% (11,915.6 thousand hectares). Similarly, the area designated as specially protected natural territories grew by 9.5% (677 thousand hectares). In contrast, lands allocated for industry, transport, communication, defense, and other non-agricultural purposes, along with reserve lands, have decreased by more than 21% (604.2 thousand hectares) and 12.3% (11,922.7 thousand hectares), respectively. Meanwhile, the area of forest reserve land remained relatively stable over this period.

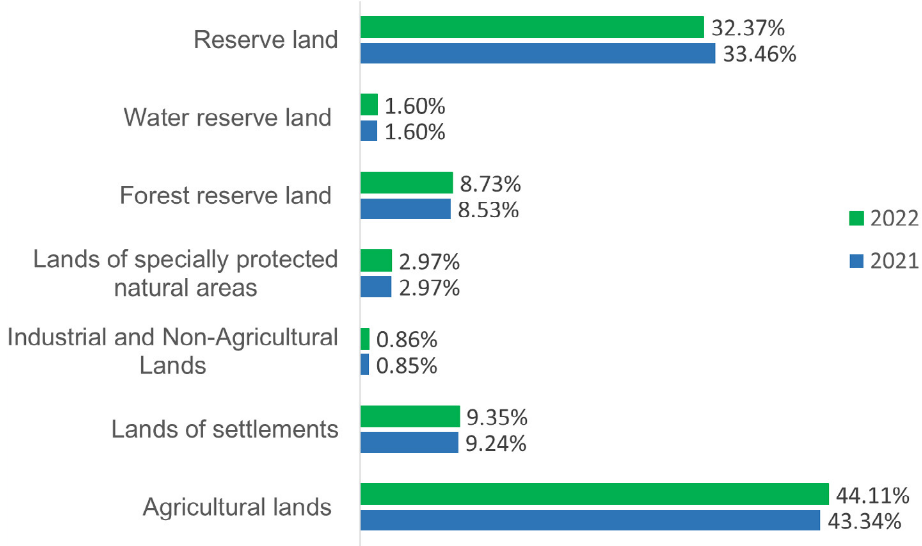
Table 2.2. Trend of changes in land resources, in thousands hectares

Land category in thousand hectares	2017	2018	2019	2020	2021	2022
Agricultural lands	104,051	105,337	106,433	108,563	113,961	115,966
Land of settlements	23,806	24,053	24,077	24,192	24,289	24,593
Lands of industry, transport, communication, defense and other non-agricultural purposes	2,877	2,245	2,318	2,209	2,239	2,273
Lands of specially protected natural areas	7,134	7,284	7,697	7,706	7,811	7,811
Forest reserve land	22,881	22,738	22,398	22,398	22,435	22,964
Water reserve land	4,140	4,145	4,222	4,208	4,207	4,209
Reserve land	97,037	96,707	95,716	93,642	87,989	85,115

Source: "Indicators of the Green Economy of the Republic of Kazakhstan. Land Resources", Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2017–2022.

[9] https://www.gov.kz/memleket/entities/kgk/press/article/details/2328?lang=ru Demarcation of the state border of the Republic of Kazakhstan

Figure 2.3. Structure of land resources of Kazakhstan, 2021–2022.



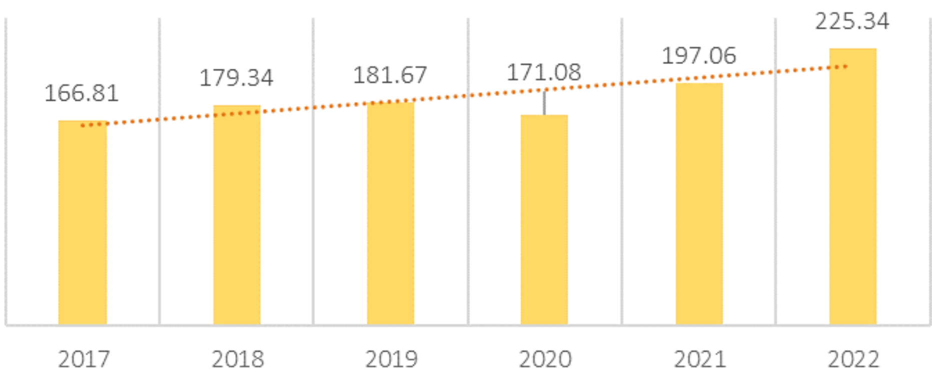
Source: Indicators of the Green Economy. Land resources. Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2022.

In the context of land use and the state of land resources, the steady annual expansion of agricultural land by an average of 1% (or 1.1 million hectares) poses a dual challenge. It may lead to an increase in GHG emissions while reducing carbon removals associated with land use and land use change. Furthermore, this expansion heightens the risk of land degradation, a threat exacerbated by the growing aridity of the climate and unsustainable agricultural and land management practices. These trends emphasize the urgent need for adaptation measures, particularly to prevent and mitigate land degradation and its associated impacts.

2.A.1.4. Economic profile

The gross domestic product (GDP) of Kazakhstan showed a steady growth between 2017 to 2022[10]. (Figure 2.4)

Figure 2.4. Gross Domestic Product, USD billion[11]



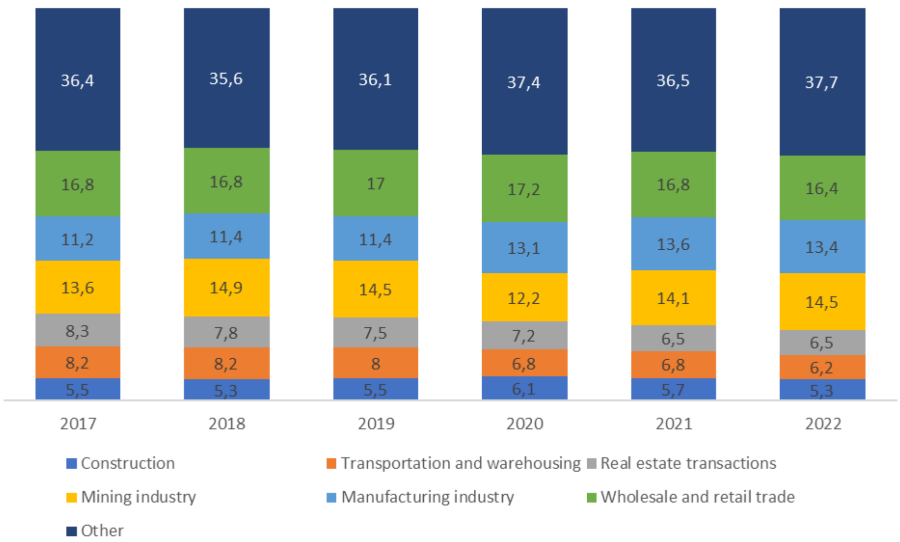
Source: Kazakhstan in Figures. Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics, 2022. National Bank of the Republic of Kazakhstan. Archived exchange rates for 2017–2022.

[10] Gross domestic product by method of production, in current prices. Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics, 2022.
[11] https://nationalbank.kz/ru/news/oficialnye-kursy National Bank of the Republic of Kazakhstan.

In 2022, industry, which accounts for 29.5% of the total GDP, consists of the mining sector (14.5% of GDP), manufacturing industry (13.4%), electricity supply (1.4%), and water supply (0.2%).

Between 2017 and 2022, the industry's share of GDP increased by 2.7 percentage points, rising from 26.8% to 29.5% (Figure 2.5)[12].

Figure 2.5. Contribution of major economic sectors to the Gross Domestic Product in 2017-2022, percentage



Source: GDP structure by production method. Agency for Strategic Planning and Reforms of Kazakhstan. Bureau of National Statistics, 2022.

Significant GDP growth between 18–20% is recorded in 2021–2022 following the lifting of restrictions caused by the COVID-19 pandemic and subsequent economic recovery.

According to the results of the 2021–2022 period, the most attractive sectors for investment remain industry, namely the mining sector, metallurgy, and construction (Table 2.3).

Table 2.3. Structure of investments in fixed capital by sector in 2021–2022, in mln KZT and USD mln.

Directions for use	2021		2022	
	KZT mln (USD mln)	%	KZT mln (USD mln)	%
Agriculture, forestry and fishing	772,475 ***(1,813)***	5.8	853,521 ***(1,854)***	5.7
Industry	6,500,085 (***15,257***)	49.1	7,257,220 ***(15,760)***	48.2
Construction	126,672 ***(297)***	1.0	215,383 ***(468)***	1.4
Wholesale and retail trade; cars and motorcycles repair	270,543 ***(635)***	2.0	334 550 ***(727)***	2.2
Transportation and warehousing	1,472,265 ***(3,456)***	11.1	1,584,783 ***(3,442)***	10.5
Provision of accommodation and food services	173,730 ***(408)***	1.3	131,096 ***(285)***	0.9
Information and telecommunication	147,419 ***(346)***	1.1	178,939 ***(389)***	1.2
Financial and insurance activities	95,862.5 ***(225)***	0.7	123,712 ***(2,684)***	0.8
Real estate transactions	2,597,289 ***(6,097)***	19.6	3,053,863 ***(6,632)***	20.3
Professional, scientific and technical activities	68,507 ***(161)***	0.5	57,167 ***(124)***	0.4
Administrative and support services activities	155,092 ***(364)***	1.2	144,183 ***(313)***	1.0

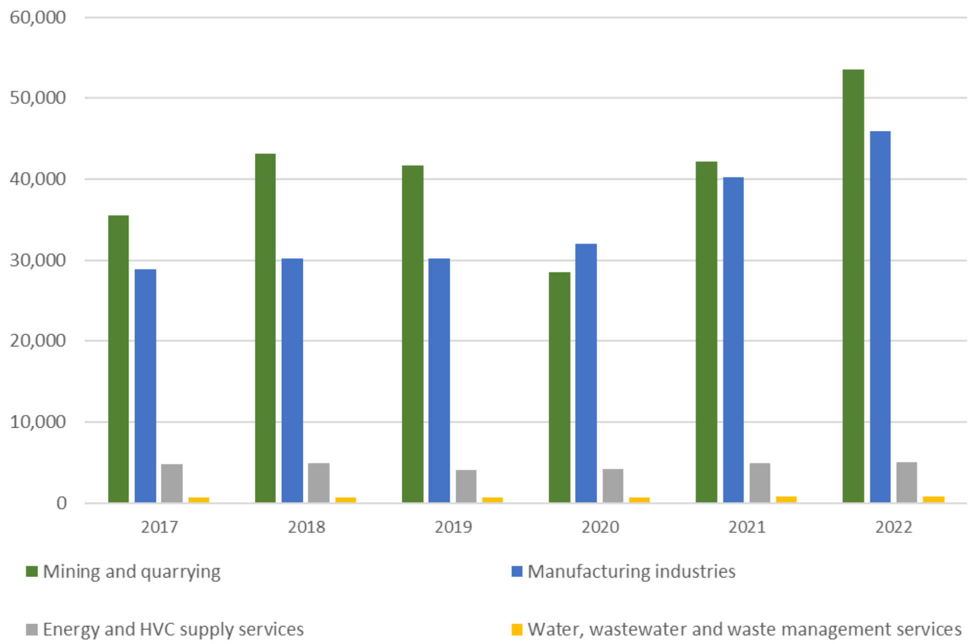
[12] GDP structure by production method. Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics, 2022.

Directions for use	2021		2022	
	KZT mln (USD mln)	%	KZT mln (USD mln)	%
Public administration and defence; compulsory social security	66,494 ***(156)***	0.5	160,996 ***(350)***	1.1
Education	282,907 ***(664)***	2.1	369,371 ***(802)***	2.4
Public health and social services	187,287 ***(440)***	1.4	272,972 ***(593)***	1.8
Arts, entertainment and recreation	264,499 ***(61)***	2.0	249,164 ***(541)***	1.7
Provision of other types of services	61,108 ***(143.4)***	0.5	77,513 ***(168)***	0.5

Source: Agency for Strategic Planning and Reforms of the Republic of Kazakhstan. Bureau of National Statistics, 2021–2022. National Bank of the Republic of Kazakhstan. Exchange rates for 2021–2022, according to the National Bank data.

Between 2017 and 2022, the manufacturing industry collectively produced industrial output totaling KZT 82.9 trillion (USD180 billion) (Figure 2.7).

Figure 2.6. Gross output of the industrial sector for 2017–2022 in current prices, USD million



Source: Volume of products (goods, services) in current prices by types of economic activities for 2017–2022. Bureau of National Statistics of the Republic of Kazakhstan. National Bank of the Republic of Kazakhstan. Archived exchange rates for 2017–2022.

In 2022, Kazakhstan's foreign trade turnover (exports plus imports) reached USD135.5 billion, marking an increase of USD57.4 billion compared to 2017, and net foreign trade balance remained positive by a large margin. This growth reflects the country's efforts to overcome the impacts of the COVID19 pandemic and regional geopolitical tensions through reforms in trade logistics. (Table 2.4)

Table 2.4. Foreign trade turnover of Kazakhstan

	2017	2018	2019	2020	2021	2022
Exports, USD mln	48,503.3	61,111.2	58,065.6	47,540.8	60,321.0	84,593.1
Imports, USD mln	29,599.6	33,658.5	39,709.3	38,929.1	41,415.4	50,934.4
Foreign trade turnover, USD mln	78,102.9	94,769.7	97,774.9	86,469.9	101,736.4	135,527.4
Growth rate compared to the previous period, %	125.70	121.34	103.17	88.44	117.66	133.20

Source: Foreign trade turnover of the Republic of Kazakhstan, 2017–2022. Bureau of National Statistics.

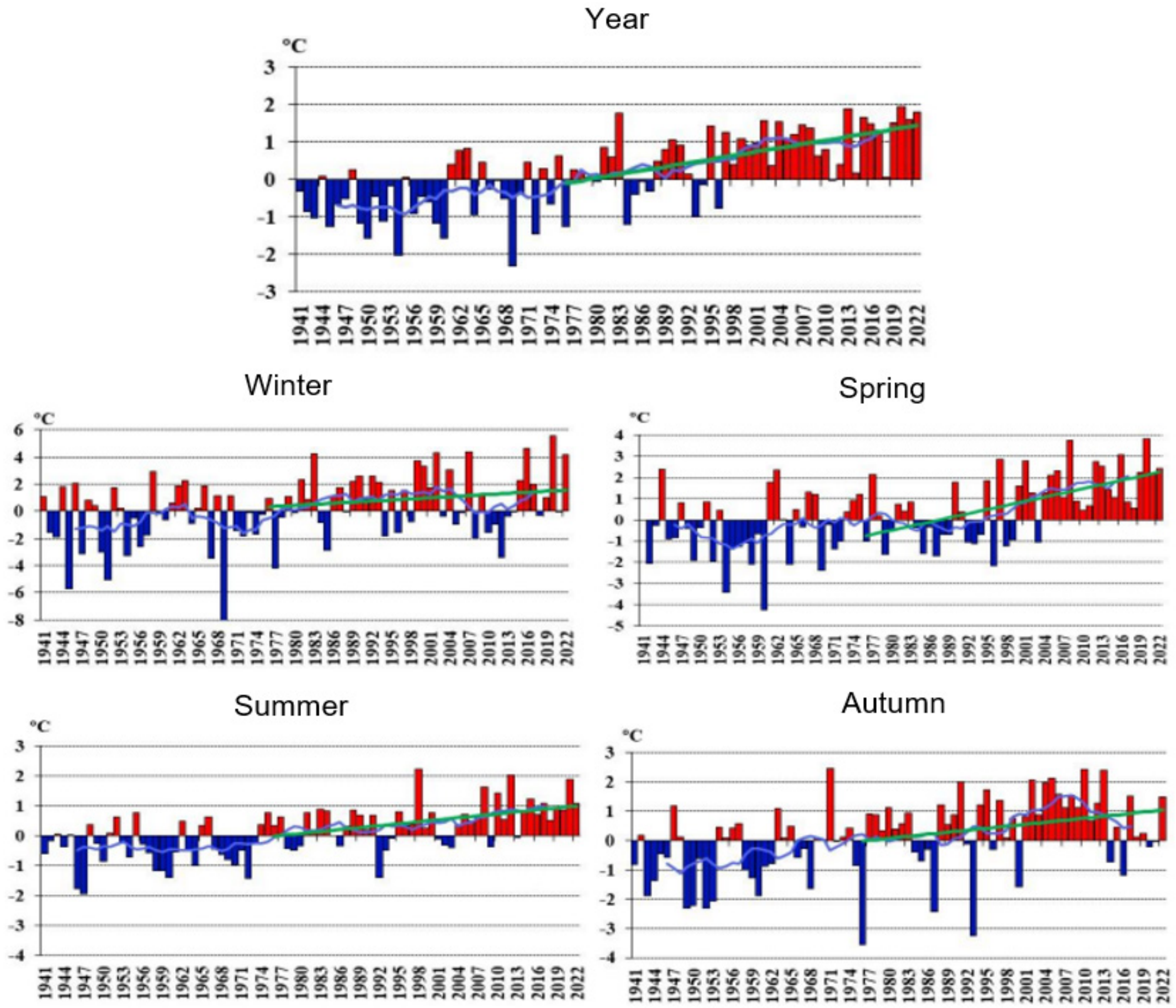
2.A.1.5. Climate profile

The vast territory of Kazakhstan is distinguished by a remarkable variety of relief, ranging from extensive lowland plains to highlands. Western, south-western, northern and central regions of Kazakhstan are characterized by flat relief with low altitudes in the range of 200–300 m above sea level. Hummocky terrain have elevations up to 500–600 m, foothill and mountainous areas occupy about 10% of the territory of Kazakhstan and are located in the south, south-east and east.

The climate of Kazakhstan due to its great remoteness from the World Ocean is sharply continental with long hot summers and cold winters, with large daily and annual fluctuations in air temperature.

The average annual air temperature across the territory of Kazakhstan has increased by 0.33 °C per decade during the period from 1976 to 2022, contributing to 30% of the total temperature variability. This warming trend is not limited to the rise in average air temperature but also includes an increased frequency of high summer temperatures. In the hot and dry summer conditions characteristic of the western and southern regions of Kazakhstan, these changes have adverse effects not only on vegetation but also on human and animal health and well-being (Figure 2.9).

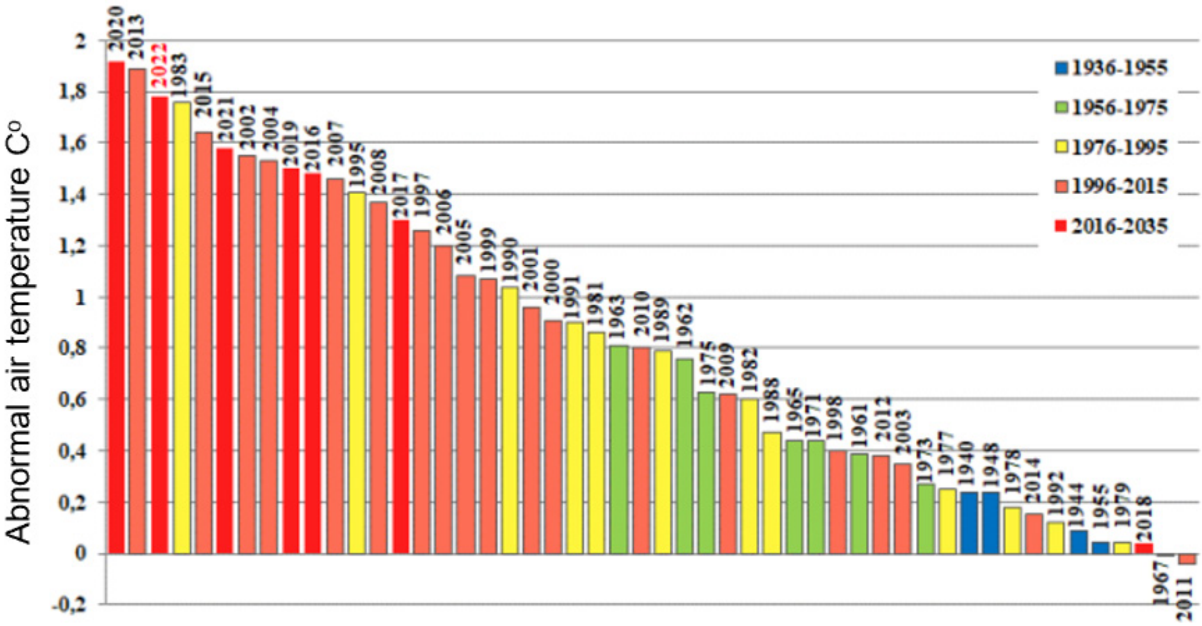
Figure 2.7. Time series of anomalies of annual and seasonal air temperatures (°C) averaged over the territory of Kazakhstan for the period from 1941 to 2022.



Source: Annual bulletin of monitoring of the state and climate change of Kazakhstan 2022. Kazhydromet RSE, Ministry of Ecology and Natural Resources of the Republic of Kazakhstan.

In 2022, the average annual air temperature in Kazakhstan exceeded the climatic norm for the 1961–1990 reference period by 1.78 °C. This ranks as the third-highest temperature in the series of warmest years recorded from 1941 to 2022. Additionally, 2022 was among the top 5% of exceptionally warm years in the country's recorded climate history (Figure 2.8).

Figure 2.8. Ranked series of positive anomalies of mean annual (January-December) surface air temperatures averaged over the territory of Kazakhstan for the period from 1941 to 2022.



Note: Information presented in this figure is based on data from 121 meteorological stations). Anomalies are calculated relative to the base period between 1961 and 1990.

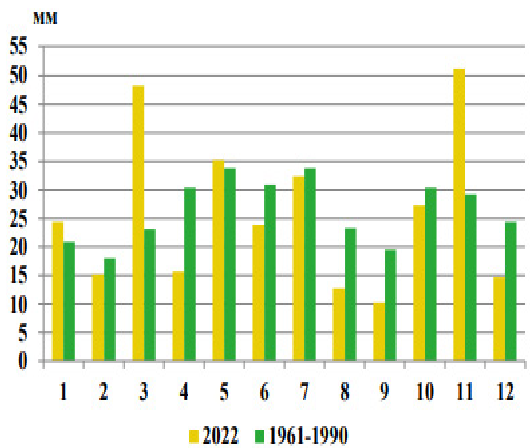
Source: Annual bulletin of monitoring of the state and climate change of Kazakhstan 2022. Kazhydromet RSE, Ministry of Ecology and Natural Resources of the Republic of Kazakhstan.

Extremely high annual temperatures were recorded at the majority of weather stations across the country. In the western, southern, and eastern regions, 2022 was the warmest year since 1941, with record temperature anomalies ranging from +1.13 to +3.11 °C.

In many regions of Kazakhstan, January, April to June, and September experienced extreme heat, with daily maximum temperatures in 2022 exceeding 30 °C and even 35 °C across the country, except in high mountainous areas.

During the summer of 2022, average precipitation was below normal at 78.4%. In contrast, precipitation during winter, spring, and fall was near or above normal, amounting to 92.8%, 113.6%, and 112.2%, respectively (Figure 2.9).

Figure 2.9. Averaged monthly precipitation amounts over the territory of Kazakhstan in 2022 and their base values for the period from 1961 to 1990.



Source: Annual bulletin of monitoring of the state and climate change of Kazakhstan 2022. Kazhydromet RSE, Ministry of Ecology and Natural Resources of the Republic of Kazakhstan.

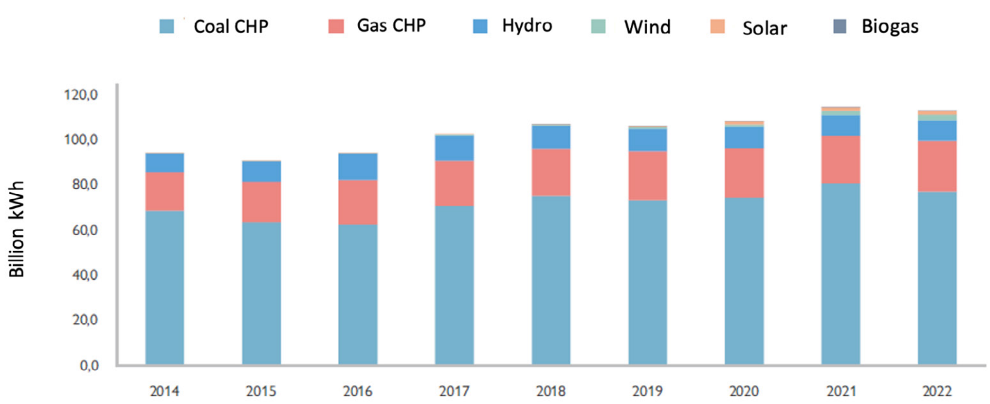
However, an average precipitation deficit was observed across much of Kazakhstan throughout the year, particularly in February, April, from June to October, and in December. April (15.7 mm, 52% of the norm) and September (10.2 mm, 53% of the norm) were notably dry months. Conversely, March was the wettest month on record, with an average rainfall of 48.3 mm (209% of the norm), followed by an exceptionally wet November, which recorded 51.2 mm of rainfall (175% of the norm).

2.A.1.6. Sectoral details

2.A.1.6.1. Energy

The structure of electricity generation in Kazakhstan is dominated by coal-fired power plants, which account for 68.2% of total electricity generation in the country. Gas-fired power plants account for 20.1%, hydropower plants for 8.1%, and wind and solar power plants for 2.1% and 1.6% respectively (Figure 2.10). Since 2014, total electricity generation has increased by 20% (18.9 billion kWh). Over the same period, the share of coal-fired generation has decreased from 72.9% to 68.2% due to the expansion of gas-fired power generation and growth of renewable energy sources (RES).

Figure 2.10. Electricity generation structure, bln kWh



Source: KAZENERGY National Energy Report, 2023.

In 2022, 207 power plants of various ownership types were operating in Kazakhstan. As of December 31, 2022, their total installed capacity reached 24,5 GW, with an available capacity of 19 GW. During the year, 17 RES facilities were commissioned, adding a combined capacity of 561.7 MW. Total national RES facilities generated 5 billion kWh of electricity, accounting for 4.4% of total electricity production in 2022[13].

The heat sector in Kazakhstan is predominantly reliant on centralized heat supply, with district heating systems accounting for approximately 43% of total heat consumption. By the end of 2022, 37 thermal power plants and over 2,500 boiler houses served as the primary heat energy sources for centralized heating systems. The total installed capacity of heat sources was 43,231 Gcal/h in 2022. And the available capacity was 37,567 Gcal/h. Heat production in 2022 in Kazakhstan amounted to 94 mln Gcal.

Coal from Kazakhstani deposits (~80%), natural gas (~15%) and fuel oil (~5%) are the fuels of choice for heat generation. Centralized heating networks cover nearly 80% of the urban population, but less than 5% of rural residents. In rural areas, solid fuel stoves or boilers are the

[13] Annual Report, 2022. KEGOC JSC https://www.kegoc.kz/upload/iblock/68b/pwd8mvqgomgjuz2ub5kt5ci1cq1cl3mq.pdf

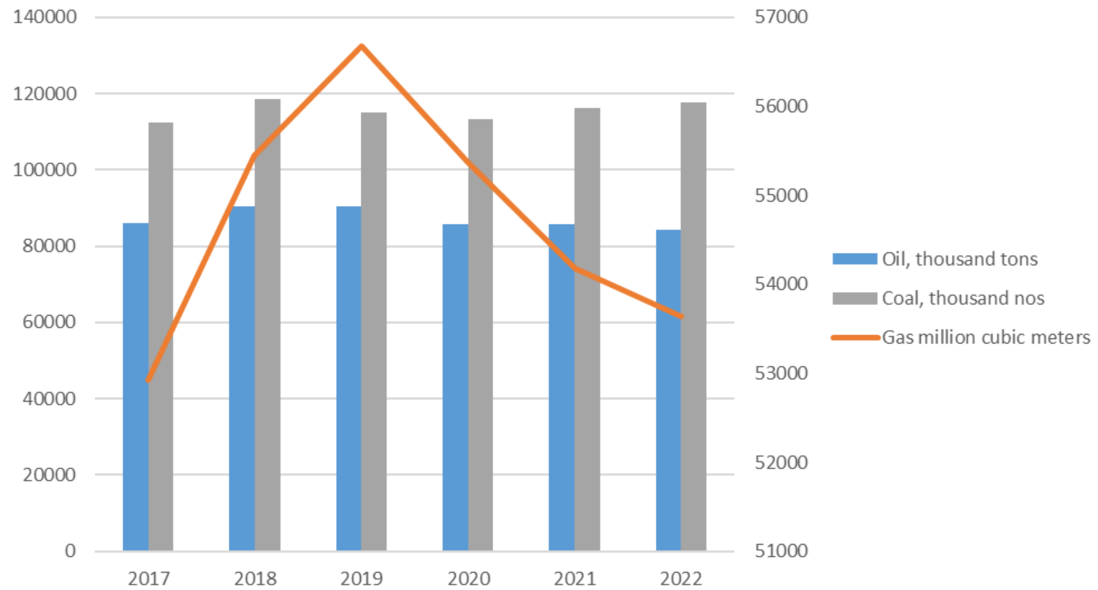
most common heating methods. Approximately 30% of all households do not receive heat from the centralised system and use coal as their primary heating source, 20% use gas and 5% use other sources. Electricity for heating is used only to a limited extent.

The total length of two-pipe heat networks in Kazakhstan is approximately 12,278 kilometers, of which around 30% (3,936 kilometers) require replacement. The average depreciation of heat networks is 57%. The heat supply sector is marked by low efficiency, with an average efficiency of 75% for boilers and 58% for the whole system. Heat losses during transportation and distribution range from 18 to 42%, resulting in significant emissions and inefficiencies[14].

Kazakhstan's oil and gas sector is a cornerstone of the country's socio-economic development, contributing substantially to tax revenues and accounting for approximately a quarter of GDP. Hydrocarbon production is concentrated in three major fields: Tengiz, Karachaganak, and Kashagan. Kazakhstan remains a net exporter of primary energy resources – crude oil accounts for about 80% of energy exports, followed by natural gas and other hydrocarbons. In 2022, crude oil production declined by 2.7% compared to 2021.

The dominant role of coal in Kazakhstan's heat and power generation, coupled with its widespread use by households, remains a key driver of the country's total coal production. Despite efforts to expand household and regional national gas supply and convert some urban combined heat and power plants from coal to gas, both coal production and domestic consumption have shown a gradual upward trend (Figure 2.11).

Figure 2.11. Total coal, oil and gas production in absolute terms



Source: Kazakhstan in Figures Statistical Yearbook, 2017–2022. Bureau of National Statistics. Agency for Strategic Planning and Reforms of the Republic of Kazakhstan

The oil sector, along with electricity and heat production, represents a vital component of Kazakhstan's energy sector. Crude oil refining and petroleum product manufacturing take place in three refineries. In 2022, domestic fuel producers met 99.1% of Kazakhstan's demand for gasoline (including aviation gasoline), 96.7% for diesel fuel and just 85.9% for kerosene.

When assessing the GHG emissions from the *Energy Industry* sector, it is essential to take into account the total fuel consumption that in 2022 stood at 1,516.768 PJ, a 25.6% increase compared to 2021. The total consumption mix

[14] Concept of electric power industry development in the RK for 2023–2029. Resolution of the Government of the Republic of Kazakhstan dated March 28, 2023, No. 263.

comprises 63.6% solid fuels, followed by 26.2% gaseous fuel, and 9.9% is liquid fuel.

Total GHG emissions in 2022 in the *Energy Industry* category amounted to 126.1 million tons CO2-eq., which is 11.4% below 1990 levels but 4.0% higher than in 2021. CO_2 emissions account for more than 99% of all GHG emissions in this category, totalling 125.6 million tons.

Fugitive emissions from production, processing, transmission, storage and use of coal, oil and natural gas amounted to 38.5 Mt CO_2-eq, reflecting 52% decrease compared to 1990.

The Energy Industry category contributes the largest share (44.5%) to total GHG emissions in the Energy sector, which includes emissions from fuel combustion. Within this category, electricity and heat generation account for 92.6% of emissions, while the remainder comes from oil, gas, and solid fuel extraction and distribution, as well as oil refining.

The increase in GHG emissions in the Energy sector is driven by the rise in heat and power generation that is almost entirely based on fossil fuel combustion. The existing plans to expand coal and oil production indicate that dependence on fossil fuel sources will continue in the future. To mitigate emissions from the Energy sector, the country needs to upgrade the existing coal-fired power plants and pursue the development of RES.

2.A.1.6.2. Transport

Kazakhstan's central location in Eurasia underscores the strategic importance of its transport sector. Roads and railroads form the backbone of ground transportation. Kazakhstan's transport system is based on a well-developed infrastructure, which includes all known modes of mass transportation. By the end of 2022, the transportation system comprised[15]:

- 94,781 km of public roads, of which 86,311.6 km are paved roads;
- 16,006 km of public railroads, of which 4,237.5 km are electrified (26.5%);
- 29,048 km of pipeline mains for transporting oil, gas and petroleum products;
- 2,169 km of navigable waterways.

Additionally, Kazakhstan has a well-developed air transportation system, with airports in all cities of regional significance. In recent years, significant updates have been made to the ground infrastructure of transportation hubs. In 2022, the transport sector contributed approximately 6.0% to the country's GDP.

According to the data of the Bureau of National Statistics of Kazakhstan[16], the number of registered passenger vehicles and buses has increased by the end of 2022; the volume of transport services (freight and passenger transportation) has increased as well, and air communication has been fully restored[17]. Clearly, this is due to the lifting of COVID-19 pandemic-related restrictions and quarantine measures.

GHG emissions from the transport category in Kazakhstan have shown steady growth. By the end of 2022, total emissions reached 28 Mt of CO2-eq., representing increases of 21.6% compared to 1990 levels and 6.2% compared to 2021. Road transport, which accounts for the majority of passenger transportation, was the largest contributor, responsible for 78.6% of emissions. Rail transport accounted for 11.7%, domestic aviation for 3.7%, and other modes of transport for 6.1%[18].

The main reason for the growth of GHG emissions from transport is seen in the change in the structure of transportation during the years of Kazakhstan's independence with

[15] Key transportation performance indicators for 2022. Bureau of National Statistics, ASP&R RK.
[16] https://www.gov.kz/memleket/entities/aspr?lang=ru Agency for Strategic Planning and Reforms of RK
[17] Bus, car, truck transportation for 2022. Bureau of National Statistics, ASP&R RK.
[18] Inventory of greenhouse gas emissions in Kazakhstan, 2024.

a major shift towards road transport. Since 1990, road transport's share has risen to 81%, while pipeline transport increased from 2% to 7%. In contrast, the share of railroad transport dropped from 23% to 4%, and water transport declined slightly from 0.9% to 0.7%. Aviation, despite modest annual growth, has maintained a relatively stable share of 4%, except during the past two years, when COVID-19 restrictions temporarily reduced its activity.

2.A.1.6.3. Industry

Emissions from industry in this section cover emissions from industrial processes including cement production.

The mining sector contributed the biggest share of Kazakhstan's GDP in 2022, accounting for 14.5%, followed by the manufacturing industry with a share of 13.4%, which has shown dynamic growth in recent years. The construction industry, while less significant, contributed 5.3% to GDP.

Recent growth in the manufacturing sector has been driven by the significant growth in the production of motor vehicles, trailers and semi-trailers, machinery and equipment, other vehicles, coke and refined petroleum products, food products, and metals.

Despite the growth in investment in the manufacturing sector, the foreign direct investment amounted USD5,460 million in 2021 and USD5,605 million in 2022[19],manufacturing production largely relies on outdated fixed assets. In recent years, the depreciation of fixed assets at existing industrial enterprises has been increasing, which may become a constraint to the implementation of potential improvements in the quality and competitiveness of manufactured goods and associated GHG emissions.

In 2022, the total fuel consumption in the industry sectors was 302.5893 PJ. Solid fuels accounted for the major share of the fuel use, accounting for 63.2%, followed by liquid fuels at 19.7% and gaseous fuels at 17.0%. The mining sector was the primary consumer of solid fuels, with the combustion of solid fossil fuels serving as the largest source of GHG emissions. The main categories contributing to GHG emissions were ferrous and non-ferrous metallurgy, the production of non-metallic minerals, and the mining industry.

The fossil fuel combustion from the Industry category contributed 9.8% to the total GHG emissions in the Energy sector in 2022.

Beyond emissions from fossil fuel combustion, several industries in Kazakhstan are also significant sources of GHG emissions from industrial processes. These include the production of mineral products (cement production, limestone, and dolomite use), the chemical industry (ammonia and nitric acid production), metal production (iron, steel, ferroalloys, and aluminum), the use of solvents and non-energy products from fuels, and the use of fluorinated gases as substitutes for ozone-depleting substances (e.g., in air cooling and conditioning) and sulfur hexafluoride.

The rise of the construction industry in the country has led to an increase in cement production, resulting in a 16.0% rise in CO2 emissions from this sector compared to 2021. The contribution of GHG emissions from cement production in the category mineral products was 46%.

The contribution of GHG emissions from the chemical industry is 2.1% in 2022 (2.4% in 2021) of all emissions from the sector. The main source of GHGs from the chemical industry are CO2 emissions from ammonia production and N2O emissions from the production of nitric acid, which are used in the production of complex mineral fertilizers. This type of industrial process is not a key category in Kazakhstan's national inventory due to the insignificance of the contribution.

The Industrial Processes sector in Kazakhstan is a growing source of emissions, mainly driven by

[19] Volume of gross FDI inflows to industry. National Bank of the Republic of Kazakhstan

both, the emissions from the metal production and construction industries, despite some improvements in efficiency that was achieved there, and added contributions from the ozone depleting substances, which were not present in 1990 GHG emissions[20].

2.A.1.6.4. Buildings and urban infrastructure

The country's housing stock has been steadily growing since the 2000s, amounting to 405.2 million square meters of total housing area at the end of 2022. Of these, 395.9 million square meters are privately owned and 9.3 million square meters remain state-owned. The urban housing stock accounts for 263.9 million square meters and the rural housing stock totals 141.2 million square meters. The level of housing provision per capita in 2022 increased to 23.4 square meters.

The housing stock of Kazakhstan is steadily improving not only in terms of area per capita, but also in terms of water supply, sewerage treatment, central heating and electrification. The only exception is gas supply. In 2022, key indicators of improvement included 98.2% access to water supply, 74.0% access to sewerage systems, and 43.9% access to central heating[21]. Coal-fired power generation remains the primary source of central heating and electrification for both private housing and municipal buildings.

In September 2022, Kazakhstan approved the Concept of Housing and Communal Infrastructure Development for 2023–2029. One of its key objectives is to create conditions for affordable housing for all segments of society, including socially vulnerable groups.

Enhancing energy efficiency and energy savings is another significant focus in Kazakhstan's housing sector. The country remains one of the most energy-intensive economies globally. However, progress has been made since the adoption of the Law on Energy Saving and Energy Efficiency in 2012[22]. By 2021, the energy intensity of GDP had been reduced by 8.3% compared to 2014 levels, demonstrating the effectiveness of energy efficiency and saving policies.

This reduction in the energy intensity of GDP was mainly driven by energy efficiency improvements in different sectors, including the housing sector. These improvements were achieved through energy audits and implementation of five-year energy saving plans. Since 2012, more than 2,000 energy audits have been conducted, resulting in investments in energy efficiency measures totaling KZT 323 billion[23].Stricter building codes, improved thermal-insulation of buildings and low tariffs for electricity supply can not only further reduce the heating demand, but also for decreased demand for cooling caused by climate change. These measures enhance the comfort and livability of buildings, ensuring resilience in the face of changing climatic conditions.

GHG emissions in *Buildings and Urban Infrastructure* (category "*Other Sectors of GHG inventory*) are directly related to electricity and heat consumption. In 2022, total GHG emissions from this category were 2% lower than in 1990, with CO2 emissions comprising more than 96% of the total. This category accounted for 17% of total emissions from the energy sector.

[20] Inventory of greenhouse gas emissions in Kazakhstan, 2024.
[21] On housing stock, 2022, Bureau of National Statistics ASP&R RK.
[22] Law of RK dated January 13, 2012, No. 541-IV. "On Energy Saving and Energy Efficiency Improvement" (with amendments and additions as of 29.06.2020).
[23] Annual Report of "Institute of Electric Power Industry Development and Energy Saving (Kazakhenergoekspertiza)" JSC for 2022. https://eedi.kz/docs/docs/2130883007662f99e86f14e2.15820442.pdf

2.A.1.6.5. Agriculture

Agriculture, including forestry and fishery, contributes only 5.2% of the GDP[24]. The total cultivated agricultural area has steadily increased from 21,839 million hectares in 2017 to 23,162 million hectares in 2022[25]. Agriculture comprises two major sectors: crop production and livestock farming.

In crop production, the largest areas are allocated to cereals, legumes, fodder and oilseed crops. While the area planted with forage crops declined by 3.4% in 2022 compared to 2021, the areas for cereals, legumes, and oilseeds grew by 0.2% and 12.0%, respectively. Gross crop production output has seen significant growth, rising from KZT 2.3 trillion (USD6.8 billion) in 2017 to KZT 5.8 trillion (USD12.6 billion) in 2022[26].

Livestock farming mainly consists of cattle breeding, sheep breeding and poultry farming[27]. The gross output of livestock production has grown significantly, increasing from KZT 1.8 trillion (USD5.5 billion) in 2017 to KZT 3.7 trillion (USD8.0 billion) in 2022.

However, livestock numbers for all species decreased in 2022 compared to 2021 due to a recalculation of animal counts. Despite this, the sector saw substantial investment activity, with 267 new projects launched in 2022, totaling KZT 241.3 billion. As a result, during the reporting period the volume of investments in fixed capital of agriculture increased by 6.9% and amounted to KZT 855.7 billion[28].

Global climate change and urbanization, which reduces the share of the rural population, are recognized as major challenges to the development of Kazakhstan's agro-industrial complex[29]. In response, efforts to enhance risk insurance within the sector are steadily progressing. Today, the state supports farmers by subsidizing rates on 16 insurance products covering crop and livestock farming. This includes cereals, legumes and oilseeds, apple trees, cattle, small livestock, horses, birds, etc[30]. Additionally, in light of new climate-related risks, the government is exploring opportunities to expand the range of insurance options.

The target indicators for the use of mineral fertilizers and pesticides were achieved, covering 9% and 27%, respectively, of the projected sown area.

Agriculture is the second largest source of GHG emissions in Kazakhstan. The sector's share of greenhouse gas emissions from nationwide emissions changed from 10.8% in 1990 to 9.3% in 2022.

2.A.1.6.6. Land use, land use change and forestry

The lands of the forest fund in Kazakhstan include areas covered with forests as well as those designated for forestry activities but not forested. According to the national land balance data, the total area of the forest fund has steadily increased: from 29.8 million hectares in 2017, to 30.9 million hectares in 2022.

The largest forest fund areas are located in the regions of Kyzylorda (7,010 thousand ha), Zhambyl (4,429 thousand ha), Turkestan (3,030

[24] GDP structure by production method, Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan.
[25] Total adjusted sown area of main crops by years in RK, Bureau of National Statistics, ASP&R RK.
[26] Gross output of agricultural products (services) by year. Bureau of National Statistics, ASP&R RK.
[27] Main indicators of livestock development in the Republic of Kazakhstan for the period from 2017 to 2022, Bureau of National Statistics of the Agency for Strategic Planning and Reforms of the Republic of Kazakhstan.
[28] https://www.gov.kz/memleket/entities/moa/press/news/details/487599?lang=ru 2022 Development Outcomes.
[29] Concept for development of Agro-Industrial Complex of the RK for 2021–2030, Resolution of the Government of the RK dated 30.12. 2021, No. 960.
[30] https://primeminister.kz/ru/news/vozmozhnost-strakhovaniya-posevov-ot-saygakov-i-saranchi-rassmotryat-v-kazakhstane-28634

thousand ha), Almaty (2,253 thousand ha), and East Kazakhstan (2,154 thousand ha). Areas of forest and tree and shrub plantations listed as part of the forest fund – in Kyzylorda region (5,916 thousand ha), Almaty region (1,666.1 thousand ha), Zhambyl region (2,239.2 thousand ha) and East Kazakhstan region (1,449.7 thousand ha).

The forested area as a percentage of the total land area: 4.9% in 2017, 5.2% in 2022[31].

The North Kazakhstan (88.8%) and Pavlodar (86.6%) regions have the highest forest cover among Kazakhstan's forest fund lands, while the Turkestan region has the lowest at 16.5%.

In 2022, forest reproduction efforts expanded significantly, according to the Committee of Forestry and Wildlife of the MENR[32]. As part of the Head of State's initiative to plant 2 billion trees on forest fund lands, 283 million trees were planted over 166 thousand hectares. Furthermore, phyto-forest reclamation on the dried Aral Sea bed covered 250 thousand hectares, including the planting of 3.6 million saxaul seedlings across 12 thousand hectares.

To ensure the successful implementation of this initiative, regional authorities and the MENR developed comprehensive reforestation plans, assigning over 1.5 billion seedlings to local executive agencies, 251 million to the MENR, and 210 million to other natural resource users. These efforts are guided by scientific recommendations and account for zoning and ecological risks.

Notably, reclamation on the Aral Sea bed expanded from 101 thousand hectares in 2021 to 250 thousand hectares in 2022, demonstrating significant progress in restoring degraded landscapes and improving the environment.

One of the key risks to the climate mitigation function of forests is forest fires. In 2022, over 800 forest fires were registered on the territory of the state forest fund, affecting a total area of 104 thousand hectares. Compared to 2021 data, the number of forest fires in the country increased by 50 cases.

To mitigate fire risks, local authorities implement restrictions during high fire danger periods, including limiting public access, vehicle entry, and specific activities in state forest fund areas. Forests are monitored continuously through satellite systems, with data and imagery provided by NC Kazakhstan Gharysh Sapary JSC. Satellite monitoring in 2022 revealed 150 instances of illegal deforestation within the state forest fund and digitized 139,234.3 hectares of burned areas. Additionally, 2.45 million hectares of forest-steppe fires across Kazakhstan were mapped, highlighting the extensive impact of fire events on the country's ecosystems[33].

GHG fluxes in the forestry sector are represented as removals (–), mainly by natural ecosystems (forest lands and pastures) and as emissions (+) from agro-ecosystems (croplands). In the base year of 1990, the sector was a net sink (–4.8 million tons of CO_2-eq.).

Emissions and carbon stock changes from forests have fluctuated since 1990, reflecting the impact of activities such as logging, reforestation, forest management, and land tenure changes. In 2022, the total net GHG emissions for the sector were 4.1 million tons of CO_2e., decrease of 11.9% compared to 2021[34], indicating a positive change in the sector.

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[31] Green Economy Indicators. Forest Resources. Bureau of National Statistics, ASP&R RK
[32] Results of the extended meeting on the results of activities for 2022, Committee of Forestry and Wildlife of the Ministry of Ecology and Natural Resources of the RK, https://www.gov.kz/memleket/entities/forest/press/news/details/516508?lang=ru
[33] https://bitrix.gharysh.kz/docs/pub/5c33f1e55b2df82f3f75aad9be90a406/default/?& Annual report for the year 2022 of NC Kazakstan Gharysh Sapary JSC.
[34] Inventory of greenhouse gas emissions in Kazakhstan, 2024.

2.A.1.6.7. Waste

Waste generation in Kazakhstan is influenced by a variety of factors, including population growth, urbanization, economic development, and overall growing consumption patterns.

Urbanization and higher population density have highlighted the need for significant investments in waste management infrastructure. Waste is categorized into three main streams: municipal solid waste (MSW), wastewater treatment, and a smaller category of waste incineration.

MSW encompasses waste from households, manufacturing, parks, streets, markets, and construction sites.

In 2022, a total of 3,823 kt of MSW was generated, with a recycling and disposal rate of 15.57% (Table 2.5). Then, 595 kt of MSW were collected and recycled in 2022. From 2019 to 2022, the MSW generation per capita declined by 1.8% and in 2022 reached 195 kg.

Table 2.5. Intensity of waste generation and recycling rate, relating to Municipal Solid Waste (MSW)

		Units	2019	2020	2021	2022
1	Generation of municipal waste	kt	3.674	3708.5	4006.5	3822.8
2	Index of municipal waste generation	% 2010 = 100	97.08	97.99	105.86	101.01
3	Recycling and disposal of municipal waste	kt	418.3	760.0	546.3	595.3
4	Share of recycling and disposal of municipal waste	%	11.39	20.49	13.64	15.57
5	Generation of municipal waste per capita	kg	198.45	197.73	210.86	194.69
6	Population of the Country	people	18,513,673	18,755,666	19,000,987	19,634,983

Source: Bureau of National Statistics: Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2024

The reduced per capita waste generation partly mitigated the effects of population growth, contributing to a steady increase in MSW generation until 2021, when it peaked at 4,006 kt. However, in 2022, MSW volumes declined by 4.95% compared to 2021 levels.

Regarding waste composition, two approaches have been applied by Kazakhstan's national statistics: one used until 2020 and a more recent method adopted thereafter, both providing valuable insights.

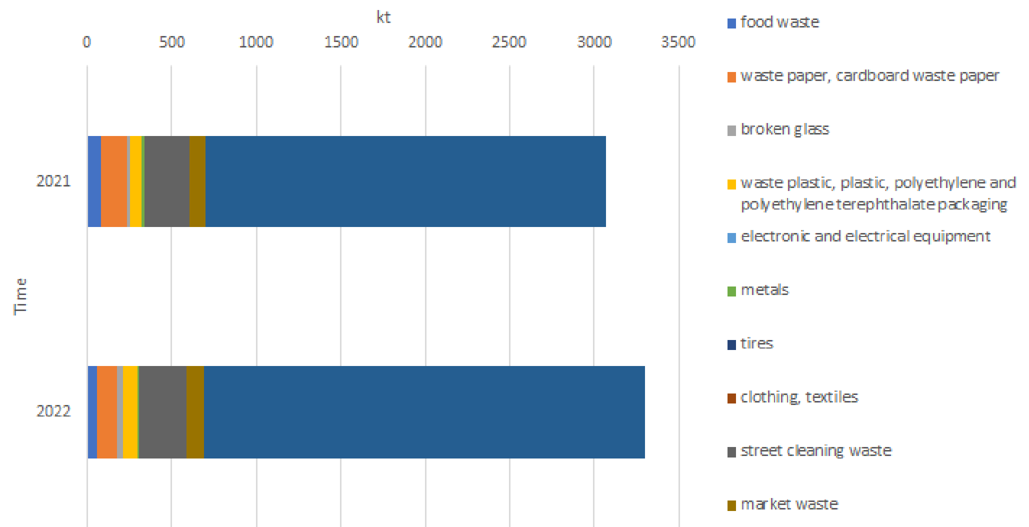
Data on waste types produced between 2018 and 2020 indicates that (i) household waste accounts for the largest share of around 73% of the total waste generated during all three years; (ii) industry waste was the second largest type that peaked in 2019 at 458 kt and decreased in 2020 to 411 kt; (iii) street litter and market waste have increased over time, remaining the third largest waste type; (iv) park waste accounted for the smallest share, steadily declining from 10.2 kt in 2018 to 8.6 kt in 2020. While total MSW generation remains high, certain categories, such as household and industrial waste, show a notable downward trend.

Data on MSW types produced between 2021 and 2022 following the recently adopted approach are presented in Figure 2.12. This approach provides more detailed data on disaggregated waste types, including food waste, waste paper, broken glass, plastic, electronic and electrical equipment, metals, tires, clothing and textiles, street cleaning waste, market waste, and other mixed MSW. The shift to this approach was driven by the need to support policies related to Extended Producer Responsibility (EPR) for agricultural machinery, packaging fees, and cable/wire products.

In 2021, the total MSW generated was 3,335 kt. The largest category was other mixed MSW, which amounted to 2,374 kt, or 71.2% of the total waste. This was followed by (i) street cleaning waste, 263 kt, or 7.9% of the total waste; (ii) waste paper, 149 kt, 4.5%; (iii) market waste 98 kt, 2.9%; (iv) food waste, 84 kt, 2.5%; (v) plastic waste, 68 kt, 2.1%; (vi) broken glass, 24 kt, 0.7%. Smaller waste streams included: (i) metals, 10 kt, 0.3%; clothing and textiles, 0.6 kt; (ii) tires, 0.1 kt, and; (iii) electronic and electrical equipment at 0.2 kt.

In 2022, the total generated MSW slightly decreased to 3,297 kt. Other mixed MSW remained the largest category, growing to 2,605 kt, or 79.0% of the total waste. Street cleaning waste also rose to 282 kt (8.6%), while waste paper declined to 120 kt (3.6%). Market waste grew to 107 kt (3.3%), but food waste saw a significant decrease to 60 kt (1.8%). Plastic waste increased to 84 kt (2.6%), and broken glass rose to 32 kt (1.0%). Metals decreased to 5 kt, and tires were no longer recorded. Clothing and textiles experienced a noticeable rise to 1 kt, while electronic and electrical equipment saw a slight increase to 0.3 kt.

Figure 2.12. Amount of the MSW generated for 2021–2022, kt/year



Source: Bureau of National Statistics: Agency for Strategic Planning and Reforms of the Republic of Kazakhstan, 2024

GHG emissions from MSW and wastewater treatment and discharge are shown in Table 2.6 for 2018 and 2022. The data are presented in terms of the total emissions from MSW, with a breakdown into emissions from MSW landfilling, emissions from waste incineration, and emissions from wastewater treatment and discharge.

Table 2.6. Greenhouse gas emissions in the municipal solid waste and wastewater management sector, in kt of CO2 equivalent.

	2018	2019	2020	2021	2022
Total Waste	5,681	5,856	6,507	6,849	6,917
MSW disposal on landfills	3,244	3,329	3,410	3,461	3,306
Waste Incinerator	0.22	0.29	0.22	0.25	0.29
Wastewater management (treatment and discharge)	2,356	2,446	3,016	3,301	3,528

Source: UNFCCC, 2024; Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan, 2022

In 2018, total GHG emissions from MSW amounted to 3,244 kt CO_2e, and in 2022, they increased to 3,306 kt CO_2e. GHG emissions from wastewater treatment and discharge showed continuous growth, from 2,356 kt CO_2e in 2018, reaching 3,528 kt CO_2e in 2022. While emissions from waste incineration increased, they remain negligible.

Relatively high level of emissions from MSW results from more than 85% of waste generated going to landfills. The remainder is sorted and further treated or disposed of[35].

In 2022, the number of organizations involved in sorting, recycling, and depositing MSW in Kazakhstan grew to 243. The state organization "Zhasyl Damu" JSC was designated as the operator of the extended producer responsibility program for MSW[36]. To streamline waste management, "Zhasyl Damu" introduced the automated information system EcoQoldaý, which consolidates data from key participants in the secondary raw materials market onto a single electronic platform, enabling efficient payment for services[37].

Regarding GHG emissions from wastewater treatment, Kazakhstan employs mechanical, physical-chemical, and biological methods. The most common method of wastewater treatment in the housing and public utilities sector is biological, which is carried out under aerobic conditions. All municipal wastewater in the cities of Kazakhstan enters the sewerage systems and undergoes full biological treatment at aeration stations. In rural areas, the use of septic systems and sewerage infrastructure increased significantly in 2022 due to regional and infrastructure development initiatives. Altogether, this led to a small increase in GHG emissions from wastewater treatment despite the high rate of population growth in recent years.

2.A.2. Impact of national circumstances on GHG emissions and removals

Kazakhstan has a pronounced continental climate with warm summers and very cold winters. Precipitation varies between arid and semi-arid conditions, with winter being particularly dry. The climate is warming, with an increasing frequency and duration of high air temperatures in warm periods of the year. This leads to negative consequences not only for human and animal organisms, but also for transportation infrastructure due to deformation of the road surface, for urban and recreational areas, for the energy sector, as there is a need for additional energy generation for cooling buildings.

Kazakhstan's major navigable rivers are transboundary, with approximately 50% of surface water inflow originating from neighboring countries such as China, Russia, Uzbekistan, and Kyrgyzstan. However, this inflow is rapidly declining due to the accelerating economic and social development of these countries.

The country has vast land resources with low population density and huge potential for sustainable agriculture. However, due to the sharply continental climate and lack of water resources, agriculture is mostly in the risky farming zone. To enhance sustainability, the country's agricultural policy emphasizes diversification, including reducing reliance on monoculture sowing, adopting modern moisture-saving technologies, preserving soil fertility, and increasing the use of both mineral and organic fertilizers.

Kazakhstan has limited forest cover, spanning approximately 13 million hectares or about 5% of the territory. Shrubs and protective plantations

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[35] On complaint with municipal waste, Bureau of National Statistics ASP&R RK.
[36] https://www.gov.kz/memleket/entities/ecogeo/press/news/details/314583?lang=ru
[37] https://recycle.kz/ru/otchety Progress report on implementation of extended obligations of manufacturers, importers for 2021.

https://www.gov.kz/memleket/entities/ecogeo/press/news/details/851835?lang=ru cover about 10 million hectares while only 3.3 million hectares are covered by the main tree species: conifers, soft-wooded and hard-wooded broadleaved species. A significant part of the territory classified as forest land, in fact, not forested, as confirmed by satellite data. Almost all forests are state-owned and are protected with cutting restrictions. Since 2021, Kazakhstan has intensified efforts to increase forest cover; recognizing the critical role of forests in carbon sequestration. Enhancing the absorptive capacity of forests is central to the country's ambitious goal of achieving carbon neutrality, a priority reflected in all strategic government documents.

Kazakhstan has rich reserves of a great variety of minerals, both fuel resources and raw materials. While the hydrocarbon industry remains the backbone of the economy, the majority of employment is concentrated in the service sector. Recognizing the need for economic diversification, the national government is focused on transitioning industries towards higher value-added production.

Kazakhstan's economy is among the most energy-intensive in the world, influenced by its cold climate and low population density and energy intensive industry that affects higher emissions levels. Reducing energy intensity in industry, particularly in the manufacturing sector is a key priority of Kazakhstan's industrial and innovative development strategy.

In the energy sector, most of the country's electricity is generated by the traditional method of burning solid fossil fuels. Kazakhstan ranks 10th in coal reserves or 2.4% of the world's total coal resources. Due to the climate of the country, harsh and long winters prevail in most of the territory of Kazakhstan, and the heating season for households extends from October to April. Due to extremely low temperatures in winter, central heating is critical to maintain livable conditions, however, the relation between the heat supply levels and the actual heat demand is poor. This is because of the significant losses in the heat transportation and distribution networks and poor quality of supplied heat energy (so-called overheating and underheating). These issues together with the low energy efficiency of the residential sector, leads to high levels of GHG emissions[38].

Taking into account the climate agenda and Kazakhstan's goals to achieve carbon neutrality, as well as the steadily accelerating climate change, a comprehensive approach is needed to reduce GHG emissions from coal-fired generation through the implementation of measures to improve plant efficiency, reduce transmission and distribution losses of electricity, enhance energy efficiency in the residential sector, and identify alternatives to replace coal-fired sources in the medium term.

Kazakhstan's growing number of sunny days and regions with stable, strong winds create favorable conditions for the development of renewable energy sources, particularly solar and wind power. The Government of Kazakhstan actively supports RES projects by providing unified electricity purchase agreement for RES facilities, providing tax and customs incentives, and state land grants.

About 60% of Kazakhstan's population lives in urban areas and the remaining 40% in rural areas. The increasing urbanization trend affects the growing need to generate more energy, as urban populations typically consume more energy. Also, urbanization has an impact on emissions from the waste sector and this needs to be addressed by increasing MSW recycling programmes and encouraging urban residents to adopt waste minimization practices, including separation and recycling.

[38] Concept of electric power industry development in the RK for 2023–2029. Decree of the Government of the Republic of Kazakhstan dated 28.03.2023, No. 263.

2.A.3. Information on institutional arrangements established to monitor progress in the implementation and achievement of its NDC under Article 4

In Kazakhstan, several institutional arrangements have been put in place to track progress in the implementation and achievement of Nationally Determined Contributions (NDC):

- National coordinating bodies, which include various ministries and agencies responsible for development and implementation of climate policy. These bodies coordinate actions on implementation of the NDC and ensure inter-ministerial cooperation.
- National plans and strategies that include measures to reduce greenhouse gas emissions and adapt to climate change.
- Monitoring and reporting systems that include mechanisms for regular data collection, analysis and reporting on achievement of climate goals. These systems help track progress and adjust strategies as needed.
- International cooperation and support arrangements, through which Kazakhstan actively participates in international initiatives and cooperates with international organizations to obtain technical and financial support in the implementation of its NDC.

These arrangements provide for an integrated approach to tracking and achieving climate goals and contribute to sustainable development of the country.

"The Concept of transition of the Republic of Kazakhstan to 'green' economy"[39], adopted by the President of Kazakhstan in 2013 and its recent update, sets ambitious goals to reduce the energy intensity of GDP, improve air quality, increase the share of alternative energy sources and natural gas supply of the country. An Action Plan has been developed to achieve the goals of this concept. The Government of the Republic of Kazakhstan has also introduced several "strategic plans" that set priorities and quantitative targets for the country's development until 2030.

The Council for Transition to Green Economy under the President of Kazakhstan oversees and evaluates the implementation of the goals and objectives outlined in this Concept. The MENR, acting as a working body of the Council, publishes an annual National Report on the State of the Environment and Use of Natural Resources. This report highlights the measures undertaken to advance the green economy and tracks progress toward achieving the established target indicators.

The Government of Kazakhstan has also introduced several "strategic plans" that set priorities and quantitative targets for the country's development until 2030.

Table 2.7. Strategic plans that set priorities and quantitative targets for national development up to 2030.

Document	Form and date of adoption
"Nurly Zhol" State program of Infrastructure Development for 2015–2025	Resolution of the Government of the Republic of Kazakhstan dated 31.12.2019, No. 1055
"Nurly Zher" State Program for Housing and Communal Development for 2020–2025	Resolution of the Government of the Republic of Kazakhstan dated 31.12.2019, No. 1054
Action Plan for Implementation of the Concept on Transition of the Republic of Kazakhstan to Green Economy for 2021–2030	Resolution of the Government of the Republic of Kazakhstan dated July 29, 2020, No. 479
Concept of Development of the Agro-Industrial Complex of the Republic of Kazakhstan for 2021–2030	Decree of the Government of the Republic of Kazakhstan dated 30.12.2021, No. 960
Concepts of Industrial and Innovative Development of the Republic of Kazakhstan for 2021–2025	Decree of the Government of the Republic of Kazakhstan dated 30.12.2021, No. 965

[39] On the concept of transition of the Republic of Kazakhstan to a "green" economy, Decree of the President of the Republic of Kazakhstan dated 30.05.2013, No. 577.

Document	Form and date of adoption
Strategy of the Republic of Kazakhstan for Achieving Carbon Neutrality by 2060	Decree of the President of the Republic of Kazakhstan dated 02.02.2023, No. 121

Monitoring systems that include various platforms for regular data collection on Kazakhstan's climate goals (namely, the systems operated by the Bureau of National Statistics, State Carbon and Waste Inventories, State Register of Carbon Units, Pollutant Release and Transfer Registry) as well as national reporting systems provide reliable information to track progress towards achieving the NDC.

Kazakhstan plans to voluntarily engage in approaches and activities under Article 6 of the Paris Agreement to support higher ambition in its mitigation and adaptation actions and to promote sustainable development and environmental integrity. Details of methodologies associated with the cooperative approaches that involve the use of internationally transferred mitigation outcomes, are expected to be included in Kazakhstan's initial report under Article 6.

Kazakhstan's active participation in international initiatives and cooperation with international organizations (UNDP, World Bank, GEF, etc.) provides an opportunity to receive technical and financial support in the implementation of its NDC.

The following activities and legislation has also provided basis for tracking progress toward achieving its NDC:

- Adoption of updated Environmental Code in 2021[40] that defines a policy to reduce GHG emissions by establishing a framework for a market-based ETS mechanism and setting a minimum 1.5% annual reduction in the carbon budget until 2030.
- Creation of market mechanisms to reduce greenhouse gas emissions and removals. Market mechanisms include the carbon unit trading system.

The Ministry of Energy of Kazakhstan is responsible for implementation of the state energy policy in the energy sector. The Strategic Plans of the Ministry envisage directions, goals and target indicators, the achievement of which has an impact on the reduction of GHG emissions in the energy sector. This includes increase in the share of natural gas-fired generation, development of renewable energy sources, reduction of energy intensity of GDP, energy saving and energy efficiency, increase in associated gas processing, introduction of the best available technologies at enterprises with negative environmental impact.

The Ministry of Transport is responsible for the implementation of public policy in the transport sector. The development plans of this Ministry are aimed at ensuring the accessibility, efficiency and safety of the public transport infrastructure, as well as minimizing the environmental impact by renewing the vehicle fleet and modernizing existing vehicles.

Industrial development is within the competencies of the Ministry of Industry and Construction. Development plans of this Ministry include the creation of an enabling environment for industrial development of the country taking into account the reduction of negative impact on the environment. Industrial sector envisages measures to reduce GHG emissions: introduction of the best available technologies in production and construction, improvement of energy efficiency of enterprises, use of alternative energy sources.

The Ministry of Agriculture, while implementing the state policy in the direction of GHG emission reduction, plans measures aimed at rational use of cultivated land (observance of crop rotation, fertilizer application), development of organic farming, development and conservation of livestock genetic resources, pasture management.

The MENR is the supervising state body in forestry. In order to reduce GHG emissions, the MENR plans and carries out large-scale reforestation and forest conservation and restoration of degraded land. Municipal waste

[40] Environmental Code of the Republic of Kazakhstan dated 02.01.2021, No. 400-IV ZRK

management in Kazakhstan is handled by "Zhasyl Damu" JSC; it is planned to introduce full coverage of MSW collection and sorting in the *Waste* sector to reduce GHG emissions, as well as through gradual elimination of open landfilling of waste.

The achievement of target indicators in strategic development plans of government agencies is monitored by the Parliament of the country and relevant information is publicly accessible on the "e-Government" platform and state statistical observations provided by the Bureau of National Statistics. The MENR and the Council for Transition to Green Economy analyze the impact of the implemented target indicators on the transition to a green economy and their contribution to achieving the country's NDC.

Energy Industry

The Ministry of Energy of Kazakhstan is responsible for the formulation and implementation of the state energy policy. In 2020, the "Strategic Plan for 2020–2024" of the Ministry of Energy was approved[41]. This document updates relevant goals and objectives outlined in earlier strategic plans. In the heat and power generation sector, key measures aimed at reducing GHG emissions include: increase in the share of natural gas-fired power generation, development of RES, reduction of the energy intensity of GDP, energy saving and energy efficiency improvement, and development of coal bed methane-fired generation.

The current system of state support for RES development has been embedded in Kazakhstan's legislation since 2009. In 2013, specific targets for the RES sector were established, broadly defining the market size and the potential for reducing greenhouse gas emissions through RES (Table 2.8.).

Table 2.8. RES development target indicators

Indicator	2020	2030	2040	2050
Share of alternative and renewable energy in the country's energy balance	3.0%	15%	30%	50%

Source: Concept of transition of the Republic of Kazakhstan to a green economy, Decree of the President of the Republic of Kazakhstan dated 30.05.2013, No. 577 with amendments and additions.

A new tool to support RES in Kazakhstan is the issuance of I-REC certificates[42]. ECOJER Association became an issuer of I-REC certificates in Kazakhstan. This will allow domestic RES facilities to earn additional income by certifying the energy they produce, and enable enterprises to put the principles of sustainable development into practice.

Increase in the share of natural gas-fired generation is a key measure aimed at expanding the natural gas supply in the regions across Kazakhstan. To support this goal, the Comprehensive Gas Industry Development Plan until 2026 was adopted, outlining measures to enhance the gas resource base, reform the gas market, and maintain affordable gas prices for socially vulnerable groups. The level of natural gas supply in regions serves as a target indicator for the Ministry of Energy of Kazakhstan[43] (Table 2.9).

[41] Strategic Plan of the Ministry of the Republic of Kazakhstan for 2020–2024. https://www.gov.kz/memleket/entities/energo/documents/details/100787?lang=ru
[42] https://qazaqgreen.com/journal-qazaqgreen/environmental-policy/182/
[43] Strategic Plan of the Ministry of Energy of the Republic of Kazakhstan for 2020–2024. https://www.gov.kz/memleket/entities/energo/documents/details/100787?lang=ru

Table 2.9. Target indicators of the natural gas supply activities of the Ministry of Energy

Indicator	2017	2018	2019	2020	2021	2022	2023 plan	2024 plan
Level of natural gas supply to households	47.38%	49.68%	51.47%	53.07%	52.67%	59.0%	53.89%	54.59%

Source: Reports on implementation of the strategic plan of the Ministry of Energy of the Republic of Kazakhstan for 2020–2024.

Reduction of energy intensity of Kazakhstan's GDP (measured by energy consumption per unit of GDP) is a key focus of the country's energy and environmental policy. This involves transitioning the energy sector from fossil fuel combustion to RES (solar energy, wind power, small hydroelectric power plants), efforts to reduce energy consumption and associated GHG emissions reduction in energy production, as well as in households and municipal sectors through energy saving initiatives. Targets for reducing the energy intensity of GDP are set in the Concept for Transition of the Republic of Kazakhstan to Green Economy[44] (Table 2.10).

Table 2.10. Targets to reduce the energy intensity of GDP

Indicator	Current level (2022)	2030	2040	2050
Reduction of energy intensity of the economy	1.16 (TOE/USD thousand in prices of 2000)	11%	25%	40%

Source: Concept of transition of the Republic of Kazakhstan to a green economy, Decree of the President of the Republic of Kazakhstan dated 30.05.2013, No. 577 with amendments and additions.

As part of the overall effort to reduce energy intensity, the Best Available Technologies (BAT) was introduced that has an indirect effect on the reduction of greenhouse gases in the energy sector. To reduce air pollution, Category I facilities are required to obtain Comprehensive Environmental Permits (CEPs)[45] based on the application of the BAT requirements with the emission levels specified in national BAT guides. To date, 16 BAT guides have been developed for enterprises in the mining and oil and gas industries, chemical industry, and power industry. The emission levels related to the application of BAT are practically in line with the EU BREFF guides.

In the power generation sector, in particular the traditional coal-fired generation facilities commissioned in the 1960s and 1970s, are the most problematic with regards to BAT requirements because of the low level of investments, aged assets and low rates of modernization of energy equipment. Accordingly, the implementation of BAT at such facilities brings high costs and extremely low payback rates. Coupled with reduced funding for coal-fired generation projects due to high carbon footprints, BAT implementation leads to major challenges for the power generation industry.

Agriculture and LULUCF sectors

These sectors, while not subject to carbon limitations, offer significant opportunities for enhancing carbon sinks, reducing emissions and implementing offset projects. The Environmental Code establishes regulations for implementation of offset projects in areas such as agriculture, forest and steppe landscaping, and prevention of land degradation. Kazakhstan is systematically reducing the carbon limitations in industry and respective carbon credits, which leads to the search for alternative methods of

[44] On the concept of transition of the Republic of Kazakhstan to a green economy, Decree of the President of the Republic of Kazakhstan dated 30.05.2013, No. 577.
[45] Environmental Code of the Republic of Kazakhstan dated 02.01.2021, No. 400-IV ZRK

GHG reduction. Offset projects in the land use and forestry sectors present a viable solution, enabling enterprises to meet carbon budget requirements even as carbon credit allocations decrease.

In the Forestry sector, the state carries out forest cultivation as part of the national initiative to plant 2 billion trees across Kazakhstan. Forest reproduction activities are carried out on the territory of the state forest fund and in populated areas[46].

Table 2.11. Measures on forest reproduction on the territory of the state forest fund and in populated areas

Indicator	Current level (2020)	2025
Planting trees on forest fund lands	Initial stage	2 billion
Planting trees on the lands of populated areas	Initial stage	15 million

Source: Address of the Head of State to the People of Kazakhstan, 01.09.2020.

The Agriculture sector supports initiatives focused on the rational use of cultivated land, including adherence to crop rotation and fertilizer application requirements, as well as development of organic farming. To enhance the sustainability of farming practices and mitigate associated risks, the country has established the following key indicators, detailed in Table 2.12.

Table 2.12. Indicators on the rational use of cultivated land

Indicator	Current level	2030	2040	2050
Area of agricultural land certified for organic production	114 thousand ha (2022)	150 thousand ha	200 thousand ha	300 thousand ha
Area of irrigated lands where water-saving technologies are introduced	279 thousand ha (2022)	1,040 thousand ha	1,800 thousand ha	2,300 thou-sand ha

Source: Concept of transition of the Republic of Kazakhstan to a green economy, Decree of the President of the Republic of Kazakhstan dated 30.05.2013, No. 577 with amendments and additions.

The transition to new "green" methods of animal breeding and land use, such as no-tillage farming, spot cultivation, and the restoration of steppe pasture ecosystems, along with transition to alternative zoned crops, will be introduced as part of the sector's adaptation to expected climate change.

Waste Sector

In order to achieve NDC in this sector, the legislative framework has been updated. Measures include a ban on the disposal of certain types of waste, which can be used as secondary resources, mandatory separate waste collection, and the revised performance requirements for the EPR (Extended Producer Responsibility) Operator.

With population growth and increasing urbanization, the volume of the MSW generation continues to rise. The country's strategic plans aim to increase the share of MSW recycling and wastewater treatment to meet target indicators set by these plans (Table 2.13).

[46] https://www.akorda.kz/ru/addresses/addresses_of_president/poslanie-glavy-gosudarstva-kasym-zhomarta-tokaeva-narodu-kazahstana-1-sentyabrya-2020-g

Table 2.13. Target indicators on the share of municipal waste recycling and wastewater treatment

Indicator	Current level	2030	2040	2050
Share of recycling and utilization of municipal waste from the total amount of generated waste	25.4% (2022)	40%	50%	60%
Treatment of anthropogenic waste-waters	28.55% (2018)	45%	65%	100%

Source: Concept of transition of the Republic of Kazakhstan to a green economy, Decree of the President of the Republic of Kazakhstan dated 30.05.2013, No. 577.

In order to achieve these indicators, the EPR Operator plans to implement activities aimed at modernization and improvement of the system of waste processing and utilization in different regions of Kazakhstan. Approval was obtained through Zhasyl Damu to finance three projects that passed all stages of selection: construction of technological and ecopark for sorting solid domestic waste and recycling of construction waste in Rudnyi (Kostanay region), modernization of tire recycling production in Shymkent, modernization of facilities for processing and recycling rubber products in Rudnyi (Kostanay region)[47].

2.A.4. Legal, institutional, administrative and procedural mechanisms for internal implementation, monitoring, reporting, archiving of information

In 2016, Kazakhstan submitted its Intended Nationally Determined Contributions (INDC) under the Paris Agreement, committing to reduce greenhouse gas emissions by 15–25% by 2030 compared to the 1990 baseline. This commitment includes a 15% unconditional target and a 25% conditional target, which is achievable with the provision of international support.

NDCs preparation are coordinated by the Ministry of Ecology and Natural Resources[48]. Zhasyl Damu serves as a working body responsible for collection, processing and storage of baseline information, and assessment of GHG emissions and removals. Relevant ministries and agencies provide, in accordance with their competencies, information necessary for the preparation of the inventory at the request upon request of the MENR. These entities also participate in the review and approval of the NDC.

Kazakhstan has committed to an economy-wide emission reduction target that covers all gases and all sectors, see section B of this Chapter for further detail. This is why the total net GHG emissions that are estimated in the national GHG inventory are the selected indicator to track implementation and achievement of NDCs. Accordingly, the legal, institutional, administrative and procedural mechanisms for internal implementation, monitoring, reporting, archiving of information are closely linked to those necessary to prepare the national GHG emission inventory on an annual basis

As part of the national GHG inventory system, a dedicated working group has been established. The working group consists of representatives of the MENR, Zhasyl Damu, state bodies and organizations involved in the process of providing initial data and verification. Further information on the mandate and functions of this group is provided in the 2024 NIR of Kazakhstan.

The main stages of NIR preparation include: establishment and meetings of the working group, distribution of provision of initial data between representatives of the working group; collection of information containing initial data for quantitative assessment of GHG emissions and removals from enterprises, organizations, state bodies; analysis and processing of

[47] https://www.gov.kz/memleket/entities/ecogeo/press/news/details/851835?lang=ru
[48] Environmental Code of the Republic of Kazakhstan, dated 02.01.2021, No. 400-VI Article 302

obtained data, carrying out calculations and preparation of the state inventory; quality control and quality assurance of the state inventory.

The National GHG Inventory, the results of which are presented in the NIR, is the basis for ensuring the conditions for transparency of country reporting of the progress and achievement of its NDC.

The national GHG inventory in Kazakhstan is carried out on the basis of the relevant provisions of Articles 4 and 12 of the UNFCCC and decisions of the Conference of the Parties. Institutional, legal and procedural mechanisms for preparation of greenhouse gas inventory are also regulated by internal regulatory documents of Kazakhstan, in particular the Environmental Code (Article 302).

The quality assessment and control system adopted in Kazakhstan has several stages of approval and control by the agencies involved in the national GHG inventory system and MENR. Quality control is conducted through expert cross-checks, external reviews, and validation by relevant ministries and organizations via the Department of Climate Policy of MENR.

The archiving process covers the storage of all source information and results of GHG emission and removals calculations, from the procedure of collection and storage of source data to the recording and registration of administrative and structural information for the preparation of GHG inventories.

Annual GHG inventory data and assessments are stored both electronically in a dedicated database and in hard copy in a file storage system. Special storage room has been allocated for NDC preparation that stores GHG emission reports from enterprises collected since 2010 as part of the internal ETS. Printed methodological materials, statistical yearbooks, correspondence with suppliers of source information for calculations and reporting materials for recent years are also stored there.

Based on the results of the national inventory, the Government of Kazakhstan makes decisions on further measures to achieve NDC.

Stakeholder engagement related to the implementation and achievement of NDC is based on the involvement of national experts who were not involved in the development of the national GHG inventory for external review of the inventory results; and on the involvement of key experts from industry organizations to improve the quality of the NDC. Stakeholder participation is also ensured through consultations and public discussions, which include the participation of civil society, NGOs and other stakeholders. The country has electronic platforms where draft regulations, including the country's climate policy, are published for discussion and collection of comments/suggestions.

2.B. Updated Nationally Determined Contribution of Kazakhstan (NDC)

The updated NDC of Kazakhstan was adopted on 19th April 2023 with a decree of the Government. The NDC was prepared in accordance with Articles 3 and 4 of the Paris Agreement and provisions of paragraph 2 of Article 283 of the Environmental Code of Kazakhstan from 2nd January 2021.

The updated NDC, in accordance with relevant provisions of the Paris Agreement, represents a further development of Kazakhstan's first (initial) NDC under the Paris Agreement that was submitted to the UNFCCC in December 2016. All references in this report are made with regard to the updated NDC. Kazakhstan has prepared an implementation plan for its NDC, and the information presented in this report reflects the progress made in implementation of this plan. The country is currently in the process of preparation and coordination of its next NDC (NDC 3.0).

The updated NDC consists of a single-year target, and the target type is "economy-wide absolute emission reduction". Further information necessary to ensure clarity, transparency and understanding of the NDC are provided in table 2.14.

Table 2.14. Description of NDC of Kazakhstan

Required information	Description
Target and its description	NDC envisages an unconditional economy-wide target to reduce total GHG emissions by **15%** by the end of 2030 compared to the 1990 levels, and a conditional target of a **25%** reduction by the end of 2030 compared to 1990 levels. The conditional target could be achieved when substantial additional investments from international sources are provided together with substantial support on a grant basis; an access to an international mechanism for technology transfer is granted; co-financing of and participation in international research projects is provided for research in the area of low carbon technologies and initiatives with a view to increase the national research capacity.
Target year and whether this is a single year or multi-year target	2030 is the target year for the NDC and this is a single year target
Base year and the reference values	Base year for Kazakhstan is 1990 and the value of the total GHG emissions of Kazakhstan including LULUCF is equal to 385,736.5 kt CO_2e. The base year value of total GHG emissions of Kazakhstan, including LULUCF is taken from the 2024 Submission of the National Inventory Report by Kazakhstan. It will be updated when new data become available or there will be an update of methodology for GHG inventory.
Time frame and period of implementation	NDC covers time frame and period of implementation from 1st January 2021 to 31 December 2030
Scope and coverage of NDC: sectors	Sectors covered are those contained in Annex I to decision 5/CMA.3, namely Energy, Industrial Processes and Product Use (IPPU), Agriculture, Land Use, Land Use Change and Forestry (LULUCF) and Waste.
Scope and coverage of NDC: gases	Gases covered are carbon dioxide (CO2), methane (CH4), nitrous oxide (N2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), sulphur hexafluoride (SF6).
LULUCF categories and pools	The NDC includes LULUCF categories and pools as defined in decision 5/CMA.3.
Intention to use cooperative approaches	Kazakhstan plans to achieve its unconditional target of economy-wide emission reduction using domestic measures. It keeps the possibility to engage in Article 6 mechanisms under the Paris Agreement and other international mechanisms, including by linking its national emissions trading system.
Any updates or clarifications of previously reported information, as applicable	The information reported here provides further clarification on NDC that is required by provisions of decision 18/CMA.1, such as information on LULUCF.

Note: This table is identical to the table 'Description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates', which has been submitted in electronic format as part of the CTF together with this BTR.

2.C. Information necessary to track progress made in implementing and achieving nationally determined contributions under Article 4 of the Paris Agreement

This section provides description of the indicator that was selected to track progress in NDC of Kazakhstan, methodologies and accounting approaches that were used and an assessment of progress in NDC so far as reflected in the structured summary. Further information is presented in the CTF tables II. 1–4 on tracking progress of NDCs and an appendix contained therein.

2.C.1. Identification and description of indicators to track progress and achievement of NDC

Kazakhstan prepared, communicated and maintained an NDC that it intends to achieve pursuing domestic mitigation measures in the form of an economy-wide absolute emission reduction target. The target includes all sectors, categories, activities, sources and sinks that are covered by the national GHG inventory.

Therefore, Kazakhstan selected total annual net GHG emissions and removals as the single most important and relevant indicator to track progress and achievement of its NDC.

Kazakhstan, in conjunction with its first biennial transparency report, submitted the 2024 NIR, which contains the most recent GHG inventory covering the full time series from 1990 to 2022. According to this inventory, total net GHG emissions in the base year 1990 amounted to 385,736.5 kt CO_2e.

For the first two years of NDC implementation under Article 4, the net GHG emissions were 328,422.27 ktCO_2e in 2021 and 352,973.03 ktCO_2e in 2022. (para 68) Compared to the base year level, these figures represent reductions of 14.86% and 8.49%, respectively.

Kazakhstan also provided in its NDC an overview of policies and measures that it put in place or plans to implement to achieve its NDC. This contributes to the credibility of its NDC as it demonstrates a substantial effort by the country to adhere to the target that is enshrined in its NDC. Section D of this Chapter contains a summary of the advancement of principle policies that form part of the NDC together with estimates of their effect, where available.

Kazakhstan has also provided a significant adaptation component in its NDC. Chapter 4 of the BTR contains a comprehensive overview of the country's advancement in planning through its National Adaptation Plan (NAP) and implementing the adaptation actions envisaged in the adaptation component of the NDC.

2.C.2. Methodologies and accounting approaches used to track progress of NDCs

Kazakhstan has an economy-wide absolute emission reduction target that covers all emissions by source and removals by sink. Its accounting approach and methodology used for its selected indicator, namely total annual net GHG emissions, is fully consistent with the IPCC methodology. Further details are provided in its 2024 NIR that was prepared in accordance with requirements of decision 18/CMA.1 and the 2006 IPCC guidelines.

Therefore, when accounting for its NDC, Kazakhstan fully adhered to provisions of Article 4, paragraphs 13 and 14 that require Parties to promote environmental integrity, transparency, accuracy, completeness, comparability and consistency that are the key principles to which it adhered when preparing its GHG inventory, used to calculate the NDC indicator of progress. Additionally, Kazakhstan has fully considered the methods and guidance under the Convention when planning and implementing mitigation actions related to anthropogenic emissions and removals.

In particular, Kazakhstan adheres to the requirements for provision of NDC information, as it has taken action to:

- Account for anthropogenic emissions and removals in accordance with methodologies and common metrics assessed by the IPCC that are also adopted by the Conference of the Parties serving as the meeting of the Parties to the Paris Agreement;
- Ensure full methodological consistency, including on baselines, between the communication and implementation of NDC by recalculating the full time series of emissions, including those in the base year 1990 when changes in methodologies and emission factors are made;
- Include all categories of anthropogenic emissions or removals in its NDC;

Also, when preparing information contained in section B and C of this Chapter of the BTR, the country fully adhered to provisions of decision 4/CMA.1 on Further guidance in relation to the mitigation section of decision 1/CP.21. The country has no sector or category in its NDC that are defined differently from those provided in the national GHG inventory report.

Full description of methodology and accounting approaches used for the selected indicator to track NDC progress is provided in the 2024 NID. Together with the relevant CRTs, this forms part of the 2024 submission of the NIR and includes the following details:

- Key parameters, assumptions, definitions, data sources and models used;
- How the 2006 IPCC guidelines were used;
- Use of the 100-year time-horizon Global Warming Potential (GWP) values from the IPCC Fifth Assessment Report as agreed by the CMA in order to report aggregated GHG emissions expressed in CO_2e.

In particular for the LULUCF sector, Kazakhstan uses the following approaches:

- To address emissions and subsequent removals from natural disturbances on managed lands, it uses the IPCC guidelines for accounting for emissions from natural disturbances such as draughts, wildfires, and pest outbreaks. This approach includes assessing the impact of such disturbances on carbon stock in both, croplands and grasslands, adjusting for soil carbon changes and vegetation cover;
- To account for emissions and removals from harvested wood products, it uses the stock-change approach based on national data on wood removals and the estimated lifespan of harvested products, following the IPCC recommendations for timber and wood products' carbon stock changes;
- To address the effects of age-class structure in forests it uses forest inventory data to model carbon sequestration and emissions based on the age distribution of forest stands, applying the age class approach in accordance with the 2006 IPCC guidelines.

Kazakhstan plans to engage on a voluntary basis in approaches and activities under Article 6 of the Paris Agreement with a view to gear for higher ambition of its mitigation and adaptation actions and promote sustainable development and environmental integrity. Details of methodologies associated with the cooperative approaches that involve the use of internationally transferred mitigation outcomes, which Kazakhstan has envisaged will become available as part of the information that Kazakhstan plans to include in its initial report under Article 6.

GHG emissions and removals from the 2024 NIR of Kazakhstan are used for tracking the total annual net GHG emission reductions.

The initial report will also include information on how double counting of net GHG emission reductions have been avoided through the application of corresponding adjustments to the national GHG inventory in accordance with rules, methodologies and procedures (RMPs) adopted under Article 6 of the Paris Agreement. As Kazakhstan does not implement adaptation action with mitigation co-benefits and economic diversification measures, it does not provide information on any relevant methodology.

Since the selected indicator for tracking progress, namely the total annual net GHG emissions is based on the NIR, methodology used for each of the reported years is consistent with that used for the base year levels of the indicator. There are no inconsistencies, as when any improvements in GHG inventory are introduced the whole time series are recalculated in accordance with IPCC Good Practice Guidance.

2.C.3. Assessment of progress in NDC as reflected in the structured summary

Quantitative and qualitative information required to be reported in accordance with section C of Chapter III of the MPGs on tracking NDC progress is presented in the submission of the CTFs on tracking NDC progress. This includes quantitative information on tracking progress that is reported in a structured summary as part of this submission. Highlights of the structured summary are provided in Table 2.15 below.

Since Kazakhstan has not yet engaged in Article 6 activities, it did not transfer or acquire internationally transferred mitigation outcomes. Therefore, it did not adjust its GHG inventory, and the emission balance for each year of the reported period is equal to the net annual GHG emissions estimates. According to the 2024 NIR, the indicator of NDC progress, namely the total net GHG emissions covered by the NDC, amounted to 328,422.27 ktCO_2e in 2021 and 352,973.03 CO_2e in 2022. Compared to the levels of the 1990 base year, GHG emissions in the first two years of the NDC implementation period were by 14.86% and 8.49% lower, respectively. Therefore, Kazakhstan is making progress towards its NDC as it has been reducing emissions during the years covered by NDC below 1990 levels, despite some emission increase in 2022 compared to 2021 levels. Yet, the country plans to intensify its efforts to further reduce emissions and enhance removals to achieve its target of 15% emission reduction in 2030 compared to 1990 levels.

Table 2.15. Summary of progress towards implementing and achieving the NDC by Kazakhstan

	Unit	Base year level	Values in the implementation period			Target level	Target year	Progress made towards NDC
			2021	2022	2030			
Indicator: total annual net GHG emissions consistent with values from 2024 NIR	Kt CO_2e	385,736.5	328,422.3	352,973.0	NA	15% below the base year	2030	The most recent level of the indicator is 8.49% below the base year level.

Note: More detailed information on tracking NDC progress can be found in the Common Tabular Format Table 4 ('Structured summary: tracking progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement'), which has been submitted electronically together with this BTR.

2.D. Mitigation policies and measures, actions and plans, including those with mitigation co-benefits resulting from adaptation actions and economic diversification plans, related to implementing and achieving a nationally determined contribution under Article 4 of the Paris Agreement

This section provides information on policies and actions that support implementation of the NDC under the Paris Agreement by Kazakhstan. It provides information for the following sectors, energy, transport, industrial processes and product use, agriculture, LULUCF and waste in accordance with all mandatory requirements. It also provides information on policies and measures that cuts across two or more sectors. Further information is presented in the CTF table II.5 on tracking progress of NDCs and an appendix contained therein.

Information in this section is provided in accordance with requirements from the MPGs by sector, including description of each policy together with its objective, type of instrument, status, sector and gas affected and implementing entities. Except for the waste sector where some information on cost is provided in the projections section, information on costs is not provided as such information is either not available, or highly uncertain. Information on non-GHG mitigation benefits and how mitigation actions interact with each other is very limited and presented for a few sectors only, e, g, GHG emission reductions, associated air pollution reduction and health benefits.

Information on mitigation co-benefits resulting from Parties' adaptation actions and/or economic diversification plans consistent with Article 4.7 is also not provided as Kazakhstan NDC comprises an absolute economy-wide reduction target that is fully consistent with requirements of Article 4.4 of the Paris Agreement and is not formulated in accordance with Article 4.7. There are no major policies reported in the NC8 that have been discontinued and accordingly, no information is provided on this matter.

Kazakhstan has provided to an extent possible estimates of expected and achieved GHG emission reductions for some of the key actions, policies and measures in a tabular format and, therefore, it does not need to apply flexibility provisions contained in the MPGs with regards to reporting on policies and measures. It also provided qualitative information on the non-GHG mitigation benefits, where applicable, e.g. air quality improvements and health impacts from the transition from coal to natural gas and electric vehicles in the cities.

In addition to the information provided by the sector, this section contains information on policies and measures that influence emissions from international transport, information on how its policies and measures are modifying the longer-term trends in GHG emissions and removals, and information on economic and social impact from response measures.

2.D.1. Cross-cutting policies and measures

A key component of climate change mitigation in Kazakhstan is its updated legislative framework and overarching strategies, including the Concept for the Transition to a Green Economy and the Strategy for Achieving Carbon Neutrality by 2060, which enable the implementation of sector-specific GHG reduction policies and measures, fostering a coordinated and comprehensive approach to emissions reduction and the achievement of Kazakhstan's NDC commitments.

Environmental code of Kazakhstan

The Environmental Code of Kazakhstan establishes the legal framework, objectives, principles, and mechanisms for implementing a unified state environmental policy. National legislation on GHG regulation began with the adoption of the Environmental Code No. 212 on January 9, 2007[49]. A revised version of the Code was adopted in 2021[50], incorporating significant updates to strengthen environmental governance.

The Environmental Code is a key instrument for addressing sector-specific GHG emissions and advancing national climate action. It integrates emission reduction benchmarks across sectors such as energy, industry, and waste management, aligning them with the country's NDC and climate goals. The Code enhances the regulation of the Emission Trading System (ETS), establishing a market-based mechanism for emissions reduction with an annual 1.5% reduction in the carbon budget until 2030. It promotes the adoption of Best Available Techniques (BAT) to modernize industries and enforce strict emission limits, while incentivizing renewable energy use and energy efficiency. The Code also introduces climate adaptation measures, focusing on resilience and reducing sectoral vulnerabilities.

Concept for transition of the Republic of Kazakhstan to Green Economy

Kazakhstan's Concept for Transition to a Green Economy, adopted in 2013, serves as a strategic framework for achieving sustainable development by balancing economic growth, environmental protection, and social equity. The concept focuses on reducing environmental impacts across sectors while enhancing resource efficiency and fostering innovation. The concept introduces key targets, such as increasing renewable energy's share to 50% of the energy mix by 2050, improving urban air quality, expanding organic farming to 300,000 hectares, and advancing waste management through recycling and circular economy practices.The concept further introduces plans for green finance through bonds and loans to support sustainable projects.

Strategy of the Republic of Kazakhstan on Achieving Carbon Neutrality by 2060

Kazakhstan's Strategy on Achieving Carbon Neutrality by 2060 (adopted in 2023) serves as a comprehensive framework to transform the nation's economy into a sustainable and low-carbon development model. This ambitious strategy aligns with global climate goals, including those enshrined in the Paris Agreement, and reflects Kazakhstan's commitment to addressing climate change while ensuring sustainable economic growth and social equity.

The primary goal of the strategy is to achieve net-zero GHG emissions by 2060, ensuring that any remaining emissions are balanced by equivalent removals or offsets. The strategy focuses on reducing emissions across all sectors, enhancing carbon sequestration, and integrating sustainable practices into economic activities. An interim goal of the strategy that is enshrined in Kazakhstan's NDC, is an unconditional 15% GHG reduction by 2030 from 1990 levels and a conditional target of a 25% reduction, with international support for the decarbonization of the economy.

Market mechanisms for reducing greenhouse gas emissions and absorption

Market mechanisms for reducing GHG emissions and enhancing removals are described in Chapter 20 "State regulation in the field of greenhouse gas emissions and absorption" of the Environmental Code as amended in 2021. Market mechanisms are based on a system for capping emissions from participating installations and trading of carbon units, or emission trading system (ETS). The ETS has been operating in Kazakhstan since

[49] http://adilet.zan.kz/rus/docs/K070000212
[50] https://adilet.zan.kz/rus/docs/K2100000400

2013 and has been based on free allocation of emission allowances, or quotas. Initially, the system was based on the historical approach to distributing emissions quotas.

Since 2021, the ETS operates following the "efficiency benchmarking" approach, which involves the use of specific emission factors for different types of manufacturing processes, e.g. cement and steel. Accordingly, the GHG emission quotas are calculated by multiplying the benchmarks by the average value of production for 2017–2019[51].

In the first half of 2024, following a request from MENR, several amendments were made to the ETS on the quantity of the carbon quota allocated to the regulated sectors of the economy with their gradual decrease from 2022 to 2025, except for the chemical and manufacturing industries, where carbon quota units increased in the same period. Also, amendments and additions have been made related to process of obtaining additional quotas[52].

The Jasyl Damu, which in accordance with Order No. 91 from March 28, 2022 of the MENR is the operator of the ETS, publishes information on the quantity of additional carbon quotas issued free of charge for each installation on its official Internet resource[53].

2.D.2. Policies and мeasures in the energy sector

The energy sector in Kazakhstan is the largest contributor to GHG emissions and plays a critical role in achieving the country's climate commitments and NDC targets. Guided by overarching strategies such as the Concept for the Transition to a Green Economy and the Strategy for Achieving Carbon Neutrality by 2060, Kazakhstan has implemented a range of policies and measures to promote energy efficiency, increase the share of renewable energy sources, and modernize its energy infrastructure.

Sector-specific measures include the expansion of wind, solar, and hydro power generation capacity, implementation of market-based mechanisms such as the Emissions Trading System (ETS), and the gradual phase-out of coal-fired power plants in the longer term. Key policies also target energy efficiency improvements in industrial production, residential heating, and transportation, further contributing to emissions reductions.

2.D.2.1. Policies and мeasures in the fuel combustion sector

The Concept for transition to Green Economy defines the reduction of the carbon intensity of GDP as one of the principles of such transition. Since the main GHG emissions in Kazakhstan come from the fuel combustion sector, the reduction of energy intensity and, accordingly, the carbon intensity of GDP directly depend on policies and measures in this sector.

The main goals and strategic documents related to the fuel combustion sector are described below. They are provided without a quantitative assessment of the impact on the reduction of GHG emissions, since these documents lay the foundation for the development of measures to achieve the relevant goals and objectives.

[51] https://adilet.zan.kz/rus/docs/P2100000006
[52] https://recycle.kz/ru/parnikovye-gazy
[53] https://recycle.kz/ru/parnikovye-gaz

2.D.2.2. Reducing the energy intensity of Kazakhstan's Gross Domestic Product

Low-carbon economic development involves a significant reduction in GHG emissions relative to the gross domestic product (GDP), a transition in the energy sector from the combustion of fossil fuel and energy resources to renewable energy sources (solar energy, wind energy, small hydropower plants), a reduction in the consumption of energy resources and thereby a reduction in GHG emissions in production and households and commercial sectors (energy saving).

In the context of reducing the energy intensity of GDP, on January 13, 2012, the Law "On Energy Saving and Improving Energy Efficiency"[54] (No. 541) was adopted, which defines the legal, economic and organizational foundations for the activities of individuals and legal entities in the field of energy saving and improving energy efficiency.

Table 2.16 shows the goals included in the Concept for the Transition of the Republic of Kazakhstan to a Green Economy updated in 2023.

Table 2.16. Reduction in the energy intensity of Kazakhstan's Gross Domestic Product compared to 2021

Year/ Objectives	Concept for the transition of the Republic of Kazakhstan to a green economy
2030	–15% from 2021 level
2040	–25% from 2021 level
2050	–35% from 2021 level

Note: due to the lack of distribution of the quantitative target by sectors and types of fuel for which energy intensity should be reduced, an assessment of the impact of this measure was not carried out.

2.D.2.3. Concept of development of fuel and energy complex of Kazakhstan for 2022–2026

On June 28, 2014, the "Concept for the Development of the Fuel and Energy Complex of the Republic of Kazakhstan until 2030" (No. 724) was approved. The Concept includes the goals of increasing the share of renewable and alternative energy sources in the energy balance; conserving energy and other resources, and increasing energy efficiency. Among the quantitative goals related to GHG emissions, the Concept reiterates the goals for reducing the energy intensity of GDP, which were specified in the Concept for the Transition of Kazakhstan to a Green Economy in its 2013 version.

On November 21, 2022, by the Resolution of the Government of Kazakhstan No. 931, the "Concept for the Development of the Fuel and Energy Complex of Kazakhstan until 2030" was transformed into the "Concept for the Development of the Fuel and Energy Complex of Kazakhstan for 2022–2026". In this concept, the goals for reducing the energy intensity of GDP were updated as shown in Table 2.17.

[54] https://adilet.zan.kz/rus/docs/P1400000724

Table 2.17. Reduction of energy intensity of Kazakhstan's GDP from the 2008 level by 46.6% by 2026

Year	Goals
2022	40.5%
2023	42.1%
2024	43.6%
2025	45.2%
2026	46.6%

Due to the lack of distribution of the quantitative target by sectors and types of fuel for which energy intensity should be reduced, an assessment of the impact of this measure was not carried out.

2.D.2.4. Strategic Plan of the Ministry of Energy of Kazakhstan for 2023–2027

The main short-term policies and measures in the fuel combustion sector are defined by the Ministry of Energy of Kazakhstan and are reflected in the Strategic Plan of the Ministry of Energy of Kazakhstan for 2017–2021 that was adopted on December 28, 2016. This plan defines its objective as improving the quality of the environment, ensuring the transition of Kazakhstan to low-carbon development and a "green economy" in order to meet the needs of current and future generations. The plan includes the following measures: regulation of GHG emissions and removals through a market mechanism, namely the ETS, increasing the share of renewable energy sources (RES) in the country's energy balance, modernization of thermal power plants and boiler houses, and implementation of energy efficiency.

In 2021, electricity generation from renewable energy sources reached 4.2 billion kWh, that accounts for 3.6% in the country's total energy balance[55]. Within the framework of the project "Table Efficiency in Kazakhstan", 83 social facilities (schools, hospitals, kindergartens) were modernized in 2021, compared to the planned 96 facilities[56].

On December 3, 2020, by Order No. 421 of the Minister of Energy of Kazakhstan, the "Strategic Plan of the Ministry of Energy for 2020–2024" was approved that shows continuity with the goals and objectives set in the previous strategic plans. The key objectives of the plan include achieving the goals of the Paris Agreement, identifying sources of financing, including green finance and attracting new investment, decarbonizing the economy, stimulating investment in green technologies, improving traditional energy sources and developing renewable energy sources.

The strategic plan was subsequently amended twice, with the latest amendment from November 13, 2023 by Order of the Minister of Energy of Kazakhstan No. 402, the Development Plan of the Ministry of Energy of Kazakhstan for 2023–2027 was adopted. This latest plan envisages a goal of generating up to 50% of all energy by 2050, through alternative energy sources, introducing renewable energy capacity with storage, as well as developing nuclear energy projects[57].

In addition to the strategic plans, on March 28, 2023 by the Resolution of the Government of Kazakhstan, the Concept for the Development of the Electric Power Industry of Kazakhstan for 2023–2029 was adopted. The concept reflects an assessment of the current state of

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[55] https://kz.kursiv.media/2023–04–20/zhnb-sunpower/
[56] https://aisggk.kz/%D0%BC%D0%B8%D0%B8%D1%80-%D1%80%D0%BA-%D0%B8%D1%82%D0%BE%D0%B3%D0%B8-%D0%BF%D1%80%D0%BE%D0%B5%D0%BA%D1%82%D1%8B-%D1%82%D0%B5%D0%BD%D0%B4%D0%B5%D0%BD%D1%86%D0%B8%D0%B8-%D1%8D%D0%BD%D0%B5%D1%80%D0%B3/
[57] https://www.gov.kz/uploads/2023/11/16/c8c488e940e75609573a90e4db9bc02b_original.516479.PDF

the electric power industry, its problems and opportunities, and provides an outlook for the electric power industry and pathways for future development.

The concept also reflects major tasks, such as the privatisation of the electric power industry, determining the types of independent market entities, choosing the form of organization of the electricity market, developing a mechanism for trading and settlements in the electricity market, and determining the degree, form and methods of regulation of the electricity market. By 2029, it is anticipated that the level of newly installed power capacity will reach 11.7 GW, ensuring that the demand for electricity and heat is fully met. Additionally, the share of electricity generated from renewable energy sources is projected to account for 12.5% of the total electricity generation. Altogether, achieving these goals will contribute to GHG emission reduction and increased energy efficiency in the energy industry.

2.D.2.5. Policies and мeasures in the heat and power generation sector

In the heat and power production sector, the main measures aiming at GHG emissions reduction and contributing to the achievement of the NDC target of Kazakhstan are increasing the share of natural gas in power generation, developing renewable energy sources, and commissioning nuclear capacity.

Increasing the share of natural gas in power generation

This measure is being implemented through the construction of the Saryarka main gas pipeline completed in October 2019 and the conversion of Astana heating plants from coal to natural gas. Thus, according to information provided by the Mayor of Astana A. Kulginov, on December 3, 2021, 13 hot water boilers of combined heat and power plant (CHPP)-1 and CHPP-2 were converted to natural gas[58].

The conversion of thermal power plants in Almaty from coal to gas is currently in progress. The transition to gas will begin at Almaty CHPP-2 in 2025 and will be completed in 2026. In November 2022, Almaty Power Stations signed an agreement with the European Bank for Reconstruction and Development (EBRD) for a loan of 130 billion tenge. To modernize CHPP-2, a new station with a capacity of 600 MW will be built using gas turbine technologies. In addition, reconstruction of CHPP-3 is also planned to be completed by 2025, with two combined-cycle units with a total capacity of 543.6 MW. By 2028, CHPP-1 with a capacity of up to 225 MW should also switch to natural gas[59].

The development of gas generation is envisaged in the “Action Plan for the Development of the Electric Power Industry until 2035”[60] adopted on February 20, 2024. This plan provides for the construction of combined-cycle plants in the cities of Almaty, Aktau, Atyrau, Shymkent, Taraz, Aktobe, Kyzylorda and Uralsk.

This measure has co-benefits in the form of improved air quality in cities and resulting health benefits since air pollutants from natural gas combustion are much lower than those from coal combustion. The impact assessment of this measure is given in Table 2.18.

On September 27, 2024, by order No. 342 of the Minister of Energy, the “Concept for the Development of Hydrogen Energy until 2030” was approved. The concept outlines the role of hydrogen in achieving the goal of carbon neutrality and fulfilling international obligations to reduce GHG emissions. The main focus of the concept is on the development of hydrogen technologies and attracting investment for the implementation of pilot projects in this area[61].

[58] Central Communications Service under the President of the Republic of Kazakhstan. The capital will be fully gasified – Altai Kulginov, December 3, 2021: https://ortcom.kz/ru/novosti/1638525115и.
[59] https://www.gov.kz/memleket/entities/energo/documents/details/733801?lang=ru
[60] https://www.gov.kz/memleket/entities/energo/documents/details/611688?lang=ru
[61] https://www.gov.kz/memleket/entities/energo/documents/details/733801?lang=ru

Increasing the share of renewable energy sources in power generation

Key measures to increase the share of renewable sources for power generation include the Law on Support for the Use of Renewable Energy Sources, setting targets for the development of renewable energy, introducing fixed tariffs for the purchase of electricity from renewable sources and subsequent replacement of fixed tariffs by an auction mechanism.

In 2013, the Green Economy Concept was approved, setting the strategic direction for the transition to a sustainable economy with an emphasis on renewable energy sources. The concept sets goals for Kazakhstan to achieve 15% of the share of electricity from renewable energy sources by 2030, increase it to 30% by 2040 and to 50% by 2050.

In 2014, Kazakhstan introduced fixed tariffs for renewable energy projects, which ensured a stable investment environment and incentives for accelerated implementation of new technologies. In 2018, fixed tariffs were replaced by an auction mechanism, which increased transparency and helped attract private capital.

Since 2020, by Decree of Government Nº 81[62], the renewable energy projects have been included in the list of areas for priority investment, which has allowed such projects to receive significant preferences. These include exemption from customs duties and VAT on imported goods, as well as the provision of in-kind grants, the size of which can reach up to 30% of the total investment. These grants cover land, buildings, equipment and other assets. In addition, Article 290 of the Entrepreneurial Code provides as a tax incentive a 100% reduction in corporate tax, zero rates of land tax and property tax.

As part of the development of renewable energy sources through the auction mechanism, the Ministry of Energy of Kazakhstan publishes annually a Schedule of auction trades on its website. The Ministry takes measures to incentivise the development of the renewable energy sector, such as increasing the period of guaranteed purchase of electricity to twenty years from the winners of auctions approved by order of the Minister of Energy No.16241 dated January 17, 2018[63]. Another such incentive from 2023 is publishing a plan for for holding auctions for 2024–2027, which reflects the volumes of purchased capacity for each type of renewable energy station[64].

According to the Ministry of Energy, in 2023, 6,675 million kWh of electricity was generated from renewable energy sources in Kazakhstan with the following distribution by types of renewable energy sources (RES):

- Wind power plants (WPP) produced 3,825 million kWh;
- Solar power plants (SPP) – 1,854 million kWh;
- Hydroelectric power plants (HPP) – 994 million kWh;
- Bioelectric power plants (BioPP) – 2.71 million kWh.

At the end of 2023, the share of electricity generated from renewable energy sources reached 5.92% of the total electricity production in the country, which is 18.4% higher than the planned figures set at 5%. These results indicate the successful development and integration of renewable energy sources into the energy system of Kazakhstan.

As of the end of 2023, there were 144 renewable energy facilities operating in the country with a total installed capacity of 2,868.6 MW, including:

- 57 wind power plants with a capacity of 1,394.6 MW;
- 45 solar power plants with a capacity of 1,202.61 MW;
- 39 hydroelectric power plants with a capacity of 269.605 MW;
- 3 bioelectric power plants with a capacity of 1.77 MW.

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[62] https://www.adilet.zan.kz/rus/docs/P2000000081
[63] https://adilet.zan.kz/rus/docs/V1700016241
[64] https://www.gov.kz/memleket/entities/energo/documents/details/472835?lang=ru

Despite the progress in increasing power generation capacity, in particular from renewable sources and improving energy efficiency, forecasts for 2024–2030 indicate a significant remaining gap between electricity production and consumption. According to the forecast balance of the Ministry of Energy, by 2030 the electricity deficit may reach 13.5 billion kWh.

Further development of power generation from renewable sources is envisaged in the "Action Plan for the Development of the Electric Power Industry until 2035" adopted on February 20, 2024. This plan provides for the construction of the following facilities: wind farms with energy storage systems with a total capacity of 5,000 MW by 2028; wind farms through auctions with a total capacity of 4,000 MW by 2030, solar power plants through auctions with a total capacity of 500 MW by 2029, and hydro power plants and biogas plants by 2035.

This measure has co-benefits in the form of improved air quality in cities and resulting health benefits since air pollutants from natural gas combustion are much lower than those from coal combustion. The impact assessment of this measure is given in Table 2.18.

Reducing the share of coal in electricity generation

Kazakhstan ranks eighth in the world in terms of proven coal reserves and has 49 deposits. Kazakhstan is among the top 10 countries in terms of proven coal reserves amounting to 29.4 billion tons (or 2.4% of world reserves), where 2/3 are brown coal and 1/3 are hard coal. The largest coal basins are located in the central and northern parts of the country: Ekibastuz (10 billion tons), Karaganda (6.9 billion tons) and Turgay (5.9 billion tons) (77.5% of proven coal reserves). Over the past 5 years (2019–2023), annual coal production levels according to the national fuel and energy balance data was around 110–113 million tons.

Reducing the use of coal in the economy of Kazakhstan is one of the key areas of decarbonization according to the Strategy for Achieving Carbon Neutrality by 2060. To that end, currently the Government is considering a roadmap and plan for retirement of the existing coal capacity with possible milestones and targets that are to be set in the next few years.

Reducing the share of coal in electricity generation is planned to be achieved on account of further development of the renewable energy sector, increasing the share of gas in electricity production and the commissioning of nuclear capacity.

Construction of a nuclear power plant

In early September 2021, the President of Kazakhstan K.-Zh. Tokayev initiated consideration of the need to build a nuclear power plant. The decision on building a nuclear power plant was taken on October 6, 2024, following the results of the Referendum on the Use of Nuclear Energy in Kazakhstan. In the referendum the citizens of the country were asked to vote either for the construction of a nuclear power plant or against such construction. The turnout of Kazakhstan is in the referendum was 63.66% of the number of citizens entitled to participate in the referendum[65]. According to the voting results, 71.12% voted for, 26.15% against such construction.

The impact assessment of this measure is given in Table 2.18. The assessment was carried out using the TIMES-KAZ energy model.

[65] https://tengrinews.kz/kazakhstan_news/referendum-aes-ozvuchenyi-itogovyie-rezultatyi-golosovaniya-550317/

2.D.2.6. Policies and measures in the transport sector

Energy efficiency in transport

The main areas for reducing GHG emissions from transport include the following: improving energy efficiency, switching to cleaner energy sources, updating the existing fleet of vehicles, smart urban planning and operating a smart public transport system, optimizing passenger and freight transportation, improving public transport infrastructure and improving the quality of service in public transport.

On energy efficiency, in accordance with subparagraphs 6–7 of Article 5 of the Law “On Energy Saving and Improving Energy Efficiency”, the “Energy Efficiency Requirements for Transport” (No 389) were approved on March 31, 2015. These requirements are formalised through standard indicators of energy efficiency for types of transport. The requirements apply to rail, road, sea, inland water, air and urban rail transport and transport means that are imported and produced after their entry into force.

On the path to carbon neutrality, it is expected that by 2060 all passenger cars will be electric. As a result, the share of energy consumption from transport will be reduced from the current 14% of the total energy consumption in the country to 9% by 2060.

Another measure is increase in the use of natural gas as a motor fuel for special equipment, buses and rail transport. This will require refurbishment of the existing fleet of vehicles and special equipment of municipal services with natural gas equipment, as well as natural gas supply in rail transport as a motor fuel for locomotives.

This measure has co-benefits in the form of improved air quality in cities and resulting health benefits since air pollutants from natural gas combustion are much lower than those from gasoline and diesel fuel combustion by cars and buses.

Development of public transport

Kazakhstan attaches priority to development of the public transport, An example to that end is the “Astana E-Mobility Project”[66], which provides a loan of up to €50 million (or equivalent in tenge) to the municipal public transport company City Transportation Systems LLP in Astana. The project is a continuation of the previous project supported by the EBRD’s on improving public transport in Astana. It will facilitate the introduction of electric buses and the expansion of public electric mobility in the city. It will also facilitate the transition from private to public transport with safer and more reliable public buses. The project is part of a comprehensive city program to promote environmentally friendly urban public transport, including the wider use of e-buses and the introduction of light rail transport (LRT).

The transition to electric mobility Is expected to significantly reduce GHG emissions, air pollutants from exhaust pipes and noise pollution. Thus it will bring co-benefits in the form of improved air quality in Astana and resulting health benefits.

[66] https://www.ebrd.com/work-with-us/projects/psd/55484.html

2.D.2.7. Policies and Measures in buildings

Natural gas supply to households for the population of Astana, Akmola, Karaganda regions

According to the General Scheme for Natural Gas Supply of Kazakhstan for 2023–2030[67], it is planned to provide natural gas supply to the building sector in Astana, Akmola, Karaganda regions. This is enabled by building a single gas transportation system to fully meet the need for gas supply by domestic resources given the understanding of natural gas as an environmentally friendly fuel. It is planned to increase the share of natural gas consumption on a commercial basis by households and public utilities from 21.1% to 24.5% (from 4.09 billion m^3 to 8.2 billion m^3) between 2023–2030.

This measure has co-benefits in the form of improved air quality in cities and resulting health benefits since air pollutants from natural gas combustion are much lower than those from gasoline and diesel fuel combustion by cars and buses. An assessment of the impact of this measure is given in Table 2.18.

2.D.2.8. Policies and measures in the fugitive emissions sector

According to the IPCC guidelines, fugitive emissions are defined as accidental or intentional releases of greenhouse gases during the extraction, processing and delivery of fossil fuels to their final point of use.

Ban on gas flaring and development and implementation of gas processing development programmes

After the introduction of the ban on gas flaring, the annual volumes of flared gas in Kazakhstan were reduced by more than 3.5 times on the backdrop of steadily growing volumes of gas production. These reductions were achieved through the systematic implementation of gas utilization programmes, which were provided for by the Law of the Republic of Kazakhstan dated June 28, 1995 “On Oil”.

During the period of implementation of these gas utilization programmes some problems appeared that were a result of insufficient coordination by the state authorities. A new law was then adopted in 2017 that regulates the use of underground resources and that provides for replacement of the gas utilization programmes by gas processing development programmes that are currently in place. The law imposes an obligation on the users of underground resources to develop and implement gas processing development programmes that provide for maximizing the volumes of processing and sales of the gas they produce along with oil production[68].

This measure has the co-benefits of an improved environment in the areas where oil is extracted and in nearby settlements, as air pollutants are substantially reduced.

[67] https://adilet.zan.kz/rus/docs/G23JVM00350
[68] https://adilet.zan.kz/eng/docs/K1700000125

2.D.2.9. Methodology and assumptions used to estimate GHG emission reductions or removals for each action, policy and measure

In the energy sector, the assessment of effects from most policies and measures was conducted using the TIMES-KAZ model, an energy system modeling framework. This include assessment of the impact from the following policies and measures:

- Increasing the share of natural gas in electricity generation;
- Increasing the share of renewable energy sources in electricity generation;
- Construction of a nuclear power plant.

The impact of supplying natural gas to households in Astana, Akmola and Karaganda regions was assessed using a coal-to-natural gas approach, where impact was assessed as a difference between the two cases of development of the energy system in the part of energy supply, one based on coal and another based on natural gas.

For some measures, no quantitative assessment was not carried out due to specific challenges, limitations, lack or uncertainty of data:

- Development of public transport: Kazakhstan prioritizes the development of public transport, exemplified by the “Astana E-Mobility Project.” However, this project was not assessed due to insufficient data availability;
- Reducing the share of coal in electricity generation: the lack of quantitative targets for reducing the share of coal in electricity generation made it impossible to conduct an assessment for this measure;
- Energy efficiency in transport: Insufficient data on the transport sector prevented an assessment of the impact of energy efficiency improvements in transport;
- Ban on gas flaring and development and implementation of gas processing development programs: No assessment of the impact of this measure was conducted because the ban on gas flaring was adopted in a previous period and has already been in effect for a long time in Kazakhstan.

Table 2.18. Summary of policies and measures and their impact in the energy sector

Name	Description,	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Estimates of GHG emission reductions (kt CO_2 eq)	
Energy sector									2022 Achieved	2030 Expected
Increasing the share of natural gas in electricity generation	The Concept for the transition to a "green economy" sets the goal of increasing the share of natural gas in electricity generation. The development of electricity generation based on natural gas is envisaged in the "Action Plan for the Development of the Electric Power Industry until 2035" adopted on February 20, 2024. This plan provides for the construction of combined-cycle plants in the cities of Almaty, Aktau, Atyrau, Shymkent, Taraz, Aktobe, Kyzylorda and Uralsk.	The share of electricity based on natural gas in the total electricity output: 20% in 2020, 25% in 2030. 5350 MW by 2035 according to the Electric Power Industry Development Plan until 2035	Regulatory	Implemented	Energy	CO_2, CH_4, N_2O	2013	Ministry of Energy of Kazakhstan	NE	10,034.37
Increasing the share of renewable energy sources in electricity generation	The goal is set out in the Concept for transition to a "green economy". The development of electricity generation based on renewable energy is envisaged in the "Action Plan for the Development of the Electric Power Industry until 2035" adopted on February 20, 2024. This plan provides for the construction of wind power plants with energy storage systems with a total capacity of 5,000 MW by 2028, the construction of wind power plants through auctions with a total capacity of 4,000 MW by 2030, the construction of solar power plants through auctions with a total capacity of 500 MW by 2029, and the construction of hydroelectric power plants and biogas plants by 2035.	The share of electricity based on renewables and alternative energy sources in the total electricity output: 3% in 2020, 6% by 2025, 15% by 2030, 24.4% by 2035 and up to 50% by 2050. 9700 MW by 2035 according to the Electric Power Industry Development Plan until 2035	Regulatory	Implemented	Energy	CO_2, CH_4, N_2O	2013	Ministry of Energy of Kazakhstan	NE	27,682.08

Name	Description,	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Estimates of GHG emission reductions (kt CO_2 eq)	
Construction of a nuclear power plant	Decision on building a nuclear power plant was taken on October 6, 2024 following the results of the Referendum on the use of nuclear energy in Kazakhstan. The turnout of Kazakhstanis in the referendum was 63.66 percent of the citizens entitled to participate in the referendum. According to the voting results, 71.12% voted for, 26.15% against.	Installed capacity of nuclear power plant: 1.2 GW by 2035 and 1.2 GW by 2040	Regulatory	Planned	Energy	CO_2, CH_4, N_2O	2035	Ministry of Energy of Kazakhstan	NE	12,939.07
Development of public transport	The Astana E-Mobility project is a continuation of the EBRD's involvement in supporting improvement of public transport in Astana. It will facilitate the introduction of electric buses and the expansion of public electric mobility in the city.	The shift to electric mobility will significantly reduce greenhouse gas emissions, tail pipe air pollutant emissions and noise pollution. The loan will finance the procurement of up to 100 electric buses	Economic	Planned	Energy	CO_2, CH_4, N_2O	2024–2025	European Bank for Reconstruction and Development and Astana Akimat	NE	NE
Natural gas supply to households of Astana, Akmola, Karaganda regions	According to the General Scheme for Natural Gas Supply of the Republic of Kazakhstan for 2023–2030, conditions are created for sustainable socio-economic development of the Republic of Kazakhstan by increasing the coverage of the population with gas supply by creating a unified gas transportation system to fully meet the need for gas supply using its own gas resources as an environmentally friendly fuel.	Increase in the share of commercial gas consumption by the population and public utilities from 21.1% to 24.5% (from 4.09 billion m^3 to 8.2 billion m^3).	Regulatory	Implemented	Energy	CO_2, CH_4, N_2O	2023	Ministry of Energy of Kazakhstan	NE	6,017.94

2.D.3. Policies and measures in the Industrial processes and product use sector

The IPPU sector in Kazakhstan is a significant contributor to national GHG emissions, with the metal industry, chemical manufacturing, and cement production being the primary sources. Recognizing the critical role of this sector in achieving its climate goals, Kazakhstan has implemented a range of policies and measures that integrate strategic, technological, economic, and regulatory approaches to promote decarbonization of the sector.

All of the measures that are outlined in the IPPU sector form a framework for decarbonization of the sector that is aimed at achieving both, sustainable economic growth and reducing GHG emissions in line with the Kazakhstan NDC objectives.

Strategy on Achieving Carbon Neutrality by 2060, which outlines a comprehensive approach to reducing emissions across the economy. In the IPPU sector, the strategy envisages a gradual reduction of the GHG emission quotas in the mineral and metal industries by 1–2% annually, reflecting a commitment to sustainable growth of industry.

Also, the Kazakhstan's Concept for the Transition to a Green Economy[69], sets ambitious targets for the industry sector to drive sustainable development and reduce GHG emissions. The strategy emphasizes increasing energy efficiency, adopting Best Available Techniques (BAT) to modernize industrial processes, promoting circular economy practices, and integrating renewable energy into operations in industry. It also emphasises promoting technical modernization of industry to reduce energy consumption per unit of output; promoting and stimulating innovative technologies to improve energy efficiency; creating new jobs through the development of "green" professions in industrial engineers and technologists, promoting production and use of hydrogen, etc.

Most industrial installations are covered by the ETS. By order of the Vice Minister of MENR dated July 19, 2021 No. 260, the List of benchmarks in economic sectors was approved[70] for the purposes of allocation of GHG quotas for all sectors covered by the ETS. Benchmarks in terms of emissions per unit production are provided for metal industry (ferrous and non-ferrous), mineral products (cement, lime), chemical industry (phosphorus, ammonia, hydrogen), and energy industry. The benchmarks were subsequently updated in May, 2023. The number of GHG quotas for regulated sectors of industry is calculated by multiplying the benchmark by production quantity and the quantity of GHG quotas is being decreased annually.

2.D.3.1. The Concept for the Development of the Manufacturing industry

The Concept for the Development of the Manufacturing Industry for 2023–2029[71] focuses on the technological modernization of industry and the development of innovative production of environmentally friendly building materials and chemical products in special economic zones, where a closed cycle (circular economy) and processing makes it possible to reduce production costs, increase efficiency and reduce emissions. Implementation of the concept is supported by financial entities, such as the JSC Development Bank of Kazakhstan and JSC Industrial Development Fund.

[69] https://adilet.zan.kz/rus/docs/U2400000568
[70] https://adilet.zan.kz/rus/docs/V2100023621
[71] Concept of Development of the Manufacturing Industry of the Republic of Kazakhstan for 2023–2029 https://baiterek.gov.kz/en/programs/concept-of-development-of-the-manufacturing-industry-of-the-republic-of-kazakhstan-for-2023–2029

2.D.3.2. Best available techniques

Requirements for the best available techniques (BAT) for the production of minerals, metals, and inorganic chemicals have been approved in accordance with paragraph 5 of Article 113 of the Environmental Code of Kazakhstan[72]. These requirements aim at strengthening environmental protection by introducing detailed indicators for each industrial process that indicate permissible emission levels, ensuring that companies adhere to strict environmental standards. The BAT principles are prepared in accordance with international environmental standards, reflecting the commitment of the Republic of Kazakhstan to reducing anthropogenic impact on the environment, while promoting sustainable industrial growth.

The BAT reference documents are applicable to enterprises in the mining, oil and gas, and chemical industries. The emission levels associated with the use of BAT practically correspond to the EU Best Available Techniques Reference Documents. When implementing BAT, industrial facilities are exempted from paying taxes on emissions into the environment, and for enterprises that do not receive integrated environmental permits (IEP), tax payments will be gradually increased by 2, 4, 8 times.

The introduction of the BAT allows not only to minimize the carbon footprint, but also to improve production processes and reduce energy costs. Technological changes include equipment modernization and the introduction of green technologies. These technologies are especially relevant for the coal and metallurgical industries of Kazakhstan, which are among the most carbon-intensive.

2.D.3.3. Pollutant Release and Transfer Register

Rules for maintaining the Pollutant Emissions and Transfer Register were approved by the order of the MENR dated August 31, 2021 No. 346[73]. According to the rules, the Authorized Body in the area of environmental protection provides public access to the Register of Emissions and Pollutants for each reporting year by providing a free public service called “Submission of environmental information”. Stationary sources are required to report in the digital portal information on the production and use of substances for surface treatment using organic solvents and painting, as well as emissions of specific substances such as Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Non-Methane Volatile Organic Compounds (NMVOCs), and Sulfur Hexafluoride (SF6).

2.D.3.4. Green cement

For the cement industry, a critical area is the scaling up of so-called “green” cement, including through measures such as clinker substitution, the use of alternative fuels and energy efficiency improvements. These measures have already reached a high level of technological readiness and are estimated to have a potential to reduce emissions by 30% by the early 2030s and by 40% by 2050. Further emission reductions of 60–70% will require more advanced green technologies and alternative cement production methods. Low-carbon Public procurement of low-emission technologies plays an important role in the scaling up of such technologies, as it can create strong demand and stimulate their adoption by the industry.

[72] List of requirements for the best available techniques (BAT) https://adilet.zan.kz/rus/docs/P2400000160
[73] Rules for Maintaining a Register of Emissions and Transfers of Pollutants

https://adilet.zan.kz/rus/docs/V2100024214

2.D.3.5. Improvements in the steel production

Steel production is also facing a number of changes aimed at reducing its carbon footprint. Direct reduction iron (DRI) technology using natural gas can reduce emissions by 30–42% compared to legacy technologies. In the future, the use of green hydrogen for DRI, combined with electric arc furnaces based on renewable energy sources (RES), opens up opportunities for carbon-neutral steel production, according to the scenario with the introduction of BAT.

The bulk of steel in Kazakhstan is produced using integrated coke-chemical, blast furnace and converter steelmaking technology. This technology is characterized by significant GHG emissions (about 2.0 tCO_2e/t steel), which is well above the benchmark and emission levels for similar production facilities in other countries, but will continue to be the main method of steel production in the world. One of the main reasons is the lack of access to natural gas at the metallurgical plant, where electricity and heat generation to meet own needs are based on the combustion of coal and fuel oil.

It is expected that the entire increase in steel production in the country after 2030 will be based on the use of electric arc smelting technology from scrap metal. According to the scenario with the introduction of BAT it includes a combination of energy efficiency measures, renewable energy sources and waste recycling. The implementation of the measure requires the development of a national program to stimulate the collection and recycling of ferrous scrap metal. An alternative integrated method of steel production is direct reduction of iron. Hydrogen is mainly used as a reducing agent in such production, which allows for a reduction in GHG emissions. Given that there is no policy for the use of green hydrogen in Kazakhstan yet.

2.D.3.6. Methodology and assumptions used to estimate GHG emission reductions or removals for each action, policy and measure

The assessment of greenhouse gas (GHG) emission reductions in the IPPU sector was conducted using the methodology and assumptions outlined in the 2006 IPCC Guidelines and expert assumptions on emission factor trends in the IPPU sector. Considered key drivers such as growth rates in industrial sectors (metallurgy, chemicals, and minerals) and population growth statistics for assessment demand in air conditioning, paintings and solvents.

Based on statistical data from industrial sectors, a linear regression model was applied to forecast GHG emissions in the IPPU sector. This model used the development of scenarios and enabled the evaluation of their respective impacts on GHG emissions. The projections are based on the mid-term forecast provided by the Ministry of National Economy of Kazakhstan and the target indicators outlined in the country's strategic documents related to industrial development.

The policies and measures in the IPPU (Table 2.19), include several initiatives aimed at reducing GHG emissions and fostering a circular economy. Among these measures is the support and subsidization of scrap metal and glass collection, which encourages recycling and reduces the need for primary metal and glass production. This approach aligns with updates to the Environmental Code designed to promote a circular economy, with the potential to reduce emissions by up to 370 kt CO_2e by 2030. Additionally, a ban has been placed on the export of scrap and waste materials, both ferrous and non-ferrous, as part of Kazakhstan's efforts to strengthen its circular economy, offering a further reduction potential of up to 390 kt CO_2e by 2030. A comprehensive set of measures has also been introduced to enforce the adoption of best available techniques (BAT) for sectors such as cement, lime, and inorganic chemical production. The Environmental Code mandates the use of BAT to mitigate carbon emissions in the IPPU sector, with an estimated reduction potential of up to 1,117.36 kt CO_2e by 2030. Furthermore, the establishment of the JSC Industrial Development Fund (IDF) aims to bolster domestic enterprises and advance the green manufacturing industry.

Table 2.19. Summary of policies and measures and their impact in the industrial processes and product use sector

Name	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Estimates of GHG emission reductions (kt CO_2 eq)	
IPPU sector									2022 Achieved	2030 Expected
Supporting and subsidizing the collection of scrap metal and glass (circular economy)	Reduction in the volumes of primary metal and glass melting. Changes to the environmental code to develop a circular economy	GHG emissions reduction	Regulatory	Adopted	Industry	CO_2, CH_4	2021	Ministry of Ecology and Natural resources of Kazakhstan	NE	370.00
Ban on the export of scrap and waste of ferrous and non-ferrous metals	The ban on the export of scrap and waste ferrous and non-ferrous metals as part of the development of a circular economy in Kazakhstan	GHG emissions reduction	Regulatory	Adopted	Industry	CO_2, CH_4	2022	Ministry of Industry and Infrastructure Development	NE	390.00
Set of measures to implement the requirements for best available techniques (BAT) "Production of cement, lime, inorganic chemicals" from the Environmental Code	Update of the Environmental Code in March 2024 with requirements on the use of the BAT to reduce carbon emissions in the IPPU	GHG emissions reduction	Regulatory	Adopted	Industry	CO_2, CH_4	2024	Ministry of Ecology and Natural resources of Kazakhstan	NE	1,117.36
Establishment of JSC Industrial Development Fund (IDF)	Measures aimed at supporting domestic enterprises and developing the manufacturing industry by financing projects that have a socio-economic effect, attracting external and internal investment into the country's economy	Development of industrial potential of the national economy and support of domestic producers	Institutional, economic, technological	Adopted	Industry	CO_2, CH_4	2024	Ministry of Industry and Construction of the Republic of Kazakhstan	NE	NE

2.D.4. Policies and measures in the agriculture and LULUCF sectors

2.D.4.1. Key policies and measures in the agriculture and LULUCF sectors

Similarly to the other sectors, the key policy documents that outline policies and measures in the agriculture and the LULUCF sectors are the Concept for transition to a Green economy, and Strategy on achieving carbon neutrality by 2060.

According to the Concept for transition to a Green economy, the transition should be supported by green projects that aim at promoting sustainable agriculture, sustainable pasture and livestock management, afforestation and reforestation and sustainable forest management. Specifically on sustainable forest management, such projects aim at enhancing the carbon sequestration function of forests or reducing the impact of forest activities through appropriate practices for the sustainable management of forest ecosystems. Concept also aims to increase the area under no-tillage farming to 8 million hectares by 2040.

Government plans to provide state support for private entrepreneurs by subsidising the rate of loans for projects that entrepreneurs take from second-tier banks and other financial institutions for green projects[74,75]. In addition, according to the measures of state support of private entrepreneurship, issuers of Kazakhstan Stock Exchange can issue "green" bonds, which will be guaranteed by the Government of Kazakhstan for the implementation of projects related to the reduction of GHG emissions, including in agriculture and forestry.

Accordingly, the concept envisages the green projects to be supported by green loans, for which the share is expected to rise from 3.17% in 2023 to 7.5% in 2030, 15.5% in 2040 and 20.5% in 2050[76].These projects will be also supported by green bonds, for which the share in the official list structure of the stock exchange is expected to rise from 2.27% in 2023 to 4% in 2030 and 6% in 2040.

The concept also points out the importance of preventing land degradation and restoring degraded lands; using crop rotation systems; introducing more efficient agricultural practices that minimize tillage; ensuring conservation of organic matter and moisture in the soil; and preventing soil erosion under the action of wind and water.

According to the Strategy on Achieving Carbon Neutrality by 2060, it is planned to reduce deforestation, take steps to preserve forests and restore degraded lands through sustainable forest management and reforestation[77]. In addition, the strategy calls for the expansion of sustainable agricultural practices, especially in terms of improved livestock management and expanded irrigation systems, including, but not limited to crop rotation and crop diversification.

The strategy also includes the launch of a Carbon Fund. The fund's mission will be to contribute to the achievement of carbon neutrality of Kazakhstan by 2060 through the mobilization and effective allocation of financial resources to projects aimed at reducing GHG emissions and increasing carbon sequestration, stimulating innovation and investment in environmentally sound technologies.

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[74] Resolution of the Government of the Republic of Kazakhstan dated September 17, 2024 No. 754 "On Some Measures of State Support of Private Entrepreneurship"
[75] Resolution of the Government of the Republic of Kazakhstan dated March 27, 2024 No 232. "On Amendments to the Resolution of the Government of the Republic of Kazakhstan dated December 31, 2021 No. 996 'On Approval of the Classification (Taxonomy) of Green Projects to be Financed through Green Bonds and Green Loans'
[76] Decree of the President of the Republic of Kazakhstan dated June 10, 2024 No. 568 "On introducing amendments and additions to the Decree of the President of the Republic of Kazakhstan No. 577 on the Concept for the Transition of the Republic of Kazakhstan to a Green Economy" dated May 30, 2013
[77] Decree of the President of the Republic of Kazakhstan dated February 2, 2023, No. 121 "On Approval of the Strategy of the Republic of Kazakhstan for Achieving Carbon Neutrality by 2060"

2.D.4.2. Offset projects in forestry

As part of the agreement signed in April 2024 to implement the Emissions Trading Market Implementation Partnership Project between MENR and the International Bank for Reconstruction and Development, the IBRD is supporting the country to improve and upgrade its domestic ETS, including facilitating the implementation of offset projects in agriculture and forestry[78].

The Forest Code[79] regulates public relations on possession, use and disposal of forest resources, and establishes the legal framework for protection, conservation, rehabilitation, improvement of ecological and resource potential of the forest resources and its rational use. The code was amended in 2024 (Article 104) to introduce economic principles and methods of protection, conservation and use of forest resources, reforestation and afforestation, which include: planning of actions for conservation, protection, reforestation and afforestation in the lands of the state forest resources; financing of forest management in the state forest fund; fees for the use of the specially protected forest areas; incentives for reforestation of the Republic of Kazakhstan; and liability insurance of the state forest owners and forest users[80].

Also, chapter 18 of the code introduces support for afforestation by private entities, including though reimbursement (up to fifty percent) of expenses for the establishment and cultivation of plantations of fast-growing tree and shrub species for industrial and energy purposes; and reimbursement (up to fifty percent) of expenses for the establishment and development of private forest nurseries.

In the near future, as part of the implementation of the ETS under the Environmental Code, it is expected that large industrial companies will be actively implementing offset projects in the field of afforestation or planting of forest plantations[81]. This is because the carbon budget under the ETS for companies is being reduced by 1.5% annually from 2021 to 2030, and is likely to be reduced further due to Kazakhstan's plans to achieve carbon neutrality by 2060. Exceeding emissions allocation by companies is subject to a fine of 5 monthly calculation indices (MCI) or about KZT 16800 (about USD35) per 1 ton of CO_2 equivalent.

In accordance with the "Rules for Approval of Carbon Offset and Provision of Offset Units" and Methodologies for Calculating Greenhouse Gas Emissions and Carbon Sink companies covered by the ETS will be able to receive offsets from projects related to planting and cultivation of forest[82][83].

[78] https://recycle.kz/ru/parnikovye-gazy
[79] Code of the Republic of Kazakhstan No. 477 dated July 8, 2003. Forest Code of the Republic of Kazakhstan
[80] Code of the Republic of Kazakhstan No. 477 dated July 8, 2003. Forest Code of the Republic of Kazakhstan
[81] Code of the Republic of Kazakhstan dated January 2, 2021, No. 400-VI LRK.
[82] Order of the Minister of Ecology and Natural Resources of the Republic of Kazakhstan dated January 17, 2023 No. 9. Registered with the Ministry of Justice of the Republic of Kazakhstan on January 20, 2023 No. 31735. "On Approval of Methodologies for Calculating Greenhouse Gas Emissions and Carbon Sink"
[83] Order of the Acting Minister of Ecology, Geology and Natural Resources of the Republic of Kazakhstan dated November 5, 2021 No. 455. Registered with the Ministry of Justice of the Republic of Kazakhstan on November 9, 2021 No. 25074. "On Approval of the Rules for Approval of Carbon Offset and Provision of Offset Units"

2.D.4.3. Support of livestock breeding and Rational use of pastures

According to the Concept of Development of Agro-industrial Complex of the Republic of Kazakhstan for 2021–2030, in order to ensure sustainability of livestock production, and to enhance the efficiency of the use of natural resources, the share of public expenditures for these purposes will gradually increase[84]. As a result "the Comprehensive Plan for the Development of Agricultural Products Processing for 2024–2028"[85] was developed, which significantly increased the effort of the Government to subsidize livestock breeding. A large-scale farmer training program and advisory support is planned to be provided to introduce the world's best practices and farming technologies on animal caring, efficient feeding and fodder harvesting, modern breeding and artificial insemination methods, improvement of product quality and safety, sustainable pasture management and other demanded practices. In addition, the concept envisages rehabilitation of degraded pastures through their radical and surface improvement, improved grazing practices and involvement of unused pastures into turnover through their watering through further improvement of existing state incentives and application of new approaches.

2.D.4.4. Prevention of land degradation and desertification and Rational use of arable land

Preventing soil degradation involves policies such as fertilizer subsidies[86], the law on rational land use[87]. Since the rate of humus decline in arable soils is about 1% per year[88], it is assumed that fertilizer subsidies stop the degradation of arable soils and no humus decline occurs on these soils.

2.D.4.5. Afforestation of two billion trees

President Tokayev in 2020 announced an ambitious plan to grow 2 billion trees by 2025. That would result in the afforestation of about 400,000 hectares of land.

2.D.4.6. Methodology and assumptions used to estimate GHG emission reductions or removals for each action, policy and measure

Methodologies and assumptions used to estimate GHG emission reduction from the AFOLU sector are consistent with those used for preparation of emission projections. They are based on the 2006 IPCC methodology for GHG emission assessment, methodologies described in the 2024 NIR submission by Kazakhstan and experts' assumptions of trends of the key drivers of emissions from the AFOLU sector, such as livestock population and subsidies coverage and others. Summary of policies and measures in the agricultural and LULUCF sectors is provided in Tables 2.20 and 2.21 accordingly.

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[84] Resolution of the Government of the Republic of Kazakhstan dated December 30, 2021 No. 960. "On approval of the Concept of development of agro-industrial complex of the Republic of Kazakhstan for 2021–2030"
[85] Decree of the Government of the Republic of Kazakhstan dated June 28, 2024 No. 512 "On approval of the Comprehensive Plan for the Development of Agricultural Products Processing for 2024–2028"
[86] Decree of the Government of the Republic of Kazakhstan dated June 28, 2024 No. 512 "On approval of the Comprehensive Plan for the Development of Agricultural Products Processing for 2024–2028"
[87] Order of the Minister of Agriculture of the Republic of Kazakhstan dated January 17, 2020 No. 7. Registered with the Ministry of Justice of the Republic of Kazakhstan on January 20, 2020 No. 19893."On approval of the Rules for the rational use of agricultural land and amendments and additions to some orders of the Minister of Agriculture of the Republic of Kazakhstan"
[88] https://unfccc.int/documents/627844

Table 2.20. Summary of policies and measures and their impact in the agriculture sector

Name	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Estimates of GHG emission reductions (kt CO_2 eq)	
Agriculture									2022 Achieved	2030 Expected
Support for livestock breeding	Supporting livestock breeding to increase productivity that in turn could allow to reduce livestock population and GHG emissions	GHG emissions reduction	Regulatory, economic	Implemented	Agriculture	CH_4, CO_2	2021	Ministry of Agriculture	NE	180.00
Rational approaches to the use of pastures	Rational use of pastures to reduce pressure and subsequent degradation of pastures.	GHG emissions reduction	Regulatory, economic	Implemented	Agriculture	CH_4, CO_2	2021	Ministry of Agriculture	NE	180.00

Table 2.21. Summary of policies and measures and their impact in the LULUCF sector

Name	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Estimates of GHG emission reductions (kt CO_2 eq)	Estimates of GHG emission reductions (kt CO_2 eq)
LULUCF									2022 Achieved	2030 Expected
Offset projects in forestry	Offset projects produce offset units for participants of Kazakhstan Emission Trading System that are additional to the existing offsets	GHG emissions reduction	Regulatory, economic	Implemented	LULUCF	CO2	2021	Ministry of Agriculture	NE	50.00

Name	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Estimates of GHG emission reductions (kt CO_2 eq)	Estimates of GHG emission reductions (kt CO_2 eq)
Prevention of land degradation and desertification	Fertilizer subsidies for cropland to help mitigate the depletion of soil humus.	GHG emissions reduction	Regulatory, economic	Implemented	LULUCF	CO2	2006	Ministry of Agriculture	NE	30.00
Aforestation (2 billion trees)	State program to grow 2 billion trees	GHG emissions reduction	Regulatory, economic	Implemented	LULUCF	CO2	2021	Ministry of Agriculture	NE	1,000
Rational use of arable land	Rational use of arable land to encourage farmers to comply with relevant agricultural technology requirements such as crop rotation to stop humus reduction in arable soil.	GHG emissions reduction	Regulatory, economic	Implemented	LULUCF	CH_4, CO2	2021	Ministry of Agriculture	NE	180.00

2.D.5. Policies and measures in the Waste sector

Kazakhstan's waste management policies are integrated into its national strategic and regulatory framework, aiming to reduce GHG emissions and promote sustainable practices. These policies focus on enhancing waste separation, recycling, disposal, and wastewater treatment, supported by legislation and monitoring systems, and enforcement mechanisms. Strict bans, enforcement through fines for violations, and adherence to national standards underscore the country's commitment to climate mitigation and sustainable waste management.

2.D.5.1. Concept for Transition to a Green Economy

The Concept for Transition to a Green Economy and its Action Plan for 2021–2030 set ambitious goals for advancing waste management. The plan aims to develop a system for separate waste collection and recycling, aiming to achieve a 40% recycling rate for industrial and municipal waste by 2030 and 50% by 2050. It also emphasizes the modernization of treatment facilities to ensure 100% wastewater treatment in cities and an increase in the reuse of treated wastewater to 20% by 2030.

The 2024 update of the concept strengthened these goals, with targets for 50% recycling and disposal of municipal waste by 2040 and 60% by 2050, with similar targets for industrial waste (55% by 2040 and 60% by 2050). These updates align with Kazakhstan's enhanced climate goals and environmental priorities.

The Kazakhstan Roadmap for Monitoring the Achievement of the Sustainable Development Goals for 2020–2022 complements the requirements of the concept, setting indicators for improved waste collection, increased recycling and safe wastewater treatment.

2.D.5.2. Regulatory framework

Environmental Code of Kazakhstan

In 2021, Kazakhstan adopted a new Environmental Code[89] that replaces the previous code from 2007 and marks a significant step in strengthening the country's environmental protection framework. Specifically for waste, the code strengthens measures for waste and wastewater management, including mandatory waste sorting and recycling, landfill gas collection to reduce methane emissions, and imposing strict standards for wastewater treatment and discharge. The code prohibits the landfilling of biodegradable and recyclable materials and enforces extended producer responsibility (EPR) to ensure proper waste management.

Key provisions include measures to reduce methane emissions, mandatory waste sorting and recycling, and extended producer responsibility. It also addresses hazardous waste management, introduces economic incentives for sustainable practices, and enhances public participation in environmental governance. Also, the code enforces stringent standards for wastewater quality and regulates its discharge, reinforcing Kazakhstan's commitment to environmental sustainability and climate action.

As part of Kazakhstan's climate policy, strict bans have been introduced on the disposal of certain types of waste in landfills, aimed at reducing GHG emissions. In accordance with the code, the disposal of plastic, polyethylene, waste paper, cardboard, paper and food waste is prohibited. These measures help reduce methane emissions, as landfill operators are required to reduce the volume of biodegradable waste and install landfill gas collection and disposal systems. Thus, these bans play a key role in the implementation of climate policy in the Waste and Wastewater Management sector.

Waste management standards

Between 2020 and 2022, mandatory national standards were adopted to align with the Environmental Code of Kazakhstan. Currently, Kazakhstan has in place 84 waste management standards, comprising 55 national and 29 interstate standards, to support effective waste management. These standards regulate the waste management hierarchy, low-capacity landfills, separate collection and disposal of

[89] https://adilet.zan.kz/eng/docs/K2100000400

medical waste, and the safe accumulation and processing of various waste types. The development and coordination of these standards are managed by RSE "KazStandard", ensuring stakeholder participation and transparency through the publication of notifications on its official platform, KazStandard (ksm.kz).

Code on Administrative Offenses

Between 2017 and 2022, significant amendments were made to the Code on Administrative Offenses to strengthen waste management regulations in Kazakhstan. These amendments included the introduction of stricter fines for violating environmental standards, such as illegal waste disposal, enhancement of control and supervision measures, and update of definitions to improve clarity and enforcement.

In 2021, liability for violations of product disposal obligations was introduced together with regulation on the submission of mandatory information. Fines for violation of environmental requirements have been doubled, as have fines for violation of waste accumulation or disposal limits, which can reach 20,000% of the waste disposal fee rate for repeated violations.

2.D.5.3. Pollutant Release and Transfer Register

Companies and organizations in Kazakhstan are required to report on waste to several monitoring systems. The Pollutant Release and Transfer Register (PRTR) collects data on pollutant emissions, including GHGs, including from waste and wastewater management. PRTR is the only source of data on actual levels of GHG emissions from the waste management sector, as this sector is not among the 6 regulated sectors required to report data for the purposes of the national GHG inventory. The State Waste Cadastre EIS OOS (ecogeo.gov.kz) systematizes data on all types of waste and their disposal sites, which helps assess greenhouse gas emissions and waste management efficiency. Integration with the Unified Information System of Environmental Protection (UIS OOS) has increased transparency and data exchange. The state statistics on waste are based on an annual monitoring and collection of data on the amount of waste generated, its processing, disposal and water use, which is important for environmental decision-making and climate policy development.

2.D.5.4. Extended Producer Obligations

To enhance waste management in Kazakhstan, economic incentives such as extended producer obligations (EPO), increased waste disposal taxes, government programs and subsidies were introduced and enhanced over the period from 2017 to 2022.

As of 2022, the JSC Zhasyl Damu has been responsible for collecting, recycling and disposing of product waste. In 2023, the EcoQolday system was launched to improve waste management and increase demand for secondary raw materials. In 2024, 77 companies applied to the system, of which 33 were approved.

In 2021, amendments were made to the Code "On Taxes", doubling the rates for the disposal of hazardous, non-hazardous and municipal waste, which will come into force in 2025.

In 2024, the JSC Zhasyl Damu updated the Old Vehicle and Agricultural Machinery Recycling Program, which was launched in 2016, by including ferrous metal recyclers.

2.D.5.5. State programmes supporting waste management

State programs **"Nurly Zhol" and "Nurly zher"** designate JSC "Kazakhstan Center for Modernization and Development of Housing and Utilities" as the primary organization for upgrading housing and utilities infrastructure. Between 2021 and 2027, the center plans to construct and reconstruct treatment facilities with a combined capacity of waste of 2,430,295 m^3/day, funded through budget transfers, loans from the European Bank for Reconstruction and Development (EBRD) and Asian Development Bank (ADB), public-private partnerships, and the issuance of government securities.

The **State Programme for Industrial and Innovative Development of Kazakhstan,** 2020–2025, prioritizes waste management as a critical economic sector. Under this program, JSC Industrial Development Fund has provided preferential leasing financing for modernizing waste sorting facilities in Karaganda and procuring equipment for collecting and sorting solid household waste.

JSC Zhasyl Damu, in collaboration with the JSC Industrial Development Fund, focuses on financing environmental projects. Between 2024 and 2026, JSC Zhasyl Damu plans to allocate 200 billion tenge to initiatives aimed at improving waste management, including the adoption of advanced technologies for waste collection, transportation, and processing.

Kazakhstan has also invested in educational and informational tools to combat climate change. In 2021, the National Platform for Reporting on the UN Sustainable Development Goals was launched, and the Pollutant Release and Transfer Register (PRTR) was updated to enhance GHG emission tracking. Also, since the 2020–2021 academic year, the Ministry of Education and Science, in partnership with UNDP, has implemented a project to improve environmental awareness. Over 6,000 teachers were trained and a set of educational materials on sustainable development were prepared within this project.

2.D.5.6. Technological instruments used in waste management

The EcoNetwork.green Portal, a technological startup launched in 2023, facilitates separate waste collection and recycling by providing tools and resources to enhance these practices. Additionally, the Kazakhstan Center for Modernization and Development of Housing and Utilities JSC initiated projects under the Housing and Utilities Development Concept, 2023–2029, to modernize and automate water supply and sanitation systems.

A key innovation in waste water management is the planned implementation of a Supervisory Control and Data Acquisition (SCADA) system, which will enable real-time data collection, processing, and display to optimize costs and improve control over water supply and sanitation. This system is expected to enhance management efficiency through the complete digitization of processes.

2.D.5.7. Methodology and assumptions used to calculate GHG emission reductions or removals for each policy and measures

Methodology used to assess effects from policies and measures in the waste sector is the same as the one used for projections of GHG emissions from waste. Accordingly, policy options were modelled using target setting for selected variables that were applied in the system dynamics model created for the waste sector. Target setting implies that specific parameters are changed in the model. The policy targets are categorized into three areas: (i) waste generation, (ii) collection and sorting, and (iii) waste management. These categories address different aspects of the waste management system and value chain and relevant policies. Further detail of the methodology that was used is presented in section 2.F.7. Waste sector projections. Summary of the key policies and measures in the waste sector is provided in Table 2.22

Table 2.22. Summary of policies and measures and their impact in the waste sector

Name	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Estimates of GHG emission reductions (kt CO_2 eq) [j, k]	Estimates of GHG emission reductions (kt CO_2 eq) [j, k]
Waste sector									2022 Achieved	2030 Expected
Preferential Project Financing Mechanism: Long-Term Lease Financing for Waste Management Projects	Measures to reduce environmental impacts include improving waste management, stimulating innovation in recycling and disposal, creating jobs, and supporting eco-friendly technologies	Support and stimulation of projects in the field of waste management, creation and modernization of infrastructure for processing, recycling and safe storage of waste	Economic Regulatory	Implemented	Waste management	CH_4, CO2, N_2O	2020	JSC "Industrial Development Fund"	NE	239.54
Environmental Code: requirements for landfill operators to reduce methane emissions and use national standards for leachate and landfill gas systems,, mandatory separate collection, recycling, and disposal of waste, and a ban on the disposal of paper, plastic, and food waste	Measures to reduce greenhouse gas emissions include decreasing the volume of biodegradable and recyclable waste sent to landfills, increasing recycling rates, and installing systems for collecting and utilizing landfill gas.	Reducing methane and greenhouse gas emissions from landfills, decreasing the amount of waste sent to landfills, increasing recycling and reuse, and implementing national standards for systems to collect and treat leachate and landfill gas.	Regulatory	Implemented	Waste management	CH_4, CO2, N_2O	2021	Ministry of Ecology and Natural Resources Landfill operators		

Name	Description	Objectives	Type of instrument	Status	Sector(s) affected	Gases affected	Start year of implementation	Implementing entity or entities	Estimates of GHG emission reductions (kt CO_2 eq) [j, k]	Estimates of GHG emission reductions (kt CO_2 eq)[j, k]
Environmental Code: introduction of tax breaks and subsidies for enterprises engaged in waste processing and disposal	Incentive measures aimed at reducing the financial burden on these enterprises, stimulating their activities and supporting environmentally friendly technologies	Stimulating environmentally friendly technologies and supporting waste recycling businesses through financial benefits	Regulatory Economic	Implemented	Waste management	CH_4, CO2, N_2O	2021	Ministry of Ecology and Natural Resources JSC " Zhasyl Damu" JSC "Industrial Development Fund"	NE	236.58
Automated information system "Eco-qolday"	Measures aimed at improved waste management and increased recycling efficiency	Increased demand for secondary raw materials and their processing	Informational, economic	Implemented	Waste management	CH_4, CO2, N_2O	2023	JSC "Zhasyl Damu"	NE	6.61

2.D.6. Policies and measures that influence emissions from international transport

Emissions from international aviation

One of the key areas of Kazakhstan's Strategy for achieving Carbon Neutrality by 2060 is the decarbonization of transport, including aviation. A key measure to implement the strategy with regards to aviation is the provision of Kazakhstan's air carriers with new aviation fuel in the form of sustainable ecological aviation fuel.

On international aviation, the global goal for international aviation agreed within the ICAO is to reduce aviation net CO2 emissions to 50% of 2005 emissions. This means improving fuel efficiency and stabilizing CO2 emissions.To achieve global goals and promote sustainable growth of international aviation, ICAO implements a set of measures, including improvements in aviation technology, operational improvements, sustainable aviation fuel and market-based measures, namely the Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA) scheme.

According to information from the ICAO[90] Kazakhstan is on the list of 107 countries that will participate in the CORSIA scheme starting from January 1, 2025. This is confirmed in the letter from Peter Griffiths, Director General of the Aviation Administration of Kazakhstan, who officially confirmed Kazakhstan voluntary participation in CORSIA in a letter to Dr. Fan Liu, ICAO Secretary General[91].

Emission reduction impact from Kazakhstan participation in ICAO was not evaluated because there is insufficient information on the format of the country's planned measures in this program.

Also, JSC "Aviation Administration of Kazakhstan", which is an authorized organization in the field of civil aviation and exercises control and supervision over the aviation industry of Kazakhstan in the field of flight safety and aviation security, reported that since 2019, Kazakhstan has been annually submitting reports to ICAO on emissions from international flights.

Kazakhstan also co-operates with the IATA on aviation fuel supply and decarbonisation of the aviation sector and on possible schemes for offsetting and reducing emissions.

This initiative was not assessed, since there is insufficient information on the format of the country's planned measures.

Emissions from international maritime transport

The International Maritime Organization (IMO) was established in response to the growing understanding that the international nature of the shipping industry meant that efforts to improve the safety of maritime navigation would be effective if they were undertaken at the international level.

On March 4, 1994, the Cabinet of Ministers of Kazakhstan adopted Resolution No. 244 "On the accession of the Republic of Kazakhstan to the International Conventions Adopted under the Auspices of the International Maritime Organization (IMO) and to the IMO Convention".

In 2018, the IMO adopted the Initial IMO Strategy for reducing GHG emissions from ships, setting out a vision that reaffirms IMO's commitment to reducing and phasing out GHG emissions from international shipping. This strategy aims to reduce overall GHG emissions from international shipping and to reduce total

[90] https://www.icao.int/environmental-protection/CORSIA/Pages/state-pairs.aspx
[91] *For further information, see* https://caa.gov.kz/en/blog/post/kazakhstan-has-become-member-carbon-offsetting-and-reduction-scheme-international-aviation-corsia.

annual GHG emissions by at least 50% by 2050 compared to 2008 levels, while pursuing efforts to phase them out.

The IMO initial strategy was revised in 2023 when a new 2023 IMO Strategy for Reducing GHG emissions from Ships was adopted. The strategy envisages a reduction of carbon intensity of international shipping by at least 40% by 2030 and includes provisions for uptake of zero and near zero GHG emission technologies and fuels that represent at least 5%, striving for 10%, of the energy used by international shipping by 2030.

Kazakhstan is not currently participating in IMO initiatives related to GHG emission reduction.

2.D.7. Actions, policies and measures that influence long-term in greenhouse gas emissions and removals

Policies and measures that are described in this section have an impact on reducing emissions and enhancing removals by sink in Kazakhstan. While some of them have an immediate and near-term effect, in particular those included in the Kazakhstan NDCs, some of them have longer term effects.

The most representative example of policies with long-term effect is the Strategy for Achieving Carbon Neutrality of the Republic of Kazakhstan until 2060, which as its name suggests will have a long-lasting impact on emissions in Kazakhstan by 2060 and beyond. Similarly, measures aimed at building a new nuclear power plant will have an impact on emission levels over the lifetime of the plant or over 50 years.

2.D.8. Assessment of economic and social impacts of response measures

This section provides brief information on the assessment of the economic and social impact from mitigation PaMs (often referred to as "response measures") on both: economy and society of Kazakhstan and with regards to economies of other developing countries that might be affected from such measures through their impact on international trade.

On impact on economy and society from major mitigation PaMs, Kazakhstan is yet to launch a process of assessing such impacts. Such assessment will be guided by the understanding that economic incentives such as tax breaks and subsidies, e.g. to promote renewable energy or the processing industry, lead to distributional impacts and restructuring of the labor market, creation of new jobs, economic diversification and stimulating economic activities. This applies not only at the national, but also at the regional levels, where creating new jobs and strengthening the economic sustainability of regions can improve the quality of life of people.

On impact on other countries from response measures taken by Kazakhstan, an important consideration is that the country is a major energy producer and net energy exporter. Therefore, any transition from coal to natural gas and shift away from fossil fuels towards renewable energy may not affect any potential revenue from fossil fuel exports from other countries.

2.E. Summary of greenhouse gas emissions and removals

This section provides a summary of GHG emissions and removals for the entire period between 1990 and 2022. This information is identical with similar information from the NIR submitted by Kazakhstan in 2024. It is also presented in the CTF table II.6 on tracking NDC progress.

Table 2.23. Summary of greenhouse gas emissions in Kazakhstan by sectors and categories, 1990–2022, kt CO_2e

Year	Energy	IPPU	Agriculture	LULUCF	Waste	Total (with-out LULUCF)	Total (with LULUCF)
1990	322,047.68	22,741.28	41,767.22	-4,789.56	3,969.87	390,526.06	385,736.50
1991	306,128.12	21,717.25	41,032.58	-4,594.00	3,925.91	372,803.86	368,209.86
1992	278,063.26	19,798.78	42,143.03	-4,410.08	3,798.77	343,803.85	339,393.76
1993	247,089.32	16,822.88	41,132.68	-4,223.40	3,693.77	308,738.64	304,515.24
1994	210,799.10	12,686.48	33,976.82	4,783.22	3,569.75	261,032.16	265,815.37
1995	196,103.92	13,991.22	30,854.46	14,056.19	3,530.70	244,480.30	258,536.49
1996	186,224.53	12,257.79	26,489.19	22,761.93	3,543.58	228,515.09	251,277.02
1997	178,067.47	15,775.82	24,462.78	32,615.09	3,557.32	221,863.40	254,478.49
1998	183,296.85	16,337.11	24,531.87	40,725.06	3,567.14	227,732.97	268,458.03
1999	145,926.94	16,793.68	26,751.51	37,543.26	3,585.49	193,057.63	230,600.89
2000	170,069.66	17,330.70	28,073.67	34,042.50	3,645.41	219,119.45	253,161.95
2001	163,157.09	18,150.15	28,228.02	33,744.19	3,738.24	213,273.51	247,017.70
2002	184,753.49	18,403.06	28,908.91	33,251.31	3,703.09	235,768.54	269,019.85
2003	202,601.07	20,190.77	29,736.67	33,230.31	3,732.19	256,260.70	289,491.01
2004	213,248.68	20,312.39	30,408.41	39,049.34	3,825.28	267,794.77	306,844.11
2005	222,385.37	20,827.04	30,975.92	45,188.02	3,902.69	278,091.02	323,279.04
2006	241,025.99	22,407.76	31,683.78	51,560.10	4,071.77	299,189.30	350,749.40
2007	242,360.76	23,338.68	31,679.61	49,247.05	4,159.22	301,538.27	350,785.31
2008	241,191.28	21,689.79	31,179.58	46,824.47	4,301.57	298,362.22	345,186.69
2009	235,123.80	21,152.10	30,918.36	42,154.90	4,576.62	291,770.88	333,925.79
2010	258,503.30	20,001.95	30,266.05	37,899.95	4,766.45	313,537.74	351,437.68
2011	249,306.40	20,956.44	28,726.33	26,119.19	4,782.39	303,771.56	329,890.75
2012	255,215.79	20,940.73	27,745.22	14,523.18	4,928.96	308,830.70	323,353.88
2013	261,646.28	23,208.50	27,420.92	2,967.72	5,040.57	317,316.27	320,284.00
2014	308,000.63	23,769.79	28,677.81	6,640.08	5,215.53	365,663.77	372,303.85
2015	309,001.88	25,363.14	29,811.37	10,585.45	5,290.71	369,467.10	380,052.55
2016	307,883.78	24,572.93	30,998.36	14,091.92	5,415.56	368,870.64	382,962.56
2017	325,554.88	25,279.00	32,557.64	18,273.09	5,537.50	388,929.01	407,202.10
2018	340,136.61	24,318.39	34,093.24	21,678.70	5,681.06	404,229.31	425,908.02
2019	305,098.92	25,581.97	35,288.35	19,242.57	5,856.27	371,825.51	391,068.08
2020	288,524.61	19,486.56	37,474.82	16,105.27	6,507.28	351,993.28	368,098.55
2021	251,405.69	26,870.86	38,608.27	4,687.98	6,849.48	323,734.29	328,422.27
2022	281,922.24	27,006.80	32,997.68	4,129.19	6,917.10	348,843.83	352,973.03

Table 2.24. Summary of greenhouse gas emissions in Kazakhstan, by gas for 1990–2022, kt CO_2e

Year	CO_2 emissions without LULUCF	CO_2 emissions with LULUCF	CH_4 emissions without LULUCF	CH_4 emissions with LULUCF	N_2O emissions without LULUCF	N_2O emissions with LULUCF	F gases total	Total (without LULUCF)	Total (with LULUCF)
1990	267,405.36	262,589.04	106,770.04	106,785.13	16,350.67	16,362.33	NO	390,526.06	385,736.50
1991	260,420.51	255,790.28	96,157.57	96,178.96	16,225.78	16,240.62	NO	372,803.86	368,209.86
1992	233,523.40	229,086.25	92,854.17	92,869.57	17,426.28	17,437.94	NO	343,803.85	339,393.76
1993	207,558.71	203,309.41	84,304.17	84,318.67	16,875.43	16,886.82	0.34	308,738.64	304,515.24
1994	174,671.11	179,367.27	71,396.49	71,444.60	14,963.41	15,002.37	1.14	261,032.16	265,815.37
1995	168,467.98	182,110.71	61,441.20	61,670.49	14,566.99	14,751.17	4.12	244,480.30	258,536.49
1996	154,715.70	177,304.20	59,750.78	59,846.57	14,043.33	14,120.97	5.28	228,515.09	251,277.02
1997	147,293.13	178,825.65	60,245.34	60,885.61	14,316.30	14,758.59	8.64	221,863.40	254,478.49
1998	145,621.87	186,103.33	67,007.64	67,141.79	15,008.83	15,118.27	94.63	227,732.97	268,458.03
1999	118,761.63	155,893.70	57,610.97	57,838.78	16,560.12	16,743.50	124.91	193,057.63	230,600.89
2000	142,196.98	175,982.64	58,899.28	59,040.84	17,763.92	17,879.20	259.26	219,119.45	253,161.95
2001	138,036.49	171,408.90	57,257.74	57,463.37	17,697.41	17,863.57	281.86	213,273.51	247,017.70
2002	156,768.22	189,726.98	60,943.74	61,105.38	17,732.38	17,863.29	324.20	235,768.54	269,019.85
2003	175,021.97	207,567.67	63,035.24	63,414.31	17,759.90	18,065.44	443.59	256,260.70	289,491.01
2004	185,475.84	224,215.39	64,108.18	64,289.99	17,648.48	17,776.48	562.26	267,794.77	306,844.11
2005	198,448.55	243,382.10	61,458.72	61,600.04	17,568.71	17,681.86	615.04	278,091.02	323,279.04
2006	219,633.15	270,730.24	61,032.04	61,288.35	17,692.11	17,898.81	832.00	299,189.30	350,749.40
2007	225,712.40	274,637.21	57,558.07	57,753.90	17,354.46	17,480.87	913.33	301,538.27	350,785.31
2008	226,102.39	272,854.59	54,563.21	54,603.42	16,378.98	16,411.04	1,317.63	298,362.22	345,186.69
2009	223,189.23	265,297.92	51,488.09	51,513.63	15,835.45	15,856.12	1,258.12	291,770.88	333,925.79
2010	248,092.77	285,899.95	49,025.82	49,077.51	14,918.55	14,959.63	1,500.59	313,537.74	351,437.68
2011	238,156.97	264,228.21	49,826.84	49,853.86	14,311.52	14,332.45	1,476.24	303,771.56	329,890.75
2012	245,262.90	259,755.33	48,769.19	48,787.75	13,209.81	13,222.00	1,588.80	308,830.70	323,353.88
2013	253,532.73	256,495.03	49,958.63	49,961.93	12,449.01	12,451.13	1,375.90	317,316.27	320,284.00
2014	299,137.34	305,704.82	51,653.94	51,693.42	13,255.98	13,289.11	1,616.51	365,663.77	372,303.85
2015	303,052.27	313,477.19	51,013.00	51,101.45	13,728.99	13,801.07	1,672.84	369,467.10	380,052.55
2016	301,738.82	315,811.63	51,148.85	51,159.74	14,262.48	14,270.70	1,720.49	368,870.64	382,962.56
2017	317,720.43	335,557.44	54,347.75	54,584.02	15,018.31	15,218.12	1,842.52	388,929.01	407,202.10
2018	329,572.13	351,146.13	57,011.58	57,069.37	15,602.38	15,649.29	2,043.22	404,229.31	425,908.02
2019	296,039.62	315,164.74	57,868.83	57,944.68	15,835.66	15,877.27	2,081.39	371,825.51	391,068.08
2020	281,789.18	297,752.82	57,728.37	57,814.08	17,449.56	17,505.48	2,348.00	359,315.12	375,420.39
2021	244,903.72	249,480.86	59,198.85	59,261.99	17,091.75	17,139.45	2,539.97	323,734.29	328,422.27
2022	274,345.57	278,292.08	56,746.04	56,862.61	15,093.75	15,159.87	2,658.47	348,843.83	352,973.03

2.F. Projections of greenhouse gas emissions and removals

This section provides information on projections of GHG emissions and removals at the national level and by sector, for three scenarios, namely, “with measures”, “with additional measures” and “without measures”. Detailed quantitative information on these scenarios and on relevant assumptions is provided in CTF tables II.7–11 on tracking NDC progress.

2.F.1. Overview

Projections of GHG emissions and removals of Kazakhstan of CO_2, CH_4, N_2O, HFCs, PFCs and SF_6, have been prepared and reported by gas and sector for the years 2025, 2030, 2035, and 2040. Total net GHG emissions in 2040 in “with measures” scenarios are projected to reach 407.3 Mt CO_2e, reflecting a modest increase of 6% compared to 1990 levels. In comparison, the “without measures” scenario envisages a significant 36% rise in emissions, while the “with additional measures” scenario predicts a 25% reduction relative to 1990 levels.

Key findings from projections by sector under the “with measures” scenario include:

- The projected emissions for the energy sector (including transport) in 2040 are expected to decrease slightly by 1% compared to 1990 levels, or by 2.1 Mt CO_2e. Despite this modest reduction, the energy sector remains the largest contributor to overall emissions among all sectors and defines by far the overall trend of GHG emissions in Kazakhstan.
- In the IPPU sector, emissions are anticipated to nearly double by 2040 due to expected growth in industry activities, representing an increase of 91% compared to 1990 levels, or by 20.6 Mt CO_2e.
- Agricultural sector emissions are projected to decrease marginally by 1% compared to 1990 levels, or by 0.5 Mt CO_2e.
- The LULUCF sector is expected to remain a net removal and to experience a significant decrease in net emissions, declining by 24% by 2040 compared to 1990 levels, or by 1.2 Mt CO_2e.
- Emissions in the waste sector are projected to double, driven by anticipated population growth and increased waste volumes. The sector is expected to grow by 118%, or by 4.7 Mt CO_2e, though its overall share of total emissions remains relatively small.

2.F.2. Total national GHG projections by gas and by sector

Projections scenarios

Projections of the GHG emissions and removals in 2040 are estimated by gas for CO_2, CH_4, N_2O, HFCs, PFCs, SF_6 and by sector.

The projections are estimated for three scenarios: “with measures”, “with additional measures” and “without measures”. The ‘with measures’ scenario considers the policies and measures that have already been implemented by 2022 and those policies and measures that were adopted and will be implemented by 2040. The ‘without measures’ scenario excludes policies and measures that are implemented, adopted, or planned before 2022, which is the starting point for that projection. The ‘with additional measures’ takes into account current policies and measures that are included in the “with measures scenario” with the assumption of possible additional measures to mitigate GHG emissions. Further details on policies and measures included in scenarios is provided in the sections on projections by sector.

Projections on GHG emissions and removals provide an indication of the impacts of mitigation policies and measures on the future trends in GHG emissions and removals and are not used to assess progress toward implementation and attainment of the NDC.

Key underlying assumptions for projections for all three scenarios are provided in Table 2.25, results from projections of emissions for "with measures" scenario by 2040 are provided in Table 2.26 and an illustration of the future trend of emissions for all three scenarios is provided in Figure 2.13.

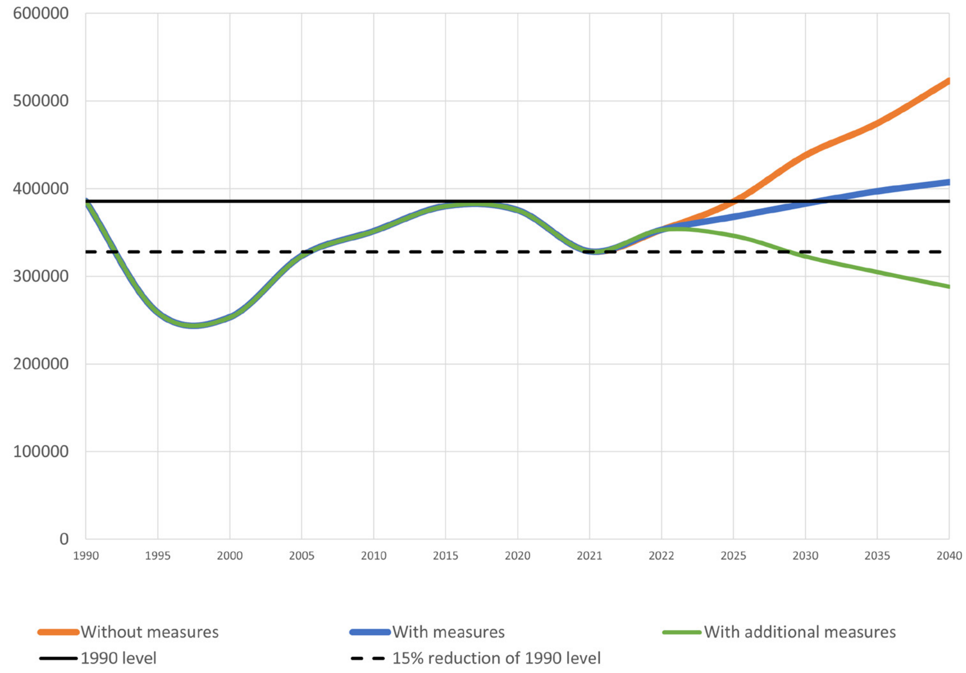
Table 2.25. Key underlying assumptions for projections

Key underlying assumptions and parameters:[c]	Unit, as applicable	*Most recent year in the Party's national inventory report, or the most recent year for which data is*	*Projections of key underlying assumptions and parameters[d]*			
		2022	*2025*	*2030*	*2035*	*2040*
Population	thousand person	19,765	20,530	21,916	22,780	24,938
GDP growth rate	annual rate, %	3.2	6.0	6.1	6.1	6.1
Total Cropland area	Million Hectares	22.6	22.3	22.7	23	23.3
Total Cropland area growth rate	%	1.8	1.5	1.35	1.2	1.05
Forest Cover	Million Hectares	13.6	13.57	13.5	13.42	13.37
Deforestation rate	%	0.1	0.1	0.14	0.18	0.2
Afforestation/reforestation rate	%	0.05	0.05	0.05	0.05	0.05
Degraded Grazed land	%	0.5	0.52	0.61	0.78	1.04
Burned Land Area Annual Growth Rate	%	1.5	1.5	1.65	2.03	2.71

Table 2.26. Information on greenhouse gas projections under a "with measures" scenario (CTF Table II.7)

	Most recent year in the Party's national inventory report (kt CO2 eq)[c]	*Projections of GHG emissions and removals, (kt CO2 eq)[c]*			
	2022	*2025*	*2030*	*2035*	*2040*
Sector[d]					319,951.87
Energy	253,947.74	262,220.28	267,657.48	274,993.90	275,467.12
Transport	27,974.51	32,490.29	36,803.94	39,866.89	44,484.75
Industrial processes and product use	27,006.80	30,453.73	35,699.71	39,334.49	43,341.38
Agriculture	32,997.69	32,915.98	35,439.46	38,132.72	41,276.20
LULUCF	4,129.19	2,479.99	-454.14	-3,466.90	-5,961.42
Waste	6,917.10	7,174.49	7,633.77	8,126.39	8,656.36
Other (specify)					
Gas					
CO2 emissions including net CO2 from LULUCF	**278,292.08**	**289,473.65**	**301,212.91**	**312,048.98**	**318,487.15**
CO2 emissions excluding net CO2 from LULUCF	274,345.58	287,176.38	301,849.79	315,698.62	324,631.30
CH4 emissions including CH4 from LULUCF	**56,862.65**	**61,958.43**	**63,834.16**	**65,632.78**	**67,714.78**
CH4 emissions excluding CH4 from LULUCF	56,746.08	61,841.95	63,717.68	65,516.30	67,598.29
N2O emissions including N2O from LULUCF	**15,159.85**	**13,522.79**	**14,738.40**	**16,079.55**	**17,586.94**
N2O emissions excluding N2O from LULUCF	15,093.74	13,456.54	14,672.15	16,013.30	17,520.69
HFCs	2,648.53	2,769.52	2,983.56	3,214.15	3,462.55
PFCs	7.38	7.720	8.32	8.96	9.66
SF6	2.53	2.650	2.86	3.08	3.32
NF3					
Other (specify)					
Total with LULUCF	**352,973.03**	**367,734.76**	**382,780.21**	**396,987.49**	**407,264.40**
Total without LULUCF	**348,843.83**	**365,254.77**	**383,234.35**	**400,454.39**	**413,225.82**

Figure 2.13. Greenhouse gas emissions by scenarios, total net GHG emissions, kt CO_2e



2.F.3. Energy sector projections

This section provides information on the projections for the "with measures", "with additional measures" and "without measures" scenarios for GHG emissions and removals in the energy sector.

2.F.3.1. Methodologies, assumptions and sensitivity analysis

TIMES-KAZ energy system model was used to prepare projections of GHG emissions from the energy sector. The same model was used to prepare GHG emission projections in the NC8 and the Fifth Biennial Report of Kazakhstan, and to prepare GHG emission projections as part of the development of the Strategy for Achieving Carbon Neutrality by 2060. Information on the model, the assumptions for the scenarios and the sensitivity analysis is provided below. Results from the sensitivity analysis are provided as part of the description of results for the "with measures" scenario.

TIMES-KAZ energy system model for GHG emission projections

The TIMES-KAZ model to 2060 was used to prepare projections and to assess the overall impact of policies and measures in the energy sector. This model was generated on the basis of TIMES (The Integrated MARKAL-EFOM System) model generator, which was developed under the International Energy Agency (IEA) ETSAP (Energy Technology Systems Analysis Program).

TIMES model generator combines two different, but complementary, systematic approaches to energy modeling: a technical approach and an economic approach. The energy system model generated by the TIMES model generator is a technologically rich and bottom-up model. TIMES is an optimization model and aims to minimize the total energy system cost and demand over a given time horizon, subject to constraints such as resource availability, emission limits, and technology performance. Model uses linear programming, balancing supply and demand across sectors, considering technology characteristics, costs, and environmental impacts. Model covers sectors, such as electricity and heat generation, energy extraction sectors, transportation of fuel in any form, industry, public utilities, transportation, agriculture, energy imports and exports. Detailed information on the TIMES family of models is available on the IEA website[92].

In this report, the TIMES-KAZ model was used for combustion sectors according to the IPCC classification and covers all major greenhouse gases: CO2, CH_4, N_2O. The reference year for the model is 2021, and the model's estimated range spans the period through 2060.

The TIMES-KAZ model is used to explore possible energy futures based on different scenarios and does not consider the interaction of the sectors where energy combustion occurs with the rest of the economy, and therefore cannot account for cross-sectoral interactions with them. The TIMES-KAZ model can be used both to calculate quantitative estimates separately and together. And in the latter case, there is an interaction of policies and measures.

Since the NC8 and BR5 where the model was used, adjustments have been made to capacity and generation in the electricity and heat generation industry. Model databases on the parameters of new technologies are being continuously updated as information becomes available in various scientific and technical publications.

Key assumptions and metrics used in preparing the projections

Key assumptions used to calculate all scenarios, include:

- GDP growth in the period up to 2023 according to statistical data of the Bureau of National Statistics, from 2024 to 2029 at 6% per year according to the social economic forecast of the Ministry of National Economy, and further from 2030 to 2040 at 6.1% per year;
- Population growth is based on statistical data of the Bureau of National Statistics and the Demographic Forecast for 2023–2050 from the Department of Forecasting and Research of JSC "Center for Labor Resources Development". According to the demographic forecast, the annual population growth will be 1.3% in the period from 2023 to 2050[93];
- Oil production increases to a maximum peak (115 million tons) in 2035 and gradually declines thereafter;
- Natural gas supply is growing within a range from a minimum level according to the future national gas balance to shares envisaged in different scenarios.

Table 2.27. Summary of key variables and assumptions used in for projections in the energy sector

Key fundamental assumptions		Projected			
Assumptions	Units	2025	2030	2035	2040
Population	thousand people	20,530	21,916	22,780	249,38
Gross Domestic Product	annual growth rate, %	6,0	6,1	6,1	6,1

Sensitivity analysis

The energy system is a complex structure consisting of many interconnected components that work synchronously to ensure a reliable and efficient energy supplier. Constantly changing economic, social, technological and environmental conditions create a number of uncertainties that affect the future scenarios of the energy system.

Sensitivity analysis is a key tool for assessing how much a change in one or more external parameters can affect the model results. Understanding the sensitivity of the model results to these parameters not only helps to refine forecasts, but also identifies potential threats and opportunities associated with changes in external conditions.

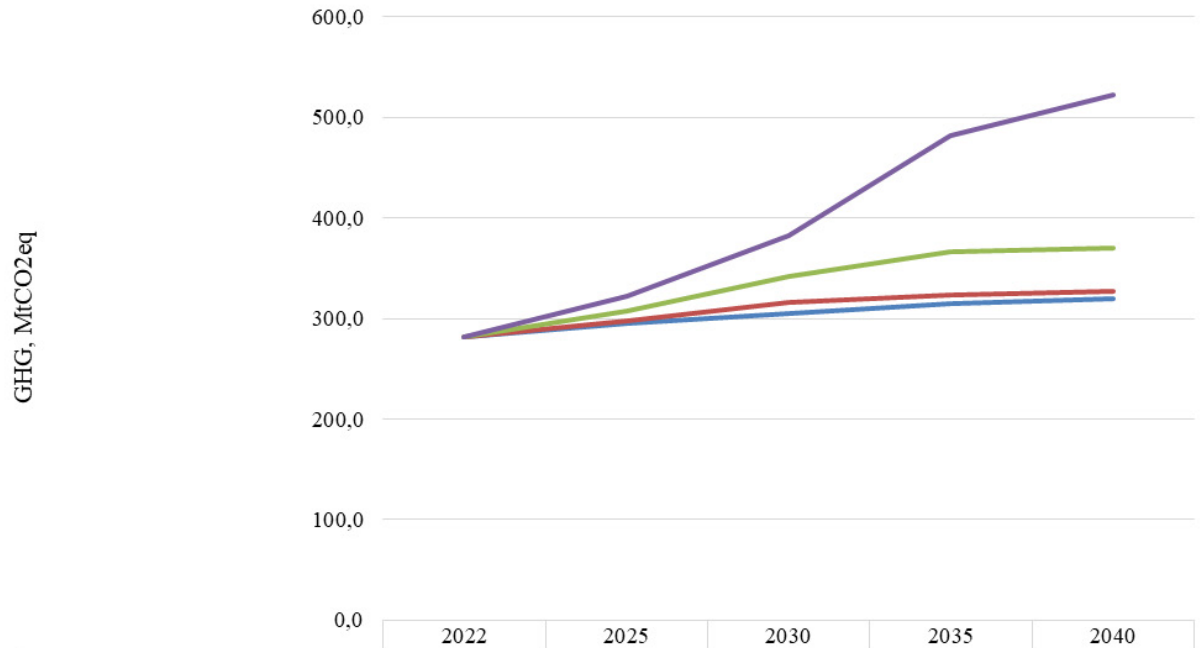
The selected parameter for sensitivity analysis is the growth rate of the GDP. This indicator reflects the overall economic development of

[92] https://iea-etsap.org/index.php/etsap-tools/model-generators/times
[93] https://www.enbek.kz/ru/analytical-data/6447

the country and can have a significant impact on the development of the energy system, energy consumption, investments in energy infrastructure, etc. For the analysis of sensitivity to changes in GDP, all growth rates under consideration were increased by one, five and ten percentage points in order to analyze the possible consequences of such changes for the structure of the country's energy system.

Results from the sensitivity analysis are shown in Figure 2.14. These results suggest a noticeable response to a change in the initial parameters that begins to appear immediately from 2025 in the sensitivity scenarios, and from this point on, the GHG emissions projections diverge.

Figure 2.14. Greenhouse gas emissions by scenarios for sensitivity analysis of energy projections, Mt CO2 eq



	2022	2025	2030	2035	2040
With measures	281,9	294,7	304,5	314,9	320,0
Scenario with GDP plus 1 p.p.	281,9	297,7	316,3	324,0	327,4
Scenario with GDP plus 5 p.p.	281,9	307,4	342,2	366,2	370,6
Scenario with GDP plus 10 p.p.	281,9	322,1	381,8	482,1	522,3

The main conclusions from the results of the sensitivity analysis is that GDP has a major role in the analysis and in projecting future trends of GHG emissions. This is explained by the fact that GDP is a kind of indicator reflecting the general level of economic activity, which is directly related to energy consumption and, therefore, the level of GHG emissions. That is why preparing accurate forecasts for GDP, as well as the analysis of the impact of various factors on its change, are critical aspects in the formulation of energy sector development strategies and associated future GHG emissions trends.

2.F.3.2. Scenarios definition

The definition of future scenarios for the development of Kazakhstan's energy system and associated GHG emissions is based on several considerations.

Scenario without measures: this scenario represents a possible variant of changes in GHG emissions in a counterfactual situation which excludes policies and measures implemented, adopted and planned after the starting point for the projections. Further growth in the economy comes from the use of fossil fuels.

Scenario with measures: this scenario includes implemented, adopted and planned measures and policies that aim directly at reducing greenhouse gas emissions:

- The share of electricity generation from natural gas at the level of 20% and 25% in 2020 and 2030, respectively;
- The share of electricity generation from RES at the level of 3%, 6%, 15% and 24.4% in 2020, 2025, 2030 and 2035 respectively, and further in accordance with the plans for installed capacities of the Ministry of Energy;
- Commissioning of a nuclear power plant (NPP) with a capacity of 1.2 GW in 2035 and 1.2 GW in 2040.

Scenario with additional measures: this scenario includes in addition to the policies and measures included in the "with measures" scenario further policies and measures that are aimed specifically at reducing GHG emissions. Importantly, this includes introduction of a carbon tax in all parts of the energy system. This measure is based on the following assumptions regarding the level of the tax: in 2024 – $5 per ton of CO2; in 2025–2030 – growth of $10 per ton of CO2 each year, reaching $65 by 2030; from 2031 growth by $5 each year. This scenario envisages other measures, such as the introduction of technologies aimed at decarbonizing heavy industry, in particular the launch of a hydrogen-powered steelmaking facility.

Assumptions for all three scenarios are summarised in Table 2.28.

Table 2.28. Summary of assumptions for GHG projections from the energy sector

Common assumptions for all scenarios	Scenario without measures	Scenario with measures	Scenario with additional measures
Common assumptions for all scenarios			
GDP growth in the period up to 2023 according to statistical data of the Bureau of National Statistics, in 2024–2029 according to the social economic forecast of the Ministry of national economy in 2025–2029, and further from 2030 to 2040 at 6.1% per year	V	V	V
Population growth is based on statistical data of the BNS ASPiR RK and the Demographic Forecast for 2023–2050 from the Department of Forecasting and Research of JSC "Center for Labor Resources Development". According to the demographic forecast, the annual population growth will be 1.3% in the period from 2023 to 2050	V	V	V
Oil production increases to maximum (115 million tons) in 2035	V	V	V
Natural gas supply is increasing according to the projected gas balance of Kazakhstan as follows: *2020–24587 mln m^3 (minimum); 2025–22243 mln m^3 (minimum); 2030–21016 mln m^3 (minimum)*	V	V	V
Scenario assumptions			
Share of natural gas-fired power generation is set at 20% and 25% in 2020 and 2030, respectively	X	V	V
The share of electricity generation from renewable energy sources is at the level: 2020–3%; 2025–6%; 2030–15%; 2035–24,4%.,	X	V	V
Commissioning of a 1.2 GW nuclear power plant (NPP) in 2035 and 1.2 GW in 2040	X	V	V
Carbon tax on all energy sectors: 2024 – $5 per ton of CO2; 2025–2030 – growth by $10 per ton of CO2 each year reaching $65 by 2030; from 2031, growth by $5 each year.	X	X	V

Note: V indicates that the measure or parameter is considered and X indicates that the measure or parameter is not considered in the scenarios that are indicated in the columns.

2.F.3.3. Projections results

Results from projecting future levels of GHG emissions for all three scenarios are presented in Figure 2.15. These results suggest that in the "with measures" scenario, growth of emissions that was observed since 2021 will extend in the future and emissions in 2040 will reach their 1990 levels.

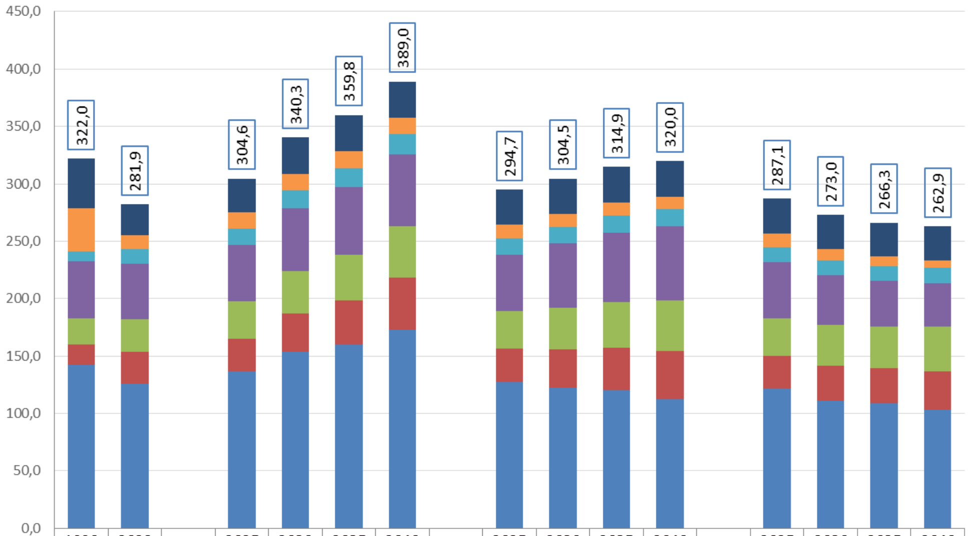
The growth in emissions for this scenario is expected despite the policies and measures that are included there, such as large-scale reforms such as switching to renewable energy, phasing out coal generation, and improving energy efficiency at all levels. Even though the policies and measures contribute to slowing down the growth in emissions they are not sufficient to reach levels that are consistent with the 2030 targets that are enshrined in the NDC of Kazakhstan. Therefore, results from this scenario emphasize the need for a deeper transformation of the energy sector.

For scenario "without measures" the growth in GHG emissions that is expected for the "with measures" scenario is more pronounced. This is because in contrast with the "with measures scenario", the "without measures" scenario assumes that current technologies will remain unchanged and energy use will increase in response to increasing economic and population needs. By 2040, emissions will exceed their 1990 levels.

In the scenario "with additional measures" emissions gradually decline and reach in 2030 and 2040 levels that are by 15% and 16% lower than those in 1990. The measure that is envisaged in the "with additional measures" scenario is introduction of a carbon tax, which helps reverse the rising trend in emissions and bring them down to levels consistent with the NDC target.

Since the energy sector is by far the most important sector in Kazakhstan in terms of GHG emissions, emission reductions in this sector are of critical importance to achieve the unconditional target enshrined in the NDCs of 15% GHG emission reduction in 2030 compared to 1990 levels. Results from projections in this sector suggest that only in the "with additional measures" scenario, contribution of emissions reductions from the energy sector is in line with the NDC target.

Figure 2.15. Scenarios of greenhouse gas emissions from the energy sector, Mt CO_2-eq.



	Fact		Without measures				With measures				With additional measures			
	1990	2022	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040
Oil and natural gas - fugitive emissions	43,5	26,9	29,7	31,4	31,2	31,4	30,0	31,0	31,0	31,6	30,1	30,0	29,4	29,5
Solid fuels - fugitive emissions	37,3	11,6	13,7	14,4	15,0	14,1	12,5	11,4	11,8	10,5	12,1	9,6	8,2	6,8
Other (Not specified elsewhere)	8,9	13,2	14,2	15,8	16,7	18,1	13,7	14,2	14,7	14,9	13,4	13,0	13,1	13,0
Other sectors	49,5	48,4	49,4	54,3	58,4	62,6	49,4	55,6	60,6	64,4	49,0	43,1	39,9	37,8
Transportation	23,0	28,0	32,5	37,0	40,0	44,6	32,5	36,8	39,9	44,5	32,3	35,7	36,1	39,4
Manufacturing and construction	17,4	27,8	28,9	33,3	38,2	45,2	28,9	32,8	36,9	41,6	28,4	30,3	30,7	33,0
Energy inudstry	142,3	126,1	136,3	153,9	160,3	173,0	127,7	122,7	120,1	112,5	121,9	111,3	108,8	103,5
Total	322,0	281,9	304,6	340,3	359,8	389,0	294,7	304,5	314,9	320,0	287,1	273,0	266,3	262,9

Projections results for GHG emissions from the energy sector for all three scenarios are shown in Table 2.29 and projections by gas are shown in Table 2.30.

Table 2.29. Projections of greenhouse gas emissions from the energy sector for the three scenarios, Mt CO_2e.

	2022	2025	2030	2035	2040
Without measures	281,9	304,6	340,3	359,8	389,0
With measures	281,9	294,7	304,5	314,9	320,0
With additional measures	281,9	287,1	273,0	266,3	262,9

Table 2.30. Projections of greenhouse gas emissions from the energy sector by gas for the three scenarios, Mt CO_2e

	Actual emissions		Without measure				With measure				With additional measure			
	1990	2022	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040
CO2	244,6	250,2	268,8	302,3	322,0	350,4	259,7	269,4	279,9	285,1	252,7	241,3	236,7	234,2
CH_4	76,0	30,3	34,7	36,7	36,6	37,2	34,0	34,0	33,9	33,8	33,4	30,8	28,7	27,9
N2O	1.5	1,5	1,1	1,2	1,3	1,4	1,0	1,0	1,1	1,1	1,0	0,9	0,8	0,8

Detailed analysis of projections for all sectors where energy combustion occurs is provided below.

Energy industry

This category "energy industry" includes subcategories, such as production of electricity, heat, petroleum products and other solid energy.

The main activity that defines emissions in this category is emissions from the electricity and heat production industry. The structure of electricity generation that shows the changes by fuel type and technology for all three scenarios is shown in Table 2.31 and 2.32.

Table 2.31. Electricity generation by type of fuel and technology for the three scenarios, billion kWh

	Without measure				With measure				With additional measure			
	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040
Coal	85,8	98,3	104,8	115,9	71,6	65,4	62,7	55,5	73,6	64,0	59,6	56,3
Natural gas	24,3	29,2	37,2	46,9	33,8	39,4	44,6	58,0	29,9	37,7	53,9	63,8
Hydropower – large	10,4	10,6	10,5	10,5	10,8	10,8	10,7	10,7	10,8	10,8	13,2	13,8
Hydropower – small	0,8	0,8	0,8	0,8	0,8	0,8	2,6	2,6	0,8	0,8	0,8	0,8
Nuclear energy	0,0	0,0	0,0	0,0	0,0	0,0	8,1	16,2	0,0	0,0	8,1	16,2
Solar energy	1,4	1,4	1,4	1,0	1,4	2,3	2,6	41,9	1,4	2,3	2,6	43,3
Wind energy	6,4	6,4	6,4	6,4	7,9	32,9	48,3	48,3	7,9	35,2	54,3	54,3
Bioenergy	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Hydrogen energy	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Total	129,1	146,7	161,2	181,4	126,4	151,6	179,5	233,1	124,5	150,9	192,6	248,5
RES	8,6	8,6	8,6	8,2	10,2	36,0	53,5	92,7	10,2	38,3	57,8	98,5

Table 2.32. Structure of electricity generation by type of fuel and technology for the three scenarios, percentage

	Without measure				With measure				With additional measure			
	2025	2030	2035	2040	2025	2030	2035	2040	2025	2030	2035	2040
Coal	66,5	67,0	65,1	63,9	56,6	43,2	34,9	23,8	59,1	42,4	30,9	22,6
Natural gas	18,8	19,9	23,1	25,8	26,7	26,0	24,8	24,9	24,0	25,0	28,0	25,7
Hydropower – large	8,1	7,2	6,5	5,8	8,6	7,1	6,0	4,6	8,7	7,2	6,9	5,5
Hydropower – small	0,6	0,6	0,5	0,4	0,7	0,5	1,4	1,1	0,7	0,5	0,4	0,3
Nuclear energy	0,0	0,0	0,0	0,0	0,0	0,0	4,5	6,9	0,0	0,0	4,2	6,5
Solar energy	1,1	1,0	0,9	0,5	1,1	1,5	1,5	18,0	1,2	1,5	1,4	17,4
Wind energy	4,9	4,4	4,0	3,5	6,3	21,7	26,9	20,7	6,4	23,3	28,2	21,9
Bioenergy	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Hydrogen energy	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
Total	100	100	100	100	100	100	100	100	100	100	100	100
RES	6,7	5,9	5,3	4,5	8,1	23,7	29,8	39,8	8,2	25,4	30,0	39,6

In the “with measures” and “with additional measures” scenarios, levels of coal based power generation are lower than the “without measures” scenario and decreases over time, while power generation based on natural gas, hydropower, solar and wind power increases. Nuclear power has a similar role in both, “with measures” and “with additional measures” scenarios.

By 2040, the energy mix is expected to change depending on the measures taken to support the transition to cleaner energy sources. In the scenario “without measures”, coal dominates, accounting for 63.9% of the energy mix in that year, followed by natural gas, 21.8%, and only 4.5% RES. This scenario maintains dependence on fossil fuels and the share of renewable energy sources remains limited.

In the “with measures” scenario, by 2040, the share of coal will decrease significantly to 23.8%. Natural gas, on the other hand, increases to 24.9%, playing the role of the main “bridge” to cleaner energy. Hydropower plants (large and small) gradually reduce their share, while new renewable energy sources, solar and wind, show significant growth, reaching 39.8% by 2040. The introduction of nuclear energy with a share of 4.5% in 2035 and 6.9% in 2040 also contributes to CO2 reduction. Since the “with measures” scenario includes policies and measures that are implemented or committed the transition to sustainable energy sources becomes visible.

The scenario “with additional measures” shows more prominent trends of energy transition to clean sources and an energy system with a more diverse energy mix for power generation. By 2040, coal will be reduced to 22.6% of the power generation mix, and natural gas will increase to 25.7%, which emphasizes its key role in ensuring the energy balance. Renewable energy sources will grow steadily, accounting for 39.6% of the power generation mix, with increased contributions from solar (17.4%) and wind (21.9%). Nuclear energy reaches 6.5% of the power generation mix in 2040.

Manufacturing industries and construction

GHG emissions from the manufacturing industries and construction sector are expected to grow, due to economic development and increased production. However, in the “with additional measures” scenario this growth is less prominent than in the other two scenarios, due to the introduction of technologies aimed at decarbonizing heavy industry, in particular the launch of a hydrogen-powered steelmaking facility.

In addition to hydrogen-powered steel production, other measures could include the use of cleaner and more efficient technologies in other industrial processes. For example, the introduction of carbon capture and storage (CCS) technologies in cement and chemical plants could also have a significant impact on reducing emissions.

Transport

In all scenarios, GHG emissions from the transport sector are expected to continue to grow, which is related to the expected steady economic growth and the increase in demand for freight and passenger transport. The gradual expansion of trade, population growth and rising living standards stimulate increased mobility and demand for logistics, which inevitably leads to an increase in GHG emissions.

In the scenario "with measures", where the use of natural gas in transport increases, both positive and negative effects are observed in the modelling results. On the one hand, gas as a fuel helps to reduce emissions in the short term, since it is less carbon intensive compared to the traditional liquid fuels. However, the increasing levels of natural gas consumption leads to an increase in its cost, which makes it less accessible for transport companies and individual car owners. As a result, a trend is observed of switching from hybrid cars to gas (using gasoline as an alternative) to a complete removal of natural gas transport in favor of gasoline transport, with associated significant increase in GHG emissions.

In order to reduce emissions in the transport sector in the long term, additional measures are needed, such as incentives for electric vehicles, an increase in the share of biofuels and hydrogen fuels, and improved public transport infrastructure, which would help reduce emissions in the context of economic growth and demand for mobility.

Other sectors

In the other sectors category, which includes emissions from households and commercial sources such as residential and commercial buildings and agriculture, scenarios show different trends in GHG emissions.

In both, "without measures" and "with measures" scenarios emissions from the other sectors steadily increase by 2040. This increase is explained by the continued increase in energy consumption in the residential and commercial sectors, where energy efficiency measures and cleaner technologies are not envisaged or are envisaged to be implemented to a limited extent.

The most significant reduction in emissions is observed in the "with additional measures" scenario. This is due to the implementation of energy efficiency standards, as well as the expanded adoption of renewable energy and a carbon tax. Due to such measures, households and businesses switch to less carbon-intensive forms of energy, which significantly reduces GHG emissions.

The carbon tax incentivizes companies and organizations to reduce emissions by making carbon-intensive energy sources less economically viable. As a result, the commercial sector adapts faster to new requirements by introducing energy-saving technologies and cleaner energy sources, which helps reduce GHG emissions.

The agricultural sector shows a steady increase in emissions in all scenarios, due to increased production and increased use of machinery and equipment to improve productivity. Agriculture is one of the country's priority areas of economic development, and the demand for products that supports this growth leads to an increase in emissions.

Other (Not specified elsewhere)

GHG emissions in this sector are those emissions whose sources are not identified and allocated to the relevant sectors. This is due to the fact that full reporting of fuel use does not occur.

Emissions in this sector are modeled by linking to emissions projections in other sectors. It is assumed that emissions in this sector follow the same trend, namely the trend that reflects the effect from introducing a carbon tax.

Solid fuels – fugitive emissions

This category covers emissions from coal mining, processing, storage and transportation. These emissions are the result of the release of volatile organic and carbon compounds from solid fuels, which release a certain amount of GHG emissions, including methane and carbon dioxide, when in contact with air.

In the scenario "without measures", fugitive emissions from solid fuels gradually increase by 2040, due to an increase in coal mining and transportation. Without additional environmental measures, the amount of fugitive emissions continues to grow, which contributes to a further increase in the amount of GHG in the atmosphere.

The "with measures" scenario shows a more moderate increase in fugitive emissions in this sector. This change is attributed to the introduction of restrictions on coal mining, improved fuel storage and transportation technologies, which help reduce methane leaks and other fugitive emissions.

The most significant reduction in emissions from solid fuels is achieved in the scenario "with additional measures". This scenario demonstrates how the introduction of a carbon tax could significantly reduce emissions and the impact on fugitive emissions from solid fuels.

Oil and natural gas – fugitive emissions

This category includes emissions arising during the production, processing, transportation and storage of oil and natural gas. These emissions are a result from leaks of methane and other hydrocarbons that easily evaporate and enter the atmosphere when in contact with air. Fugitive emissions are a significant source of GHG emissions, since CH_4, one of the main components of natural gas, has a much higher global warming potential than that of CO_2.

In the scenarios "without measures" and "with measures", emissions from fugitive emissions from oil and natural gas steadily increase by 2040. This increase is due to an increase in the production and consumption of oil and gas, as well as the absence of restrictions and leakage control.

The increase of fugitive emissions by 2040 is the smallest for the "with additional measures" scenario compared to the other two scenarios. This is because this scenario envisages comprehensive measures, including the introduction of new methane capture technologies and regulation to limit emissions at all stages of oil and gas production, transportation and processing.

2.F.4. Industrial processes and product use sector projections

This section provides information on the projections for the "with measures", "with additional measures" and "without measures" scenarios for GHG emissions and removals in the IPPU sector by 2040.

2.F.4.1. Methodology and assumptions

A linear regression model was used to prepare projections of GHG emissions from the IPPU sector. The model allows to prepare industrial and environmental development scenarios, assessing the impact of technological change on GHG emissions and exploring opportunities for transition to low-carbon technologies. The approach that is integrated in the model takes into account changes in supply and demand in industry, and the impact of economic and technological factors. This allows for tracking trends and developing scenarios for transition of the IPPU sector to green economy.

To prepare projections of emissions from the IPPU sector, a set of data on energy consumption data from the country's energy balance were used, see Table 2.33. According to these data, consumption of electricity and heat energy in 2023 by different industrial sectors were as follows: electricity, 41,668.8 million kWh, and heat, 52,440.9 TJ.

Table 2.33. Electricity and heat consumption by the industrial sector in 2023.

Industrial sector	Electricity	Heat energy	Analysis
Ferrous metallurgy	14,003.2 mln kWh	20,956.1 TJ	Ferrous metallurgy is the largest consumer of both electricity and heat energy. High consumption volumes are due to intensive processing and high energy intensity.
Non-ferrous metallurgy	12,592 mln kWh	7,148.8 TJ	Non-ferrous metallurgy also consumes significant amounts of energy, although less than ferrous metallurgy. This is due to the lower energy intensity of the processes.
Chemical production	2,995.7 mln kWh	5,893.1 TJ	The chemical industry requires significant amounts of heat energy for chemical processes and synthesis, reflecting its high energy intensity.
Mining industry	6,293.8 mln kWh	5,720.7 TJ	The mining industry is also a significant consumer of energy, especially electricity used in mining and processing.
Production of non-metallic products	1,996.8 mln kWh	1,896.1 TJ	Small consumption volumes but important role in production chain.
Mechanical engineering and transportation equipment	625.6 and 54.9 mln kWh, respectively	1,760.9 and 255.5 TJ, respectively	These sectors show moderate energy consumption, but their contribution to the total energy sector is significant.
Food industry	1,537.5 mln kWh	6,334.4 TJ	High heat consumption is caused by the processes of food processing and storage (refrigeration).
Construction	1,133.5 mln kWh	1,353 TJ	Small amounts consumed, but it is important to consider contributing to sustainable development.

GHG emissions from the IPPU sector for mineral production come from three source categories: cement, lime, and glass production. In the chemical industry GHG emissions come from production of ammonia and calcium carbide. In ferrous metallurgy GHG emissions comes from production of pig iron, steel, blast furnace coke, ferroalloys (ferrochrome, ferrosilicon, ferrosilicon chrome and ferro silico manganese); in non-ferrous metallurgy GHG emissions come from production of aluminum, lead, zinc. Non-energy fuel product use and solvent use include GHG emissions from use of lubricants, production and use of asphalt, and use of solvents in varnish-and-paint products.

Important assumptions used for projections are the expected growth in industrial output and population growth. According to the Ministry of National Economy, based on the forecast for the socio-economic development of Kazakhstan for 2025–2029, the annual growth of the industrial output (Gross Value Added) is expected to average 2%. According to the Ministry of Labor, the annual population growth rate will be 1.3% between 2023 and 2050.

2.F.4.2. Scenarios definition

Without measures scenario

The “without measures” scenario represents a possible trajectory of GHG emissions in a situation where no mitigation measures are implemented, no modernization occurs, and national emission factors per unit of production remain unchanged after the starting year for projections. In this scenario, GHG emissions are assumed to depend on the overall GDP growth rate, population growth, and the current rates of transition to less energy-intensive sectors of the economy. It is assumed that this scenario does not include any measures and policies that have already been implemented in the country in recent years.

With measures scenario

This scenario, unlike the scenario “without measures”, includes measures and policies to reduce GHG emissions that have been implemented, adopted and are planned to be adopted in the nearest future. These measures include the National Quota Allocation Plan for 2023–2024 and the Green Economy Transition Action Plan for 2021–2030.

With additional measures scenario

The scenario “with additional measures” includes current policies and measures and further possible additional measures, such as the Efficiency improvement program for metallurgy, mineral products, chemical production, and transition to carbon-neutral economic development in the Republic of Kazakhstan, and list of BAT for cement, lime, and metal production (Paragraph 5 of Article 113 of the Environmental Code of the Republic of Kazakhstan, dated March 11, 2024, No. 160):

- Implementation of projects on application of the concept of “green” steel production, natural gas supply to metallurgy, replacement of fuel burning with natural gas, use of colliery gas, and modernization and reconstruction of ferroalloy plants;
- Commissioning of gas cleaning equipment and an automated monitoring system in lime roasting shops;
- Replacement of gas cleaning units at the aluminum plant;
- Online emission monitoring in the chemical industry;
- Use of green hydrogen for ammonia, ammonium nitrate production;
- Reduction of clinker share in cement and use of green concrete in cement production.

The technologies used in metallurgy require continuous improvement to achieve environmental goals, such as GHG emission reduction. The chemical sector, which includes the production of ammonia and nitrogen fertilizers with volumes of approximately 1.5 and 2 Mt annually, respectively, is also a major source of CO_2 and N_2O emissions, making it a key area for implementation of innovations aimed at decarbonization.

The production of minerals, including clinker, lime and caustic soda, also contributes to total GHG emissions. Clinker production of about 3 Mt annually is associated with high levels of CO_2 emissions, which in 2021 amounted to 3,841 kt CO_2e. There is an increase in the overall volume of industrial production, including clinker production.

More data used for projections of GHG emissions from the IPPU sector are provided in Table 2.34, data on Gross Value Added of industry, Table 2.35 and 2.36, structure of supply-demand balance for 2022, for coal and its derivatives, gas, oil and oil products.

Table 2.34. Gross value added (GVA) of industries 2023, KZT mln.

Common Classifier of Economic Activity	2023	Contribution to 2023 GVA.
Industry	32,012,445	28,85%
Mining and quarrying	15,365,189	13,85%
Manufacturing industry	14,677,340	13,23%
Construction	6,720,925	6,06%

Table 2.35. Structure of supply-demand balance for 2022, for coal and its derivatives, and gas, TJ

Industrial sector	Coal and its derivatives						Gas
	Coal concen-trate	Power sta-tion black coal	Lignite (brown coal)	Coke and semi-coke from coal	Resins obtained by distillation from coal	Blast fur-nace gas and Coke gas	
Ferrous metallurgy	-	32,102.9	-	16,569.4	-	10,137.2+ 503.4	15,183.9
Chemical industry (in-cluding petrochemical industry)	123.0	362.3	0.5	6,413.1	-	-	15,003.8
Non-ferrous metallurgy	-	66,759.0	258.6	8,769.5	801.9	-	286.9
Production of non-metal-lic products	-	27,364.5	124.1	299.5	-	-	11,991.6
Mining industry	-	17,442.7	394.4	545.3	-	-	9,996.6
Production of food, beverages and tobacco products	-	1,012.8	316.9	2.6	-	-	8,604.2
Manufacturing industry	-	24.9	-	-	-	-	135.0

Table 2.36. Structure of supply-demand balance for 2022, for oil and oil products, TJ

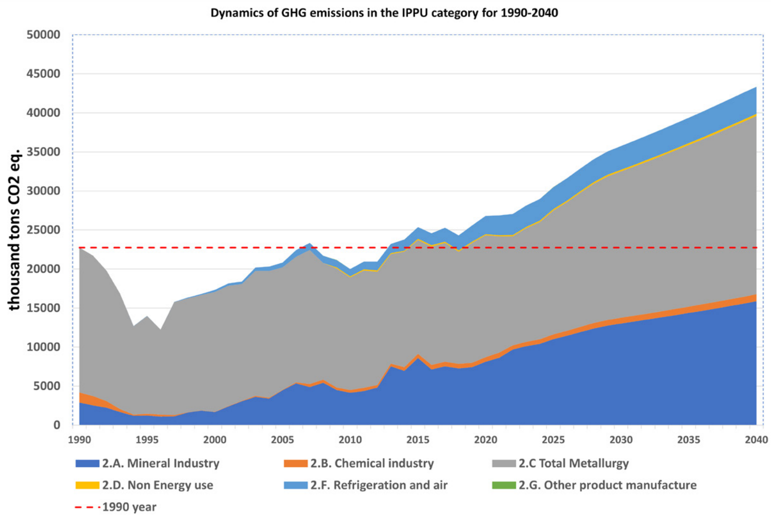
Industrial sector	Oil and gas products					
	Liquid pro-pane and butane	Motor petrol	Kero-sene	Heating and other gas oils	Petroleum fuel oil (fuel), with sulfur content of more than 1%	Oil and shale coke
Ferrous metallurgy	1,878.5	0.8	1.6	1,860.5	7,472.9	-
Chemical industry (includ-ing petrochemical industry)	1,358.5	110.7	-	547.7	167.3	-
Non-ferrous metallurgy	45.0	0.6	2.6	4,578.2	0.0	5,637.7
Production of non-metallic products	798.0	157.1	0.2	4,525.7	354.9	-
Mining industry	276.3	7.9	0.1	18,260.0	219.8	-

2.F.4.3. Projections results

Projections results for the IPPU sector show continuous increase in GHG emissions by 2040 for all three scenarios. This is a continuation of the existing trend in GHG emissions that have been on an upward trajectory for most of the time in the recent two decades, following the sharp decline in the mid-1990s.

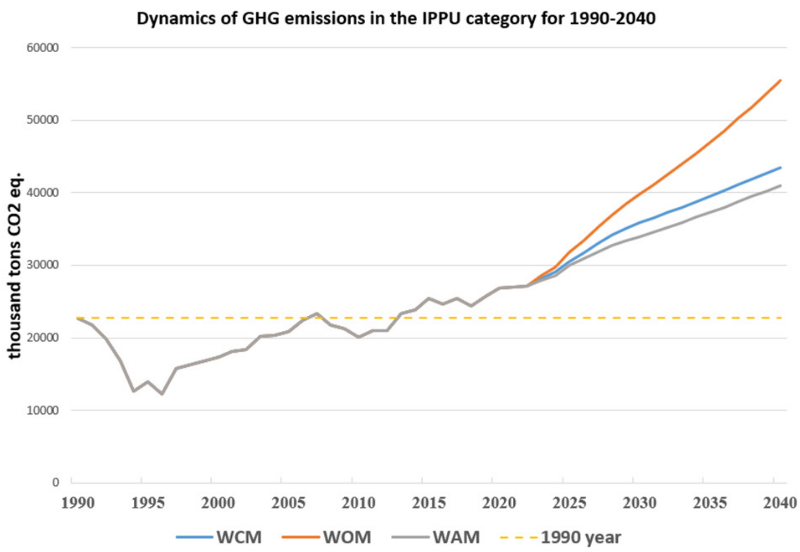
Projections of GHG emissions by 2040 for the key categories of the IPPU sector, namely minerals, chemicals, metallurgy, non-energy fuel use, fluorinated substitutes for ozone-depleting substances (ODS), and other product use are shown in Figure 2.16 for the "with measures" scenario. Of particular interest is the increase in emissions from fluorinated ODS substitutes since the 2000s, driven by increased use of refrigeration and air conditioning. These results highlight the need to transition to cleaner technologies and develop strategies to reduce emissions from the IPPU sector in the long term.

Figure 2.16. Greenhouse gas emissions from the IPPU sector under the "with measures" scenario for different industries, kt CO_2e.



Projections for all three scenarios for GHG emissions from the IPPU sector by 2040 are presented in Figure 2.17. Each of these scenarios reflects different stages of economic development, structural changes and adaptation to global challenges.

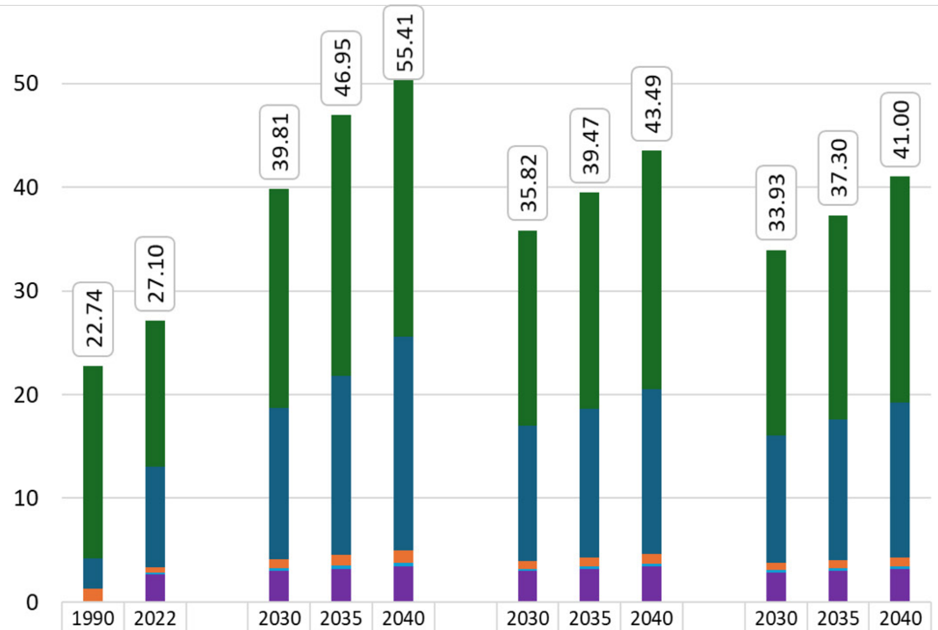
Figure 2.17. Trends of greenhouse gas emissions from the IPPU sector for all three scenarios for 1990-2040, ktCO_2e.



Projections for 2022–2040 suggest continuous growth in GHG emissions from the IPPU sector for all three scenarios. The growth is most pronounced in the "without measures" scenario, which indicates possible further development of technology-oriented sectors and an increase in their contribution to the economy. The other two scenarios, "with measures" and "with additional measures" also show continuous growth although at a slower pace, reflecting expectations for stable growth of traditional economic sectors.

Further data on GHG emission projections from the IPPU sector by 2040 for all three scenarios are presented in Figure 2.18. These include data for industrial sectors, such as minerals, chemicals, metallurgy, non-energy fuel use and fluorinated gases as substitutes for ozone depleting substances.

Figure 2.18. Greenhouse gas emissions from the IPPU sector for all three scenarios and for different sectors of industry, Mt CO_2e.



	1990 year	2022 Fact	2030 WOM	2035 WOM	2040 WOM	2030 WCM	2035 WCM	2040 WCM	2030 WAM	2035 WAM	2040 WAM
Metal industry	18.57	14.04	21.14	25.11	29.92	18.85	20.81	22.98	17.87	19.73	21.78
Mineral industry	2.90	9.69	14.60	17.33	20.59	13.01	14.37	15.86	12.28	13.56	14.97
Chemical industry	1.27	0.57	0.86	1.02	1.21	0.77	0.85	0.94	0.72	0.78	0.85
Non-energy products from fuels and solvent use	0.0024	0.16	0.24	0.28	0.33	0.21	0.23	0.26	0.20	0.22	0.24
Other product manufacture and use	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Product uses as ODS substitutes	0	2.64	2.98	3.21	3.45	2.98	3.21	3.45	2.86	3.01	3.16
Total	22.74	27.10	39.81	46.95	55.41	35.82	39.47	43.49	33.93	37.30	41.00

Projections of GHG emissions for the IPPU sector by industry show that metallurgy and minerals remain the main sources of emissions from the sector, but since 2022, a significant increase in the contribution of other sectors such as fluorinated substitutes for ODS is expected to take place.

By 2040, emissions are projected to continue to grow, particularly in the metals sector, due to the expansion of production and increased demand for metal products. Similarly, GHG emissions from minerals production are expected to grow substantially and those from the chemicals sector to show moderate growth.

The total contribution of GHG emissions from the IPPU sector by 2040 to the total GHG emissions of the country is expected to reach 55.41 Mt CO_2e, 43.49 Mt CO_2e, and 41 Mt CO_2e for the "without measures", "with measures" and "with additional measures" accordingly. This underlines the need to increase the uptake of environmentally friendly technologies and reduce the carbon footprint in key industries in Kazakhstan.

2.F.5. Projections for the agriculture sector

2.F.5.1. Methodology, assumptions and sensitivity analysis

Methodology

The Environmental eXternalities Accounting Tool (EX-ACT), developed by the Food and Agriculture Organization (FAO), was used to prepare projections of the GHG emissions and removals in Kazakhstan's Agriculture, Forestry, and Other Land Use (AFOLU) sector. EX-ACT offers a standardized framework for calculating the net carbon balance, enabling scenario-based analyses of mitigation potential in the AFOLU sector under different policy and technological interventions. The EX-ACT tool is based on internationally recognized methodologies, ensuring robust and consistent results, including:

- 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories that provides a comprehensive framework for estimating emissions and removals across sectors, ensuring alignment with Kazakhstan's GHG inventory reporting requirements;
- 2014 IPCC Supplement to the 2006 Guidelines for Wetlands that offers methodologies for assessing emissions from wetland ecosystems, enhancing the accuracy of broader AFOLU sector assessments;
- Scientific Research: EX-ACT integrates data and methodologies from peer-reviewed studies, refining emissions estimates and ensuring reliable and precise projections.

Further information on the EX-ACT tool can be found on the official FAO website[94].

Assumptions

Data Quality: projections preparation relies on the most current and comprehensive datasets available, acknowledging potential gaps and uncertainties.

Policy Implementation: in the "with measures" scenario, only measures that have been implemented or adopted by the starting year for projections are taken into account, while in the "with additional measures" scenario, it is assumed that all already implemented, adopted, and planned measures will be fully and effectively realized.

Technological Adoption: it is expected that advances in agricultural practices, forestry management and mitigation technologies will occur as part of scenarios, except for the "without measures" scenario where they are expected to remain largely unchanged.

External Factors: Socio-economic and climatic conditions are assumed to follow historical trends, with no significant disruptions or changes.

Sensitivity Analysis

To address the inherent uncertainties in the projections, sensitivity analyses were conducted to evaluate how changes in key variables might influence emissions trajectories:

- Livestock Population Growth: variations in the rate of livestock population increase (±10%) were tested to assess impacts on methane emissions from enteric fermentation;
- Fertilizer Use: scenarios with ±15% changes in fertilizer application rates were modeled to understand their impact on nitrous oxide emissions;
- Adoption Rates of Mitigation Technologies: different rates of adoption for advanced practices, such as methane inhibitors or precision agriculture, were analyzed to gauge their mitigation potential.

The sensitivity analysis identified livestock population growth as the most significant driver of emissions projections, with even slight increases

[94] https://www.fao.org/in-action/epic/ex-act-tool/suite-of-tools/en/

resulting in substantial methane emissions from enteric fermentation. While changes in fertilizer use and adoption rates of mitigation technologies showed a more moderate impact, their combined effect remains critical for achieving meaningful emissions reductions.

2.F.5.2. Scenarios definition

The scenarios considered for the development of Kazakhstan's agricultural system and its GHG emission trends include "without measures", "with measures" and "with additional measures". Each scenario reflects varying levels of policy intervention and mitigation strategies that have impact on emissions from livestock, crop cultivation, and manure management.

Without measures scenario

The "without measures" scenario establishes a baseline projection of GHG emissions, assuming no policies or measures are implemented, adopted, or planned beyond the starting point of the projections. It represents a continuation of historical trends in agricultural and land-use practices.

Economic growth under this scenario is moderate, driving agricultural development without integrating sustainable advancements. Traditional farming methods persist, reinforcing reliance on conventional approaches and practices. Livestock populations, particularly cattle and sheep, grow moderately, leading to proportional increases in CH_4 emissions from enteric fermentation and manure. Outdated manure management practices continue to contribute to rising CH_4 and N_2O emissions, while the absence of technological or policy-driven mitigation leads to continued inefficiencies.

Crop cultivation is characterized by agricultural intensification, with increased reliance on fertilizers to boost yields. Nitrogen inputs grow annually by an estimated 2%, driven by pre-existing fertilizer import trends, directly increasing N_2O emissions from agricultural soils. The lack of advancements or policy incentives perpetuates inefficient practices in manure handling and fertilizer use, resulting in continued growth of emissions.

This scenario highlights the trajectory of Kazakhstan's agricultural emissions in the absence of mitigation interventions, serving as a benchmark for evaluating future efforts.

With measures scenario

This scenario projects GHG emissions based on the assumption of continuation of currently implemented and adopted PaMs, reflecting a realistic trajectory under a static policy framework. The focus is on maintaining existing policies and small-scale initiatives without significant expansion or enhancement.

Livestock management includes moderate improvements in feed quality and management practices, reducing CH_4 emissions from enteric fermentation by 10% compared to baseline values. This is achieved through higher-quality forage and dietary adjustments, particularly at medium and large-scale farms.

Sustainable agricultural practices are gradually adopted, including the introduction of nitrogen-fixing crops, cover cropping, and conservation tillage. These measures optimize nitrogen inputs, reduce soil disturbance, and indirectly decrease N_2O emissions. However, the overall impact remains limited due to the slow pace of adoption and lack of systemic policy changes.

Manure management improves marginally at large-scale farms, with basic digesters and impermeable covers installed to capture CH_4 emissions. These measures reduce CH_4 emissions by 20% in targeted operations but do not extend to smaller farms or rural areas.

The "with measures" scenario demonstrates moderate progress in GHG emissions reduction through the continuation of existing measures, though the lack of policy expansion constrains the potential for transformative change of the agriculture sector.

With additional measures scenario

The "with additional measures" scenario represents an advanced vision of the future of agriculture in Kazakhstan, integrating all implemented, adopted, and planned PaMs with ambitious new policies and strategies. It envisions large-scale deployment of advanced technologies, introduction of comprehensive best practices, and provision of robust policy support to significantly reduce GHG emissions from agriculture.

In livestock management, methane inhibitors, such as 3-Nitrooxypropanol (3-NOP), are incorporated into feed to reduce CH_4 yield by 30%. Breeding programmes focus on low-emission livestock, while dietary optimization further enhances feed conversion efficiency. Supported by financial incentives and technical training, these measures achieve substantial CH_4 emission reductions.

Crop cultivation employs precision agriculture techniques, such as site-specific soil testing and remote sensing, to align fertilizer application with crop nutrient requirements. Enhanced-efficiency fertilizers, slow-release formulations, and split application methods reduce N_2O emissions by up to 30%, while maintaining or improving crop yields. The integration of organic and inorganic nutrient sources promotes soil health and sustainability.

Manure management systems undergo significant upgrades, with advanced anaerobic digesters capturing up to 50% of CH_4 emissions. Nutrient recycling processes convert manure solids into organic fertilizers, reducing reliance on synthetic alternatives. These measures, supported by national policy frameworks and incentives, achieve a 50% reduction in CH_4 emissions from manure.

The "with measures" scenario illustrates the transformative potential of innovative technologies and policies, providing a roadmap for achieving substantial emission reductions and fostering a sustainable agricultural sector in Kazakhstan.

2.F.5.3. Projections results

Results for projections of GHG emission from agriculture for all three scenarios are shown in Table 2.37.

Table 2.37. Projections of GHG emission from agriculture for three scenarios, kt CO_2e

Year	Scenario	Enteric Fermentation (kt CO_2e)	Cultivated Soils (kt CO_2e)	Manure Management (kt CO_2e)	Total (kt CO_2e)
2025	Without measures	19,506.05	11,575.02	2,960.53	34,041.60
	With measures	19,018.40	10,996.26	2,901.32	32,915.98
	With additional measures	13,654.23	9,838.76	2,785.27	26,278.26
2030	Without measures	20,867.25	12,779.75	3,108.56	36,755.56
	With measures	20,345.58	12,140.76	2,953.13	35,439.47
	With additional measures	14,607.08	9,584.81	2,657.81	26,849.70
2035	Without measures	22,325.39	14,109.88	3,218.56	39,653.83
	With measures	21,767.26	13,404.39	2,961.07	38,132.72
	With additional measures	15,627.77	9,171.42	2,072.75	26,871.94
2040	Without measures	23,887.49	15,578.45	3,540.41	43,006.35
	With measures	23,290.31	14,799.53	3,186.37	41,276.21
	With additional measures	16,721.24	7,789.22	1,593.18	26,103.64

”Without measures” scenario: GHG emissions steadily increase driven by intensified farming practices and a growing livestock population, highlighting agriculture’s significant role as an uncontrolled contributor to Kazakhstan’s GHG emissions.

- 2025: emissions increase to 34,041.60 kt CO_2e;
- 2040: emissions continue to increase to 43,006.

“With measures”scenario: this scenario envisaged more moderate GHG emission growth because of the measures included therein, such as improved farming practices and limited adoption of mitigation technologies. Although these measures contribute to slowing down the emissions growth, they do not lead to significant reductions in emissions from the agricultural sector.

- 2025: emissions increase to 32,915.98 kt CO_2e;
- 2040: emissions continue to increase to 41,276.21 kt CO_2e.

“With additional measures” scenario: GHG emissions steadily decrease because additional measures that are envisaged therein, such as methane-reducing feed additives, precision agriculture, and advanced manure management deliver significant emission reductions.

- 2025: emissions decrease from 26,278 kt CO_2e;
- 2040: emissions continue to increase to 26,103 kt CO_2e.

Key trends across scenario include:

- Methane emissions from enteric fermentation remain the largest contributor across all scenarios. Even with substantial reductions under the “with additional measures” scenario, methane emissions from enteric fermentation are projected to reach 16,721 kt CO_2e by 2040, emphasizing the ongoing need for innovation in livestock management practices;
- Nitrous oxide emissions from cultivated soils experience the greatest reductions under the “with additional measures” scenario, declining from 9,838.76 kt CO_2e in 2025 to 7,789.22 kt CO_2e by 2040. This decrease is attributed to the precision farming techniques and the application of nitrogen-efficient fertilizers, that are envisaged in this scenario, highlighting the effectiveness of targeted measures in soil management;
- Emissions from manure management are the smallest GHG emissions source and show relatively modest declines even in the “with additional measures” scenario, from 2,960.53 kt CO_2e in 2025 to 1,593.18 kt CO_2e by 2040. This suggests a need for further advancements in manure handling and utilization technologies.

Overall, the agriculture sector remains a persistent and significant source of GHG emissions in Kazakhstan, dominated by CH_4 from livestock and N_2O from cultivated soils. While emissions continue to rise under the “without measures” scenario and are envisaged to decline only slightly under the “with measures” scenario, the “with additional measures” scenario indicates the sector’s potential for substantial mitigation through possible ambitious policies and measures. The scenarios suggest that even though it may not be possible to completely eliminate emissions from agriculture, the sector’s mitigation potential is essential for achieving Kazakhstan’s climate targets. By integrating sustainable agricultural practices into a broader mitigation framework, it is possible to balance productivity with environmental sustainability, which can also provide co-benefits such as improved soil conditions, enhanced biodiversity, and increased resilience for rural communities.

2.F.6. Projections for the LULUCF sector

2.F.6.1. Methodology, assumptions and sensitivity analysis

The methodology for projecting emissions and removals in Kazakhstan's LULUCF sector aligns with the approach described in the Agriculture section, utilizing the AFOLU (Agriculture, Forestry, and Other Land Use) modeling framework implemented through the EX-ACT tool. Developed by the FAO, EX-ACT provides a standardized and robust platform for estimating GHG fluxes and evaluating the net carbon balance under various land-use scenarios.

As with the projections from agriculture, the LULUCF analysis adheres to internationally recognized methodologies, ensuring consistency with Kazakhstan's GHG inventory and reporting obligations. The integration of EX-ACT ensures that emissions and removals across land-use categories are systematically assessed within the broader AFOLU framework, capturing the complex interactions between agricultural and forestry activities.

Assumptions underpinning projections

The assumptions applied for preparing projections from the LULUCF sector build upon those detailed for projections from agriculture, with additional considerations specific to land-use transitions and forestry dynamics:

- Land-use change and carbon stocks: projections assume a continuation of historical trends in land conversion, such as deforestation driven by agricultural expansion and urban development. Afforestation and reforestation efforts are modeled based on anticipated growth rates, biomass density, and forest stand age, similar to the crop productivity assumptions in Agriculture. Degradation factors, including logging and fire impacts, are incorporated to reflect changes in net carbon stocks;
- Soil carbon and grasslands: soil carbon dynamics in grasslands are modeled in line with the approach for croplands, considering the impacts of overgrazing, soil erosion, and vegetation loss. Restoration measures, such as rotational grazing and reseeding, are factored into scenarios where policy or financial incentives are expected to drive implementation;
- Technological adoption and mitigation measures: consistent with the agriculture sector, the adoption of advanced practices, such as sustainable forestry management, fire suppression technologies is assumed to vary depending on economic incentives, policy enforcement, and capacity-building efforts. The impact of these practices on emissions from deforestation, forest degradation, and wildfires is quantified using similar sensitivity analyses;
- External factors and drivers: climatic variability, socio-economic conditions, and market dynamics are assumed to evolve along historical trajectories, influencing land-use decisions and mitigation potential;
- Integration with agriculture methodology: assumptions used for the LULUCF projections broadly overlap with those used for the agriculture sector, particularly in areas where land-use transitions and emissions intersect. For example, the conversion of forest land to cropland accounts for carbon losses due to biomass removal and soil disturbance, while afforestation projects are evaluated for their contribution to long-term carbon sequestration. Similarly, the methodologies for modeling nitrogen inputs, fertilizer use, and soil restoration in Agriculture inform the assumptions for cropland management within the LULUCF sector.
- By adopting a unified modeling approach, EX-ACT ensures coherence between the analysis for the agriculture and LULUCF sectors, providing a comprehensive understanding of Kazakhstan's AFOLU emissions. The tool's capacity for scenario-based analysis and sensitivity testing further enhances its utility in evaluating the

mitigation potential of integrated land-use strategies. This coherent approach provides policymakers with actionable insights into the mitigation potential of various land-use strategies, complementing the agriculture section, while ensuring alignment with Kazakhstan's GHG inventory and a sound basis for assessing implementation of the international reporting commitments.

Key variables and sensitivity analysis

As with the Agriculture sector, the projections are sensitive to changes in critical variables:

- Forest area dynamics: rates of deforestation, afforestation, and reforestation are tested under ±10% variations to assess impacts on net carbon stocks;
- Land degradation and restoration: sensitivity to the success of soil restoration efforts in grasslands and croplands is analyzed using ±15% adjustments;
- Adoption of advanced practices: variability in the implementation of fire management, sustainable grazing, and conservation policies is assessed to determine their influence on emissions trajectories.

2.F.6.2. Scenarios definition

Kazakhstan's LULUCF sector emissions are projected under three scenarios.

- The "without measures" scenario assumes no additional policies or mitigation measures after the starting year for projections, leading to continued deforestation driven by agricultural expansion, minimal investment in sustainable practices, and weak enforcement of forest protection laws;
- The "with measures" scenario reflects ongoing policies that are implemented or adopted with modest afforestation and reforestation efforts, improved enforcement of regulations, and limited conservation initiatives;
- The "with additional measures" scenario envisages implementing advanced strategies such as strict sustainable forest management, expansion of protected areas, introduction of financial incentives for reforestation and agroforestry, and transforming forests into a significant net carbon sink.

Kazakhstan's forests, classified as low-cover and vulnerable to degradation, play a dual role as emission source and carbon sink. Over the past decade, emissions have declined due to stricter logging regulations, enhanced monitoring, and afforestation projects, including a commitment to planting two billion trees by 2025. However, wildfires remain a challenge, particularly in dry regions. While fire management practices have improved, additional investments in prevention, reforestation, and sustainable management are needed to maximize forests' carbon sequestration potential.

Cropland emissions have steadily risen due to agricultural expansion, often involving the conversion of grasslands and natural ecosystems, resulting in significant soil carbon loss. Existing soil conservation policies are inconsistently implemented, and without targeted efforts, emissions are expected to increase. Under the "without measures" scenario, unchecked agricultural expansion continues to drive emissions. "With measures" scenario envisages moderate adoption of sustainable practices like no-till farming, with limited impact on soil carbon loss. The "with additional measures" scenario includes nationwide implementation of best practices, strict legal protections for grasslands, and financial incentives to achieve significant reductions in soil carbon loss, targeting an 80% reduction by 2040.

Kazakhstan's grasslands, covering 190 million hectares, face significant degradation due to overgrazing, unsustainable practices, and climate variability. Overutilized pastures suffer from compaction, reduced vegetation, and erosion, driving emissions. While natural regeneration occurs in underutilized areas, it is insufficient to offset losses. The "without measures" scenario envisages further degradation and annual emission increases, while the "with measures" scenario introduces basic policies encouraging slow ecosystem recovery. The "with additional measures" scenario envisages comprehensive support for regeneration, including legal protections, financial incentives, and large-scale restoration projects, enhancing biodiversity and carbon sequestration.

Wildfires are another significant emission source. In the "without measures" scenario, increasing fire frequency and intensity, combined with inadequate management, exacerbate emissions. The "with measures" scenario includes the continued application of existing fire prevention systems. Consequently, the emissions trajectory is expected to remain largely stable. The "with additional measures" scenario emphasizes advanced fire management, including satellite-based detection, fire-resistant practices, and proactive suppression strategies, significantly reducing wildfire frequency and impact.

2.F.6.3. Projections Results

Results from projections of GHG emissions from the LULUCF sector for all three scenarios are shown in Tables 2.38–2.42. The LULUCF sector shows significant mitigation potential under the "with additional measures" scenario, with emissions transitioning from a net source to a net sink over the projection period.

Table 2.38. Projections of GHG emission from forest land, kt CO_2e

	Without measures	With measures	With additional measures
2025	-15,550.55	-16,171.23	-17,007.51
2030	-14,788.42	-16,678.95	-18,777.66
2035	-14,063.64	-17,100.11	-18,239.72
2040	-13,374.38	-17,531.91	-22,889.87

Table 2.39. Projections of GHG emission from cropland, kt CO_2e

	Without measures	With measures	With additional measures
2025	42,795.04	39,128.98	34,575.13
2030	47,249.19	37,211.27	24,581.92
2035	52,166.92	35,387.55	15,698.97
2040	57,596.5	33,653.21	8,990.29

Table 2.40. Projections of GHG emissions from grassland, kt CO_2e

	Without measures	With measures	With additional measures
2025	-20,049.87	-20,660.49	-21,599.46
2030	-19,553.61	-21,182.19	-23,847.55
2035	-19,069.64	-21,717.07	-29,890.03
2040	-18,597.64	-22,265.45	-34,650.74

Table 2.41. Projections of GHG emissions from biomass burning, kt CO_2e

	Without measures			With measures			With additional measures		
kt CO_2e	CH_4	N_2O	Total	CH_4	N_2O	Total	CH_4	N_2O	Total
2025	120.31	67.74	188.05	116.48	66.25	182.73	113.39	63.91	177.30
2030	126.45	71.20	197.64	116.48	66.25	182.73	107.83	60.78	168.61
2035	132.90	74.83	207.72	116.48	66.25	182.73	102.55	57.80	160.35
2040	139.67	78.65	218.32	116.48	66.25	182.73	97.52	54.97	152.49

Table 2.42. Projections of GHG emissions from all sources of the LULUCF sector, kt CO_2e by Scenario

Year	Without measures	With measures	With additional measures
2025	7,382.67	2,479.99	-3,854.54
2030	13,104.80	-454.14	-17,874.68
2035	19,241.36	-3,446.90	-32,270.43
2040	25,842.80	-5,961.42	-48,397.83

Key trends from all three scenarios for GHG emissions from the LULUCF sector are outlined below.

"Without measures" scenario: emissions steadily increase due to deforestation, land degradation, and minimal conservation efforts:

- 2025: Net emissions increase to 7,382.67 kt CO_2e.
- 2040: Net emissions further increase to 25,842.80 kt CO_2e.

"With measures" scenario: shows some slow down of emissions growth, reflecting modest mitigation efforts:

- 2025: Net emissions decrease to 2,479.99 kt CO_2e.
- 2040: Net emissions further decrease to –5,961.42 kt CO_2e, reflecting limited carbon sequestration.

"With additional measures" scenario: shows potential for significant reductions, transforming the sector into a substantial net carbon sink:

- 2025: Net emissions shift to a net sink of –3,854.54 kt CO_2e.
- 2040: Net emissions show a major decrease and reach -48,397.83 kt CO_2e and the LULUCF sector provides a major contribution to reducing the total GHG emissions of the country.

Key trends across scenarios include:

- Afforestation and reforestation: afforestation projects under the "with additional measures" scenario ensure enhanced carbon sequestration, with areas like the dry Aral Sea bed playing a pivotal role;
- Deforestation and Forest Degradation: measures to halt deforestation and convert degraded lands into productive forests contribute to emissions reductions;
- Grassland and Cropland Management: restoration of degraded lands and sustainable agricultural practices mitigate emissions and enhance soil carbon storage.

Overall, the LULUCF sector holds substantial mitigation potential for Kazakhstan. While the "without measures" scenario indicates increasing emissions, the "with measures" and "with additional measures" scenarios underline the transformative impact of targeted policies and measures as the sector becomes a net removal. By 2040, the "with additional measures" scenario demonstrates the possibility of achieving significant carbon sequestration, aligning Kazakhstan's LULUCF sector with its climate commitments under the Paris Agreement.

2.F.7. Waste sector projections

2.F.7.1. Methodologies, assumptions and sensitivity analysis

Methodologies

The waste model utilized for this assessment is embedded in the Green Economy Model (GEM), a national systems model that offers an integrated representation of socio-economic and environmental dynamics, and the natural capital that supports them, at the country level[95].[96]

Several key features of GEM model are of relevance with regards to waste and associated emissions: (i) the integration of GDP and population forecasts; (ii) the estimation of associated waste generation; (iii) the allocation of waste (by product) to different waste management flows; and (iv) the addition of several policy options for waste management and emission reduction.

By providing forecasts and assessing the outcomes of various policies and investments in relation to medium- and long-term national development targets it informs policy makers with regards to sustainable development policies. By offering a systemic approach, the model forecasts the outcomes of action or inaction across sectors, actors, dimensions of development and over time. Further, the model enables the formulation of policies and investment packages that result in a more inclusive, robust, and resilient outlook for the country.

In the systems model created for the waste sector, population growth is the primary driver of municipal solid waste generation. The model calculates municipal solid waste generation and domestic wastewater generation using a per capita multiplier. This applies to waste from households, public services, and other urban activities. The link between population and waste generation emphasizes that residential waste streams, such as paper, food, plastics, and textiles, relate directly with the number of people and their consumption patterns. On the other hand, industrial wastewater generation is mainly driven by economic factors, particularly Kazakhstan's GDP growth. As the economy expands, particularly in sectors like manufacturing, the volume of wastewater from industrial sources increases also.

The two drivers used in the model, population for MSW and domestic wastewater, and GDP for industrial wastewater, allow for a nuanced analysis of how different factors contribute to overall waste management challenges and emissions.

Assumptions

Two main assumptions are used to estimate future waste generation: the growth rate of population and GDP. In alignment with the assumptions used in other sectoral projections, population is expected to grow at an average rate of 1.3% annually from 2022 through 2050[97]; real GDP growth is assumed to average 6.0% in 2025 and 2026, 6.1% in 2027, 6.0% in 2028 and 6.4% in 2029[98] and then remain stable at 6.0% from 2030 to 2050. On waste-specific assumptions, the model is grounded in a comprehensive review of literature, policy documents, and national reports, which

[95] Bassi, A. (2015). Moving towards integrated policy formulation and evaluation: The green economy model. Rigas Tehniskas Universitates Zinatniskie Raksti, 16, 5.
[96] Pallaske, G., Bassi, A. M., Garrido, L., & Guzzetti, M. (2023). Exploring the virtuous interdependencies existing between climate action and sustainability in the context of low-carbon development. In F. J. López, M. Mazzanti, & R. Zoboli, Handbook on Innovation, Society and the Environment (pp. 281–308). Edward Elgar.
[97] Center for Development of Labour Resources. (2022). 2023–2050 жылдарға ДЕМОГРАФИЯЛЫҚ БОЛЖАМ. Astana: enbek.
[98] Ministry of National Economy of the Republic of Kazakhstan. (2024). FORECAST OF SOCIO-ECONOMIC DEVELOPMENT OF THE REPUBLIC OF KAZAKHSTAN FOR 2025–2029. Astana: Ministry of National Economy of the Republic of Kazakhstan.

together provide a robust foundation for its assumptions.

Summary of data and assumptions used for GHG emission projections from waste for 2022 and 2050 is presented in Table 2.43 for three scenarios, "without measures", "with measures", and "with additional measures", for 2022 and 2050.

Table 2.43. Overview of data and model assumptions used for projections of GHG emissions from waste in 2022 and 2050 for all three scenarios

Variable	Unit	Value					
		Without measures		With measures		With additional measures	
		2022	2050	2022	2050	2022	2050
Generation factor							
MSW generation	ton/person	0.183	0.2	0.183	0.183	0.183	0.147
Municipal wastewater	t DC/person	0.028	0.028	0.028	0.028	0.028	0.028
Industrial wastewater	t DC/USD	2.40E-06	2.40E-06	2.40E-06	2.40E-06	2.40E-06	2.40E-06
Waste flows							
Collection Rate	%	100%	100%	100%	100%	100%	100%
Sorted waste	%	43%	43%	43%	43%	43%	43%
Mixed waste landfilled[99]*	%	100%	100%	100%	100%	100%	100%
Mixed waste recycled	%	0%	0%	0%	0%	0%	0%
Sorted waste landfilled*	%	77%	77%	77%	77%	77%	30%
Sorted waste recycled	%	22%	22%	22%	22%	22%	70%
Emission factors							
Domestic wastewater	t co2e/t DC	5.67941	5.67941	5.67941	5	5.67941	4
Industrial wastewater	t co2e/t DC	0.84	0.84	0.84	0.6	0.84	0.5
Recycled MSW	t co2e/ton	0.709	0.709	0.709	0.709	0.709	0.709
Landfilled MSW	t co2e/ton	1.12	1.12	1.12	1.12	1.12	1.12

Data and assumptions that are presented in Table 2.43 highlight the following key trends (i) MSW generation per capita increases in the "without measures" scenario, remains stable in the "with measures" scenario and declines in the "with additional measures" scenario; (ii) municipal wastewater per capita stays the same across all scenarios, while industrial wastewater declines in the "with measures" and "with additional measures" scenarios; (iii) waste recycling is improved only under the "with additional measures" scenario. Overall, assumptions applied to the "with additional measures" scenario show enhanced reductions in waste generation, increased recycling rates, and decreased emissions, particularly from wastewater sources, by 2050.

Sensitivity analysis

Sensitivity analysis was performed to test the results of the model under varying assumptions. GDP and population growth were considered for the sensitivity analysis, given that these are the two main model inputs to define waste generation, which then affects waste management and resulting GHG emissions. The following ranges were considered: for population growth (0.6%-2.0%, with the baseline value of 1.3%) and GDP growth (4.5%-7.5, with the baseline value of 6.0%).

At the low end of the ranges, in 2040 the population will reach 21.75 million and a GDP will reach a value of USD552 billion. In contrast,

[99] **With a 100% ban on landfilling paper, plastic, and food waste by 2040

at the high end of the ranges, in 2040 the population will reach 27.13 million, and GDP will reach a value of USD754 billion, which is 37% higher than at the low end of the range.

Results from sensitivity analysis suggest that MSW generation will range between 4,000 kt and 4,991 kt in the low and high ends of ranges. This trend extends to wastewater and as a result, in 2040 the range of degradable components of the wastewater generation will be from 1,939 kt to 2,576 kt degradable organic component. The corresponding total emissions from waste in 2040 will range from 7,634 kt of CO_2e to 9,620 kt of C O2e in 2040.

2.F.7.2. Scenario definition

Definitions for the three scenarios that were prepared for GHG emissions from waste, namely "without measures", "with measures", and "with additional measures" are consistent with the definitions for scenarios for the other sectors.

Without measures scenario

The "without measures" scenario represents a case in which the current situation is kept unchanged for the years to come. It projects GHG emissions and related indicators excluding the impact of all major policies and measures after the starting point for projections 2022, even if they are adopted or in the course of implementation. It serves as a baseline to evaluate the impact of current and additional policies over time.

With measures scenario

The "with measures" scenario considers all actions that have been implemented and adopted by 2022. This means that the impact of policies that are adopted through legislation are considered in this scenario up to their target expiration. Thus, it represents the expected trajectory of emissions if no new policies or measures are introduced beyond those already in place.

With additional measures

The "with additional measures" (WAM) scenario includes implementation of additional policies and strategies on top of ones that are already in place. This scenario explores the impact of additional policies and strategies beyond those included in existing regulation and legislation, highlighting the potential for further reduction of GHG emissions. It provides an outlook on how potential policies could shape waste management outcomes in the future, including GHG emissions.

2.F.7.3. Projections results

Scenarios for GHG emissions from municipal solid waste

GEM model forecasts the flow of MSW and associated emissions for Kazakhstan, with this section focusing on results from 2022 to 2040. Waste flows are calculated using waste generation intensities based on population and GDP to determine total waste generated. Then, shares for collection, recycling, and incineration (for both mixed and sorted waste) are applied to allocate waste into relevant material flow streams. Emission factors are subsequently applied to each specific waste flow, with intensities derived from corresponding activities in the GHG inventory.

Projections of GHG emissions from MSW are presented in Table 2.44. As data shown in this table suggest, the total GHG emissions in the “without measures” scenario are projected to increase by 40%, from 3,305 kt CO_2e in 2022, to 4,615 kt CO_2e in 2040.

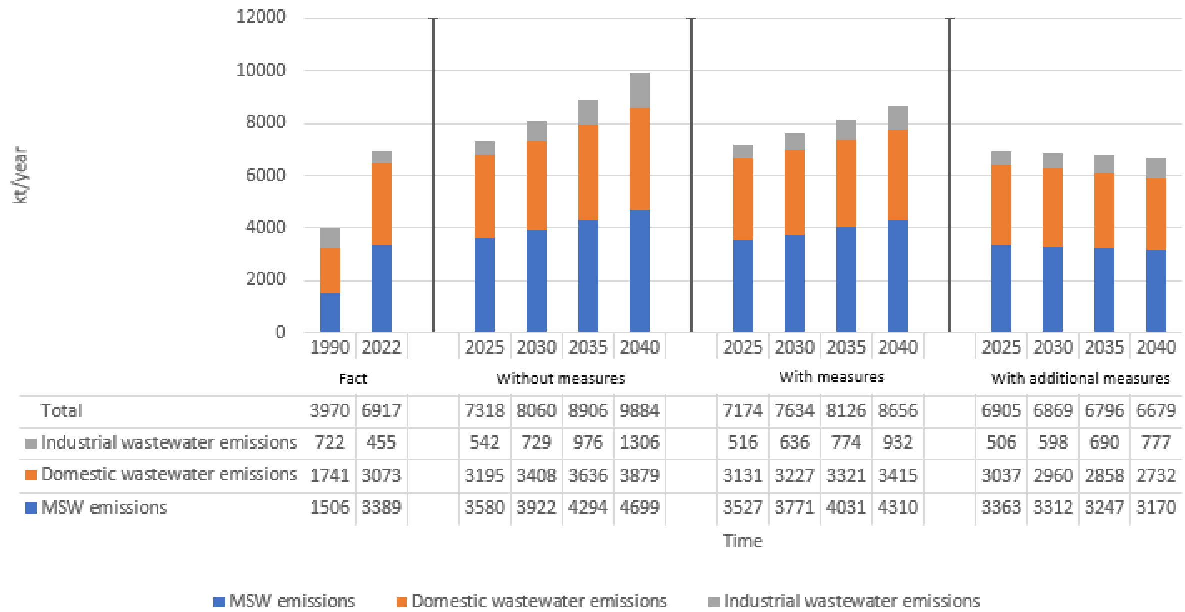
Table 2.44. Projections of GHG emissions from MSW for the “without measures” scenario by 2040, kt

Year	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037	2038	2039	2040
Total MSW (kt of CH_4)	118	120	123	125	127	130	132	135	137	140	142	145	148	150	153	156	159	162	165
Total MSW (kt of CO_2e)	3,305	3,368	3,431	3,496	3,562	3,629	3,697	3,767	3,837	3,909	3,982	4,057	4,133	4,210	4,288	4,368	4,449	4,531	4,615

Scenarios for GHG emissions from wastewater treatment

Projections of GHG emissions from wastewater for all three scenarios are shown in Figure 2.18, along with projections for MSW. As shown in this figure, GHG emissions from wastewater for the “without measures scenario” increase over time. While in 2020 the share of emissions from wastewater (both municipal and industrial) is 46% of total emissions, this share is forecasted to increase to 53% by 2040. The increasing share of emissions from municipal and industrial wastewater is linked to the growth of Kazakhstan’s GDP and GDP per capita. As the model uses population as the primary driver for MSW and municipal wastewater, these do not expand as quickly as economic activity. Consequently, the growth in industrial wastewater becomes more pronounced compared to residential waste streams.

Figure 2.19. Projections of GHG emissions from waste for all three scenarios by 2040, kt CO_2e.



Without measures scenario for the waste sector

Projections of emissions of CO_2, CH_4, and N2O from the waste sector under the without measures scenario are shown in Table 2.45 by 2040. Projections results show the following trends:

- CH_4 emissions from MSW increase from 120 kt in 2022 to 167 kt in 2040, while emissions from municipal wastewater grow from 96 kt in 2022 to 121 kt in 2040. CH_4 emissions from industrial wastewater rise notably, increasing from 16 kt in 2022 to 47 kt by 2040.
- N2O emissions remain stable for MSW at 0.11 kt through the entire projection period, while N2O emissions from municipal wastewater increase gradually from 1.46 kt in 2022 to 1.90 kt in 2040.
- Total CH_4 emissions for this scenario are expected to grow from 232 kt in 2022 to 334 kt in 2040, and total N2O emissions, from 1.57 kt in 2022 to 2 kt by 2040.

As a result, the total emissions from the sector, expressed in CO_2e show for this scenario a consistent upward trend, rising from 6,917 kt in 2022 to 9,884 kt in 2040, representing a 43% increase from 2022 levels.

Table 2.45. Projections of GHG emissions from the Waste sector for the “without measures” scenario by 2040, kt

		Actual emissions		Without measures scenario				
		1990	2020	2022	2025	2030	2035	2040
MSW (Municipal solid waste)	CO2	0.00	0.00	0.25	0.30	0.30	0.30	0.30
	CH4	53.22	123.63	119.98	126.81	139.01	152.30	166.76
	N2O	0.06	0.11	0.11	0.11	0.11	0.11	0.11
Municipal wastewater	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CH4	53.77	87.41	95.94	99.28	105.90	112.97	120.51
	N2O	0.89	1.28	1.46	1.57	1.67	1.78	1.90
Industrial wastewater	CO2	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	CH4	25.80	8.20	16.25	19.37	26.05	34.86	46.66
	N2O	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total	CO2	0.00	0.00	0.25	0.30	0.30	0.30	0.30
	CH4	132.79	219.24	232.17	245.45	270.96	300.13	333.93
	N2O	0.95	1.39	1.57	1.68	1.78	1.90	2.01
	CO_2e	3969.87	6507.07	6917.10	7317.66	8059.78	8906.26	9883.80
% difference from 2022					6%	17%	29%	43%

With measures scenario for the waste sector

Projections of emissions of CO2, CH4, and N2O from the waste sector under the “with measures” and “with additional measures” scenarios are shown in Table 2.46. By 2040. projections results show the following trends for the “with measures” scenario:

- CH4 emissions show consistent growth, rising from 232 kt in 2022 to 241 kt in 2025, 257 kt by 2030, and reaching 292 kt by 2040. The majority of these emissions come from MSW, which increases from 120 kt in 2022 to 153 kt by 2040, while municipal wastewater CH4 emissions also rise steadily from 96 kt to 106 kt over the same period. Industrial wastewater contributes significantly to the CH4 increase, growing from 16 kt in 2022 to 33 kt by 2040;

- N2O emissions follow a moderate upward trend, starting at 1.6 kt in 2022, reaching 1.7 kt by 2025, and peaking at 1.8 kt in 2040. This growth is driven by MSW and municipal wastewater, with MSW contributing a consistent 0.11 kt annually and municipal wastewater emissions rising from 1.5 kt to 1.7 kt by 2040;
- CO2 emissions remain low, increasing slightly from 0.25 kt in 2022 to 0.30 kt by 2035 before marginally declining to 0.29 kt in 2040;

As a result, the total emissions from the sector, expressed in CO_2e show for the “with measures” scenario increase from 6,917 kt in 2022 to 7,174 kt in 2025, 7,633 kt in 2030, and 8,656 kt by 2040, representing a 25% increase over 2022 levels.

Table 2.46. Projections of GHG emissions from the Waste sector for the “with measures” and “with additional measures” scenarios by 2040, kt

		Actual emissions		WM					WAM				
		1990	2020	2022	2025	2030	2035	2040	2022	2025	2030	2035	2040
MSW (Municipal solid waste)	CO2	0	0	0,25	0,3	0,3	0,3	0,29	0,25	0,29	0,28	0,28	0,27
	CH4	53,22	123,63	119,98	124,91	133,61	142,91	152,86	119,98	119,06	117,24	114,96	112,23
	N2O	0,06	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,11	0,1
Municipal wastewater	CO2	0	0	0	0	0	0	0	0	0	0	0	0
	CH4	53,77	87,41	95,94	97,29	100,26	103,2	106,1	95,94	94,37	91,96	88,81	84,88
	N2O	0,89	1,28	1,46	1,54	1,58	1,63	1,68	1,46	1,49	1,45	1,4	1,34
Industrial wastewater	CO2	0	0	0	0	0	0	0	0	0	0	0	0
	CH4	25,8	8,2	16,25	18,44	22,72	27,64	33,29	16,25	18,05	21,34	24,64	27,74
	N2O	0	0	0	0	0	0	0	0	0	0	0	0
Total	CO2	0	0	0,25	0,3	0,3	0,3	0,29	0,25	0,29	0,28	0,28	0,27
	CH4	132,79	219,24	232.17	240,64	256,59	273,75	292,25	232,17	231,48	230,54	228,42	224,85
	N2O	0,95	1,39	1,57	1,65	1,69	1,74	1,79	1,57	1,6	1,56	1,51	1,44
	CO_2e	3969,87	6507,07	6917,1	7174,49	7633,77	8126,39	8656,36	6917,1	6905,43	6868,84	6795,76	6678,92
% difference from 2022					4%	10%	17%	25%		-0,20%	-0,70%	-1,70%	-3,40%

With additional measures scenario for the waste sector

The “with additional measures” scenario includes policies aimed at reducing waste generation, increasing recycling rates, and decreasing landfilling that are additional to those included in the “with measures” scenario.

This scenario envisages specific reduction targets for waste generation, beginning with a 5% reduction by 2030, progressing to 7.5% by 2035, 10% by 2040, and reaching 15% by 2050.

To support recycling, the “with additional measures” scenario includes policies such as subsidies for recycling, measures to limit waste sent to landfills, bans on the landfilling of certain waste types, specifically paper, plastic, and food waste and initiatives to promote shared recycling. A recycling rate target of 40% is set for 2030 and is maintained through 2040, with a subsequent increase to 70% by 2050 (this corresponds to 50% of all waste being collected, sorted and recycled). All these targets are aligned with the vision for the transition to a green economy.

For landfill use, the “with additional measures” scenario establishes stricter controls. Policies include a ban on biodegradable waste in landfills and increased recycling for biomass, an additional 4% by 2040. Landfill rate targets are set to decline in phases, from 70% in 2030 to 60% by 2035, 50% by 2040, and reaching 20% by 2050. All these targets are aligned with the vision for the transition to a green economy. This structured approach aims to adjust waste generation and waste management processes over time, setting measurable targets across key areas.

According to the data for the “with additional measures” scenario that are shown in Table 2.46. the following trends could be expected:

- CH4 emissions remain largely stable, decreasing slightly from 232 kt in 2022 to 231 kt by 2025 and then decreasing to 225 kt by 2040. Emissions from MSW decline from 120 kt in 2022 to 112 kt in 2040, while municipal wastewater CH4 emissions drop from 96 kt to 85 kt over the same period. However, industrial wastewater CH4 emissions increase from 16 kt in 2022 to 33 kt by 2040, contributing to the total CH4 levels.
- N2O emissions under WAM show a slight decrease from 1.57 kt in 2022 to 1.44 kt by 2040, with reductions observed in both MSW and municipal wastewater.
- CO2 emissions remain stable at 0.25 kt in 2022 but decrease slightly to 0.27 kt by 2040.

As a result, the total emissions from the Waste sector, expressed in CO_2e for the “with additional measures” scenario remain stable, decreasing slightly to 6,905 kt by 2025 before gradually declining further to 6,678 kt by 2040, representing a 3.4% reduction compared to 2022 levels.

These results underline the importance of introducing the additional measures that are envisaged in the “with additional measures” scenario in order to reverse the growth in emissions that is expected for the “without measures” and “with measures” scenarios. For a breakdown of emission reductions achieved through each option envisaged in the “with additional measures” scenario see intervention option, see Table 2.22 in the policies and measures section.

INFORMATION RELATED TO CLIMATE CHANGE IMPACTS AND ADAPTATION UNDER ARTICLE 7 OF THE PARIS AGREEMENT

3

CHAPTER III:

Information related to climate change impacts and adaptation under Article 7 of the Paris Agreement

This chapter provides information on a broad range of issues related to climate change impacts and adaptation in Kazakhstan. These issues cover relevant national circumstances and institutional arrangements; impacts, risks and vulnerabilities, adaptation priorities and barriers, adaptation strategies, policies, plans, goals and actions; progress in implementing adaptation; monitoring and evaluation of adaptation action; loss and damage associated with climate change impacts; and co-operation, good practices and lessons learned.

3.A. National circumstances, institutional arrangements and legal frameworks

3.A.1. National circumstances relevant to its adaptation actions, including biogeophysical characteristics, demographics, economy, infrastructure and information on adaptive capacity

Kazakhstan, the ninth largest country in the world and the largest landlocked nation, features predominantly flat terrain, which covers 90% of its territory. This flat landscape increases the country's vulnerability to droughts and floods. In contrast, the high mountain regions in the southeast and east, where vertical climatic zonation occurs, pose unique challenges for natural resource management. The country spans four distinct landscape zones: forest-steppe, steppe, semi-desert, and desert. Most of the terrain lies in arid zones, including desert, semi-desert, and dry-steppe. However, the northern areas offer more favorable moisture conditions, with steppes and forest-steppes dominating the landscape.

Kazakhstan's sharply continental climate, shaped by its distance from oceans, experiences extreme temperature variations. Summers are hot, winters are cold, and daily and annual fluctuations are significant. These climatic conditions create substantial risks for agriculture and water resources. Precipitation peaks between April and July, with a notable decline in August and September.

Climate change has intensified these vulnerabilities. Rising average temperatures, irregular precipitation, and extreme weather events increasingly affect Kazakhstan. In 2024, rapid snowmelt and heavy rainfall triggered one of the most devastating flood events in decades, causing significant damage to infrastructure and displacing thousands in the northern and western regions. The economic impact of these floods reached approximately KZT 300 billion (USD480 million)[1].

[1] https://www.interfax.kz/?lang=eng&int_id=21&news_id=69390

As mentioned in the section on National circumstances in the part on climate profile, Kazakhstan's climate has already warmed significantly. Projections indicate that surface air temperatures will continue to rise in all seasons.

Despite these challenges, Kazakhstan possesses significant adaptive potential, supported by its abundant natural resources, economic opportunities, and evolving institutional framework. Further details on observed climate changes are provided in the section on National Circumstances of Chapter II.

3.A.2. Institutional arrangements and governance, including for assessing impacts, addressing climate change at the sectoral level, decision-making, planning, coordination and addressing cross-cutting issues

This section provides an overview of the institutional arrangements and governance, including for assessing impacts, addressing climate change at the sectoral level, decision-making, planning, coordination and addressing cross-cutting issues, adjusting priorities and activities, consultation, participation, implementation, data governance, monitoring and evaluation, and reporting.

Since 2020, Kazakhstan has integrated climate change adaptation into strategic documents and legislation. A major milestone was the inclusion of adaptation provisions in the Environmental Code[2]. In 2021, a dedicated chapter on state management of climate change adaptation was added, offering comprehensive definitions of adaptation, climate impacts, and vulnerability. The chapter outlines a phased approach to adaptation and prioritizes key economic sectors, including agriculture, water management, forestry, and disaster risk.

Since 2019, Ministry of Ecology and Natural Resources (MENR) has overseen implementation of adaptation policies and actions, working closely with sectoral ministries, such as the Ministry of Agriculture, Ministry of Water Resources and Irrigation, and Ministry of Emergency Situations.

An arrangement for monitoring state adaptation policy has been developed. The implementation of sectoral policies and adaptation measures will be monitored, and annual reporting will be submitted to the MENR in accordance with Paragraph 33 of the Rules for Organizing and Implementing the Climate Change Adaptation Process, approved by Order No. 170 of the Minister of Ecology and Natural Resources of the Republic of Kazakhstan on June 2, 2021. This reporting is aimed at preparing international reports in accordance with subparagraph (b) of Paragraph 7 of the Paris Agreement.

In 2023, Kazakhstan updated its NDC to include both, climate change adaptation and more ambitious national policy to deal with climate challenges. On adaptation, the updated NDC outlines measures like infrastructure modernization, sustainable water resource management, and strengthening agricultural resilience against extreme weather.

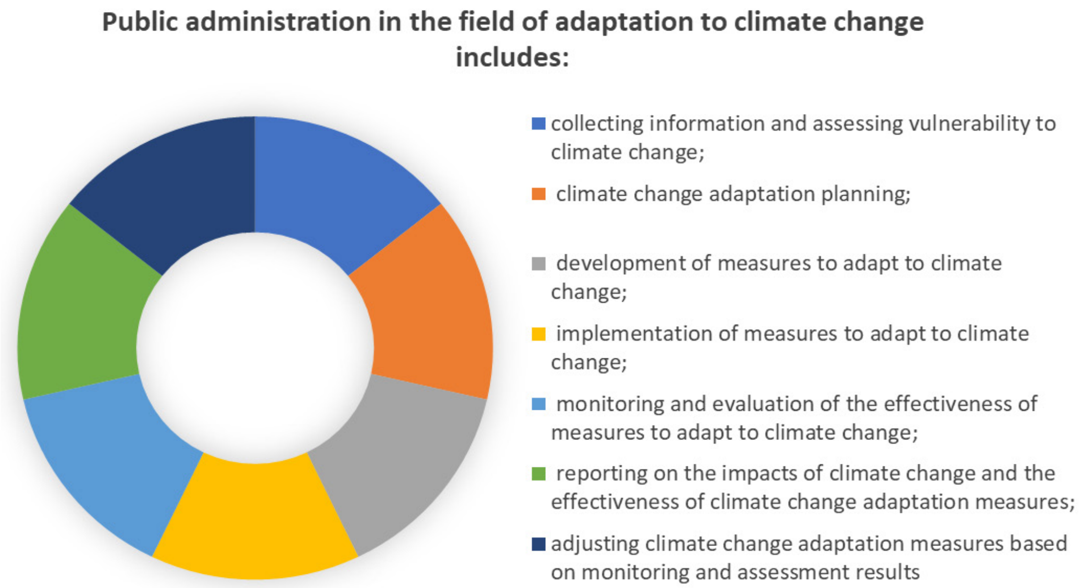
The Environmental Code of 2021 also emphasizes land protection (Articles 228–238). The Code mandates protection against soil degradation, land disturbance, and desertification and requires individuals and organizations to prevent soil depletion during land use. In line with the Forest Code[3], Kazakhstan introduced a system in 2021 for granting long-term access to state forest fund lands through the "State Register" platform. This platform enables private individuals and companies to lease lands for forestation, with potential expansion to other land categories in the future.

[2] Environmental Code https://adilet.zan.kz/rus/docs/K2100000400https://adilet.zan.kz/rus/docs/K2100000400

[3] Forest Code of the Republic of Kazakhstan. Code of the Republic of Kazakhstan No. 477 dated July 8, 2003.

In accordance with the Code, the MENR developed and approved rules for organizing and implementing climate change adaptation on June 2, 2021 (Order No. 170). State management in the field of climate change adaptation encompasses all stages of governance, forming a complete adaptation cycle (Figure 3.1).

Figure 3.1. Stages of the adaptation cycle in accordance with provisions of the Environmental code



Adaptation planning requires systematic research on impacts and climate data. Climate change is a global challenge, but its effects manifest locally with intensities that differ from the global average. Long-term planning for climate change response and adaptation must to some extent rely on climate data and models, which provide decision-makers with scenarios to guide the selection of appropriate policies and measures. Research is needed to understand how the physical risks of climate change will affect Kazakhstan's population, ecosystems, and economy.

At the same time, among the main stages of adaptation, collecting data and assessing vulnerability is singled out in the "Requirements for Information Collection and Climate Vulnerability Assessment" from the Code. This assessment relies on data about historical and current climate trends, as well as projections of future impacts. RSE "KazHydroMet", the national hydrometeorological service, leads these efforts. It monitors environmental conditions, conducts meteorological and hydrological observations, and provides critical information at national and international levels.

A number of other organizations contribute to adaptation efforts. The Institute of Geography and Water Security JSC researches surface water resources and natural hazards in mountainous regions. It also studies glaciology and forecasts water regimes under climate change. The National Center of Space Research and Technology JSC monitors aridity for agricultural purposes. Mudflow and landslide-prone areas are monitored by RSE "KazHydroMet" and observation posts of "Kazselezashchita" under the Ministry of Emergency Situations.

The adaptation measures planned by the Government involve the participation of stakeholders, including local communities, scientists, businesses, public organizations, youth and women's organizations. They also require the support of local executive bodies in the regions and cities of national significance, as well as the inclusion of measures to promote gender equality.

Thus, institutional arrangements with regards to climate adaptation include a legislative framework, primarily the Environmental Code (see section 3.A.3), overall design and coordination of adaptation policies and actions by the MENR, implementation of adaptation measures by relevant ministries, such as the Ministry of Agriculture, Ministry of Emergency Situations, Ministry of Water

Resources and Irrigation, and meteorological data collection and climate change assessment by Kazhydromet.

Key institutional advancements in adaptation include the adoption of the Environmental Code, establishing interagency coordination, development of an adaptation roadmap, and launch of the National Adaptation Plan (NAP) project. These efforts underscore Kazakhstan's commitment to addressing climate change through a coherent and integrated approach and related institutional arrangements.

3.A.3. Legal and policy frameworks and regulations

Developing and adopting measures to adapt to the negative impacts of climate change across all economic sectors requires a well-defined legal framework, sufficient public financial resources, and clear accountability at all levels of government. The Paris Agreement, ratified by Kazakhstan in November 2016, obliges signatory countries to take action both to limit the rise in global average temperature and to enhance economic resilience to climate change.

While Kazakhstan has yet to develop a NAP, various projects have supported adaptation initiatives in most cases funded through grants. Insights and results from these projects are documented in the relevant chapters of the Eight National Communication. The recent project launched by the MENR and UNDP to prepare the NAP marks a critical step toward creating a comprehensive state-level adaptation planning.

Recognizing the challenges posed by climate change, Kazakhstan has enacted several legal frameworks that directly or indirectly support climate adaptation, including:

- Strategy Kazakhstan-2050: A New Political Course of the Established State" (2012): acknowledges water scarcity as a future challenge to agriculture and advocates for increased utilization of water-saving technologies. Additionally, the strategy includes the objective of positioning Kazakhstan as a global leader in environmentally sustainable agricultural production;
- Concept on Transition to Green Economy (2013): One of its key objectives is to enhance the efficiency of resource utilization (including water, land, and biological resources) and their management;
- Environmental Code of the Republic of Kazakhstan (2021): includes a dedicated chapter on climate change adaptation, defining core principles and implementation stages;
- Water Code of the Republic of Kazakhstan (2003)[4]: establishes mechanisms for sustainable water resource management under changing climatic conditions;
- Forest Code of the Republic of Kazakhstan (2003): focuses on sustainable forest management and reforestation to enhance carbon sinks and increase resilience to climate impacts;
- Land Code of the Republic of Kazakhstan (2003)[5]: Addresses land use practices to prevent degradation and support adaptation in the agricultural sector;
- Law on Civil Protection (2014): The Law does not specifically mention climate change, but it addresses emergencies resulting from hazardous natural phenomena mainly related to climate change;
- Law on Organic Farming (2016): regulates organic farming and food production by emphasizing efficient use of water, land, and biological diversity
- Law on Pastures (2017): promote the rational use of pastures and introduces measures to mitigate land degradation;
- Law on State Regulation of Agriculture development and Rural Territories (2005, with amendments 2021): considered climate vulnerability assessment, identification, and

[4] Water Code of the Republic of Kazakhstan. Code of the Republic of Kazakhstan dated July 9, 2003 No. 481. https://adilet.zan.kz/rus/docs/K030000481

[5] Land Code of the Republic of Kazakhstan. Code of the Republic of Kazakhstan dated June 20, 2003 No. 442.

implementation of adaptation measures, monitoring and evaluation.

Adaptation policies are reflected in several strategic plans developed by the sectoral ministries. Notably, climate adaptation is embedded in state programmes such as “Ak Bulak,” “Agribusiness 2020,” and “Taza Qazaqstan”. These programmes demonstrate Kazakhstan’s commitment to integrating adaptation into its national and sectoral development strategies.

3.B. Impacts, risks and vulnerabilities

3.B.1. Current and projected climate trends and hazards

Information about climate trends is provided in the previous relevant chapters and the latest official bulletin issued by the national hydrometeorological service, RSE “Kazhydromet”[6].

A consistent increase in average annual air temperatures has been observed across all regions of Kazakhstan from 1976 to 2023. Linear trend coefficients range from 0.24 °C to 0.56 °C per decade, with statistically significant trends at a 5% confidence level.

Changes in precipitation patterns show limited long-term variability. From 1976 to 2022, seasonal precipitation trends were minor, contributing less than 3% to total variability. Positive trends are observed in winter and spring precipitation, while summer and fall precipitation exhibit decreasing trends.

Extreme Weather and Natural Disasters.

Kazakhstan experiences diverse extreme weather events, including heavy snowfalls, snowstorms, and prolonged frosts during the cold season, as well as severe downpours, hail, and squally winds during the warm season. Heatwaves, aridity, and wildfires are also becoming more frequent. Aridity, which has historically affected grain-growing regions[7], is projected to increase significantly. Between 1966 and 2016, severe aridity occurred eight times, with a recurrence probability of once every three years in the central and western regions. By the end of the century, arid conditions that were once rare (100-year droughts) may become 4–10 times more frequent[8].

Floods and mudflows are another significant threat. Kazakhstan experienced at least seven major floods between 1985 and 2024, with the most devastating occurring in 2010 and 2024[9]. The 2024 flood alone caused USD480 million in damage. Glacial lake outburst floods (GLOFs) in the Tien Shan mountains also pose risks, particularly for Almaty[10] and surrounding areas[11], where dangerous lakes have been identified.

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[6] ANNUAL BULLETIN OF MONITORING THE STATE AND CHANGE OF CLIMATE IN KAZAKHSTAN: 2023 https://www.kazhydromet.kz/uploads/files/1891/file/675274ea2635aezhegodnyy-byulleten-ik-za-2023_rus_ot_27–11–24.pdf

[7] Baysholanov S. S. On the recurrence of droughts in grain-growing regions of Kazakhstan // Hydrometeorology and Ecology. No. 3. Алматы, 2010.) RSE Kazgidromet, p.27–38

[8] NASA Earth Observatory. (2015). Glacial lake outburst near Almaty. URL: https://earthobservatory.nasa.gov/images/86300/glacier-lake-breakthrough-flood-near-Almaty [accessed 24/10/2024]

[9] Broka, S., Hertz, A., Christensen, G. N., Rasmussen, D. L., Morgunov, A., Fileccia, T., Rubaiza, R. (2016). Kazakhstan – Agricultural Sector Risk Assessment. Global agricultural practice, technical assistance. Washington, DC, The World Bank Group. URL: https:// openknowledge.worldbank.org/handle/10986/23763

[10] NASA Earth Observatory. (2015). Glacial lake outburst near Almaty. URL: https://earthobservatory.nasa.gov/images/86300/glacier-lake-breakthrough-flood-near-Almaty [accessed 24/10/2024]

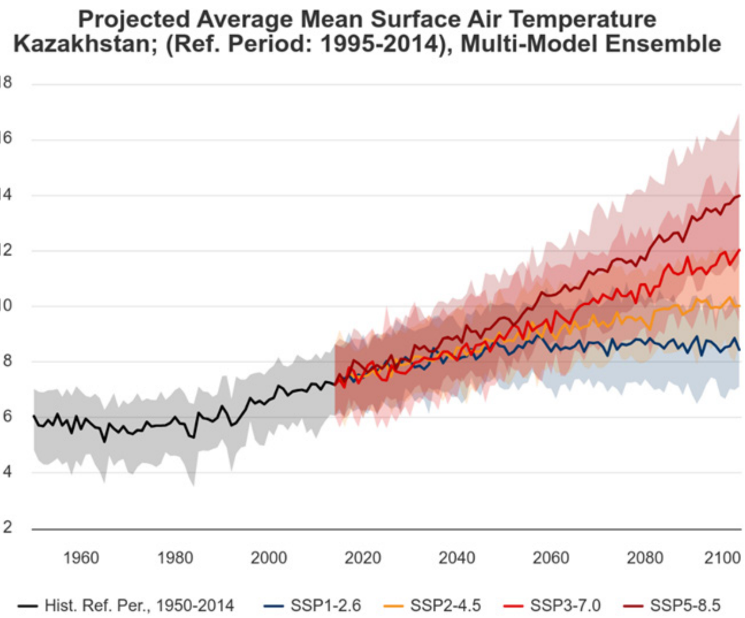
[11] Bolch, T., Peters, J., Egorov, A., Pradhan, B., Bukhreutner, M., Blagoveshchensky, V. (2012). Identification of potentially dangerous glacial lakes in the Northern Tien Shan.

Projected Climate Changes.

Surface air temperatures in Kazakhstan are expected to continue rising across all seasons[12,13,14]. By 2100, under the highest emissions scenario (SSP5–8.5), average annual temperatures could increase by more than 6 °C, which is 3 °C higher than under the low-emissions scenario – Figure 3.2. This highlights the critical importance of reducing global GHG emissions. The warming rate in Kazakhstan is expected to exceed both the global average and that of most Asian countries.

By mid-century, precipitation in Kazakhstan is projected to increase by 7–8%, depending on emission scenarios, with the most significant increases in winter (20–35%). However, summer precipitation could decrease by 12%, exacerbating aridity and water scarcity during the growing season.

Figure 3.2. Projected increase in average surface temperature according to modeling calculations[15].



In all IPCC SSP scenarios, the highest air temperature rise is expected in the northern regions of Kazakhstan[16]. By 2050, no significant changes in precipitation are projected in northern Kazakhstan (both annually and during the vegetation season from May to August). However, due to higher air temperatures, droughts, and evaporation, a decrease in water availability (humidity index) during the vegetation season by 8–17% is projected by 2050[16]. In the scenario with the highest emissions, a northward shift of Kazakhstan's humid zone by 250–300 km is projected by 2085[17].

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[12] Naumann, G., Alfieri, L., Weiser, C., Mentaski, L., Betts, R. A., Carrao, H.,. . . Feyen, L. (2018). Global changes in drought conditions under different levels of warming. Geophysical Research Letters, 45(7), 3285–3296. DOI: https://doi.org/10.1002/2017GL076521

[13] White, K., Tanton, T., & Rycroft, D. (2014). The impact of climate change on water resources of the Amu Darya basin in Central Asia. Water Resources Manag. 28: 5267–5281. URL: https://link.springer.com/article/10.1007/s11269–014–0716-x

[14] Salnikov, V.; Talanov, Y.; Polyakova, S.; Assylbekova, A.; Kauazov, A.; Bultekov, N.; Musralinova, G.; Kissebayev, D.; Beldeubayev, Y. An Assessment of the Present Trends in Temperature and Precipitation Extremes in Kazakhstan. Climate 2023, 11, 33. https://doi.org/10.3390/cli11020033

[15] https://climateknowledgeportal.worldbank.org/country/kazakhstan/climate-data-projections

[16] NC7, pp. 201–2.

[17] NC2.

Table 3.1. below provide information on temperature projections and anomalies for maximum, minimum, and mean daily temperatures in Kazakhstan for the periods 2040–2059 and 2080–2099 compared to the baseline period 1986–2005 across all Representative Concentration Pathways (RCP) scenarios. The table shows the median of the RCP model ensemble with the 10th–90th percentiles in brackets[18].

Table 3.1. Projected anomaly daily temperatures in Kazakhstan (changes in °C).

	Average Daily Maximum Temperature		Average Daily Temperature		Average Daily Minimum Temperature	
Scenario	2040–2059	2080–2099	2040–2059	2080–2099	2040–2059	2080–2099
RCP2.6	1.7 (–1.0, 4.7)	1.6 (–1.1, 4.5)	1.7 (–0.7, 4.4)	1.6 (–0.8, 4.2)	1.8 (–0.5, 4.1)	1.6 (–0.6, 4.1)
RCP4.5	2.2 (–0.4, 5.0)	2.9 (0.5, 5.9)	2.1 (–0.3, 4.6)	2.9 (0.5, 5.6)	2.3 (0.0, 4.6)	3.1 (0.6, 5.7)
RCP6.0	2.0 (–0.6, 4.7)	3.6 (1.0, 6.8)	2.0 (–0.4, 4.5)	3.6 (1.3, 6.5)	2.0 (–0.3, 4.4)	3.7 (1.4, 6.3)
RCP8.5	2.8 (0.2, 5.7)	5.7 (2.9, 9.0)	2.8 (0.5, 5.4)	5.8 (3.3, 8.6)	3.0 (0.7, 5.4)	6.1 (3.4, 8.7)

Long-Term Impacts

Modeling results indicate that most of northern Kazakhstan will transition into an arid or semi-arid zone. In the central and western regions of Kazakhstan (West Kazakhstan, Aktobe and Karaganda regions), where such conditions are already prevalent, aridity frequency during the period 1966–2010 ranged from 31% to 38%, compared to 22–33% in the three northern regions. The frequency of severe aridities – those causing at least a 50% reduction in wheat yield – was 16–24% in central/western Kazakhstan compared to 2–13% in northern Kazakhstan. Overall, a significant increase in the duration and severity of aridities is expected in Central Asia[19].

The warming projected by the model ensemble may accelerate the melting of Kazakhstan's glaciers, which is expected to increase flood risks in the medium term but subsequently lead to reduced river flows[20]. The scale of future flood peaks will also depend on the operation of reservoirs. River runoff in the Tian Shan mountains has already significantly increased in spring, summer, and autumn due to increased glacial melt runoff[21]. Melting is also expected to

[18] WBG Climate Change Knowledge Portal (CCKP, 2020). Climate Data: Projections. URL: https://climateknowledgeportalworldbank.org/ country/kazakhstan/climate-data-projections

[19] Seneviratne, at all, 2021: Weather and Climate Extreme Events in a Changing Climate. In *Climate Change 2021: The Physical Science Basis. Contribution of Working Group I to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1513–1766, doi:10.1017/9781009157896.013.

[20] World Bank Climate Change Knowledge Portal (CCKP, 2020). Climate data: historical. URL: https://climateknowledgeportalworldbank.org/country/kazakhstan/climate-data-historical

[21] Sorg, A., Huss, M., Rohrer, M. & Stoffel, M. (2014). The days of plenty may soon be over in the glacier-covered watersheds of Central Asia. Environmental Research Letters, 9, 104018. URL: https://iopscience.iop.org/article/10.1088/1748–9326/9/10/104018

shift to earlier in the year, altering the seasonal flow regime and pushing its peak to earlier times[22].

Projected changes in the amount of precipitation from intense downpours, which can trigger mudflows, show a consistent increase across all pathways and time horizons, typically ranging from 5% to 20%. One study projected a tenfold increase in the frequency of mudflows, posing a threat to 156 cities and towns in Kazakhstan, including Almaty[23].

Wildfires in steppe and forested areas are expected to become more frequent in the coming decades due to higher temperatures and more frequent aridities, leading to land degradation[13].

3.B.2. Observed and potential impacts of climate change, including sectoral, economic, social and/or environmental vulnerabilities

The future impacts of climate change in Kazakhstan may include both negative and positive effects.

Kazakhstan faces increasing average temperatures, irregular precipitation, and heightened risks of natural disasters due to climate change. Warming in Kazakhstan is projected to occur faster than the global average, with temperatures expected to rise by 1.6 °C to 5.3 °C by the 2090s[19]. These changes amplify the risks of heat stress for the population, increasing pressure on the healthcare system. More frequent severe aridities are anticipated, exacerbating environmental challenges such as land degradation, desertification, and dust storms. Concurrently, more intense downpours[24] are expected to increase the frequency and severity of floods and mudflows, with weather-related emergencies rising from 39 in 2012 to 130 in 2021. Mudflows alone are projected to increase tenfold, threatening 26% of Kazakhstan's population living in high-risk areas, particularly mountainous regions[25].

Kazakhstan's infrastructure, designed for past climatic conditions, is increasingly vulnerable to the negative impacts of climate change. In arid regions, the rising probability and intensity of heatwaves and shifts in the hydrological cycle pose severe challenges. Increased temperatures will elevate cooling demands during the warm season while reducing heating needs during the cold season. While fewer freezing days positively impact public health and energy demand, icy road conditions caused by heatwaves during winter present new hazards.

Declining snowfall due to rising cold-season temperatures will reduce snow accumulation, adversely affecting dry-land farming in the northern grain-producing regions. In mountainous areas, reduced snowfall and shrinking glaciers disrupt water availability for irrigated agriculture in submontane regions of the south and southeast, which rely heavily on meltwater.

Longer growing seasons in some northern and southeastern regions, combined with increased precipitation and shorter periods without rainfall, may enhance crop production in specific areas. However, this potential benefit is outweighed by the overall threat to agriculture, a critical sector for Kazakhstan's economy and food security. Rising temperatures and changing precipitation patterns are expected to negatively affect crop yields, particularly wheat, Kazakhstan's primary agricultural export.

The 8NC identifies 4 priority sectors, which are also highlighted as priorities in the Environmental Code, namely water resources, agriculture, forestry and extreme events. In addition to these four sectors, the 8NC details two other sectors – health and tourism – as initial groundwork for further rapid

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[22] Siegfried, T., Bernauer, T., Guiennet, R., Sellars, S., Robertson, AW, Mankin, J., Baurt-Gottwein, P. и Yakovlev, A. (2012). Will climate change worsen water shortages in Central Asia? Climate Change, 112, 881–899. URL: https://orbit.dtu.dk/en/publications/ climate-change-will-worsen-water-deficit-in-central-asia

[23] USAID. (2017). Climate Risk Profile – Kazakhstan. URL: https://www.climatelinks.org/sites/default/files/asset/document/2017_ USAID%20ATLAS_Climate%20Risk%20Profile%20-%20Kazakhstan.pdf [date of access 24/10/2024]

[24] Westra, S., H. J. Fowler, J. P. Evans, L. V. Alexander, P. Berg, F. Johnson, E. J. Kendon, G. Lenderink, and N. Roberts. 2014. "Future Changes to the Intensity and Frequency of Short-Duration Extreme Rainfall." Reviews of Geophysics 52: 522–55. https://agupubs.onlinelibrary.wiley.com/doi/10.1002/2014RG000464.

[25] ADB & World Bank (2021) – Climate Risk Country Profile – Kazakhstan

research, should it become necessary to supplement the existing priority sectors with new ones that need to be incorporated into national legislation.

The six sectors mentioned above are prioritized due to their significant impact on Kazakhstan's economy, public health, food security, and ecosystem sustainability. Background information on most of these sectors is provided in section 1: National circumstances of Chapter II.

These six sectors provide for the initial focus for implementing adaptation strategies, as they offer the highest potential for building resilience and addressing the country's climate challenges effectively.

Climate change impacts on water resources.

Kazakhstan, with its vast territory, faces significant climate impacts, particularly in priority sectors like water resources. The country's arid climate, characterized by extensive semi-desert and steppe zones, makes water management critical. Rising temperatures accelerate glacier melt, initially increasing river flows in mountain basins such as the Aral-Syrdarya, Ertis, Shu-Talas, and Balkhash-Alakol before mid-century. However, as glaciers deplete, river flows are projected to decline significantly by the end of the century.

In contrast, plains-based watersheds, including the Nura-Sarysu, Esil, Zhaik-Caspian, and Tobol-Torgai basins, are expected to experience reduced water flow by the century's end. This decline is driven by higher air temperatures, increased evapotranspiration, and minimal changes in precipitation levels. These trends threaten water availability in regions already grappling with resource scarcity.

Impact on lakes and desertification. Rising temperatures are also expected to accelerate the drying of major water bodies like Lake Balkhash, located in southeastern Kazakhstan. The lake basin supports about one-fifth of the population, and its desiccation would exacerbate problems such as desertification, soil salinization, and frequent dust storms. These challenges highlight the critical need for sustainable water resource management to safeguard local ecosystems and communities.

Transboundary Water Risks and Regional Demand. Kazakhstan's water supply is highly dependent on transboundary resources, with nearly half originating from neighboring countries. This dependency presents significant risks, especially as regional demand for water in agriculture, industry, and electricity generation is expected to grow in the coming decades. Basins such as the Syr Darya, Ili, Lake Balkhash, and the rivers Zhaiyk, Chu, and Talas have been identified as hotspots for climate-related security risks. Effective international cooperation and comprehensive management strategies are essential to address these shared challenges.

Increased water demand and scarcity. Planned agricultural expansion will further strain water resources. Kazakhstan aims to increase its irrigated area to 3 million hectares by 2030, with water consumption per hectare also expected to rise due to higher average temperatures. Combined with reduced runoff, these trends could lead to widespread water scarcity, particularly in plains and mountainous regions.

The water deficit problem is likely to worsen during summer due to low precipitation and extreme temperatures, accelerating desertification across the plains of Western, Northern, and Central Kazakhstan. Simultaneously, glacial melt, driven by rising temperatures, will increase flood risks in southern and eastern regions in the medium term while threatening overall water availability by mid-century. Since 1950, Kazakhstan's glaciers have lost 14–30% of their mass, underscoring the urgency of addressing these trends.

Climate change is increasing the frequency of arid conditions, reducing water resources critical for both drinking supplies and agricultural irrigation. These aridities exacerbate existing challenges, particularly in regions already prone to drought and desertification. Addressing these risks will require implementing adaptive strategies, including more efficient water use, modern irrigation technologies, and strengthened international collaboration.

Climate change impacts on agriculture

Agriculture is a priority sector for Kazakhstan, the largest wheat producer in Central Asia. The sector relies heavily on precipitation and temperature conditions, making it particularly vulnerable to climate change. Rising temperatures, shifting precipitation patterns, and the northward expansion of arid and semi-arid zones are expected to increase the frequency and severity of droughts in northern Kazakhstan[26]. These changes pose significant risks to crop yields, food security, and the national economy, particularly for rainfed wheat production.

To mitigate these impacts, Kazakhstan must adopt drought-resistant crop varieties and implement water-saving technologies. According to the MENR, if current water consumption trends continue, the country will face a water deficit of 11.7 km^3 by 2030[27]. More efficient water use and technological advancements are essential to addressing this challenge.

Land degradation and erosion. Climate change is expected to increase the risk of land degradation and erosion, further lowering agricultural productivity. Droughts, already a significant threat to the industry, will exacerbate these issues, particularly in rainfed regions. Addressing these risks requires targeted soil conservation practices and sustainable land management strategies to preserve productivity and reduce vulnerability.

Vulnerability of mountain rangelands. Mountain rangelands are especially susceptible to climate change. By 2030, pasture yields in mountainous areas, such as the Asy plateau, are projected to decrease by 20%, reaching only 80% of current levels. While flatlands are expected to see minor reductions in pasture productivity, mountainous regions in southern Kazakhstan will experience more significant declines, reducing the optimal pasture load and livestock capacity.

Regional variability in agricultural conditions. Future agricultural conditions are likely to vary across regions. Some areas may benefit from increased rainfall, improving agricultural productivity, while others will face intensified droughts and water scarcity.

Climate change impacts on forestry

Forestry is a critical sector for Kazakhstan, as forests play a key role in mitigating climate change by absorbing carbon dioxide from the atmosphere and conserving biodiversity. Forests also protect soil from erosion, regulate water cycles, and provide essential habitats for diverse species. However, climate change is increasing the risks of forest fires, ecosystem degradation, and a decline in forests' capacity to sequester carbon.

In 2022, over 800 forest fires were recorded in Kazakhstan's state forest fund, affecting a total area of 104,000 hectares. This represents an increase of 50 cases compared to the previous year. The growing frequency and scale of forest fires highlight the urgent need to strengthen fire prevention and control measures.

Climate change impacts on disaster risk

The frequency of extreme weather events is rising in Kazakhstan due to climate change, with floods, heatwaves, heavy snowfalls, and aridities becoming more frequent and severe. These phenomena threaten lives, property, and infrastructure, highlighting the importance of the emergency management sector and increase disaster risk. The costs allocated to managing emergency situations are increasing, reflecting the growing scale and impact of these events.

During the cold season, Kazakhstan experiences heavy snowfalls, snowstorms accompanied by hurricane-force winds, prolonged frosts, ice formation, and late spring frosts. In the warm season, the country faces heavy downpours with thunderstorms, hail, squally winds, and extreme fire danger during dry summers. Severe aridities also cause sharp declines in crop yields, further straining the agricultural sector.

Abnormally low air temperatures pose additional risks, disrupting daily life and leading to emergencies, including accidents in heating and power systems as well as engineering networks.

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[26] NC7, p. 153.

[27] https://www.undp.org/sites/g/files/zskgke326/files/migration/kz/4d9b74756b8a3ac831309d96e5ebf718045612ff6f9c0a 50a2a8ef19fc474263.pdf

Floods are the most frequent hydrological hazards in Kazakhstan, accounting for:

- Mountain river floods: 47% of total cases.
- Plain river floods: 26%.
- Ice jams: 13%.
- Mudflows: 7%.
- Extreme low water levels: 6%.

Floods on mountain rivers are linked to climate change, rising air temperatures, glacier degradation, and increased glacial runoff. Warmer mountain climate also expand the area where precipitation falls as rain, increasing the risk of rain-induced floods. On plain rivers, ice jams during the thawing season often result in flooding. Rivers flowing from south to north, such as the Syr Darya, Ertis, Yesil, and Tobol, are particularly vulnerable due to the asynchronous melting of ice upstream and downstream.

Mudflows are among Kazakhstan's most destructive natural hazards in terms of prevalence, recurrence, and impact. Their high frequency necessitates substantial investment in early warning systems and risk reduction measures. The degradation of mountain glaciers and increased rainfall intensity further exacerbate mudflow risks.

Climate change impact on public health

Weather and climate are closely linked to key factors affecting public health. Climate change exacerbates health risks in Kazakhstan in several ways, including increasing the spread of diseases and amplifying the impact of extreme weather events.

More frequent floods, driven by glacial retreat and irregular precipitation patterns, threaten the quality of drinking water by washing pollutants from industrial, mining, and agricultural activities into water sources. This increases the risk of gastrointestinal diseases, which are already a leading cause of death in Kazakhstan. Rising temperatures are also predicted to accelerate the spread of infectious diseases carried by ticks, mites, and rodents.

Extreme weather events, such as heatwaves, cold waves, floods, and droughts, pose direct threats to life through injuries, heat-related illnesses, and hypothermia. Indirectly, these events exacerbate non-communicable and communicable diseases, highlighting the need for robust health systems and preparedness measures. Understanding the connection between climate and health is essential for developing effective protective measures against climate-related risks[28].

Detailed research has explored the health impacts of climate change, as documented in various reports and methodologies[29,30,31,32,33]. Analysis of statistical data from the Ministry of Health's annual report, *Health of the Population of the Republic of Kazakhstan and the Activities of Healthcare Organizations*, has identified the following significant relationships:

- Floods increase the risk of injuries, infectious diseases, and psychosocial issues.
- Long-term health consequences include displacement, water shortages, reduced access to healthcare, and prolonged recovery from disasters.
- A 2012 study in Astana found that a 1 °C increase in daily effective air temperature led to a 2% rise in deaths from self-harm and a 9.55% rise in accidental drowning deaths. Additionally, a 1% increase in relative humidity was associated with a 4.87% rise in drownings[34].

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28 https://gfcs.wmo.int/sites/default/files/Fact_Sheets/Health/GFCS_healthflyer_ru.pdf
29 https://apps.who.int/iris/bitstream/handle/10665/104200/9789241564687_eng.pdf
30 https://wedocs.unep.org/bitstream/handle/20.500.11822/32746/HMCCIAAS.pdf?sequence=1&isAllowed=y
31 https://documents1.worldbank.org/curated/en/552631515568426482/pdf/122328-WP-PUBLIC-WorldBankClimateChangeandHealthDiagnosticMethodologyJan.pdf
32 https://health2016.globalchange.gov/high/ClimateHealth2016_FullReport.pdf
33 https://ehia.curtin.edu.au/wp-content/uploads/sites/42/2018/05/cc-guideline-10615.pdf
34 Report "Impact, vulnerability and assessment of adaptive capacity of the healthcare system of the Republic of Kazakhstan to climate change", Ministry of Health of the Republic of Kazakhstan, Astana, 2012.

- Seasonal variations in temperature and humidity were linked to a higher incidence of strokes and cardiovascular diseases[35].
- Under the IPCC RCP8.5 scenario, projections suggest that by 2050, Kazakhstan could experience approximately 42.97 climate-related deaths per million population due to food shortages[36]. These figures underscore the importance of addressing climate-health connections to reduce future risks.

Climate change impacts on tourism

Kazakhstan boasts significant natural and recreational resources, along with numerous sites of world cultural and historical heritage. Its unique natural diversity attracts visitors from around the globe. However, tourism is increasingly recognized as a vulnerable sector to climate change. The most prominent impact is the shortening of the recreational season, which reduces the efficiency and profitability of resort and tourist complexes. As such, tourism is identified as a priority sector for adaptation.

Climate change poses both direct and indirect threats to the tourism sector, including:

- Extreme weather events: more frequent and intense storms, floods, and heatwaves disrupt tourist activities and infrastructure.
- Rising costs: Increased insurance and security costs are required to manage risks associated with extreme weather.
- Water scarcity: limited water availability impacts tourism operations and visitor comfort.
- Loss of biodiversity and attractions: damage to natural and cultural heritage sites reduces their appeal to visitors.
- Reduced snow cover: declining snow cover in winter undermines the viability of snow-based tourism activities.

The most serious impacts stem from changes in temperature, both average summer and winter temperatures, which contribute to perceptions of an inhospitable climate. Extreme summer heat and harsh winter cold deter potential visitors, while the increasing frequency and intensity of extreme events further strain tourism infrastructure.

3.B.3. Approaches, methodologies and tools, and associated uncertainties and challenges

The Notre Dame-Global Adaptation Index (ND-GAIN)[37] was used to evaluate Kazakhstan's current vulnerability to climate change and its readiness to attract private and public sector investments for adaptation actions. While Kazakhstan's ND-GAIN index has improved over time, growth has slowed in recent years.

Figure 3.3 below presents the ND-GAIN index as a matrix divided into four quadrants. The matrix is delineated by the global average vulnerability score for all countries and years, as well as the calculated median readiness score. The vertical axis represents vulnerability, while the horizontal axis reflects readiness.

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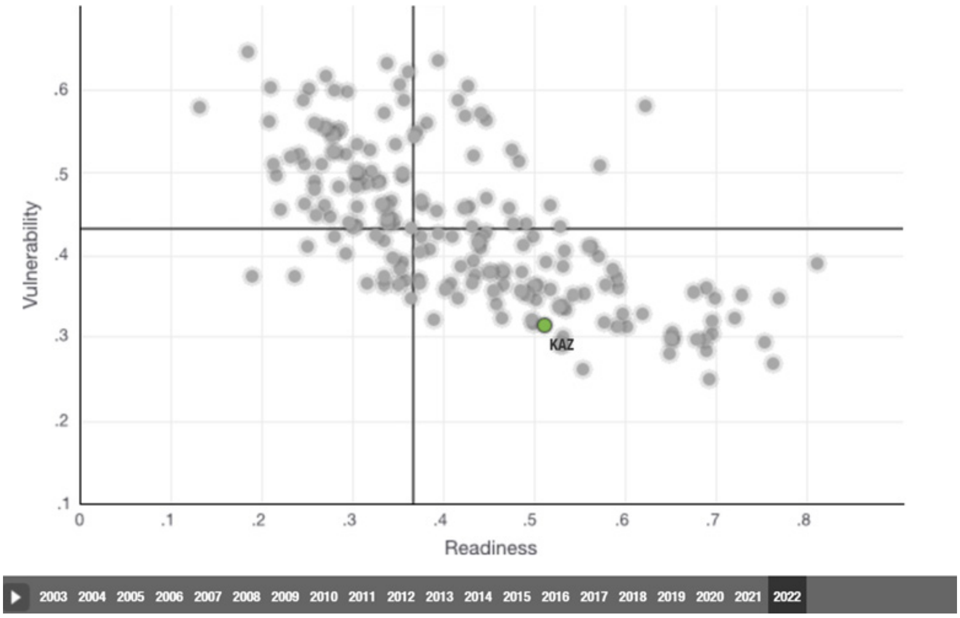
[35] https://www.mediasphera.ru/issues/zhurnal-nevrologii-i-psikhiatrii-im-s-s-korsako va-2/2013/3/031997–72982013319

[36] Springmann, M., Mason-D'Croz, D., Robinson, S., Garnett, T., Godfray, H. C. J., Gollin, D.,. . . Scarborough, P. (2016). Global and regional health effects of future food production under climate change: a modelling study. The Lancet: 387: 1937–1946. DOI: 10.1016/S0140-6736(15)01156-3

[37] https://gain.nd.edu/our-work/country-index/

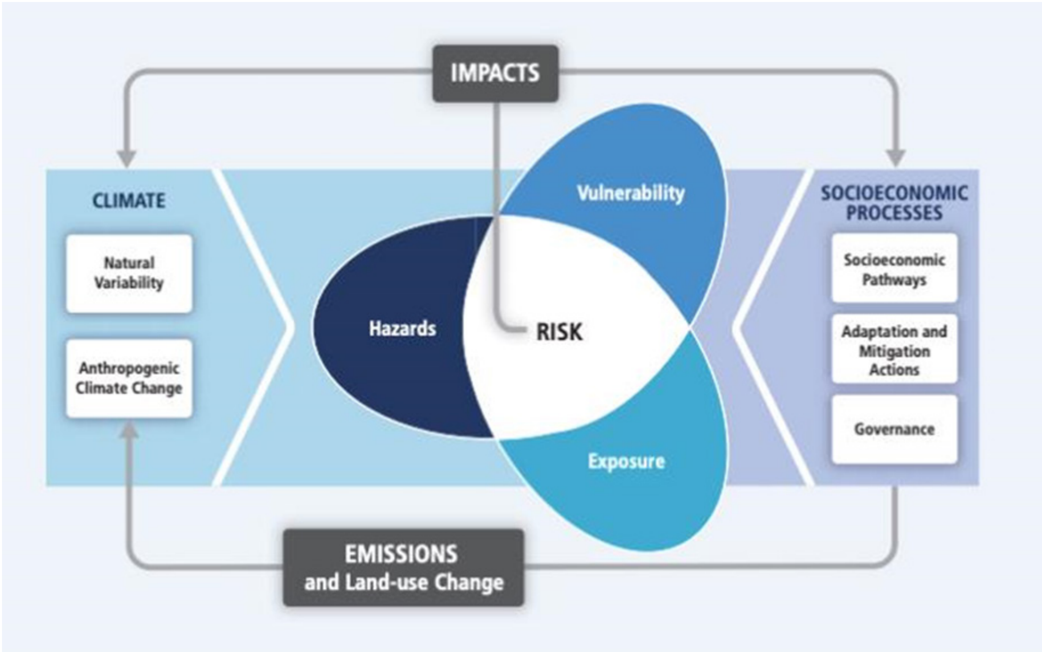
Figure 3.3. ND-GAIN index matrix (Kazakhstan, 2022)[38]



The Climate Risk and Vulnerability Assessment (CRVA) methodology was employed to evaluate risks associated with climate change and identify appropriate adaptation measures. It includes an analysis of key indicators, such as extreme temperatures and droughts, considering their impact on economic sectors.

This methodology provides valuable insights for practitioners and decision-makers by pinpointing the most vulnerable areas, sectors, and social groups. Climate change adaptation options can be developed and implemented in a context-specific manner. Assessing climate change involves many parameters to consider, and the combination of these parameters strongly influences the outcome – Figure 3.4.

Figure 3.4. General scheme of the CRVA methodology[39].



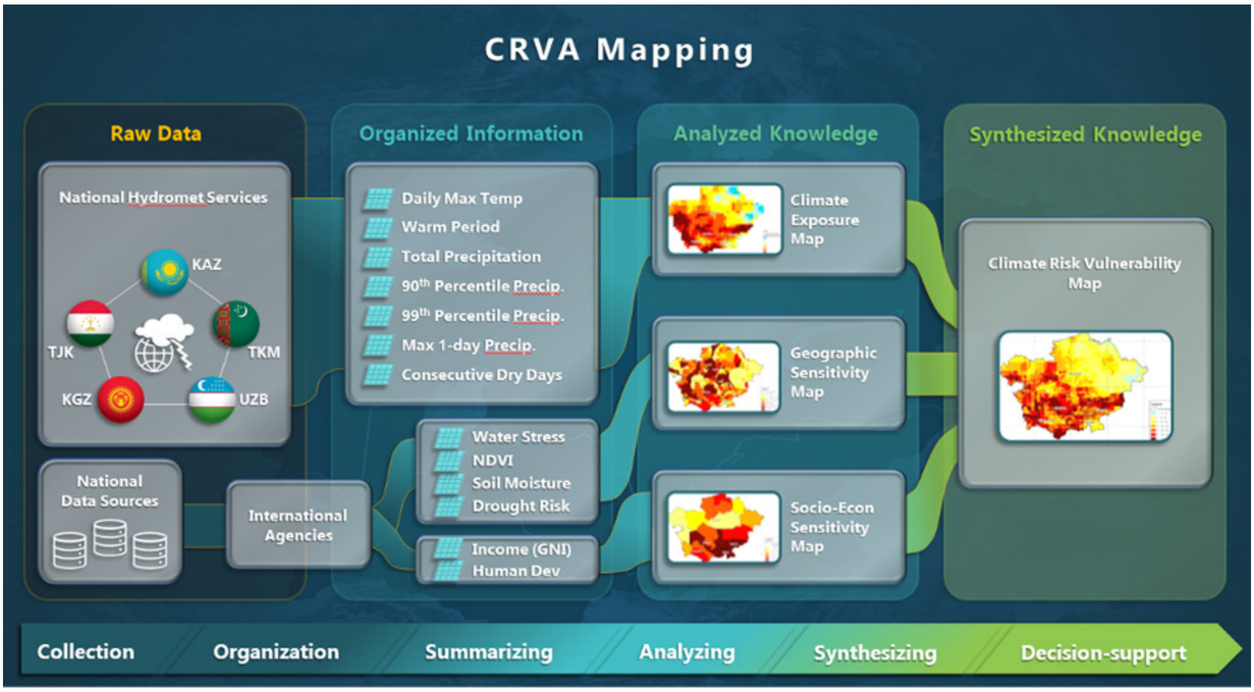
[38] https://gain.nd.edu/our-work/country-index/matrix/
[39] https://crva.centralasiaclimateportal.org/methodology/assessment

Most climate change impacts are driven by several climate indicators that have varying degrees of influence on these changes. Key indicators are those that are most strongly associated with climate impacts. These are mostly not general indicators (such as average temperature and precipitation), but rather indicators related to extreme events. Extreme indicators change more rapidly than average indicators and more accurately illustrate the potential impact of climate change. Therefore, the CRVA methodology uses extreme and estimated indicators (e.g. drought duration, heat wave duration, degree-day summary) – all these data are extracted from daily weather information. Essential climate variables from satellite information on soil cover, land use, soil moisture, humidity, etc. are taken into account based on chain of influence analysis.

A weakness of the methodology is that potential uncertainties are carried over from local level assessments to subnational and national levels, and that mountainous areas contain complex local characteristics that are difficult to account for. The methodology also requires sufficient human and financial resources to carry out the necessary data collection and analysis.

In general, the vulnerability assessment methodology includes data collection, processing, analysis and evaluation – Figure 3.5. A more detailed description of the methodology is given on the CRVA portal[40].

Figure 3.5. General scheme of vulnerability analysis and assessment and spatial presentation[41].



Methodology and uncertainties of water consumption. In order to predict the volume of water consumption, a multivariate regression model of stationary time series estimated using the least squares method was used. The variables selected were the areas of irrigated agricultural lands and the average annual air temperature of the most representative meteorological point in the southern region of Kazakhstan, which accounts for the largest part of the country's irrigated areas. The dependent variable used is the corresponding indicator of the National Statistics Bureau of the Agency for Strategic Development and Reform, reflecting the annual volume of fresh water consumption in agriculture from 2000 to 2019 in million cubic meters.

[40] https://crva.centralasiaclimateportal.org/ru/process
[41] https://crva.centralasiaclimateportal.org/methodology/crva-mapping

The model assumes that the volume of water consumption in agriculture depends linearly on the area of agricultural land where fresh water is used, as well as on air temperature, with an increase (decrease) in which more (less) water is required for irrigation of land.

The period of retrospective evaluation of the model covered 2010–2019, since statistically significant relationships between the dependent and explanatory variables were found during this time period. The forecast period was limited to 2030 due to the availability of official data on the plans of the Government of Kazakhstan related to the expansion of the area of irrigated land.

In addition to methodologies used for climate impact, risks and vulnerability assessment, a FAO methodology was used specifically for assessing economic losses resulting from climate change in agriculture, more specifically on wheat, sunflower and pasture yield sectors. In order to determine the losses, an assessment was made of the volumes of production reduction due to climate change in the sectors of spring wheat, sunflower seeds and pasture yields in Kazakhstan for the compiled forecasts of changes in productivity of the sectors under consideration until 2030 and 2050. The basic logic of the adapted methodology for assessing losses in agricultural sectors from climate change:

- Determining the level of impact of climate change on agricultural productivity based on climate change projections;
- Estimation of agricultural losses due to changes (decreases) in productivity under the influence of climate change based on the compiled forecasts.

The following main assumptions were used in estimating losses:

- The assessment of losses is made at fixed prices on the date, at the prices of agricultural producers;
- Changes in crop yield and changes in harvested area are assumed to be independent;
- The assessment considers only the impact of climate change, but does not consider forecasts and effects of possible changes in production technology and techniques, market conditions, changes in the structure and preferences of product consumption, other environmental, political, demographic, economic or technological factors, etc.

In order to determine economic losses from climate change in the wheat, sunflower and pasture growing sectors in Kazakhstan, a forecast of wheat, sunflower seed and pasture yields under climate conditions up to 2050 was used[42]. The main data from this forecast are used to estimate economic losses under the IPCC RCP 4.5 climate change scenario.

Methodologies and uncertainties in health. There are also a number of methodological uncertainties in health-related research. Although at the moment we can see an increase in the incidence of diseases, the occurrence and exacerbation of which may be associated with climate change, but it is difficult to confirm this relationship, since the development of diseases can also be influenced by living in an environmentally unfavorable area, bad habits, heredity, ignoring existing screening medical programs, remoteness from medical organizations, or, conversely, improving the quality and accessibility of medical care, which allows to increase detection and, consequently, to improve the quality and accessibility of health care, which allows to increase the number of people with disabilities.

[42] Baysholanov S. S. Vulnerability and adaptation of agriculture of the Republic of Kazakhstan to climate change // UNDP – Astana, 2017. – 94 p.

3.C. Adaptation priorities and barriers

3.C.1. Domestic priorities and progress towards those priorities

The "Development strategy of the Republic of Kazakhstan until 2050"[43] is the long-term basis for all state planning documents, including strategic plans of ministries and departments, as well as state development programs. The Government of Kazakhstan recognizes the scale of climate risks and has begun integrating adaptation measures into the strategy to achieve carbon neutrality by 2060[44]. However, advancing implementation of this strategy requires clearer interagency coordination and increased funding. Kazakhstan does not have a specific document dedicated to adaptation and risk reduction related to natural disasters. However, Kazakhstan is increasingly aware of the need to reduce its vulnerability to the effects of climate change.

Although, as mentioned above, the National Adaptation Plan (NAP) of Kazakhstan has not yet been adopted, initiatives are being promoted in Kazakhstan that contribute to the NAP. In particular, according to the Environmental Code and the "Rules for the organization and implementation of the process of adaptation to climate change" (MENR Order)[45], adaptation measures are being developed and integrated into existing programs at both local and national levels.

In Kazakhstan, with the support of UNDP, a draft Roadmap for Adaptation to Climate Change[46] was developed. The roadmap includes strategic actions as well as packages of possible adaptation measures in four priority sectors – agriculture, water and forestry, and civil protection (natural hazards). These sectors have the greatest need for adaptation and have potential to build resilience. The draft Roadmap was sent to MENR for further discussion and coordination with line ministries and organizations. It is expected to serve as a basis for further work. Specific adaptation measures for the four priority sectors as well as for human health and tourism will be included in the NAP, which will be a major step towards implementing adaptation measures.

Two other adaptation related actions include development of a Handbook on Climate Change Adaptation "Simply About Climate Change" that was widely disseminated in 2022 and new project entitled "Integration of climate change adaptation issues into strategic planning in Kazakhstan started in 2024"

The inclusion of climate adaptation measures in strategic planning and programme documents of Kazakhstan is supported by elaboration of a legal framework governing adaptation that outlines competencies at the national and local levels as follows:

- At the national level, climate change adaptation planning is carried out through consideration of climate change impacts and consideration of climate change adaptation measures in relevant state programs on priority areas of public administration for climate change adaptation;
- At the local level, climate change adaptation planning is carried out by local executive bodies of oblasts, cities of republican significance, and the capital by considering climate change impacts and considering climate change adaptation measures as part of the implementation of state environmental policy at the local level.

Following UNEP/FAO recommendations on the application of nature-based solutions (NbS), sectoral and administrative-territorial climate change adaptation planning related to the NDC was supplemented with an ecosystem/basin approach. For Kazakhstan, this approach is particularly important, as water resource management and the preservation of natural ecosystems require cross-sectoral and interregional cooperation.

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43 https://www.akorda.kz/en/official_documents/strategies_and_programs

44 https://unfccc.int/sites/default/files/resource/Carbon_Neutrlaity_Strategy_Kazakhstan_Eng_Oct2024.pdf

45 https://adilet.zan.kz/rus/docs/V2100022974

46 Draft Roadmap for Adaptation to Climate Change https://docs.google.com/document/d/1ynC1PtZFIbAJxzjQxeY_y-TNFwd2Onp0/edit

The basin approach to water resource management also allows for refining objectives and strengthening the interconnections and synergies between sectoral and territorial adaptation programs. In the new draft Water Code, the basin approach was adopted as the foundation for water resource management and water sector adaptation programs. According to this Code, basin-specific climate change adaptation programs will be developed for each of Kazakhstan's eight river basins.

3.C.2. Adaptation challenges and gaps, and barriers to adaptation

There are common adaptation challenges and gaps and barriers to the implementation of adaptation measures across sectors. Key barriers and gaps in advancing adaptation actions and policies include insufficient institutional coordination, limited availability and access to data at the local level, and a lack of funding. These barriers complicate the implementation of adaptation measures, especially in the agriculture and water resource sectors.

Kazakhstan has taken some measures to address these barriers and gaps by institutionalizing climate policy development and coordination, including adaptation measures, but remaining institutional gaps may affect further implementation of adaptation policies. The 2021 Environmental Code identifies the MENR as the central institution responsible for the climate agenda. However, due to the cross-sectoral nature of climate change issues actions thereon require involvement of almost all sectoral ministries, departments and agencies. Because the provisions of the Environmental Code can be widely interpreted by relevant ministries and agencies, an enhanced coordination is required. Although the MENR is responsible for such coordination, it doesn't have the necessary level of authority, resources and capacity to develop and coordinate the implementation of adaptation policies and allocate necessary budget for all stakeholders involved. This is why, despite some progress, coordination of and support for implementation of adaptation policies in Kazakhstan remain limited and results in fragmentation of efforts.

Specific barriers for the water sector, is the poor condition of most of the irrigation systems resulting from insufficient maintenance. This reduces their efficiency and ability to cope with droughts.

Agriculture and forestry have a large number of barriers. These are capacity barriers, barriers related to climate change, as the agricultural extension service system does not provide farmers with knowledge and information on climate risks, technologies and adaptation practices in a systematic manner and at the required scale, which prevents them from adopting climate-adapted farming practices.

There are barriers that are cross-cutting for both agriculture and forestry. These include institutional barriers arising from the lack of coordination between the MoA and "KazHydroMet", and the extension system to promote farm credit. In general, public policy and governance in the agricultural sector does not fully address the objectives of climate risk management and adaptation. The lack of an integrated system for providing farmers with advice, climate information and finance – combined with a lack of clarity on existing government subsidies (e.g. for inputs and equipment) and complex application procedures – prevents farmers from adopting adaptive farming.

Another critical cross-cutting barrier is the insufficient access to targeted financial resources for necessary for the effective assessment and implementation of adaptation measures. Small and medium-sized enterprises (SME) farms lack the capacity and information to assess (i) the climate adaptive technologies best suited to the specific needs of their farms and (ii) the financial implications of related investments (impact on yields and income, payback period). Few credit formats are available for small and medium-sized farms, and they are not adapted to anticipated climate change adaptation investments.

Existing infrastructure and technology need to be modernized. This is especially true in the water and forestry sectors, where innovative solutions are needed to adapt to changing climatic conditions.

Finally, there are cross-cutting information barriers arising from the limited availability of data and methodologies. There is a lack of capacity at the local level to conduct comprehensive risk and vulnerability assessments. This limits the scope for strategic planning and prioritization of adaptation measures. The low level of coordination between different sectors, such as agriculture, water and forestry, as well as difficulties regarding a cross-sectoral approach to adaptation project management, pose additional obstacles to the implementation of measures.

In the sector of disaster risk, early warning and monitoring systems need to be modernized. This is particularly important for responding to natural disasters related to climate change, such as floods, droughts and mudslides. Inter-agency collaboration between different structures remains weak, which slows down decision-making and implementation of disaster risk reduction measures in the context of climate change.

3.D. Adaptation strategies, policies, plans, goals and actions to integrate adaptation into national policies and strategies

3.D.1. Implementation of adaptation actions in accordance with the global goal on adaptation as set out in Article 7, paragraph 1, of the Paris Agreement

Kazakhstan recognizes that along with mitigation, adaptation is a global challenge and a key component of the long-term global response to climate change, that includes efforts and actions of each country to respond to the climate-related risks and vulnerabilities. The country has implemented actions that contribute to the global goal on adaptation as set out in Article 7, paragraph 1 of the Paris Agreement, as outlined in this section.

As part of the implementation of the Strategy for Achieving Carbon Neutrality by 2060 Kazakhstan has undertaken systematic action at both, strategic and legislative levels, and has launched policies and measures on adaptation along with those on mitigation. Another strategic plan is the Action Plan for the implementation of the Concept for the transition of the Republic of Kazakhstan to Green Economy[47]. It is coordinated with the National Strategic Development Plans of the Republic of Kazakhstan and includes measures aimed at the rational use of natural resources with the application of efficient use technologies.

The impacts, risks and vulnerabilities observed in the country are described in the updated NDC[48] of the Republic of Kazakhstan to the global response to climate change. The updated NDC provides information on adaptation actions and economic diversification plans, as well as gender aspects.

The Water Code sets priorities on improvement of international relations on water by strengthening water diplomacy, digitalization, accounting and monitoring of water resources, and introduction of water-saving technologies. It envisages state support in the form of subsidies and reduced tariffs for water supply services depending on the degree of implementation of water saving technologies in agriculture and industry. Separate provisions are included for the protection of wetlands and glaciers.

The Government of Kazakhstan is increasingly engaged in enhancing capacity to close the adaptation gap through bilateral and multilateral adaptation projects that include:

- Disaster and Climate Risk Management Project, World Bank (2010–2016): Developing innovative catastrophe insurance products covering the risks of weather extremes;
- GIZ Regional Project “Ecosystem-based approach to adaptation to climate change in the high mountain regions of Central Asia” (2017–2018): Adaptation to climate change in the high mountain regions;

[47] https://www.fao.org/faolex/results/details/en/c/LEX-FAOC179494/
[48] https://online.zakon.kz/Document/?doc_id=34915732

- Second Irrigation and Drainage Improvement Project, IBRD/ Government of Kazakhstan (2014–2021): Improving irrigation and drainage systems for farmers;
- Supporting Kazakhstan's Transition to a Green Economy Model, EU/UNDP (2015–2018): Promoting environmental governance systems, state-of-the-art water management policies and practices, environmental impact assessment procedures, and economic incentives for sustainable use of water resources;
- Ecosystem-based Adaptation to Climate Change in High Mountainous Regions of Central Asia, GIZ (2015–2019): Introducing ecosystem-based approaches to climate adaptation;
- Sixth Operational Phase of the GEF Small Grants Programme in Kazakhstan, GEF/ UNDP (2016–2022): Building social-ecological resilience in steppe and desert landscapes.

Kazakhstan does not prepare and submit a separate report as Adaptation Communication under the UNFCCC and the Paris Agreement. Instead, it prepares and periodically submits information on adaptation on a regular basis in the relevant chapters of its national communications, the NC8 submitted in 2023 as an example, and in its NDCs.

As mentioned already, Kazakhstan launched in 2024 preparation of a NAP under a project by the MENR and UNDP with financial support from the GCF.

3.D.2. Adaptation goals, actions, objectives, undertakings, efforts, plans (e.g. national adaptation plans and subnational plans), strategies, policies, priorities, programmes and efforts to build resilience

In Kazakhstan, a number of measures are being implemented in priority adaptation sectors – agriculture, water management, forestry, disaster risk, healthcare and tourism. The key measures are outlined in this section below.

Key adaptation priorities in agriculture include implementation of more efficient farming practices and methods, such as minimum and no-till farming ("water conservation practices"), diversification into drought-tolerant wheat varieties, switching to more resilient non-wheat crops (e.g. sunflower and other seeds) and snow retention. These actions also include precision farming methods such as laser leveling, precision seeding, automated soil nutrient management systems, satellite monitoring of crop growth and crop nutrients, optimized use of fertilizers, and digital land management. These methods usually result in increased productivity, which at least partially compensates for the decrease in yield in a dry year. Implementation of these methods requires investment in new equipment (direct seeding machines, sprayers, rippers, snow blowers, etc.), knowledge and training. This is particularly relevant for minimum-till and no-till farming, which requires farm-specific organizational changes and assistance due to the complexity of these methods compared to traditional ones and the time required for farmers to master the technology[49].

Measures already partially implemented in the agricultural sector include crop diversification, a gradual phase-out of water-intensive crops, the adoption of water-saving technologies, the modernization of irrigation systems and related infrastructure based on scenario assessments of river runoff changes and redistribution, the transition to modern organic farming, and more efficient soil management to maintain carbon sequestration. Additional actions include modifying animal feed to reduce methane emissions from livestock, preventing overgrazing, and ensuring sustainable management and protection of pastures. Another planned measure is the implementation of agro-climatic zoning across the country, taking into account observed changes in conditions for growing crops.

In water management, the main priorities for adaptation action are related to water conservation to mitigate the growing water deficit (up to 50% by 2030), upgrading infrastructure to prevent and alleviate increasing risks of floods and droughts,

[49] World Bank (February 2016). *Kazakhstan: Agricultural Sector Risk Assessment, p. 97.*

improving transboundary water cooperation, and changing water management practices to consider the role of aquatic and water-related ecosystems in shaping and regulating water flows that support precipitation, river and lake renewal, and other processes.

In particular, to improve water resource management and water use while ensuring stable water supply, Kazakhstan is implementing basin management and the principles of Integrated Water Resources Management (IWRM). The country has initiated projects to expand wastewater treatment coverage in urban areas, reduce water losses in supply networks, construct reservoirs and retention basins for collecting excess precipitation, modernize and reconstruct water supply systems and hydraulic structures, adopt advanced irrigation methods and modern water-saving technologies, promote the use of drip irrigation, and enhance water use efficiency in industry. Efforts also include transitioning to less water-intensive crops in agriculture.

Frameworks to incentivize the adoption of water-saving technologies in industry, agriculture, and the residential sector will also be improved.

There are a number of areas in forestry that require increased attention with regards to adaptation. These areas include prevention and control of forest fires, illegal logging, control over the appointment of forest protection measures.

Sustainable forest development principle (constant increase in forest cover) is enshrined in the forest legislation of the Republic of Kazakhstan. The Forest Code in particular, includes measures to prevent forest fires, their timely detection and suppression, ban on burning of grassy vegetation on all categories of land. There is one exception from this ban, namely controlled burning on the territory of the forest fund and adjacent territories, carried out by forest owners in order to reduce the fire hazard risks. Increasing the forest cover of water bodies' catchment areas is planned as one of the measures to reduce the shortage of water resources.

Where necessary, local authorities restrict visits of individuals to forests and entry of vehicles into them, as well as certain types of work on the territory of the state forest fund for the period of high fire risks. The regional authorities approve and coordinate with the MENR comprehensive plans for forest reproduction and reforestation.

Kazakhstan has committed to restoring at least 1.5 million hectares of degraded land through afforestation and reforestation by 2030 as part of the Bonn Challenge.

To increase forest cover during the 2022–2030 period, the Government plans to enhance the support framework to incentivize the establishment of private industrial plantations and forest nurseries, as well as to implement pilot projects in this area through public-private partnerships. Additional measures to protect forests are also planned.

In 2020, the National Action Plan for the implementation of the Address of the Head of State to the People of Kazakhstan on September 1, 2020, titled "Kazakhstan in a New Reality: Time for Action," was adopted. According to the Plan, over two billion trees must be planted in forest reserves and 15 million trees in settlements within five years, aligning with the goals of the Bonn Challenge.

The activities are carried out in accordance with scientific recommendations and forestry requirements, taking into account the existing risks and zoning context[50].

Climate change will negatively impact agriculture, water resources, ecosystems, and public health in Kazakhstan. However, the anticipated increase in the frequency of natural disasters and emergencies, in addition to slow-onset events, will require mobilizing governmental responses and strengthening the disaster risk reduction component in the planning and implementation of adaptation measures.

Since Kazakhstan adopted the Sendai Framework for Disaster Risk Reduction (2015–2030)[51], progress has been made in implementing activities aligned with the Framework's four priorities. The legislative and institutional framework related to disaster risk

[50] https://www.gov.kz/memleket/entities/forest/activities/59355?lang=ru&parentId=55254, Forestry Committee
[51] Global Network of Civil Society Organisations for Disaster Reduction https://www.gndr.org/images/newsite/PDFs/SFDRR-ru.pdf

reduction enables the comprehensive integration of climate change adaptation and risk management at both national and subnational levels. This process includes engaging stakeholders such as vulnerable communities and youth, incorporating gender considerations, and expanding regional cooperation through the Center for Emergency Situations and Disaster Risk Reduction[52], established in Almaty in 2016, which serves Kazakhstan and Kyrgyzstan.

3.D.3. Best available science, gender perspective and indigenous, traditional and local knowledge that are integrated into adaptation

The Strategy "Kazakhstan-2050" calls for the modernization of the country's agricultural, taking into account the latest methods in science, technology and management. It also provides for an increase in the share of SME in GDP from 26% to 50%, since such increase is considered as a way to help strengthen the economy, create jobs and develop the country's innovative and adaptive potential.

Consideration of gender perspectives in climate change mitigation and adaptation policies and actions is deemed essential in Kazakhstan at both, national and subnational levels. It is well understood that effectiveness of climate change policies depends on the extent to which laws, programs, and projects consider the interests of men and women, as well as the extent to which they are represented at decision-making levels. Gender policy in Kazakhstan is integrated with social policy. Based on this, an assessment was made of the degree of gender accounting in documents that directly or indirectly deal with climate change issues using the following criteria: no reference to gender, gender is recognized and accounting for gender.

Table 3.2. below list laws, policies, strategies, plans and guidelines on climate change, environment, gender, agriculture, forestry and energy issues and assessment of the extent to which climate change and gender considerations are integrated into policies and implementation processes.

Table 3.2. Key policy documents relevant to climate change and gender consideration

Level of gender accounting		
Gender is recognized	Gender is accounted	No reference to gender
Environmental Code of the Republic of Kazakhstan dated January 2, 2021 No. 400-VI Law of the Republic of Kazakhstan.	Forecast scheme of territorial-spatial development of the country until 2030[53].	Rules for organizing and implementing the process of adaptation to climate change.
Resolution of the Government of the Republic of Kazakhstan No. 759 of September 18, 2024, signed by Prime Minister Bektenov "On approval of the Action Plan of the Government of the Republic of Kazakhstan to ensure equal rights and opportunities for men and women for 2024–2027."	–	State program for regional development for 2020–2025, Resolution of the Government of the Republic of Kazakhstan dated December 27, 2019 No. 990.

[52] https://cesdrr.org/en
[53] https://adilet.zan.kz/rus/docs/P1900000625

Level of gender accounting		
Gender is recognized	Gender is accounted	No reference to gender
–	–	Strategic plan of the Ministry of Agriculture of the Republic of Kazakhstan for 2020–2024, No. 476 dated 31.12.2019[54] .
–	–	Strategic plan of the Ministry of Ecology, Geology and Natural Resources of the Republic of Kazakhstan for 2020–2024[55]
–	–	Strategic plan of the Ministry of Energy of the Republic of Kazakhstan No. 445 dated December 31, 2019
–	–	Forest Code, dated July 2003, No.477
–	–	Water Code, dated July, 2003, No.481

Overall, consideration of gender aspects in Kazakhstan's climate policy remains limited, which in turn provides for limited women's participation in the development and implementation of adaptation measures. Enhancing gender integration by providing equal opportunities for women and men in decision-making is considered among the most important area where improvement is needed. The role of women in adapting agricultural practices to climate change, participating in decision-making processes, planning and implementing projects to raise awareness and promote behavioral changes toward more responsible use of water and energy, understanding climate risks, and addressing other identified challenges will be reflected in relevant state programs in priority areas for climate change adaptation at the national and local levels.

3.D.4. Development priorities related to climate change adaptation and impacts

In relation to adaptation, Kazakhstan's state priorities encompass transition to a sustainable economy, ensuring food security and the development of green technologies, as well as promoting adaptation in various key sectors, such as water management, agriculture, forestry, disaster risk reduction, health care and tourism. These priorities are enshrined in national strategies such as the "Kazakhstan – 2050" Strategy, which calls for the modernization of the country's agricultural sector, taking into account the latest methods in science, technology and management. Also, priorities related to climate change adaptation and its impacts include the Strategy for Achieving Carbon Neutrality by 2060 and the Environmental Code of the Republic of Kazakhstan.

[54] https://www.gov.kz/memleket/entities/moa/documents/details/123797?lang=ru
[55] https://www.gov.kz/memleket/entities/ecogeo/documents/details/54833?lang=ru

3.D.5. Adaptation actions and/or economic diversification plans leading to mitigation co-benefits

Investments in a number of adaptation actions are known to generate co-benefits. Through adaptation, economic losses resulting from climate change can be reduced not only in agriculture, but also through the supply chain to related industries.

Agriculture and forestry are the sectors where such co-benefits are most significant. Climate change adaptation measures in these sectors can not only increase their resilience, but also play a key role in reducing GHG emissions by enhancing carbon removal. In agriculture, adaptation measures such as introduction of drought-tolerant crops, precision farming methods, and minimum and no-tillage practices, help to reduce CH_4 and N_2O emissions compared to the traditional farming practices. For example, conservation agriculture practices such as crop rotation and intercropping improve soil fertility and carbon sequestration, which reduces soil degradation and CO_2 emissions into the atmosphere.

In forestry, an important adaptation measure is the expansion of forest areas and reforestation, which helps increase the capacity of ecosystems to absorb CO_2 emissions. Increasing forest cover, especially in watersheds, helps reduce soil erosion and improves ecosystem services such as water regulation, which are important for climate change mitigation. In addition, adaptation measures in forests, such as reducing risks from forest fire and restoration of degraded forests helps maintain biodiversity and carbon removal. Thus, adaptation in agriculture and forestry in Kazakhstan not only protects these sectors from climate risks, but also contributes to global efforts to reduce GHG emissions and improve natural carbon removals, playing an important role in addressing climate change.

Other adaptation measures in agriculture, such as innovative farming methods, including precision farming systems and water-saving technologies in combination with expanding the area of irrigated land, water harvesting and creating water-saving infrastructure are critical in contexts where water is scarce. Efforts to integrate climate change into development efforts, plans, policies, programmes, including related capacity building activities are outlined in sections 3.D.1 to 3.D.4. Nature-based solutions to climate change adaptation are addressed in section 3.D.1 and stakeholders involvement is covered in sections 3.D.1 to 3.D.4.

3.E. Progress on implementation of adaptation

3.E.1. Implementation of the adaptation actions

Kazakhstan recognizes the importance of reducing the country's vulnerability to climate change and has initiated the development of measures and policies to adapt to climate change. Kazakhstan is currently aligning its commitments with the goals set out in the Paris Agreement, in particular the global goal on adaptation[56].

Since 2017, UNDP has been involved in multi-year projects to promote national adaptation plans with financial support from the Green Climate Fund Readiness Programme. The information provided in sections 3.D.1 to 3.D.5 showcase the ongoing efforts by Kazakhstan to promote the implementation of adaptation. The country is now transitioning to more systematic and integrated adaptation planning and implementation through the project "Institutionalization of adaptation planning and integration of climate risks into development planning processes of Kazakhstan to ensure the implementation of adaptation measures within the framework of a consistent national adaptation planning policy", for the period of 2024–2030. This project envisages a transition from planning individual actions, policies and measures to a holistic and inclusive planning process that covers all vulnerable sectors, and includes establishment of a robust monitoring and evaluation system.

In 2020, the Government of the Republic of Kazakhstan adopted Resolution No. 479 "On the

[56] https://www.undp.org/ru/kazakhstan/press-releases/pravitelstvo-kazakhstana-i-proon-zapuskayut-proekt-po-predostavleniyu-klimaticheskoy-otchetnosti-v-ramkakh-ramochnoy

Approval of the Action Plan for the Implementation of the Concept for Kazakhstan's Transition to a 'Green Economy' for 2021–2030," which aligns with the NDC. The Action Plan for 2021–2030 includes a set of measures related to climate change adaptation, particularly in reducing water use intensity, transforming agriculture, improving energy efficiency, modernizing housing and communal services, developing sustainable transport, preserving ecosystems, and increasing forest cover.

The implementation of the 2021–2030 Action Plan is coordinated by the MENR. A permanent coordination mechanism for integrating adaptation policies and measures into sectoral and territorial policies will follow the channels of the existing government coordination framework, linking MENR with other ministries responsible for national planning, finance and development, agriculture, forestry, energy, health, science, and education.

3.E.2. Integrating adaptation into national plans and strategies

Kazakhstan has taken steps to formulate, implement, publish and update the national plans, programmes, strategies and measures. It has also taken steps towards integrating adaptation into relevant aspects of the national plans and strategies as outlined in this section.

Adoption of measures for formulating and updating national and regional programs, strategies and measures: The Water Code of the Republic of Kazakhstan as of July 9, 2003 No. 481 recognizes climate change and envisages appropriate measures. The new Water Code that is currently under consideration envisages a separate chapter on adaptation to climate change. A priority area for implementation of adaptation action is improving interstate water relations by strengthening water diplomacy, digitalization, accounting and monitoring of water resources, as well as the introduction of water-saving technologies[57].

The assessment of vulnerability to climate change in priority areas at the national level is organized by authorities with competencies in the areas of agriculture, water management, forestry and disaster risk. This assessment provides the basis for further planning of adaptation and integration measures in accordance with the following principles:

Mandatory inclusion of climate change impacts assessment in medium-term and long-term plans for socio-economic development;

Phased implementation of the process of adaptation to climate change, starting with priority areas;

Cross-cutting approach to climate change adaptation by the local executive authorities that cover all the priority areas specified above;

The assessment of vulnerability to climate change at the local level is organized by the local executive authorities of regions, cities of republican significance and the capital in areas that are priority areas for climate change adaptation. Accordingly, climate change adaptation planning is carried out by the local executive authorities taking into account climate change impacts and vulnerability, and considering climate change adaptation measures as part of the implementation of state environmental policy at the local level.

Implementation of adaptation measures from previous NC: The NC8 outlines possible climate change scenarios with corresponding adaptation measures for agriculture, water management, health, ecosystem protection and socio-economic development, and such measures have now been incorporated into national policies and enabled by a legislative framework. Specific adaptation measures are being implemented mostly through projects including projects on reforestation and the adoption of water-saving technologies. Satellite monitoring is also being utilized to assess agricultural and natural resource conditions to enhance their resilience.

[57] https://kapital.kz/gosudarstvo/95535/v-kazakhstane-nachali-razrabatyvat-novyy-vodnyy-kodeks.html

Implementation of adaptation actions specified in the NDC adaptation component: Kazakhstan's updated NDC that was submitted in 2023 emphasizes the importance of an ecosystem-based approach, which has been incorporated into water resource management and adaptation measures. Basin-specific adaptation programs are planned for each river basin in the country. The NDC also envisaged establishing information and training centers on climate change adaptation using the potential of existing non-governmental organisations, schools, farms and others.

Coordination activities and changes in policy regulation: Since 2020, Kazakhstan has introduced legislative changes to enable coordination of adaptation measures, including a dedicated chapter on adaptation in the Environmental Code. Coordination among ministries has improved through the implementation of adaptation rules, but institutional and resource constraints continue to slow progress.

3.E.3. Key achievements and results

Within the framework of the GIZ Regional Project "Ecosystem-based approach to adaptation to climate change in the high mountain regions of Central Asia" (2017–2018), support was provided to the Ministry of Energy and the regional authority of the East Kazakhstan Region in developing a Regional Adaptation Plan as a basis for adaptation planning processes at the national level with further vertical integration into the structure of the National Adaptation Plan. The implementation of this project has led to three main lessons:

- Although the existing information on climate change scenarios is limited, it is sufficient to conduct risk and vulnerability assessments on local level.
- There is a need to build capacity to conduct risk and vulnerability assessments for climate change adaptation at the regional level.
- The allocation of financial resources from the budget is crucial to ensure the implementation of any type of planning and implementation of measures for adaptation to climate change.

One of the results from this and other projects is that the climate change impact on traditional agro-technologies and decrease in the share of rural population due to urbanization became threats to the development of agro-industrial complex of Kazakhstan[58].

Another result is that the level of risk insurance in the agro-industrial complex is gradually increasing. Today, the state supports farmers by subsidizing rates on 16 insurance products in crop and livestock farming[59]. This concerns grain, leguminous and oil crops, apple trees, cattle, small cattle, horses, birds, etc[60]. Possibility of expanding the types of insurance with regards to these risks is currently explored.

The Action Plan for the implementation of the Concept for the Development of the Agro-Industrial Complex of the Republic of Kazakhstan for 2021–2030[61] and the Concept for the Development of the AIC of the Republic of Kazakhstan provide for several measures that contribute to adaptation to climate change such as the introduction of water-saving technologies, improved land management, development of sustainable agricultural practices, improvement of infrastructure, etc.

The state forest fund of the country is now controlled through satellite on a permanent basis. Relevant data and images of forest areas subjected to fires are provided by JSC "Kazakhstan Gharysh Sapary". Satellite monitoring results for 2022 showed that:

- In the territories of the state forest fund there are 150 illegal logging sites and 139,234 hectares of burnt areas have been digitized;

[58] Concept for the development of the agro-industrial complex of the Republic of Kazakhstan for 2021–2030, Resolution of the Government of the Republic of Kazakhstan dated 30.12. 2021 No. 960.
[59] https://primeminister.kz/ru/news/vozmozhnost-strakhovaniya-posevov-ot-saygakov-i-saranchi-rassmotryat-v-kazakhstane-28634
[60] https://primeminister.kz/ru/news/vozmozhnost-strakhovaniya-posevov-ot-saygakov-i-saranchi-rassmotryat-v-kazakhstane-28634
[61] Resolution of the Government of the Republic of Kazakhstan dated 28.02.2024 No. 132.

- 2.45 million hectares of burnt areas of forest-steppe fires throughout the territory of Kazakhstan have been digitized[62][68].

To implement public control over forest activities, the MENR, together with "Kazakhstan Gharysh Sapary", has developed an interactive map showing the progress in planting seedlings.

To improve the environmental situation, along with forest reproduction, reclamation works are carried out on the dried Aral Sea bed. In 2021, saxaul was planted on 101 thousand hectares and on 250 thousand hectares in 2022.

3.F. Monitoring and evaluation of adaptation actions and processes

Given the high importance of adaptation as a response to climate change, Kazakhstan is working on the development and practical implementation of a comprehensive Monitoring and evaluation (M&E) system. The implementation of M&E system using relevant indicators is expected to enable a comprehensive assessment of how progress is being made on adaptation, which in turn will allow to achieve the highest efficiency of adaptation action at the national and sectoral levels.

Related to adaptation M&E is the monitoring and reporting system for the implementation of the Action Plan for the implementation of the Concept of the transition of the Republic of Kazakhstan to Green Economy that was established by Resolution of the Government of the Republic of Kazakhstan No. 479 dated July 29, 2020.

A similar arrangement will be created to monitor the implementation of the Roadmap for the implementation of the National Center for Vulnerability in Kazakhstan. A system is planned to monitor the implementation of the Roadmap for the implementation of the updated NDC, once the Roadmap is adopted. As part of the evaluation of the Roadmap implementation, a review is envisaged every five years to adjust planning by including further measures. The progress in implementation will be assessed using a set of sector-specific indicators. In addition to the annual reports submitted by government bodies, scientific data will be used wherever possible for the purposes of this assessment.

Currently, M&E actions are taken on the basis of specific projects, such as "Improving the climate resilience of grain farming in Northern Kazakhstan", "Sustainable food systems and improved ecosystems service", "Institutionalization of adaptation planning and integration of climate risks into development planning processes in Kazakhstan to ensure the implementation of adaptation measures within the framework of a consistent national adaptation planning policy"[63], "Climate reporting project" and "Indicators of the climate change adaptation plan using the example of the Balkhash-Alakol basin".

The results and lessons learned from M&E of individual adaptation projects provide a good basis for further scaling up of project results to the national level and will facilitate the development and implementation of a national M&E evaluation system.

3.G. Information related to averting, minimizing and addressing loss and damage associated with climate change impacts.

Some relevant information on loss and damage is provided in Section B. "Impacts, risks and vulnerabilities, where relevant." The basic idea is that climate change will increase the vulnerability of national development, food security and the natural environment in such a way that adaptation limits will be reached and it will be impossible to cope with the consequences through adaptation.

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[62] https://bitrix.gharysh.kz/docs/pub/5c33f1e55b2df82f3f75aad9be90a406/default/?& Annual report for 2022 JSC "NC "Kazakhstan Garysh Sapary"
[63] https://www.gov.kz/memleket/entities/ecogeo/press/news/details/805843?lang=ru

For example, the water shortage problem will be exacerbated by a combination of low rainfall and extreme summer temperatures, as well as melting glaciers, increasing flood risks in the southern and eastern regions in the medium term and threatening water availability by mid-century. This subsection describes only the damages associated with climate change impacts.

In 2024, Kazakhstan faced some of the most devastating high waters in decades, which particularly affected the northern and western regions of the country. Flooding caused by rapid snowmelt and heavy rains damaged both infrastructure and the population (Figure 3.6).

More than 119,000 people were evacuated from the affected areas, including children and pets. Thousands of homes, as well as social and transport infrastructure, were damaged or destroyed. In total, 12,086 residential buildings and 7,380 summer cottages, which were the only housing for the victims, were flooded[64]. For example, in regions such as Akmola, Kostanay, East Kazakhstan and North Kazakhstan regions, significant areas of agricultural land were flooded[65,66].

The economic damage from the floods is estimated at approximately KZT 300 billion (about USD480 million)[1]. The floods also destroyed grain storage facilities and flooded areas intended for sowing, which could negatively impact the agricultural sector.

In addition, the floods caused damage to water and electricity supplies, especially in the North Kazakhstan region, where the main waterway supplying Petropavlovsk was polluted.

Agriculture is also suffering losses and damages associated with climate change. According to UNDP[67], economic losses in wheat yields are estimated at 33% (or KZT 457 billion in 2019 prices) of the current potential by 2030 and 12% (KZT 608 billion in 2019 prices) by 2050.

Figure 3.6. Flooded Petropavlovsk[68].

64 https://www.zakon.kz/obshestvo/6439260-pavodki-v-kazakhstane-predvaritelnyy-razmer-ushcherba-ozvuchili-v-pravitelstve.html
65 https://www.acaps.org/fileadmin/Data_Product/Main_media/20240423_ACAPS_briefing_note_Kazakhstan_floods.pdf
66 https://www.gov.kz/memleket/entities/moa/press/news/details/743854?lang=ru
67 https://www.undp.org/ru/kazakhstan/stories/kazakhstan-mozhet-ponesti-ekonomicheskie-ubytki-v-proizvodstve-pshenicy-iz-za-izmeneniya-klimata
68 https://vlast.kz/fotoreportazh/60074-kak-topilo-kazahstan.html

Regarding extreme events and associated natural disasters, the Republic of Kazakhstan is significantly exposed to natural disasters associated with climate and weather conditions. In the western part of the country, in the coastal areas of the Caspian Sea, economic activity can be damaged by storm surges; in the central part of the country, floods on lowland rivers pose a significant danger in the spring; and in the eastern and southeastern mountainous areas of the country, virtually all types of natural disasters occur, such as earthquakes, landslides, mudflows, avalanches, floods, hurricane winds, hail, heavy rainfall, etc[69].

To date there is no single database of recorded natural disasters indicating the physical characteristics and extent of the socio-economic damage caused. The highest number of victims and deaths was recorded in 2017. There is a tendency towards increasing expenditures directed towards eliminating emergency situations[70].

Further information on the impact of extreme weather events is presented in Section B. "Impacts, risks and vulnerabilities, where relevant."

3.H. Cooperation, good practices, experience and lessons learned

Adaptation is a new area for climate policy development and implementation in Kazakhstan, and the country attaches importance to strengthening international cooperation to enhance its adaptation capacity and learn from the experiences of other countries. The areas of cooperation mainly cover exchange of information and data sharing, including on methodologies related to climate and climate-related events by the "KazHydroMet".

At present, the exchange of information and methodological approaches is of great importance to overcome gaps and barriers in the development of NAP. Work on NAP development is well under way as the MENR and UNDP Kazakhstan are leading such development under a relevant project that was launched in 2024. Also, in 2019 a regional seminar on the development of experience and methodology for the development of NAP was held in Astana, organized by the Ministry of Energy of the Republic of Kazakhstan with the support of GIZ and the NAP Global Network.

Another area of co-operation is on ensuring the safety of navigation and other activities in the waters and coast of the Caspian Sea, which depend on changes in weather and climate. This includes cooperation with the following entities:

- Member countries of the Interstate Council on Hydrometeorology of the CIS countries[71];
- The Caspian countries within the framework of the Coordinating Committee for Hydrometeorology and Pollution Monitoring of the Caspian Sea (CASPCOM)[72];
- Within the framework of meetings, conferences, and seminars held by the World Meteorological Organization in the RAII (Asia) and RAVI (Europe) Regions[73].

As a representative of the Republic of Kazakhstan to the World Meteorological Organization, "KazHydroMet" takes part in all its programmes and projects relating to meteorology, climatology and hydrology. "KazHydroMet"engages in cooperative activities with other countries and organisations through bilateral and multilateral agreements, memorandums, cooperation programs and protocols.

The main areas of cooperative activities by "KazHydroMet" include:

- Cooperation within the framework of international organizations and conventions;
- Cooperation within the WMO;
- Cooperation on Caspian Sea issues, including the Coordinating Committee on Hydrometeorology and Pollution Monitoring of the Caspian Sea (CASPCOM);

[69] Kozhakhmetov P.Zh., Nikiforova L. N. // Weather elements in Kazakhstan in the context of global climate change. – Astana, 2016. – 36 p.

[70] Original source: local executive bodies: https://stat.gov.kz/official/industry/157/statistic/7

[71] https://e-cis.info/cooperation/3212/77770/

[72] http://www.caspcom.com/

[73] https://public.wmo.int/ru/%D0%BE-%D0%BD%D0%B0%D1%81/%D1%87%D0%BB%D0%B5%D0%BD%D1%8B

- Multilateral cooperation within the framework of the Interstate Council on Hydrometeorology of the Commonwealth of Independent States (Interstate Council on Hydrometeorology of the CIS countries);
- Cooperation with the European Meteorological Satellite Agency (EUMETSAT);
- Cooperation with the Central Asia Regional Ecology Center (CAREC), ECMWF (the European Centre for Medium-Range Weather Forecasts), USAID and the World Bank;
- Participation in the activities of other international organizations and conventions.

Kazakhstan is the leader among the countries from Central Asia in terms of the scale of attracted international climate financing and in this regard it cooperates with a number of organizations, such as:

- United Nations Development Programme (UNDP);
- Food and Agriculture Organization of the United Nations (FAO);
- Central Asia Regional Ecology Center (CAREC);
- German Development Cooperation Agency (GIZ);
- United Nations Economic Commission for Europe (UNECE);
- World Bank (WB), other regional banks;
- International Fund for Aral Sea Saving (IFAS) and others.

"KazHydroMet" also participates in GOS (Global Observing System), which is one of the main WMO programmes aimed at coordinating and integrating meteorological data from different parts of the world. "KazHydroMet" contributes to GOS by providing data on weather and climate conditions in the country, including meteorological, hydrological and climate data that help the global observing system better track climate change.

In addition, "KazHydroMet" is a member of the CIS Interstate Council on Hydrometeorology, to solve problems of timely receipt and use of hydrometeorological information.

Kazakhstan is involved in a number of regional adaptation-related initiatives, projects and cooperation strategies with countries in the region, namely Azerbaijan, Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan, including:

- Regional Climate Change Adaptation Strategy (RCCAS)
- Coordinating Committee for Hydrometeorology of the Caspian Sea
- International Fund for Aral Sea Saving (IFAS),
- Cooperation with Central Asia Regional Ecology Center (CAREC),
- Agreements and Cooperation Programs with the countries of Central Asia;

At the 28th Conference of the Parties to the UN Framework Convention on Climate Change in 2023 (COP28) in Dubai, the governments of Kyrgyzstan, Kazakhstan, Tajikistan, Turkmenistan and Uzbekistan presented and adopted the Regional Climate Change Adaptation Strategy (RCCAS), developed through a high-level policy dialogue process in cooperation with the GIZ Green Central Asia (GCA) initiative.

Until an implementation plan for this strategy is developed and approved, the "Regional Action Plan for Joint Policy Dialogue on Climate, Environment and Security" ("Green Central Asia") will be used as the initial action plan for implementing the strategy. This plan identifies stakeholders and partners at the national level and sets out timelines for the adoption of various measures up to 2025. A number of partnerships on a bilateral basis have been established by Kazakhstan with key donors and international development institutions. In particular, Kazakhstan is engaged in cooperation partnership with the UNDP, the US Agency for International Development – USAID, the Japan International Cooperation Agency – JICA, German Development Cooperation Agency – GIZ, the Korean International Cooperation Agency – KOICA, the Slovak Agency for International Development – SlovakAID, and the Czech International Development Agency – CzD A.

Kazakhstan is also engaged in cooperation on a bilateral basis with the other countries from Central Asia and other countries from Asia and Europe, such as Azerbaijan, Austria, Belarus, China, Germany, Kyrgyzstan, Russia, Slovakia, Switzerland, Tajikistan, Turkmenistan, Uzbekistan, Finland, Turkey and Ukraine.

Within the framework of multilateral and bilateral international cooperation, Kazakhstan continues to develop and strengthen its ties with global programmes and initiatives aimed at adapting to climate change. This allows Kazakhstan to move towards strengthening adaptation policies, build human and institutional capacity, and acquire necessary knowledge and technologies to effectively respond to the challenges of climate change. Altogether, this helps to advance of policies and practices aimed at minimizing climate risks and increasing the resilience of key economic sectors.

3.I. Any other information related to climate change impacts and adaptation under Article 7 of the Paris Agreement

Table 3.3. provides summary of vulnerability and adaptation for priority sectors in Kazakhstan.

Table 3.3. Summary of information on vulnerability and adaptation to climate change provided by Kazakhstan.

Vulnerability	Examples/comments/adaptation measures reported
Agriculture	Vulnerability: Projected higher temperatures, coupled with increased irrigated agricultural land, could significantly increase water demand from 16,366 million m3 in 2020 to 41,575 million m3 in 2030. Economic losses in wheat yield and livestock productivity are estimated at 33 and 10 percent, respectively, by 2030 and 12 and 15 percent, respectively, by 2050. In contrast, climate warming could have a positive impact on sunflower seed yields, with production increasing by 8 percent by 2030 and by about 4 percent by 2050. Adaptation: Increased adoption of water-saving technologies and the shift to drought-tolerant crops are key factors in achieving water efficiency in the country.
Water resources	Vulnerability: Model results showed that runoff is expected to decline by the end of the twenty-first century in almost all watersheds. Impacts on water availability could be exacerbated by expected increases in water use due to the projected expansion of irrigated agricultural land by 2030 and higher average annual temperatures. Adaptation: Potential water shortages projected by climate modelling should be taken into account in the projected expansion of irrigated agricultural land, particularly for rivers in lowland and mountainous areas.
Forestry	Vulnerability: Climate change increases the risk of wildfires, reducing their ability to absorb carbon and support biodiversity. For example, in 2022, more than 800 fires were recorded, covering 104,000 hectares. Adaptation: Forest areas are expanding, fires are being fought.
Disaster risk	Vulnerability: Extreme weather events such as floods, droughts and landslides are becoming more intense. The 2024 floods caused USD480 million in damage, and landslides in mountainous areas pose a significant risk to communities. Adaptation: Early warning and monitoring systems are being upgraded.

Vulnerability	Examples/comments/adaptation measures reported
Healthcare	Vulnerability: Climate change-related health conditions include injuries, poisonings and accidents, cardiovascular diseases, respiratory diseases, infectious diseases and mental illness. Diseases that are potentially influenced by climate factors and that may occur more frequently and be worsened by climate change have been difficult to confirm such a link due to other non-climatic factors. Adaptation: The findings from the impact assessment are probabilistic and require further investigation and confirmation. For a more reliable assessment and identification of trends, at least five years of monthly climate and morbidity and mortality data are needed.
Tourism	Vulnerability: The tourism industry is likely to be affected by changes in the characteristics, timing and length of seasons, which could harm as well as benefit tourism. Unseasonal weather and extreme weather events can indirectly impact the industry through damage to infrastructure, which will have the greatest impact on activities more closely linked to the natural environment. Vulnerable industries include beach tourism, ski tourism, medical and health tourism and ecotourism. Adaptation: Potential adaptation options include implementing a permanent adaptation strategy for coastal tourism, expanding research on the impacts of climate change on ski tourism, providing infrastructure support to resorts and ensuring that tourist resorts remain accessible during periods of severe spring flooding and other extreme weather events, and increasing preparedness for unexpected and extreme weather events.

INFORMATION ON FINANCIAL, TECHNOLOGY DEVELOPMENT AND TRANSFER AND CAPACITY-BUILDING SUPPORT NEEDED AND RECEIVED UNDER ARTICLES 9–11 OF THE PARIS AGREEMENT

4

CHAPTER IV:

Information on financial, technology development and transfer and capacity-building support needed and received under Articles 9–11 of the Paris Agreement

This chapter provides information on financial, technology development and transfer and capacity building support needed and received by Kazakhstan to enable implementation of its commitments under the Paris Agreement, including of its NDC. Further information is presented in electronic format in CTF tables III. 6-13 on financial, technology development and transfer and capacity-building support provided and mobilized, as well as support needed and received, under Articles 9–11 of the Paris Agreement.

4.A. National circumstances, institutional arrangements and country-driven strategies

Sections below provide information on national circumstances, institutional arrangements and country strategies that are relevant to Kazakhstan's reporting on the support needed and received.

4.A.1. Description of the systems and processes used to identify, track and report support needed and received, including a description of the challenges and limitations

The Ministry of Ecology and Natural Resources (MENR) is the primary institution responsible for implementing Kazakhstan's Strategy on Achieving Carbon Neutrality by 2060, meeting the GHG emissions reduction targets, and implementing climate adaptation measures outlined in the updated NDC by 2030. Through its dedicated Department of Climate Policy, the MENR oversees national climate policy and is also tasked with gathering information on the support needed and received for climate-related actions and projects at the national level[1].

Although Kazakhstan has not yet implemented green tagging for budget cash flows, efforts in this direction have already commenced. For instance, the State Fund for Entrepreneurship Development 'DAMU' has introduced an internal green labeling system for small business projects, which serves as a criterion for providing state support. Additionally, the Agency of Kazakhstan for Regulation and Development of Financial Markets (ARDFM), in collaboration with UNDP, is working to introduce IFRS climate-related reporting. This initiative aims to enhance the transparency of organizations' risks and activities related to climate-related issues in Kazakhstan.

Kazakhstan's Strategy on Achieving Carbon Neutrality by 2060 has both national and regional dimensions. The Ecological Code (Article 29.2) mandates that state authorities in regions, cities of republican significance, and the capital are responsible for the implementation of the national environmental policy at the local level, within their competencies. However, local authorities currently require assistance in implementing these obligations, particularly in monitoring and

[1] https://www.gov.kz/memleket/entities/ecogeo/about/structure/departments/leadership/2217/1?lang=ru

evaluating actions. This support is essential to enable them to take informed actions based on a clear understanding of potential impacts.

In the context of adaptation, capacity building is critical to assess risks and develop simple, cost-effective, and sustainable adaptation and risk-prevention projects at the local level.

The Organization for Economic Cooperation and Development (OECD), plays an important role in tracking at the international level received climate finance and publishes relevant data and information. For the purposes of this report, OECD data were used in relation to the financing received[2], as these data represent the most complete and structured data set that is easily acceptable.

4.A.2. Information on priorities and strategies of Kazakhstan and on support needed for implementation of NDC under Article 4 of the Paris Agreement

The Strategy on Achieving Carbon Neutrality aims to fulfill Kazakhstan's sustainable development goals and achieve carbon neutrality by 2060. The mid-term objective of the Strategy, as outlined in the NDC of Kazakhstan, is to reduce total net GHG emissions by 15% by 2030 compared to 1990 levels (an unconditional target) and to achieve a 25% reduction by 2030, contingent on receiving international support for the decarbonization of the economy (a conditional objective).

As mentioned in Section 1.5 of Chapter I, the Energy sector accounts for the largest share of GHG emissions in Kazakhstan, around 79.9% of national total net emissions (2022), followed by the Agriculture sector (9.3%), the IPPU sector (7.7%), Waste sector, (2%) and LULUCF sector (1.2%).

At COP28, Kazakhstan joined the Global Methane Pledge. By joining the Pledge, countries commit to work together to collectively reduce methane emissions by at least 30% below 2020 levels by 2030.

The Strategy on Achieving Carbon Neutrality contains a macroeconomic estimate of USD610 billion of total investment required to achieve carbon neutrality by 2060, where 96.2% of the estimated amount should come from the private sector[3]. Ensuring such investments is a major challenge, which requires concerted effort by the Government and international support.

There are a number of sectors and sub-sectors in Kazakhstan, where investments are less than sufficient due to the low return on capital and/or high risk. These sectors and sub-sector need additional investments, technical assistance and technology transfer to implement climate change mitigation and adaptation measures are listed below together with a short overview of their needs.

For investment in mitigation, these sectors include the following:

- The housing sub-sector is responsible for 30,8% final energy consumption[4] in Kazakhstan, and the energy efficiency of multi-dwelling residential buildings is particularly low. The sector is under-invested, especially compared to the public buildings and corporate sector. There are 321 990 multi-dwelling residential buildings in Kazakhstan (as of January 1, 2017, survey by United Nations Economic Commission for Europe)[5], and around 60 000 need full energy modernization. The estimated investments required to improve energy efficiency in the multi-dwelling residential sector in Kazakhstan is around USD15 billion, according to the UNDP[6]. Such energy efficiency improvements require a comprehensive approach, including investment support, capacity building, awareness raising, technology transfer and energy audits to

[2] https://webfs.oecd.org/climate/RecipientPerspective/
[3] https://adilet.zan.kz/rus/docs/U2300000121#z67
[4] https://stat.gov.kz/ru/industries/business-statistics/stat-inno-/publications/5186/
[5] https://unece.org/sites/default/files/2022–01/CP_Kazakhstan_web.ENG_.pdf
[6] https://www.undp.org/kazakhstan/stories/road-carbon-neutrality

help apartment owner communities plan and manage their projects.

- Promotion of renewable energy in Kazakhstan is guided by the target to increase the share of renewable energy in energy balance from the current 4.5% to 15% by 2030[7]. The country is making steady progress towards this target, however, one of the main challenges is to ensure large scale investment. Another challenge is that while utility-scale investments are supported by the system of renewable energy auctions[8], smaller scale renewable energy projects need additional support. Moreover, to balance the intermittent nature of renewables, the country needs to develop enabling technologies, as described below.
- Enabling technologies for increasing the share of renewable energy include electric power storages, smart grids, demand management technologies, utilizing off-peak electricity for heating with the heat storages, smart charging stations for electric vehicles, maneuverable power generating capacities, and other similar technologies. All of these enabling technologies are new to Kazakhstan and need both expertise, technology transfer efforts and investment to roll out.
- Implementing projects for methane emission reduction in agriculture, coal mining, oil and gas industry, is feasible as methane may be captured and utilized, or leaks of methane may be prevented. As an example, a large-scale program for the introduction of biodigesters can reduce methane emissions from cattle farming while also providing rural populations with biogas for clean cooking solutions.
- Transition energy technologies that allow shift away from coal use for power production, which are included in Kazakhstan National Taxonomy of "green" projects are based on natural gas and nuclear power. While the latter was supported by the national referendum only recently (October 6, 2024), the former is an important part of the national Green Transition Strategy. This is because the largest cities of Kazakhstan experience high air pollution levels caused by coal-fired combined heat and power plants (CHP), and replacement of coal by natural gas will substantially reduce the GHG emissions and air pollution and will alleviate impact from pollution on human health. Smaller-scale use of natural gas for replacing the coal for heating homes may also have major effects for GHG emissions reduction and improving human health.
- National electric power grid needs modernization: losses of energy reach 12–15%, according to different sources as the grid is obsolete – its wear reaches 66%, and by the recent survey (expert poll) of UNDP "grid risk" is growing since 2020. The total length of electrical networks in the Republic of Kazakhstan is 467 422 km, of which about 27 thousand km are national electrical networks (mains) and about 274 thousand km are networks of regional electrical grid companies.

For investment in adaptation, these sectors include the following:

- Water shortage in the region affects agriculture that depends on irrigation because of the combined effect from climate change (reduced water flows from the glaciers up in the mountains) and growing population[9]. Addressing water shortages requires a major shift towards water saving technologies. In Kazakhstan this could include digitalization of the irrigation sector, introduction of volume-based water consumption tariffs, large-scale construction of pipelines instead of inter-farm canals to prevent losing water through infiltration and evaporation, and large-scale use of modern irrigation methods such as sprinkler or drip irrigation. Addressing water shortages in a holistic way will not only need large-scale investments, but also technology transfer, capacity building and awareness raising efforts.
- Floods represent a particular threat for Kazakhstan, as evidenced by the floods that occurred in the spring of 2024 in North

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[7] https://primeminister.kz/en/news/renewable-energy-sources-to-account-for-15-of-kazakhstan-energy – balance-by-2030-alikhan-smailov-24599

[8] https://www.undp.org/kazakhstan/press-releases/undp-presented-results-project-de-risking-investments-green-energy-sector-kazakhstan

[9] https://eabr.org/en/analytics/special-reports/efficient-irrigation-and-water-conservation-in-central-asia/

Kazakhstan. Unusually heavy snowfalls and fast melting of accumulated snow caused floods and destruction of thousands of homes. The country needs new hydrotechnical infrastructure, sophisticated water flows forecasting and early warning systems, and this also adds to the estimated large scale investments and technology transfer needs.

Finally, there are several sectors for investment in both, mitigation and adaptation action, that include the following:

- Forestry sector is an important priority for Kazakhstan, primarily for planting of new forests, and the restoration of forests damaged by fires. According to the MENR, as of January 1, 2022, forests occupy approximately 5% of the territory of Kazakhstan, or 13.6 million hectares[10]. Almost half of this is saxaul. Increasing forest area is an important part of the climate change adaptation strategy, as forests reduce the negative impacts of extreme weather events, especially drought, and help retain moisture in the soil. In the southern regions of the country, saxaul forests are an important factor in protecting against desertification. Investments in forest planting are insufficient, and the MENR is currently working to create a more favorable regulatory framework for both domestic investors and to attract international donors. One aspect of this work is to create conditions for monetizing GHG removals resulting from implemented forest plans.
- For the agriculture sector, combating droughts and desertification is yet another challenge for Kazakhstan. A proven practice for reducing the impact of heat waves on crops and pastures is the planting of tree belts (shelterbelts). Tree belts significantly reduce wind speed and the associated soil drying, which increases crop yields and pasture productivity, especially in dry years. Depending on the tree species, this positive effect can last for decades or centuries. In addition, planting shelterbelts is a good example of combined climate change mitigation and adaptation measures. However, due to the slow growth of trees, investments in planting shelterbelts begin to pay off after more than 10 years, and land users are not interested in such investments. In addition, in many cases the land is leased, which also discourages long-term investments.

4.B. Underlying assumptions, definitions and methodologies

The methodological basis for the presentation and structuring of the collected data and information in this chapter was the UNFCCC Modalities, procedures and guidelines for the transparency framework for action and support referred to in Article 13 of the Paris Agreement (Decision 18/CMA.1)[11].

4.B.1. Determination of the reporting year and the time frame

The reporting period for the funding and other assistance received and committed is 2020–2022. In a few cases that are indicated, the report may cover more recent activities – up to the time of preparing the present report (October 2024).

The forward-looking statements and forecasts, as well as expressed needs refer to the time immediately after the planned publication of this report – early 2025 and onwards.

[10] https://www.undp.org/ru/kazakhstan/stories/lesa-kazakhstana-prirodnoe-sokrovische-dlya-buduschikh-pokoleniy
[11] https://unfccc.int/sites/default/files/resource/cp24_auv_transparency.pdf

4.B.2. Converting domestic currency into United States dollars

For the purposes of this report, the national currency of Kazakhstan, the tenge (KZT), is converted into US dollars (USD) at the exchange rate of the National Bank of Kazakhstan[12] as of 31 December 2022: 462.65 tenge to 1 USD. For the sake of clarity and consistency, monetary values are presented in US dollars wherever possible.

For the financing received report, OECD data are expressed in "2022 USD", i.e. at the 2022 exchange rate to the relevant currency, taking into account all factors, since 2022 is taken as the base year for the financing received report.

For consistency and comparability, the original USD values are used wherever possible, with the tenge values being the result of calculation using the exchange rate referred to in the previous paragraphs. This approach reflects the typical nature of foreign financing, which is provided in USD in most cases.

Wherever monetary values are given in national currency without additional commentary on the exchange rate, the conversion was made at the rate indicated above.

4.B.3. Estimation of the amount of support needed

At present it is difficult to provide estimates of the support required, however the relevant work is ongoing in the context of the preparation of a Roadmap for the Strategy on Achieving Carbon Neutrality by 2060. Under the leadership of the Ministry of National Economy the road map is prepared in the form of an investment plan with specific activities and estimated investments. Expectations are for the roadmap to be completed in 2025. At present, there is only a general understanding of the priority sectors and an estimate of the total amount of investment. The projects provided in CTF Table III.6 do not provide an exhaustive list, but rather give an idea of some of the potential projects and relevant support that is needed.

4.B.4. Identification of support as coming from specific sources

As mentioned already, climate finance for Kazakhstan within the framework of international organizations' programmes and in bilateral programmes is monitored by the MENR and the OECD. Some projects with private investments may currently remain beyond the scope of this report, but with the coming introduction of disclosure standards in Kazakhstan, information on such projects of large corporations will also become available. In addition, a system of green tagging of public budget cash flows is likely to be established in the future.

4.B.5. Determination of the support as committed, received or needed

The presented information on the received financial support, technology development and transfer, as well as capacity building support, in accordance with Articles 9–11 of the Paris Agreement, is based on known donor commitments. Since the vast majority of donors are organizations with the highest credit ratings, their commitments are very reliable. Still, some of the climate finance that was committed may not yet be actually delivered. This is why the information on committed support was verified through publicly available sources, such as web pages or official reports.

The information on the required support included in this chapter is based on the expert estimates by the relevant ministries of the Government of Kazakhstan according to their competencies and role in decarbonization of economy, as well as on individual project examples proposed by

[12] https://nationalbank.kz/ru/exchangerates/ezhednevnye-oficialnye-rynochnye-kursy-valyut

private businesses through the "Kazakh Invest" agency. The list of projects that require support is not exhaustive, but rather provides a general idea of the national investment priorities in the area of decarbonization and adaptation through examples of actual projects that need support, in the form of climate finance and other assistance.

4.B.6. Identification and reporting the status of the supported activity (planned, ongoing or completed)

The information in this report on the financial, technology development and transfer, and capacity building support needed and received under Articles 9–11 of the Paris Agreement is based on known commitments, which implies that in some cases this support may not have been actually delivered and in some cases it is in the process of ongoing implementation. Where the status is indicated as "Planned", the presence of funding commitments implies that preparatory work on the projects has been carried out and there is a high degree of readiness for implementation of the projects. Where a project is indicated as "on-going", this means that work on the project is ongoing and funding is in the process of being delivered or has already been received, but the project cannot be considered completed: the investment (procurement, works) has not been completed and the project output has not been announced and made available to stakeholders – otherwise the project should be designated as "Completed".

To the extent possible and applicable, the status of projects is indicated in CTF Table III. 7, using one of these three categories of project status. If the status is not specified, it is assumed that the support activities have either been completed or will be completed with a high degree of certainty. Checks have been implemented, in particular for large projects, to ensure that projects that are reported have not been cancelled. Several projects from the OECD database were cancelled – these are not included in the present report.

4.B.7. Identification and reporting the support channels (bilateral, regional or multilateral)

Resources to address climate change are provided to Kazakhstan principally by both multilateral international organizations and within the framework of bilateral co-operation with OECD member states.. However, this does not exclude the participation of other organizations, countries and private donors.

4.B.8. Identification and reporting the type of support (mitigation, adaptation or cross-cutting)

Reporting on the financial support received is based on the OECD classification of each case as a project that aims to mitigate climate change, adapt to climate change, or a combination of both.

The information on the required funding is based on general assumptions about the types of projects: in each case, green finance is considered whether it significantly increases resilience to the impacts of climate change that are common in Kazakhstan: droughts, floods, wildfires or other extreme weather-related events (adaptation), or if the direct or indirect traceable effect of the activity is a reduction in GHG emissions (mitigation), or if there is a combination of mitigation and adaptation effects.

4.B.9. Identification and reporting the financial instruments (grant, concessional loan, non-concessional loan, equity, guarantee or other)

Definitions of the types of financial instruments used for the purposes of this report include:

- Grant – non-refundable conditioned financing with pre-defined usage and reporting to verify the compliance with the terms of providing the funding;
- concessional loan – refundable debt with the interest rate substantially below the current market rates for a similar project and / or more favorable repayment term than available at the market and/or more favorable requirements for collateral than generally expected, and/or other conditions that make it unavailable on normal commercial terms;
- Non-concessional loan – market-based refundable debt;
- Equity – funding in exchange for a participation in share capital, providing the holder with ownership rights to the funded project or entity;
- Guarantee – a documented commitment to repay a third-party loan or redeem equity on pre-agreed terms (e.g. default or bankruptcy of the project), reducing the investment risk for the loan provider or equity holder;
- Other – instruments that do not fall in the categories above that require descriptions on a case-by-case basis.

4.B.10. Identification and reporting sectors and subsectors

With regard to the funding received, the OECD classification, which is more detailed than the UNFCCC classification (14 categories are used), was transformed into the UNFCCC classification. The transformation into the UNFCCC classification was carried out in such a way that all sectors not represented in the UNFCCC classification (8 categories) were defined as “Other” with an additional explanation.

Table 4.1. Comparison of OECD and UNFCCC classifications

	OECD classification	Transformation of the list to make it compatible with the UNFCCC classification
1	I.1. Education	Other – education
2	I.2. Health	Other – health
3	I.3. Population Policies/Programmes & Reproductive Health	Other – population policies, programs and reproductive health
4	I.4. Water Supply & Sanitation	Water and sanitation
5	I.5. Government & Civil Society	Other – government and civil society
6	I.6. Other Social Infrastructure & Services	Other – social infrastructure and services
7	II.1. Transport & Storage	Transport
8	II.3. Energy	Energy
9	II.4. Banking & Financial Services	Other – banking and finance
10	III.1. Agriculture, Forestry, Fishing	Agriculture or forestry
11	III.2. Industry, Mining, Construction	Industry

	OECD classification	Transformation of the list to make it compatible with the UNFCCC classification
12	III.3.a. Trade Policies & Regulations	Other – trade
13	IV.1. General Environment Protection	Cross-cutting
14	IV.2. Other Multisector	Cross-cutting

Projects requiring funding were classified according to the sector categories from the UNFCCC CTF. The sub-sector categories used indicate the specific area for which funding is requested.

A list of the highest priority sub-sectors within each sector for climate investment in Kazakhstan, is provided in the table below.

Table 4.2. List of the high priority sectors and subsectors for climate investment in Kazakhstan

Sector	Subsector
Energy	1. Residential Sector Energy Efficiency 2. Renewables – Large-Scale 3. Energy transmission – District Heating 4. Energy transmission- Grids 5. Renewables – Small-Scale 6. Enabling Technologies (Demand Response, Smart Grids, Energy Storage, Electric Vehicle Charging Stations, Hydrogen Production) 7. Oil & Gas – Methane Capture 8. Carbon Capture, Utilization and Storage 9. Transition Energy Technologies – Natural Gas and Nuclear
Transport	10. Electric vehicles 11. Public transport 12. Railways electrification
Industry	13. Replacement of industrial gases 14. Power grid modernization 15. Thermal insulation modernization 16. Waste heat utilization 17. Waste recycling 18. Packaging reduction
Agriculture	19. Organic agriculture 20. Hydroponics 21. Modern animal feed 22. Fish farming 23. Precision farming 24. Technologies for preventing methane emissions
Forestry	25. Afforestation 26. Reforestation 27. Agroforestry – tree belts (protection of pastures and arable land) 28. Anti-erosion forests – protection against desertification

Sector	Subsector
Water and sanitation	29. Modern Irrigation 30. Digitalization of Natural Water Systems and Irrigation, Flood Prediction 31. Hydraulic Structures 32. Water Conservation in the Residential Sector 33. Water Treatment and Reduction of Bottled Water Use
Cross-cutting	34. Responsible consumption 35. Education, training in new technologies
Other	36. Financial schemes for adaptation to climate change 37. Waste management, use of recycled resources

Information with detailed assessment of the investment needs in each of the sub-sectors enumerated in Table 4.2 is not currently available. Such information may become available once the Roadmap for the Strategy for Achieving Carbon Neutrality by 2060 that was mentioned already is completed in 2025. However, it is assumed that among the sub-sectors listed in Table 4.2 the investment needs on average would be up to 100 Million, except for sub-sectors listed under cross-cutting sector, which are provided for information purposes only.

For example, according to UNDP, in the residential buildings sub-sector in Kazakhstan, at least 60 000 multi-dwelling residential buildings require comprehensive modernization[13], with the cost for one such building estimated at less than USD250 thousand. Thus, the investment needs for the residential buildings sub-sector are at least USD15 billion[14]. At the same time, residents, as a rule, are not able to immediately pay all expenses in full and, therefore, blended financing instruments are required that combine grants and long-term concessional loans.

Another example is planting tree belts, where with an average planting density of 4 500 trees per hectare, planting 1 hectare will cost at least USD500. The area of arable land in Kazakhstan is 25 million hectares and the area of pastures is 70 million hectares[15]. Assuming that 80% of the land will be protected and forest belts will occupy about 6% of the land, it will be necessary to plant 4.56 million hectares of tree belts, and this will require an investment of at least USD2.28 billion. GHG removals and the increased land productivity resulting from tree belt projects typically begin many years after the initial investment. However, their benefits can persist for decades or even centuries. Therefore, blended financing instruments are needed to launch tree belts projects, comprising a combination of grants and long-term concessional loans.

[13] https://www.undp.org/ru/kazakhstan/press-releases/effektivnuyu-model-finansirovaniya-dlya-modernizacii-mnogokvartirnykh-zhilykh-domov-vnedrili-v-stolice
[14] https://www.undp.org/ru/kazakhstan/stories/na-puti-k-uglerodnoy-neytralnosti
[15] https://www.worldbank.org/en/country/kazakhstan/brief/sustainable-livestock-development-program-for-results

4.B.11. Reporting on the use, impact and estimated results of the support needed and received

Depending on the nature of the project or programme, it may have direct and indirect impacts, quantitative and/or qualitative results. For the funding received, the reporting by the implementing agencies is taken as a basis for evaluation of results, taking as given that reputable international and national organizations have the relevant procedures and safeguards in place to prepare and publish accurate and reliable information, unless updates available from publicly available sources provide more accurate information. For the funding needed, the key approach to defining the expected impacts and results from the new projects is based on the following criteria:

- Estimates of expected results and/or impacts from a new project were available before the funding decision was made, including impacts on GHG emissions reduction;
- Results from a comprehensive review of the project and implementing organisations were available, including the feasibility of the project/programme and its comparative advantage over potential alternative uses of funds.

4.B.12. Identification and reporting support as contributing to technology development and transfer and capacity-building

Information on whether the project requires technology transfer and capacity building is provided in CTF Table III.6. In the vast majority of projects that need financial support that are included in this table, new, more efficient or innovative technologies and training are an essential part of these projects. To a large extent, it is the innovation element of the projects and associated risks that make it difficult to secure financing on market terms. Conversely, simpler projects using more traditional technologies and standard types of equipment are usually more suitable for financing by banks on a commercial basis.

4.B.13. Methods to avoid double counting in reporting support information

The main method of avoiding double counting in relation to projects where investments are received is reporting on such projects as distinct units, with mandatory identification of donors for each individual project. Also, information on the finance received is taken from a single source – the OECD, in order to avoid double counting of the same projects, which would be possible if information would be taken from different sources. Information on investments needed is taken from several sources, however the projects mentioned are clearly described, their number is limited and duplication is unlikely.

In order to avoid double counting in relation to the required financing, reference to the location and/or recipient of financing is made and verification by several experts during the preparation of the report, including by experts from the MENR is conducted. Transparency-related capacity building for implementation of Article 13 of the Paris Agreement is reported separately from the other information on support needed and received.

4.C. Information on financial support needed by Kazakhstan under Article 9 of the Paris Agreement

4.C.1. Introduction to the information presented in the Common Tabular Format

The decarbonization of Kazakhstan's economy and the fulfillment of its commitments under the Paris Agreement present significant challenges. As highlighted in the Strategy on Achieving Carbon Neutrality by 2060, the estimated investment required to address both climate change mitigation and adaptation amounts to approximately USD610 billion by 2060. The strategy covers most of the sectors and subsectors for priority investments that are listed in Table 4.2. In some of the subsectors, such as new housing construction or modernization of some industrial processes, investments are mobilized on a commercial basis and driven by the new regulatory requirements.

However, attracting investments for climate mitigation and/or adaptation in a number of sectors and subsectors faces a number of challenges and barriers. Most important of such barriers are high risks and low return on investments, and high rates of commercial loans that lead to postponing of investments to a later date or even cancelling investment plans.

Concessional finance could significantly increase the overall level of investments in projects with climate mitigation and/or adaptation effects in Kazakhstan, due to the "blended finance" effect, whereby a small amount of concessional financial resources can mobilize significant private investment on a commercial basis. "Blended finance" instruments are rarely used in Kazakhstan: as shown in the section on support received, 93.4% of the resources received by Kazakhstan under development programs are non-concessional loans, accompanied by limited amounts of technical assistance in the form of grants.

Other instruments that could help implement projects with climate mitigation and/or adaptation effects in Kazakhstan are equity investments and loan guarantees – these instruments involve higher risk, but at the same time facilitate the launch of projects and the subsequent attraction of significant investment on a commercial basis. Equity investments and loan guarantees could be a good alternative to grant financing in many cases. However, international organizations and banks either do not offer equity investments and loan guarantees for Kazakhstan at all or offer them very rarely.

In preparing this report and information in relevant CTF tables, the operational definition on climate finance by the UNFCCC Standing Committee on Finance was used, namely:

- Climate finance is defined as "finance that aims at reducing emissions, and enhancing sinks of GHGs and aims at reducing vulnerability of, and maintaining and increasing the resilience of, human and ecological systems to negative climate change impacts." This definition has been used by the SCF for its flagship publication "Biennial assessment and overview of climate finance flows" since 2014.
- This definition is suited to the context of Kazakhstan as it reflects climate finance in its broadest form, including financing of projects, programmes and activities, that fully takes into account climate change considerations.

4.C.2. The objectives of the projects included in the list of projects requiring funding

A number of ministries, organisations and private entities have formulated projects and programmes on climate change mitigation and adaptation. Summary of projects for which public information is available is provided in CTF Table 6. In addition, this section provides brief description of several projects with a following aim:

- Increase awareness among stakeholders to the need to formulate in a consistent way investment projects that contribute to the decarbonization of Kazakhstan;
- Inform potential donors about the required financing in the medium term, priorities and needs of the country, as a starting point for discussing specific investment plans and international assistance programs;
- Provide certainty for domestic private investors and financial institutions to mobilize domestic funds along with the international financing;
- Assist both project developers in preparing attractive project proposals and national and international development organizations in their efforts to attract or provide international climate finance;
- Indicate the most promising technologies and sectors for decarbonization.

Selection of the projects listed below was guided by criteria, such as lack of readiness among investors unless some kind of concessional funding becomes available.

Projects have some degree of innovation: technological (product or process), organizational, scale, transferring technology to Kazakhstan.

Most of the projects address climate change mitigation, in particular in the energy, industry and waste management sectors. Projects in adaptation are limited. In many cases, needs are identified in areas where mitigation, adaptation and sustainable development are addressed in conjunction, such as planting tree belts to protect pastures and croplands from drought while enhancing carbon dioxide removal. The example of projects that are provided here do not necessarily reflect the actual structure of needs for two reasons:

- Information on projects in some sectors may not have been available at the time of preparation of this report, such as rail electrification or energy efficiency projects in households;
- Projects taken together do not reflect the actual level of investment needs for sectors and subsectors, such as the energy efficiency in household subsectors, where total investment needed could be many times higher than the estimate provided.

The support required for the projects presented in Table 4.3 aligns with the strategic directions defined in Kazakhstan's NDC, as all the listed projects will contribute to climate mitigation and/or adaptation. However, an important aspect of investment support for these projects is the demonstration of new business models: it is anticipated that the replication and scaling up of such projects could become widespread.

Table 4.3. Information on financial support – examples of projects in Kazakhstan

	Project 1	Project 2
(a) Title (of activity, programme or project)	Reforestation Mitigation Project	Implementation of a pilot project for small-scale Carbon Capture Use and Storage (CCUS) technology with a capacity of 9 000 tons of CO2 per year

	Project 1	Project 2
(b) Programme/project description	Planting a forest on an area of 2 000 hectares in Pavlodar region to obtain carbon offset units. The project is planned to be implemented jointly with Chevron Corp. The implementation of a pilot forest climate project to grow forests to generate offset carbon units is of key importance for the Republic of Kazakhstan, as it helps the country to enter the international carbon market, reduce the country's carbon footprint in accordance with national climate commitments, including carbon neutrality goals by 2060. The project was presented by the MENR	The low-carbon development program of JSC NC "KazMunayGas" seeks financial support from international sources. The project aligns with Kazakhstan's Strategy on Achieving Carbon Neutrality by 2060. The project is presented by JSC NC "KazMunayGas"
(c) Estimated amount (KZT / USD)	n/a	KZT 11 566 million / USD25 000 thousand
(d) Expected time frame	2024–2025 – Completion of the Working Project for Afforestation. Development and approval of the project for monetization of carbon units. 2025–2029 – Planting and care. 2031–2060 – Delivery of carbon units	2031–2060
(e) Expected financial instrument	Grant and concessional loan Cost sharing with Chevron Corp.	Grant Possibility to use equity as part of blended finance will be determined after the approval of international support and the completion of the technical and economic feasibility study.
(f) Type of support (mitigation, adaptation or cross-cutting)	Mitigation	Mitigation
(g) Sector and subsector	Forestry, afforestation	Energy, oil and gas
(h) Whether the activity will contribute to technology transfer and/or capacity-building	Yes	Yes
(i) Whether the activity is anchored in a national strategy and/or an NDC	Yes	Yes
(j) Expected use, impact and estimated results	The project will improve air quality, ecosystems and support biodiversity. Carbon offset units can be used to offset CO2 emissions, as well as to attract international investment in afforestation / reforestation and to open global carbon markets for Kazakhstan.	The implementation of a small-scale CCUS technology pilot project will reduce GHG emissions by 9 000 tons of CO2 per year and introduce innovative technology

	Project 3	Project 4
(a) Title (activity, programme or project)	The implementation of the CCUS technology project with a capacity of 412 000 tons of CO_2 per year	Implementation of a pilot project for the production of blue hydrogen (using CCUS technology)
(b) Programme/project description	The low-carbon development program of JSC NC "KazMunayGas" seeks financial support from international sources. The project aligns with Kazakhstan's Strategy on Achieving Carbon Neutrality by 2060. The project is presented by JSC NC "KazMunayGas"	The low-carbon development program of JSC NC "KazMunayGas" seeks financial support from international sources. The project aligns with Kazakhstan's Strategy on Achieving Carbon Neutrality by 2060. The project is presented by JSC NC "KazMunayGas"
(c) Estimated amount (KZT / USD)	KZT 323 855 million / USD700 000 thousand	KZT 171 181 million / USD370 000 thousand
(d) Expected time frame	2031–2060	2031–2060
(e) Expected financial instrument	Grant Possibility to use equity as part of blended finance will be determined after the approval of international support and the completion of the technical and economic feasibility study.	Grant and Concessional loan Possibility to use equity as part of blended finance will be determined after the approval of international support and the technical and economic feasibility study.
(f) Type of support (mitigation, adaptation or cross-cutting)	Mitigation	Mitigation
(g) Sector and subsector	Energy, oil and gas	Energy, oil and gas
(h) Whether the activity will contribute to technology development and transfer and/or capacity-building	Yes	Yes
(i) Whether the activity is anchored in a national strategy and/or an NDC	Yes	Yes
(j) Expected use, impact and estimated results	The implementation of a small-scale CCUS technology pilot project will reduce GHG emissions by 412 000 tons of CO_2 per year and introduce innovative technology	The implementation of the project will reduce GHG emissions by 172 000 tons of CO_2 per year

	Project 5	Project 6
(a) Title (activity, programme or project)	Organic trout production	Meat and bone powder production plant in Kasym Kaisenov village, Ulan district, East Kazakhstan region
(b) Programme/project description	The project envisages the cultivation of sea trout (Oncorhynchus mykiss) in cages with a capacity of 5 000 tons of fish per year. Location: Caspian Sea, 3 000 hectares, 20 km from the port of Kuryk. The lease of the site for the project was agreed upon by the Fisheries Committee of the MENR of the Republic of Kazakhstan, approved by the Mangistau Regional regional authority. Implementation of the project will reduce pressure on biodiversity, as well as reduce emissions associated with the transportation of fish to Kazakhstan. The project is in line with Kazakhstan's Strategy on Achieving Carbon Neutrality by 2060: "To further ensure food security, agroforestry and organic farming practices will be expanded and producer-consumer chains will be shortened". Organic Fish LLP project submitted through "Kazakh Invest".	The plant will enable more efficient use of poultry waste for animal feed production, with an output of approximately 5 750 tons of various products per year. Waste reduction aligns with the Strategy for Achieving Carbon Neutrality by 2060 and the NDC. The project of JSC "Aitas KZ" is submitted through "Kazakh Invest".
(c) Estimated amount (KZT / USD)	KZT 10 225 million / USD22 100 thousand	KZT 6 338 million / USD13 700 thousand
(d) Expected time frame	2025–2031 (achievement of full planned scale)	2025–2027 (achievement of full planned scale)
(e) Expected financial instrument	Indicative funding needs to be discussed: USD19.5 million – equity or mezzanine loan required. USD2.6 million – own funds of the initiator	Estimated investment needs of around: USD4.1 million in a form of concessional loan required USD9.6 million – project proponent own funds.
(f) Type of support (mitigation, adaptation or cross-cutting)	Cross-cutting	Cross-cutting
(g) Sector and subsector	Agriculture, fish farming	Agriculture, animal feed
(h) Whether the activity will contribute to technology development and transfer and/or capacity-building	Yes	Yes
(i) Whether the activity is anchored in a national strategy and/or an NDC	Yes	Yes
(j) Expected use, impact and estimated results	Reducing transportation needs and replacing livestock products with fish will reduce GHG emissions; replacing climate-sensitive food production will improve adaptation.	Reducing animal-related waste, and reducing the need for transportation to deliver animal feed will result in GHG emission reduction; replacing of climate-sensitive food production will improve adaptation.

	Project 7	Project 8
(a) Title (activity, programme or project)	Hydroponic green fodder farming with a production capacity of 20 tons per day.	Cooking oil extraction plant and by-products: protein and biofuel pellets
(b) Programme/project description	Year-round production of fresh green grass for cows, allowing for immediate consumption without drying. This improves the health and growth of the animals. Water and energy savings are in line with the Strategy on Achieving Carbon Neutrality by 2060 and the NDC. Zhana-Bereke LLP project, part of the Altyn Taga cooperative, submitted through “Kazakh Invest”.	Deep and comprehensive use of raw materials (oil seeds) for maximum yield of useful products. Raw material and energy savings align with the Strategy for Achieving Carbon Neutrality by 2060 and the NDC. The project by TOO “Atameken-Agro Oils,” is submitted through “Kazakh Invest”.
(c) Estimated amount (KZT / USD)	KZT 824 million / USD1780 thousand	KZT 21559 million / USD46600 thousand
(d) Expected time frame	2026 (full planned scale achieved)	2025–2028 (achieving full planned scale)
(e) Expected financial instrument	Estimated funding needs of around: USD1.25 million – concessional loan required USD0.53 million – project proponent own funds.	Estimated funding needs of around: USD23.3 million – concessional loan required USD23.3 million – project proponent own funds.
(f) Type of support (mitigation, adaptation or cross-cutting)	Cross-cutting	Mitigation
(g) Sector and subsector	Agriculture, animal feed	Industry, food industry
(h) Whether the activity will contribute to technology development and transfer and/or capacity-building	Yes	Yes
(i) Whether the activity is anchored in a national strategy and/or an NDC	Yes	Yes
(j) Expected use, impact and estimated results	The hydroponic system allows efficient use of water and energy. Plants receive precise amounts of water and nutrients, automation saves energy. Eliminating dependence on weather is an adaptive feature.	The modern biofuel production as a by-product of the vegetable oil manufacturing will save energy and materials, as well as produce green fuel from waste, contributing to Kazakhstan’s efforts to reduce GHG emissions and setting a new standard of deep utilization of raw materials for the industry

	Project 9	Project 10
(a) Title (activity, programme or project)	Granulated fish feed factory in the village of Baisereke, Ili district, Almaty region	Project of alfalfa cultivation using sprinkler irrigation in Shieli district of Kyzylorda region
(b) Programme/project description	The factory, with a capacity of 6 000 tons of fish feed per year, will be built on 10 hectares of land. By-products will be used to produce high-calorie animal feed. The factory will be located in the "Baiserke Agro" industrial zone, which has the necessary infrastructure The savings in raw materials and energy align with the Strategy on Achieving Carbon Neutrality by 2060 and the NDCs. The "KazBioFeed" project is submitted through "Kazakh Invest".	The project envisages the production of high-quality alfalfa-based feed on a land plot with a total area of 10 000 hectares. Investments in climate change adaptation projects are in line with the Strategy on Achieving Carbon Neutrality by 2060 and the NDCs. Project TOO "Tin Oris", presented through "Kazakh Invest".
(c) Estimated amount (KZT / USD)	KZT 7 079 million / USD15 300 thousand	KZT 30 812 million / USD66 600 thousand
(d) Expected time frame	2025–2026	2025–2026
(e) Expected financial instrument	Estimated funding requirements are around: USD10.7 million in a form of concessional loan USD4.6 million – project proponent own funds.	Estimated funding needs are estimated at around: USD46.6 million in a form of concessional loan required USD20.0 million – project proponent own funds.
(f) Type of support (mitigation, adaptation or cross-cutting)	Cross-cutting	Adaptation
(g) Sector and subsector	Agriculture, animal feed	Agriculture, animal feed
(h) Whether the activity will contribute to technology development and transfer and/or capacity-building	Yes	Yes
(i) Whether the activity is anchored in a national strategy and/or an NDC	Yes	Yes
(j) Expected use, impact and estimated results	The modern fish feed production plant will help save energy and materials, contributing to Kazakhstan's GHG emission reduction efforts. Aquaculture reduces the dependence of food production on climatic conditions (adaptation effect)	Dependence on weather conditions and natural disasters increases the risk of crop losses or poor-quality harvests. The irrigation system minimizes the negative impact of weather conditions, contributing to climate change adaptation.

	Project 11	Project 12
(a) Title (activity, programme or project)	Production of organic and organo-humic complex fertilizers in Karaganda	Construction of a plant for production of biofuel from flax shives in Akmola region
(b) Programme/project description	The project plans to utilize off-balance (oxidized in seams) brown coals, which are unutilized mining waste that pollutes the environment. Investments in waste processing projects align with the Strategy on Achieving Carbon Neutrality by 2060. The project of the Special Economic Zone Sary Arka is presented through "Kazakh Invest".	Production of fuel pellets and briquettes from flax shives (woody parts of flax stems) with a capacity of 40 000 tons per year. Renewable and environmentally friendly energy sources are in high demand in industrial enterprises in Europe and East Asia. Renewable energy is at the core of the UN Sustainable Development Goals (SDGs) and Kazakhstan's Strategy on Achieving Carbon Neutrality by 2060. The project "Armandas Star" is presented through "Kazakh Invest".
(c) Estimated amount (KZT / USD)	KZT 1989 million / USD4 300 thousand	KZT 2 082 million / USD4 500 thousand
(d) Expected time frame	2025–2026	2025–2026
(e) Expected financial instrument	Estimated funding requirements are around: USD3.0 million in a form of concessional loan required USD1.3 million – equity requirement.	Estimated funding requirements are around USD2.2 million in a form of concessional loan and USD0.9 million in a form of required equity. USD1.4 million – project proponent own funds.
(f) Type of support (mitigation, adaptation or cross-cutting)	Mitigation	Cross-cutting
(g) Sector and subsector	Industry, fertilizers	Energy, solid biofuel
(h) Whether the activity will contribute to technology development and transfer and/or capacity-building	Yes	Yes
(i) Whether the activity is anchored in a national strategy and/or an NDC	Yes	Yes
(j) Expected use, impact and estimated results	The replacement of chemical fertilizers with organic ones reduces GHG emissions	The replacement of coal with biofuel will lead to a reduction in environmental pollution, a GHG emission reduction, and stimulating further economic growth and diversification in the agricultural sector

	Project 13	Project 14
(a) Title (activity, programme or project)	Recycling of industrial waste (big bags, plastic), to produce plastic granules	Production of pulp and paper products from straw
(b) Programme/project description	The production of recycled plastic granules and shredded plastic-12 000 tons per year in Pavlodar. The project will process five types of plastic waste: high-density polyethylene (HDPE), low-density polyethylene (LDPE), polypropylene (PP), acrylonitrile butadiene styrene (ABS), and polystyrene (PS) Investments in waste recycling projects align with Kazakhstan's Strategy on Achieving Carbon Neutrality by 2060 and the Environmental Code of Kazakhstan. The project TOO "Ak-Service" is presented through "Kazakh Invest".	In the city of Atbasar, Akmola region, it is planned to build a plant for the production of rolled paper (150 000 tons per year) and cardboard (50 000 tons per year) from straw waste. Straw will be purchased from local suppliers Investments in waste recycling and forest conservation projects align with Kazakhstan's Strategy on Achieving Carbon Neutrality by 2060 and the Environmental Code of Kazakhstan. The project "Turkestan Pulp and Paper Mill" is presented through "Kazakh Invest".
(c) Estimated amount (KZT / USD)	KZT 1018 million / USD2 200 thousand	KZT 68 611 million / USD148 300 thousand
(d) Expected time frame	2025–2028	2025–2026
(e) Expected financial instrument	Estimated funding needs are estimated at: USD1.54 million – concessional loan USD0.66 million – project proponent own funds.	Estimated funding needs amount to USD103.8 million in a form of concessional loan USD44.5 million – project proponent own funds
(f) Type of support (mitigation, adaptation or cross-cutting)	Mitigation	Mitigation
(g) Sector and subsector	Industry, waste management	Industry, waste management
(h) Whether the activity will contribute to technology development and transfer and/or capacity-building	Yes	Yes
(i) Whether the activity is anchored in a national strategy and/or an NDC	Yes	Yes
(j) Expected use, impact and estimated results	Reusing plastic reduces GHG emissions and environmental pollution.	Using straw instead of wood helps prevent deforestation and preserves carbon sequestration. Reusing straw helps to reduce emissions of CO2 and methane (which would otherwise occur if the straw decomposed).

A detailed information on the financial support needed is provided in CTF Table III.6.

4.D. Information on financial support received by Kazakhstan under Article 9 of the Paris Agreement

4.D.1. General information

According to the OECD data used for this report[16,17] for the reporting period 2020–2022, funding commitments for Kazakhstan amounted to USD721,322 million from 19 donors and for 155 individual projects (in some cases, projects are parts of broader programmes).

OECD data that were used may be incomplete and the level of detail may be not necessarily sufficient, but to avoid possible double counting, no other data sources have been used. Where data other than those from the OECs were available, they are referred to in the report. For example, most loans that the OECD classifies as non-concessional are accompanied by technical assistance programmes. In particular, the largest donors – the ADB, the EBRD and the World Bank – provide technical assistance as part of the projects that they support. In cases where projects from the OECD database were cancelled[18] related information was not included in this report.

4.D.2. Main countries and international organisations that provide financial support for Kazakhstan

The main international development organizations that provided the largest amount of financing to Kazakhstan in 2020–2022 were the European Bank for Reconstruction and Development (EBRD), 13 programmes, and the World Bank (WB), 3 programmes, that together provided 91.4% of all climate financing in 3 years mentioned. Other major providers of climate finance are the European Investment Bank, the Asian Development Bank and the Green Climate Fund, the US and Japan, which together account for 7.6% of the funding provided.

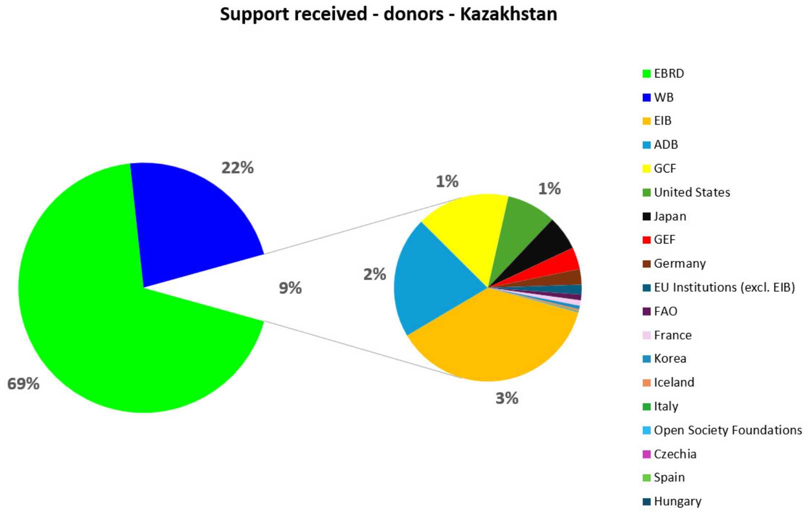
Table 4.4. Financial support from international organizations

International development banks and developed countries that provide financial support to Kazakhstan	USD thousand	share
European Bank for Reconstruction and Development EBRD)	497 519	69,0%
World Bank (WB)	161 663	22,4%
European Investment Bank (EIB)	23 102	3,2%
Asian Development Bank	13 037	1,8%
Green Climate Fund (GCF)	9 989	1,4%
USA	5 279	0,7%
Japan	3 702	0,5%
Global Environment Facility (GEF)	2 356	0,3%
Germany	1 664	0,2%
European Union institutes (excluding EIB)	1 052	0,1%
Food and Agriculture Organization	624	0,1%
France	571	0,1%

[16] https://webfs.oecd.org/climate/RecipientPerspective/
[17] https://www.oecd.org/
[18] https://www.vsemirnyjbank.org/ru/news/statement/2022/04/21/cancellation-of-sustainable-livestock-development-program-for-results-in-kazakhstan

International development banks and developed countries that provide financial support to Kazakhstan	USD thousand	share
Korea	386	0,1%
Iceland	211	0,0%
Italy	79	0,0%
Open Society Foundations	53	0,0%
Czech Republic	17	0,0%
Spain	16	0,0%
Hungary	2	0,0%
Total	1051 532	100,0%

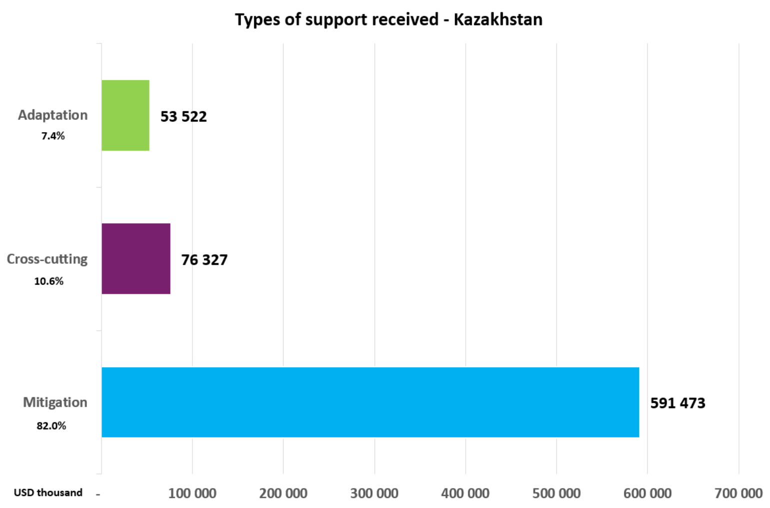
Figure 4.1. Financial support provided for Kazakhstan by source



4.D.3. Types of financial support

The main focus of climate finance – 82% supports GHG emission mitigation projects. Projects focused solely on climate change adaptation received a small share of funding – 7.4%. Projects combining adaptation and mitigation accounted for 10.6% of the funding received.

Figure 4.2. Financial support received by Kazakhstan by type of support in USD million



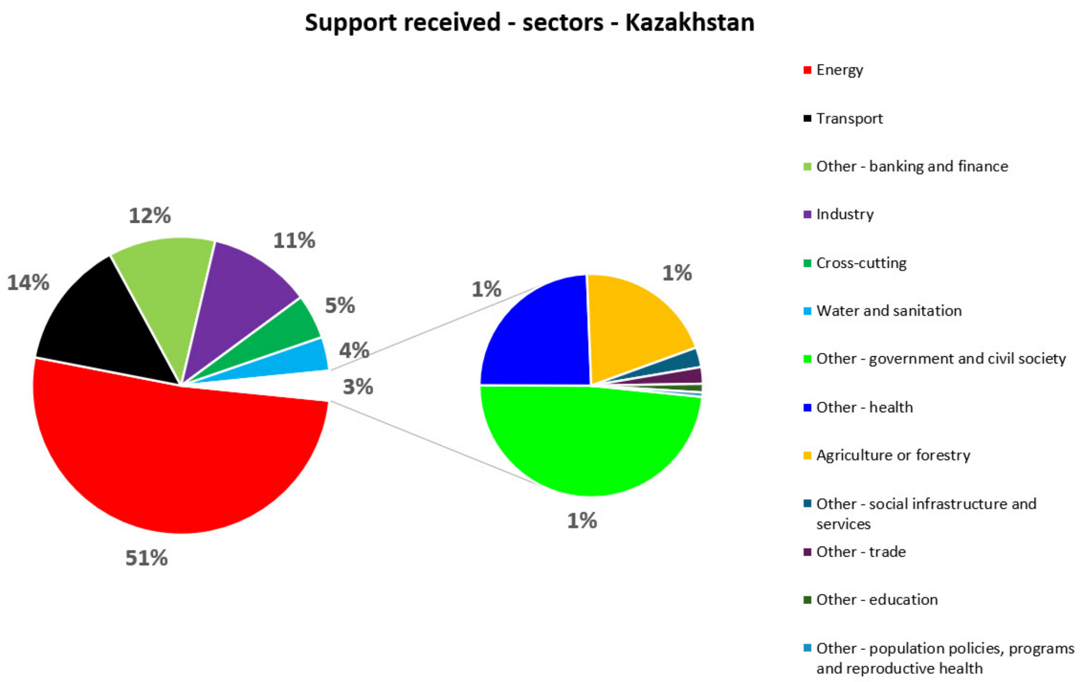
4.D.4. Sectors receiving financial support in Kazakhstan

Projects with a major climate mitigation effect are mainly in the Energy sector. In total, 51.4% of climate finance that was received for 2020–2022 covered all subsectors of the Energy sector.

The transport sector is the second largest sector, accounting for 14% of international climate finance that was received for 2020–2022, with the main focus on the construction and reconstruction of roads.

The households sector, the largest end-user of energy in Kazakhstan (30.8% of final consumption[19]), did not receive funding, and finance for energy efficiency of multi-dwelling residential buildings is particularly low. International donors also provide little support for climate projects in sectors such as agriculture and forestry.

Figure 4.3. Financial support provided for Kazakhstan by sector



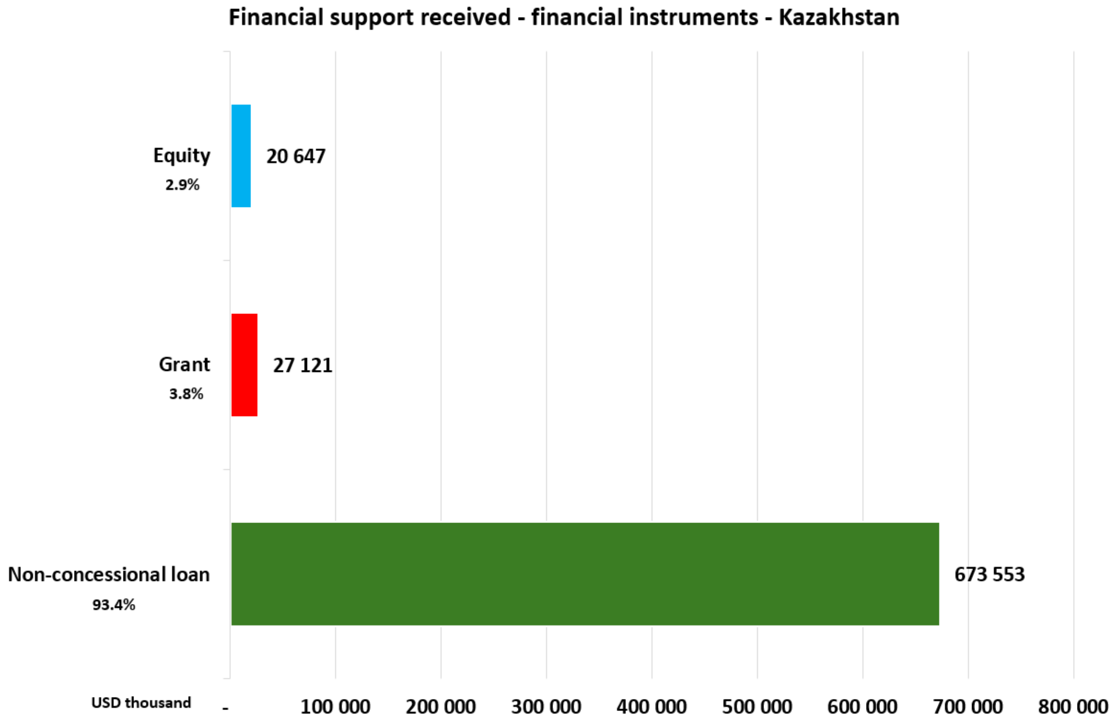
4.D.5. Financial support received by type of financial instruments used

Non-concessional loans were by far the most important instrument of financial support provided to Kazakhstan, accounting for 93.4% of the total amount of received finance. The non-concessional loans provided by international organizations are more affordable as they provide for interest rates that are slightly below the loans that are purely market-based. In addition, in most cases, such loans are also accompanied by grant financing for the purposes of technical assistance. The technical assistance can also contribute to the development of the sustainable financing market in the long term, for example, by increasing the competencies and potential in the areas of sustainable financing of local banks through which loans from international organizations are provided to end users. An example of such an approach is the EBRD GEFF project, described in the next section.

[19] https://stat.gov.kz/ru/industries/business-statistics/stat-inno-/publications/5186/#:~:
text=%D0%B6%D0%B8%D0%BB%D0%B8%D1%89%D0%BD%D1%8B%D0%B9%20%D1%81%D0%B5%D0%BA%D1%82
%D0%BE%D1%80%20%E2%80%93%2030%2C8

The structure of support received by Kazakhstan by type of financial instruments is presented in Figure 4.4. Information presented there shows clearly that non-concessional loans dominate by far as the key instrument for climate finance in Kazakhstan, followed by grant funding, 3.8%, and equity, 2.9%.

Figure 4.4. Structure of support received by Kazakhstan by type of financial instruments used



4.D.6. Support in the form of non-refundable (grant) funding

According to the OECD, 125 grants were provided in Kazakhstan in 2020–2022, including the largest number by the government of Japan: 35 grants amounting to USD3.7 million. The US government provided 34 grants amounting to USD5.3 million. The third largest number of grants was provided by the German government: 14 grants amounting to USD1.7 million.

Climate finance on a grant basis is provided in relatively small amounts, but its importance cannot be underestimated. Grant funds often play a big role in changing the situation in a country as a whole: changes in the regulatory environment, the removal of barriers, and showcasing best practice examples can open up new opportunities in the future on a scale that far exceeds the modest grant amounts.

A prominent example is the 2020 GEF grant, channeled through the UNDP to support the green bond market in Kazakhstan. Under a related project, amendments were drafted and then adopted to the Law “On Support for the Use of Renewable Energy Sources”, which improved the enabling conditions for private investment in small renewable energy sources. Also, a system of project auctions with documentation for large renewable energy sources was created, which significantly reduced investment risks. All these changes significantly enabled the inflow of private domestic investment. For example, with regard to green bonds market volume, this leverage ratio as of today is more than USD4 000 per 1 grant dollar[20]. Altogether, the UNDP-GEF project disbursed around USD200 thousand to support the first issuance of green bonds of Damu Fund.

[20] https://aifc.kz/wp-content/uploads/2024/07/ustojchivoe-finansirovanie-v-czentralnoj-azii.pdf

4.D.7. Financial support in form of equity investments

Equity (shares or stakes in companies) remains an extremely rare form of climate finance in Kazakhstan, despite its important catalytic role. According to the OECD, in 2020–2022, there was only one case of equity provided by the EBRD to the Meridiam Sustainable Infrastructure Europe IV fund, which invests in equity of companies, including investments in Kazakhstan, that amounted to just over USD20 million. Equity investments, which are associated with higher risk, but at the same time allow for the launch of new projects that in turn may attract large scale investment on a commercial basis, remain extremely rare in Kazakhstan. This is an obvious gap that deserves the attention of international financial institutions.

4.D.8. Absence of loan guarantees and concessional loans

Guarantees and concessional loans are completely absent from the instruments used for climate finance by international providers in 2020–2022. These instruments could be of significant help in several areas where it is extremely difficult to attract loans on a commercial basis, as well as in sectors where there is a problem with attracting investments. An example is the modernization of the residential sector, where the return on investments is low, while potential for reducing GHG emissions is significant and there is an opportunity to gradually repay concessional loans through revenue from energy savings.

Long-term loans with an interest rate of about zero would be very useful for the agroforestry sub-sector: protecting pastures and arable land from droughts by planting tree belts, with the monetization of carbon absorption in the future and with very long payback periods, but at the same time the prospect of useful use for tens or hundreds of years in future. Loan guarantees from international organizations with high ratings could also play an important role in attracting such loans.

4.D.9. Examples of international funding programs

Two examples of climate change programmes and projects supported through international funding are provided here. The examples are selected randomly to demonstrate the most common ways of financing climate projects in Kazakhstan.

Box 4.5 *Example of a financial support program provided to Kazakhstan – a loan program*
EBRD Green Economy Financing Facility

The EBRD launched the pilot phase of the Green Economy Financing Facility (GEFF) in Kazakhstan in 2020, and in 2023 the EBRD launched the 2nd phase[21] (GEFF Kazakhstan II) of this successful programme. Under GEFF, the EBRD provides loans to private businesses and individuals through selected financial intermediaries. GEFF aims to further support investments in the green economy, including, among others, energy efficiency, renewable energy, resource efficiency, the circular economy and climate resilience measures. Funds can also be provided to suppliers and manufacturers of eligible materials and equipment covered by the Green Technology Selector for Kazakhstan. The loans are supported by Technical Assistance.

The programme is supported by the Government of Austria and the Global Environment Facility (GEF). The pilot phase[22] was accompanied by a subsidy on the principal amount of 10–15%, while in the 2nd phase, rates were close to

[21] https://www.ebrd.com/work-with-us/projects/psd/53502.html
[22] https://ebrdgeff.com/kazakhstan/ru/

market rates (1–2% lower, e.g. 23% instead of 24% per annum in local currency). Loans come in different sizes, targeting different groups, from households to medium-sized businesses. The OECD has tracked around USD40 million in loans to two commercial banks and one microfinance institution in Kazakhstan in 2020–2022, while the EBRD has announced a total volume of around USD150 million in local currency for the GEFF Kazakhstan II programme. One more bank has joined the programme in 2023.

The programme is clearly a success, continuing to expand over time. One important factor in the programme's success is the educational efforts of the participating local financial institutions, which promote green investments among different target groups. The programme is supported by a technical assistance package to improve the skills of participants, integrate a gender perspective into operations and raise awareness among stakeholders; the total technical assistance package for GEFF II is €2.7 million. To date, GEFF Kazakhstan II[23] has engaged more than 1500 clients and committed more than USD30 million to energy and resource efficiency projects across the country, reducing annual carbon emissions by more than 200000 tons and achieving immediate energy savings of more than 573000 megawatt-hours. More than 60% of these projects have involved women-led and rural businesses.

Box 4.6 *Example of a financial support program provided to Kazakhstan – a grant program*
Global Environment Facility Small Grants Programme in Kazakhstan (implemented by UNDP)

Since 2007, Kazakhstan Small Grants Programme has provided financial and technical support to local civil society and community-based organizations in areas such as biodiversity loss, climate change mitigation and adaptation, land degradation and waste management. The programme was funded by the Global Environment Facility Small Grants Programme[24] and is implemented by the United Nations Development Programme (UNDP). In 2020–2022, the OECD reported providing around USD2 million through 2 sub-programmes in grants to support environmental initiatives by local NGOs in Kazakhstan that are creating replicable positive examples of conservation, mitigation and adaptation projects. Several dozen small projects are expected to be supported, with an average co-investment rate of 50%. The size of each grant was capped at USD50000. "Engaging young people in biodiversity conservation in the East Kazakhstan region through work with school forestries and the use of traditional knowledge" is a typical example of such small projects implemented in 2021.

The goal of the small project in the East Kazakhstan region was to involve young people, parents, teachers, forestry specialists, local population, including women, in the activities of small forestries created at schools to conserve biodiversity, taking into account traditional knowledge. The main goals were: (1) creating school forestries and strengthening their role in environmental education of young people, raising awareness and responsibility of young people and local population for the conservation of biological species, unique objects and balanced use of biological diversity; (2) reviving traditional knowledge about the relationship between humans and the environment by collecting and documenting it from local residents, foresters for many generations.

In the East Kazakhstan region, 10 school forestries were created on the basis of 9 rural schools and 1 city school. Traditional knowledge on the ecology of the region, reforestation, traditional crafts (hunting, fishing, gathering, forestry, agriculture) was collected. Cultural heritage will be included in programs and used in the work of school forestries to preserve biodiversity, including methods for growing pine seedlings at home. The project indirectly affected the territory of about 600100 hectares. School forestries participated in planting pine trees, competitions, rallies, events, excursions, eco-camps, scientific and practical conferences, collecting traditional knowledge from residents in their places of residence. Children feed animals and birds in winter, make

[23] https://kapital.kz/finance/114176/yebrr-zapuskayet-v-kazakhstane-proyekt-finansirovaniya-zelenoy-ekonomiki.html
[24] https://www.thegef.org/sites/default/files/documents/2024–01/2023_AMR_Infographic-final.pdf

birdhouses, feeders, supporting bird and animal populations. Children and parents make holes in ice in winter, supplying fish with oxygen.

The project directly benefited 306 people, including 286 schoolchildren (148 girls, 138 boys), indirectly benefited 1056 people, including 652 women, and more than 5 000 people received information about the importance of preserving biodiversity and the project's activities.

Table 4.5 provides summary information on the financial support received by Kazakhstan under Article 9 of the Paris Agreement, while full information is reported in Table III.7 of the Common Reporting Format of the UNFCCC.

Table 4.5. Financial support received by Kazakhstan under Article 9 of the Paris Agreement: summary of information that is reported in Table III.7 of the Common Reporting Format of the UNFCCC

Title of activity, program, project or other	Description of program / project	Provider	USD (thousand)	Type of support	Sector
Modernization of Almaty CHPP-2	A loan of up to EUR252 million in tenge equivalent to Almaty Electric Stations JSC for the comprehensive modernisation of Combined Heat and Power Plant 2 (CHPP-2) with the complete replacement of coal with natural gas as the main fuel to reduce CO2 emissions and improve air quality in Almaty. Almaty CHPP-2 is the largest source of heating in the country's largest city. The project is part of the EBRD's Green Cities Programme. The project aims to reduce CO2 emissions in the city by approximately 3 million tonnes (a reduction of approximately 56%) and completely eliminate emissions of particulate matter and NOx into the atmosphere. The latter is especially important given Almaty's alarming statistics on pollution-related diseases.	EBRD	182 691	Mitigation	Energy
The Private Sector and a More Sustainable Economic Recovery DPF	Supporting institutional and policy changes, a more sustainable economic recovery for: (i) a more competitive economy driven by a more dynamic private sector and a responsible public sector; and (ii) a more sustainable economic transition.	World Bank	86 218	Mitigation	Energy

Title of activity, program, project or other	Description of program / project	Provider	USD (thousand)	Type of support	Sector
Atyrau Oil Refinery, LLC	An 80 million USD loan in Kazakhstani tenge to Atyrau Oil Refinery for the modernization of industrial water treatment facilities in accordance with best available solutions and the rehabilitation of evaporation ponds adjacent to the city of Atyrau. The modernization of industrial water treatment plants and the reuse of water will be possible through the rehabilitation of evaporation ponds adjacent to the city of Atyrau with a total area of 860 hectares.	EBRD	79 506	Mitigation	Industry
Expansion of Almaty International Airport	Providing a syndicated loan of up to USD229.4 million to finance: (i) the capital expenditure program of Almaty International Airport (ALA), including the construction of a new passenger terminal and (ii) the refinancing of the acquisition of ALA and its related fuel company Venus Trading LLP (VT) by a consortium of investors led by TAV Airports. The terminal will be the first EDGE Advanced certified sustainable airport terminal in Central Asia, implementing climate mitigation, water conservation and material efficiency techniques.	EBRD	47 624	Mitigation	Transport
Reconstruction of the Kyzyl-Orda-Zhezkazgan road	A loan of 96.9 billion tenge (two tranches) under a state guarantee to JSC KazAvtoZhol, a 100% state-owned operator of highways. The first tranche of 74.8 billion tenge is for the reconstruction of a 204 km section of the road between the cities of Kyzylorda and Zhezkazgan. The second tranche of 22.1 billion tenge is for the construction of a 14.8 km bypass road around Kyzylorda adjacent to the highway. The project includes measures to adapt to climate change, increasing the road's resilience to extreme weather events.	EBRD	36 132	Adaptation	Transport
Other projects*	150 projects		289 149		
Total**			721 322		

Detailed information on the financial support received is provided in CTF Table III.7.

* full information on these 150 projects is available at OECD website: https://webfs.oecd.org/climate/RecipientPerspective/CRDF-RP-2022.xlsx, 2 cancelled projects (2 lines) by World Bank are excluded: https://www.worldbank.org/en/news/statement/2022/04/21/cancellation-of-sustainable-livestock-development-program-for-results-in-kazakhstan.

** difference due to rounding

4.E. Information on technology development and transfer support needed by Kazakhstan under Article 10 of the Paris Agreement

Kazakhstan's NDC under the Paris Agreement and its Strategy on Achieving Carbon Neutrality by 2060 emphasizes the essential role of support and transfer of climate technologies. According to the NDC, Kazakhstan's unconditional target provides for reduction of greenhouse gas emissions by 15% by the end of 2030 relative to the base year 1990 emissions level, while the conditional target provides for reduction of greenhouse gas emissions by 25% by the end of 2030 relative to the base year 1990 emissions level, subject to significant additional international investment and substantial grant assistance; access to an international technology transfer mechanism; co-financing and participation in international research projects, development of promising low-carbon technologies and initiatives to build local expertise.

The Development Strategy of the Republic of Kazakhstan until 2050 and the updated Concept for the Transition of the Republic of Kazakhstan to a Green Economy, approved by the Decree of the President of Kazakhstan dated June 10, 2024 No. 568, also set long-term goals such as reducing the energy intensity of GDP by 50% by 2050 from the 2008 levels and increasing the share of alternative energy sources to 50% by 2050.

Measures to achieve these goals are outlined in the National Development Plan of Kazakhstan until 2025 (Decree of the President of the Republic of Kazakhstan dated February 15, 2018 No. 636) and the Action Plan for the implementation of the Concept for the transition of the Republic of Kazakhstan to a "green" economy for 2021–2030 (Resolution of the Government of the Republic of Kazakhstan dated July 29, 2020 No. 479). These plans contain provisions for support and implementation of climate technologies to reduce GHG emissions and early warning systems, energy efficiency and energy saving, development of sustainable transport, infrastructure for electric vehicles and traffic flow management systems, municipal waste management, transition to sustainable land use methods and organic agriculture, afforestation and other issues, including issues of identifying technology needs.

4.E.1. Plans, needs and priorities related to technology development and transfer by sector

Information on the main plans, needs and priorities for the development and transfer of technologies to meet Kazakhstan's obligations under the Paris Agreement, outlined in the Strategy on Achieving Carbon Neutrality by 2060 (hereinafter referred to as the Strategy) and other related Government documents, are is provided in the sections below and in Tables III.8 and III.9 of the CTF.

With regards to technology development and transfer, Kazakhstan needs support in the sectors that are outlined below.

In the energy sector, the most serious challenge is the transition away from coal, as coal's contribution to national net GHG emissions exceeds 55.7% (68.9% of electricity production and 99% of heat production). The Strategy notes that most power plants use outdated technologies and exceed their design lifetime. In 2022, there were 179 power plants in Kazakhstan: 68 thermal power plants (TPP): 28 coal-fired, 38 gas-fired, 2 fuel oil-fired, of which 41 are combined heat and power plants (CHP); 51 are hydroelectric power plants. The average age of coal-fired power plants in 2022 was 55 years, gas-fired power plants – 40 years, and hydroelectric power plants – 56 years. About 40% of installed generating capacity is over 40 years old and more than 60% is over 30 years old. The development and adoption by the Government of a Roadmap for the transition from coal to low-carbon technologies is required to meet the goals of the Strategy on Achieving Carbon Neutrality by 2060.

A major problem is the deteriorated distribution systems of both electricity and heat, which lead to high energy losses (up to 35%) and consequently to additional GHG emissions. The sector's outdated assets require updating and modernization using new technologies and replacing obsolete equipment and infrastructure with modern low-carbon and carbon-free technologies, such as gas-fired thermal power plants in the transition phase, as well as the active introduction of alternative and renewable energy sources. The law on support for renewable energy sources provides for financing the construction, reconstruction and modernization of power grids at the expense of the budget. Also, the decommissioned coal capacities will be given priority rights and support for the transition to "green" technologies and energy projects.

The Roadmap for Energy Saving and Improving Energy Efficiency in the Republic of Kazakhstan for 2022–2026 provides support for climate technologies and innovations in the construction, industry, utilities and other sectors. In order to achieve carbon neutrality, scenarios for increasing the share of renewable energy sources and emissions trading systems with differential distribution of quotas by sector are in place. In 2022, the Concept for the Development of the Electric Power Industry of the Republic of Kazakhstan until 2035 was adopted. According to this concept, by 2035, the installed capacity of renewable energy sources will increase to 40.1 MW (almost twice as much as in 2022). Further integration of renewable energy sources into the energy system will require an increase in balancing capacities and the construction of energy storage facilities.

The key objective of the Strategy is the development of renewable energy sources. In 2023, Kazakhstan updated the auction mechanism for selecting renewable energy projects, replacing the fixed tariff that was in effect until 2018 and initially launching the renewable energy development process. As a result, the prices of auctions for the selection of solar power plant projects in Kazakhstan have halved since 2018, from 34.61 tenge/kWh at a fixed tariff to 16.97 tenge/kWh. At the auction in September 2024, the minimum price was recorded – 9.9 tenge/kWh (construction of a solar power station with a capacity of 10.5 MW in the Aral district of the Kyzylorda region). In June 2024, amendments were made to the Law on Support for the Use of Renewable Energy Sources, which give the right to the population, small and medium-sized businesses and farms to install renewable energy sources with a capacity of up to 200 kW and sell their surplus to the grid. An important issue of technology transfer is setting up in the country of small-scale renewable energy production facilities, the assembly of solar panels, etc. **Further development of renewable energy sources also requires training, affordable preferential lending, subsidies and service technology centers, as well as the development of cooperatives and associations of renewable energy users at the local and regional levels.**

Energy system and smart grids. Although the share of renewable energy sources in Kazakhstan is currently relatively small (6,5%), it is growing rapidly. This requires a transition from the current centralized energy system model to smart grids with flexible operation of energy sources, energy storage and green hydrogen production.

In the medium to long term, carbon capture and storage (CCS) technologies are needed. In this regard, it will be necessary to develop a program for decommissioning coal-fired capacities with a current lifetime of more than 30 years and to introduce CCS technology for those units that will continue to operate after 2035 if this is economically feasible. CCS technology also plays a certain role in ferrous metallurgy and non-metallic mineral extraction.

Cost and efficiency estimates for CCS technologies are highly uncertain, and further innovative developments in CCS technologies are needed to achieve overall carbon capture efficiencies of up to 95%. The cost of transporting and injecting CO2 in the places of permanent disposal, such as aquifers also varies from USD10 to USD100 per ton, depending on the length of transport and the geophysical characteristics of the aquifers. The experience of the KazMunayGas oil company pilot project and related analysis provides a basis to explore the possibilities of developing infrastructure for the transportation and storage of CO2 using CCS technologies in Kazakhstan.

In the buildings and infrastructure sector, the average energy consumption level is 270 kWh/m2, which is more than twice higher than the same indicator in Europe (100–120 kWh/m2), and also significantly higher than energy consumption in Russia (210 kWh/m2). The reason for the low energy efficiency of buildings in Kazakhstan, in addition to climate conditions, is high energy losses due to insufficient thermal insulation of buildings. Heat losses in buildings are primarily caused by inefficiencies in ventilation system design and operation, which account for 56% of all losses, followed by losses through walls (22%), windows (14%), and floors (8%). Residential and non-residential buildings collectively accounted for 43.3% of total final energy consumption in Kazakhstan. Out of 2.4 million buildings in Kazakhstan, 31.5% are over 50 years old and another 32.9% are over 25 years old. In rural areas, most heat is produced by burning coal and oil products. In large cities, centralized heating covers about 50% of consumption, but lack of investment in obsolete distribution networks means that energy losses during distribution amount to up to 35%. For the widespread use of new and more efficient technologies in the building sector, incentives are needed for thermal modernization of buildings and the introduction of new heating technologies to reduce energy consumption in the sector. Successful transfer of such technologies to Kazakhstan could allow their replication and wide distribution in the country that can in turn lead to the sale of relevant products at low cost. In the medium and long term, active support will also be required for technologies that use geothermal energy and hot water supply using renewable energy sources.

Industry, including industries that are difficult to decarbonize, produces more than a fifth of all GHG emissions in Kazakhstan. Options for decarbonising industrial processes include upgrading equipment and restructuring production to separate manufacturing processes or upgrading equipment from low-carbon to zero-carbon technologies, including switching from natural gas to hydrogen (a technology that refines iron ore at lower temperatures with less energy and scale). The Strategy envisages transitional technologies and process improvements (injection of CO2 into concrete, which will subsequently be supplied with its own CCS installations) at the initial stage, followed by the complete elimination of GHG emissions. The mechanical engineering sector will require innovative low-carbon developments and other technologies to decarbonise the sector.

The transport sector, including the sustainable urban mobility in Kazakhstan operates almost entirely on fossil fuels and is, therefore, also a major source of GHG emissions. The volume of passenger traffic in Kazakhstan has increased threefold over 10 years, while the vehicle fleet largely consists of old vehicles. The Strategy provides for the optimization of passenger and freight flows, the development of public transport systems, urban planning, the active use of alternative fuels, large-scale electrification and modernization of existing vehicles, and the transition to transport using alternative and renewable energy sources. The use of biofuels and hydrogen is expected in those types of transport that are difficult or impossible to fully electrify (for example, in water and air transport). In addition to this, a new trend in the transport sector is electromobility and broader issues of planning and improving urban systems.

Agriculture together with LULUCF emitted around 10.5% of national net GHG emissions in 2022. At the same time, more than 80% of agricultural infrastructure is physically obsolete. The transition to organic farming is slow: currently only 1% of agricultural land in the country is allocated to organic farming. However, limited access to concessional finance and significant subsidies for chemical fertilizers prevent farmers from developing a more productive and climate-resilient agricultural sector. The implementation of the Strategy requires the adoption of carbon-efficient and advanced farming technologies, the development of climate-resistant agricultural crops, the promotion of organic farming, and the introduction of smart greenhouse systems.

Technologies for carbon sequestration in soil and biomass in forests, croplands, grasslands, wetlands and other lands are poorly used. Failure to observe crop rotation, insufficient and untimely fertilization, etc. leads to a decrease in the humus level, loss of soil properties to retain water and its ability to maintain the hydrological regime, capture carbon dioxide from the atmosphere and deposit it. Technologies are needed to enhance soil productivity, restore its water retention capacity, and maintain soil balance for carbon sequestration. These advancements are essential for adapting agriculture to climate change and facilitating the transition to sustainable agri-food systems.

The forest fund of Kazakhstan, including 30.1 million hectares of forests, forest plantations (state and private) is a priority area of Kazakhstan's climate policy. Forestry is the largest carbon sink in Kazakhstan. In 2020, Kazakhstan announced an ambitious plan to plant more than 2 billion trees by 2025. However, there is a need to develop a Roadmap for the integrated development of the forestry sector using technologies for the restoration of natural ecosystems – more reliable and sustainable than artificial reforestation, which, as international experience shows, leads to disruptions in the water balance and generally has a negative impact on local ecosystems. These measures will increase the capacity of forests to absorb CO2 and adapt. The implementation of sustainable forest management and reforestation will make it possible to cover GHG emissions from the entire agricultural sector and partially from other sectors by 2060.

In 2024, at the initiative of MENR with the support of UNDP, the development of the Concept on biodiversity conservation until 2030 was launched This concept covered issues of restoration of pasture productivity, which, in addition to mitigation and adaptation benefits, will allow to solve the problems of land erosion, improve soil water retention properties, and restore groundwater reserves. In order to fulfill obligations on restoration of degraded lands and pastures, it will be necessary to train and apply the best practices and technologies of ecosystem restoration, as well as to implement pilot projects with the support of public-private partnership.

Implementation of plans for the development of the forest sector and conservation of biodiversity also requires effective technologies for combating forest pests and diseases, creating forest plantations and seed banks, remote monitoring of forests, early detection and extinguishing of fires.

The "Water and Sanitation" sector is a priority for Kazakhstan's future development due to the growing water deficit and the reduction of transboundary water flow from neighboring countries. To mitigate and adapt to climate change, the government has introduced new programs, established the Ministry of Water Resources and Irrigation, and is in the process of developing a new Water Code. In addition to these measures, international support is recommended to advance key areas such as biological methods for cleaning rivers and lakes, modern localized water supply and treatment technologies, the digitalization of water management through integrated databases and platforms (including those for transboundary rivers), water-free irrigation technologies, river restoration, soil property recovery, and more.

The waste management system is dominated by the lowest level of the waste management hierarchy, namely disposal at landfills. GHG emissions from waste have been growing continuously since 1994: 52.2% of GHG emissions in this sector come from MSW management, 47.4% from wastewater treatment, and 0.4% from waste incineration. Separate collection of MSW and its preliminary sorting are poorly developed. At the same time, about 37% of MSW, or around 2 million tons per year can be used using biogas production technologies.

Similarly, on wastewater, there is very limited capacity of treatment facilities in cities and other settlements and poor state of such facilities, namely physical deterioration and obsolete wastewater treatment technologies using chlorine. It is necessary to create an infrastructure for the treatment and disposal of sewage sludge: sludge is buried in sludge beds or landfills regardless of the content of organic and other substances in it. Given the growing climate risks, there is a need to decentralize wastewater treatment and drinking water supply systems through the development and application of effective local technologies.

4.E.2. Policies aimed at attracting investment and creating conditions for the development and transfer of new technologies and enhancement of endogenous capacity and technology

The Strategy on Achieving Carbon Neutrality by 2060, the State Program for Industrial and Innovative Development for 2020–2025 and other programs provide for state support for the implementation, replication and scaling of climate technologies, including their support through fiscal, import-related, investment and budget policies, provision of incentives for energy and water conservation, restoration of land fertility and natural ecosystems, support and dissemination of low-carbon technologies and CCS technologies.

In order to attract investment and technology, new standards are being developed that are consistent with international standards, including in the areas of green construction, green transport, energy efficiency of buildings and residential premises, and environmental management. Policies to stimulate technology and investment are complemented by measures to improve the general business environment and investment climate, taking into account transparent criteria for green investments and ESG criteria.

In order to promote new decarbonization technologies in Kazakhstan, it is necessary to select and implement pilot projects in various sectors and then to explore the potential for scaling up and the development of relevant measures for state support through legislation, provision of incentives, and implementing financial and non-financial measures. The International Center for Green Technologies and Investment Projects could take this work forward with the support of international partners.

The development of climate technologies in Kazakhstan is supported by a robust legal framework established in the Environmental Code and other relevant legislation. To encourage the adoption of new technologies, the Environmental Code outlines specific requirements and incentives aimed at minimizing environmental harm. According to Article 418, Paragraph 4 of the Code, starting in 2025, facilities that have a significant negative impact on the environment will be required to obtain an integrated environmental permit. This permit mandates the implementation of Best Available Techniques (BAT). These provisions have been in place since 2021 to facilitate a gradual transition toward sustainable practices.

Considering that the most serious consequences of climate change in Kazakhstan are associated with growing water scarcity and degradation of natural ecosystems, a new chapter dedicated to adaptation to climate change was introduced into the Environmental Code in 2021. As aquatic ecosystems transcend sectoral and provincial programs and mandates, climate change adaptation planning has been complemented by an ecosystem/basin approach in the NDC. The basin approach will significantly expand the possibilities for climate innovation, investment and technology based on intersectoral and transboundary cooperation. However, international experience and pilot projects are needed to reform the water resources management system based on basin management for climate innovation and investment.

In 2021, the Ministry of Digital Development, Innovation and Aerospace Industry of Kazakhstan was also created with the tasks of formulating and implementing state policy on innovation and digital development. To that end, in 2023–2024, the ministry -conducted a study under the GreenTech program on low-carbon development, adaptation to climate change and achieving carbon neutrality to be achieved through development of proposals for priority technologies in the sectors of renewable energy, energy efficiency, sustainable buildings, transport, air protection, water resources management and waste minimization.

In 2023, following a request by the President of Kazakhstan, the Ministry of Water Resources and Irrigation was established, and the development of a new Water Code has continued, providing for protection of the country's water resources and aquatic ecosystems, including through the support and widespread use of water conservation technologies and the restoration of aquatic ecosystems, reducing the risks of floods, droughts and other dangerous natural phenomena associated with climate change. The objectives set will require strategic assessment and identification of technologies least affected by climate risks, in particular those related to radical renewal of water and energy infrastructure, with consideration of possible solutions based on natural processes and restoration of aquatic ecosystems.

The Concept of Investment Policy of Kazakhstan until 2026 (Resolution of the Government of the Republic of Kazakhstan dated July 15, 2022 No. 482) also defines the principles of investment policy, including the development of green financing instruments. By the Decree of the Government of the Republic of Kazakhstan dated December 31, 2021 No. 996, the Taxonomy of

Green Technologies and Projects was adopted with a classification of technologies in various sectors subject to state support and financing, including through green bonds and green loans. According to the NDC, an update of the green taxonomy is required, considering international indicators of energy efficiency and conservation, GHG emission reductions and climate change adaptation.

The action plan for the implementation of the program 'Fair Kazakhstan – for everyone now and forever' (Decree of the President of the Republic of Kazakhstan dated 26 November 2022 No. 2) provides for attracting at least USD150 billion in foreign direct investment by 2029; ensuring at least 60% of the country's level of natural gas supply; increasing renewable energy production by 1.5 times; reducing emissions of harmful substances by 20% through the introduction of new technologies; increasing the forest area to 14.5 million hectares; reducing pollution from industrial enterprises; creating the necessary infrastructure in all major cities for the development of an electric vehicle fleet.

All of the above documents provide for the development of technologies for the digitalization of the energy sector, water management, land use and other sectors in the form of a single climate platform, which will increase the effectiveness of measures to develop climate technologies and create a basis for intersectoral interaction.

At the same time, the NDC and the Strategy on Achieving Carbon Neutrality 2060 highlight barriers to technology transfer, including: lack of access to affordable finance for RES and other low-carbon technologies for local consumers and investors, while brownfield assets retain access to guarantees and financing with lower interest rates; lack of climate criteria in the budgeting process and insufficient regulatory and economic incentives for the introduction of climate technologies in the construction, agricultural, water sectors, sectoral legislation and policies; lack of harmonized methods of collection, analysis of information and documentation related to climate technologies.

In all the above sectors, additional technical assistance is also required to build endogenous expert capacity, which is critical to strengthening climate policy and implementing decarbonization measures.

Summary of the information on technology development and transfer support needed is provided in CTF Table III.8.

4.F. Information on technology development and transfer support received by Kazakhstan under Article 10 of the Paris Agreement

Support and cooperation with international partners and the private sector in the development and transfer of climate technologies focused primarily in the energy sector and aimed at promoting renewable energy sources, improving energy efficiency of manufacturing industry and buildings, as well as in the forestry and water resources management sectors.

4.F.1. International support received in in relation to technology development and transfer

The technology cycle includes several stages, namely: research and development, demonstration, implementation, dissemination and transfer of technology. Almost all international support provided was mainly related to the last stage, i.e. technology transfer related to renewable energy, energy efficiency, agriculture, forestry and water management

In Kazakhstan, the renewable energy sector was one of the most attractive for investing in new technologies. In 2024, 148 renewable energy facilities were built in the country using a financing scheme, in which up to 70% of the project cost was covered by loans. Almost two-thirds of renewable energy projects were implemented by Kazakhstani investors and 59% of all renewable energy capacity was financed by foreign investors, as they are motivated in implementing large projects. For example, the Chinese company Sany Group Co. Ltd is implementing a project to build a wind power plant in the Zhambyl and Pavlodar regions with a capacity of 1 GW and an investment of more than USD1 billion. Also, over the past five years, another

Chinese company, China Power International Holding, has built a wind power plant in Zhanatas and a solar power plant in Karaganda.

Among the major innovative projects implemented in Kazakhstan is the German-Swedish mega-project SVEVIND for the production of "green" hydrogen in the Mangistau region. The project includes the construction of a desalination plant, a 40 GW renewable energy (wind, solar) station, and a 20 GW water electrolysis plant with an annual production capacity of 2 million tons of "green" hydrogen or 11 million tons of "green" ammonia. The preliminary estimate of the investment level is around Euro 50 billion euros. A comprehensive environmental impact assessment is planned together with assessment of alternative uses of water and other resources. The project is planned to be launched in 2027.

As of 2024, there are 148 renewable energy facilities operating in the country with a total capacity of 2904 MW, of which: 59 wind power plant projects with a capacity of 1409 MW, 46 solar power plant projects with a capacity of 1223 MW and 40 hydroelectric power plant projects with a capacity of 270 MW. In the first half of 2024, according to the Kazakhstan Association "QAZAQGREEN", the share of renewable energy sources in total electricity generation reached 6.5% (3.896 billion kWh). Table 4.6 provides information on capacity of renewable sources and electricity produced therefrom in 2024.

Table 4.6. Information on the capacity of renewable energy sources and electricity production therefrom for the first nine months of 2024

Indicators	Units of measurement	For 9 months of 2024
Installed capacity including**:**	MW	2,904
wind power plants	MW	1,410
small hydroelectric power plants	MW	270
solar power plants	MW	1,223
bioelectric power plants	MW	1.8
Electricity generation including:	million kWh	5783
wind power plants	million kWh	3225
small hydroelectric power plants	million kWh	944
solar power plants	million kWh	1613
bioelectric power plants	million kWh	0.56
The share of electricity generated by renewable energy sources in the total volume of electricity production	%	6.67
The increase in electricity generation by renewable energy sources for the first 9 months of 2024 compared to the first 9 months of 2023 is 18%.		

A significant number of projects by state-owned companies, private sector entities, and international partners have focused on introducing technologies to enhance energy efficiency, modernize production processes, and ultimately reduce energy consumption. Nearly all large, medium, and small private and state-owned companies have undertaken measures to improve energy efficiency, including Total Energies, ACWA Power, KazMunaiGas, Kazakhoil, KTK, Samruk-Kazyna, KEGOC, and ENRC. For instance, KazMunaiGas, in collaboration with Chevron under a memorandum of cooperation, is implementing a pilot project on carbon capture, utilization, and storage (CCUS). This project aims to enhance oil recovery from depleted reservoirs while contributing to emissions reduction.

International organizations: UNDP, EBRD, ADB, World Bank, GIZ, DENA and others in partnership with GCF, GEF and other specialized funds. The governments of Germany, Japan, France, Switzerland, the EU and others have also actively supported Kazakhstan's efforts to decarbonize the energy, forestry, water management and other sectors.

The Kazakh government has also announced plans to build a nuclear power plant on the shores of Lake Balkhash. Several companies have been pre-selected for construction: CNNC (China), KHNP (South Korea), EDF (France) and Rosatom (Russia). The final decision on the possibility of creating a consortium will be made in 2025.

Kazakhstan's experience of cooperation with the EBRDin promoting renewable energy has been successful. The joint program envisaged increasing the use of renewable energy sources to 3% by 2020. In 2019, following the successful implementation of the first phase of the programme worth EUR200 million, the Bank approved the second phase of EUR300 million for solar, wind, hydro and biogas energy projects, as well as electricity distribution and transmission projects. In addition to funding, the cooperation program includes the provision of preferential financing from the Green Climate Fund (GCF) in the amount of $110 million, support in the preparation and holding of auctions for renewable energy projects, the development of carbon markets and the expansion of economic opportunities for women in the renewable energy sector. It is also expected that at least 400 MW of new renewable energy sources will be financed, which will lead to a reduction in CO_2 emissions of at least 500 kt annually.

The Asian Development Bank provided technical support in four technology related areas: (i) the establishment of a Renewable Energy Center at KEGOC to safely integrate unstable renewable energy generation while ensuring reliable and sustainable operation of the power system; (ii) the installation of modern software at KEGOC for high-quality forecasting of renewable energy generation, which will optimize the operation of maneuverable capacities to ensure the balance stability of the power system; (iii) a technical assessment of the balancing capabilities of the power system in accordance with the best international practices to improve the efficiency of using existing and newly commissioned generating capacities; (iv) improving KEGOC's tariff methodology to increase the operational efficiency and profitability of the company.ADB is also helping the government prepare and conduct private sector auctions for hydropower projects with a potential capacity of about 600 MW in the Alakol, Balkhash, and Irtysh/Zaisan river and lake basins in the southeast of the country.

The World Bank approved an operational program for Kazakhstan in 2022 amounting to $600 million, marking a key step in a series of reforms aimed at promoting sustainable and inclusive economic growth in the country. The low cost and relatively long repayment period of the World Bank financing align with the needs of the government. The funding will support government reforms and actions aimed at developing greener and more efficient energy systems, in line with the recommendations of the "Country Climate and Development Report." These measures are designed to help reduce Kazakhstan's carbon footprint as part of the country's contribution to global efforts to combat climate change

With the support of the World Bank and the Regional Environmental Centre for Central Asia, within the framework of the Climate Adaptation for the Central Asian Countries (CAMP4ASB) program, a project on adaptation to climate change at the local level was implemented for farmers, housewives, schools and NGOs in all countries of the region. The project summarized the experience of using climate technologies in various countries and created a database of more than 150 technologies to support people's basic needs for energy, water, food and housing in the face of climate change. The project also included the creation of training materials, demonstration sites and practical training in learning how to make and use the technologies. To develop this area, it is necessary to create demonstration and training centers at the local level based on existing NGOs, schools, farms and SMEs.

4.F.2. National programs and measures to promote the development of new low-carbon and climate-resilient technologies

National and local programs and private initiatives adopted in Kazakhstan to develop innovations and technologies to provide the population and enterprises with heat, electricity, housing, transport, food, drinking water, as well as training and capacity building programs are also important for the purposes of achieving the targets enshrined in the NDC. For example, the Concept for the Development of the Water Resources Management System of the Republic of Kazakhstan for 2024–2030 and the Comprehensive Plan for the Development of the Water Sector for 2024–2028 are aimed at supporting sustainable water supply to the population, economy and natural ecosystems in the face of growing climate risks. The plan includes large-scale modernization of water management infrastructure, introduction of water-saving technologies, construction of new reservoirs and storage ponds for accumulation of melt and flood waters. The plan also includes treatment and reuse of wastewater, reforms in water resources management, including on the basis of technologies for creation of an integrated digital water monitoring platform in the country and at the transboundary level. The program is financed from state and local budgets, international loans and grants. The total funding for the Plan is more than KZT 3.3 trillion (USD7 billion)

Another example of national efforts to support innovative climate solutions is the recently adopted Concept for the Development of Hydrogen Energy in Kazakhstan until 2030. The concept envisages the development of production of “green” or “blue” hydrogen through R&D to study the production, use, transportation and storage of hydrogen, infrastructure development, investment attraction, international cooperation and provision of state support for large-scale hydrogen energy projects (Order of the Minister of Energy of the Republic of Kazakhstan dated September 27, 2024 No. 342). Given that hydrogen production may have additional environmental impacts, a comprehensive impact assessment and mitigation is also necessary.

Specialized organizations have also been created in Kazakhstan to support the development of new technologies and materials. The National Agency for Technological Development (QazInnovations) is a structure that supports the development, implementation and commercialization of new technologies. The Agency’s programs finance start-ups and projects in various sectors. Over the past few years, they have supported more than 300 projects through grant programs. There is also a Program for Industrial and Innovative Development. As part of this program, Kazakhstan has produced more than 500 new types of products, which stimulates technological modernization and increased innovation activity in industry.

The Science Fund has also been in operation since 2006 and has supported over 180 projects aimed at commercializing research and technology development in sectors such as agribusiness, health, information technology and the environment. A number of projects are being implemented with the support of international partners at the regional level in cooperation with the countries of Central Asia and the Caspian states. For example, the transboundary program “Green Central Asia”, with long-term and targeted support from the German government, contributed to the implementation of a number of projects on mitigation and adaptation to climate change in Kazakhstan, as well as the adoption in 2023 of the Regional Strategy for Adaptation to Climate Change in Central Asia with a package of pilot projects for coordinated actions by countries in the region that have shared water and forest resources, glaciers, mountain and other ecosystems. The projects provide for the harmonization of approaches to the application of modern methods and technologies for planning, monitoring, and preventing hazardous natural phenomena and restoring ecosystems.

The Government of Japan supports the efforts of Kazakhstan and Central Asian countries to mitigate the consequences of the Aral Sea environmental disaster, and also supports the Joint Credit Mechanism (JCM) to attract investment in projects to reduce GHG emissions. Within the framework of the regional cooperation “Central Asia plus Japan”, Japan and UNDP signed an agreement on a project to increase the resilience of Central Asian cities to climate risks through regional cooperation mechanisms and national strategies, as well as promoting sustainable development in Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

As part of cooperation with UNDP, the Damu Fund has implemented tools to support technologies for energy efficiency of urban infrastructure, reduction of GHG emissions and reduction of risks of investing in renewable energy sources since 2017. 81 projects were supported for a total of KZT 6.8 billion (USD20.420 million). In addition, the Damu Fund facilitated private investment in 150 projects, which resulted in the implementation of significant initiatives, including rate subsidies and loan guarantees for SMEs, and supported 25 projects worth KZT 2.351 billion (USD7 million).

In total, several hundred projects on implementation and transfer of technologies that contribute to the achievement of NDC goals in the sectors of energy, industry, utilities, transport, water, forestry and agriculture, biodiversity and others were implemented in Kazakhstan in 2019–2023 by private, state, local and international organizations. More than 238 projects were financed by international organizations and donor countries (OECD data on climate projects in Kazakhstan for 2019–2023. https://drive.google.com/file/d/1_MQLY6rIkTFYC8UG2kw8txIBrIGvT-hq/view?usp=sharing)

Summary of the information on technology development and transfer support received is provided in CTF Table III.9.

4.G. Information on capacity-building support needed by Kazakhstan under Article 11 of the Paris Agreement

In Kazakhstan's state programs and reports on SDGs and climate change, consider capacity building as a process of strengthening and developing human, institutional, technical and financial resources necessary for the effective achievement of national and international commitments in the field of sustainable development and climate change. This includes training of specialists, development of national research centres, improvement of monitoring systems, as well as creating potential for upgrading technologies to prevent and adapt to the effects of climate change. Capacity building also includes the development and support of a legislative framework, improved coordination between government agencies and development of public understanding and participation in environmental initiatives. For Kazakhstan, capacity building is a priority and a prerequisite for meeting international commitments on climate change.

Since 2019, Kazakhstan, independently and with the support of international partners, has carried out significant work to create and enhance the potential for implementing national commitments under the Paris Agreement. Due to participation of state, local, public, international organizations and the private sector, more than 200 projects were implemented and more than 300 training sessions and seminars were held on issues of decarbonization of economic sectors, as well as adaptation of the water, agricultural, forestry and other sectors of the country.

However, despite the work done, Kazakhstan faces a number of challenges in the area of capacity building that require additional national efforts and international support.

4.G.1. Capacity building requires national efforts and strengthening of the institutional framework

The role and potential of the MENR, supported by a strong coordination mechanism, can also be strengthened in setting climate policy targets and indicators and in analyzing the implementation of programs and projects. At the same time, all ministries and departments, as well as local government bodies, need to have clear and understandable roles and responsibilities. For example, the Agency for Strategic Planning and Reforms under the President of the Republic of Kazakhstan could help develop a comprehensive approach to incorporating climate change issues into public administration and planning processes at all levels and in all areas. The Ministry of National Economy and the Ministry of Finance of the Republic of Kazakhstan could provide the necessary support for integrating climate change measures into strategic and budgetary planning processes across all sectors.

In order to integrate water, agriculture and other sectors' programs, sectoral and administrative-territorial planning under the NDC will be complemented by an ecosystem/basin approach, with Basin Councils empowered to coordinate climate change adaptation measures. The basin approach will strengthen the links and synergies of departmental and territorial programs on mitigation and adaptation to climate change.

Informing citizens, building capacity to understand climate change mitigation and adaptation, and ensuring public support is a key component of climate policy. Strong citizen support is needed to implement successful reforms. Although 71% of Kazakhstan's residents (lower than other countries in Europe and Central Asia) consider climate change a serious problem, the country has one of the lowest levels of awareness of climate change, its impacts, and measures taken to address it (World Bank, 2022). Public support for climate action is also lower than in other countries. Less than 50% of respondents agreed that the country needs to switch to alternative energy sources and less than 67% supported cutting government subsidies for fossil fuels. There is also no clear understanding of the impacts of climate change and the need for greater accountability of polluting industries, while decarbonizing the energy sector would reduce air pollution by 86% from today's levels and generate $1 billion in savings from fewer lost workdays and $2.5 billion in reduced health care costs.

The development of private entrepreneurship potential in the country is constrained by the dominant role of state-owned enterprises and the high level of overregulation. The public sector and state-owned enterprises dominate the economy, leading to lack of sufficient incentives for entrepreneurs and investors to engage in climate policy. The private sector in Kazakhstan is still not ready to lead the green transition. According to World Bank estimates, private sector enterprises in Kazakhstan are less willing to implement green practices and invest in developing environmentally friendly solutions than those in other Central Asian countries. Only 18.5% of Kazakhstani enterprises have set targets for energy consumption and CO_2 emissions, the share of such enterprises in Kazakhstan is much lower than in comparable countries in the Central Asian and European regions.

A key challenge is also to strengthen institutional capacity to address climate impacts on water resources. Although water policy has already identified areas for action, further strengthening of water cooperation and governance systems is needed. Priority measures for climate mitigation and adaptation are not systematically taken into account in water policy; criteria and procedures for taking climate risks into account are not used in project planning and decision-making. Basin management, which is the basis of water resources management, remains an underdeveloped mechanism and does not fulfill its role in uniting efforts to protect aquatic ecosystems and to strengthen the participation of water users and the public in decision-making. Another important task is to strengthen the analytical and scientific-technical potential of water resources management in research institutes and universities. It is also necessary to improve the capacity and capabilities for monitoring and controlling compliance with regulatory requirements in order to ensure water intake and discharge indicators that optimize the use of water resources, improve environmental protection and restore natural complexes, such as the ecosystems of the Northern Aral Sea, the Ural River Delta and Lake Balkhash.

4.G.2. Capacity building requiring national efforts with international support

Kazakhstan has extremely limited capacity to plan nature-based solutions for climate change mitigation and adaptation. It is known that restoration of forests and soil properties on slopes and catchment areas in the upper reaches of rivers, floodplain and delta ecosystems and wetlands, as well as the creation of "green" infrastructure facilities (protective belts, forest plantations, natural meadows) are more effective and reliable solutions than traditional measures based on technical and so-called "grey" solutions, such as the construction of concrete banks, dams and levees. Changing these approaches requires analytical information, training for specialists from relevant ministries, departments, local authorities and enterprises, as well as study tours and pilot projects, including projects for strategic assessment of proposed programs with consideration of alternative solutions.

Increased capacity is also needed for landscape carbon sequestration when planning for forest restoration and wildfire reduction. Forests and landscapes have significant potential to sequester carbon, which can replace more expensive measures in hard-to-decarbonize sectors. According to available data, the sequestration potential of meadows, pastures and forests in Kazakhstan in 2060 will amount to 20 to 40 million tons of CO_2-eq./year at a cost of USD62–124 million per year in the period from 2022 to 2060. However, to achieve this goal, it is necessary to begin work now to assess the potential for sequestration, as well as to implement promising solutions on a pilot basis. At the same time, the scaling of such projects must continue until 2050 inclusive, otherwise the sequestration potential will remain unrealized. The 2003 Forest Code also needs to be updated to enhance the role of forests in maintaining climate stability, preserving biodiversity and water cycles.

Although the Government has set a target of planting 2 billion trees by 2025, a roadmap and implementation plan are needed. Support from international organizations in planning and a coordinated approach across the country with a forward-looking vision and sustainable funding could help address these important challenges. Urgent measures also include the creation of a training center to teach methods of restoring landscapes and soil properties based on natural processes, which will achieve a triple effect: restoring soil fertility, reducing water erosion, increasing the soil's ability to retain CO2, and significantly reducing the threat of floods.

Increased human resource capacity and information and analytical support are also required to integrate climate goals into land legislation and strategies. Despite the obvious advantages of environmentally friendly agricultural production, the state program for 2021–2030 does not include targets for preserving and restoring land fertility. Including climate-related provisions in the Land Code (2003) and the Law on Pastures (2017) could facilitate the implementation of a holistic approach to addressing land degradation, soil erosion and ecosystem fragmentation. Consideration should also be given to the use of strategic environmental assessment to integrate environmental, social and climate issues into sectoral and territorial development planning. This also requires amendments to the Environmental Code to expand the scope of application of strategic environmental assessment in Kazakhstan.

There is a need to strengthen the capacity to scale up climate finance. In addition to the known credit constraints, developers, investors and businesses lack the knowledge and information needed to evaluate low-carbon proposals and prepare quality projects. In order to fill this gap, educational training is needed, as well as state support for innovation, research and development. The government needs to allocate funds to finance R&D for the development and implementation of low-carbon technologies to address the lack of private investment in this area.

In conclusion, it should be noted that in order to increase the capacity of state, public, analytical and scientific institutions, technical experts and the population in all areas related to climate, it will be necessary to: (i) develop and conduct training programs for capacity building; (ii) familiarize with the best international practices and conduct educational seminars on international standards, certification, including on the preparation and management of projects and costs, logistics and efficiency improvement; (iii) improve access to information, its processing and dissemination – create national and territorial centers for training and climate information on the basis of a digital platform and sustainable financing; (iv) conduct information campaigns on the risks and benefits of the "green" transition through magazines, mass media, television and social networks in cooperation with the government, NGOs, local communities, associations, business and international organizations.

Summary of information on capacity-building support needed is provided in CTF Table III.10.

4.H. Information on capacity-building support received by Kazakhstan under Article 11 of the Paris Agreement

Intersectoral cooperation, increasing the capacity and awareness of the population and business on climate change issues are also a priority in all programs and projects of international organizations that provide support to Kazakhstan. Supported by UNDP, the World Bank, the Governments of Germany, Japan, Switzerland, France, Finland and other partners, national and regional platforms and programs for strengthening environmental and climate potential and cooperation in various sectors between government institutions and public organizations, ministries and governments of Central Asian countries have been designed, launched and are successfully operating in the country. Examples that are provided below show how capacity building received at the national, regional and local levels enabled relevant institutions and stakeholders to engage more actively in climate action and in supporting effective implementation of climate policies.

Since 2019, the Regional Environmental Centre for Central Asia has been supporting a climate policy and information platform that brings together the positions of 5 Central Asian countries and provides knowledge on climate change and mitigation in the region. The target groups of this platform are decision makers, civil society, SMEs and farms. Germany also supports the Central Asian Climate Adaptation Program, which prioritizes capacity building and strengthening climate cooperation between Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan.

The European Bank for Reconstruction and Development is playing a leading role in increasing the capacity to attract financing for the construction of renewable energy sources, the modernization of transport infrastructure and the improvement of water supply systems and agriculture. The Bank assists Kazakhstan in simplifying regulatory procedures and attracting international partners and private capital to renewable energy sources, and also provides funds to increase the potential of large enterprises and SMEs in the development of renewable energy sources and energy efficiency. For example, the Green Almaty project actively involved local residents in energy saving campaigns and the promotion of environmentally friendly modes of transport, such as bicycles and electric cars.

The World Bank assists Kazakhstan in implementing national climate strategies and plans by providing assistance to increase the energy efficiency capacity of large industrial enterprises and the agricultural sector, strengthen economic mechanisms, institutional structures, legislative framework, and integrate climate goals and policies into economic programs. The Bank also supports a program to preserve the Northern Aral Sea and to involve local communities in a landscape restoration program in Kazakhstan.

The Asian Development Bank also aids Kazakhstan and Central Asian countries in strengthening the capacity of government and financial institutions through a special training program, as well as in creating and strengthening mechanisms and platforms aimed at increasing climate finance, including for the construction of new hydropower plants.

Examples of work to engage local communities and populations and build their capacity are UNDP projects in the energy efficiency sector, as well as in other sectors, including water and biodiversity. With the support of UNDP-GEF in partnership with the Damu Fund, more than 20 demonstration projects were implemented on thermal modernization of residential buildings with effective solutions for reducing energy consumption, cutting costs and improving living conditions, as well as on the development of organizational and financial models to improve the competence of homeowners and local governments for their subsequent scaling in the regions of Kazakhstan.

GIZ programs play an important role in increasing Kazakhstan's potential to fulfill the obligations of the Paris Agreement. For example, a program to support workers in the coal industry and minimize the socio-economic consequences of the transition to carbon neutrality includes educational courses and training to prepare workers for new conditions in the labor market. The sustainable farming project supports local farmers in adapting to climate change through training and access to new technologies for water management and crop resilience. GIZ also supports projects to develop energy-efficient construction in Kazakhstan, including the modernization of heating systems and the installation of energy-saving equipment with the participation of the population. In programs to increase water resilience in rural areas, GIZ supports the implementation of water management systems that enable agricultural communities to use water more efficiently, maintain environmental sustainability and increase the potential to minimize the impact of droughts.

The support received by Kazakhstan from international partners has significantly contributed to strengthening the country's climate potential. EBRD, ADB, World Bank and UNDP projects in the field of renewable energy and energy efficiency played an important role in strengthening capacity and developing national qualified personnel in the field of climate planning, low-carbon technologies and climate risk management. Programs for forecasting and assessing climate risks, increasing energy efficiency, water conservation, green transport, access to drinking water and others helped improve the planning skills for decarbonization of key sectors of the economy with the participation of the private sector, scientific and public organizations.

Summary of information on capacity-building support received is provided in CTF Table III.11.

4.I. Information on support needed and received by developing country Parties for the implementation of Article 13 of the Paris Agreement and transparency-related activities, including for transparency-related capacity-building

In the Paris Agreement and the United Nations Framework Convention on Climate Change (UNFCCC), the term "transparency" refers to a system of reporting, monitoring and verification aimed at building trust among participating countries and increasing accountability for their actions to reduce greenhouse gas emissions and other climate commitments.

The purpose of the transparency framework is to provide an objective and comparable view of global efforts to combat climate change, strengthen international cooperation and monitor progress to support the achievement of the goals of the Paris Agreement.

The Republic of Kazakhstan attaches great importance to transparency and the relevant provisions of Article 13 of the Paris Agreement. The Government believes that transparency is central to the implementation of the Paris Agreement as it builds trust and confidence that all countries are making every effort to achieve the goals of the Paris Agreement. Furthermore, transparency is important to facilitate effective implementation as it helps a country identify the best possible avenues for cooperation on both mitigation and adaptation.

4.I.1. To meet its commitments with regards to transparency, Kazakhstan needs support on a number of issues

There is a need for support for advancing the following issues:

- Improving the national monitoring, reporting and verification (MRV) of data related to GHG emission inventory, mitigation and adaptation measures;
- Improving the national Enhanced Transparency Framework under Article 13 of the Paris Agreement, including s tracking of NDC progress in implementing and achieving the economy-wide emission reduction target that is included therein
- Preparation of national GHG inventory and Biennial Transparency Report and their submission on an annual and biennial basis respectively;

It is necessary to create a single national digital climate platform. The effectiveness of climate policy, sectoral and territorial planning, coordination and cooperation can be significantly strengthened through the creation of a single digital climate platform integrated with information platforms on energy, water resources, environmental protection and other sectors. The platform will significantly improve the reliability and quality of data, collection and analysis, help fill information and cross-sectoral gaps, and improve the decision-making system and its transparency, as well as the cooperation of all stakeholders in the process of transition to carbon neutrality.

There is a need to strengthen monitoring, reporting and verification (MRV) by providing the necessary methodologies and strengthening the capacity and skills of experts and institutions to conduct quality analysis regularly. There is also a need to strengthen expert capacity to use the full range of information and analysis available for the purposes of the ETF, strengthening data- and science-based climate change policymaking that aims to achieve national climate change goals.

To further improve transparency and increase the capacity of government, public, analytical and scientific institutions, technical experts and the population, the following support is also needed:

(i) Develop and deliver capacity building training programs;

(ii) Familiarize with best international practices and conduct educational seminars on international accounting, regulation, standards, certification and reporting systems;

(iii) Improve access to information, its processing and dissemination – create a digital platform and, on its basis, national and territorial climate information and training centres;

(iv) Conduct information campaigns through the media and social networks in cooperation with the government, NGOs, associations, businesses and international organizations and local communities.

4.I.2. Kazakhstan received support to enhance its capacity on transparency issues, from several organizations

With the support of GIZ in the context of the preparation of the Strategy on Achieving Carbon Neutrality by 2060, Kazakhstan has clarified data on current and planned emissions in key sectors of the economy and developed models and scenarios for future development of these sectors with associated emission levels.

Together with UNDP and GEF, Kazakhstan developed and submitted the Eighth National Communication and the Fifth Biennial Report, providing detailed data on GHG emissions, measures to achieve carbon neutrality and adaptation to climate change, including gender analysis.

UNDP is also aiding the country in preparing this report as part of the ongoing BTR1 and NC9/BTR2 project. Kazakhstan regularly holds seminars to exchange experiences and best practices in the field of climate policy and transparency. These measures also contribute to raising awareness and competence on issues of transparency and climate data accounting.

There are also other international transparency initiatives taking place in Kazakhstan and the Central Asian region, including:

CAREC's regional project on climate action transparency, supported by the ICAT, helps coordinate and improve reporting on climate measures in Kazakhstan and Central Asia. The Centre's activities are aimed at facilitating the exchange of information, increasing transparency and integration of national climate policies at the regional level.

Supported by UNEP and UNDP, the SPACES project is being implemented, which includes components on the development of methods for monitoring and reporting on biodiversity that take into account the impact of climate change, as well as educational activities on the analysis of biodiversity data and the implementation of effective measures to conserve biological diversity, taking into account climate change. The project provides for improved access to environmental information, including the creation of environmental data banks.

The EU-supported Sustainable Energy Contribution Framework (SECCA) promotes the integration of climate reporting in the energy sector. The initiative provides Kazakhstan with advice and funding to adapt its energy infrastructure and reporting to environmental and climate requirements, thereby increasing transparency and sustainability in the energy sector.

The support received by Kazakhstan from international partners has significantly contributed to strengthening the country's climate capacity to implement Article 13 of the Paris Agreement and activities related to transparency.

Additional information on the needs and assistance received to improve transparency is provided in the tables below.

Summary of information on support needed and received is provided in CTF Table III.12. and CTF Table III.13.