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Acronyms

(ActionPlan) Action Plan for the Production and Promotion of Agricultural Products and Organic Food;
(AGIF) Agency for Integrated Rural Fire Management
(AIGP) Integrated Areas for Lanscape Management
(AOGCM) Atmosphere-Ocean GCM
(APA) Portuguese Environment Agency, I.P.
(AR) Autonomous Regions
(ARA) Autonomous Region of the Azores
(ARM) Autonomous Region of Madeira
(BP) Bank of Portugal
(BPS) Basic Payment Scheme
(CAP) Common Agricultural Policy
(CC) Climate Change
(CHP) Combined heat and power
(C-ITS) Intelligent Transport Systems Services
(CLC) CORINE Land Cover
(CMIP) Coupled Model Intercomparison Project
(CORDEX)Coordinated Regional Downscaling Experiment
(COS) Land Use and Occupation Map
(CPR)Constitution of the Portuguese Republic
(DGT) Directorate-General for Territory
(DSB) Norwegian Directorate of Civil Protection
(EADER) European Agricultural Fund for Rural Development
(EAF) Electric Arc Furnace
(ECO.mob) Program for Sustainable Mobility in Public Administration 2015-2020
(ECO@SAÚDE) Ministry of Health's Sustainability Program
(EE2020) Europe 2020 Strategy
(EEA) European Environment Agency
(EMFF) European Maritime, Fisheries and Aquaculture Fund
(ENAB) National Strategy for Organic Farming
(ENEAPAI2030) National Strategy for Agricultural and Agroindustrial Effluents 2030
(EN-H2) National Hydrogen Strategy
(ENMAC2020-2030) National Strategy for Active Cycling Mobility 2020-2030
(ENMAP) National Strategy for Active Pedestrian Mobility
(EP) Livestock Effluents
(ERAC) Regional Strategy for Climate Change
(ERDF) European Regional Development Fund
(ERSE) Energy Services Regulatory Authority
(ESD) Effort Sharing Decision
(ESR) Effort Sharing Regulation
(ETS) EU emissions trading system
(EU) European Union
(FA)Environmental Fund
(FCUL) Faculty of Science of the University of Lisbon
(Ferrovia 2020) Railway Investment Plan
(FIZ) Forest Intervention Zones
(FPC) Portuguese Carbon Fund
(FRESAN) Project for the Strengthening Food and Nutrition Resilience and Security in Angola
(FSC) Forest Stewardship Council
(FTJ) Just Transition Fund
(GAW) Global Atmosphere Watch

(GCM) Global Climate Models
(GCOS) Global Climate Observing System
(GDP) Gross domestic product
(GHG) Greenhouse Gases
(GNR) National Gendarmerie
(GOS) Global Observing System
(GTS) Global Telecommunication System
(GVA) Gross Value Added
(ICNF) Institute for Nature Conservation and Forests
(IFN6) National Forest Inventory
(IH) Hydrographic Institute
(IMOP) Instruments and Methods of Observation Programme
(INERPA) National Inventory of Anthropogenic Emissions by Sources and Removal by Sinks of Atmospheric Pollutants
(IPCC) Intergovernmental Panel on Climate Change
(IPMA) Institute for Sea and Atmosphere
(IPMA) Portuguese Institute of Sea and Atmosphere
(ISP) Tax on energy products
(LULUCF) Land Use, Land Use Change and Forest
(MAAC) Ministry of Environment and Climate Action
(MBT) Mechanical and Biological Treatment
(MIBEL) Iberian Electricity Market
(MRE) Monitoring, Reporting and Evaluation
(MSW) Municipal solid waste
(NECP 2030) National Energy Climate Plan
(NREAP) National Renewable Energy Action Plan
(NUTS) Nomenclature of territorial units for statistics
(OE) Ocean Economy
(OSA) Ocean Satellite Account
(P3AC) Action Program for Adaptation to Climate Change
(PA11) Programme areas of Environment and Ecosystems
(PA13) Climate Change Mitigation and Adaptation
(PART) Fare Reduction Support Programme
(PDM) Municipal Master Plan
(PDR2020) Rural Development Program
(PEFC) Programme for the Endorsement of Forest Certification
(PETI3+) Strategic Plan for Transport and Infrastructure 2014-2020
(PERSU) Strategic Plan for Municipal Solid Waste
(PFN) National Railway Plan
(PGRH) River Basin Management Plans
(PGRI) Flood Risk Management Plans
(PHV) Private Hire Vehicles with a Driver
(PM) Prime Minister
(PNAC2020/2030) National Program for Climate Change
(PNEC2030) National Energy and Climate Plan 2030
(PNDFCI) National Forest Fire Protection Plan
(PNGIFR) National Integrated Rural Fire Management Plan
(PNI2030) National Investment Programme 2030
(PNPOT) National Spatial Planning Policy Programme
(PNRegadios) National Irrigation Program
(POSEUR) Operational Programme for Sustainability and Efficiency in the Use of Resources
(POC) Shoreline Management Programs

(PP) Portuguese Parliament
(PR) President of the Republic
(PRAC) Regional Programme for Climate Change
(PRGP) Landscape Planning and Management Programmes
(PROF) Regional forest management plans
(PROTransP) Programme to Support the Densification and Strengthening of the Public Transport Offer
(PTP) National Landscape Transformation Programme
(RCM) Regional Climate Models
(REOT) Report on the State of Spatial Planning
(RES) Renewable Energy Sources
(RESCCUE) Resilience to deal with climate change in urban areas
(RES-E) RES Sources Consumed in Electricity Production
(RES-H&C) RES Sources Consumed in Heating and Cooling
(RES-T) RES Sources Consumed in Transport
(RFM) Rural Fire Management
(RFP) Rural Fire Protection
(RNA2100) National Roadmap for Adaptation 2100 project - Assessment of the vulnerability of the Portuguese territory to climate change in the 21st century
(RNC2050) Carbon Neutrality Roadmap 2050
(SAU) Agricultural Area Used
(SGCIE) System for Management of Intensive Energy Consumption
(SIAM) Climate Change in Portugal. Scenarios, Impacts and Adaptation Measures
(SWDS) Solid Waste Disposal on Land
(SPeM) National System for Policies and Measures and Projections
(TEN-T) Trans-European Transport Network
(TVDE) Transportation in an Uncharacterized Vehicle from an Electronic Platform
(UNFCCC) United Nations Framework Convention on Climate Change
(VAT) Value-added tax
(WAM) With Additional Measures
(WCP) World Climate Programme
(WEM) With Existing Measures
(WHYCOS) World Hydrological Cycle Observing System
(WMO) World Meteorological Organisation
(WWW) World Weather Watch
(ZEV) Zero Emissions Vehicles

Executive Summary (1)

Introduction (1.1)

The 8th National Communication to the United Nations Framework Convention on Climate Change (5th National Communication in the context of the Kyoto Protocol) hereby presented, is organised in accordance with articles 4th and 12th of the Convention, as well as the relevant guidelines adopted by the Conference of the Parties, as follows: national circumstances; information concerning the national system and greenhouse gas (GHG) inventory, information about policies and measures, projections of greenhouse gas emissions; impacts, vulnerability and adaptation; financial commitments, technology transfer, and international cooperation; systematic research and observation and, finally, education, training and awareness of the people.

The objective is to have a document containing information covering the 1990-2020 period, coherent with the National Inventory of Anthropogenic Emissions by Sources and Removals by Sinks of air pollutants, previously submitted to the Convention (2022), covering emissions up to 2020. In some cases and specific chapters, updated information to most recent years was also included.

National Circumstances (1.2)

The Portuguese Republic is a democratic State of Law, sustained on popular sovereignty, pluralism of expression and democratic political organization, on respect and effective guarantees for fundamental rights and freedoms and on the separation and inter-dependence of powers, aiming to achieve economic, social and cultural democracy and a more participative democracy.

Portugal is a unitary State that respects, regarding its organization and function, the rule of self-governing system of the islands and the principles of subsidiarity, autonomy of local authorities and the democratic decentralisation of public services. The archipelagos of the Azores and Madeira are autonomous regions with their own political and administrative statutes and their own institutions of self-government.

In relation to climate change, and its impacts, the current Government's Organic Law maintained in its structure the Ministry of Environment and Climate Action (MAAC), with responsibility for environmental and energy issues. The Portuguese Environment Agency, I.P. (APA), is Portugal's public administration body responsible for the climate policy, thereby assuming a decisive role in the proposal, development and implementation of related policies. APA remains under oversight of the MAAC, and it retains the powers to propose, develop and monitor the implementation of environmental policies, notably in the field of climate change.

Resident population estimates for the years 2011 and 2020 show a tendency for a slight decrease both in mainland Portugal and the Autonomous Regions. Age distribution of resident population shows a prevalence, in 2020, of older age groups to the detriment of younger ones in Portugal, which is further confirmed by a growing ageing index and an increase in the total dependency ratio.

In mainland Portugal, resident population is concentrated along the coastline, between Viana do Castelo (north top of the map) and Setúbal, and the only two metropolitan areas of the country, Porto and Lisbon, are included in this territorial line. The Autonomous Region of Azores, due to its geographical features, shows significant population dispersion. However, the trend of significant concentration of population in main cities may also be seen in São Miguel and on the entire island of Terceira. In the Autonomous Region of Madeira, resident population is also concentrated near the city of Funchal.

The period 2011-2020 shows a general increase in Gross Domestic Product, both chronologically and geographically in 2020 compared to data from 2011 both in mainland Portugal and in the Autonomous Regions. This trend is similar when analyzing Gross Value Added, with an increase in 2020 compared to 2011 of the values recorded also in mainland Portugal and Autonomous Regions. The Services sector continues to be responsible for the biggest share in overall GVA and the *Agriculture, animal production, hunting, forestry and fishing* shows the most expressive growth from 2011 to 2020. A significant increase in total exports value has contributed to a more balanced trade balance. A slight increase in employment figures in mainland Portugal and a stabilization/decrease in Autonomous Regions was also registered from 2011-2020.

Portugal's territory has a total area of 92 225.20 km2 , a perimeter of 3 931 km, an extensive coastline (2 612 km) and comprises three different areas, one of the parts in the European Continent (the Mainland) and the other two are archipelagos in the Atlantic Ocean (the Archipelago of the Azores and the Archipelago of Madeira).

The mapping of land use and occupation classes allows a general reading of the use of territorial resources and identification of macro landscapes that reflect the diversity of the Portuguese territory. The most recent Land Use and Occupation Map (COS), from 2018, shows that 73.3% of the continental territory has forest, agricultural and agroforestry occupation. This value reaches 92.3% of territory if shrublands and grasslands are also considered, demonstrating its high potential for forestry and agricultural production and for the valorization of natural capital and landscape.

The climate in mainland Portugal is predominantly influenced by latitude, topography and its proximity to the Atlantic Ocean; some climate variables, such as precipitation and temperature have strong north-south and west-east gradients as well as a very significant seasonal and inter-annual variability.

Since the mid-70s the average air temperature has risen in all regions of Portugal at a rate of approximately 0.3°C/decade. It should be noted that out of the 10 warmest years, eight occurred after 1990, with 1997 being the warmest year and 2017 the second warmest. There is an increase in the number of days with high air temperatures and a decrease in the number of days with low temperatures, in particular after 1976. There is also an increase in the intensity and duration of heat waves. The 2011-2020 decade was the warmest since 1931 in mainland Portugal, surpassing the previous highest value that occurred in the 1991-2000 decade. Annual precipitation has decreased (-20mm/decade): the last 20 years have had particularly low rainfall in mainland Portugal. It should also be noted that 6 of the 10 driest years occurred after 2000, with 2005 being the driest year, 2007 the second driest and 2017 the third driest. The last four decades have been continuously drier, the driest one being 2001-2010. The decade 2011-2020 was the second driest in mainland Portugal, since 1931, with a difference of only +5mm from, 2001-2010 decade. The most frequent extreme weather events in Portugal are associated with periods of intense heat (heat waves) and lack of precipitation (droughts).

In recent years, Portugal has put in place several policies to increase the use of renewable energy sources, energy efficiency and security of supply, decrease energy import dependency and improve the economic sustainability of the energy system. In particular, the focus on renewable energy allowed to achieve very positive results in terms of increase in domestic energy production and decrease of external energy dependency. Portugal's national energy resources come almost exclusively from renewable energy, mainly biomass, with 51% of domestic production in 2020 and renewable electricity (36%), which is produced essentially by hydro, wind and photovoltaic. Portugal's lack of fossil fuel resources and its relatively low domestic energy production result in a high energy import dependency. The investment on renewable energies and energy efficiency in the 20-year period between 2001 and 2019 has allowed Portugal to lower its energy dependency from 85.6% to 74.2%. Between 2011 and 2020 the average annual growth rate of total Primary Energy Consumption was -0.7%, which compares with -1.0% in the previous 10-year period (2001-2010). Between 2011 and 2020 the average annual growth rate of total Final Energy Consumption was -0.7%, which compares with -0.6% in the previous 10-year period (2001-2010). There is no prospection and production of oil in Portugal, so all crude oil in the country is imported. Furthermore, the recently adopted Portuguese Climate Law, prohibits any new hydrocarbon prospection or exploration permits in the national territory. Portugal has phased-out electricity production through coal in 2020.

In 2020 the fleet of motorized road vehicles presumably in circulation remained at 7,0 million vehicles and recorded, for the first time in the available series, a slight decrease in year-on-year terms (-0.1%). The decrease was caused by the decrease in the number of heavy vehicles (-10.0%), since the number of light vehicles grew slightly (+0.1%). Vehicles that were 10 years old or older represented 64.4% of the total light-duty passenger cars and 72.9% of the total of heavy-duty passenger vehicles. In 2020, the fleet of light passenger vehicles was composed of 56.5% diesel-powered vehicles and 40.3% gasoline-powered vehicles, representing 96.8% of the total. In 2020, the light-duty passenger car fleet was divided into diesel-powered vehicles (56.5%) and gasoline-powered vehicles (40.3%). LPG-powered vehicles represented 1.1% of the total and vehicles that use other types of fuel 2.2%. With regard to heavy-duty passenger motor vehicles, the most commonly used fuel is diesel (94.85%). In what regards electric mobility (figure 2.7.5), there were 33.898 electric vehicles registered until 2020, reflecting an increase of 43% over the previous year, from which 84% are light-duty passenger cars and light commercial vehicles, while 7.3% are tricycles and quadricycles. Until 2021 51.499 electric vehicles were registered in PT, of which around 87% are light vehicles (passengers + goods).

Industry includes emissions resulting from physical and chemical processing of raw materials in industrial processes, excluding combustion processes related to energy production. The relevant industrial sectors operating in Portugal include: Mineral Industry (Cement, Lime, Glass, Other Uses of Carbonates); Chemical Industry (Ammonia, Nitric Acid, Ethylene, Carbon Black, Fibres, Sulfuric Acid, Explosives, Fertilisers, etc.); Metal industry (Iron and Steel Production, Metals and Metal Alloys); Non-Energy Products from Fuels and Solvent Use (Lubricant Use, Paraffin Wax Use, Solvent Use, Asphalt for Road Paving and Manufacture of Catalytic Converters with Urea); Electronics Industry (Integrated Circuits, Semiconductors, TFT Flat Panel Display, Photovoltaics and Heat Transfer Fluids); Product uses as ODS substitutes (Refrigeration, Air Conditioning, Foams, Fire Extinguishers, Aerosols, Solvents and Other Applications); Other Product Manufacture Processes (Electrical Equipment, Use of SF_6 and PFCs, Use of N_2O in medical applications); Other (Paper, Pulp, Food and Beverages Industry).

The production of municipal waste increased strongly since 1990, after the peak around the year 2010, presents a decreasing tendency, resulting from the policies on preventing, reducing and recycling of waste. Since 2014, however, an inversion of this tendency is registered and, with the exception of 2020 due to the COVID-19 pandemic crisis, Portugal registered since 2014 a growing trend of municipal waste production. This increase is attributed to an improvement of the economic situation of Portugal until 2019, seeming to indicate that the goal of decoupling waste production from economic growth is not being fulfilled. Although landfilling remains the main final destination for municipal waste, Disposal on Land and the disposal of waste in landfills have decreased since 2010, despite some variations. This trend has been accompanied by the growth of importance of Mechanical and Biological Treatment (MBT) as well as Sorting units. The number of waste management infrastructures for organic recovery and biological treatment have grown expressively in the last decade, with the aim to increase the direct diversion of biodegradable waste from landfills and increase recycling. As a consequence, composting has been growing in importance (exception for 2020). These measures have contributed also to an increase in multi-material recycling and the organic recovery and recycling of waste, with a consequent decrease of biodegradable waste in landfills. The recovery of biogas at landfills have been also growing importance along the years.

In the majority of regions, as well as in mainland Portugal, there has been an increase in the surface area of artificially developed territories, despite the decrease in the respective resident population. Both on the mainland and in all its regions, there was a growth in artificialized territory per capita between 1990 and 2018. In 2018, the capitation of artificialized territory was only lower than the Continent (476 m^2/inhabitant) in the Metropolitan Areas (230 m^2/inhabitant in Lisbon and 297 m^2/inhabitant in Porto) and in the region of Tâmega and Sousa (469 m^2/inhabitant). The fact that 47% of the resident inhabitants in mainland Portugal in 2018 are concentrated in the two Metropolitan Areas justifies these two regions having the highest proportions of their surface occupied by artificialised territory (25.1% for Porto and 21.7% for Lisbon). From 2011 to 2020, Portugal had an increase of 63.625 buildings and 104.122 dwellings, corresponding to relative increases of 1.8% for both buildings and dwellings. In 2019, the Portuguese housing stock was estimated at 3.6 million buildings and 6.0 million family dwellings, which corresponds to an increase of 0.2% compared to the previous year, both in the number of buildings and dwellings.
The agricultural sector is mainly regulated by regulations linked to the implementation of the Common Agricultural Policy (CAP), which has evolved over the years to adapt to socio-economic and environmental changes within the European Union. the 2019 Agricultural Census made by the INE registered about 290,000 farms, 15,000 fewer than in 2009, which corresponds to a reduction of 4.9%. The Agricultural Area Used (SAU) increased 8.1% compared to 2009, occupying 3.9 million hectares (43% of the territorial area). The average size of the holdings increased by 13.7%, from 12.0 hectares in 2009 to 13.7 hectares of SAU per farm in 2019.

The latest CAP reform for the period 2015-2020 includes specific programmes for agricultural practices beneficial to the environment and climate and also associated with the inclusion of certain agri-environmental and climate measures in rural development programmes. In fact, the maintenance of the "cross-compliance" regime, in force since 2005, has subjected the full receipt of most CAP payments to a set of standards to ensure "good agricultural and environmental soil conditions" (BCAA), as well as certain obligations, known as legal management requirements (LGRs), such as the Nitrates Directives, Sllats, Groundwater, Natura 2000 Network and sustainable pesticide application. Another instrument with identical objectives is the so-called "Greening". This is a type of direct payment to farmers based on the principle that farmers should be rewarded for the public goods they provide.

Farmers entitled to payment of the Basic Payment Scheme (BPS) were entitled to greening payments, provided that certain agricultural practices were observed in the eligible areas: crop diversification, maintenance of permanent grassland and the creation of areas of ecological interest were priorities, with the main objectives to improve soil quality, fix carbon and safeguard and improve biodiversity, respectively. From 2018 the greening rules were amended, so that all farmers benefiting from CAP direct payment schemes should apply for the green payment, which therefore became a compulsory scheme. The "Agri-Environmental Measures" are similar to the ecological payment for rewarding farmers for certain practices beneficial to the environment and climate. However, unlike greening, they are contractual and are based on voluntary commitments made to farmers. In the 2014-2020 programming period, Member States should, similarly to the previous programming period, use at least 30% of the total EAFRD contribution dedicated to each rural development programme in climate change mitigation and adaptation to climate change, as well as on environmental issues. In mainland Portugal, about 18.4% of the useful agricultural area and 19.5% of the area of forest settlements are part of the Natura 2000 Network, which occupies 21% of the territory. In addition, the existence of a proportion of agricultural area based on extensive production systems, with special focus on permanent pasture areas, based on indigenous breeds and traditional plant varieties, contributes to the reduction of pressure on natural resources and biodiversity.

According to the National Forest Inventory (IFN6), mainland Portugal has a forested area of 3224 thousand hectares, corresponding to more than 36% of the overall land cover. Forestry resources play an important role in the national economy. Forest based products (cork and timber based products, including wooden furniture, and nuts and resins) represent approximately 10% of the total Portuguese exports, while the sector is only responsible for 4% of the national imports. Fires are one of the major threats to forests in the country and 2017 was the worse year for decades. Right after the catastrophic fires that took place in 2017, a new rural fire management system was set up, and in 2020 the new National Integrated Rural Fire Management Plan (PNGIFR) established a strategy and measures regarding also the role of wildfire management in climate change. Rural fire management actions play a central role in national policies to combat and adapt to climate change and one of the main underlying objectives of the PNGIFR the reduction in the probability of catastrophic fire seasons as they greatly increase the emission of CO2.

Greenhouse Gases Inventory Information (1.3)

The National Inventory System of Emissions by Sources and Removals by Sinks of Air Pollutants (SNIERPA), is established by Council of Ministers Resolution 20/2015, of 14th April , which revised and updated the previous one of 2005. It includes the institutional and legal definitions and procedures designed to ensure the estimation of emissions by sources and removals by sinks of air pollutants, their report and the archive of all relevant information. Two SNIERPA instruments guarantee, in technical and methodological terms, the accuracy, completeness and reliability of the inventory: Methodological Development Program (MDP) and Quality Control and Assurance System (QCAS).

In 2020, total Portuguese GHG emissions, including indirect CO2, without land-use, land-use change and forestry (LULUCF) were estimated at about 57.7 Mt CO2e, representing a decrease of 2.1 % compared to 1990 levels and a decrease of 9.5 % compared to the previous year (2019). When considering the LULUCF sector, the national level of emissions in 2020 totalled 53.0 Mt CO2e., corresponding to a 19.7 % decrease in relation to 1990 and a variation of -10.6 % from 2019 to 2020.

CO_2 is the primary GHG, accounting for about 72 % of Portuguese emissions on a carbon equivalent basis in 2020 (LULUCF excluded). The second most important gas is CH_4, followed by N_2O, representing, respectively, 16 % and 6 % of total emissions in 2020. Portugal has chosen 1995 as the base year for fluorinated gases. In 2020, these gases represented about 6 % of total GHG emissions. NF3 emissions are non-occurring in Portugal. CO2 emissions in Portugal are mainly generated from fossil fuel combustion in energy-related activities (IPCC categories 1). Transports and energy industries are the primary sources of Portuguese GHG emissions, representing, respectively, 25.8% and 18.1% of total GHG emissions excluding LULUCF in year 2020. Fossil fuel combustion in energy-related activities has been the major driving factor of the national emissions, reflecting the evolution of the Portuguese economy, which was characterized by a strong growth associated with increased energy demand and mobility during the 1990s. Forest land and other land uses can also be a net source of CO2 emissions, through land use conversion or wildfires, or a net sink for CO2 when net additions of biomass occur. LULUCF categories have been estimated as a source or sink according to the years, with the occurrence of wildfires being the main factor explaining this change. CH4 is primarily generated through anaerobic decomposition of organic matter in biological systems, like enteric fermentation in animals, decomposition of municipal and animal waste and waste-water handling systems. Agricultural soils represents the largest source, accounting for 68% of N2O emissions in 2020. Fluorinated gases have become increasingly important since 1995, driven by the gradual replacement of fluorinated gases as substitutes for substances that deplete the ozone layer in particular in refrigeration and air conditioning.

Policies and Measures (1.4)

In response to the commitment assumed by Portugal in 2016, to achieve net-zero emissions by the end of 2050, the Carbon Neutrality Roadmap 2050 (RNC 2050) was adopted. It identifies the main decarbonisation vectors in all sectors (energy and industry, mobility and transport, waste and wastewater and agriculture and forests) and the path to reduce emissions of the all economy in order to achieve net zero in 2050, under different scenarios of socio-economic development.

RNC 2050 is the Portuguese Long-term Strategy and was submitted to the UNFCCC, in accordance with the Paris Agreement, on the 20th of September 2019, and to the European Commission, to comply with the EU Energy Union and Climate Action Governance Regulation. It is a forward-looking document of where to go, contributing to the definition of trajectories, not a policy and measures planning documentUnder the RNC 2050 Portugal revised its previous 2030 target (-30 to -40%) to -45% to -55% by 2030. Additionally, a trajectory up to 2050 was established comprising emission reductions of - 65% to -75% by 2040, and from -85% to -90% by 2050 compared to 2005. Aligned with the long-term strategy Portugal also developed an integrated National Energy and Climate Plan (NECP 2030), that is the main instrument of energy and climate policy for the 2021-2030 decade.

While maintaining the targets established for 2020, the National Energy and Climate Plan (NECP 2030), identifies the main priority areas of action for the next decade, seting ambitious targets for the 2030 horizon concerning the reduction of GHG emissions (45% to 55%, compared to 2005 – already driven by the RNC2050), the incorporation of renewable energies (47%), the energy efficiency (35%) and electricity interconnections (15%) and sets the policies and measures for an effective application of the vision and trajectories foreseen in the RNC2050. It also revises the national sectorial targets previously set for 2030.

The Portuguese Climate Law, which came into force on February 1, 2022, recognizes the climate emergency situation, confirms the commitment to achieve climate neutrality by 2050 and stipulates the study, by 2025, of the anticipation of this target to 2045. It also establishes national emission reduction targets, in line with previously established trajectories, stipulating a reduction of at least -55% by 2030; 65% to -75% by 2040; at least -90% by 2050; and a net CO2 eq sink of the LULUCF sector by at least 13 million tonnes between 2045 and 2050.

Following the approval of the Fit for 55% package, and also taking in consideration the energy crises derived from the war in Ukraine, that showed the need to speed up the energy transition and the deployment of endogenous renewable energy in order to reduce the EU dependence on Russian fossil-fuel products, Portugal started the revision of the national Carbon Neutrality Roadmap (2050) and the National Energy and Climate Plan (2030), work that is ongoing.

Flaship policies and measures in place include the participation of Portuguese industry in the ETS, the strong support for renewable energy technologies (wind and more recently solar), the phase-out of coal generated electricity by the end of 2021 and the green tax reform including a carbon tax, the promotion of electric mobility and more rencetly the support for the promotion of green hydrogen.

Projections and the total effects of policies and measures (1.5)

The analysis of emissions projections confirms that all sectors have significant GHG emission reduction potential in the different analysed scenarios, although the rates of reduction are different.

Even in an existing policy scenario, it is already foreseen a sharp reduction in GHG emissions in the coming decades and there is a cost-effective potential for Portugal to achieve total emission reductions of around 51% in 2030 compared to 2005, up to 60% by 2040 and around 64% by 2050 (without LULUCF).

In 2030 this reduction is largely due to the decommissioning of coal-fired power stations and the commitment to strengthening the role of renewable energies in the national energy mix, with boost to solar energy, with the electricity generation sector representing in 2030 a potential GHG emission reduction of about 93% compared to 2005 (and about 97% reduction in 2040). In the transport and mobility sector, profound changes are foreseen, with large penetration of the electric vehicle, which can lead to an emission reduction of about 41% in 2030 compared to 2005, and about 60% in 2040.

For most sectors there is a need to consider a set of additional policy measures in order to pursue a more ambitious low carbon path and achieve carbon neutrality by 2050. With regards to the additional policy scenario (or neutrality scenario), unlike the previous one, emission restrictions consistent with carbon neutrality were imposed in 2050. This scenario thus allows to assess the additional effort required for each sector so that overall achieve neutrality, not accurately translating a typical scenario of policy impact assessment and planned measures. There is still a cost-effective potential to reduce GHG emissions more sharply compared to the existing policy scenario, around 55% compared to 2005, rising to 73% by 2040 and around 82% by 2050 (without LULUCF), decarbonizing almost entirely electricity production, and strongly reducing emissions from mobility and transport and buildings, over the next decades. Thus, the electricity generation sector in an additional policy scenario has in 2030 a GHG emission reduction potential of around 95% compared to 2005, the transport sector by 46% and the building sector by 48%, rising to 98%, 84% and 82% respectively by 2040. As for the industrial processes sector, reductions of around 39% in 2030 to 48% in 2040 are expected, due to the expected improvements in process efficiency and the use of less polluting fuels, with the incorporation of more Fuels Derived from Waste/ RDF (refused derived fuel), biomass and electrification of some subsectors.

The need to strenghten the role of forest sink and other land uses, and effective agroforestry management is a determining factor in achieving the goal of neutrality in 2050.

Vulnerability assessment, climate change impacts and adaptation measures (1.6)

For mainland Portugal, climate simulations for the future, which are obtained by the European Consortium ECEARTH and available in "Portal do Clima", provide projections for the end of the 21st century of an increase in average annual air temperature by 2°C (RCP 4.5 scenario) to 4°C (RCP 8.5 scenario). This heating should be higher in the summer and in inland and southern regions of the country. Regarding precipitation, these scenarios show a decline of 15% by 2040 and 30% by 2100, which will be more marked in southern mainland Portugal.

The new temperature and precipitation regimes associated with climate change imply an increase in the number of heatwave occurrences, their duration and intensity; an increase in the number and intensity of major rural fires, and extreme, unpredictable, intense, and localised meteorological phenomena, such as torrential rain, hail, cyclones and tornados. In addition to the tendency for heatwaves to become more intense and frequent or spatially extensive, it is also predicted that there will be a change in their seasonal distribution. Although heatwaves typically occur in the spring and summer, this phenomenon is expected to gain equal importance in the autumn. In this context, climate change scenarios predict a significant increase in meteorological conditions conducive to large areas of fire across the Iberian Peninsula, namely the whole of Portugal.

The coastline is also particularly vulnerable to coastal erosion and coastal overtopping with very significant and severe effects. This is due to sea-level rise, hourly rotation of the mean wave direction on the west coast, and storm surge regime (despite uncertainty about the future evolution on this last point). The effects of coastal erosion and overtopping are further aggravated by the characteristics of the anthropogenic occupation of the territory's coastal strip that substantially increases the risk of socio-economic costs of climatic phenomena. The rise in sea level also increases the risk of saline contamination of coastal aquifers, estuaries, and the final stretches of rivers, impacting some water supply systems.

The ongoing project National Roadmap for Adaptation 2100 (RNA2100) enables a prospective approach and long-term planning of adaptation policies, including an assessment on inaction costs and necessary investments, taking into account Portugal's vulnerabilities to climate change. In order to achieve the established objectives, RNA 2100 project will define narratives and generate a set of projections of the evolution of vulnerabilities and impacts of climate change on the Portuguese Economy until 2100.

Financial resources and transfer of technology (1.7)

From a geographical point of view we continue to prioritize cooperation activities towards the lusophone developing countries, in particular the Portuguese Speaking African Countries (PALOP) and Timor-Leste, new beneficiary countries have been added in the last years, from North and Western Africa and Latin America regions, such as Tunisia, Cote d'Ivoire, Colombia and Argentina. ODA for environment has had limited expression regarding total values by virtue of the sectorial strategic priorities that essentially lie in areas such as Education, Health, Security and Justice, however considerable efforts have been made in order to curve this trend by strengthening mainstreaming guidelines and updating the range of sectoral priorities regarding the alignment to Paris Agreement. Portugal has just adopted a new cooperation for development strategy fully aligned with the 2030 Agenda for Sustainable Development and the Paris Agreement, in which the climate change and the green just transition issues have a more prominence. The strategic framework and guidelines for development cooperation are aligned with the needs and priorities of partner countries and established by Strategic Cooperation Programs (PEC) signed with each partner country in particularly with longtime partners such as PALOP and Timor-Leste.

Research and systematic observation (1.8)

In the period between 2017 and 2021, FCT funded 401 scientific research projects that may be classified in the field of climate change, with a budget line of over 45.5 M€. there is a tendency for an increase in funding for projects related to this subject. This increase in funding of climate science projects is especially evident when comparing to the previous analyzed period: between 2010 and 2016, FCT funded 107 projects that dealt with the issue of climate change. in the same period, 152 research grants that may be classified in the field of climate change were funded (doctoral and post-doctoral level, among others), with a total value of over 9 M€. Between 2017 and 2021 FCT financially supported 177 contracts that may be classified in the field of climate change, within the scope of Scientific Employment for PhD graduates, the value of which amounted to over 22.5 M€. Between 2017 and 2021 the European Union (EU) funded, through the Horizon 2020 (H2020) and Horizon Europe, 127 research projects within the field of climate change in which national research teams are (or were) involved. This represents significant increase comparing to the period of 2010-2016 (with 44 projects funded).

As a member of the WMO, Portugal develops and operates several weather and climate observation networks in the framework of its global programmes, in particular the World Weather Watch (WWW) through the Global Observing System (GOS), but also the Global Atmosphere Watch (GAW) and the World Hydrological Cycle Observing System (WHYCOS), and it follows the recommendations of the Instruments and Methods of Observation Programme (IMOP) and of the World Climate Programme (WCP) of the WMO. In 2022 IPMA has 137 automatic climatological stations operating in Portugal, of which 11 are also conventional. All stations measure air temperature, wind speed and direction, air humidity and precipitation, among other climate elements, and almost all also measure global solar radiation, while some also measure atmospheric pressure.

On the mainland there are 105 stations with a density of 1.2/1000 km2, in Madeira there are 20 stations with a density of 25/1000 km2 and in the Azores there are 12 stations with a density of 5.2/1000 km2. Of those stations, 4 prepare and disseminate monthly through the WMO's global meteorological telecommunications system, communicated in the form of CLIMAT code, which contains monthly climatological data.

Portugal continues to participate in the GSN network with 3 surface weather stations, one on the mainland (Lisbon – belonging to the Geophysical Institute of the University of Lisbon), one in Madeira (Funchal Observatory – IPMA) and one in the Azores (Ponta Delgada (Nordela – IPMA). There are 12 weather stations in the Azores, running under the responsibility of the NWS (IPMA). All 12 of those stations submit SYNOPs reports regularly to the GTS. Only three of these stations performed 24h visual observations with personal. Concerning the GSN, only Ponta Delgada station (08512) has submitted CLIMAT reports. Portugal’s contribution to the Global Atmosphere Watch program (GAW) is currently done through two main monitoring programs: total ozone, UV radiation and greenhouse gases.

As a EUMETNET member the national marine meteorology service maintains active IPMA’s participation in the EUMETNET Surface Marine Programme (VOS national focal point) with national commercial, fishing and research vessel, integrating the lack of automatic and systematic atmospheric and oceanic data observations under the North Atlantic sea areas. This programme allows not only obtaining daily meteorological and oceanographic parameters over the sea, but also disseminating through the Global Telecommunication System (GTS). IPMA shares daily in situ meteorological and oceanographic data through the GTS system to International Centres, under different codes (SHIP and BUFR format), including our national oceanic buoys in collaboration with Portuguese Hydrographic Institute (Portuguese navy).

Education, Training and Public Awareness (1.9)
In the framework of formal education, environmental content and themes have been integrated in school programmes since the late 70’s. From the 80’s onwards, it has been made possible for schools to be formally involved in project methodologies with a focus on environmental issues from the perspective of study and intervention at local level. In 2002, programmes for Geography, Natural Sciences and Physicochemical Science in basic education were replaced by curricular guidelines, reinforcing the relationship between Science, Technology, Society and Environment in a critical approach to economic and technological development. Issues related to proper management of natural resources, comprising climate change impacts, have been included in

these curricular guidelines and may be dealt with across all subjects. In Basic and Secondary Education, Citizenship Education was adopted as a cross-cutting topic in all programmes, including Climate Change and broader environmental themes.

The National Strategy for Citizenship Education (ENEC), adopted in January 2017, is a reference document to be implemented in the 2017/2018 school year, both in public and private schools which form part of the project on curricular autonomy and flexibility, in line with the Learner's Profile when Finishing Compulsory Education and Key Learnings. Citizenship education is compulsory in all education levels and cycles and subject to evaluation. The different areas of Citizenship Education are organised in three groups with different implications: the first one is compulsory for all education levels and cycles (since these are cross-sectoral and longitudinal areas). This subject includes Environmental Education, with the Framework of Environmental Education for Sustainability as the reference document for its curriculum, in which climate change is one of the topics, including: Climate change causes, Climate change impacts, Climate change adaptation and Climate change mitigation.

In higher education, there are several doctoral programmes in climate change. This issue is further addressed in several master's degrees such as the Master's in Ecology and Environmental Management and the Master's in Risks, Cities and Spatial Planning. Likewise, it is included in undergraduate courses, such as the Bachelor's degrees in Environmental Engineering, in Geology, in Geography and in Ecology.

Portugal has adopted the National Strategy for Environmental Education 2020 (ENEA 2020) through a unique process of public debate and participation, aimed at promoting effective ownership and accountability of civil society. The delivery of this Strategy focuses on thematic and cross-cutting activities which are able to ensure the fulfilment of national and international commitments undertaken by Portugal in the area of Sustainability and Climate Change. These include, in particular, the Paris Agreement and the Sustainable Development Goals of the United Nations – 2030 Agenda. For the period 2017-2020, ENEA 2020 seeks to establish a strategic and collaborative commitment to cohesion, building up environmental literacy in Portugal which, through inclusive and visionary citizenship, leads to a paradigm shift in thinking that translates into sustainable behaviour models in all dimensions of human activity. For the implementation of ENEA 2020, approximately 18 million euros have been allocated for the period 2017-2020 through the FA.

Associativism is, in Portugal, a fundamental instrument of participation of the populations and intervention in society. Environmental citizenship and the dynamics of civil society organizations is essential in this process.

The Non-Governmental Environment Organisations – NGOs play a fundamental role in the promotion, protection, awareness and valuation of the environment, developing actions of public interest in their communities. all climate policy instruments were subject of public consultation processes. General public, as well as specific stakeholders and NGO's, are also involved in many activities, and dissemination actions Climate Change related, developed by either MAAC, APA or other public and private entreprises.

National Circumstances Relevant to Greenhouse Gas Emissions and Removals (2)

Government structure (2.1)

The Portuguese territory comprises the following three geographic areas:

- The mainland (located in the European Plateau);
- The Azores (located on the convergence of the American, European and African Plateaus);
- The Archipelago of Madeira (located in the African Plateau).

In accordance with Article 1 of the Constitution of the Portuguese Republic (CPR), Portugal is a Sovereign Republic, based on human dignity and popular will, committed to building a free, fair and solidary society.

The Portuguese Republic is a democratic State of Law, sustained on popular sovereignty, pluralism of expression and democratic political organization, on respect and effective guarantees for fundamental rights and freedoms and on the separation and inter-dependence of powers, aiming to achieve economic, social and cultural democracy and a more participative democracy (article 2 CPR).

Portugal is a unitary State that respects, regarding its organization and function, the rule of self-governing system of the islands and the principles of subsidiarity, autonomy of local authorities and the democratic decentralisation of public services. The archipelagos of the Azores and Madeira are autonomous regions with their own political and administrative statutes and their own institutions of self-government (article 6 CPR). Politically and administratively speaking, the Portuguese Republic structure is based on a tripartite division of its territory: Districts (total of 20), Municipalities (total of 308) and Parishes (total of 3092).

These administrative levels reflect the specificities of the Portuguese territory, namely of Portugal mainland and of the Autonomous Regions (AR):

a) Portugal mainland: 18 districts, 278 municipalities and 2882 parishes;
b) Autonomous Region of Azores: 1 District, 19 municipalities and 156 parishes;
c) Autonomous Region of Madeira: 1 District 11 municipalities and 54 parishes.

Regarding Sovereign Organs, the CPR distinguishes the President of the Republic, the Portuguese Parliament, the Government and the Courts of Law (article 110 CPR). All should care for the separation and the interdependency established by the Constitution (article 111/1 CRP).

The President of the Republic (PR) who represents the Portuguese Republic ensures the national independence, the unity of the State and the normal functioning of the democratic institutions and, inherently, he is also the Supreme Commander of the Armed Forces (article 120 CPR).

The election is effected through universal, direct and secret suffrage (article 121 CPR) and all citizen voters of Portuguese origin, over 35 years, are eligible (article 122 CPR). The President is elected to a five-year term (article 128 CPR). However, his re-election is not allowed for more than two consecutive terms, nor during the years immediately following the end of the second consecutive term (article 123/1 CPR).

The PR has competences concerning other bodies of the Republic (article 133 CRP), such as the Council of State, the Government and the representatives of the Republic for the Autonomous Regions. He has also competences to practice is own acts (article 134 CPR) and in international relations (article 135 CPR).

The second body of sovereignty to describe is the Portuguese Parliament – the Assembleia da República (AR) - the representative assembly of all Portuguese citizens (article 147 CPR), composed by a minimum of 180 and a maximum of 230 Members of Parliament (article 148 CPR).

Members of Parliament (MoP) are elected by electoral districts geographical established by law, which may determine the existence of multi-member and single member electoral districts as well as their nature and complementary, to ensure the system of proportional representation and the Hondt highest average method in conversion of votes into the number of seats. The number of MoP per plurinominal circle of the national territory, except for the domestic circle, when exiting, that is proportional to the number of registered electors (article 149 CPR). It is important to emphasize that despite the connection between the MoP and the geographic circles, by the time they assume their roles they also assume the responsibility of representing the whole country (Article 152/2 CPR).

The AR is responsible for exerting political and legislative power (article 161 CPR), supervise competences (article 162 CPR) and concerning other organs (article 163 CRP), witness the swearing-in ceremony of the PR or give the PR its consent to leave the national territory. Each legislature last for four legislative sessions (article 171 CRP), each one starting on the 15th of September and ending on the 15th of June.

The third body of sovereignty is the Government which is responsible for setting general policy of the country. It is also the superior organ of the Public Administration (article 182 CPR) and it is formed by the Prime Minister, the Ministers and Secretaries and Secretaries of State. The Government has political (article 197 CPR), legislative (article 198 CPR) and administrative (article 199 CRP) competences.

The Prime Minister (PM) is nominated by the PR, after hearing the parties represented in the AR and in accordance with the election results (article 187 CRP). Therefore the PMs are accountable to the PR and to the AR, under the political responsibility of the Government (article 191 CRP).

Finally, the Courts, the fourth Portuguese body of sovereignty, have the competence to administrate the justice on behalf of the people (article 202/ 1 CPR). They are independent and are only subjected to Law (article 203 CPR).

The government currently in office is the 23rd Constitutional Government[1] (took office in early 2022) maintains an approach of continuity from the 22nd Constitutional Government (took office by the end of 2019), while making some adjustments to deal with emerging realities. The current

[1] Organic Law: Decree-Law No 32/2022, of 9th May

Government's Organic Law maintained in its structure the Ministry of Environment and Climate Action (MAAC), with responsibility for environmental and energy issues.

Currently, the mission of the MAAC is to propose, manage, execute and evaluate policies in the areas of environment, urban, suburban and road passenger transport, mobility, climate, forestry, nature conservation, animal welfare, energy, geology and forests, in a development perspective sustainability and social and territorial cohesion, as well as planning in matters within its competence, including the shoreline and rural areas.

Concerning the several thematic responsibilities of the MAAC, such as the water managment, waste, spatial planning, cities policy, transports, mobility, energy, geology, nature conservation and forests, the 23rd Government established that this must be shared with the Council of Ministers, Ministry of Finances, the Ministry of Infrastructures and Housing and the Ministry of Territorial Coesion.

The Portuguese Environment Agency, I.P. (APA)[2], is Portugal's public administration body responsible for the climate policy, thereby assuming a decisive role in the proposal, development and implementation of related policies. APA remains under oversight of the MAAC, and it retains the powers to propose, develop and monitor the implementation of environmental policies, notably in the field of climate change, an area for which the MAAC is directly responsible.

Concerning the APA's structural organization, its major purpose is to develop its activities sustained on rigor and control of the revenues and expenditures, transparency and effectiveness of the perfomed operations and turn effective the coordination and participation in the sectors that its integrates, promoting a form of performance based on positive collaboration with other governmental entities, businesses, non-governmental organizations, and citizens in general.

Until the 31st of December of 2016, APA was fully reponsible by the administrative management of several financial funds related to environment, namely the Portuguese Carbon Fund (FPC)[3], a financial instrument which main purpose was to support the transition to a resilient, competitive and low-carbon economy by financing or co-financing measures that contribute to the fulfilment of the commitments of Portugal under the Kyoto and other international and EU commitments on climate change protocol.

In 2016, it was established that a single environmental fund should be created by aggregating resources from existing funds, so as to obtain an instrument with greater financial capacity and more adaptability to challenges. The Environmental Fund (FA)[4] was therefore set with effect from 1st January 2017, thus terminating the FPC, the Environmental Action Fund, the Fund for the Protection of Water Resources and the Fund for the Conservation of Nature and Biodiversity.

As a consequence, the FA takes up all responsibilities inherent to the former funds, aiming to support environmental policies in order to achieve the sustainable development goals, thus

[2] Organic law: Decree-Law 56/ 2012 of March 12th
[3] The FPC was created by Decree-Law 71/ 2006 of March the 24th
[4] The FA was created by Decree-Law No 42-A/2016, of 12th August

helping to meet national and international objectives and commitments, including those related to climate change, water resources, waste and conservation of nature and biodiversity.

In order to address the emerging challenges associated with the commitment to achieving carbon neutrality by 2050, the FA was subject to an amendment[5] to reinforce the role of this financial instrument in pursuing national and international objectives and commitments (such as the Paris Agreement) in several areas of his activity. It also integrated the Energy Efficiency Fund, the Permanet Fund for Forests, and the Fund for the Sustainability of the Energy Sector. The Environmental Fund is under the direct responsibility of the MAAC and its day-to-day management is performed by the Secretary General of the MAAC.

Population Profile (2.2)

The analysis to the Demographic Profile is structured within a timeframe between 2011 and 2020 (Portugal, Mainland, the Autonomous Region of the Azores and the Autonomous Region of Madeira).

Resident population estimates for the years 2011 and 2020 show a tendency for a slight decrease in the four territorial dimensions under analysis (Table 2.2.1).

Table 2.2.1

Years	Total resident population estimates (No) by place of residence and sex (M/F)			
	Portugal	Mainland	ARA	ARM
2011	10 542 398	10 030 968	247 194	264 236
2020	10 298 252	9 802 128	242 201	253 923
Years	Development of total resident population estimates (%) by place of residence and sex (M/F)			
	Portugal	Mainland	ARA	ARM
2011-2020	-2,32	-2,28	-2,02	-3,90
2015-2020	-0,42	-0,38	-1,45	-0,98
Source: National Statistical Institute (INE), 2017				

Regarding the age distribution of resident population, the analysis to Figures 2.2.1, 2.2.2, 2.2.3 and 2.2.4 shows a prevalence, in 2020, of older age groups to the detriment of younger ones in Portugal, especially in the mainland (this is less marked in the ARA and ARM) – the top tends to be wider than the bottom, which indicates a reverse of the natural structure of the age pyramid.

Attention should be drawn to the gender imbalance in the three age groups at the top of the pyramid (75-79 years, 80-84 years and 85 years and over) in the Autonomous Regions, where the male population is significantly smaller than the female population.

[5] Decree-Law No 114/2021, of 15th of December

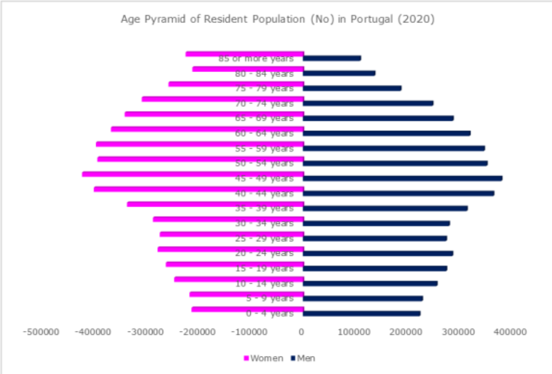

Figure 2.2.1

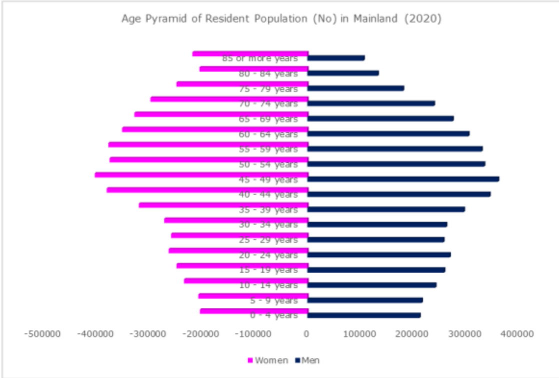

Figure 2.2.2

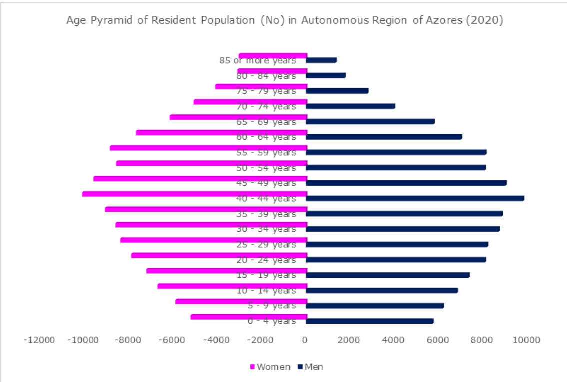

Figure 2.2.3

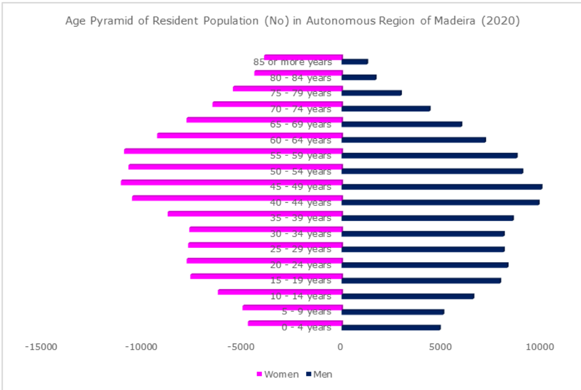

Figure 2.2.4

As for the elderly in relation to young people, the analysis to the ageing index[6] for the years 2011 and 2020 (Table 2.2.2) reveals a growing ageing trend in all territorial dimensions under analysis.

Table 2.2.2

Years	Ageing index (No) by place of residence			
	Portugal	Mainland	ARA	ARM
2011	127,60	130,50	72,30	87,00
2020	167,00	169,60	101,40	136,40

Source: National Statistical Institute (INE), 2022

As regards young people and the elderly in relation to the working-age population, i.e. the total dependency ratio[7], Table 2.2.3, an increase in Portugal and its mainland component is visible.

[6] Ratio between the number of people aged 65 and over and the number of people aged between 0 and 14 years (usually expressed by 100 (10^2) persons aged 0 to 14 years).
[7] Usually understood as the ratio between the number of people aged between 0 and 14 years together with people aged 65 and over, and the number of people aged between 15 and 64 years (usually expressed by 100 (10^2) persons aged 15-64).

In turn, the rising trend mentioned above for the ARA and the ARM is not reflected here, as these territorial dimensions stand out with a decrease in total dependency ratio values for 2020 compared to 2011.

Table 2.2.3

Years	Total dependency ratio (No) by place of residence			
	Portugal	Mainland	ARA	ARM
2011	51,40	51,80	44,60	44,80
2020	55,90	56,60	43,50	43,10

Source: National Statistical Institute (INE), 2022

The set of demographic data mentioned in previous paragraphs is confirmed when analysing the Natural Balance indicator (Table 2.2.4), which establishes the difference between the number of live births and the number of deaths during a given period of time.

There is a falling trend in the number of live births in relation to population replenishment needs, in view of the number of deaths recorded, which underpins the following statements:

- Reduction of resident population: a (virtually) residual population growth will have a damaging influence on the number of residents in the medium or long term.
- Aging of resident population: it should be noted that some evidence supports the suggestion that an inversion process of the age pyramid occurs, whereby its bottom will be occupied by older age groups to the detriment of younger ones.

Table 2.2.4

Years	Natural balance (No) by place of residence			
	Portugal	Mainland	ARA	ARM
2011	-5 992	-6 291	373	-74
2015	-38 828	-37 639	-336	-853

Source: National Statistical Institute (INE), 2022

Looking at the spatial distribution of resident population, Figures 2.2.5, 2.2.6 and 2.2.7 enable the visualisation and identification of certain dynamics which vary according to the geographic location involved.

In mainland Portugal, resident population is concentrated along the coastline, between Viana do Castelo (north top of the map) and Setúbal, and the only two metropolitan areas of the country, Porto and Lisbon, are included in this territorial line. Another population cluster is the region of the Algarve, in particular the city of Faro, with characteristics differing from those of the earlier case (metropolitan areas of Porto and Lisbon). The main economic driving force in this region is based on tourism, an economic activity which is deeply linked to seasonality.

The ARA, due to its geographical features, shows significant population dispersion. However, it should be noted that there is a significant concentration of population to the east of the island of São Miguel and in the island of Terceira.

In the ARM, resident population is concentrated in the south of the island, especially near the city of Funchal.

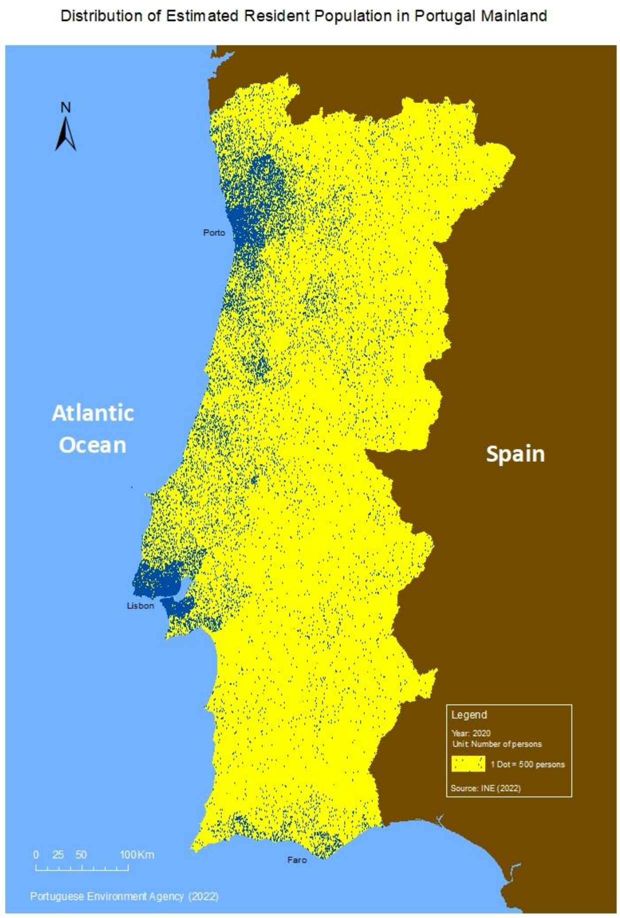

Figure 2.2.5

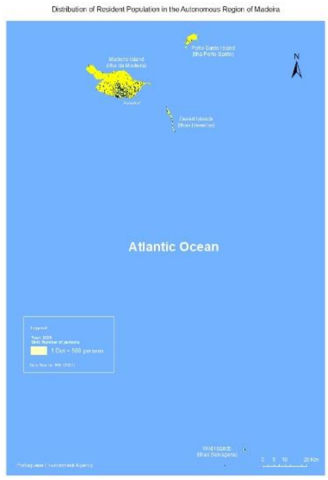

Figure 2.2.6

Figure 2.2.7

In what concerns population density (Table 2.2.5), Portugal and its mainland dimension show a slight decrease in values, suggesting a slight increase in territorial dispersion of resident population.

Table 2.2.5

Years	Population density (No/km²) by place of residence			
	Portugal	Mainland	ARA	ARM
2011	114,1	112,6	106,5	329,8
2020	111,7	110,0	104,3	317,0

Source: National Statistical Institute (INE), 2017

Economic Profile (2.3)

The Economic Profile analysis is structured within a timeframe between 2011 and 2020 in the light of the requirements related to geographical disaggregation in accordance with the UNFCCC guidelines for this reporting (Portugal, Mainland, Autonomous Region of the Azores and Autonomous Region of Madeira).

Looking at the Gross Domestic Product indicator (Table 2.5.1), a general increase can be seen, both chronologically and geographically in 2020 compared to data from 2011. In particular, Portugal and its mainland component show growth figures equivalent to 13.62% and 14.04% respectively. This trend is stronger in the ARA and ARM, which show values equivalent to 11.54% and 0.49% respectively.

Table 2.5.1

Gross Domestic Product at current prices by geographic location (EUR 10^6)				
Year	Portugal	Mainland	ARA	ARM
2011	176 096.17	167 757.21	3 722.27	4 440.13
2020po	200 087.57	191 314.29	4 151.89	4 461.71

Source: National Statistical Institute (INE), 2022

Development of Gross Domestic Product at current prices by geographic location (%)				
Year	Portugal	Mainland	ARA	ARM
2011-2020	13.62	14.04	11.54	0.49

The Gross Value Added indicator (Table 2.5.2) shows a trend which is very similar to that observed for the Gross Domestic Product, with an increase in 2020 compared to 2011 of the values recorded in Portugal and in its mainland component by 13.09% and 13.52% respectively. The ARM show a slight decrease in 2020 compared to 2011 by 0.23%.

Table 2.5.2

Gross Value Added at current prices by geographic location – base year 2011 (EUR 10^6)				
Year	Portugal	Mainland	ARA	ARM
2011	154 128,2	146 795,2	3 257,2	3 921,4
2020po	174 309,6	166 641,5	3 616,4	3 912,5

Source: National Statistical Institute (INE), 2022

Development of Gross Value Added at current prices by geographic location – base year 2011 (%)				
Year	Portugal	Mainland	ARA	ARM
2000-2020	13.09	13.52	11.03	-0,23

Looking at the *Gross Value Added* indicator from a sectoral point of view (Table 2.5.3), it should be pointed out that there are various territorial dynamics, which enable the identification of some of the national economic *drivers*.

First of all, a general increase in values equivalent to 13.09%, 13.52%, 11.03% for Portugal, Mainland and ARA. The ARM shows a slight decrease in 2022 compared to 2011 by 0.23%.

With regard to the economic sector of *Agriculture, animal production, hunting, forestry and fishing*, in 2020 compared to 2011, Portugal, Mainland and ARA show an expressive increase equivalent to 30.44%, 30.88% and 30.71%, respectively. The ARM experience a minor increase equivalent to 10.63%.

As regards the economic sector of Mining and Quarrying, Manufacturing, Electricity, gas, steam and air conditioning supply, Water collection, treatment and supply, Sewerage, waste management and remediation activities and Construction, it shows an increase in values for the territorial dimensions of Portugal (18.32%), Mainland (18.59%), ARA (1.66%) and ARM (8.82%).

The Services sector presents a general increase in values equivalent to 11.58%, 12.02%, 10.13% for Portugal, Mainland and ARA, respectively. The ARM shows a slight decrease in 2022 compared to 2011 by 1.06%.

Table 2.5.3

Gross Value Added at current prices by geographic location and sector of activity (EUR 10^6)

Year	Total				Agriculture, animal production, hunting, forestry and fishing			
	Portugal	Mainland	ARA	ARM	Portugal	Mainland	ARA	ARM
2011	154 128.2	146 795,2	3 257,2	3 921,4	3 229,6	2 910,5	251,0	68,1
2020po	174 309,6	166 641,5	3 616,4	3 912,5	4 212,6	3 809,2	328,1	75,4
Year	**Mining and quarrying; Manufacturing; Electricity, gas steam and air conditioning supply;Water collection, treatment and supply; Sewerage, waste management and remediation activities; Construction**				**Services**			
	Portugal	Mainland	ARA	ARM	Portugal	Mainland	ARA	ARM
2011	25 601,4	25 089,0	263,2	249,2	125 297,2	118 795,7	2 742,9	3 604,1
2020po	30 290,8	29 752,0	267,6	271,2	139 806,1	133 080,3	3 020,8	3 566,0

Source: National Statistical Institute (INE), 2022

Development of Gross Value Added at current prices by geographic location and sector of activity (%)

Year	Total				Agriculture, animal production, hunting, forestry and fishing			
	Portugal	Mainland	ARA	ARM	Portugal	Mainland	ARA	ARM
2011-2020po	13,09	13,52	11,03	-0,23	30,44	30,88	30,71	10,63
Year	**Mining and quarrying; Manufacturing; Electricity, gas, steam and air conditioning supply; Water collection, treatment and supply; Sewerage, waste management and remediation activities; Construction**				**Services**			
	Portugal	Mainland	ARA	ARM	Portugal	Mainland	ARA	ARM
2011-2020po	18,32	18,59	1,66	8,82	11,58	12,02	10,13	-1,06

The following analysis focuses on indicators that shape the trade balance, which consists of imports and exports; it should be clarified that the statistical information used is only available for the territorial dimension of Portugal.

Thus, an analysis to imports in the first place (Table 2.5.4) reveals an increase in 2020 compared to 2011 for the indicators Total (15.48%), Goods (13.46%) and Services (27.55%) in Portugal.

Table 2.5.4

Portugal imports (EUR 10^6)			
Year	Total	Goods	Services
2011	68 051,8	58 328,0	9 723,8
2020	78 584,8	66 181,7	12 403,0

Source: National Statistical Institute (INE), 2022

Development of Portugal imports (%)			
Year	Total	Goods	Services
2011-2020	15,48	13,46	27,55

As for exports (Table 2.5.5), significant increases are recorded for 2020 compared to 2011 for the indicators Total (22.43 %), Goods (21.78 %) and Services (24.23 %) in Portugal.

Table 2.5.5

Portugal exports (EUR 10^6)			
Year	Total	Goods	Services
2011	60 673,7	44 470,8	16 202,9
2020	74 285,8	54 156,8	20 129,0

Source: National Statistical Institute (INE), 2022

Development of Portugal exports (%)			
Years	Total	Goods	Services
2011-2020	22,43	21,78	24,23

When comparing the values recorded in 2020 with the ones from 2011, the ARA and ARM downward trend is clear (-0.3% and 10.2&, respectively). However, the territorial dimensions of Portugal (1.8%) and Mainland (2.2%) show a slight increase.

Table 2.5.6

Employment – Total of individuals by geographic location (10^3 persons)				
Year	Portugal	Mainland	ARA	ARM
20011	4 776,7	4 535,3	112,5	125,9
2020po	4 861,1	4 632,8	112,2	113,0

Source: National Statistical Institute (INE), 2017

Employment development – Total of individuals by geographic location (%)				
Year	Portugal	Mainland	ARA	ARM
2011-2022po	1,8	2,2	-0,3	-10,2

The Ocean Satellite Account (OSA) includes approximately 53 thousand entities, whose activity represented, on average, 3.9% of Gross Value Added (GVA) in the 2016-2018 triennium and 4.0% of employment (Full Time Equivalent - FTE) of the Portuguese economy, in the period 2016-2017. The performance of the economic activities considered in the OSA was above the overall national economy: between 2016 and 2018, the GVA grew 18.5% (the national GVA increased 9.6%) and, between 2016 and 2017, employment grew 8.3% (in the national economy the change was 3.4% in the same period).

The ocean economy represented 3.9% of national GVA in the 2016-2018 triennium and 4.0% of national employment in 2016-2017. Between 2016 and 2018, the ocean economy GVA registered an increase of 18.5%, while the national GVA increased 9.6%. Between 2016 and 2017, ocean economy compensation of employees increased 8.8% and employment by 8.3%, both above that observed in the national economy (6.0% and 3.4%, respectively).

Regarding the Autonomous Region of Madeira (ARM), the ocean economy represented 10.3% of the Gross Added Value (GVA) of the region, 9.4% of employment and 10.8% of wages in the 2016-2017 biennium.

Between 2016 and 2017, "Sea" GVA grew by 18.2%, while regional GVA increased by only 6.7%. The weight of the regional "Sea" GVA in the national was 6.8% in 2017, higher compared to the total GVA, in which this weight was 2.5%. In absolute terms, ARM's "Sea" GVA reached 453.1 million euros in 2017.

In turn, between 2016 and 2017, "Sea" employment increased by 12.8%, while in the economy as a whole this growth was 4.2%. In 2017, the weight of regional "Sea" employment in the national amounted to 5.9%, while in terms of total employment this proportion was only 2.5%. Total employment in full-time equivalent (FTE) - defined as the result of total hours worked divided by the annual average hours worked in full-time jobs in the economic territory - was 11,135 in 2017.

With regard to "Sea" wages, these rose by 14.8% between 2016 and 2017, substantially above the economy as a whole, in which this variation did not exceed 5.0%. In 2017, the weight of regional "Sea" remunerations in national ones was 5.7%, a proportion above that found for total remuneration, which did not exceed 2.3%. In absolute terms, the value of "Sea" Remuneration, in 2017, amounted to 222.1 million euros.

Geographical Profile (2.4)

Portugal includes a continental area that is part of the Iberian Peninsula and two archipelagos located in the Atlantic Ocean: the Archipelago of the Azores and the Archipelago of Madeira (Figure 2.4.1).

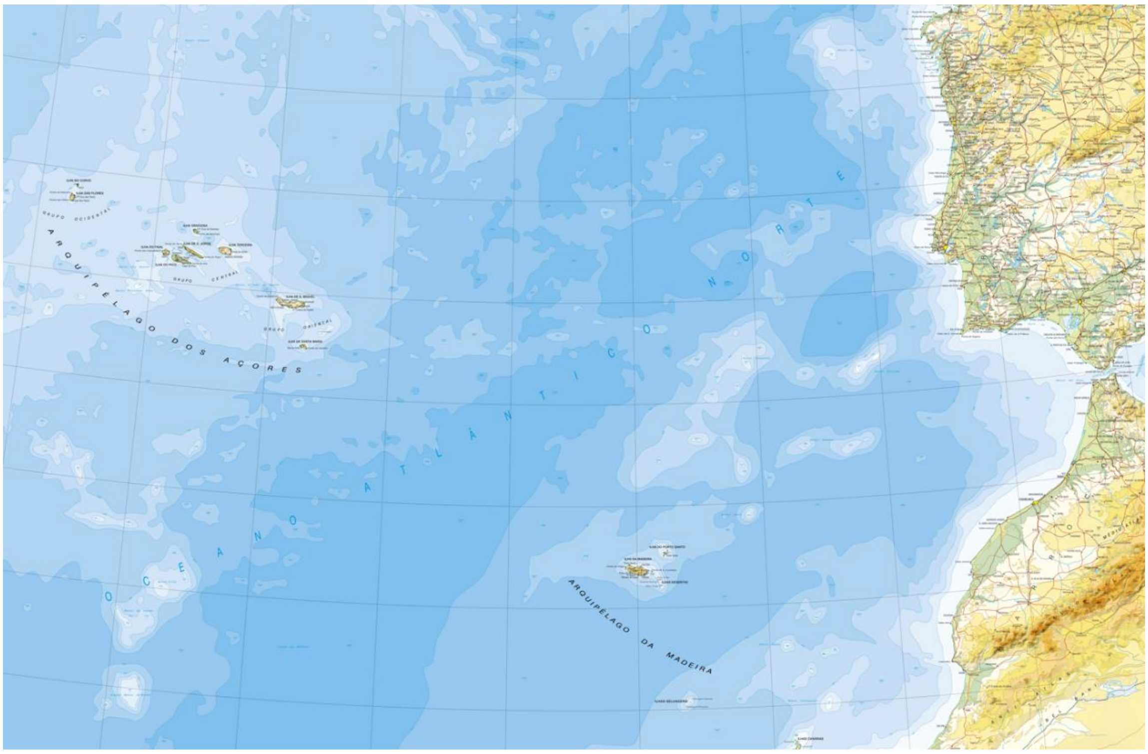

Figure 2.4.1
Map of Portugal (1:2 500 000 scale)
Source - Directorate-General for Territory, 2003

Portugal is situated in the south-west corner of the European continent, between the 30°01'49'' and 42º09'15'' parallels of north latitude, and between the 06º11'20'' and -31°16'07'' meridians west of Greenwich (Table 1).

Table 2.4.1
Extreme points of geographic position by NUTS I, 2020

	Latitude				**Longitude**			
	North		South		East		West	
	Location	*Geographic coordinate*	*Location*	*Geographic coordinate*	*Location*	*Geographic coordinate*	*Location*	*Geographic coordinate*
Portugal	Mouth of Trancoso river, confluence with Minho river	42° 09' 15''	Ponta do Sul - Ilhéu de Fora (Selvagens)	30° 01' 49''	Marco de fronteira 494 (Rio Douro)	-06° 11' 20''	Fajã Grande (Ilha das Flores)	-31° 16' 07''
Mainland	Mouth of Trancoso river, confluence with Minho river	42° 09' 15''	Cape of Santa Maria	36° 57' 42'	Border marker 494 (Douro river	-06° 11' 20''	Ponta da França (Berlenga, municipality of Peniche)	-09° 31' 01''
Archipelago of Madeira	Ilhéu de Fora	33° 07' 41''	Ponta do Sul - Ilhéu de Fora (Selvagens)	30° 01' 49''	Ponta do Leste (Selvagem Grande)	-15° 51' 21''	Ponta do Pargo	-17° 15' 57''
Archipelago of the Azores	Ponta do Mar	39° 43' 34''	Ponta do Castelo	36° 55' 39''	Ponta das Eirinhas	-25° 00' 47''	Fajã Grande (Flores island)	-31° 16' 07'

Source: Directorate-General for Territory, 2020

Portugal has a total area of 92.225,20 km^2, a perimeter of 3.931 km and an extensive coastline of 2.612 km (Table 2.4.2).

Table 2.4.2
Area, perimeters, maximum extension and altitudes by NUTS I, 2020

	Portugal	Mainland	Archipelago of Madeira	Archipelago of the Azores
Area (km2)	92.225,20	89.102,14	801,10	2.321,96
Perimeter (km)	3.931	2.559	429	943
Coastline (km)	2.612	1.240	429	943
Land borders (km)	1.319	1.319	0	0
Maximum Length North-South (km	1.345	577	344	311
Maximum Length East-West (km)	2.258	286	134	547
Maximum Altitude (m)	2.351	1.993	1.862	2.351

Source: Directorate-General for Territory, 2020

The Mainland is located at the European Tectonic Plate, occupies an area of 89.102,14 km2 and has a total perimeter of 2.559 km, 1.240 km corresponding to the Atlantic Ocean coastline and 1.319 km shared, at north and east, with Spain. The Archipelago of Madeira is located at the African Tectonic Plate, it occupies a total area of 801.10 km^2 and has a total perimeter and coastline of 429 km. This part of Portugal includes the islands of Madeira, Porto Santo, Ilhas Desertas and Ilhas Selvagens. The Archipelago of the Azores is located in the American, African and European Tectonic Plates, occupies a total of 2.321,96 km^2 and has a total perimeter and coastline of 943 km. This archipelago comprises nine major islands divided into three groups according to their geographic location: the western group (Flores and Corvo), the central group (Terceira, Graciosa, São Jorge, Pico and Faial) and the eastern group (Santa Maria and São Miguel).

The mapping of land use and occupation classes allows a general reading of the use of territorial resources and identification of macro landscapes that reflect the diversity of the Portuguese territory. The Land Use and Occupation Map (COS), produced by Directorate-General for Territory (DGT), give land use and occupation figures for mainland Portugal. Elaborated in vectorial format (based on photointerpretation), this map has 1 ha as the minimum cartographic unit and its nomenclature has more than 80 classes. COS updates (1995, 2007, 2010, 2015 and 2018) allows comparative analyses to be carried out between the different versions, namely analyses of land use and land cover dynamics for the continent.

Like other countries, in Portugal, the land-use is dynamic but changes are relatively small on a year-to-year basis. The most recent COS, from 2018, shows that 73.3% of the continental territory has forest, agricultural and agroforestry occupation. This value reaches 92.3% of territory if shrublands and grasslands are also considered, demonstrating its high potential for forestry and agricultural production and for the valorization of natural capital and landscape.

Portuguese Territorial Indicators System

DGT has been developing several projects to respond to territorial challenges that are increasing in the context of adaptation to climate change.

Within the scope of the National Spatial Planning Policy Programme – PNPOT[8] the territorial indicators system stands out. This system is structured in different themes, that aim to support

8 General framing of the National Spatial Planning Policy Programme (PNPOT) is provided in Section GEOGRAPHICAL PROFILE (2.4)

the establishment of public policies with territorial expression and the development of a country vision.

In the context of adaptation to climate change, the following set of indicators has been selected:

- Built-up area in the Coastal Zone (500 m) - quantifies the evolution from 2015 to 2018 of the built-up area (occupied by edification in percentage values) along a zone of 500 metres from the coastline in mainland Portugal[9].
- Built-up area in the Coastal Zone (2000 m) - quantifies the evolution from 2015 to 2018 of the built-up area (occupied by edification in percentage values) along a zone of 2000 metres from the coastline[10].
- Natural habitats of Community interest in the 2000 m of the coastal zone - Percentage of the territory with natural and semi-natural habitats of Community interest (PSRN 2000), within a area of 2000 metres from the coastline, in 2018[11].
- Artificialized area in flooding risk areas - Quantification of the artificialised areas located in areas at risk of flooding, in 2010, 2015 and 2018[12].
- Area covered by riparian zones - Percentage of area of the municipality occupied by riparian zones (LCLU 2012), in 2018[13].
- Percentage of areas occupied by sealed soils within the wetland corridors, in 2018[14].
- Parks and gardens in urban areas, in 2018[15].
- Area with ecosystem services funding - Percentage of area with financing for ecosystem services, by municipality, in 2019[16].
- Burnt area - Percentage of area in each municipality that was burned by fires in the years 2017 and 2018[17].

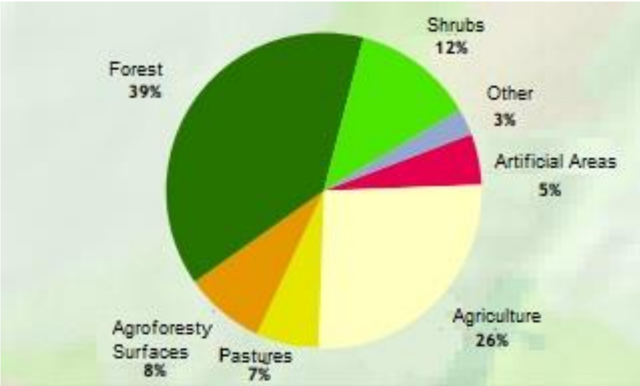

Figure 2.4.2
Land use and occupation distribution in Portugal, 2018
Source: Directorate-General for Territory, 2020

Forest is the most representative land use and occupation class in Portugal, especially in the mainland. This forest is composed of diverse species and is dominated by wild pine, eucalyptus and cork trees. Cork trees are particularly concentrated in specific regions, especially in the

9 https://observatorioindicadores.dgterritorio.gov.pt/mapa?p=559&c=0
10 https://observatorioindicadores.dgterritorio.gov.pt/mapa?p=560&c=0
11 https://observatorioindicadores.dgterritorio.gov.pt/multimapa?p=599
12 https://observatorioindicadores.dgterritorio.gov.pt/multimapa?p=577&g=5&d=2010,2015,2018
13 https://observatorioindicadores.dgterritorio.gov.pt/multimapa?p=879&g=5&d=
14 https://observatorioindicadores.dgterritorio.gov.pt/multimapa?p=880
15 (https://observatorioindicadores.dgterritorio.gov.pt/multimapa?p=765
16 (https://observatorioindicadores.dgterritorio.gov.pt/multimapa?p=611
17 https://observatorioindicadores.dgterritorio.gov.pt/multimapa?p=648&g=5&d=2017,2018

south of Portugal. The eucalyptus and the pine trees correspond to 56% of the area occupied by forest, in very similar proportions. Other species, such as oaks, are also relevant.

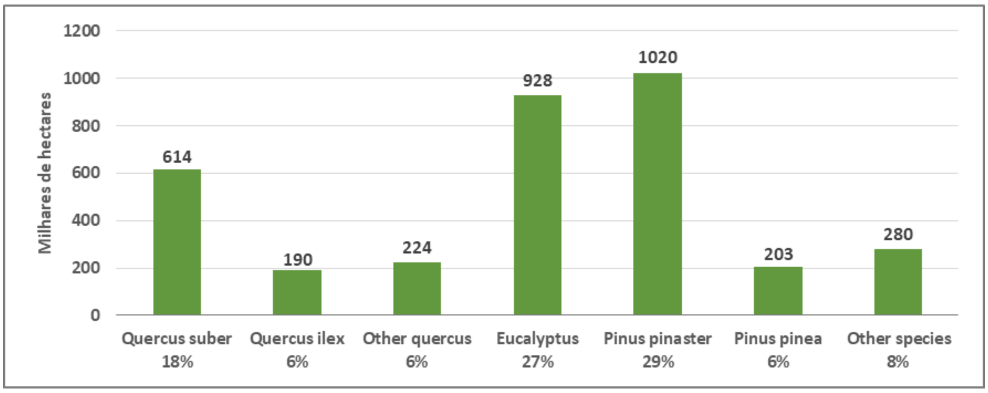

Figure 2.4.3
Dominant species in COS class 'Forest'
Source: Directorate-General for Territory, 2020

The forest composition has been changing, with an increase in areas of most types of forest, especially eucalyptus and cork oak (Quercus suber), and a reduction in areas of maritime pine (Pinus pinaster) and holm oak (Quercus rotundifolia).

The increase in eucalyptus has been boosted due to the short rotation period and the existence of a market for wood, making this species a good investment with a fast financial return. The increase in the cork oak has been driven by financing instruments aimed at private individuals, which include the afforestation of former agricultural land. Decreases in Maritime Pine are mainly driven by forest/rural fires and the pine nematode.

Agricultural land is divided into two main groups: annual or temporary crops and crops of a more permanent nature that remain on the ground for longer periods of time. This group includes vineyards, orchards, and olive groves, with olive groves prevailing over the other types of crops mentioned. Their distribution reflects the specific conditions of the territory and the use of the opportunities associated with its infrastructure. Annual crops (wheat, corn, tomatoes, potatoes, etc.), rainfed or irrigated, are the largest subclass of COS and represent almost 50% of all agriculture on the mainland.

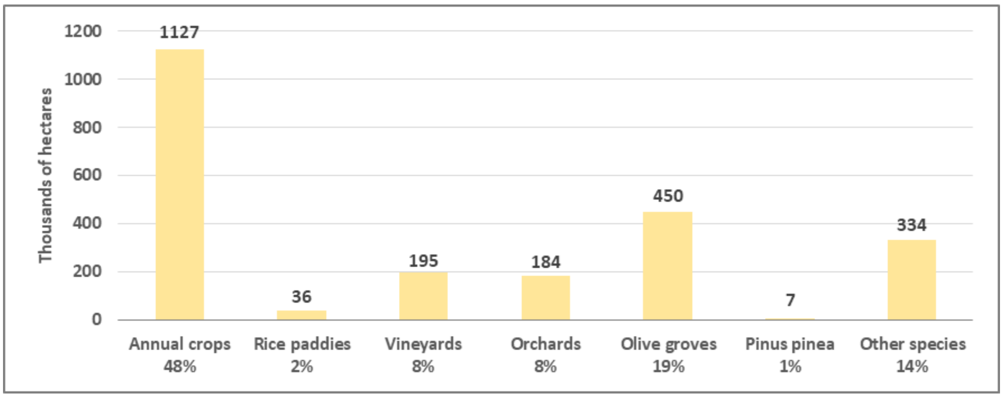

Figure 2.4.4
Dominant species in COS class 'Agriculture'
Source: Directorate-General for Territory, 2020

Artificialized areas include predominantly residential buildings, in continuous and discontinuous urban sprawl, business location areas, areas with infrastructures, equipment, public space (parks and gardens) and other artificialized occupations.

Almost 50% of the artificialized territory corresponds to discontinuous built up areas, with low soil sealing intensity, mainly associated with dispersed settlement. These characteristics lead to territorial specificities that are relevant to the planning of environmental infrastructures, in mobility options and in the access to services of general interest for the public.

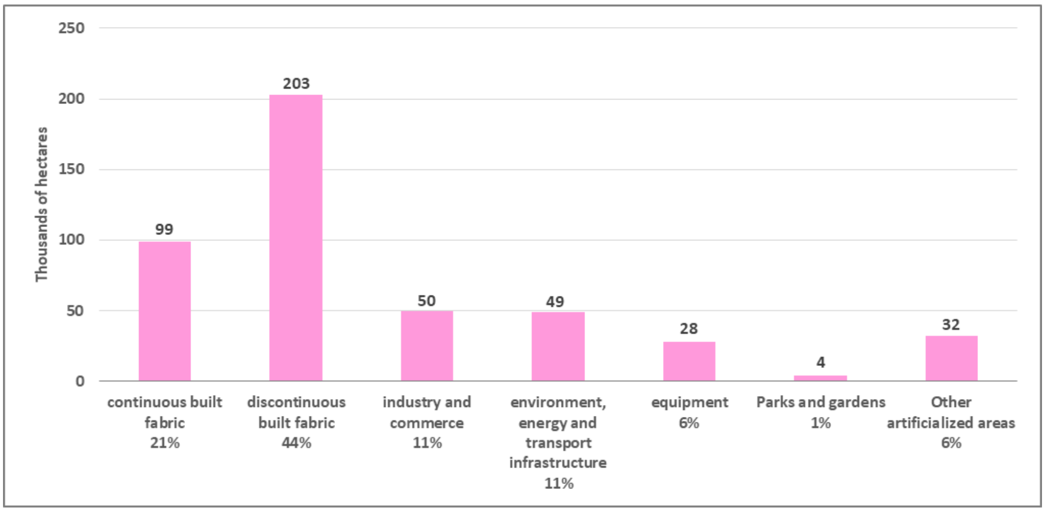

Figure 2.4.5
Dominant land use classes in 'Artificial Areas'
Source: Directorate-General for Territory, 2020

In the context of this macro reading, the analysis of disaggregated data related to sub-classes of land use and occupation allows us to infer specific realities, influenced by biophysical conditions, natural, human and material resources, property structure and economic return of land use.

Between 1995 and 2018 there were changes between classes of land use and occupation in about 12% of the territory, representing approximately one million hectares. In terms of general balance, only classes relating to artificialized areas and forest areas increased, while the remaining classes recorded more or less significant losses.

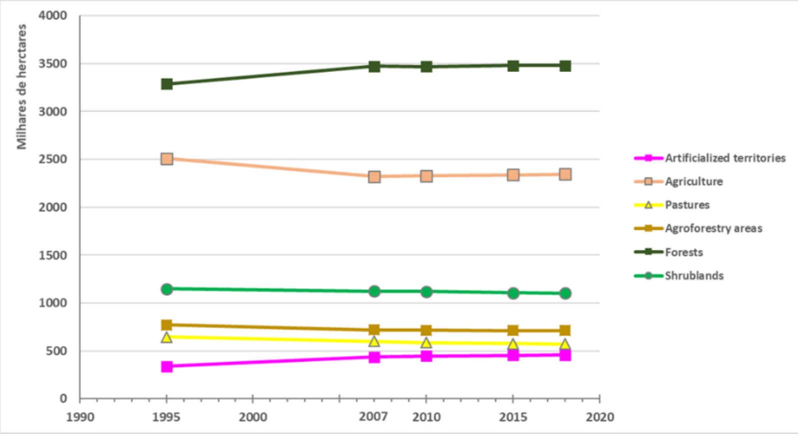

Figure 2.4.6
Land uses and ocupation dynamics 1995-2018
Source: Directorate-General for Territory, 2020

The dynamic changes between 2015 and 2018 are shown in the following table. There is a stable trajectory of the areas affected by each land use class, with a slight increase in agriculture standing out.

Table 2.4.3
Average annual variation of classes

	2015-2018 (hectares)
Artificialized territories	1293
Agriculture	6122
Pastures	-2936
Agroforestry areas	-309
Forests	-592
Shrublands	-4199
Others	621

Source: Directorate-General for Territory, 2020

The causes of the transformation of portuguese landscapes are mostly the population loss, the abandonment of small family farming, continuous and monospecific forestry, land and cadastral management, and forest fires, as well as the inappropriate use of land for urbanization, construction and major infrastructures.

Climate Profile (2.5)

Mainland Portugal

The climate in mainland Portugal is predominantly influenced by latitude, topography and its proximity to the Atlantic Ocean; some climate variables, such as precipitation and temperature have strong north-south and west-east gradients as well as a very significant seasonal and inter-annual variability.

Temperature

The spatial distribution of average annual mean air temperature in mainland Portugal shows the combined effect of three main factors, whose relative importance varies within the annual cycle, while a significant temperature gradient is evident in the north-south direction during winter and a strong gradient in coastal areas during summer.

Average annual values for mean air temperature are lower in highland areas in inland North and Centre (Serra da Estrela), between 6°C and 9°C, and higher, above 17°C, in eastern Algarve and the Guadiana valley (Fig 2.5.1).

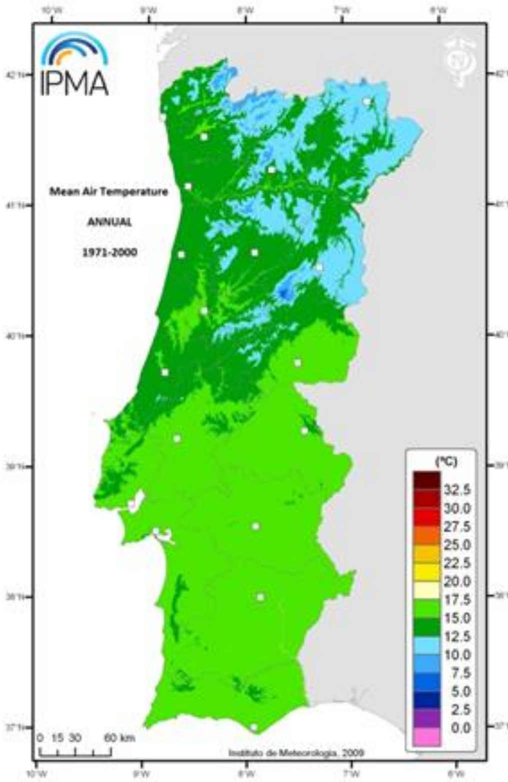

Figura 2.5.1.
Spatial distribution of the annual average mean air temperature in mainland Portugal (1971-2000 climate normal

Average monthly temperatures variate regularly throughout the year, reaching a peak in August and a minimum value in January. In the summer, average values for maximum air temperature vary between 20°C in Cabo Carvoeiro and 33°C Amareleja. The highest values for maximum air temperature in the summer are recorded in the whole region of inland Centre and inland Alentejo, between 30°C and 34°C, while the lowest figures of 20°C to 25°C occur in almost the entire western coastline (Fig. 2.5.2). Average values for minimum air temperature in winter range from -1°C to 2°C in northern and central inland mountainous areas and from 9 to 10°C in the headlands south of Cabo Carvoeiro and in the coastal region of the Algarve (Fig. 2.5.3).

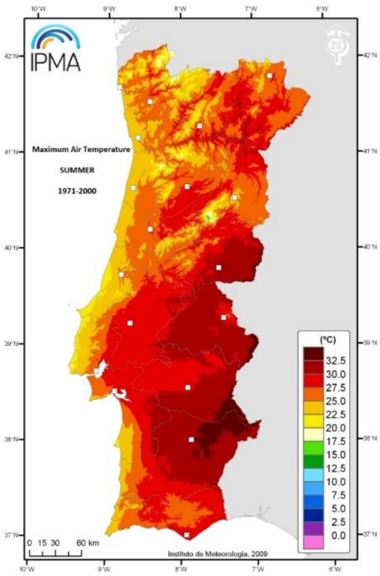

Figura 2.5.2.
Spatial distribution of the maximum air temperature in the summer in mainland Portugal (1971-2000 climate normal)

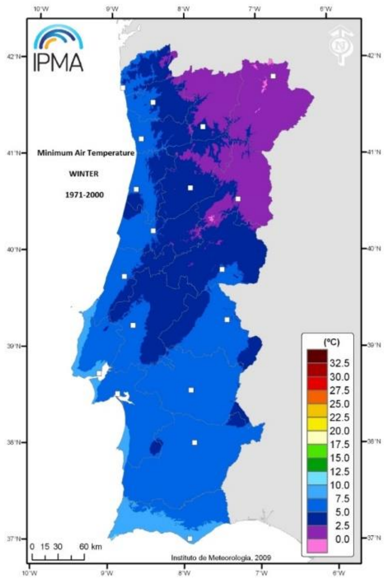

Figura 2.5.3.
Spatial distribution of the minimum air temperature in the winter in mainland Portugal (1971-2000 climate normal)

The number of days in a year with a minimum air temperature below or equal 0°C is higher (40 to 60 days) in northern and central inland regions and lower in southern coastal regions. The number of days in a year with a minimum air temperature equal or above 20°C or (tropical nights) shows maximum values in the region of Beira Baixa/Alto Alentejo, in the area of Amareleja, and in eastern Algarve; the lowest values (1-2 days) occur in the coastal North and Centre regions.

The number of days with a maximum air temperature equal or above 25°C (summer days) is higher than 80 days in almost the whole territory except in the western coastline. The regions of the Douro Valley, Ribatejo, Alentejo and eastern Algarve have the highest number of days (> 120 days). Days with a maximum air temperature equal or above 30°C (warm days) occur mainly in the summer (more than 20 days in the whole territory) and more frequently in the regions of the Douro Valley, Beira Baixa and Alentejo.

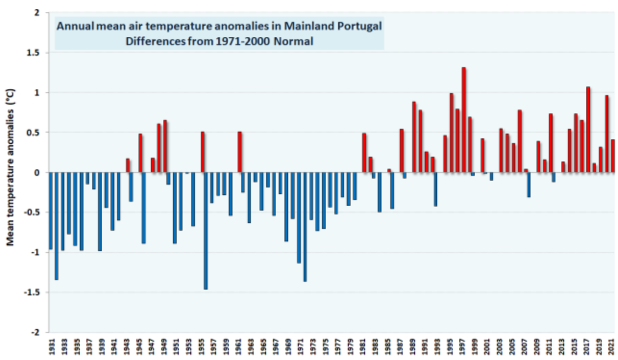

Figura 2.5.4.
Annual mean air temperature anomalies in mainland Portugal (1931-2021)

Since the mid-70s the average air temperature has risen in all regions of Portugal at a rate of approximately 0.3°C/decade (Figure above). It should be noted that out of the 10 warmest years, eight occurred after 1990, with 1997 being the warmest year and 2017 the second warmest.

There is an increase in the number of days with high air temperatures and a decrease in the number of days with low temperatures, in particular after 1976. There is also an increase in the intensity and duration of heat waves.

The 2011-2020 decade was the warmest since 1931 in mainland Portugal, surpassing the previous highest value that occurred in the 1991-2000 decade (Figure 2.5.5).

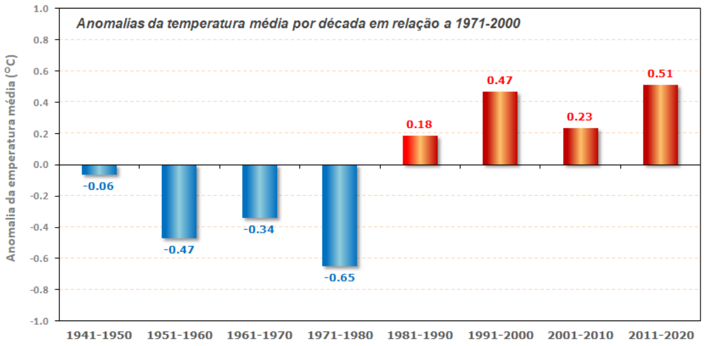

Figura 2.5.5
Decadal average mean air temperature anomaly in mainland Portugal, relative to1971-2000 normal

Precipitation

Average annual precipitation in mainland Portugal (Figure 2.5.6) shows a strong spatial variability, with the highest values observed in the mountainous regions of Minho, exceeding 2500 mm, and the lowest values, below 600 mm, in some northern and central inland regions (non-mountainous areas) and in inland Alentejo. Precipitation has very strong variations from year to year, making the region vulnerable to extreme events associated to lack (droughts) or excess (floods) of rainfall.

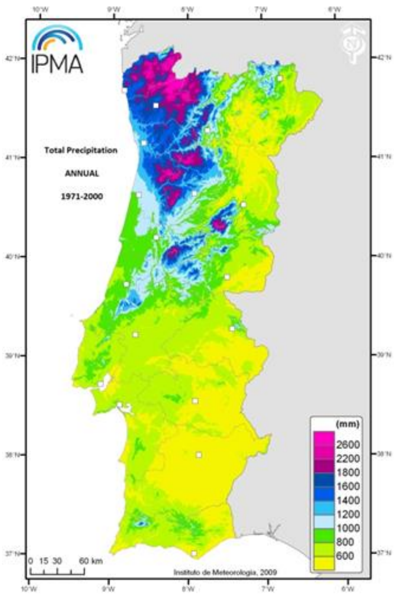

Figura 2.5.6.
Spatial distribution of the average annual precipitation in mainland Portugal (1971-2000 climate normal)

On average, around 40% of annual precipitation occurs during winter (December to February) and only 7% of total annual precipitation occurs during summer, June to August (Figure 2.5.7). Transition seasons – spring (March to May) and autumn (September to November) – show a high variable inter-annual distribution, with approximately 24% and 28% of total average precipitation during these seasons, respectively

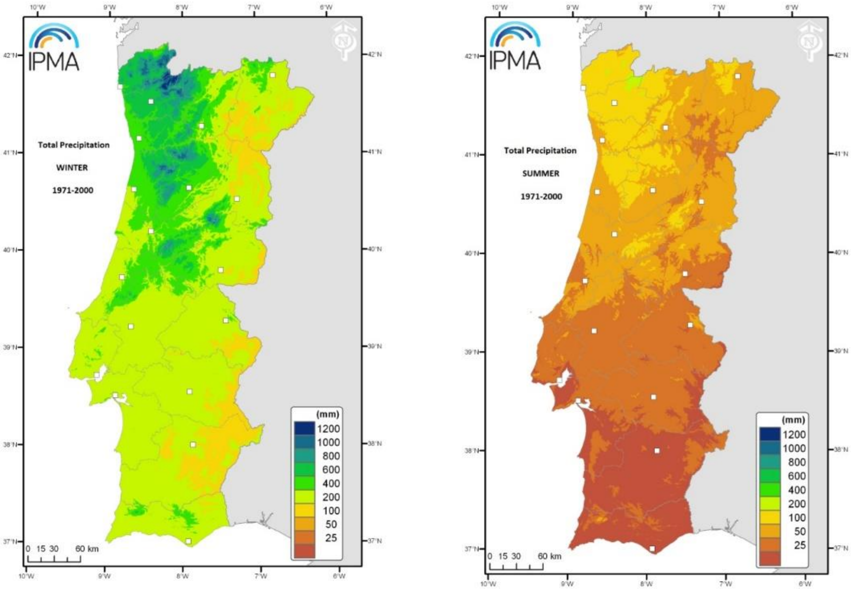

Figura 2.5.7.
Spatial distribution of the average seasonal precipitation in mainland Portugal (1971-2000 climate normal)

The number of days with precipitation equal or above 0.1, 1 and 10mm show a very similar pattern, since the largest number of days occurs in northern and central coastal regions, while the southern inland regions show fewer days. Regarding the number of days in a year with precipitation equal or above 30 mm, the highest values (> 20 days) occur in the region of Minho and the lowest (< 3 days) in the northern inland regions and in Alentejo.

Annual precipitation has decreased (-20mm/decade): the last 20 years have had particularly low rainfall in mainland Portugal (Figure 2.5.8). It should also be noted that 6 of the 10 driest years occurred after 2000, with 2005 being the driest year, 2007 the second driest and 2017 the third driest.

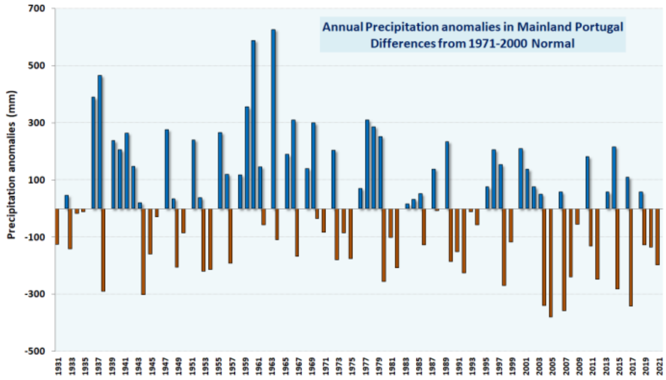

Figura 2.5.8.
Annual total precipitation in mainland Portugal (1931-2021) – Differences from 1971-2000 normal

The last four decades have been continuously drier, the driest one being 2001-2010. The decade 2011-2020 was the second driest in mainland Portugal, since 1931, with a difference of only +5mm from, 2001-2010 decade (Figure 2.5.9).

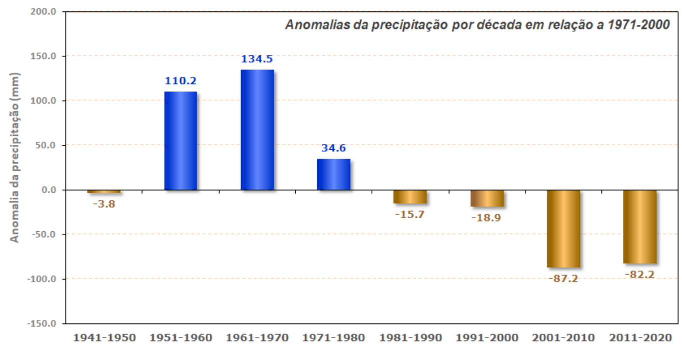

Figura 2.5.9.
Decadal precipitation anomaly in mainland Portugal relative to 1971-2000 normal

Seasonal precipitation shows great variability, with a decrease in spring (statistically significant), summer and winter and an increase in autumn, reflecting a shorter winter period and early spring. There has been an increase in extremely rainy days (above the 99^{th} percentile) within annual precipitation, especially in the past 30 years and in southern regions.

Archipelago of the Azores

The archipelago of the Azores is situated in the subtropical area of the northern hemisphere anticyclones, and the dominant factor for its weather conditions is the Azores anticyclone.

The Azores are characterised by a temperate and humid climate, however given the variation of air temperature according to altitude, its climate is ocean cold in highland regions, where it is extremely rainy.

Average annual values range from 14°C to 18°C in coastal regions and from 6°C to 12°C in higher areas, except for the highest spot on the island of Pico (Pico mountain) where average temperature is below 2°C.

The Figure 2.5.10 shows the annual mean air temperature anomalies in three meteorological stations of Azores: Flores, Horta and Ponta Delgada. The last 5 years recorded mean air temperature near or above normal.

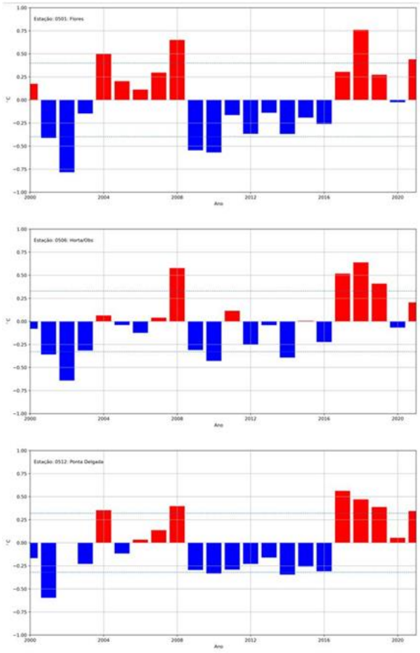

Figure 2.5.10
Annual mean air temperature anomalies in Flores, Horta and Ponta Delgada (Azores), between 2000 and 2021. Dashed lines correspond to one standard deviation (±σ).

Values for average monthly temperature vary regularly throughout the year, reaching a maximum in summer, particularly in August, and a minimum in winter, namely in the months of January and February. Average monthly values for mean air temperature in January and February are lower in areas of higher altitude in the archipelago and vary between 4°C and 8°C, except for the Pico Mountain (Ponta do Pico) where values are even lower, below 0°C. In August, the hottest month, the highest values for the archipelago of the Azores are close to 22°C and occur in some coastal areas of all islands, but mainly in Santa Maria (west), São Miguel (south), Corvo, Pico and Faial (south-east).

The distribution of average annual precipitation recorded in the archipelago of the Azores (figure 2.5.11) at lower elevations varies from west to east and rainfall is more abundant in the Western Group, on the island of Flores, with an average of 1 666 mm (Boca da Baleia), while the lowest quantities of precipitation are recorded in the Eastern Group, on the island of Santa Maria (729 mm).

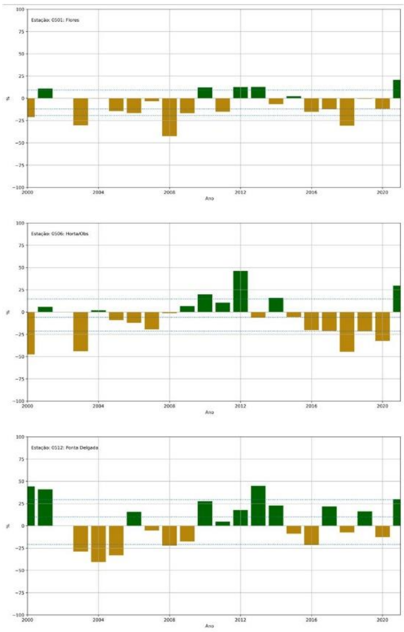

Figure 2.5.11

Annual precipitation relative anomalies in Flores, Horta and Ponta Delgada (Azores), between 2000 and 2021. Dashed lines correspond to first and fourth quintiles and medians of the distributions.

The amount of average annual precipitation in this archipelago is also strongly influenced by its topography, with the highest average annual precipitation values recorded in certain islands with higher elevations, as is the case of some locations on the island of Pico, where values above 4000 mm/year may occur, for example in Lagoa do Caiado, which has an average of 4695mm.

The Figure 2.5.11 shows the annual precipitation anomalies between 2000 and 2020 in the meteorological stations of Azores: Flores, Horta and Ponta Delgada. There were recorded positive anomalies in 2021 in the 3 locations. However in Flores and Horta reference for the sequence of drier years than normal between 2016 and 2020.

The season between September and March is predominantly rainy, characterized by the frequent passage of low pressure disturbances associated with the polar front, the average amount recorded during these months exceeds 500 mm. In the remaining months, the seasons are less rainy due to the influence of the Azores anticyclone.

<u>Archipelago of Madeira</u>

Climate in the archipelago of Madeira is warm, both in winter and summer, except in the highlands areas where temperatures are lower. The low pressure systems that cross the Atlantic in winter and descend to the latitude of Madeira, or those that are formed between the archipelago and mainland Portugal, can cause significant rainfall. Winds from the north (linked to the eastern branch of the Azores anticyclone) predominate in the summer. However, the complex topography of the island of Madeira is at the origin of many microclimates (temperate with dry and hot summers, temperate with dry and mild summers, temperate with dry and cool summers).

Values for average annual mean air temperature vary between 8°C in the highest peaks and 22°C in the coastal areas of the island of Madeira and in almost the entire island of Porto Santo. The region of Funchal, which is south and downstream of dominant winds, is the warmest location on the island.

Since 1994, the average mean air temperature in Funchal has been consecutively higher than normal (last 28 years). 2020 was the warmest one and 2021 was the 2nd warmest year in Funchal meteorological station, along with the years of 2004 and 2019 (Figure 2.5.12).

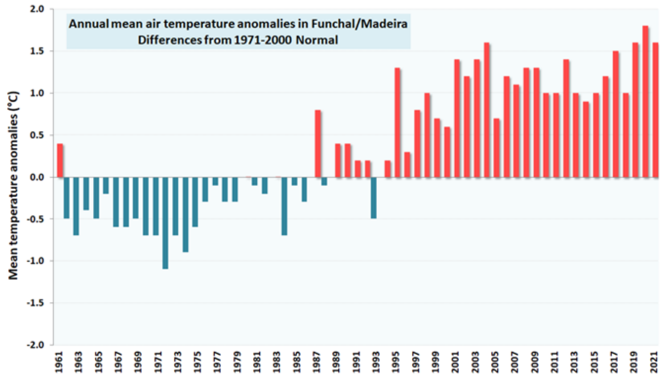

Figura 2.5.12.
Annual mean air temperature anomalies in Funchal between 1961 and 2021. Differences from 1971-2000 normal

In the archipelago of Madeira the average annual precipitation shows a variation between islands, with rainfall being more abundant on the island of Madeira than on the island of Porto Santo, and Funchal having 596mm on average.

Annual precipitation in Madeira varies between 3400mm (highest peaks) and 600mm (Funchal region) and is strongly influenced by its topography. The most abundant rainfall occur at higher elevations of the island (Encumeada 2 794mm, Bica da Cana 2 635mm and Arieiro 2620mm/year). There is also a significant contrast between the north and higher locations, where precipitation values are very high, and the south with low precipitation.

Precipitation in winter exceeds 1400mm in the highest areas, while it is less than 300mm in the regions of Funchal and Machico valley. In the summer months the amount of precipitation varies between 150mm in highland areas and less than 50mm on the south coast of the island. The fact that it rains more in the northern part of Madeira during summer is clearly linked to the dominant direction of the wind (north) during that season and to the fact that precipitation is essentially orographic.

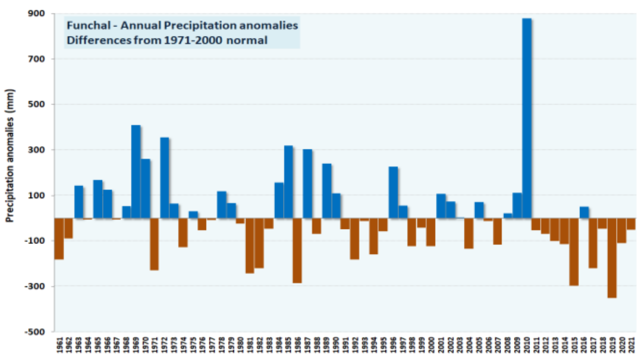

Figure 2.5.13.
Annual total precipitation in mainland Portugal between 1961 and 2021. Differences from 1971-2000 normal

The annual precipitation in Funchal in the last 10 years record values below the average (except in 2016) (Figure 2.5.13). The driest year was 2019 and the second driest was 2015.

Extreme weather events in Portugal

The most frequent extreme weather events in Portugal are associated with periods of intense heat (heat waves) and lack of precipitation (droughts).

A heat wave is considered to occur when, within a period of at least 6 consecutive days, the daily maximum temperature is 5°C higher than the daily average value in the reference period.
Heat waves, which can occur at any time of the year, are more notorious and felt through their impacts when they occur in the summer months (June, July and August).

Since the 1940s, a period in which daily meteorological information is available in a greater number of stations, heat waves have been observed, of variable space-time extension.
In the last 30 years, more extreme heat wave events have been observed in the summer period in mainland Portugal. This situation has been notorious throughout the territory, however the inner regions of the North and Center (districts of Bragança, Vila Real, Viseu and Guarda) and the Alentejo region (districts of Setúbal, Évora and Beja) are the most affected.

The most severe episodes of heat waves (highest number of heat waves and higher number of days in a heat wave) occurred after 1990 in the inner North and Center region and after 2000 in the South region.
The summers with the highest percentage of weather stations experiencing a summer heat wave since 2000 were:

- 2013 (89%)
- 2006 (85%)
- 2003 (76%)
- 2018 and 2022 (74%)

The highest total number of days in a heat wave, 918 days[18], occurred in the summer of 2022, with a significant contribution from the Northeast region; in this region, in some meteorological stations, there were 4 heat waves, which corresponded to a total of more than 40 days in heat wave. It should be noted Bragança, Mirandela and Carrazeda with 44, 42 and 41 days, respectively.

Highlight also for the years 2003 and 2006 with more days in a heat wave (687 and 667 days[19] respectively).

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[18] Value calculated by adding the number of days in a heat wave that occurred in the summer months (June, July and August) at the meteorological stations of IPMA network, in a total of 54 stations.

[19] Value calculated by adding the number of days in a heat wave that occurred in the summer months (June, July and August) at the meteorological stations of IPMA network, in a total of 54 stations.

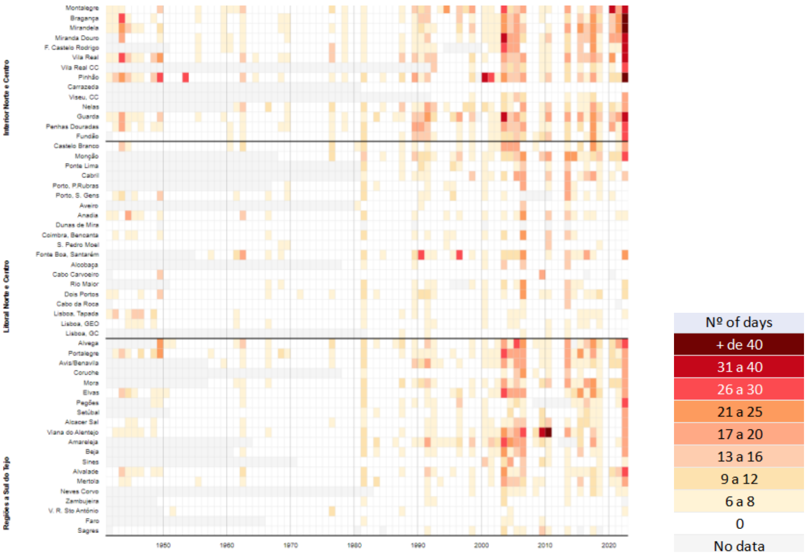


Figure 2.5.14
Number of days of heat waves (summer period) per year - Since 1941

Another extreme event that has greatly affected Mainland Portugal in recent years and with serious consequences in the agricultural and water sectors is droughts.

In recent years there has been a greater frequency of episodes of meteorological drought, some of which have lasted for more than one wet period (autumn and winter) and dry period (spring and summer) and have also covered a greater percentage of the territory. This situation affect the whole territory, however the Northeast and the Southern regions are the most affected.

Between 1941 and 2022, several drought episodes occurred in Portugal, from the droughts of the 40's to the most recent ones, after 2000. Since 1980, there have been nine episodes in which more than 10 % of the territory was in a extreme drought situation and four in which more than 75 % of mainland Portugal was experiencing severe or moderate drought.

In the last 80 years, the episodes of meteorological drought with greater severity were:

- 1944/45, 1948/49, 1980/82, 1991/93, 1994/95
- 2004/06, 2011/12, 2015, 2017/18, 2019 and 2022

Of the meteorological droughts referred to, the most severe were:

- Drought 1944/45: the longest since 1941;
- Drought of 2004/06: the one with the greatest territorial extension (100% of the affected territory) and the most intense (taking into account the consecutive months of severe and extreme drought).

The meteorological drought of 2016/2017 should also be highlighted, an event that registered a very significant worsening in early autumn, an unusual situation, since in previous drought situations there was a strong improvement in the territory of the severe and extreme drought classes in September and October. In 2017, on October 31st, 25% of the territory was in severe drought and 75% in extreme drought.

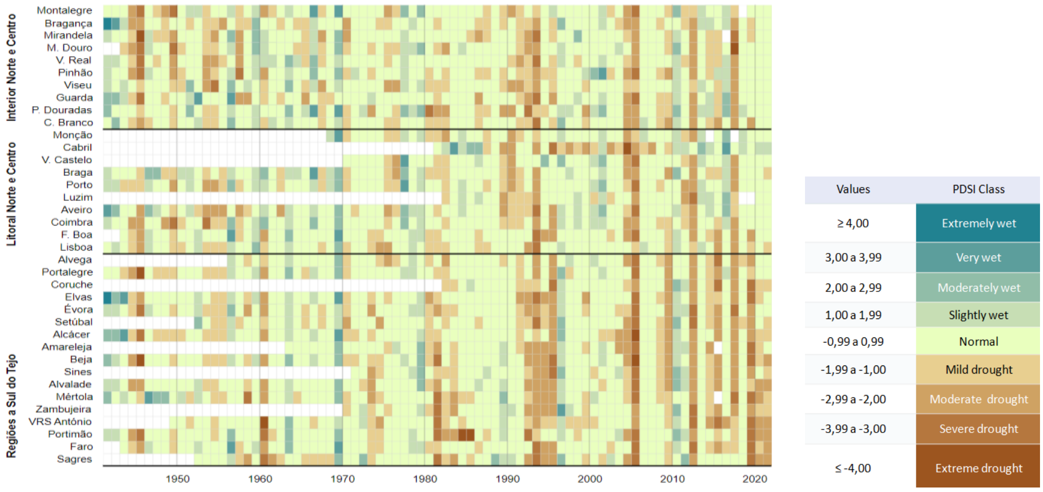


Figure 2.5.14
PDSI Annual Averages - since 1941

Energy Profile (2.6)

In recent years, Portugal has put in place several policies to increase the use of renewable energy sources, energy efficiency and security of supply, decrease energy import dependency and improve the economic sustainability of the energy system, which directly contributes to the goal of reducing environmental impacts. In particular, the focus on renewable energy allowed to achieve very positive results in terms of increase in domestic energy production and decrease of external energy dependency.

It should be noted that 2020, in the context of the restrictions imposed by the COVID-19 pandemic, was an atypical year in terms of energy consumption (primary and final), with a significant reduction, particularly in final energy consumption, due essentially to the reduction in travel/mobility, with the transport sector having the greatest impact on reducing final energy consumption (road and aviation).

National Energy Resources (2.6.1)

Domestic production

Portugal's national energy resources come almost exclusively from renewable energy, mainly biomass, with 51% of domestic production in 2020 and renewable electricity (36%), which is produced essentially by hydro, wind and photovoltaic. In 2020, domestic energy production (figure 2.6.1.1) reached 6 656 608 toe,having increased around 3% compared to 2019, essentially due to the higher contribution of hydro, and photovoltaic electricity generation.

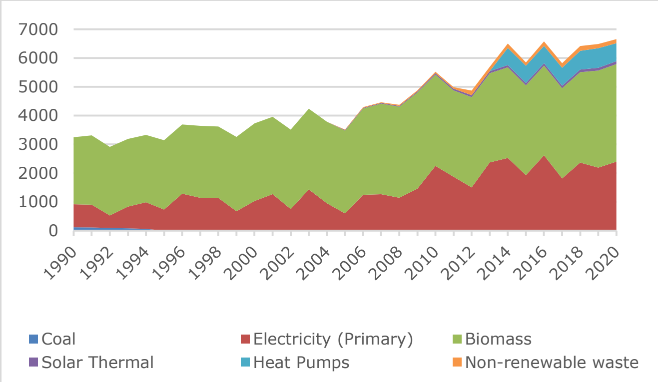


Figure 2.6.1.1
Evolution of domestic energy production (ktoe)
Source: Directorate-General of Energy and Geology (DGEG), 2022

In 2020 the domestic energy production (figure 2.6.1.2) in Portugal accounted for 32% of total Primary Energy Consumption, which represents a 3.1% increase compared to 2019, due not only to a decrease in total Primary Energy Consumption but also to a higher uptake of renewable electricity, mainly from hydro and photovoltaic, and solar thermal energy.

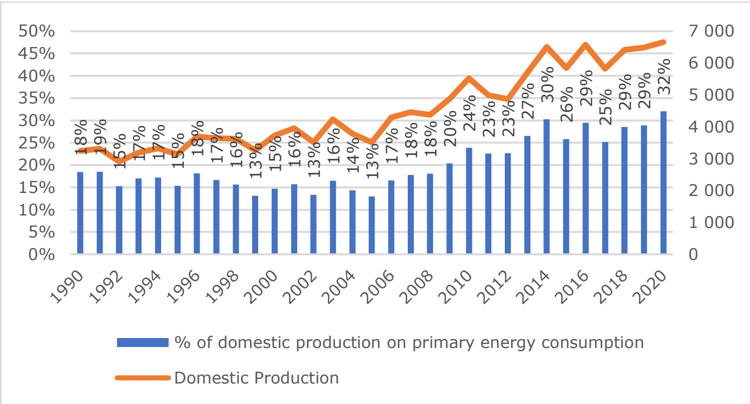


Figure 2.6.1.2
Development of domestic energy production (ktoe)
Source: Directorate-General of Energy and Geology (DGEG), 2022

National targets for renewable energy

Under Directive 2009/28/EC of the European Parliament and of the Council, on the promotion of the use of energy from renewable sources, Portugal submitted a National Renewable Energy Action Plan (NREAP), setting the 2020 national targets for the share of energy from renewable in gross final energy consumption (overall target), also on RES sources consumed in electricity production (RES-E), transport (RES-T) and heating and cooling (RES-H&C), as well as their penetration paths, in accordance with the implementation pace of the measures and actions envisaged for each of these sectors, considering the effects of other policies related to energy efficiency on energy consumption. In its NREAP, Portugal committed to attaining the targets set in the Directive, in particular the overall target of 31% of energy from renewable sources in gross final energy consumption and 10% in final energy consumption within the transport sector.

In 2020, the share of renewable energy sources (RES) in gross final energy consumption (figure 2.6.1.3) was 34.0%, meaning that Portugal has largely exceeded its target for 2020. The significant rise in this indicator was strongly influenced by the reduction in fossil fuels consumption (reduction in final energy consumption) due to the context of the COVID-19 pandemic, namely road transport fuels and aviation (as previously mentioned).

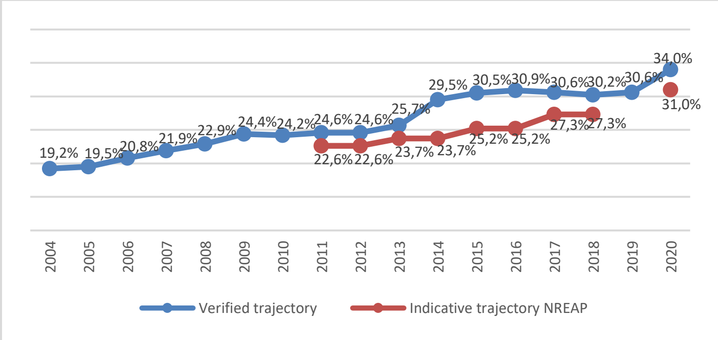


Figure 2.6.1.3

Evolution of the share of RES in gross final energy consumption, in accordance with Directive 2009/28/EC

Source: Directorate-General of Energy and Geology (DGEG), 2022

At sectoral level (figure 2.6.1.4), in 2020 the share of renewable energy sources in electricity production (RES-E) was 58.0 % (+4.2 p.p. compared to 2019), in the heating and cooling sector (RES-H&C) 41.6 % (-0.1 p.p. compared to 2019) and in the transport sector (RES-T) 9.7 % (+0.6 p.p. compared to 2019). In transport there was a significant increase in 2014, that resulted from the implementation of the certification process of biofuels, which allowed to increase the accounting for the purposes of the Directive. Also, since 2014 the incorporation of RES-H&C includes the contribution of heat pumps (in accordance with the Directive), leading to a significant and progressive increase of renewable energy in this sector.

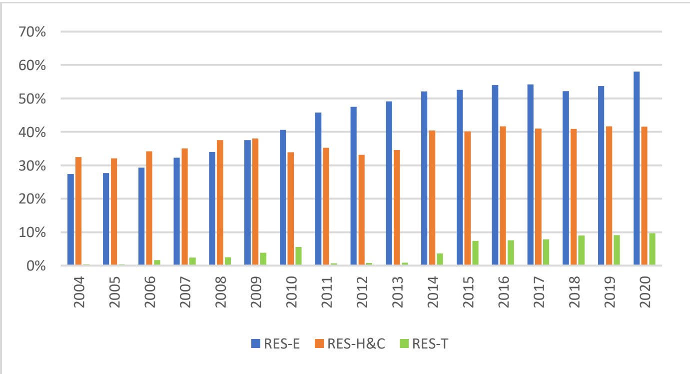


Figure 2.6.1.4

Development of sectoral targets to incorporate renewables in energy consumption in accordance with Directive 2009/28/EC

Source: Directorate-General of Energy and Geology (DGEG), 2022

<u>Energy dependency</u>

Portugal’s lack of fossil fuel resources and its relatively low domestic energy production result in a high energy import dependency (figure 2.6.1.5). Nonetheless, the investment on renewable energies and energy efficiency in the 20-year period between 2001 and 2020 has allowed Portugal to lower its energy dependency from 85.6% to 65.8%. As already referred the Covid-

19 pandemic had a significant impact in the energy consumption, that are linked with the need of energy imports, and consequently in the reduction of energy dependency in 2020.

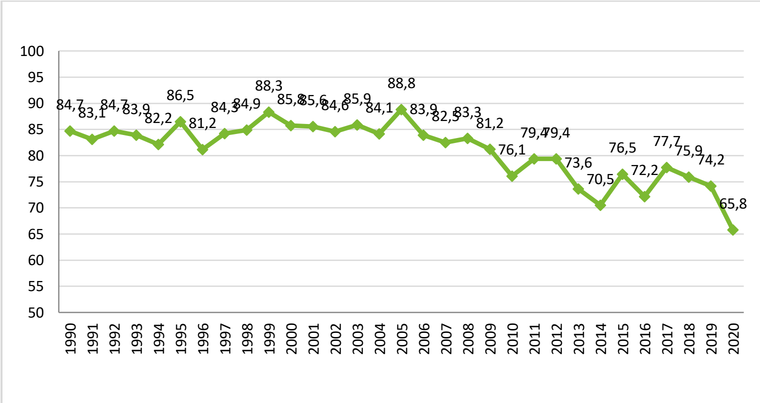


Figure 2.6.1.5

Development of Energy dependency in Portugal (%)

Source: Directorate-General of Energy and Geology (DGEG), 2022

Looking at the Normalised Energy Dependency (figure 2.6.1.6), which is determined considering the normalised electricity generated from hydropower and wind power in compliance with Directive 2009/28/EC (the average of the last 15 years for hydropower and the average of the last 5 years for wind power), a normalised dependency of 66.0 % is recorded for 2020. The analysis of this indicator allows to mitigate the effect of the variability associated to hydro and wind power production and to obtain energy dependency values for an average year in terms of water and wind availability.

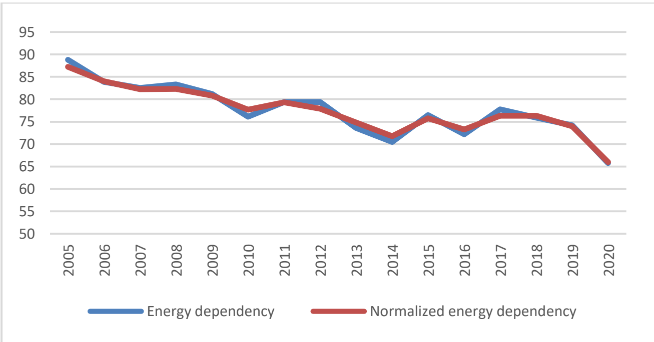


Figure 2.6.1.6

Development of Normalised Energy Dependency (%)

Source: Directorate-General of Energy and Geology (DGEG), 2022

Energy import balance

The Portuguese energy import balance has been decreasing almost consistently since 2005 (exceptions in 2011, 2015 and 2017) reaching the lowest value in 2020 (14 470 656 toe). Between 2011 and 2020 the average annual growth rate of the energy import balance was -2.8%, which compares with -1.9% in the previous 10-year period (2001-2010).

From 2019 to 2020 the energy import balance (figure 2.6.1.7) decreased 22%, which resulted mainly from an abrupt decrease of 99% in imports of coal for electricity production.

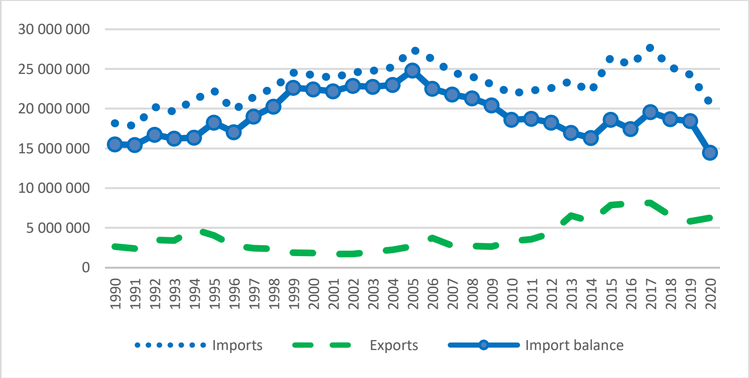


Figure 2.6.1.7
Evolution of Energy Import Balance (toe)
Source: Directorate-General of Energy and Geology (DGEG), 2022

Production (2.6.2)

Primary Energy (2.6.2.a)

Portugal has no production of crude oil, natural gas or coal and relies entirely on imports for these energy sources. Domestic energy production comes primarily from bioenergy (direct use and electricity generation) and electricity generation mainly from hydro, wind and photovoltaic (endogenous/renewable sources), as stated in point 2.6.1.

Consumption (2.6.3)

Primary Energy (2.6.3.a)

In 2020 total Primary Energy Consumption in Portugal reached 20 790 947 toe (-7.5% compared to 2019). Between 2011 and 2020 the average annual growth rate of total Primary Energy Consumption was -0.7%, which compares with -1.0% in the previous 10-year period (2001-2010).

Regarding the consumption of the different energy sources (figure 2.6.3.a.1) in 2020, crude oil is the main source of primary energy consumption (41%), followed by natural gas (25%), biomass (15%) and electricity (12%). Primary Energy Consumption of coal has the highest decrease in the 10-year period between 2011 and 2020, with an average annual growth rate of -14.1%, followed by crude oil, with -2,2%. In contrast, non-renewable waste and solar thermal, included in the "Others" category, reached the highest average annual growth rates (9.3% and 6.0%, respectively).

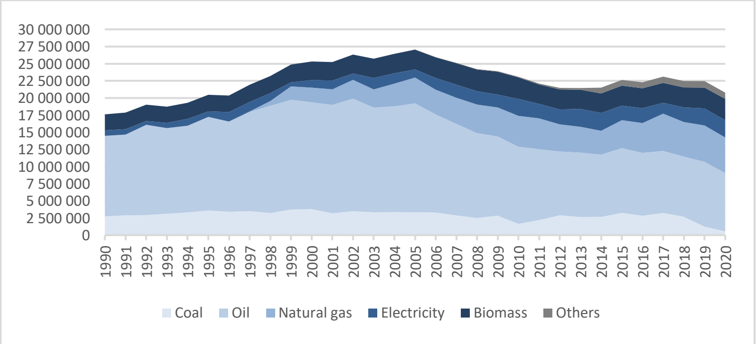


Figure 2.6.3.a.1
Evolution of total Primary Energy Consumption (toe)
Others: Solar thermal, heat pumps and non-renewable waste
Source: Directorate-General of Energy and Geology (DGEG), 2022

Final Energy (2.6.3.b)

Total Final Energy Consumption (figure 2.6.3.b.1) in 2020 was 15 445 800 toe, which represents a decrease of 7.2% compared to 2019. Between 2011 and 2020 the average annual growth rate of total Final Energy Consumption was -0.7%, which compares with -0.6% in the previous 10-year period (2001-2010).

Oil products were the main source of final energy consumption in 2020 (44%), followed by electricity (26%), natural gas (11%), heat (CHP) and biomass (7% each). Final Energy Consumption of coal has the highest decrease between 2011 and 2020, with an average annual growth rate of -7.9%, followed by oil products, with -2.3%. In contrast, solar thermal and non-renewable waste, included in the "Others" category, reached the highest average annual growth rates (6.0% and 2.7%, respectively).

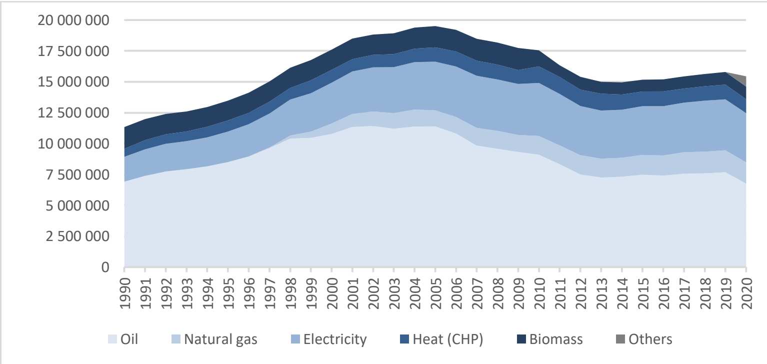


Figure 2.6.3.b.1
Evolution of total Final Energy Consumption (toe)
Others: Coal, gas works, solar thermal, heat pumps and non-renewable waste
Source: Directorate-General of Energy and Geology (DGEG), 2022

At sectoral level (figure 2.6.3.b.2), in 2020 the transport sector was the main final energy consumer, with 33% of total Final Energy Consumption, followed by industry (31%), residential (19%), services (13%) and agriculture and fisheries (3%). Final Energy Consumption in transport has the highest decrease between 2011 and 2020, with an average annual growth rate of -2.0%, followed by industry, with -0.9%. In contrast, Final Energy Consumption in agriculture and fisheries reached the highest average annual growth rate (1.5%), followed by the residential sector (0.8%).

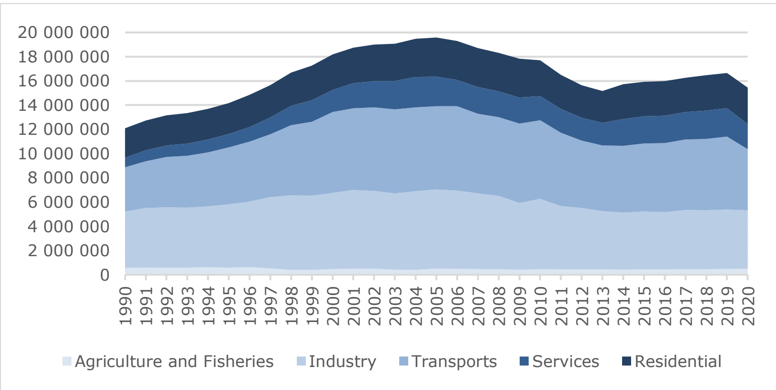


Figure 2.6.3.b.2
Evolution of total Final Energy Consumption by sector of activity (toe)
Source: Directorate-General of Energy and Geology (DGEG), 2022

Market Structure (2.6.4)

Electricity

Portugal has liberalised electricity markets: any supplier can sell electricity at the wholesale and retail levels and every consumer has the right to choose its supplier or to freely switch between suppliers. Portugal and Spain have a common wholesale electricity market (MIBEL) that is part of the European common electricity market.

In the retail electricity market, customers are divided between the regulated market and the liberalised market. The process of extinction of regulated tariffs for electricity sales to end customers started in 2011. Since then, transitional tariffs began to be applied to customers that have not chosen a new supplier. These tariffs are expected to apply until December 31, 2025, the date on which the transitional period ends.

The market shares of wholesale and retail electricity suppliers operating in Portugal and the ownership of Portugal's generation capacity are highly concentrated among a few private companies.

MIBEL wholesale market

The MIBEL wholesale market uses a market coupling model that produces a single price for Portugal and Spain when there are no constraints on cross-border interconnection capacity. Market splitting ranged from 2% to 7% between 2014 and 2020 and has been 4% or lower since 2018. The market operator responsible for the management of MIBEL is based on a bipolar interconnected structure, with OMIE (Spanish centre) responsible for day and intraday market management and OMIP (Portuguese centre) responsible for the management of forward markets. The Energy Services Regulatory Authority (ERSE) continues to work on deepening the integration of MIBEL and co-ordinates with other national energy regulators to integrate the Portuguese electricity market with other regional and European markets.

EDP owns the majority of Portugal's installed generation capacity. In 2020, it owned 57% of total generation capacity, 100% of large hydro capacity, 66% of coal capacity, 53% of CCGT capacity and 17% of renewable capacity excluding large hydro (mostly onshore wind). EDP is by far the largest supplier of electricity purchased at the wholesale level in Portugal.

Retail market

In 2020, 15.3% of total electricity retail market customers (table 2.6.4.1) were in the regulated market, which represents a decrease of 4.4% in the four-year period between 2017 and 2020. The regulated market accounted for 5.3% of electricity consumption in 2020, corresponding to a decrease of 1.7% compared to 2017[20]. In 2020, apart from the suppliers of last resort, responsible for the supply of the regulated market customers, there were 34 suppliers active in Portugal's retail electricity market, an increase of 42% compared to 2017.

Table 2.6.4.1.
Customers, consumption and suppliers in the electricity retail market (2017-2020)

		2017	2018	2019	2020
Customers	Regulated Market	1 222 546	1 125 340	1 034 006	965 643

[20] Source: "Relatório sobre os mercados retalhistas de eletricidade e de gás natural em Portugal 2017" and "Relatório sobre os mercados retalhistas de eletricidade e de gás natural em Portugal 2020" (ERSE).

	Liberalised Market	4 964 434	5 100 303	5 243 352	5 336 828
	Regulated Market (%)	19,8%	18,1%	16,5%	15,3%
	Liberalised Market (%)	80,2%	81,9%	83,5%	84,7%
Consumption	Regulated Market (GWh)	3 132	2 901	2 491	2 333
	Liberalised Market (GWh)	41 864	43 076	43 207	42 016
	Regulated Market (%)	7,0%	6,3%	5,5%	5,3%
	Liberalised Market (%)	93,0%	93,7%	94,5%	94,7%
Active suppliers		**24**	**30**	**32**	**34**

Source: ERSE

In 2020, EDP Comercial was by far the dominant supplier in the liberalised retail market (figure 2.6.4.1), accounting for 76% of customers and 41% of supply, and the top four companies (EDP Comercial, Endesa, Iberdrola and Galp) accounted for 81% of retail supply and 94% of customers.

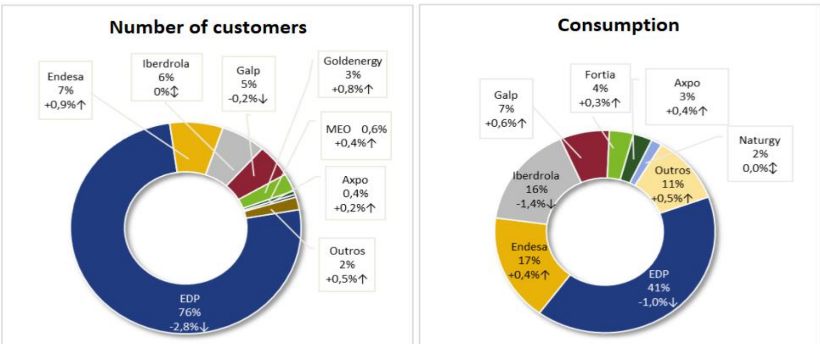


Figure 2.6.4.1
Liberalised retail electricity market shares (2020)
Source: ERSE

Natural Gas

Wholesale market

Portugal does not have an organised wholesale gas market. There is no national gas trading platform or price formation, and the wholesale gas supply continues to be purchased primarily through long-term bilateral contracts with limited price transparency.

The Portuguese gas transmission system operates as a single balancing/entry-exit zone and suppliers are free to import or export gas through the interconnection points (imports only at the Sines LNG terminal), with physical exchanges of natural gas determined bilaterally through the Portuguese virtual trading point (VTP).

Wholesale gas supply

In 2020, four companies with large gas import contracts accounted for about 95% of total wholesale gas supply. Galp Gás, the historic gas incumbent, is by far the dominant supplier for both LNG and pipeline imports. In the 2017-2020 period, Galp Gás share of Portugal's wholesale gas supply varied between a maximum of approximately 73%, in 2018, and a minimum of around 62%, in 2020. In 2020, Galp's dominant position in wholesale gas supply was based on four large contracts with the gas producers Sonatrach (Algeria) and Nigeria LNG Limited (Nigeria). EDP Gás and Endesa were also notable players at the wholesale level, and held import contracts (primarily for LNG), mainly to fuel their gas-fired power plants in Portugal. Naturgy

(GNF), a major supplier in the large consumer segment of the gas retail market, was the only other company with a notable share of the wholesale gas supply (around 6%).

For additional information about gas trading/imports, please see the section about *"Prices, Taxation, Subsidies and Trade"*.

Retail market

The process of liberalisation of the gas sector in Portugal has been carried out progressively, with the liberalised retail market (table 2.6.4.1) being consolidated, in large part, due to the process of extinction of regulated tariffs which, in January 2013, began to cover all consumption levels. Since then, transitional tariffs began to be applied to customers that have not chosen a new supplier. These consumers are supplied by a supplier of last resort and have a period of transitory tariffs, until December 31, 2022 (consumptions greater than 10 000 m^3, supplied at low pressure), and until December 31, 2025 (consumptions lower or equal to 10,000 m^3).

In 2020, there were 1 513 686 consumers in Portugal's gas retail market. The majority of consumers (83%), representing 98% of total gas consumption, participated in the liberalised retail market. From 2017 to 2020, the share of consumers receiving the regulated tariff dropped around 4% and the share of regulated market consumption in total gas consumption decreased around 1%[21].

Table 2.6.4.1
Customers, consumption and suppliers in the gas retail market (2017-2020)

		2017	2018	2019	2020
Customers	Regulated Market	311 549	286 479	283 874	260 859
	Liberalised Market	1 144 657	1 196 315	1 198 451	1 252 827
	Regulated Market (%)	21,4%	19,3%	19,2%	17,2%
	Liberalised Market (%)	78,6%	80,7%	80,8%	82,8%
Consumption	Regulated Market (GWh)	1 232	1 188	1 068	964
	Liberalised Market (GWh)	40 838	41 848	42 042	39 721
	Regulated Market (%)	2,9%	2,8%	2,5%	2,4%
	Liberalised Market (%)	97,1%	97,2%	97,5%	97,6%
Active suppliers		13	12	13	21

Source: ERSE

In 2020, the liberalised market accounted for the following shares of gas demand by retail market segment: large consumers (100%), industry (96%), residential (85%) and small businesses (77%), with 19 suppliers active in the residential segment, 16 in the small business segment, 15 in the industrial segment and 9 in the large consumer segment. In 2020, four companies (Galp, Endesa, EDP and Naturgy) accounted for around 92% the retail market gas supply, with Galp alone accounting for 60% of supply. Four companies (EDP, Galp, Goldenergy and Endesa) supplied 94% of consumers, with EDP alone suppling 51% of consumers (Figure XX)[22].

[21] Source: "Relatório sobre os mercados retalhistas de eletricidade e de gás natural em Portugal 2020" (ERSE)
[22] Source: "Relatório anual sobre os mercados de eletricidade e de gás natural em 2020" (ERSE)

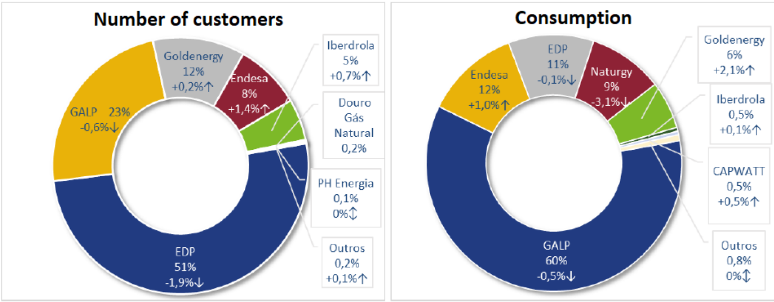


Figure 2.6.4.1.
Liberalised retail gas market shares (2020)
Source: ERSE

Oil/Oil Products[23]

Currently, there is no prospection and production of oil in Portugal, so all crude oil in the country is imported. Furthermore, the recently adopted Portuguese Climate Law[24], prohibits any new hydrocarbon prospection or exploration permits in the national territory (Art. 45). Galp Energia is the most important player in the Portuguese downstream oil sector. It is the only operator with domestic refining capacity, and it is active in every downstream sector activity (procurement, refining, logistics and retail). The remaining major operators (BP Portugal S.A., Repsol Portuguesa S.A., Cepsa Portuguesa Petróleos S.A. and Prio Supply S.A) are active in procurement, logistics and retail.

Wholesale market

From 2018 to 2020, four operators (Galp, Repsol, BP and Cepsa) dominated the wholesale market, accounting for over 87% of diesel sales and over 85% of gasoline sales. Galp, the only operator that owns refining capacity in Portugal, has the largest shares of the wholesale markets for diesel and gasoline (between 30% and 40% in 2020, provisional data). The wholesale market for bottled LPG is highly also concentrated. From 2018 to 2020, three operators (Galp, Rubis and Repsol) accounted for over 75% of bottled propane sales and over 85% of bottled butane sales; Galp's market share was over 40% for both fuels. These three operators are also owners of the three largest LPG storage facilities in Portugal: CLC, Pergás and Sigás.

Retail market

In 2020, mainland Portugal had around 3 199 retail service stations selling transportation fuels, an increase of around 6% compared to 2017. All stations sell diesel and gasoline, while around 350 also sell automotive LPG.

The ownership of stations and the share of retail fuel sales are highly concentrated among a few companies, with Galp controlling the largest market share. In 2020, the four largest operators (Galp, Repsol, Cepsa and BP) owned 61% of retail service stations in Portugal, the same share registered in 2017. Small independent players owned 23% of stations and supermarkets owned 9%.

[23] Source: "Análise do Mercado de Combustíveis Líquidos Rodoviários 2018-2020" (ERSE)
[24] Law 98/2021, of 31st december

Prices, Taxes, Subsidies and Trade (2.6.5)

Prices, Taxation and Subsidies

Electricity

Retail electricity prices in Portugal are composed of wholesale electricity costs, tariffs paid to system operators, operating margins of retail suppliers and taxes (figures 2.6.5.1, 2.6.5.2, 2.6.5.3 and 2.6.5.4). The tax component of electricity prices is composed of the tax on energy products (ISP), value-added tax (VAT), and a variety of other taxes and fees. The maximum VAT rate of 23% is applied to all electricity sales but is refunded 100% for industrial consumers. In 2020, only 33% of the average household retail price for electricity was composed of energy costs; the remaining 67% came from tariffs and taxes. For industrial consumers, around 40% of the average retail price for electricity was composed of energy costs, with the remaining 60% coming from tariffs and taxes.

The ISP for electricity is EUR 1.00 per MWh and has been unchanged since it was introduced in 2012. The ISP rate is the same for all consumers regardless of the sector, and rates do not vary with the level of demand. However, since 2013, industrial consumers have a 100% exemption from the ISP for electricity and industrial fuels if they are covered by the EU Emissions Trading System (ETS) scheme or by an energy consumption rationalisation agreement (ARCE) under the main programme for industry energy efficiency, the System for Management of Intensive Energy Consumption (SGCIE). In addition, all industrial consumers receive a full refund of the VAT charged on energy products (including electricity).

In 2019 and 2020, Portugal made changes to the VAT charged on electricity and gas demand that reduced taxation of electricity in comparison to gas for many consumers and created VAT rates for electricity that increase with higher levels of demand to encourage efficiency. For consumers connected to the low-voltage electricity network with a contract not exceeding 3.45 kVA and for natural gas consumers connected to the low-pressure gas network with a contract not exceeding 10 000 cubic metres per year, the VAT charged on the fixed component of network access tariffs was lowered from 23% to a "reduced rate" of 6% in mainland Portugal, 4% in the Azores and 5% in Madeira. For electricity consumers with a contract lower than or equal to 6.9 kVA (and those receiving the social tariff), the VAT charged on the entire electricity bill (but not gas bill) was reduced from 23% to an "intermediate rate" of 13% in mainland Portugal, 9% in the Azores and 12% in Madeira.

Electricity prices are also indirectly affected by the ISP and the carbon tax charged to operators of natural gas and coal-fired electricity plants. Historically, coal and gas used for electricity generation were exempt from the ISP and carbon tax. However, Portugal has been reducing the tax exemption on fossil fuels used by power plants to support decarbonisation. Starting in April 2020, natural gas used for electricity generation (excluding co-generation), was no longer fully exempt from the ISP or the carbon tax, and operators began to pay 10% of the ISP and 10% of the carbon tax. Both of these percentages will be progressively increased to 40% in 2023. In 2018, Portugal introduced a progressive elimination of the ISP and carbon tax exemptions for coal-fired power plants, with the exemption to be completely eliminated in 2022. This revenue is set aside by 50% to the National Electricity System (SEN) to reduce the electricity sector tariff deficit to be allocated to the Energy Sector Systemic Sustainability Fund and by 50% to the Environment Fund for decarbonization projects.

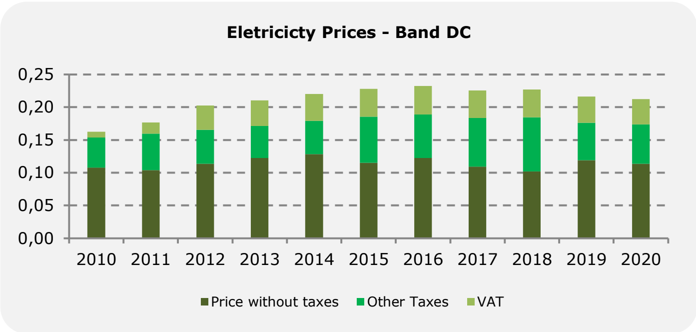


Figure 2.6.5.1.
Evolution of average electricity Households prices in Portugal – Band DC (EUR/kWh)
Source: DGEG

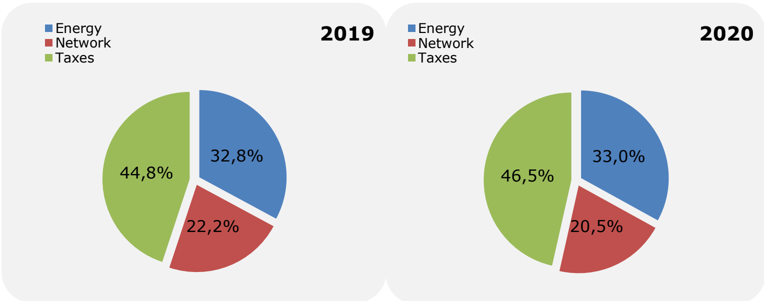


Figure 2.6.5.2.
Decomposition of electricity Households prices in Portugal – Band DC
Source: DGEG

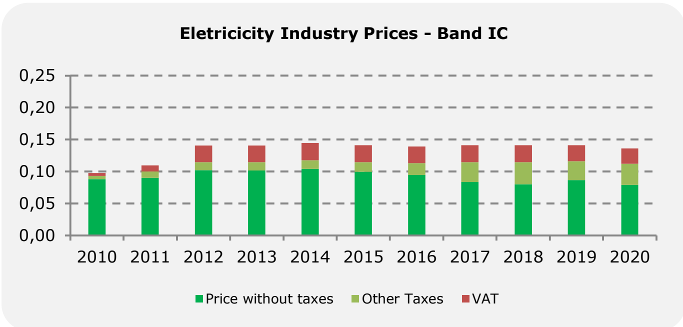


Figure 2.6.5.3.
Evolution of average electricity industry prices in Portugal – Band IC (EUR/kWh)
Source: DGEG

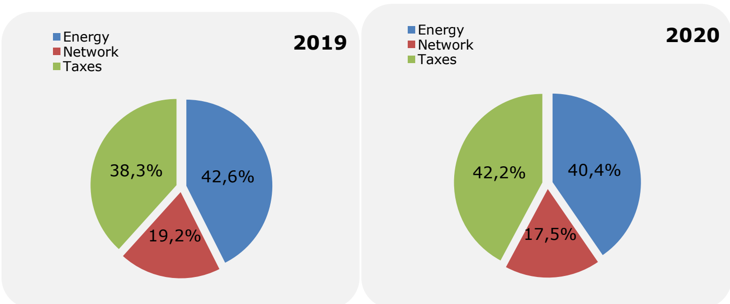


Figure 2.6.5.4.
Decomposition of electricity industry prices in Portugal – Band IC
Source: DGEG

Gas

Retail natural gas prices in Portugal are composed of wholesale gas costs, network tariffs, operating costs and taxes (figures 2.6.5.5, 2.6.5.6, 2.6.5.7 and 2.6.5.8). In 2020, only around 37% of the average retail price (Household) was composed of energy costs, with 63% coming from tariffs and taxes. The tax component of natural gas prices is composed by the ISP, the carbon tax and the VAT, with the maximum rate of 23%. For the ISP and the carbon tax, there are two tax categories for natural gas: one for gas used in the residential, commercial and industry sectors and one for gas used in the transport sector.

The ISP and carbon tax rates for all energy products are the same for all consumers. There are not different rates for households or industrial consumers and rates do not vary with the level of demand. However, industrial consumers have a 100% exemption from the ISP and the carbon tax for industrial fuels (including gas) and electricity if they are covered by the EU Emissions Trading System regime or an energy consumption rationalisation agreement (ARCE) under the main programme for industry energy efficiency, the SGCIE. In addition, all industrial consumers receive a full refund of the VAT charged on energy products.

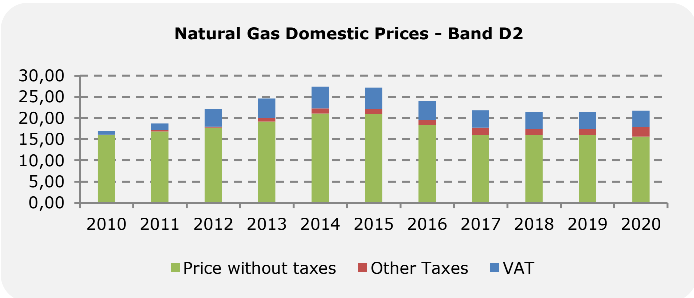


Figure 2.6.5.5.
Evolution of average natural gas Households prices in Portugal – Band D2 (EUR/GJ)
Source: DGEG

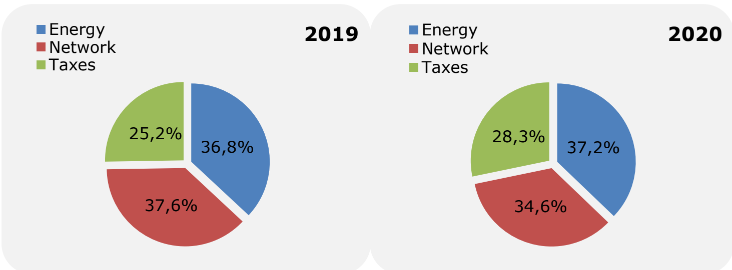


Figure 2.6.5.6.
Decomposition of natural gas Households prices in Portugal – Band D2
Source: DGEG

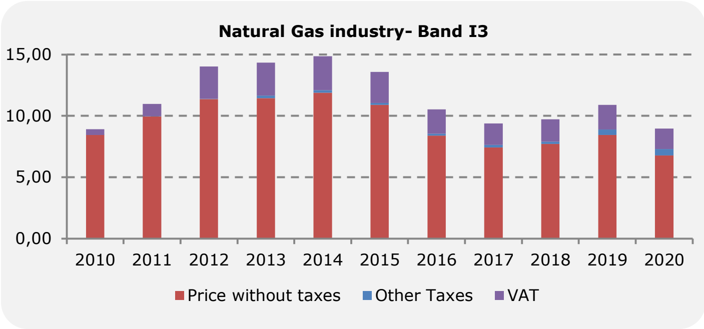


Figure 2.6.5.7.
Evolution of average natural gas industry prices in Portugal – Band I3 (EUR/GJ)
Source: DGEG

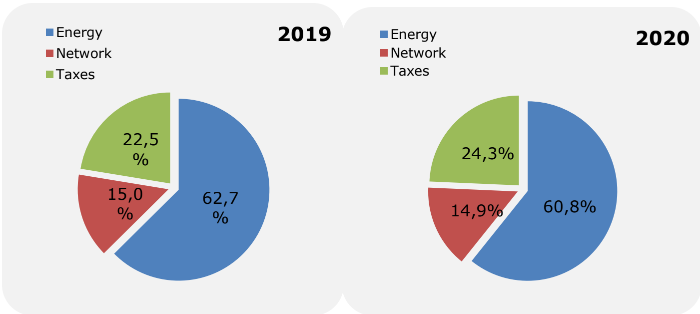


Figure 2.6.5.8.
Decomposition of natural gas industry prices in Portugal – Band I3
Source: DGEG

<u>Oil/Oil Products</u>

The oil products markets in mainland Portugal have been liberalised since 2004 with prices determined by market forces. The governments of the autonomous island regions of the Azores and Madeira continue to regulate retail oil products prices for many fuels. Retail fuel prices in mainland Portugal consist of the wholesale price, logistics and retail costs, supplier margin, and a tax component. The tax component is composed of the tax on energy products (ISP), the carbon tax and the value-added tax (VAT), with the maximum 23% rate applied for all oil products. Road transportation fuels (automotive diesel, gasoline and LPG) are also assigned a road service contribution tax, which is used to cover road infrastructure maintenance costs.

Starting in April 2020, oil used for electricity generation (including co-generation), which previously was exempt from the ISP and the carbon tax, began to pay 25% of the ISP and 25% of the carbon tax (this change excludes the autonomous island regions where almost all oil-fired electricity generation takes place). Both of these percentages will be progressively increased to 100% in 2023.

Annual evolution of the structure of the average price for automotive diesel and gasoline for road use (figures 2.6.5.9, 2.6.5.10 and 2.6.5.11):

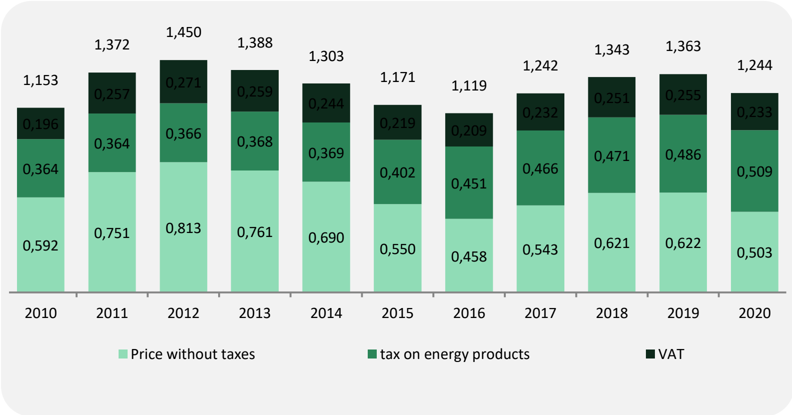


Figure 2.6.5.9
Evolution of average price for Diesel (Eur/liter)
Source: DGEG

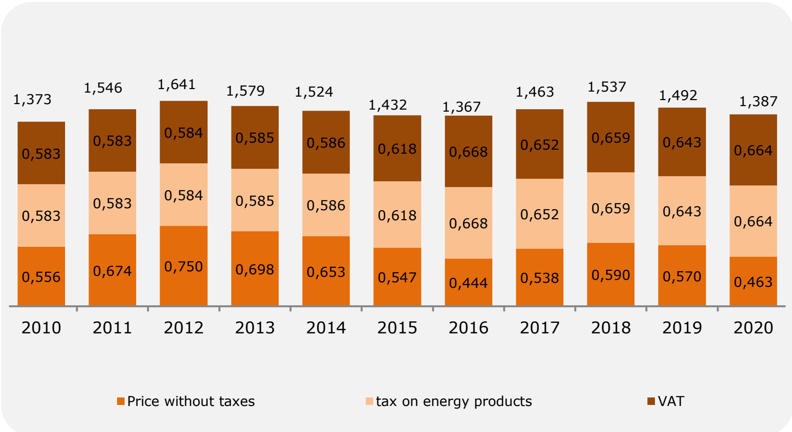


Figure 2.6.5.10.
Evolution of average price for Gasoline (Eur/liter)
Source: DGEG

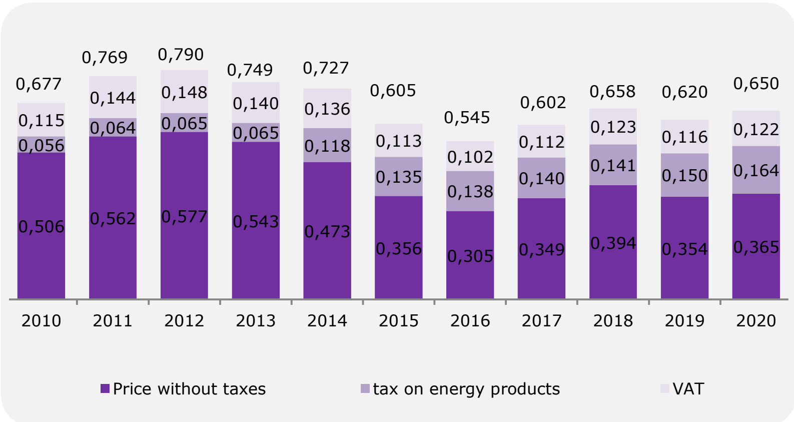


Figure 2.6.5.11.
Evolution of average price for LPG (EUR/Liter)
Source: DGEG

Energy taxation

Table 2.6.5.1
Tax on energy and petroleum products (ISP)

		Automotive Diesel	Gasoline Diesel	Automotive LPG	Natural Gas	Eletricity
From	To	EUR/liter	EUR/liter	EUR/liter	EUR/MWh	EUR/MWh
01/01/2004	12/02/2004	0.2998	0.5176	0.0510	NA	NA
13/02/2004	31/12/2004	0.3083	0.5226	0.0510	NA	NA
01/01/2005	09/06/2005	0.3083	0.5226	0.0520	NA	NA
10/06/2005	31/12/2005	0.3144	0.5330	0.0520	NA	NA
01/01/2006	18/01/2006	0.3144	0.5330	0.0532	NA	NA
19/01/2006	31/12/2006	0.3394	0.5580	0.0532	NA	NA
01/01/2007	07/01/2007	0.3394	0.5580	0.0543	NA	NA
08/01/2007	22/02/2007	0.3644	0.5830	0.0543	NA	NA
23/02/2007	31/12/2007	0.3644	0.5830	0.0543	NA	NA
01/01/2008	09/01/2008	0.2784	0.5190	0.0555	NA	NA
10/01/2008	31/12/2008	0.2784	0.5190	0.0555	NA	NA
01/01/2009	28/02/2009	0.2784	0.5190	0.0555	NA	NA
01/03/2009	31/12/2009	0.2784	0.5190	0.0555	NA	NA
01/01/2010	28/04/2010	0.2784	0.5190	0.0555	NA	NA
29/04/2010	11/08/2010	0.2784	0.5190	0.0559	NA	NA
12/08/2010	31/08/2010	0.2784	0.5190	0.0559	NA	NA
01/09/2010	31/12/2010	0.2784	0.5190	0.0559	NA	NA
01/01/2011	11/03/2011	0.2784	0.5190	0.0638	NA	NA
12/03/2011	31/12/2011	0.2784	0.5190	0.0638	NA	NA
01/01/2012	31/12/2012	0.2784	0.5190	0.0652	NA	1.0000
01/01/2013	27/02/2013	0.2784	0.5190	0.0652	1.0799	1.0000
28/02/2013	31/12/2013	0.2784	0.5190	0.0652	1.0799	1.0000
01/01/2014	31/12/2014	0.2784	0.5190	0.0652	1.0799	1.0000
01/01/2015	31/12/2015	0.2784	0.5190	0.0652	1.0799	1.0000
01/01/2016	11/02/2016	0.2784	0.5190	0.0652	1.0799	1.0000
12/02/2016	12/05/2016	0.3384	0.5790	0.0652	1.0799	1.0000
13/05/2016	16/11/2016	0.3284	0.5690	0.0652	1.0799	1.0000
17/11/2016	31/12/2016	0.3184	0.5690	0.0652	1.0799	1.0000
01/01/2017	31/12/2017	0.3384	0.5490	0.0672	1.0907	1.0000
01/01/2018	31/12/2018	0.3432	0.5566	0.0681	1.1051	1.0000
01/01/2019	31/12/2020	0.3432	0.5266	0.0681	1.1051	1.0000

Source: DGEG
NA – Not Available

Carbon Tax

Table 2.6.5.2

		Automotive Diesel	Gasoline Diesel	Automotive LPG	Natural Gas
From	To	EUR/liter	EUR/liter	EUR/liter	EUR/MWh
01/01/2015	31/12/2015	0.013	0.012	0.008	1.028
01/01/2016	31/12/2016	0.017	0.015	0.010	1.347
01/01/2017	31/12/2017	0.017	0.016	0.010	1.383
01/01/2018	31/12/2018	0.017	0.016	0.010	1.383
01/01/2019	14/02/2020	0.032	0.029	0.019	2.573
15/02/2020	31/12/2020	0.058	0.054	0.035	4.770

Source: DGEG

Road Service Contribution

Table 2.6.5.3.

		Automotive Diesel	Gasoline Diesel	Automotive LPG
From	To	EUR/Liter	EUR/Liter	EUR/Liter
01/01/2008	31/12/2011	0.086	0.064	-
01/01/2012	31/12/2012	0.088	0.065	-
01/01/2013	31/12/2013	0.089	0.066	-
01/01/2014	31/12/2014	0.091	0.067	0.053
01/012015	Now	0.111	0.087	0.063

Source: DGEG

VAT (%)

Table 2.6.5.4

From	To	General	Natural gas Electricity
05.06.02	30.06.05	19	5
01.07.05	30.06.08	21	5
01.07.08	30.06.10	20	5
01.07.10	31.12.10	21	6
01.01.11	30.09.11	23	6
01.10.11	31.12.11	23	23
01.01.12	now	23	23

Source: DGEG

Trade

Electricity

The electricity imports and exports (figure 2.6.5.12) in Portugal are highly dependent of hydro-storage capacity and the market prices on MIBEL, as well as hydrology for each civil year. Portugal is only electrically interconnected with Spain. Historically, Portugal has been a net importer of electricity, but became a net exporter of electricity between 2016 and 2018.

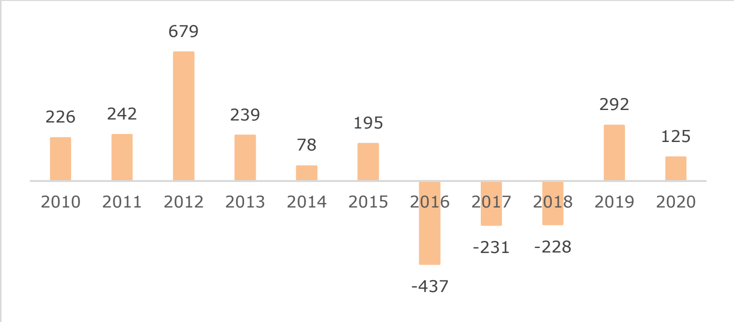


Figure 2.6.5.12
Electricity import balance in Portugal - 2010-2020 (kton)
Source: DGEG

<u>Oil/Oil products</u>

Portugal has no indigenous production of oil and therefore imports 100% of the crude processed in its refineries and it has diversified crude oil supply sources. Total imports of crude oil and oil products (figure 2.6.5.13), in 2020, were 14 421 kton, which corresponds to a decrease of 11% compared to 2019. In the period 2010-2020 there was an average annual growth rate of -0.2%.

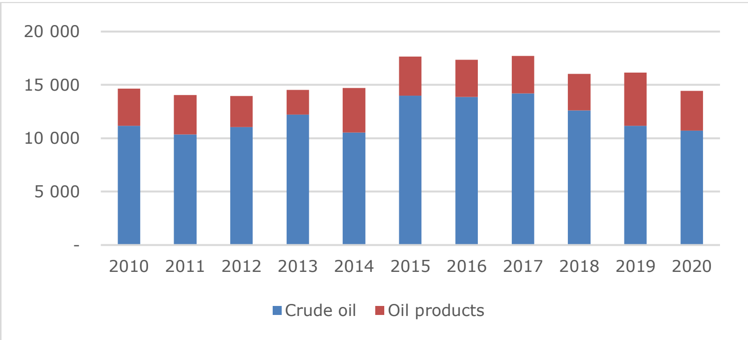
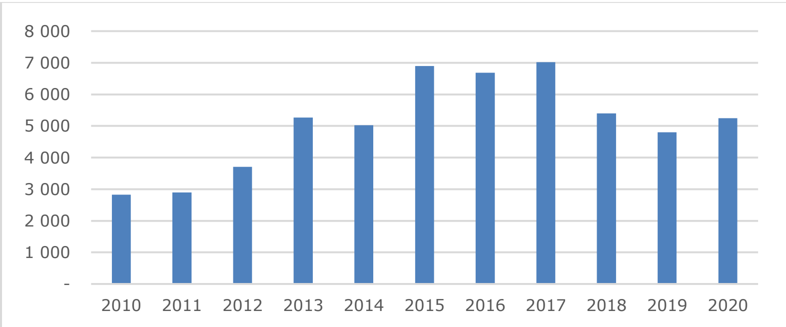


Figure 2.6.5.13.
Crude oil and oil products imports in Portugal - 2010-2020 (kton)
Source: DGEG

Oil products exports (figure 2.6.5.14) reached 5 251 kton in 2020, which corresponds to an increase of 9% compared to 2019. In the period 2010-2020 there was an average annual growth rate of 6.4%.

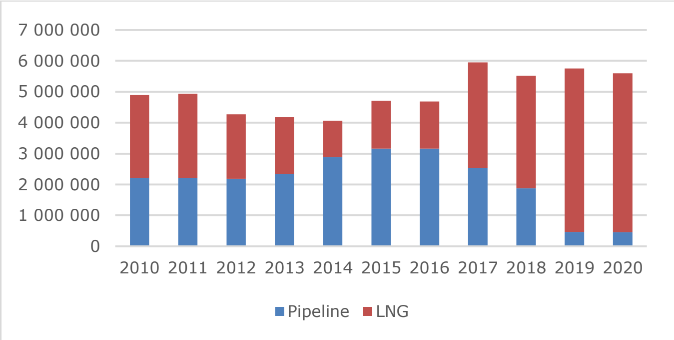


2.6.5.14
Oil products exports in Portugal - 2010-2020 (kton)
Source: DGEG

Gas

Portugal does not have domestic natural gas production, so all natural gas comes from third countries, through the pipeline interconnections with the Spanish natural gas network, through the LNG terminal at Sines, and, in a very small percentage, by truck. Almost all of Portugal's pipeline imports originate from Algeria under a long-term contract. LNG imports are also dominated by long-term contracts with a supplier in Nigeria, but there has been more diversity of LNG imports, with the United States becoming a major supplier in recent years.

Total imports of natural gas (figure 2.6.5.15), in 2020, reached 5 598 234 10^3Nm^3, which corresponds to a decrease of 3% compared to 2019. In the period 2010-2020 there was an average annual growth rate of 1.4%.



2.6.5.15
Natural gas imports in Portugal - 2010-2020 (10^3Nm^3)
Source: DGEG

Energy Intensity and Carbonic Intensity (2.6.6)

In 2020 the Portuguese energy intensity (figure 2.6.6.1) in primary energy was 111 toe/M€`2016 (+0.9% compared to 2019), while the energy intensity in final energy was 83 toe/M€'2016 (+1.2% compared to 2019). The energy intensity in electricity was 253 MWh/M€'2016 (+5.9% compared to 2019).

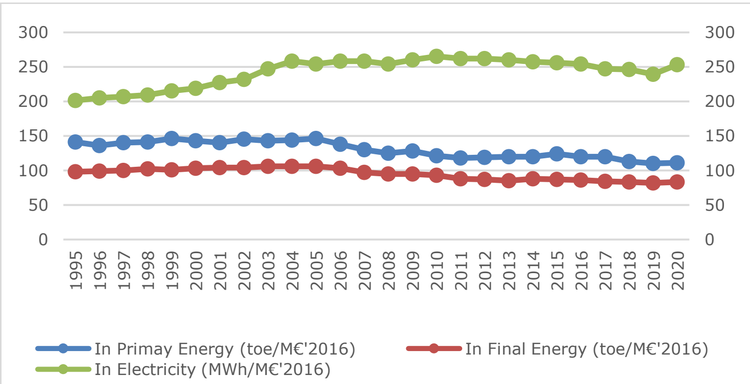


Figure 2.6.6.1
Evolution of Energy Intensity
Source: Directorate-General of Energy and Geology (DGEG), 2022

At sectoral level (figure 2.6.6.2), in 2020 the agriculture and fisheries sector had an energy intensity of 135 toe/M€'2016 (+12,5% compared to 2019), the industry sector 128 toe/M€'2016 (+3.2% compared to 2019), the transport sector 27 toe/M€'2016 (-10.0% compared to 2019), the residential sector 25 toe/M€'2016 (+8,7% compared to 2019), and the services sector 17 toe/M€'2016 (-5,6% compared to 2019).

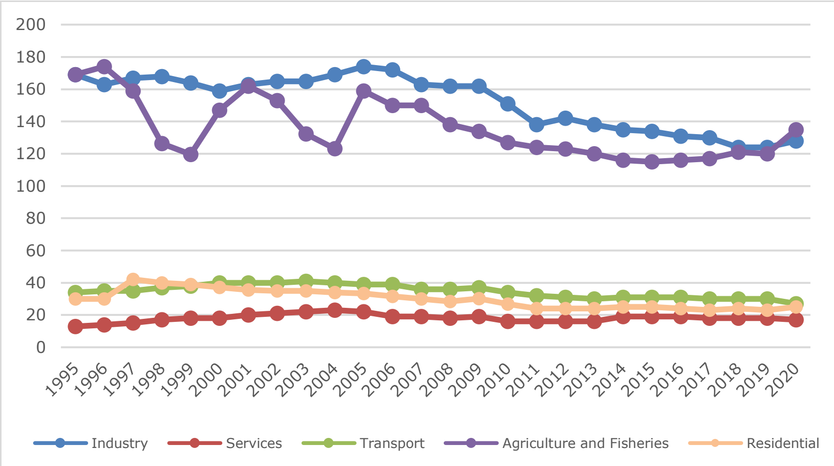


Figure 2.6.6.2

Evolution of Energy Intensity by sector of activity

Source: Directorate-General of Energy and Geology (DGEG), 2022

Regarding per capita energy consumption indicators (figure 2.6.6.3), in 2020 primary energy consumption was 2.0 toe/inhabitant (-9.1% compared to 2019), final energy consumption 1.5 toe/inhabitant (-6.3% compared to 2019), and electricity consumption 4.6 MWh/inhabitant (-2.1% compared to 2019).

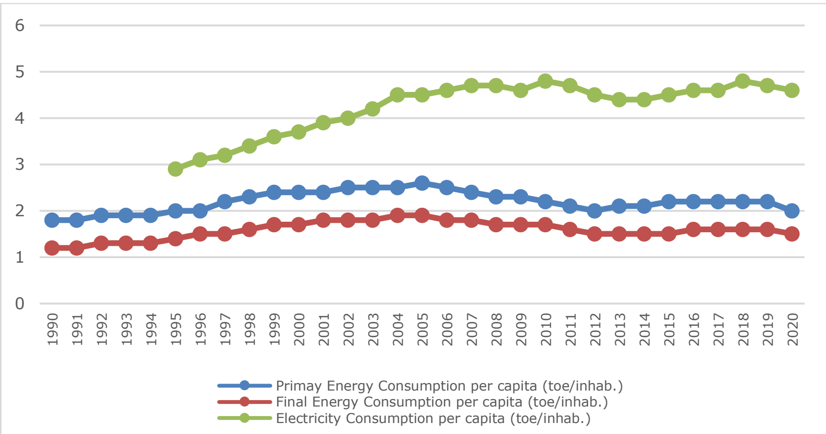


Figure 2.6.6.3

Evolution of per capita Energy Consumption

Source: Directorate-General of Energy and Geology (DGEG), 2022

In 2020, CO_2 emissions from the national electricity generation system (figure 2.6.6.4) were estimated at 258 ton CO2/GWh (+2.0% compared to 2019).

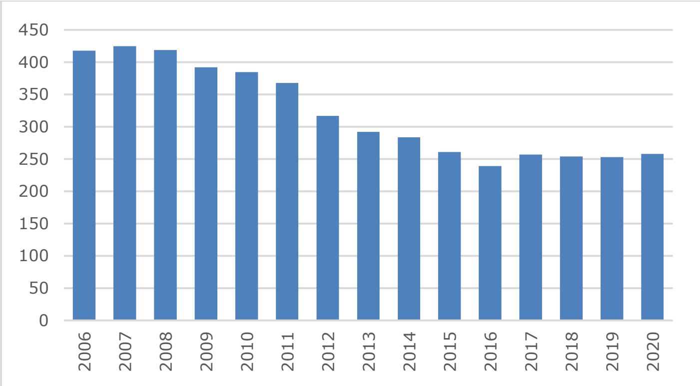


Figure 2.6.6.4

CO_2 emissions from the national electricity generation system (ton CO2/GWh)

Source: Directorate-General of Energy and Geology (DGEG), 2022

Transportation (2.7)

In 2020 the volume of passengers transported in Portugal was 20 009 million passengers-kilometre, corresponding to a decrease of 66% compared to 2019, as a result of the COVID-19 pandemic which strongly affected mobility.

Table 2.7.1

Passengers-kilometre by transport mode (Unit: 10^6 Pkm)

Transport mode	2016	2017	2018	2019	2020
Rail					
Heavy rail system	4146	4391	4487	4964	2552
Underground rail systems	1061	1121	1177	1292	666
Road [(a)]	7612	7413	7926	7941	3939
Air (National airline carriers)	29513	37119	40780	44682	12852

Note: [(a)] Data refers to Mainland

Source: Transport and communication statistics, INE (2019 and 2020)

Road and maritime modes of transport of goods are predominant. The volume of carried goods was, in 2020, 27 081 million tonnes-kilometre, which represents a decrease of 22% compared to 2019 and reflects also the effects of the COVID-19 pandemic. Despite the fact that the road sector stands out with the majority of goods transportation (90% of tonnes-kilometre carried in 2020), the sector has been progressively registering a reducing annual trend in terms of tkm of -5%, -4% and -2% in 2019, 2018 and 2017, respectively.

Likewise, the maritime transport accentuated the decrease of the volume of goods transported compared to previous years (respectively, -7%, -6% and -3% in 2020, 2019 and 2018).

Table 2.7.2
Tonnes-kilometre by transport mode (Unit: 10^6 Tkm)

Transport mode	2016	2017	2018	2019	2020
Rail	2774	2751	2765	2478	2402
Road [(a)]	34684	34073	32676	31087	24402
Air (National air transport companies)	341	478	475	559	277

Note; [(a)] Data refers to Mainland
Source: Transport and communication statistics, INE (2019 and 2020)

Fuel consumption in transport was 5 035 ktoe in 2020. After the constant growth of fuel consumption registered until the beginning of the 2000s, a period of stabilization was observed, followed by a decrease from the years 2006 to 2013. In the following years, until 2019, there was a reversal of this trend. In 2020, however, there was a strong reduction of fuel consumption in transport (-16% compared to 2019), due to the impact of COVID19 response measures. The road sector represented in 2020 96 % of that consumption, while the national air and maritime sectors account for 2 % each and the railway sector for 1%.

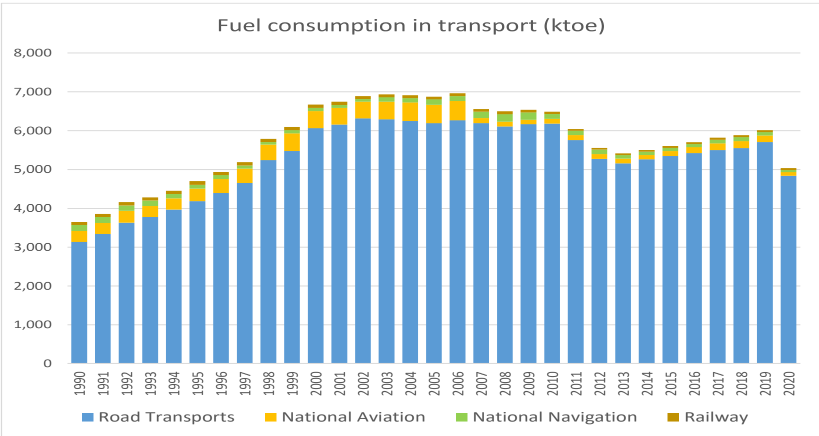


Figure 2.7.1

Source: Energy balance, Directorate-General for Energy and Geology (DGEG)

The length of the national road network remained unchanged in 2020, totaling 14,325 kilometers.

In 2020, in Portugal, the fleet of motorized road vehicles presumably in circulation remained at 7,0 million vehicles and recorded, for the first time in the available series, a slight decrease in year-on-year terms (-0.1%). The decrease was caused by the decrease in the number of heavy vehicles (-10.0%), since the number of light vehicles grew slightly (+0.1%).

The number of vehicles registered and cancelled fell sharply in 2020, -28.3% and -13.4%, respectively (after +0.7% and +0.5% in 2019). 293.6 thousand vehicles were registered and 120.7 thousand were cancelled.

In 2020, the light vehicle fleet increased slightly (+0.1%) to 6,9 million vehicles (98.1% of the total). On the other hand, the number of heavy vehicles fell (-10.0%) to 132,2 thousand vehicles.

In 2020 there were 540 light passenger vehicles per 1000 inhabitants in Portugal (figure 2.7.2), a number which has been increasing since 2013;

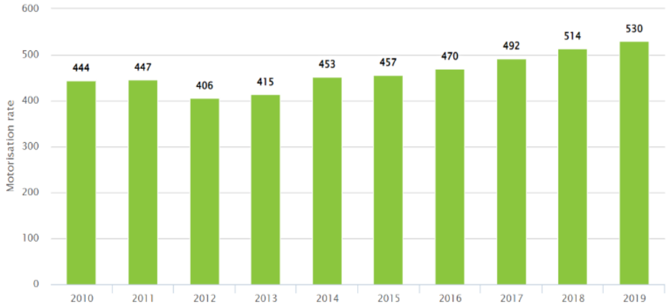


Figure 2.7.2
Motorization rate in Portugal
Source: Eurostat, 2021

Considering the fleet of light-duty passenger cars presumably in circulation, vehicles that were submitted to, at least, one of the last two mandatory inspections (figure 2.7.3), one can see that the average age rose to 13.5 years old (+0.4 years than in 2019).

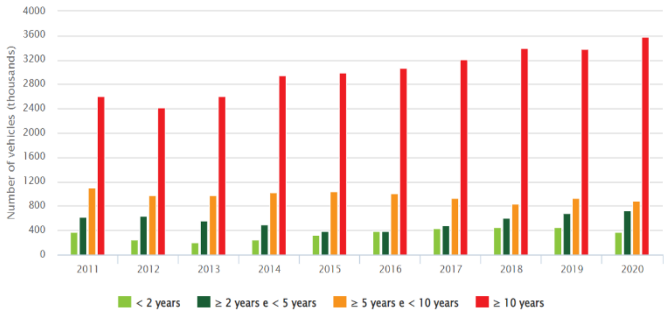


Figure 2.7.3.
Light-duty passenger car fleet by age, in Portugal
Source: INE, 2021

Vehicles that were 10 years old or older represented 64.4% of the total light-duty passenger cars and 72.9% of the total of heavy-duty passenger vehicles (figure 2.7.4).

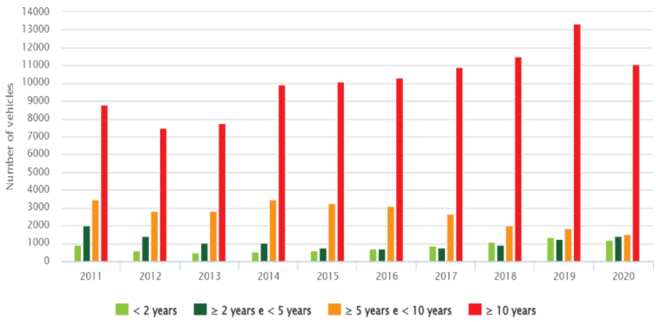


Figure 2.7.4
Heavy-duty passenger vehicle fleet by age, in Portugal
Source: INE, 2021

In 2020, the fleet of light passenger vehicles was composed of 56.5% diesel-powered vehicles and 40.3% gasoline-powered vehicles, representing 96.8% of the total (figure 2.7.5).

In 2020, the light-duty passenger car fleet was divided into diesel-powered vehicles (56.5%) and gasoline-powered vehicles (40.3%). LPG-powered vehicles represented 1.1% of the total and vehicles that use other types of fuel 2.2%. With regard to heavy-duty passenger motor vehicles, the most commonly used fuel is diesel (94.85%).

With regard to commercial cargo vehicles, in 2020 diesel vehicles accounted for 99.97% and 99.75% of light-duty commercial vehicles and heavy-duty goods vehicles (trucks and tractors), respectively.

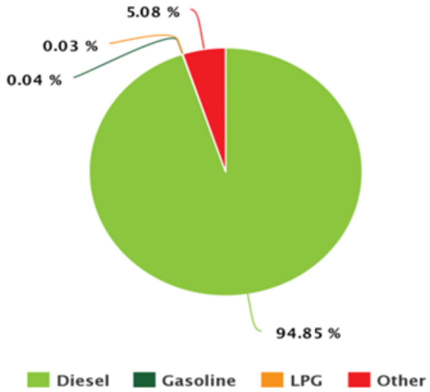


Figure2.7.5.
Light-duty passenger cars by type of fuel, in Portugal, in 2020
Source: INE, 2021

In what regards electric mobility (figure 2.7.6), there were 33.898 electric vehicles registered until 2020, reflecting an increase of 43% over the previous year, from which 84% are light-duty passenger cars and light commercial vehicles, while 7.3% are tricycles and quadricycles.

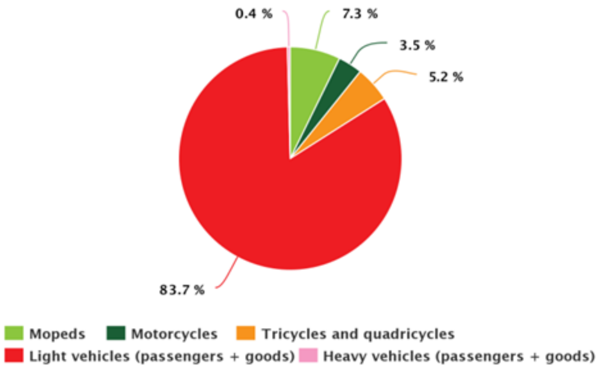


Figure 2.7.6.
Electric vehicles registered by category, in Portugal, until 2020
Source: IMT, 2021

The following figures achieved in Portugal at the end of 2021 should be highlighted

- **Electric vehicles:**
  - Until 2021 (incl.) 51.499 electric vehicles were registered in PT, of which around 87% are light vehicles (passengers + goods)
  - In 2021 there is a 53% increase in BEVs compared to the previous year

- 2.068 **EV charging stations** and 4.343 **EV charging points**

[redacted]

Chargers	Charging stations	Charging points
Normal (<22kw)	506	1011
Semi-fast (22 kw)	1004	1810
Fast (22 a 50 kw)	480	1363
Ultra-fast (> 50kw)	78	159

Source: https://www.mobie.pt/en/using-the-network (2022)

In the road sector, fossil fuels remain the main source of consumption, and although the use of biofuels and electricity has increased, its consumption is still low. There has also been an increase in the consumption of diesel, LPG and natural gas, and a decrease of 36% in petrol consumption.

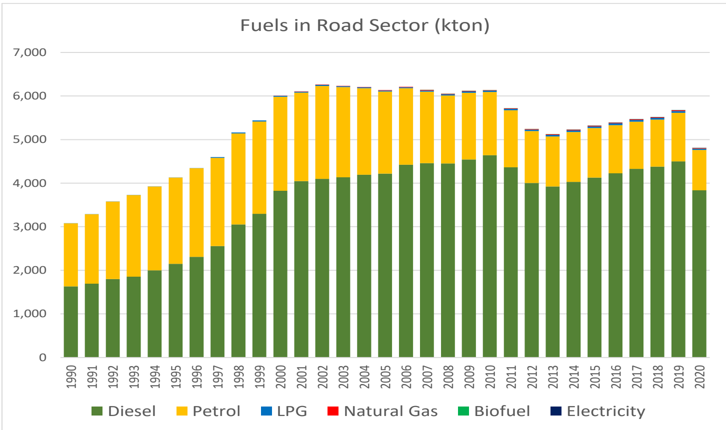


Figure 2.7.7
Source: Energy balance, Directorate-General for Energy and Geology (DGEG)

Kilometers travelled in the road transport sector go hand in hand with fuel consumption, with an increase of 71% since 1990. It can be seen that, among the various categories of this type of transport, passenger cars and light commercial vehicles have almost doubled the kilometers travelled.

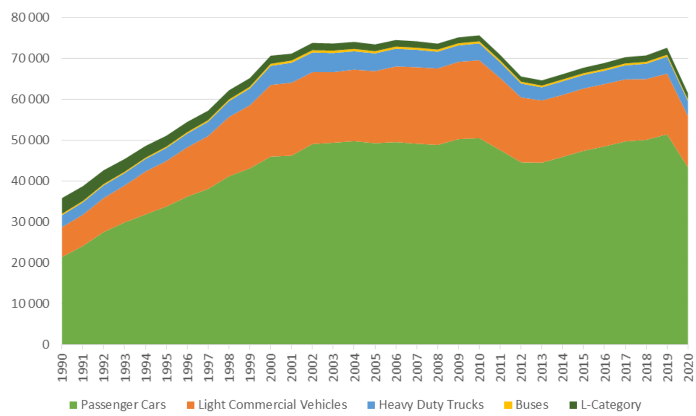


Figure 2.7.8 - Kilometers travelled by vehicle type (Mvkm)
Source: National Inventory Report, Portuguese Environment Agency (APA)

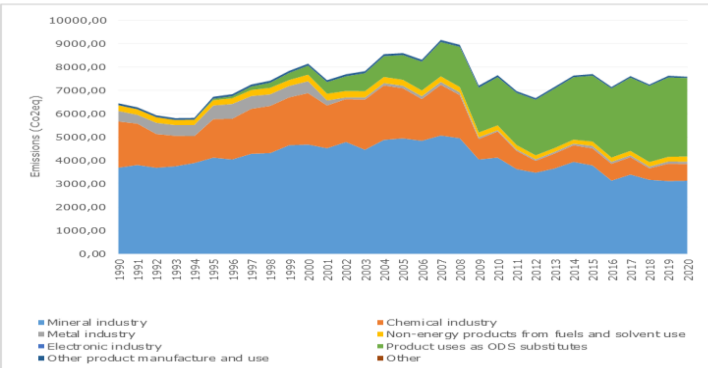
Prices of transport fuels (2.7.3)
Please see the Prices, Taxes, Subsidies and Trade (2.6.5)

Industry (2.8)
This sector includes emissions resulting from physical and chemical processing of raw materials in industrial processes, excluding combustion processes related to energy production, in accordance with the following classification:

- Mineral Industry (Cement, Lime, Glass, Other Uses of Carbonates);
- Chemical Industry (Ammonia, Nitric Acid, Ethylene, Carbon Black, Fibres, Sulfuric Acid, Explosives, Fertilisers, etc.);
- Metal industry (Iron and Steel Production, Metals and Metal Alloys);
- Non-Energy Products from Fuels and Solvent Use (Lubricant Use, Paraffin Wax Use, Solvent Use, Asphalt for Road Paving and Manufacture of Catalytic Converters with Urea);
- Electronics Industry (Integrated Circuits, Semiconductors, TFT Flat Panel Display, Photovoltaics and Heat Transfer Fluids);
- Product uses as ODS substitutes (Refrigeration, Air Conditioning, Foams, Fire Extinguishers, Aerosols, Solvents and Other Applications);
- Other Product Manufacture Processes (Electrical Equipment, Use of SF_6 and PFCs, Use of N_2O in medical applications);
- Other (Paper, Pulp, Food and Beverages Industry).

When analysing the sector of Industrial Processes in an aggregated form (figure 2.8.1), in terms of total greenhouse gas (GHG) emissions, an increase can be seen between 1990 and 2020 of around 18%, from 6.4 Mt CO_2e in 1990 to 7.6 Mt CO_2e in 2020.

In 2020, a considerable proportion of GHG emissions from IPPU sector (54.2%) was linked to CO_2. Fluorinated gases have become increasingly relevant (44.66%) due to the phasing out of the use of ozone depleting substances, replacing these by fluorinated gases in refrigeration and air-conditioning equipment from 1995 onwards. N_2O emissions are not very relevant, as they are linked to the production of nitric acid and the use of N_2O for medical purposes. CH_4 emissions are a non-relevant part, associated with petrochemical production.



2.8.1.
Greenhouse gas emissions trend by subsector of Industrial Processes
Source: APA, NIR (2022)

Mineral Industry

Sector "2.A – Mineral Industry" (mostly clinker production for the manufacture of cement) is the most relevant IPPU sector at national level, accounting for 57.2% of GHG emissions from industrial processes in 1990 and 41.3% in 2020.

From 2008 to 2012 there was a significant decrease in clinker production (figure 2.8.2) due to falling demand in the Portuguese, Spanish and North African markets. Between 2013 and 2014 there was an increase in clinker production, linked to the increase of exports to Africa and South America. The decrease seen in 2015 is due to a downturn in sales in external markets, due to oversupply in the Mediterranean area and a consumption decrease in Africa.

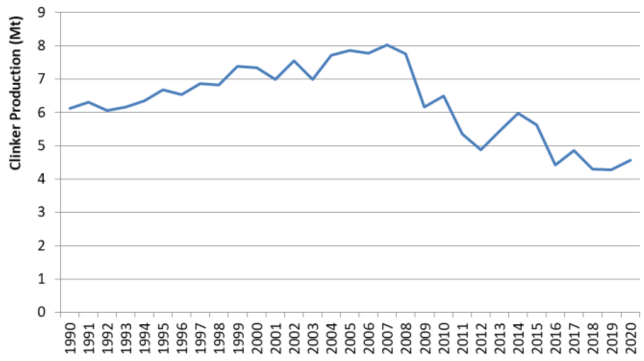


Figure 2.8.2
Clinker production (Mt)
Source: INE (2022)

In 2020, there were 5 dedicated lime production units and 5 paper pulp production units with an associated lime kiln (figure 2.8.3).

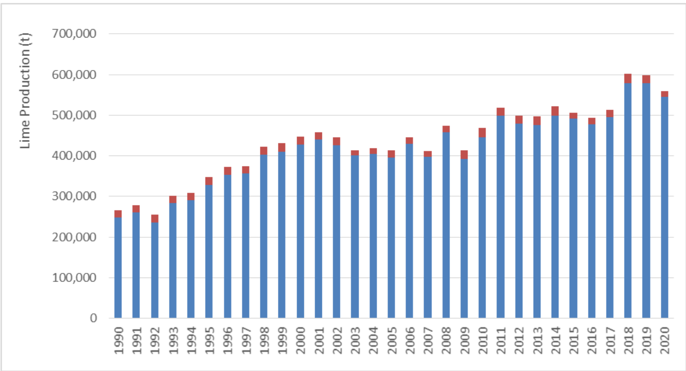


Figure 2.8.3
Lime production (t)
Source: INE (2022)

From 2009 onwards, there is no Flat Glass production in Portugal. In 2020, 98.5% of the glass produced in Portugal was container glass, the remaining 1.5% being crystal glass (figure 2.8.4).

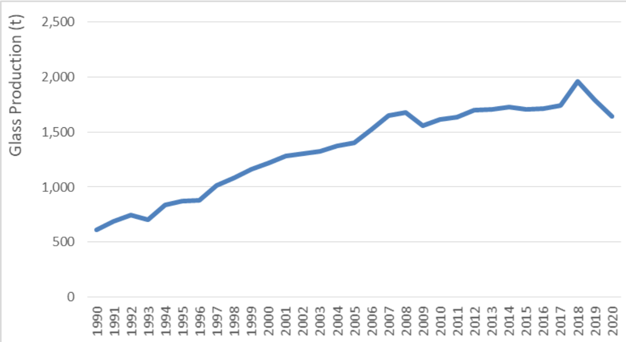


Figure 2.8.4
Glass production (Mt)
Source: INE (2022)

Chemical industry

The most relevant emissions are associated with the production of ethylene (Figure 2.8.5), CO_2 and CH_4 emissions, and nitric acid (N_2O emissions).

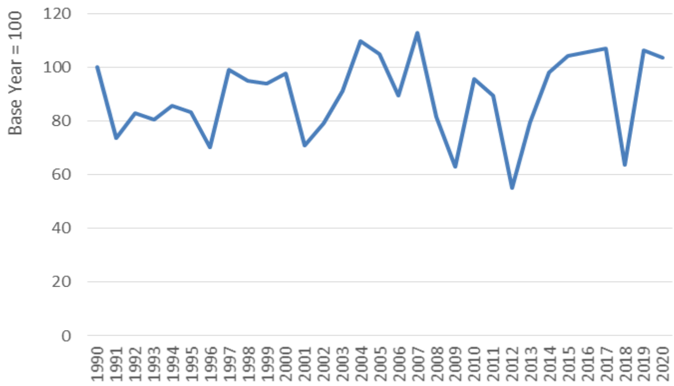


Figure 2.8.5
Ethylene production (index compared to 1990)
Source: INE (2022)

From 2008 to 2009, there was a sharp fall in emissions from the chemical sector (Figure 2.8.6) due to the shutdown of the only plant producing ammonia in Portugal.

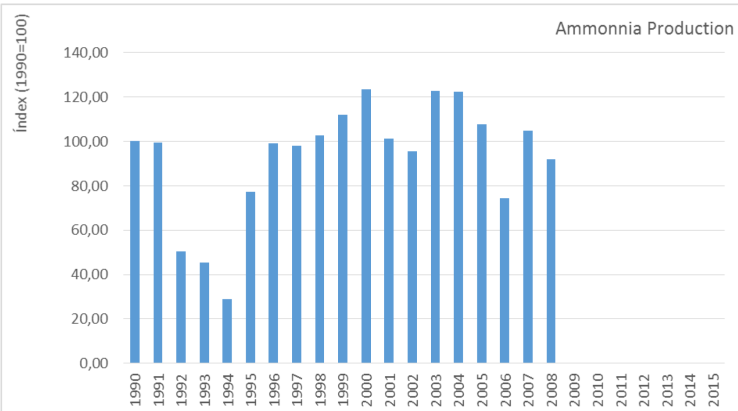


Figure 2.8.6
Ammonia production (index compared to 1990)
Source: INE (2022)

As of 2011, there has been a substantial reduction in N_2O emissions linked to the production of nitric acid, due to the installation of a new catalytic converter in one of the plants, the shutdown of old facilities and the commissioning of new facilities with a lower emission profile.

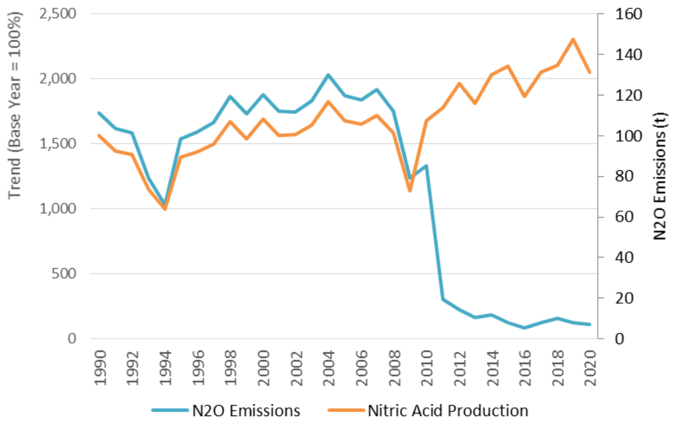


Figure 2.8.7
Nitric acid production and associated N2O emissions
Source: INE (2022)

Metal Industry

There are two iron and steel production plants operating in Portugal (figure 2.8.8) , dedicated to steel billets production, which are then processed mostly into long-product rolling like wire rod and rebar in straight lengths.

One of the plants started in 1976 and remained ever since as a secondary steel-making facility, producing steel mainly from recycled steel scrap in an Electric Arc Furnace (EAF).

The other plant started in 1961, as a primary facility that produced both iron and steel from iron ore as well as scrap, otherwise known as an integrated iron and steel production facility. Since this process did not consume all the available scrap, the surplus was also used to produce steel, but in an independent EAF. This facility integrated iron and steel production until 2001.

From 2002 onwards, Portugal started producing steel only from scrap, which led to a substantial emission reduction between 2001 and 2002.

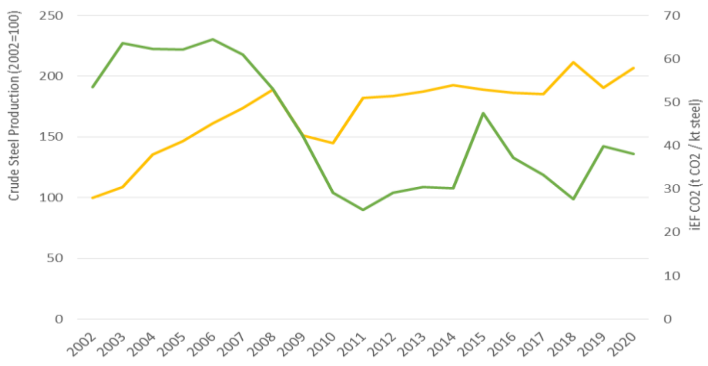


Figure 2.8.8
Steel production and associated CO2 emissions
Source: Plant specific data

Non-energy Products and Solvent Use

The most relevant sectors in Portugal are: Solvent Uses and Asphalt for Road Paving.

Consumption of Fluorinated Gases

There has been a considerable increase in the representativeness of emissions related to the consumption of fluorinated gases (figure 2.8.9) when compared to total emissions from industrial processes between 1995 and 2020 (they represent 44.3% of CO_2 e emissions from this sector). This increase is due to a shift towards the use of fluorinated gases as substitutes for ozone depleting substances in applications for refrigeration, air conditioning, foams, inhalers for asthma and fire protection systems.

The most relevant sectors are: Stationary Air Conditioning (42%), Commercial Refrigeration (29%) and Mobile Air Conditioning (19%).

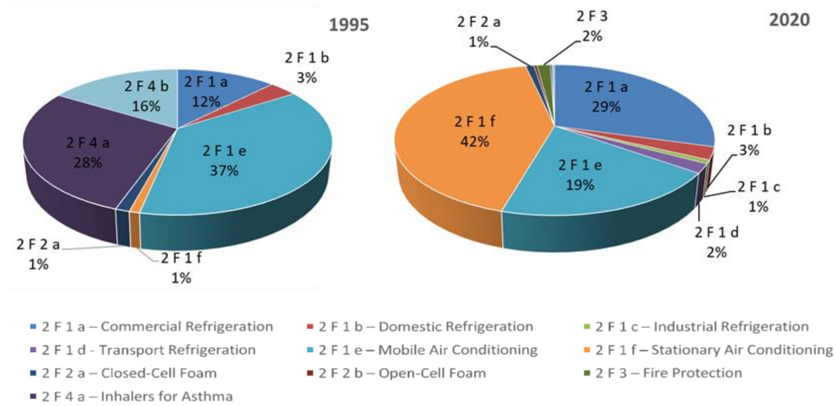


Figure 2.8.9
Source: APA (2022)

Waste (2.9)

The production of municipal waste increased significantly since 1960, driven by changes in consumption patterns and life style associated with the steady economic growth registered in particular in the years following the Portuguese accession to the EU in 1986.

After the peak around the year 2010, municipal solid waste (MSW) production presented a decreasing tendency, resulting from prevention policies, but mostly due to the economic crisis effect on consumption. Since 2014, however, an inversion of this tendency is registered and, with the exception of 2020 due to the COVID-19 pandemic crisis, Portugal registered since 2014 a growing trend of municipal waste production. This increase is attributed to an improvement of the economic situation of Portugal until 2019, seeming to indicate that the goal of decoupling waste production from economic growth is not being fulfilled.

Among the factors that explain these tendencies, is the significant increase of inbound tourists in Portugal before the COVID-19 pandemic crisis, contributing both to the Portuguese economic development and to the growth of municipal waste generation.

The Gross Domestic Product (GDP) growing tendency verified since 2014 was broken in 2020 due to the economic downturn caused by the COVID-19 viral pandemic. The shutdown measures to contain the pandemic have launched the national economy into recession, with a registered downfall of 8.4% in GDP (2019/2020 variation).

Nevertheless, the Portuguese MSW production per capita in 2020 corresponded to approx. 513 kg/year above the EU28 average per capita MSW production.

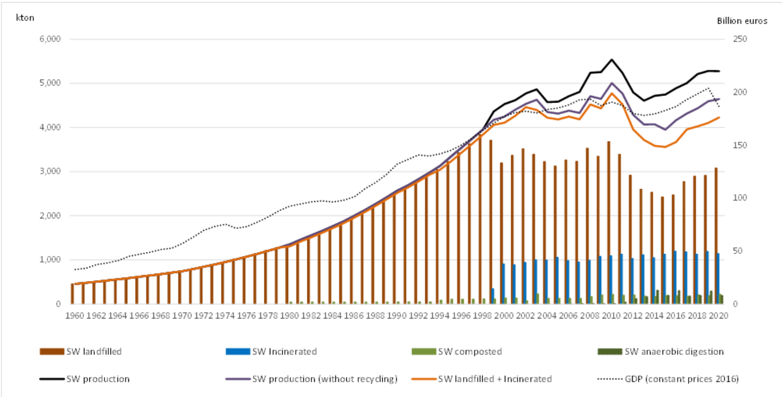


Figure 2.9.1 - Municipal waste trends
Source: APA (2022) includes estimates

The geographical distribution of the population changed considerably since the early '60s with a significant increase of the population living in urban centres. This trend was accompanied by the development of solid waste collection systems that covered only 40% of the population in 1960. Although the level of collection had improved satisfactorily and was extended to the whole country in the year 2000, that was not accompanied by the construction of the adequate infrastructures for waste treatment and disposal, with the consequent proliferation of open dumps.

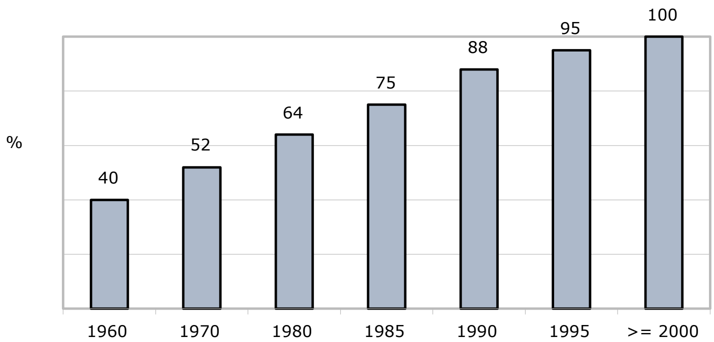
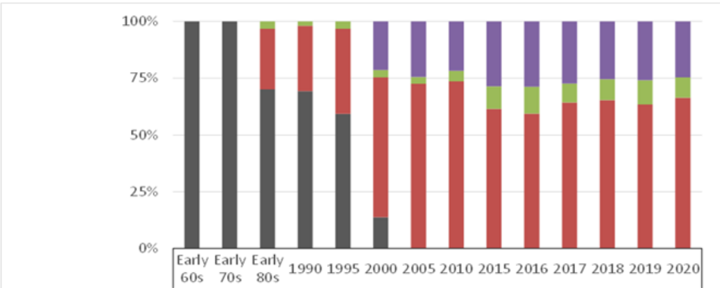


Figure 2.9.2 - Population served by waste collection systems.
Source: APA (2022)

The first Strategic Plan for Municipal Solid Waste (PERSU), approved in 1997, settled the main axis of action in this domain: the deactivation and closure of all uncontrolled dumping sites which occurred in 2002, the implementation of several treatment infrastructures, and the launch of selective collection in bring points (ecopontos).

Until the late '90s, landfilling remained almost exclusively the main waste disposal practice. In 1999/2000, with the start of operation of two MSW incineration units in Mainland Portugal, in 2001/2002 one more in the Autonomous Region of Madeira, and at the end of 2015 another one in the Autonomous Region of Azores, waste started to be diverted from SWDS - Solid Waste

Disposal on Land and the disposal of waste in landfills have decreased since 2010, despite some variations. All MSW incineration occur with energy recovery.



	Early 60s	Early 70s	Early 80s	1990	1995	2000	2005	2010	2015	2016	2017	2018	2019	2020
Incinerated	0	0	0	0	0	21	24	22	29	29	27	25	26	25
Composted/ AD	0	0	3	2	3	3	3	5	10	12	8	9	11	9
Managed landfills	0	0	27	29	37	61	72	74	62	59	64	65	63	66
Open dump sites	100	100	70	69	59	14	0	0	0	0	0	0	0	0

Figure 2.9.3 - Evolution of municipal waste treatment by final destination[25].
Source: APA (2022) estimates

This trend has been accompanied by the growth of importance of Mechanical and Biological Treatment (MBT) as well as Sorting units as foreseen in the Municipal Solid waste Strategic Plans (PERSU) and the National Plan for Waste Management (PGNR2014-2020). The number of waste management infrastructures for organic recovery and biological treatment have grown expressively in the last decade, with the aim to increase the direct diversion of biodegradable waste from landfills and increase recycling. As a consequence, composting has been growing in importance (exception for 2020). These measures have contributed also to an increase in multi-material recycling and the organic recovery and recycling of waste, with a consequent decrease of biodegradable waste in landfills.

The figure below presents the evolution of recyclable waste recovered in different treatments in recent years. The significant increase registered in 2015 (approx. 30%) can be explained by the start of operation of new MBT and Sorting units. The data presented also shows for 2020 an increase in the quantity of recovered recyclables, compared to 2019, by about 6%. The recovery of biogas at landfills have been also growing importance along the years.

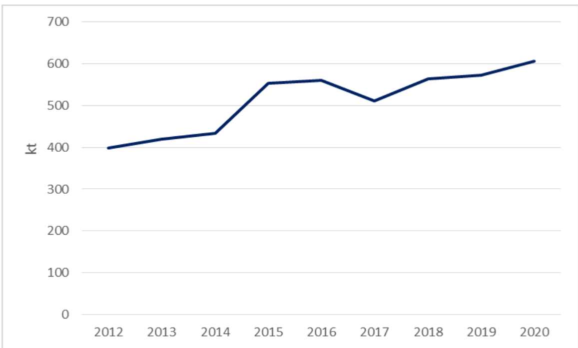


Figure 2.9.4 - Evolution of recyclable waste recovered[26].
Source: APA (2022)

[25] Note: The figure refers to the final destination of waste, which includes the "direct disposal of waste" and the "indirect disposal" of additional amounts of waste, understanding the latter as rejected amounts from the previous handling processes, such as mechanical treatment and screening.

[26] Note: Data refer to recyclable waste recovered in incineration, MBT, organic valorisation and sorting units.

Non-municipal waste generated in Portugal amounted to 11.3 million tonnes in 2020, corresponding to a decrease of 104.4 thousand tonnes (-0.9%) compared to 2019, slightly reversing the upward trend of recent years.

The sectors related to Waste Management and the Manufacturing Industry are the major waste producers, accounting for more than 54% of the total sectoral waste in 2020. The Commerce and Services sector had a contribution of 21,7%, a small decrease compared to the value of 23,4% in 2019. On the other hand, the Construction sector showed in 2020 an increase of around 120 thousand tonnes of waste generated compared to 2019.

Within the Manufacturing Industry, the major waste producers are the "Pulp, Paper and Cardboard Industries", the "Base Metallurgy" and the "Non-metallic Minerals", which together generated 1.58 million tonnes of waste in 2020, representing 53.7% of the waste generated in all manufacturing industries.

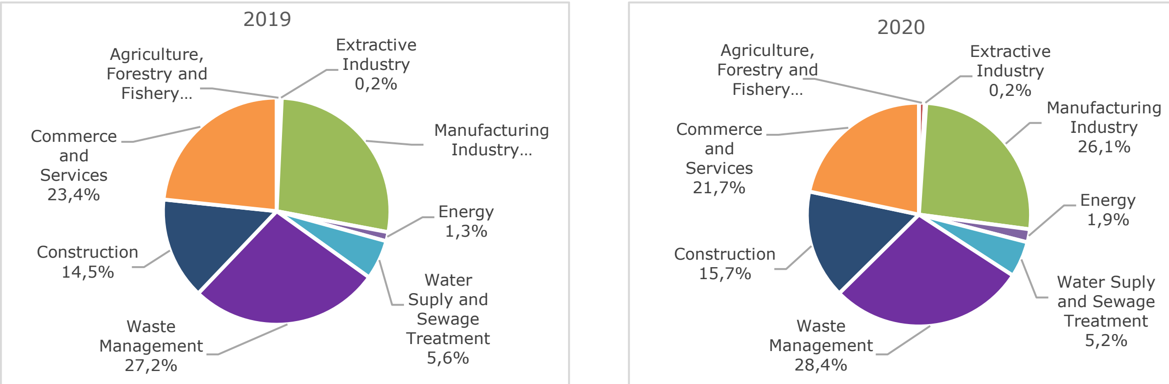


Figure 2.9.5 - Sectoral waste generated by major economic sectors in 2019 and 2020.
Source; INE (2022)

The evolution of management waste operations reflects the continuous prevalence of recovery operations compared to disposal along the years, representing approximately 85% of the sectoral waste produced in 2020.

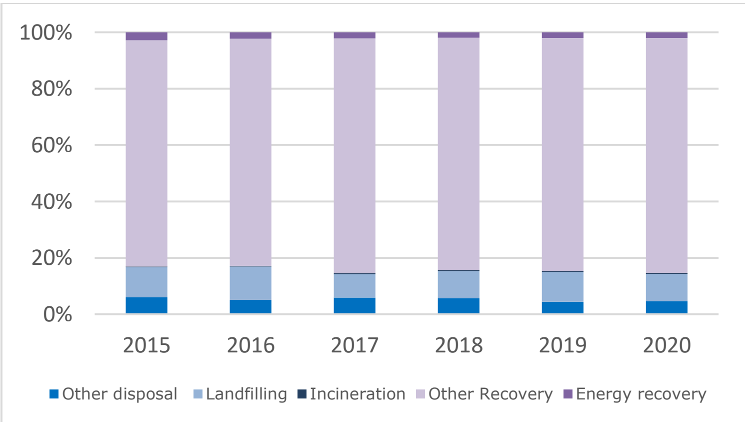


Figure 2.9.6 - Sectoral waste by major management types (2015-2020).
Source: INE (2022)

As regards municipal wastewater treatment, there was a considerable evolution since the early '90s where a significant percentage of the population was not served by a sewer system and less than 20% of the population was served by wastewater facilities. The situation has improved since then, with the percentage of the population served by any kind of wastewater treatment being at present more than 80%.

Table 2.8.1 - Percentage of population by wastewater handling system.

Wastewater handling systems	1990	1994	1999	2000	2005	2010	2015	2020
	% population							
Population without sewerage	**38.5**	**31.6**	**21.2**	**22.3**	**27.5**	**21.2**	**16.1**	**15.6**
% Pop: without sewerage (latrines)	37.0	23.4	6.4	5.3	0.0	0.0	0.0	0.0
% Pop: individual treatment (private septic tanks)	1.5	8.2	14.8	16.9	27.5	21.2	16.1	15.6
Population with sewerage	**43.3**	**47.4**	**36.8**	**31.9**	**7.5**	**7.1**	**1.5**	**1.4**
% de Pop: with discharge into the ocean, without treatment	6.5	6.5	6.5	5.6	1.0	1.1	0.4	0.3
% de Pop: with discharge into inland waters, without treatment	36.8	40.8	30.3	25.9	4.0	1.1	0.2	0.2
% de Pop: with discharge into soil, without treatment	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.0
% de Pop: unknown disposal	0.0	0.0	0.0	0.4	2.4	4.9	0.9	0.9
% Pop: with treatment	**18.2**	**21.1**	**42.0**	**45.8**	**65.0**	**71.7**	**82.4**	**83.0**
% Pop: colective septic tanks	2.2	2.3	5.0	5.0	5.0	2.7	0.7	0.7
% Pop: with preliminary treatment	0.0	0.0	0.0	0.5	3.0	6.9	1.8	1.1
% Pop: with primary treatment	5.2	5.2	9.0	8.5	6.0	2.9	10.1	9.4
% Pop: with secondary and tertiary treatment	**10.8**	**13.6**	**28.0**	**31.8**	**51.0**	**59.3**	**69.7**	**71.8**

Source: APA

The total organic load in wastewater, aggregated per industrial group, is presented in the Figure below, showing a continuous growth of discharge until the mid-2000 followed by a stabilization or decrease in some years. In later years an increasing trend can be observed again. The predominance of wastewater loads from the industry of food and drink, wood and wood derivatives and the chemical industry can also be observed.

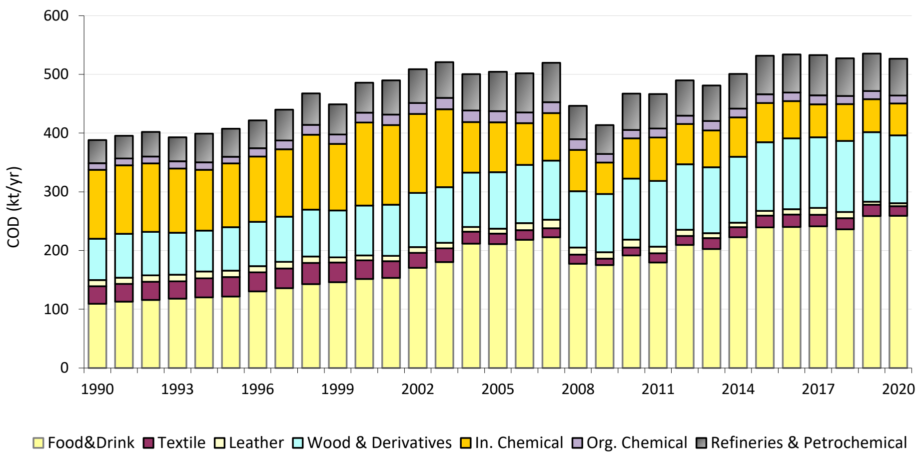


Figure 2.9.7 - Industrial Wastewater load from major groups of industrial activity.

The situation concerning industrial wastewater treatment have been registering improvements with the development of treatment types and coverage along the years.

Table 2.9.2 - Fraction of industrial wastewater by wastewater handling system (% of total industrial load expressed as COD).

Wastewater Handling System		1990	1995	2000	2005	2010	2015	2020
No treatment, discharge in river or soil	%	15.0	14.5	11.4	19.0	14.0	6.1	6.9
Primary	%	4.5	6.7	6.3	5.1	8.8	7.2	0.3
Secondary treatment: Aerobic, well managed	%	17.8	18.3	18.0	18.6	37.0	41.6	58.9
Secondary treatment: Aerobic, not well managed	%	9.6	9.6	8.0	7.3	16.9	14.8	3.3
Secondary treatment: Anaerobic, no CH4 recovery	%	0.0	0.0	0.2	2.2	2.9	2.3	2.5
Septic Tank	%	1.0	1.2	0.9	0.0	0.0	0.0	0.0
Municipal Sewer system, treatment with Municipal Waste Water	%	3.1	4.6	4.9	7.7	11.8	18.1	18.0
Unknown	%	48.9	45.0	50.3	40.0	8.6	9.9	10.1

Building Stock and Urban Structure (2.10)

DGT has been studying the evolution of the dynamics of soil artificialization verified in Mainland Portugal in the periods 1990-2007 and 2007-2018. For this purpose, an analysis of national information on land use and occupation was carried out. The COS of 1990, 2007 and 2018 were reclassified based on the third level of the CORINE Land Cover (CLC) nomenclature.

Between 2007 and 2018, the importance of the expansion of economic facilities and infrastructures in the artificialization of the territory, exceeded the residential expansion, and the processes of conversion of non-artificialized areas into industrial and commercial areas, construction sites and transport networks were particularly relevant. These three processes were responsible for the creation of 68% of the artificialized territory. In this period, there was a decrease in the weight of sprawled residential expansion (11%).

Comparing the variation of the area occupied by artificialized territories with the evolution of the resident population (annual estimates produced by Portugal Statistics), disaggregated by NUTS III, in the period 2007-2018, as well as for 2018, allowed to calculate the joint variation of the area allocated to artificialized territories, or of the Land Take surface, with the number of residents.

The following figure illustrates the capitation of artificialized territory by NUTS III and in the Mainland in the years 1990, 2007 and 2018.

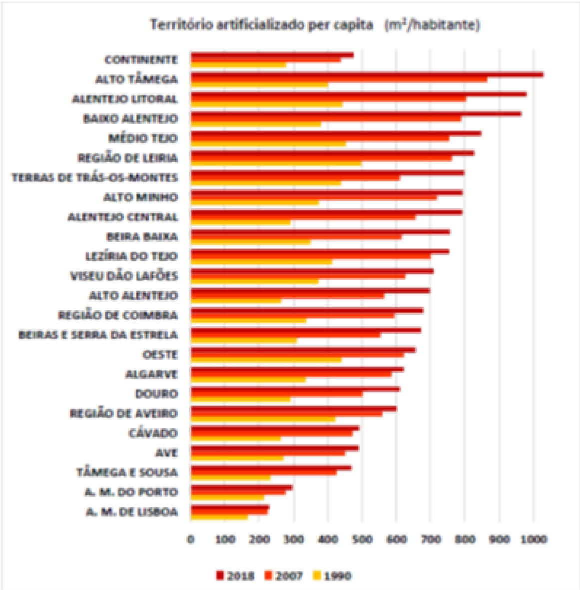


Figure 2.10.1
Artificialized territory per capita (m2 /inhabitant) by NUTS3 and for the Continent for the years 1990, 2007 and 2018

Both on the mainland and in all its regions, there was a growth in artificialized territory per capita between 1990 and 2018. In 2018, the capitation of artificialized territory was only lower than the Continent (476 m^2/inhabitant) in the Metropolitan Areas (230 m^2/inhabitant in Lisbon and 297 m^2/inhabitant in Porto) and in the region of Tâmega and Sousa (469 m^2/inhabitant). It is also important to highlight the capitations of artificialized territory in Alto Tâmega, Alentejo Litoral and Baixo Alentejo (superior to 900 m^2/inhabitant).

In the majority of regions, as well as in mainland Portugal, there has been an increase in the surface area of artificially developed territories, despite the decrease in the respective resident population. In about half of the NUTS III, the reduction in inhabitants even exceeded the expansion of artificialized territory, in relative terms. The Lisbon Metropolitan Area and the Algarve region are exceptions to this situation, due to the growth in the number of residents, but this growth was percentually lower than the expansion of their artificialized territory.

The fact that 47% of the resident inhabitants in mainland Portugal in 2018 are concentrated in the two Metropolitan Areas justifies these two regions having the highest proportions of their surface occupied by artificialised territory (25.1% for Porto and 21.7% for Lisbon). Although Lisbon has more than a million more inhabitants than Porto, the capitation of artificialized territory in 2018 was higher in Porto (297 m^2/inhabitant) than in Lisbon (230 m^2/inhabitant), which reflects the capital's higher densification.

Despite the higher proportions of artificialized territory observed in the two metropolitan areas (see next table), the regions of Cávado, Ave, Aveiro, Tâmega e Sousa and Oeste are also noteworthy for presenting in 2018 more than 10% of their surface occupied by artificialized territories. Among these, the lowest capitation of artificialized territory was observed in Tâmega e Sousa (469 m^2/inhabitant) and the highest was observed in the Oeste (656 m^2/inhabitant).

NUTS3	Território artificializado per capita (m^2/hab.)	Território artificializado (%*)
	2018	2018
ALTO MINHO	793.5	8.3
CÁVADO	491.9	15.9
AVE	490.4	13.9
A. M. DO PORTO	297.4	25.1
ALTO TÂMEGA	1028.5	3.0
TÂMEGA E SOUSA	468.8	10.7
DOURO	609.7	2.9
TERRAS DE TRÁS-OS-MONTES	797.8	1.6
ALGARVE	621.6	5.5
OESTE	656.3	10.5
REGIÃO DE AVEIRO	601.3	12.9
REGIÃO DE COIMBRA	679.1	6.8
REGIÃO DE LEIRIA	827.9	9.6
VISEU DÃO LAFÕES	709.1	5.5
BEIRA BAIXA	756.1	1.3
MÉDIO TEJO	847.5	5.9
BEIRAS E SERRA DA ESTRELA	671.7	2.3
A. M. DE LISBOA	229.7	21.7
ALENTEJO LITORAL	980.4	1.7
BAIXO ALENTEJO	964.2	1.3
LEZÍRIA DO TEJO	753.5	4.2
ALTO ALENTEJO	698.0	1.2
ALENTEJO CENTRAL	792.9	1.6
PORTUGAL CONTINENTAL	475.5	5.2

Table 2.10.1
Indicators on the evolution of resident population, artificialised area and Land Take surface, in 2018 by NUTS3 - Mainland Portugal

In 2014, the control of urban sprawl and dispersed construction, the increase of use of interstitial urban areas and the promotion of urban regeneration have become objectives in the context of spatial planning.

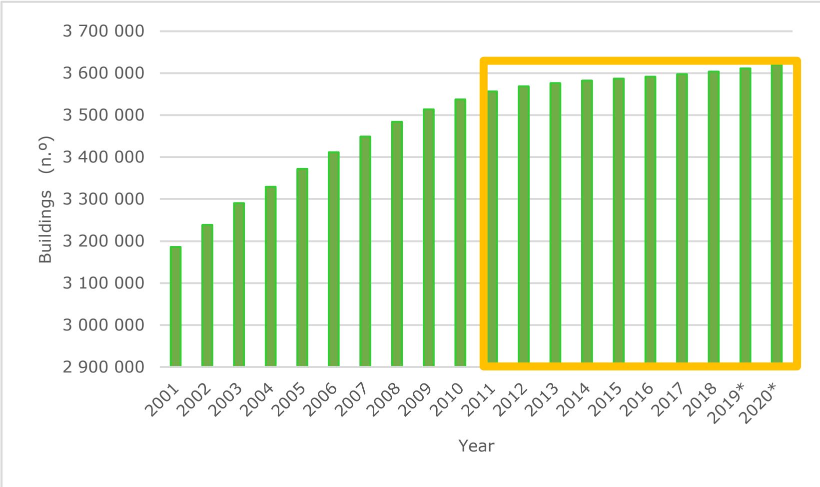
Considering that in 2022, there are 131 revision procedures of Municipal Master Plan (PDM) in mainland Portugal, it can be concluded that 47% of the municipalities are still in the process of implementing such goals in the municipal planning and that their materialisation will only be evident in the next decade. It is therefore expected that the reduction of the artificialization, caused by the growth of recycled territories and renaturalization, will be more obvious in the medium term.

Regarding the building stock, according to Statistics Portugal[27], in the reporting period, the Covid19 pandemic played a significant role in the evolution of the number of buildings.
"The year 2020 was characterized by a general slowdown of different indicators in construction and real estate transaction that had been started in 2019. The number of licensed buildings and dwellings and the number dwellings transactions decreased in 2020, being that for the first time since 2012, the number of dwelling transactions decreased, as a result of the adverse economic context due to the COVID-19 pandemic However the number of buildings and dwellings completed grew in 2020, but less strongly than in 2019" (*in* page 10 - Construction and housing statistics – 2020).

From 2011 to 2020, Portugal had an increase of 63.625 buildings and 104.122 dwellings, corresponding to relative increases of 1.8% for both buildings and dwellings. In 2019, the Portuguese housing stock was estimated at 3.6 million buildings and 6.0 million family dwellings, which corresponds to an increase of 0.2% compared to the previous year, both in the number of buildings and dwellings. In that same year, there were 23,608 buildings permits, registering an annual growth of 4.1%. of the total number of buildings permits, 70.2% corresponded to the construction of new buildings. The number of building permits in new construction for family housing was 24,148 dwellings, corresponding to an annual growth of +15.2%.

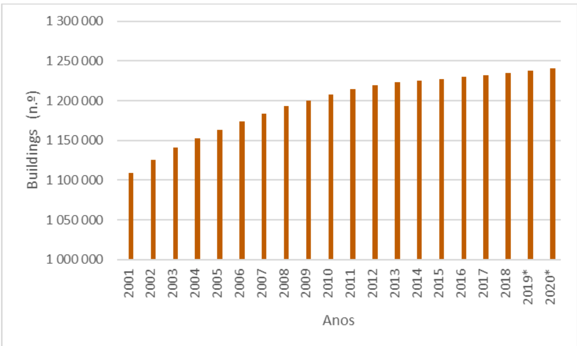
[27] Statistics Portugal - Web Portal (ine.pt)

Figure 2.10.2
Number of Family Classic Buildings in Portugal (2001-2020)

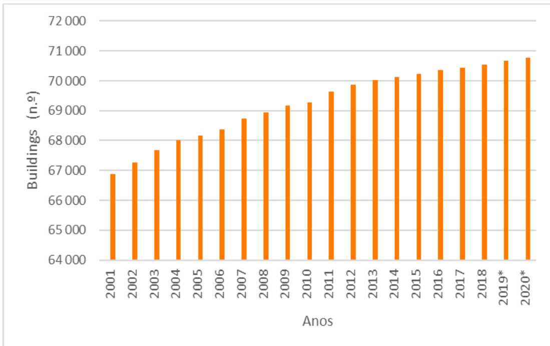


* Information based on Completed Works Estimates.
Source: Statistics Portugal, 2020

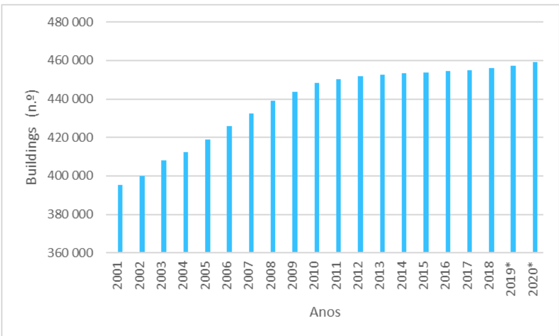
Figure 2.10.3
Number of Family Classic Buildings in Mainland Portugal and NUT II (2001-2020)
Source: Statistics Portugal, 2020



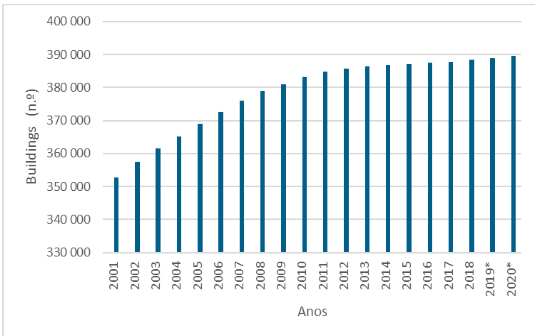
North



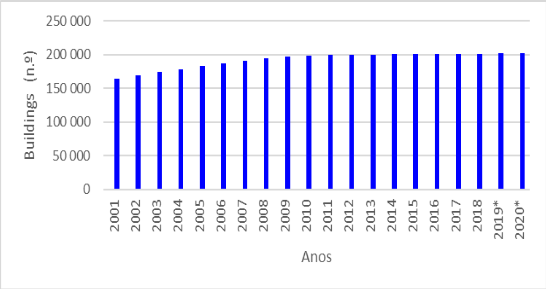
Centre



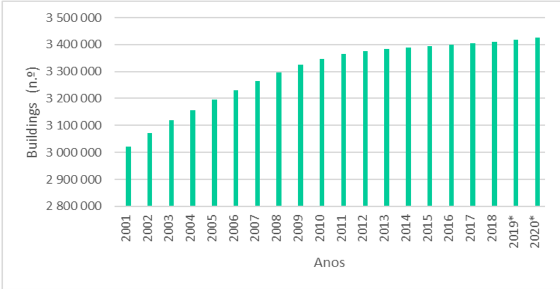
Metropolitan Area of Lisbon



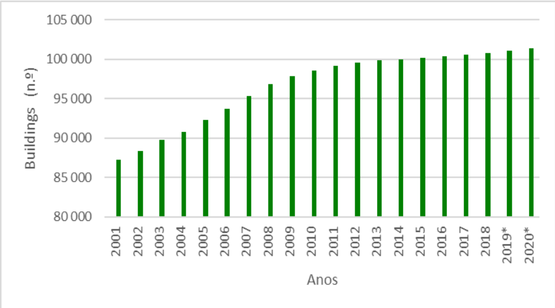
Alentejo



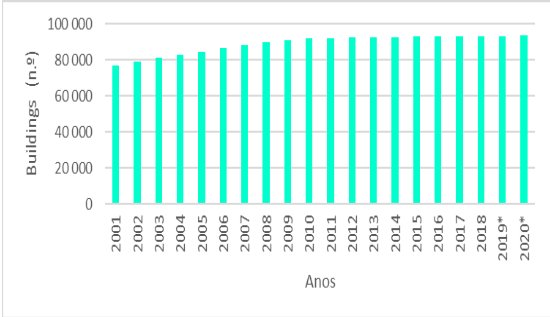
Algarve



Mainland



Autonomous Region of the Azores



Autonomous Region of Madeira

* Information based on Completed Works Estimates.

Table 2.10.2
N.º of Family Classic Buildings - NUTS II e NUTS III (2001, 2005, 2010 -2020)

Unidade: Número

	2001	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019*	2020*
Portugal	**3 185 972**	**3 372 219**	**3 537 701**	**3 556 114**	**3 568 429**	**3 576 630**	**3 582 116**	**3 586 893**	**3 591 873**	**3 597 345**	**3 603 719**	**3 611 322**	**3 619 739**
Continente	**3 022 087**	**3 195 252**	**3 347 384**	**3 364 703**	**3 376 453**	**3 384 137**	**3 389 340**	**3 393 848**	**3 398 557**	**3 403 762**	**3 409 813**	**3 416 974**	**3 424 899**
Norte	**1 108 945**	**1 163 750**	**1 207 369**	**1 214 511**	**1 219 594**	**1 223 088**	**1 225 490**	**1 227 557**	**1 229 688**	**1 231 928**	**1 234 454**	**1 237 399**	**1 240 498**
Alto Minho	109 519	115 445	120 657	121 340	121 900	122 283	122 581	122 830	123 067	123 277	123 501	123 757	123 961
Cávado	107 432	115 798	123 888	125 226	125 994	126 552	126 941	127 287	127 665	128 099	128 580	129 204	129 885
Ave	122 349	131 272	137 805	138 761	139 448	140 004	140 351	140 678	141 030	141 457	141 954	142 512	143 064
Área Metropolitana do Porto	396 220	409 311	417 702	419 161	420 535	421 465	422 104	422 574	423 045	423 536	424 173	424 866	425 789
Alto Tâmega	57 763	59 944	63 004	63 342	63 490	63 594	63 672	63 755	63 821	63 893	63 990	64 072	64 154
Tâmega e Sousa	139 576	149 587	156 804	158 121	159 027	159 577	159 971	160 337	160 723	161 097	161 444	161 873	162 274
Douro	109 210	114 231	118 222	118 925	119 328	119 577	119 734	119 857	119 988	120 128	120 259	120 437	120 603
Terras de Trás-os-Montes	66 876	68 162	69 287	69 635	69 872	70 036	70 136	70 239	70 349	70 441	70 553	70 678	70 768
Centro	66 876	68 162	69 287	69 635	69 872	70 036	70 136	70 239	70 349	70 441	70 553	70 678	70 768
Oeste	137 578	150 046	160 450	161 398	162 026	162 407	162 692	162 947	163 223	163 503	163 850	164 184	164 605
Região de Aveiro	127 410	135 323	141 261	142 027	142 575	142 984	143 231	143 477	143 721	143 993	144 280	144 605	144 973
Região de Coimbra	183 660	194 826	203 731	204 843	205 640	206 118	206 409	206 624	206 883	207 168	207 440	207 780	208 040
Região de Leiria	119 614	127 053	133 141	133 794	134 278	134 611	134 838	135 039	135 238	135 448	135 715	136 019	136 316
Viseu Dão Lafões	125 229	133 156	140 119	140 933	141 515	141 910	142 212	142 444	142 701	142 974	143 235	143 576	143 847
Beira Baixa	53 220	55 060	56 333	56 532	56 642	56 700	56 736	56 769	56 791	56 827	56 884	56 963	57 050
Médio Tejo	116 264	120 976	127 338	127 896	128 244	128 452	128 588	128 721	128 838	128 955	129 115	129 271	129 424
Beiras e Serra da Estrela	138 105	143 836	147 612	148 096	148 361	148 541	148 648	148 732	148 848	148 967	149 071	149 185	149 290
Área Metropolitana de Lisboa	**395 350**	**418 773**	**448 329**	**450 406**	**451 867**	**452 776**	**453 340**	**453 841**	**454 387**	**455 082**	**456 062**	**457 390**	**459 258**
Área Metropolitana de Lisboa	395 350	418 773	448 329	450 406	451 867	452 776	453 340	453 841	454 387	455 082	456 062	457 390	459 258
Alentejo	**352 813**	**369 031**	**383 149**	**384 777**	**385 744**	**386 309**	**386 727**	**387 086**	**387 441**	**387 842**	**388 323**	**388 862**	**389 468**
Alentejo Litoral	47 516	50 531	53 362	53 629	53 816	53 939	54 052	54 125	54 202	54 279	54 371	54 484	54 628
Baixo Alentejo	71 101	72 844	74 725	75 009	75 157	75 220	75 276	75 329	75 383	75 464	75 535	75 630	75 723
Lezíria do Tejo	94 760	101 291	106 867	107 462	107 788	107 970	108 098	108 206	108 313	108 447	108 609	108 774	108 967
Alto Alentejo	64 977	66 874	67 844	68 017	68 129	68 191	68 226	68 268	68 312	68 362	68 428	68 488	68 556
Alentejo Central	74 459	77 491	80 351	80 660	80 854	80 989	81 075	81 158	81 231	81 290	81 380	81 486	81 594
Algarve	**163 899**	**183 422**	**198 552**	**199 490**	**199 967**	**200 241**	**200 429**	**200 611**	**200 798**	**201 075**	**201 384**	**201 740**	**202 130**
Algarve	163 899	183 422	198 552	199 490	199 967	200 241	200 429	200 611	200 798	201 075	201 384	201 740	202 130
Reg. Aut. Açores	**87 267**	**92 297**	**98 531**	**99 197**	**99 522**	**99 843**	**100 011**	**100 168**	**100 357**	**100 543**	**100 763**	**101 069**	**101 395**
Reg. Aut. Açores	87 267	92 297	98 531	99 197	99 522	99 843	100 011	100 168	100 357	100 543	100 763	101 069	101 395
Reg. Aut. Madeira	**76 618**	**84 670**	**91 786**	**92 214**	**92 454**	**92 650**	**92 765**	**92 877**	**92 959**	**93 040**	**93 143**	**93 279**	**93 445**
Reg. Aut. Madeira	76 618	84 670	91 786	92 214	92 454	92 650	92 765	92 877	92 959	93 040	93 143	93 279	93 445

Source: Statistics Portugal, 2020

Table 2.10.3

N.º of Dwellings - NUTS II e NUTS III (2001-2020)

Unidade: Número

	2001	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019*	2020*
Portugal	**5 357 900**	**5 671 596**	**5 852 186**	**5 879 280**	**5 898 977**	**5 911 736**	**5 919 999**	**5 927 019**	**5 934 771**	**5 942 832**	**5 953 267**	**5 966 536**	**5 983 402**
Continente	**5 151 939**	**5 448 680**	**5 614 277**	**5 639 809**	**5 658 584**	**5 670 449**	**5 678 310**	**5 684 976**	**5 692 367**	**5 700 071**	**5 710 060**	**5 722 664**	**5 738 757**
Norte	**1 710 642**	**1 797 184**	**1 843 861**	**1 853 560**	**1 861 017**	**1 865 982**	**1 869 304**	**1 872 108**	**1 875 271**	**1 878 314**	**1 882 204**	**1 887 170**	**1 894 453**
Alto Minho	143 780	148 029	150 276	151 081	151 746	152 176	152 507	152 815	153 117	153 369	153 634	153 935	154 389
Cávado	170 621	182 142	189 741	191 168	192 570	193 303	193 784	194 200	194 633	195 205	195 872	196 854	198 070
Ave	175 713	185 090	189 388	190 710	191 549	192 217	192 677	193 127	193 574	194 082	194 710	195 599	196 809
Área Metropolitana do Porto	753 216	798 830	824 938	828 532	831 044	832 869	834 065	834 878	835 970	836 785	838 211	839 787	842 972
Alto Tâmega	68 584	70 504	71 537	71 768	71 919	72 025	72 111	72 207	72 276	72 351	72 493	72 576	72 661
Tâmega e Sousa	181 300	190 263	194 922	196 214	197 271	197 930	198 412	198 819	199 329	199 794	200 239	200 855	201 525
Douro	134 966	138 056	138 532	139 188	139 740	140 059	140 236	140 433	140 587	140 802	140 975	141 257	141 502
Terras de Trás-os-Montes	82 462	84 270	84 527	84 899	85 178	85 403	85 512	85 629	85 785	85 926	86 070	86 307	86 525
Centro	**1 361 452**	**1 413 337**	**1 442 180**	**1 449 360**	**1 454 749**	**1 458 168**	**1 460 547**	**1 462 434**	**1 464 658**	**1 467 004**	**1 469 835**	**1 472 988**	**1 476 529**
Oeste	201 509	215 767	222 716	224 128	224 958	225 588	226 008	226 307	226 719	227 140	227 716	228 173	228 863
Região de Aveiro	173 073	186 165	191 377	192 567	193 377	193 975	194 420	194 837	195 124	195 508	196 028	196 615	197 331
Região de Coimbra	266 974	275 331	280 498	282 004	283 227	283 939	284 389	284 661	285 014	285 508	285 974	286 518	286 936
Região de Leiria	159 054	165 764	169 673	170 521	171 221	171 643	171 947	172 175	172 482	172 737	173 125	173 543	174 028
Viseu Dão Lafões	159 303	164 756	167 456	168 376	169 162	169 640	170 062	170 446	170 889	171 261	171 654	172 283	172 846
Beira Baixa	70 307	71 275	71 176	71 433	71 625	71 737	71 791	71 824	71 917	71 980	72 101	72 231	72 401
Médio Tejo	151 413	153 539	158 922	159 506	160 044	160 288	160 462	160 631	160 790	160 972	161 175	161 377	161 638
Beiras e Serra da Estrela	179 819	180 740	180 362	180 825	181 135	181 358	181 468	181 553	181 723	181 898	182 062	182 248	182 486
Área Metropolitana de Lisboa	**1 307 577**	**1 411 817**	**1 481 959**	**1 487 124**	**1 490 556**	**1 492 543**	**1 493 651**	**1 494 726**	**1 495 744**	**1 497 043**	**1 499 073**	**1 501 811**	**1 505 397**
Área Metropolitana de Lisboa	1 307 577	1 411 817	1 481 959	1 487 124	1 490 556	1 492 543	1 493 651	1 494 726	1 495 744	1 497 043	1 499 073	1 501 811	1 505 397
Alentejo	**450 334**	**463 193**	**469 008**	**470 499**	**471 822**	**472 577**	**473 102**	**473 493**	**473 971**	**474 465**	**475 028**	**475 668**	**476 499**
Alentejo Litoral	64 782	67 375	68 326	68 620	68 854	69 079	69 231	69 308	69 400	69 482	69 582	69 702	69 888
Baixo Alentejo	83 448	83 838	84 654	84 832	85 112	85 182	85 255	85 314	85 371	85 468	85 547	85 654	85 771
Lezíria do Tejo	126 371	134 058	137 060	137 633	138 007	138 239	138 393	138 502	138 633	138 830	139 028	139 245	139 512
Alto Alentejo	81 100	81 077	81 002	81 143	81 256	81 328	81 370	81 423	81 466	81 519	81 598	81 663	81 744
Alentejo Central	94 633	96 845	97 966	98 271	98 593	98 749	98 853	98 946	99 101	99 166	99 273	99 404	99 584
Algarve	**321 934**	**363 149**	**377 269**	**379 266**	**380 440**	**381 179**	**381 706**	**382 215**	**382 723**	**383 245**	**383 920**	**385 027**	**385 879**
Algarve	321 934	363 149	377 269	379 266	380 440	381 179	381 706	382 215	382 723	383 245	383 920	385 027	385 879
Reg. Aut. Açores	**96 992**	**102 209**	**109 004**	**109 890**	**110 448**	**110 949**	**111 147**	**111 377**	**111 595**	**111 798**	**112 076**	**112 448**	**112 882**
Reg. Aut. Açores	96 992	102 209	109 004	109 890	110 448	110 949	111 147	111 377	111 595	111 798	112 076	112 448	112 882
Reg. Aut. Madeira	**108 969**	**120 707**	**128 905**	**129 581**	**129 945**	**130 338**	**130 542**	**130 666**	**130 809**	**130 963**	**131 131**	**131 424**	**131 763**
Reg. Aut. Madeira	108 969	120 707	128 905	129 581	129 945	130 338	130 542	130 666	130 809	130 963	131 131	131 424	131 763

Source: Statistics Portugal, 2020

In 2020, the Portuguese housing stock was estimated at 3.619.739 buildings and 5.983.402 dwellings, corresponding to increases of 0.23% and 0.28%, respectively, compared to 2019 and an absolute increase of 8.417 buildings and 18.866 dwellings.

Table 2.10.4

Dwellings according to Type and Type of Building (Mainly Residential)– NUTS II e NUTS III (2020)

Unit: Number

	Mainly Residential							
	T0	T1	T2	T3	T4	T5+	n.e.	Total
Portugal	**62 471**	**365 760**	**1 226 533**	**1 357 013**	**557 214**	**526 680**	**1 853 967**	**5 949 638**
Continente	**58 119**	**344 005**	**1 177 820**	**1 308 378**	**531 536**	**498 033**	**1 788 791**	**5 706 682**
Norte	**18 061**	**108 021**	**361 733**	**476 356**	**195 435**	**201 300**	**522 996**	**1 883 902**
Alto Minho	1 114	5 368	19 311	33 036	16 242	17 345	61 267	153 683
Cávado	1 252	7 735	28 473	55 892	24 003	25 620	53 807	196 782
Ave	1 386	8 415	37 126	61 585	21 364	20 390	45 468	195 734
Área Metropolitana do Porto	10 435	68 669	208 447	208 382	81 004	83 940	177 955	838 832
Alto Tâmega	612	2 300	6 994	13 056	7 662	7 337	34 352	72 313
Tâmega e Sousa	1 696	8 926	36 917	58 445	21 024	21 376	51 724	200 108
Douro	940	4 181	16 212	28 895	14 649	14 951	60 712	140 540
Terras de Trás-os-Montes	626	2 427	8 253	17 065	9 487	10 341	37 711	85 910
Centro	**10 349**	**52 816**	**211 038**	**323 576**	**158 806**	**165 040**	**546 143**	**1 467 768**
Oeste	1 922	10 478	44 993	48 140	20 409	17 515	83 950	227 407
Região de Aveiro	1 846	8 658	31 341	44 706	25 537	28 518	55 389	195 995
Região de Coimbra	2 191	11 003	39 329	59 333	32 468	38 967	101 931	285 222
Região de Leiria	1 119	5 430	23 532	44 659	21 228	20 375	56 572	172 915
Viseu Dão Lafões	1 062	4 870	19 109	39 480	19 259	20 737	67 611	172 128
Beira Baixa	397	2 142	7 691	14 527	7 192	6 397	33 662	72 008
Médio Tejo	801	4 602	23 551	39 027	15 679	15 398	61 562	160 620
Beiras e Serra da Estrela	1 011	5 633	21 492	33 704	17 034	17 133	85 466	181 473
Área Metropolitana de Lisboa	**19 807**	**133 496**	**452 574**	**351 450**	**113 073**	**75 163**	**353 471**	**1 499 034**
Área Metropolitana de Lisboa	19 807	133 496	452 574	351 450	113 073	75 163	353 471	1 499 034
Alentejo	**4 882**	**25 852**	**88 093**	**100 779**	**43 700**	**40 830**	**168 176**	**472 312**
Alentejo Litoral	870	4 144	14 134	12 460	5 032	4 072	28 487	69 199
Baixo Alentejo	948	4 476	14 092	16 349	7 739	6 977	34 141	84 722
Lezíria do Tejo	1 361	7 402	29 060	35 002	13 514	11 627	40 655	138 621
Alto Alentejo	683	3 842	11 885	15 157	7 658	8 359	33 416	81 000
Alentejo Central	1 020	5 988	18 922	21 811	9 757	9 795	31 477	98 770
Algarve	**5 020**	**23 820**	**64 382**	**56 217**	**20 522**	**15 700**	**198 005**	**383 666**
Algarve	5 020	23 820	64 382	56 217	20 522	15 700	198 005	383 666
Reg. Aut. Açores	**1 621**	**7 567**	**18 643**	**22 182**	**14 627**	**18 881**	**28 502**	**112 023**
Reg. Aut. Açores	1 621	7 567	18 643	22 182	14 627	18 881	28 502	112 023
Reg. Aut. Madeira	**2 731**	**14 188**	**30 070**	**26 453**	**11 051**	**9 766**	**36 674**	**130 933**

Table 2.10.5

Dwellings according to Type and Type of Building (Mainly non Residential)– NUTS II e NUTS III (2020)

Unit: Number

	Mainly non Residential							
	T0	T1	T2	T3	T4	T5+	n.e.	Total
Portugal	**814**	**2 137**	**4 978**	**5 826**	**2 648**	**2 900**	**14 461**	**33 764**
Continente	**740**	**1 979**	**4 701**	**5 619**	**2 535**	**2 768**	**13 733**	**32 075**
Norte	**185**	**559**	**1 483**	**2 380**	**966**	**1 050**	**3 928**	**10 551**
Alto Minho	13	42	79	154	63	47	308	706
Cávado	18	56	150	373	144	128	419	1 288
Ave	14	50	163	298	89	106	355	1 075
Área Metropolitana do Porto	87	284	708	869	359	390	1 443	4 140
Alto Tâmega	8	13	38	60	41	47	141	348
Tâmega e Sousa	10	65	217	362	121	136	506	1 417
Douro	9	28	71	153	91	122	488	962
Terras de Trás-os-Montes	26	21	57	111	58	74	268	615
Centro	**183**	**445**	**1 184**	**1 490**	**780**	**793**	**3 886**	**8 761**
Oeste	39	121	302	234	115	87	558	1 456
Região de Aveiro	30	71	206	259	134	146	490	1 336
Região de Coimbra	38	77	190	262	154	174	819	1 714
Região de Leiria	34	50	158	222	122	94	433	1 113
Viseu Dão Lafões	8	29	52	114	65	89	361	718
Beira Baixa	6	11	26	46	19	27	258	393
Médio Tejo	17	47	120	193	91	77	473	1 018
Beiras e Serra da Estrela	11	39	130	160	80	99	494	1 013
Área Metropolitana de Lisboa	**191**	**580**	**1 137**	**938**	**418**	**564**	**2 535**	**6 363**
Área Metropolitana de Lisboa	191	580	1 137	938	418	564	2 535	6 363
Alentejo	**92**	**221**	**500**	**531**	**249**	**250**	**2 344**	**4 187**
Alentejo Litoral	15	50	116	139	50	38	281	689
Baixo Alentejo	22	39	84	78	42	37	747	1 049
Lezíria do Tejo	29	52	118	148	66	72	406	891
Alto Alentejo	12	26	71	57	36	46	496	744
Alentejo Central	14	54	111	109	55	57	414	814
Algarve	**89**	**174**	**397**	**280**	**122**	**111**	**1 040**	**2 213**
Algarve	89	174	397	280	122	111	1 040	2 213
Reg. Aut. Açores	**32**	**76**	**103**	**100**	**55**	**83**	**410**	**859**
Reg. Aut. Açores	32	76	103	100	55	83	410	859
Reg. Aut. Madeira	**42**	**82**	**174**	**107**	**58**	**49**	**318**	**830**

Agriculture (2.11)

The 2019 Agricultural Census (National Statistics Institute, INE) registered about 290,000 farms, 15,000 fewer than in 2009, which corresponds to a reduction of 4.9%. The Agricultural Area Used (UAA) increased 8.1% compared to 2009, occupying 3.9 million hectares (43% of the territorial area). The average size of holdings increased by 13.7%, from 12.0 hectares in 2009 to 13.7 hectares of UAA per farm in 2019.

For the reporting period (2016 and 2020), according to INE (IE2016, RA2019 and CEA), there were no significant variations in the area of agricultural holdings or in land use typologies (with the exception of permanent crops); permanent pasture continues to maintain a very significant occupation of the UAA (around 52%), associated with extensive livestock systems.

The most significant changes can be summarised as follows:

1. increases in the area of permanent crops, especially of nuts (65.4%), and in their productivity, with great emphasis on olive groves (75%), associated with the introduction of irrigation;
2. reduction in more than 20% of the area of temporary crops (with the exception of vegetables and legumes) and, simultaneously, an increase, sometimes very significant, in their productivity;
3. increase in irrigable area of about 15% in 2019 compared to 2016;
4. slight reduction in agricultural consumption of inorganic nitrogen and phosphate fertilizers and a small increase in consumption of potassic fertilizers;
5. significant reductions in livestock numbers (dairy herd decreased by 42.8%), with the exception of beef cows, other cattle and poultry.

Regarding point (3) above, on the increase of irrigable area, it should be noted that the irrigable area in 1990 recorded 877 695 hectares, with a strong reduction until 2009 when it reached its minimum (540 593 hectares) and a progressive increase since then (about 15% in 2019). The reduction in irrigable area essentially consisted of traditional irrigation (quite inefficient) while the current increase is made up of modern irrigation, with high efficiency in the use of water, fertilisers and energy. The irrigable area in 2019 was 630 539 hectares (about 16% of the UAA), with the effectively irrigated area corresponding only to 90% of the irrigable area.

Regarding point (4) above, in Portugal there was a decrease in fertilizer consumption. Portugal recorded the lowest consumption of mineral fertilizers (nitrogen and phosphorus) within the EU27, registering in 2019 a consumption less than half of the EU27 average. Nitrogen features the greatest expression in the total apparent consumption of fertilizers, with 53.8% in 2021, followed by potassium with 23.2% and lastly phosphorus with 23.0%. Between 2015 and 2021, the fall in the use of nitrogen (-22.5%) and phosphorus (-15.5%) and the increase in use of potassium (+13.5%) stand out. The 22.7% reduction in the area of cereals in the period under review contributed to the decrease in the apparent consumption of nitrogen. The 11.6% increase in permanent crop area is not unrelated to the increase in potassium consumption.

AGRI-ENVIRONMENTAL MEASURES

The latest CAP reform for the period 2015-2020 should be considered as a development stemming from the environmental concerns and the fight against climate change, resulting from the adjustments introduced in the conditionality system - regulated by Regulation (EU) No 1306/2013 of the European Parliament and the Council.

There are specific programmes for agricultural practices beneficial to the environment and climate and also associated with the inclusion of certain agri-environmental and climate measures in rural development programmes. In fact, the maintenance of the "cross-compliance" regime, in force since 2005, has subjected the full receipt of most CAP payments to a set of standards to ensure "good agricultural and environmental soil conditions" (BCAA), as well as certain obligations, known as legal management requirements (LGRs), such as the Nitrates Directives, Sllats, Groundwater, Natura 2000 Network and sustainable pesticide application. In national terms these programmes have been regulated by the following legislative documents:

- Ordinance No 101/2015 of 2 April laid down the rules for the application of the cross-compliance control system laid down in Articles 96 to 101 of Commission Regulation (DE) No 1306/2013 of 17 December and Regulation (EU) No 809/2014 of the Commission of 17 July. With regard to the structures involved, the specialised control bodies, the national authorities responsible, the Conditionality Advisory Committee and the Committee for the Coordination and Monitoring of Cross-Compliance Control stand out.
- Normative Order No. 6/2015, of February 20, which regulated the BCAA and the RLG. The list of cross-compliance framework standards in the current programming period has been simplified compared to the 2007-2013 period by reducing from 15 to 7 BCAA and from 18 to 13 RLG.

Another instrument with identical objectives is the so-called “Greening”. This is a type of direct payment to farmers introduced with the 2013 CAP reform and integrated into pillar 1. This instrument is based on the principle that farmers should be rewarded for the public goods they provide. It is the only direct payment whose main stated objective is "ecological" (improvement of the environmental performance of the CAP).

Farmers entitled to payment of the Basic Payment Scheme (BPS) were entitled to greening payments, provided that certain agricultural practices[28] were observed in the eligible areas: crop diversification, maintenance of permanent grassland and the creation of areas of ecological interest were priorities, with the main objectives to improve soil quality, fix carbon and safeguard and improve biodiversity, respectively.

In 1 January 2018 the greening rules were amended[29], so that all farmers benefiting from CAP direct payment schemes should apply for the green payment, which therefore became a compulsory scheme. The "Agri-Environmental Measures" are similar to the ecological payment for rewarding farmers for certain practices beneficial to the environment and climate. However, unlike greening, they are contractual and are based on voluntary commitments made to farmers.

[28] Regulation (EU) No 1307/2013 of the European Parliament and the Council of 17 December
[29] Amendments were made by the publication of the Commission's Delegated Regulation (EU) No 2017/11551 and Regulation (EU) No 2017/2393 of the European Parliament and the Council, which amended the aforementioned Regulation No 1307/2013

According to the European Commission, greening is the intermediate level of a pyramid of ecological instruments, with cross-compliance requirements covering the wider group of farmers at the base of the pyramid and environmental commitments in rural development, which are more ambitious and applicable to a smaller group of volunteers and a narrower area, at the top of the pyramid.

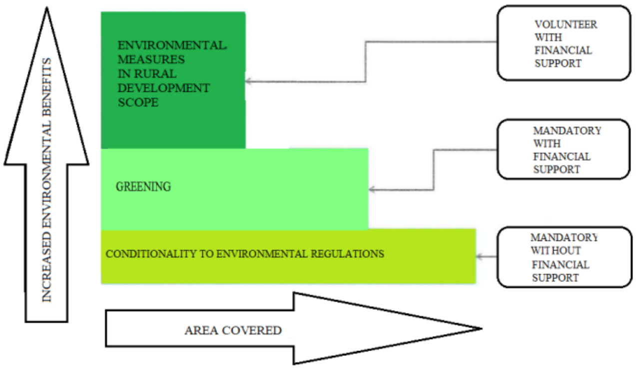


Figure 2.11.1
Agri-Environmental Measures (2014-2020) Framework

In the 2014-2020 programming period, Member States should, similarly to the previous programming period, use at least 30% of the total EAFRD contribution dedicated to each rural development programme in climate change mitigation and adaptation to climate change, as well as on environmental issues. Agri-environmental measures were part of Measure 7 "Agriculture and Natural Resources" of Area 3 of the PDR 2020. The aforementioned Regulation (DE) No 1305/2013 listed rural development objectives and defined their priorities and associated areas, respectively in Articles 4 and 5 (cf. Table 2.11.1). Agri-environmental measures have contributed in particular to the three areas of Priority 4 and, to a lesser extent, to the areas referred to in paragraphs (a) and (e) of priority 5.

Table 2.11.1
Rural Development Priorities 4 and 5 and their areas

Rural development priorities	Areas of Rural Development
(...)	
Q4 Restore, preserve and improve ecosystems linked to agriculture and forestry.	(a) restoration, preservation and enhancement of biodiversity, including in Natura 2000 zones, and in areas subject to natural or other constraints specific constraints, and in agricultural systems of high natural value, as well as the state of European landscapes; (b) improved management of water, fertilisers and pesticides; (c) prevention of erosion and improvement of soil management.
P5 Promote the efficient use of resources and support the transition to a low carbon economy resistant to climate change by the agricultural sector	(A) improved efficiency in water use by the agricultural sector; (b) improving energy efficiency in the agricultural sector and and food industry; (c) facilitation of the supply and use of renewable energy sources, of by-products, waste and scrap and of other raw materials not food to promote the bioeconomy; (d) reduction of greenhouse gas and ammonia emissions from agriculture; (E) promotion of carbon conservation and sequestration in agriculture and forestry.
(...)	

Source: regulation (EU) no 1305/2013 of the European Parliament and of the Council of 17 December.

In mainland Portugal, about 18.4% of the useful agricultural area and 19.5% of the area of forest settlements are part of the Natura 2000 Network, which occupies 21% of the territory. In addition, the existence of a proportion of agricultural area based on extensive production systems, with special focus on permanent pasture areas, based on indigenous breeds and traditional plant varieties, contributes to the reduction of pressure on natural resources and biodiversity. Evaluating the strategies implemented between 2016 and 2020, it is important to highlight the difficulty felt in achieving a reduction in emissions in the agricultural sector, the existence of a low level of carbon sequestration, and the occurrence of problems of availability and quality of water, situations whose summary is unfavorable in terms of biodiversity, social challenges and low level of modernization and innovation, and there is a need to improve the ecological and climate transition in agriculture. These indicators are visible in Table 2.11.2, with information collected by Eurostat, showing the evolution observed in Portugal in indicators related to some of those problems.

Table 2.11.2
Evolution of some agri-environmental indicators associated with SDGs 2 and 15 in Portugal

SDG													
Indicador	Sub-item	2000	2006	2009	2010	2012	2013	2014	2015	2016	2017	2018	2019
Organic Agriculture (%)	Sustainable Agriculture Production						5,31	5,74	6,52	6,75	7,04	5,93	8,16
Gross Balance of nitrogen on agricultural land (kg/ha)		39		36	41	43	37	42	41	47	46		
Gross Balance of phosphorus on agricultural land (kg/ha)		9		4	6	5	4	5	5	7	6		
Ammonia emissions from agriculture (kg/ha)	Environmental Impacts of Agriculture Productions							12,2	12,5	12,8	13,1		
Nitrates in underground water (mg/l)						20,4	17,2	14,8	16,7	19,3	18,4		
Soil Erosion by water (km2)		4.400,1			3.736,5					3.417,6			

Source: DGADR (2022)

Under the PDR2020, the Agri-Environmental Measures were part of Measure 7 "Agriculture and Natural Resources" of the area "Environment, Resource Efficiency and Climate", which also included measure 8 "Forest Protection and Rehabilitation" and Measure 9 "Maintenance of Agricultural Activity in Disadvantaged Areas".

In the architecture of the PDR2020, Area 3 corresponded to the vision of the national strategy for rural development, in the field of improving the management of natural resources and the protection of soil, water, air, biodiversity and landscape. Area 3 of the Programme involved a scheduled public expenditure of EUR 2 332 508,000, of which EUR 1 951 556,000 was financed by the EAFRD, representing 54% of the 2020 RdP. Agri-environmental measures (Measure 7), with EUR 1 031 492,000 in public expenditure and EUR 861 071 071 000 for EAFRD, represented 44% of Area 3 and 24% of the 2020 RdP. In these areas, sub-actions 7.2.1 "Integrated production" and 7.1.2 "Maintenance in organic farming"2, referred to in the following paragraphs, had a special expressiveness and financial relevance in Measure 7 of the PDR 2020 and addressed the above-mentioned problems (i.e. difficulty in achieving a reduction in emissions, a low level of carbon sequestration, problems in water quality). They seek to promote agricultural production systems with high environmental performance that bring benefits to the various resources, including the promotion and preservation of natural species and habitats, in addition to improving soil fertility, preserving water resources and reducing pollutants.

National Strategic Plan for Rural Development

In the National Strategic Plan for Rural Development the period 2014-2020, the conservation and improvement measures implemented included among its objectives of increasing the capacity to adapt and mitigate climate change, mainly through its role as carbon sinks.

In the 2014-2020 programming period, there was a Rural Development Program for each NUTII region, which coexists with a National Program and a National Framework. The latter establishes common elements for development programmes. Under this National Framework for Rural Development 2014-2020, regional Rural Development Programs (PDR´s) include measures to improve efficiency in the use of natural resources, taking into account the threefold aspect of efficient use of natural resources, mitigation and adaptation to climate change. In particular, measures to conserve and improve agricultural, agroforestry and forestry systems are among their objectives of increasing the adaptability and mitigation of climate change (mainly as carbon sinks).

The implementation of climate change mitigation and adaptation is one of the three cross-cutting objectives that this policy has set by 2020. In addition, it is part of the priorities around which the different measures of the programs are designed and focused. Specifically, one of the six priorities of rural development policy is specifically "Promoting resource efficiency and encouraging the transition to a low-carbon economy capable of adapting to climate change in the agricultural, food and forestry sectors".

As a result, following the methodology established at EU level to estimate the expenditure allocated by the Portuguese regional PDR´s to the climate change objectives, it is considered that more than 50% of the total EAFRD has contributed to the fight against climate change.

Table 2.11.4 – EU support and climate related expenditures – EUR billion (% of total) [30]

	EU support	Climate related	Of which		
			Direct mitigation	Direct adaptation	Supportive measures for both
ERDF and ETC	196.7	**37.9**	30.8	3.4	3.6
		[19.3%]	[15.7%]	[1.7%]	[1.8%]
CF	63.4	**17.6**	13.4	3.0	1.3
		[27.8%]	[21.1%]	[4.7%]	[2.0%]
ESF and Youth Employment Initiative	88.9	**1.2**	1.2	-	-
		[1.3%]	[1.3%]	-	-
EMFF	5.7	**1.0**	1.0	-	-
		[18.2%]	[18.2%]		
EAFRD	99.0	**56.5**	5.4	7.5	43.6
		[57.1%]	[5.5%]	[7.6%]	[44%]
Total	453.7	**114.2**	51.9	13.9	48.5
		[25.4%]	[11.4%]	[3.1%]	[10.8%]

[30] Commission Staff Working Document. Evaluation of the EU Strategy on adaptation to climate change. Accompanying the document Report from the Commission to the European Parliament and the Council on the implementation of the EU Strategy on adaptation to climate change (SWD(2018) 461 final).

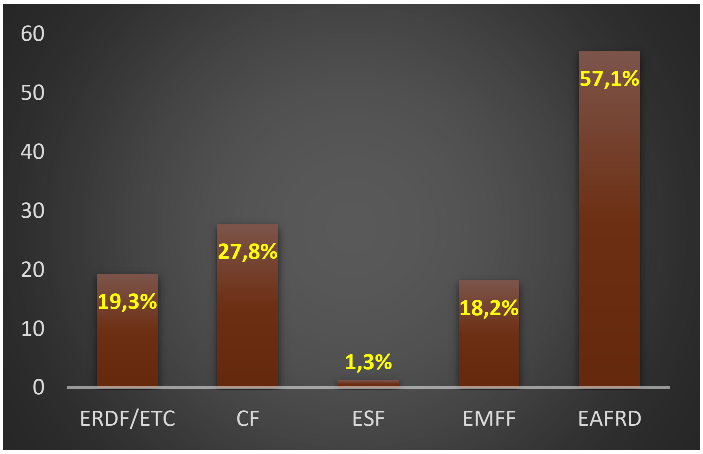


Figure 2.11.5
Climate related expenditure weight by European Funding Mechanism

IRRIGATION

In 2018, the National Irrigation Program (PNRegadios) was approved, which aims to expand, rehabilitated and modernize existing irrigations and the creation of new watered areas, with the aim of promoting irrigation and other collective infrastructure, with financial aid totaling about 560 million euros, financed through the Rural Development Program (PDR2020), by the European Investment Bank and the Council of Europe Development Bank, in a total area of intervention of around 96 400 hectares and with indirect impacts on a more comprehensive agricultural area.

The practice of efficient irrigation, which aims to optimize the use of water, as well as the protection of its quality and the reduction of costs associated with irrigation, leads to a greater productivity and sustainability of agricultural activity, which aims to reduce water losses at the level of exploitation (efficiency) and ensure the equitable supply of water to plants (uniformity of irrigation).

The efficiency and uniformity of irrigation water are indicators that the irrigation manager uses to evaluate the effectiveness of irrigation management, in order to properly adjust the irrigation system, pointing to a better efficiency of water use and ensuring that all automation and control processes are effective in irrigation management. With the above, the importance of supporting agri-environmental measures is reinforced, as it is important to mention the efficient use of water and energy, which have a very positive effect to meet the environmental challenges of irrigated agriculture. The efficient use of water is one of the support measures of the PDR2020), determined by Ordinance No. 50/2015, of February 25, and guided by the recognition system established by Ordinance No. 136/2015, of May 19 – Action 7.5. This measure was a recognition of the importance of good agricultural practices in irrigation, pointing to the optimization of water use, as well as the protection of its quality and the reduction of costs associated with irrigation, as factors leading to greater productivity and economic and environmental sustainability of agricultural activity.

In 2019, 134,700 farms with irrigation system (46.4% of the total, Table 3) were registered, with capacity to water 630,500 hectares (15.9% of SAU), and 46.8% of this irrigable area is arable land, 43.3% permanent crops and 9.9% permanent pastures. The watered area was 566.2 thousand hectares (+97.2 thousand hectares than in 2009, which represents an increase of 20.1%), corresponding to a use of 89.8% of the irrigable area and benefiting almost 1/3 of the area of temporary crops and permanent crops (32.1% and 29.7%, respectively), but only 2.4% of the area of permanent pastures.

In the last ten years there has been a widening of the potentially rentable area (+16.6%), due to the significant increase in permanent crops (+73.2%). The investment in the modernization of orchards, vineyards and olive groves was reflected in the increase in irrigation, benefiting 69.7% of fresh fruit orchards (+9.9 p.p. than in 2009), 11.5% of nuts orchards (+8.9 p.p. than in 2009), 31.7% of olive groves (+12.0 p.p. than in 2009) and 27.8% of vineyards (+13.1 p.p. than in 2009).

Table 2.11.3

Irrigated areas and farms with irrigation systems, according to agricultural regions.

Classification of holdings according to irrigated area in the agricultural year **2018/2019**	Total Holdings		Holdings with watering system	
	(no.)	(%)	(no.)	(%)
Agrarian Region				
Portugal	290 229	100,0	134 695	46,4
Continent	266 039	91,7	121 205	45,6
EDM	44 560	15,4	37 575	84,3
TM	65 211	22,5	16 354	25,1
BL	44 245	15,2	27 731	62,7
BI	33 617	11,6	14 395	42,8
RO	34 486	11,9	12 360	35,8
ALE	31 131	10,7	7 104	22,8
ALG	12 789	4,4	5 686	44,5

Source: Agricultural Census (2019)

Forest (2.12)

Portuguese forests have undergone significant changes in the past decades, both as a result of the abandonment of agriculture and of several programs to promote afforestation, with the consequent transfer of land use to forestry, leading to an increase in the area of forest until the late 90's. However, since then the area has remained quite stable due to rural fires that have reached huge proportions.

Forest policy considers the forest sector development as an integral component of sustainable development and a contributing sector to mitigate climate change, as expressed in the Forest Policy Act[31]. Furthermore, the National Forest Strategy[32] took into consideration the need to adapt forests to the possible impacts of a climate change scenario, like the increasing risk of rural fires or of pests and diseases.

[31] Law nº33/96, of 17th August

[32] Updated by the Council of Ministers Resolution nº6-B-2015, of 4th February

According to the National Forest Inventory (IFN6), mainland Portugal has a forested area of 3224 thousand hectares, corresponding to more than 36% of the overall land cover.

Table 2.12.1
Distribution of forest stands, pure and mixed, in mainland Portugal

Species	1995	2005	2010	2015			Δ [2005-2015]
	1000 ha	1000 ha	1000 ha	1000 ha	%	erro%	1000 ha
Portugal mainland	**3305,6**	**3215,9**	**3164,2**	**3224,2**	**100,0**	**0,4**	**-8,3**
Pinus pinaster	978,0	798,0	719,3	713,3	22,1	1,0	84,8
Eucalyptus sp.	717,2	785,9	810,8	845,0	26,2	0,9	-59,1
Quercus suber	746,8	731,2	717,4	719,9	22,3	1,0	11,3
Quercus rotundifolia	366,7	335,5	349,2	349,4	10,8	1,6	-13,9
Other Quercus sp.	92,0	66,3	67,2	81,7	2,5	3,4	-15,4
Pinus pinea	120,2	172,9	184,6	193,6	6,0	2,2	-20,7
Castanea sativa	32,7	38,4	42,7	48,3	1,5	4,4	-10,0
Ceratonia siliqua	12,3	12,2	12,0	16,4	<1	7,6	-4,2
Acacia sp.	2,7	4,7	5,5	8,4	<1	10,6	-3,7
other broadleaves	155,2	169,5	176,0	190,2	5,9	2,2	-20,7
other coniferous	61,4	73,5	71,1	52,2	1,6	4,3	21,3
temporalily not wooded without identified species	20,6	27,6	8,1	5,7	**<1**	13,0	22,0

Source: ICNF, IFN6

Forestry resources play an important role in the national economy. Forestry is mainly an export sector, with a net commercial balance exceeding 2.5 billion Euros in 2020. Forest based products (cork and timber based products, including wooden furniture, and nuts and resins) represent approximately 10% of the total Portuguese exports, while the sector is only responsible for 4% of the national imports.

Mean annual removals are around 10.8 million m^3 of wood, with 7 million m^3 of softwoods and 3.8 million m^3 of hardwoods (mainly eucalyptus). In 2020, roundwood timber annual removals were around 13.4 million m^3, with 4.4 million m^3 of coniferous and 9 million m^3 of non-coniferous). Cork oak stands produce an average of 120 000 tonnes of cork per year.

The export orientation of Portuguese forest sector is the dominant factor on the option for certification schemes. Main forest private companies use voluntary instruments, such as certification of SFM:

- The Programme for the Endorsement of Forest Certification (PEFC) certified 307 thousand hectares of forest, 2,983 forest producers and managers, 203 Chain of Custody's certificates related to 565 enterprises (PEFC Portugal, 2021).

- The Forest Stewardship Council (FSC) certified 530,7 thousand hectares of certified area, corresponding to 34 certificates of forest management, more than 3,350 forest owners and 459 Chain of Custody certificates (FSC Portugal, 2021)

Fires are one of the major threats to forests in the country and 2017 was the worse year for decades.

Table 2.12.2.
Burnt area by forest species 2015-2020

Land cover types (ha)	2015	2016	2017	2018	2019	2020
Forest	**23 740**	**77 502**	**329 514**	**21 941**	**21 432**	**31 725**
Pinus pinaster	7 279	17 599	164 167	1 210	7 391	19 863
Eucalyptus sp.	10 752	48 711	127 455	13 642	9 270	7 845
Quercus suber	523	1 567	2 055	2 654	1 555	1 443
Quercus rotundifolia	999	476	1 093	336	666	31
Other Quercus sp.	666	1 539	2 908	235	703	251
Pinus pinea	381	532	1 317	1 210	222	659
Castanea sativa	238	140	563	34	74	126
Ceratonia siliqua	48	0	0	34	0	0
Acacia sp.	0	140	2 111	67	37	0
other broadleaves	1 665	4 057	18 431	2 083	1 071	1 098
other coniferous	761	1 007	8 358	437	443	408
temporalily not wooded without identified species	428	1 735	1 057	0	0	0
Shrubland and Grassland	**40 672**	**84 021**	**170 585**	**19 486**	**15 913**	**28 954**
Other land	**3 888**	**6 699**	**39 822**	**3 151**	**4 740**	**6 491**
Total	**68 299**	**168 222**	**539 921**	**44 578**	**42 084**	**67 170**

Right after the catastrophic fires that took place in 2017, a new rural fire management system was set up, and in 2020 the new National Integrated Rural Fire Management Plan (PNGIFR) established a strategy and measures regarding also the role of wildfire management in climate change. Rural fire management actions play a central role in national policies to combat and adapt to climate change and one of the main underlying objectives of the PNGIFR the reduction in the probability of catastrophic fire seasons as they greatly increase the emission of CO2. More detailed information on the PNGIFR is provided in section POLICY AND MEASURES AND THEIR EFFECTS (4.2).

Forest spaces, shrubs and pastures currently occupy almost 70% of the land area of mainland Portugal. They are a fundamental element of the rural landscape, being an economic and social anchor of the territories, and play an important role in regulating the different natural cycles, having a structuring role in the conservation of nature and biodiversity. They also contribute, in a fundamental way, to carbon sequestration, essential for Portugal to achieve carbon neutrality by 2050.

However, these territories are physically characterized by sharp relief or poor soils, have been experiencing the loss and aging of the population, resulting on the abandonment of the agroforestry and pastoral models, along with an extreme fragmentation of properties, setting a panorama characterized by extensive monoculture forest areas, mostly not managed, which, in the presence of adverse weather conditions, reach levels of extreme fire danger, threatening people, animals and property, including natural and cultural heritage.

Addressed to these territories, a strategic program was created for integrated intervention in territories with vulnerabilities arising from the conflict between hazardness and land use. This program, called the National Landscape Transformation Programme (PTP)[33], has the main objective to promote the transformation of the landscape that guarantees resilience, sustainability and recognition of the territory.

One of the programmatic measures established in the PTP is the development of Landscape planning and Management Programmes (PRGP). Directed towards forest territories that present specific vulnerabilities associated with the organization of the territory, these programmes aim to prevent risks and adapt to climate change, through the planning and management of the landscape and the adoption of specific intervention measures.

In this sense, 20 more vulnerable forest territories were identified, and it was determined that they should be the subject of priority intervention through the PRGP, and the respective elaboration should be concluded by the end of 2024.

The PRGP for Serras de Monchique and Silves was the first to be published, in 2020, and its report and maps are available at https://www.dgterritorio.gov.pt/Programa-Reordenamento-e-Gestao-da-Paisagem-das-Serras-de-Monchique-e-Silves-PRGPSMS. In 2021, the following five PRGPs started to be elaborated (table 2.13.1):

Table 2.13.1

PRGP	Area (ha)	Nº parishes	Nº municipalities
Serras de Monchique e Silves	43000	6	2
Serras da Lousã e Açor	54839	10	6
Alto Douro e Baixo Sabor	44650	10	4
Serras do Marão, Alvão e Falperra	49450	18	7
Serra da Malcata	57308	20	3
TOTAL	249247	64	22

Five more PRGPs (figure 2.13.1) are scheduled to start in 2022 (Entre Minho and Lima, Alva and Mondego, Montes Ocidentais and Beira Alta, Serras da Gardunha, Alvelos and Moradal and Serra do Caldeirão PRGPs).

[33] Resolution of the Council of Ministers n.º 49/2020, of 24 June

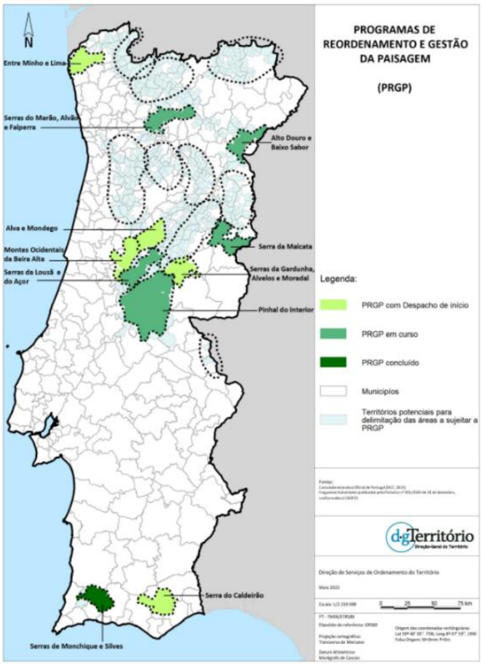


Figure 2.13.1
Landscape planning and Management Programs
Source: DGT (2022)

The execution of the PRGPs is carried out through other programmatic measures of the PTP, namely the Integrated Areas for Landscape Management (AIGP) and Integrated Operations for Landscape Management (OIGP).

The AIGPs aim to promote the management and development of agroforestry spaces in areas of small property and high fire risk. The IOGPs define, in space and time, the interventions for transforming the landscape, reconverting cultures and enhancing and revitalizing the territory, as well as the operating model, financial resources and the management and monitoring system to be implemented for active and rational management.

In 2021, 70 AIGPs were created in 36 municipalities and covering a total area of 140,861.10 hectares, that is, 1.58% of the continental territory.

Other Circumstances (2.13)
Not applicable to Portugal.

Flexibility in accordance with Article 4, paragraphs 6 and 10, of the Convention (2.14)
Not applicable to Portugal.

Greenhouse Gases Inventory Information (3)

Summary Tables of greenhouse gases (3.1)

Portugal, as a Party to the United Nations Framework Convention on Climate Change (UNFCCC) and the Kyoto Protocol, is required to produce and regularly update its inventory of emissions and removals of greenhouse gas (GHG) not controlled by the Montreal Protocol.

The GHG emission inventory is the official annual accounting of all anthropogenic emissions and removals of greenhouse gases in Portugal. The inventory measures Portugal's progress against obligations under the UNFCCC, the Kyoto Protocol, the European Union's Climate and Energy targets and the national targets.

As a general rule the inventory covers emissions occurring in the all of the Portuguese territory, i.e., mainland Portugal and the two autonomous regions of Madeira and Azores. The Autonomous Regions of Madeira and the Azores develop regional GHG inventories that contribute to the improvement of the information system regarding GHG emissions. At the end of this chapter, after the national overview, a regional GHG emissions overview is provided.

This chapter summarizes the latest information (October 2022) on Portuguese GHG emissions (1990-2020), communicated to the UNFCCC through the compilation of the Common Reporting Format (CRF) and the National Inventory Report (NIR), and also available at:

- Inventário Nacional de Emissões por Fontes e Remoção por Sumidouros de Poluentes Atmosféricos (INERPA) | Agência Portuguesa do Ambiente (apambiente.pt)

Sumary tables are presented in 3.1 to 3.5. For more information, please see tables in the Annex II.

Descriptive Summary of Portuguese GHG emissions and removals (3.2)

In 2020, total Portuguese GHG emissions, including indirect CO2, without land-use, land-use change and forestry (LULUCF) were estimated at about 57.7 Mt CO2e, representing a decrease of 2.1 % compared to 1990 levels and a decrease of 9.5 % compared to the previous year (2019). When considering the LULUCF sector, the national level of emissions in 2020 totalled 53.0 Mt CO2e., corresponding to a 19.7 % decrease in relation to 1990 and a variation of -10.6 % from 2019 to 2020 (figure 3.2.1).

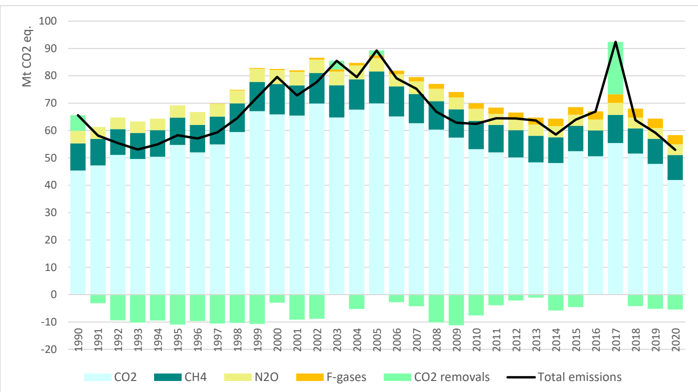


Figure 3.2.1 - Greenhouse Gas Emissions by Gas (with LULUCF and indirect CO2).

CO_2 is the primary GHG, accounting for about 72% of Portuguese emissions on a carbon equivalent basis in 2020 (LULUCF excluded). The second most important gas is CH_4, followed by N_2O, representing, respectively, 16% and 6% of total emissions in 2020. Portugal has chosen 1995 as the base year for fluorinated gases. In 2020, these gases represented about 6% of total GHG emissions. NF3 emissions are non-occurring in Portugal. Tables 0.1 to 0.5 below provide an overview of the GHG emissions and removals in Portugal by gas.

Tables 3.2.1 to 3.2.5

GHG emissions and removals in Portugal by gas

Table 3.2.1

GHG emissions and removals in Portugal

Gas/Source	1990	2005	2015	2016	2017	2018	2019	2020	Change from 1990 to 2020
	kt CO2 eq.								%
Total (net emissions)	**65,926.62**	**89,263.34**	**63,924.02**	**66,889.68**	**92,297.05**	**63,743.03**	**59,109.17**	**52,876.00**	**-19.80**
1. Energy	40,661.14	63,983.20	48,384.34	47,223.15	51,780.83	48,481.95	44,415.34	38,532.18	-5.24
A. Fuel combustion	40,459.93	63,358.50	47,173.27	46,085.73	50,563.12	47,360.04	43,208.52	37,448.29	-7.44
1. Energy industries	16,420.09	25,524.20	18,398.11	17,399.18	21,311.12	17,873.63	13,015.35	10,387.44	-36.74
2. Manufacturing industries and construction	9,012.30	10,625.73	7,842.89	7,360.62	7,613.77	7,638.68	7,871.56	7,627.80	-15.36
3. Transport	10,819.55	19,963.89	16,386.92	16,850.10	17,192.77	17,256.61	17,747.51	14,830.56	37.07
4. Other sectors	4,111.06	7,170.76	4,468.54	4,431.58	4,401.29	4,531.93	4,513.00	4,535.62	10.33
5. Other	96.93	73.92	76.82	44.24	44.16	59.18	61.10	66.87	-31.01
B. Fugitive emissions from fuels	201.21	624.70	1,211.07	1,137.42	1,217.71	1,121.91	1,206.82	1,083.88	438.68
1. Solid fuels	142.97	19.89	16.79	16.56	15.92	15.73	15.53	15.36	-89.26
2. Oil and natural gas and other emissions from energy production	58.24	604.82	1,194.28	1,120.87	1,201.79	1,106.18	1,191.28	1,068.52	1,734.76
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Industrial Processes	6,442.43	8,592.91	7,694.45	7,141.73	7,608.08	7,244.84	7,622.07	7,579.64	17.65
A. Mineral industry	3,685.78	4,940.95	3,782.78	3,130.21	3,390.29	3,166.82	3,115.34	3,126.62	-15.17
B. Chemical industry	1,978.43	2,146.27	729.47	723.74	747.34	491.38	743.97	720.51	-63.58
C. Metal industry	446.85	109.23	105.71	84.27	77.91	75.48	93.77	98.07	-78.05
D. Non-energy products from fuels and solvent use	248.25	253.72	187.90	184.23	188.27	193.88	200.25	224.42	-9.60
E. Electronic industry	NO,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	0.00
F. Product uses as ODS substitutes	NA	1,057.59	2,819.28	2,956.54	3,139.50	3,261.79	3,396.95	3,357.60	100.00
G. Other product manufacture and use	82.90	85.15	69.30	62.73	64.77	55.49	71.80	52.42	-36.76
H. Other	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-99.18
3. Agriculture	7,142.02	6,721.13	6,666.62	6,694.07	6,793.78	6,864.95	6,935.57	6,990.07	-2.13
A. Enteric fermentation	3,520.18	3,534.48	3,331.94	3,404.24	3,483.53	3,534.78	3,551.12	3,574.11	1.53
B. Manure management	1,078.38	901.61	869.34	888.32	908.11	923.57	944.57	963.81	-10.62
C. Rice cultivation	133.92	151.94	141.99	138.23	140.09	136.80	135.26	113.97	-14.90
D. Agricultural soils	2,293.18	2,041.57	2,206.29	2,145.13	2,152.51	2,166.86	2,210.02	2,240.24	-2.31
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Field burning of agricultural residues	67.88	50.23	52.07	51.89	52.41	52.11	52.78	52.11	-23.23
G. Liming	6.52	6.24	8.19	8.20	8.41	6.98	10.82	11.81	81.25
H. Urea application	21.28	18.89	48.65	48.15	41.20	34.78	22.06	24.19	13.71
I. Other carbon-containing fertilizers	20.68	16.16	8.14	9.91	7.52	9.07	8.93	9.82	-52.52
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry[(2)]	7,126.76	3,502.96	-3,708.05	1,103.84	21,453.78	-3,427.65	-4,432.44	-4,646.50	-165.20
A. Forest land	4,047.14	2,659.98	-1,097.23	3,046.16	20,830.81	371.34	-276.22	-556.15	-113.74
B. Cropland	1,470.89	-1,013.11	-1,226.32	-1,185.79	235.10	-1,597.09	-1,633.26	-1,741.18	-218.38
C. Grassland	2,585.14	1,467.81	-1,744.71	-1,240.06	-276.55	-2,690.49	-3,061.70	-3,367.87	-230.28
D. Wetlands	535.50	663.68	525.65	499.37	479.13	457.78	437.84	417.88	-21.96
E. Settlements	285.79	416.68	83.79	68.28	76.88	79.76	89.31	99.07	-65.33
F. Other land	NO	0.00	0.01	0.01	0.00	0.00	0.00	0.00	100.00
G. Harvested wood products	-2,127.08	-1,202.97	-778.63	-607.99	-440.83	-525.77	-448.61	56.76	-102.67
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Waste	4,554.28	6,463.14	4,886.67	4,726.89	4,660.58	4,578.94	4,568.63	4,420.62	-2.93
A. Solid waste disposal	2,820.64	4,796.79	3,688.19	3,645.63	3,586.62	3,562.00	3,569.34	3,456.94	22.56
B. Biological treatment of solid waste	8.62	22.42	36.72	38.49	34.07	39.92	39.26	41.70	383.67
C. Incineration and open burning of waste	8.23	13.38	24.87	24.66	27.20	33.02	31.84	33.40	305.65
D. Waste water treatment and discharge	1,716.79	1,630.54	1,136.90	1,018.11	1,012.68	944.00	928.19	888.57	-48.24
E. Other	NO,NA	0.01	0.00	0.00	0.00	0.00	0.00	0.00	100.00
6. Other *(as specified in summary 1.A)*	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
Memo items:									
International bunkers	2,962.67	3,869.16	5,213.48	5,793.59	6,431.75	6,841.05	7,505.87	3,797.46	28.18
Aviation	1,548.61	2,300.43	3,169.47	3,396.93	3,869.92	4,157.02	4,406.20	1,582.95	2.22
Navigation	1,414.06	1,568.73	2,044.01	2,396.66	2,561.83	2,684.02	3,099.67	2,214.51	56.61
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO_2 emissions from biomass	11,348.87	11,294.28	11,533.86	11,403.38	11,410.04	11,492.28	11,627.14	11,512.54	1.44
CO_2 captured	NO,NE,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	0.00
Long-term storage of C in waste disposal sites	NE	NE	NE	NE	NE	NE	NE	NE	0.00
Indirect N_2O	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	0.00
Indirect CO_2[(3)]	86.13	210.91	167.09	156.75	191.87	135.70	156.13	131.95	53.21
Total CO_2 equivalent emissions without land use, land-use change and forestry	**58,799.86**	**85,760.38**	**67,632.08**	**65,785.84**	**70,843.26**	**67,170.68**	**63,541.62**	**57,522.50**	**-2.17**
Total CO_2 equivalent emissions with land use, land-use change and forestry	**65,926.62**	**89,263.34**	**63,924.02**	**66,889.68**	**92,297.05**	**63,743.03**	**59,109.17**	**52,876.00**	**-19.80**
Total CO_2 equivalent emissions, including indirect CO2, without land use, land-use change and forestry	**58,885.99**	**85,971.29**	**67,799.17**	**65,942.59**	**71,035.13**	**67,306.38**	**63,697.74**	**57,654.45**	**-2.09**
Total CO_2 equivalent emissions, including indirect CO2, with land use, land-use change and forestry	**66,012.75**	**89,474.25**	**64,091.11**	**67,046.43**	**92,488.92**	**63,878.73**	**59,265.30**	**53,007.95**	**-19.70**

Table 3.2.2

CO2 emissions and removals in Portugal

Gas/Source	1990	2005	2015	2016	2017	2018	2019	2020	Change from 1990 to 2020
	kt CO2 eq.								%
Total CO2 (net emissions)	**51,116.59**	**71,704.95**	**47,846.41**	**50,526.37**	**74,522.29**	**47,408.69**	**42,600.13**	**36,519.53**	**-28.56**
1. Energy	39,454.08	62,799.89	47,439.88	46,281.11	50,787.55	47,511.27	43,456.11	37,612.36	-4.67
A. Fuel combustion	39,397.49	62,236.67	46,300.54	45,215.37	49,643.40	46,463.43	42,322.89	36,599.59	-7.10
1. Energy industries	16365.60	25345.92	18249.82	17248.19	21116.28	17708.11	12865.93	10250.54	-37.37
2. Manufacturing industries and construction	8854.33	10406.24	7681.73	7204.53	7454.21	7476.49	7708.20	7465.40	-15.69
3. Transport	10618.12	19694.63	16204.31	16666.74	17006.16	17066.65	17550.62	14665.81	38.12
4. Other sectors	3463.33	6716.58	4088.51	4052.03	4022.96	4153.50	4137.56	4151.53	19.87
5. Other	96.11	73.29	76.17	43.87	43.79	58.68	60.58	66.31	-31.01
B. Fugitive emissions from fuels	56.59	563.22	1139.33	1065.74	1144.15	1047.84	1133.22	1012.77	1689.78
1. Solid fuels	2.88	NO	NO	NO	NO	NO	NO	NO	
2. Oil and natural gas and other emissions from energy production	53.71	563.22	1139.33	1065.74	1144.15	1047.84	1133.22	1012.77	1785.62
C. CO_2 transport and storage	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Industrial Processes	5815.67	6865.17	4741.26	4071.02	4339.29	3865.03	4090.15	4109.43	-29.34
A. Mineral industry	3685.78	4940.95	3782.78	3130.21	3390.29	3166.82	3115.34	3126.62	-15.17
B. Chemical industry	1435.17	1561.27	664.86	672.31	682.82	428.85	680.79	660.32	-53.99
C. Metal industry	446.25	109.23	105.71	84.27	77.91	75.48	93.77	98.07	-78.02
D. Non-energy products from fuels and solvent use	248.25	253.72	187.90	184.23	188.27	193.88	200.25	224.42	-9.60
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	0.00
H. Other	0.22	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-99.18
3. Agriculture	48.47	41.29	64.98	66.26	57.13	50.83	41.81	45.83	-5.46
A. Enteric fermentation									
B. Manure management									
C. Rice cultivation									
D. Agricultural soils									
E. Prescribed burning of savannas									
F. Field burning of agricultural residues									
G. Liming	6.52	6.24	8.19	8.20	8.41	6.98	10.82	11.81	81.25
H. Urea application	21.28	18.89	48.65	48.15	41.20	34.78	22.06	24.19	13.71
I. Other carbon-containing fertilizers	20.68	16.16	8.14	9.91	7.52	9.07	8.93	9.82	-52.52
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry(2)	5705.17	1776.05	-4590.97	-72.61	19120.24	-4186.11	-5174.82	-5412.31	-194.87
A. Forest land	3402.58	1797.20	-1275.26	2621.64	19433.68	238.42	-414.42	-724.72	-121.30
B. Cropland	1323.88	-1080.17	-1286.93	-1255.00	70.85	-1658.44	-1697.94	-1806.63	-236.46
C. Grassland	2333.96	1241.50	-1806.36	-1347.98	-450.83	-2731.51	-3096.94	-3412.90	-246.23
D. Wetlands	500.93	621.97	489.20	464.48	445.81	426.02	407.65	389.25	-22.29
E. Settlements	270.92	398.52	67.01	52.23	61.56	65.17	75.44	85.93	-68.28
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Harvested wood products	-2127.08	-1202.97	-778.63	-607.99	-440.83	-525.77	-448.61	56.76	-102.67
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Waste	7.07	11.64	24.17	23.84	26.22	31.98	30.75	32.27	356.26
A. Solid waste disposal	NO	NO	NO	NO	NO	NO	NO	NO	0.00
B. Biological treatment of solid waste									
C. Incineration and open burning of waste	7.07	11.64	24.17	23.84	26.22	31.98	30.75	32.27	356.26
D. Waste water treatment and discharge									
E. Other	NA	NA	NA	NA	NA	NA	NA	NA	0.00
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Memo items:									
International bunkers	2932.64	3832.72	5165.07	5739.73	6371.99	6777.52	7436.10	3761.35	28.26
Aviation	1532.67	2279.59	3141.39	3366.86	3835.64	4120.19	4367.23	1568.89	2.36
Navigation	1399.97	1553.12	2023.68	2372.87	2536.35	2657.33	3068.87	2192.47	56.61
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO_2 emissions from biomass	11348.87	11294.28	11533.86	11403.38	11410.04	11492.28	11627.14	11512.54	1.44
CO_2 captured	NO,NE,IE		NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	NO,IE	0.00
Long-term storage of C in waste disposal sites	NE	NE	NE	NE	NE	NE	NE	NE	0.00
Indirect N_2O									
Indirect CO_2 (3)	86.13	210.91	167.09	156.75	191.87	135.70	156.13	131.95	53.21

Table 3.2.3
CH4 emissions in Portugal

Gas/Source	1990	2005	2015	2016	2017	2018	2019	2020	Change from 1990 to 2020
	kt CO2 eq.								%
Total CH4	**10,315.96**	**11,859.04**	**9,376.42**	**9,527.76**	**10,415.27**	**9,228.44**	**9,252.57**	**9,140.30**	**-11.40**
1. Energy	710.20	448.81	379.92	376.67	377.81	377.09	372.94	365.89	-48.48
A. Fuel combustion (sectoral approach)	567.93	390.27	311.30	308.07	307.43	305.84	301.84	297.20	-47.67
1. Energy industries	5.96	15.90	14.99	15.12	16.43	15.11	14.24	13.16	120.69
2. Manufacturing industries and construction	32.11	48.03	49.07	49.01	49.87	52.32	50.88	48.86	52.17
3. Transport	98.97	61.32	26.43	24.95	23.78	22.68	22.33	17.67	-82.14
4. Other sectors	430.87	265.00	220.80	218.99	217.34	215.71	214.38	217.50	-49.52
5. Other	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-31.01
B. Fugitive emissions from fuels	142.28	58.54	68.62	68.60	70.38	71.26	71.10	68.69	-51.72
1. Solid fuels	140.10	19.89	16.79	16.56	15.92	15.73	15.53	15.36	-89.04
2. Oil and natural gas and other emissions from energy production	2.18	38.66	51.83	52.04	54.45	55.53	55.57	53.33	2348.89
C. CO_2 transport and storage									
2. Industrial processes	26.13	26.80	26.61	26.93	27.30	16.24	27.10	26.40	1.00
A. Mineral industry									
B. Chemical industry	25.53	26.80	26.61	26.93	27.30	16.24	27.10	26.40	3.38
C. Metal industry	0.60	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	
D. Non-energy products from fuels and solvent use	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	0.00
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	NO	NO	NO	NO	NO	NO	NO	NO	0.00
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
3. Agriculture	4506.83	4413.56	4201.80	4283.74	4376.59	4429.38	4452.28	4463.56	-0.96
A. Enteric fermentation	3520.18	3534.48	3331.94	3404.24	3483.53	3534.78	3551.12	3574.11	1.53
B. Manure management	809.88	696.15	694.84	708.47	719.80	724.91	732.60	742.73	-8.29
C. Rice cultivation	133.92	151.94	141.99	138.23	140.09	136.80	135.26	113.97	-14.90
D. Agricultural soils	NO	NO	NO	NO	NO	NO	NO	NO	0.00
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Field burning of agricultural residues	42.84	30.98	33.02	32.81	33.17	32.89	33.30	32.75	-23.55
G. Liming									
H. Urea application									
I. Other carbon-containing fertilizers									
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry	730.07	769.55	101.39	333.97	1198.37	63.78	69.84	104.80	-85.65
A. Forest land	452.84	595.61	74.30	264.39	1005.46	49.22	56.29	82.38	-81.81
B. Cropland	86.63	17.47	3.20	9.24	80.88	2.31	4.35	4.45	-94.87
C. Grassland	190.60	156.47	23.89	60.34	112.03	12.25	9.20	17.97	-90.57
D. Wetlands	NO	0.00	NO	0.00	0.00	0.00	0.00	0.00	100.00
E. Settlements	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Other land	NO	NO	NO	NO	NO	NO	NO	NO	0.00
G. Harvested wood products									
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Waste	4342.72	6200.31	4666.71	4506.45	4435.20	4341.94	4330.42	4179.66	-3.75
A. Solid waste disposal	2820.64	4796.79	3688.19	3645.63	3586.62	3562.00	3569.34	3456.94	22.56
B. Biological treatment of solid waste	5.03	13.07	23.08	24.99	21.39	24.93	25.36	25.95	416.36
C. Incineration and open burning of waste	0.27	0.29	0.12	0.14	0.17	0.20	0.21	0.23	-12.41
D. Waste water treatment and discharge	1516.79	1390.15	955.32	835.69	827.02	754.80	735.50	696.53	-54.08
E. Other	NO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	100.00
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total CH_4 emissions without CH_4 from LULUCF	9585.89	11089.49	9275.04	9193.79	9216.90	9164.66	9182.73	9035.50	-5.74
Total CH_4 emissions with CH_4 from LULUCF	10315.96	11859.04	9376.42	9527.76	10415.27	9228.44	9252.57	9140.30	-11.40
Memo items:									
International bunkers	6.36	5.38	6.51	7.40	8.09	8.55	9.56	5.99	-5.81
Aviation	3.16	1.84	1.90	2.00	2.31	2.49	2.57	0.98	-68.82
Navigation	3.20	3.54	4.61	5.40	5.78	6.06	6.99	5.00	56.38
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO_2 emissions from biomass									
CO_2 captured									
Long-term storage of C in waste disposal sites									
Indirect N_2O									
Indirect CO_2 [(3)]									

Table 3.2.4

N2O emissions in Portugal

Gas/Source	1990	2005	2015	2016	2017	2018	2019	2020	Change from 1990 to 2020
	kt CO2 eq.								%
Total N2O	**4,580.20**	**4,826.04**	**4,025.82**	**4,012.14**	**4,386.31**	**3,956.01**	**3,991.55**	**3,967.65**	**-13.37**
1. Energy	496.86	734.51	564.54	565.37	615.47	593.59	586.28	553.93	11.49
A. Fuel combustion (sectoral approach)	494.51	731.57	561.43	562.29	612.29	590.78	583.79	551.50	11.52
1. Energy industries	48.53	162.37	133.30	135.88	178.42	150.42	135.18	123.74	154.99
2. Manufacturing industries and construction	125.87	171.46	112.09	107.08	109.69	109.88	112.48	113.54	-9.79
3. Transport	102.45	207.93	156.18	158.41	162.83	167.28	174.57	147.08	43.56
4. Other sectors	216.86	189.18	159.23	160.56	160.99	162.72	161.06	166.59	-23.18
5. Other	0.80	0.61	0.63	0.37	0.37	0.49	0.50	0.55	-31.01
B. Fugitive emissions from fuels	2.35	2.94	3.12	3.08	3.18	2.81	2.49	2.43	3.35
1. Solid fuels	NO	NO	NO	NO	NO	NO	NO	NO	0.00
2. Oil and natural gas and other emissions from energy production	2.35	2.94	3.12	3.08	3.18	2.81	2.49	2.43	3.35
C. CO_2 transport and storage									
2. Industrial processes	600.63	616.71	84.12	63.61	76.44	77.99	83.79	63.34	-89.45
A. Mineral industry									
B. Chemical industry	517.73	558.19	38.00	24.51	37.22	46.29	36.08	33.80	-93.47
C. Metal industry	NO	NO	NO	NO	NO	NO	NO	NO	0.00
D. Non-energy products from fuels and solvent use	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
E. Electronic industry									
F. Product uses as ODS substitutes									
G. Other product manufacture and use	82.90	58.52	46.12	39.11	39.22	31.70	47.71	29.54	-64.36
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
3. Agriculture	2586.72	2266.28	2399.84	2344.07	2360.06	2384.74	2441.48	2480.68	-4.10
A. Enteric fermentation									
B. Manure management	268.49	205.46	174.49	179.86	188.31	198.66	211.97	221.08	-17.66
C. Rice cultivation									
D. Agricultural soils	2293.18	2041.57	2206.29	2145.13	2152.51	2166.86	2210.02	2240.24	-2.31
E. Prescribed burning of savannas	NO	NO	NO	NO	NO	NO	NO	NO	0.00
F. Field burning of agricultural residues	25.04	19.25	19.05	19.08	19.24	19.22	19.48	19.36	-22.68
G. Liming									
H. Urea application									
I. Other carbon containing fertlizers									
J. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
4. Land use, land-use change and forestry	691.52	957.36	781.53	842.48	1135.18	694.68	672.54	661.01	-4.41
A. Forest land	191.72	267.17	103.72	160.13	391.67	83.69	81.91	86.19	-55.05
B. Cropland	60.39	49.60	57.41	59.97	83.38	59.04	60.33	61.00	1.01
C. Grassland	60.58	69.84	37.76	47.59	62.25	28.77	26.03	27.06	-55.34
D. Wetlands	34.57	41.71	36.45	34.88	33.32	31.75	30.19	28.63	-17.18
E. Settlements	14.88	18.16	16.77	16.05	15.32	14.60	13.87	13.15	-11.64
F. Other land	NO	0.00	0.01	0.01	0.00	0.00	0.00	0.00	100.00
G. Harvested wood products									
H. Other	NO	NO	NO	NO	NO	NO	NO	NO	0.00
5. Waste	204.48	251.19	195.79	196.60	199.16	205.01	207.46	208.68	2.05
A. Solid waste disposal									
B. Biological treatment of solid waste	3.59	9.35	13.64	13.50	12.69	14.98	13.90	15.74	337.96
C. Incineration and open burning of waste	0.90	1.45	0.58	0.68	0.82	0.83	0.87	0.90	0.15
D. Waste water treatment and discharge	199.99	240.39	181.57	182.42	185.66	189.20	192.69	192.04	-3.97
E. Other	NO	0.01	0.00	0.00	0.00	0.00	0.00	0.00	100.00
6. Other *(as specified in summary 1.A)*	NO	NO	NO	NO	NO	NO	NO	NO	0.00
Total direct N_2O emissions without N_2O from LULUCF	3888.69	3868.68	3244.30	3169.65	3251.13	3261.33	3319.01	3306.64	-14.97
Total direct N_2O emissions with N_2O from LULUCF	4580.20	4826.04	4025.82	4012.14	4386.31	3956.01	3991.55	3967.65	-13.37
Memo items:									
International bunkers	23.67	31.07	41.90	46.46	51.67	54.98	60.22	30.12	27.23
Aviation	12.78	19.00	26.19	28.07	31.97	34.34	36.40	13.08	2.36
Navigation	10.90	12.06	15.71	18.39	19.70	20.64	23.81	17.04	56.38
Multilateral operations	NO	NO	NO	NO	NO	NO	NO	NO	0.00
CO_2 emissions from biomass									
CO_2 captured									
Long-term storage of C in waste disposal sites									
Indirect N_2O	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	0.00
Indirect CO_2 (3)									

Table 3.2.5
F-gases emissions in Portugal

Gas/Source	1990	2005	2015	2016	2017	2018	2019	2020	Change from 1990 to 2020
	kt CO2 eq.								%
Emissions of HFCs and PFCs - (kt CO_2 equivalent)	**NO,NA**	**1,057.59**	**2,819.28**	**2,956.54**	**3,139.50**	**3,261.79**	**3,396.95**	**3,357.60**	**100.00**
Emissions of HFCs - (kt CO_2 equivalent)	NO,NA	1054.29	2805.32	2941.14	3122.48	3242.71	3375.62	3333.82	100.00
HFC-23	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
HFC-32	NO,NA	0.03	0.15	0.16	0.18	0.20	0.21	0.23	100.00
HFC-41	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
HFC-43-10mee	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
HFC-125	NO,NA	0.07	0.28	0.30	0.32	0.34	0.36	0.37	100.00
HFC-134	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
HFC-134a	NO,NA	0.41	0.76	0.78	0.80	0.82	0.84	0.83	100.00
HFC-143	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
HFC-143a	NO,NA	0.04	0.13	0.13	0.14	0.14	0.15	0.14	100.00
HFC-152	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
HFC-152a	NO,NA	0.30	0.30	0.30	0.30	0.31	0.31	0.31	100.00
HFC-161	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
HFC-227ea	NO,NA	0.00	0.01	0.01	0.02	0.02	0.02	0.02	100.00
HFC-236cb	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
HFC-236ea	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
HFC-236fa	NO,NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
HFC-245ca	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
HFC-245fa	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
HFC-365mfc	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
Unspecified mix of HFCs (4) - (kt CO_2 equivalent)	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
Emissions of PFCs - (kt CO_2 equivalent)	NO,NA	3.31	13.96	15.40	17.02	19.08	21.33	23.78	100.00
CF_4	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
C_2F_6	NO,NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
C_3F_8	NO,NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
C_4F_{10}	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
c-C_4F_8	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
C_5F_{12}	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
C_6F_{14}	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
$C_{10}F_{18}$	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
c-C_3F_6	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
Unspecified mix of PFCs (4) - (kt CO_2 equivalent)	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
Unspecified mix of HFCs and PFCs - (kt CO_2 equivalent)	NO,NA	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	NO,NE	0.00
Emissions of SF_6 - (kt CO_2 equivalent)	NO,NA	26.63	23.18	23.62	25.55	23.79	24.09	22.88	100.00
SF_6	NO,NA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	100.00
Emissions of NF_3 - (kt CO_2 equivalent)	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00
NF_3	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.00

CO2 emissions

CO2 emissions in Portugal are mainly generated from fossil fuel combustion in energy-related activities (IPCC categories 1), as shown in the next figure.

Transports and energy industries are the primary sources of Portuguese GHG emissions, representing, respectively, 25.8% and 18.1% of total GHG emissions excluding LULUCF in year 2020. Manufacturing industries and construction is the third largest source within the Energy sector with 13.3% of total emissions in 2020. Other sectors which include residential, commercial/institutional, agriculture/forestry and fisheries (excluding bunkers) represents 8.0% of total emissions. Still with some impact on emissions in 2020, fugitive emissions from oil and natural gas arose with 1.9% of emissions.

Some other non-energy production processes such as cement production (included in category 2A), are also responsible for considerable quantities of CO2 emissions.

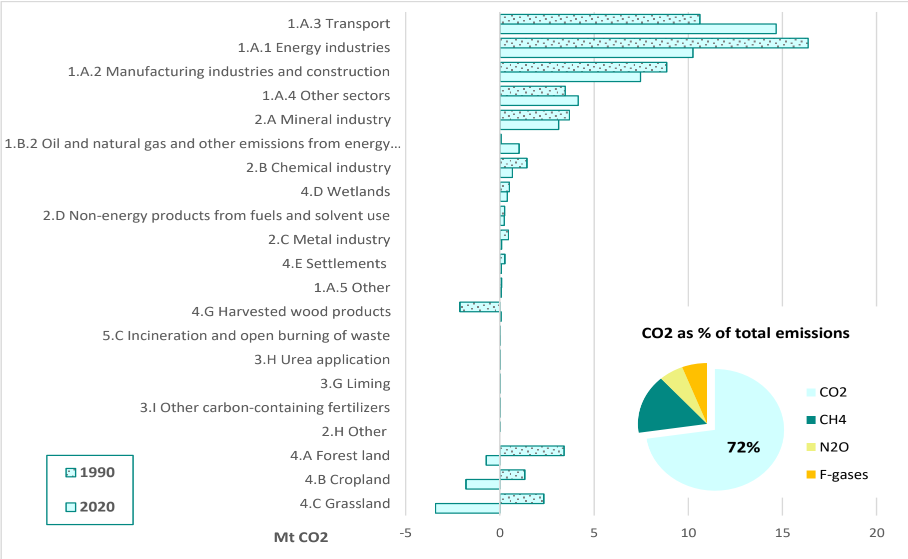


Figure 3.2.2

Source categories of CO_2: 1990, 2020 and per cent of total emissions in 2020.

Fossil fuel combustion in energy-related activities has been the major driving factor of the national emissions, reflecting the evolution of the Portuguese economy, which was characterized by a strong growth associated with increased energy demand and mobility during the 1990s. The oscillations in CO_2e emissions in the energy sector are mainly due to inter-annual variation in availability of hydropower. In recent years there has been a decreasing trend in emission resulting not only from a period of economic stagnation in Portugal but also from the implementation of measures that had a positive impact in the reduction of emissions, such as the introduction of lower carbon intensive fuels, the installation of combined cycle thermoelectric plants and co-generation units, and the use of renewable energy sources. Energy related emissions have decreased 5.2% from 1990 (base year) to 2020.

Emissions from transportation register the largest increase since 1990 (aprox. 4 Mt CO_2e. or 37%). Forest land and other land uses can also be a net source of CO_2 emissions, through land use conversion or wildfires, or a net sink for CO_2 when net additions of biomass occur. LULUCF categories have been estimated as a source or sink according to the years, with the occurrence of wildfires being the main factor explaining this change.

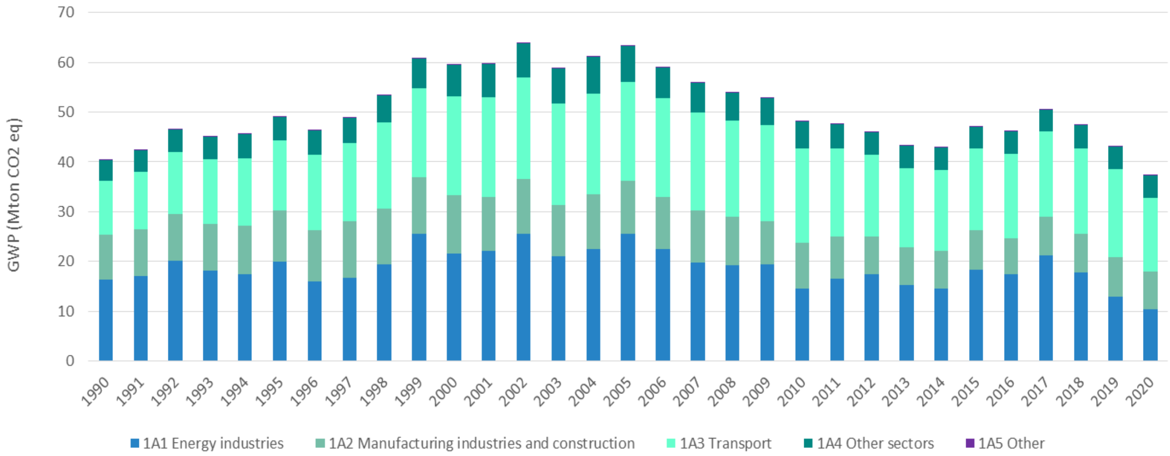


Figure 3.2.3 - Trend of total GHG emissions in source 1A, expressed as CO2e, by sub-sector.

CH4 emissions

CH4 is primarily generated through anaerobic decomposition of organic matter in biological systems, like enteric fermentation in animals, decomposition of municipal and animal waste and waste-water handling systems. Other sources are also responsible for these emissions, such as biomass burning, the distribution of natural gas and petroleum, and the incomplete combustion of fossil fuels (see next figure).

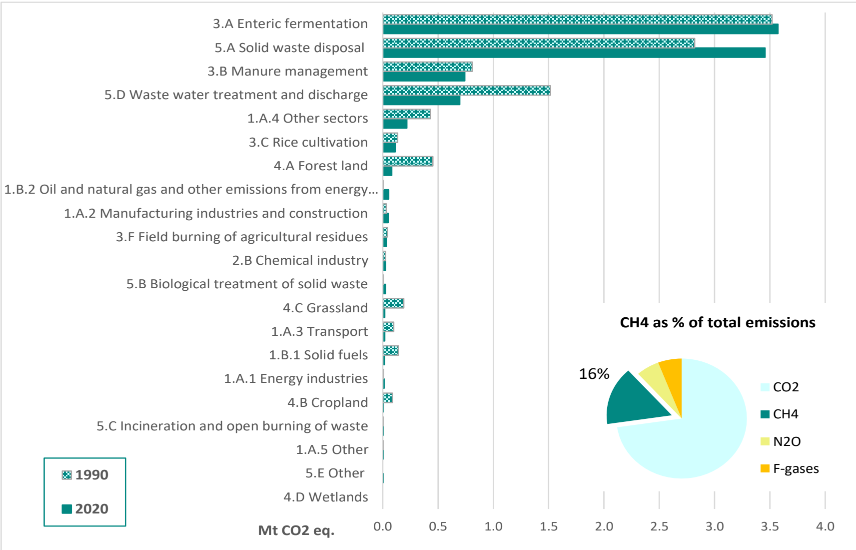


Figure 3.2.4

Source categories of CH_4: 1990, 2020 and percentage of total emissions in 2020.

Enteric fermentation is the largest source of CH4 emissions, representing, in 2020, 40% of total CH4 emissions. Emissions from this source reduced in the period 1990-2013 (-7%) but registered an increase of 9% since then. This increase is supported mainly by a significant increase in the population of non-dairy cattle and sheep.

The second largest source of CH4 emissions is solid waste deposition on land (landfilling), accounting for 38% of total CH4 emissions in 2020, and presents an increase of 23% since 1990. This increase, is closely related to the growth of waste generation driven by the change in consumption patterns associated with the steady economic growth during the 1990s and the change in the geographical distribution of the Portuguese population with a significant increase of the population living in urban centres. After 2004 there is a declining trend of these emissions associated to biogas recovery and the promotion of Mechanical and Biological Treatment, with the aim to divert urban waste from landfilling and the increase of recycling.

N2O emissions

N2O emissions are associated with direct and indirect emissions from agricultural soils, mainly related to the use of synthetic and manure fertilizers, manure deposition by livestock, nitrogen fixation by N-fixing crops (leguminous plants), and incorporation of crop residues into soils. Other significant sources are wastewater treatment, biomass burning (agricultural residues and residential combustion), and fossil fuel combustion particularly in the transport sector.

Agricultural soils represents the largest source, accounting for 68% of N2O emissions in 2020. The category presented a reduction of 2.3% since 1990, but registers annual fluctuations related to the variation of climatic conditions and crop production.

Emissions of the chemical industry (nitric acid production) reduced significantly (94%) since 1990, due to the implementation of BAT “catalytic N2O decomposition” in 2011.

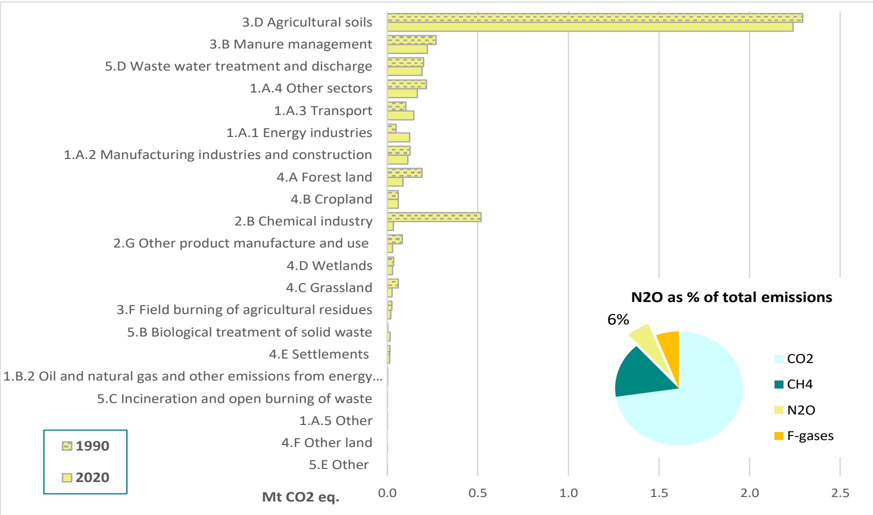


Figure 3.2.5

Source categories of N_2O: 1990, 2020 and percentage of total emissions in 2020.

F-gases emissions

Fluorinated gases have become increasingly important since 1995, driven by the gradual replacement of fluorinated gases as substitutes for substances that deplete the ozone layer in particular in refrigeration and air conditioning.

Figure 3.2.6
Source categories of F-gases: 1995, 2020 and percentage of total emissions in 2020.

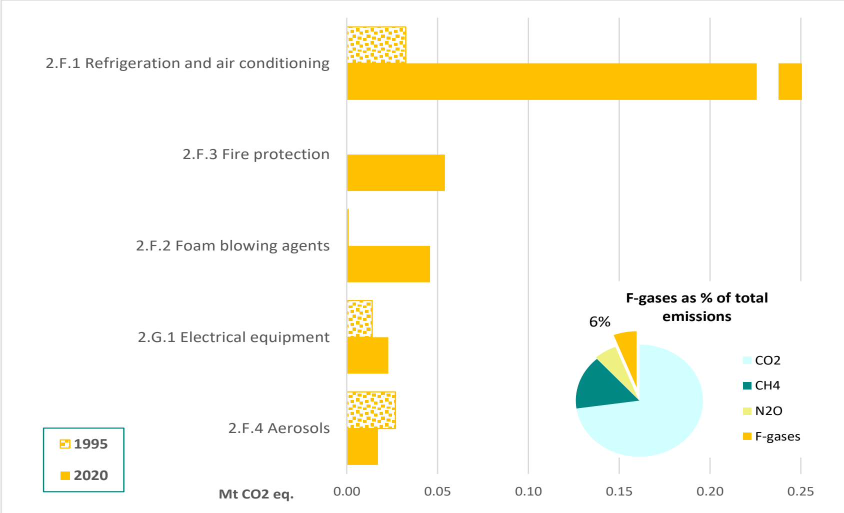
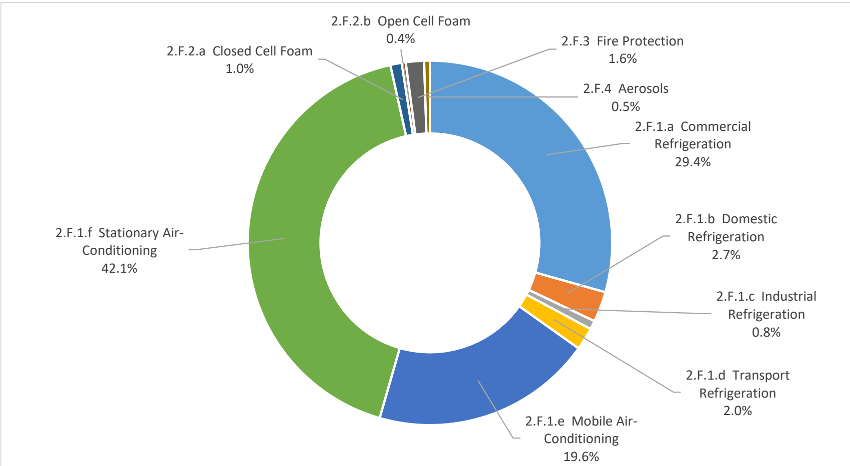


Figure 3.2.7
Consumption of Fluorinated Gases by source-categories in 2020.



GHG emissions by sector

Energy-related activities are the major sources of Portuguese GHG emissions. In 2020, the energy category accounted for 38.53 Mt CO2 eq., corresponding to 67% of the national GHG emissions.

Over the 1990-2020 period, energy emissions reduced 2.13 Mt CO2 eq. corresponding to a 5.2% decrease.

Since its peak which occurred in 2022, energy emissions decreased 25.9 Mt CO2 eq. corresponding to a 40% reduction.

Energy industries and transport are the two most important sources representing, respectively, around 18% and 26% of total emissions in 2020. Within the energy industries, public electricity and heat production amounted to 14% of the total emissions in 2020. This sector is nevertheless reducing its importance since 2017, due to both the effect of increased use of renewables in electricity generation and in particular to the shift from coal to natural gas in thermal energy production.

As the next figure shows, the peak of energy emissions occurred in 2002. The oscillations of emissions in this sector are mainly due to inter-annual variation of hydropower availability. In more recent years there has been a decreasing trend in emissions resulting not only from a period of economic stagnation but also as a result of the implementation of several measures that had a positive impact in the reduction of emissions, such as the introduction of lower carbon intensive fuels, the installation of combined cycle thermoelectric plants and co-generation units, and the use of renewable energy sources.

Total GHG emissions decreased 9.5% in 2020 as compared to 2019.

The year of 2020 was globally marked by the strong negative impact of the COVID-19 pandemic on national economy, which led to a strong contraction in the vast majority of the economic activity branches, leading in some cases to almost total paralysis.

The sector that most contributed to this downward trend is the energy sector, which globally presents a reduction in emissions of 13% compared to 2019. This variation is explained essentially by the decrease of emissions from electricity production, which registered a drop of 23.6% of the emissions compared to the previous year and a reduction of 16.4% compared to 2019 in transport. The decrease of emissions in this sector is also associated with the reduction in the refining of fuels and the drop in fugitive emissions due to the lower consumption of liquid fuels, namely in road transport.

With the exception of emissions from electricity production, whose decrease in 2020 is the result of the combined effect of the greater proportion of renewables in energy produced in Portugal (approximately 52.5% in 2020) and a 55% reduction in the use of coal in thermal production compared to 2019, the decline of emissions in the energy sector is mostly related to the consequences of the COVID-19 pandemic outbreak on the activity of companies and individuals.

Figure 3.2.8 - GHG emissions and removals by sector.

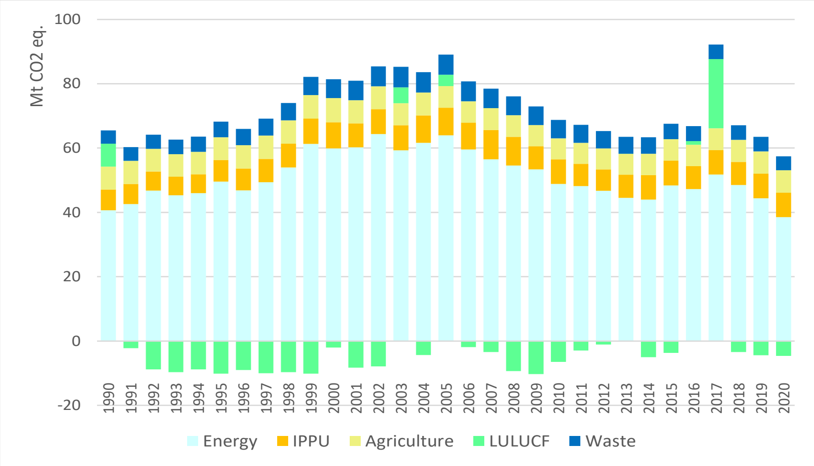


Table 3.2.6:
GHG emissions and removals in Portugal by sector

GHGs SOURCE AND SINK	1990	2005	2015	2016	2017	2018	2019	2020	Change from 1990 to 2020
CATEGORIES	CO₂ equivalent (Gg)								
1. Energy	40,661	63,983	48,384	47,223	51,781	48,482	44,415	38,532	**-5.2**
2. Industrial processes and product use	6,442	8,593	7,694	7,142	7,608	7,245	7,622	7,580	**17.7**
3. Agriculture	7,142	6,721	6,667	6,694	6,794	6,865	6,936	6,990	**-2.1**
4. Land use, land-use change and forestry	7,127	3,503	-3,708	1,104	21,454	-3,428	-4,432	-4,646	**-165.2**
5. Waste	4,554	6,463	4,887	4,727	4,661	4,579	4,569	4,421	**-2.9**
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	**NO**

The Industrial Processes and Product Use (IPPU) sector was responsible for 13% of the Portuguese emissions in 2020, presenting an increase of 18% compared to 1990. These emissions, which result from the chemical and physical transformation of raw materials in industrial transformation processes, have been driven particularly until the mid-2000s by the evolution of the mineral and chemical industry.

This sector also includes emissions of fluorinated compounds (HFC, PFC and SF6) that are used in different applications - not solely industrial, but also in domestic and services sector - as substitutes to ozone depleting substances (ODS). The increase of emissions in more recent years is related to a large extent to the increase of emissions of fluorinated gases, in particular with the subsectors of stationary air conditioning and commercial refrigeration.

Agriculture was, in the period analysed, a significant source of GHG emissions, responsible for 12% of the Portuguese emissions in 2020, corresponding to a decrease of 2% since 1990. This fact is related to the reduction in the livestock production of certain categories of animals (sheep and swine) and more recently of dairy cattle. Furthermore, the extensification of bovine (non-dairy cattle) production and the decreased consumption of fertilizers which relates in a certain extent to the conversion of arable crops to pasture also contributes to this trend. However, since the mid-2000s, in particular after 2011, this downward trend was reversed, registering since then a growing tendency (+ 7.5% emissions variation from 2011-2020), supported mainly by a significant increase in the population of non-dairy cattle, sheep and poultry.

Overall estimates of emissions and sinks from land use change and forestry category (LULUCF) show a considerable inter-annual variability, changing from a net emitter to a carbon sink according to the years. In the period 1990-2020, the LULUCF sector was estimated as a net-emitter for 6 years. The highest net-emission occurred in 2017 (+21.5 $MtCO_2eq$) and the highest net-sequestration occurred in 2009 (-10.3 $MtCO_2eq$). In 2020 the LULUCF sector emissions and removals are estimated as a net-sink of -4.6 $MtCO_2eq$.

The main contributors for the observed inter-annual variations are wildfires, largely driven by changes in weather patterns from year to year. 2017 was particularly hard hit by fires, and a record high value of 558kha of burnt area was achieved (6% of the country).

Waste represented approximately 8% of Portuguese emissions in 2020 and decreased 2.9% since 1990. The sector recorded, however, an expressive increase of emissions until 2004 (more than 50%) and presents a general downward trend since then. This increase is primarily related to the rise of waste generation (associated with the development of household income and the growth of urbanization recorded in the country during the 1990s) and the deposition of waste predominantly in landfills. The reduction in emissions in more recent years is associated to biogas recovery in waste and wastewater treatment systems, and the promotion of Mechanical and Biological Treatment, with the aim to divert urban waste from landfilling and the increase of recycling.

Indirect GHG and SO_2 emissions

Several gases do not have a direct influence in climate change but affect the formation or destruction of other GHG. CO, NO_x, and NMVOC are precursor substances for ozone which is a GHG. SO_x produce aerosols, which are extremely small particles or liquid droplets that can also affect the absorptive characteristics of the atmosphere.

In 2020, emissions from all these gases have decreased compared to 1990 levels: SO_2 -88.0 %, CO -67.1 %, NO_x -48.4 %t and NMVOC -36.4 %. The energy sector is the major responsible for emissions of NO_x, SO_2 and CO. Its contribution for NMVOC emissions is also significant, together with IPPU sector.

Within energy, transportation is responsible for the largest share of NO_x emissions, approx. 44% of 2020 totals. Despite the fast growing trends of the transport sector (mainly road) since the 90s, the introduction of new petrol-engine passenger cars with catalysts converters and stricter regulations on diesel vehicles emissions, resulted in the limitation of the growth of these emissions or even in their decrease. In fact, the situation started to shift in the mid-2000s, as transport emissions growth has first stabilized and started to decline since 2005. In the most recent years, the situation has been inversed with an increase of emissions after 2013. In the reporting period, 1990-2020, NO_x emissions from transport decreased 45%; and CO and NMVOC emissions registered reductions of more than 80%. Other sectors (commercial/institutional, residential and agriculture/forestry) is a primary source of CO emissions representing approx. 40% of the 2020 totals.

SO2 emissions are mainly generated in the energy industry sector (approximately 30% of total emissions in 2020) and combustion in manufacturing industries (approximately 43% of total emissions in 2020), which are major consumers of fossil fuels. In the past, oil and coal represented the biggest share of the fuel mix used in thermal electrical production in the country. The situation shifted along the years with the significant development of renewable sources and its greater importance in electrical production, and the introduction of new stricter laws regulating the residual fuel oil[34]. The introduction of natural gas and its increasing use since 1997 was a major step in the control of SO2 emissions. In 2020, natural gas represented the main fuel used in electric thermal generation.

The emissions variation in the period 1990-2020 shows in fact a decrease in SOx emissions in both sub-categories: energy industries and manufacturing industries -94% and -79%. Since 2007, SOx emissions from the energy industries registered a significant reduction (approximately 89%) which is explained by the implementation of two new abatement systems (desulfurization in two Large Point Source Energy Plants in Mainland Portugal).

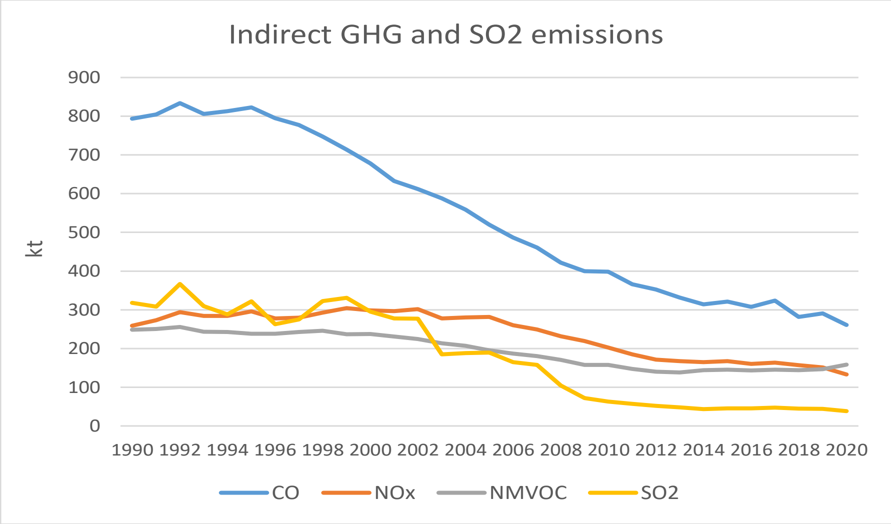
The reduction of all indirect gas emissions in 2020 compared to 2019 is the result of the impact of the COVID-19 pandemic outbreak on the national economy and the population activity, leading in particular to a significant decrease of emissions in transport (more than 20%).
The decline in emissions in electricity production in 2020 compared to the previous year (-17% SOx) is the result of the 55% reduction in the use of coal in thermal production in view of the closure of the two Portuguese coal plants until the end of 2021, and the greater proportion of the renewable domestic production in 2020, due in particular to a more favourable hydraulic availability (IH = 0.97) and a higher hydroelectric production (+33%), and an increase of biomass use in electricity production (+29%).

Table 3.2.7
Indirect GHG and SO2 emissions: 1990-2020

Gas	1990	2005	2015	2016	2017	2018	2019	2020	Change from 1990 to 2020
			(Gg)						
CO	793	520	322	308	324	282	291	261	**-67.1**
NOx	259	282	168	161	164	157	151	133	**-48.4**
NMVOC	249	195	146	143	145	144	147	158	**-36.4**
SO2	318	190	46	46	47	45	44	38	**-88.0**

[34] Decree-Law 281/2000, of 10th November

Figure 3.2.9 - Indirect GHG and SO2 emissions.



Descriptive Summary of GHG emissions and removals in the Autonomous Regions of Madeira and the Azores

Autonomous Region of Madeira

In 2020, ARM GHG emissions, without land-use, land-use change and forestry (LULUCF) were estimated at around 0,941 Mt CO2eq. When considering the LULUCF sector, that was responsible for an aditional emission of about 0,138 Mt CO2eq., the total liquid GHG emission for ARM totalled 1,079 Mt CO2eq, corresponding to a 54,8% increase in relation to 1990 and a variation of -10,7% from 2019 to 2020.

In the RAM (figure 3.2.1.a), CO_2 represents nearly 92% of the regional GHG emissions and is also the one that grew the most (+92 % since 1990, having thus increased its weight in the total emissions. The least expressive gas is N2O, representing nearly 3% of emissions.

Comparing with national totals, ARM represents about 2,04% of total emissions (1,78% escluding LULUCF). The emission profile is, however, quite distinct, with a predominance from the energy sector in ARM, and almost with a total absence of industrial processes and product use. These sectorial differences have also meaning in the gas emission profile, being the total weight of CO2 substancially higher than the national total. In the RAM, the energy sector is the main responsible for the CO2 emission and the waste sector is the main responsible for CH4 emissions.

Autonomous Region of Azores

In 2020, ARA GHG emissions were estimated at around 1.72 Mt $CO_{2eq.}$, with the Land Use and Forestry sector being responsible for a net sequestration of about 0.016 Mt $CO_{2eq.}$, which puts the net emissions of the ARA at 1.70 Mt CO_{2eq}. These total emissions without Land Use and Forestry represent a decrease of 5.2% compared to the previous year. These values are 54.4% above those estimated for 1990.

The emissions profile by sector remains reasonably stable, with the Energy sector accounting for 49.2% of emissions. The Agriculture sector is the one that grew the most (+88.2% since 1990) and consequently increased its weight in total emissions.

The weight of the sequestration of the Land Use and Forestry Sector in the total of other emissions has been decreasing until 2020, more due to the growth observed in total emissions than to changes in the sink capacity of the ARA, which has remained reasonably stable in most of the years.

The greenhouse gas emissions profile also remains reasonably stable, with Carbon Dioxide (CO_2) representing 49.2% of emissions. The least expressive gas is Nitrous Oxide (N_2O), which represents about 12.2% of emissions. The Energy sector is primarily responsible for CO_2 emissions, while the Agriculture and Waste sectors are responsible for almost all CH_4 and N_2O emissions.

National Inventory Arrangements (3.3)

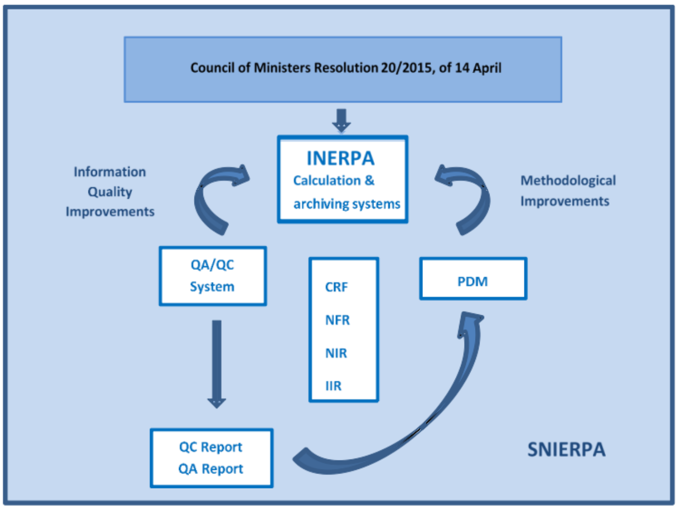
National Inventory System

The national inventory system and the institutional arrangements have not changed since the 7th National Communication and 4th Biennial Report to the UNFCCC.

The legal framework for the Portuguese Inventory System[35] was adopted in 2015. The 2015 Council of Ministers Resolution, restructures and elaborates the previous legal framework on the National System (SNIERPA), specifying its 4 different components:

i. a calculation and archiving system of the national inventory;
ii. the QA\QC System;
iii. the Methodological development Plan (PDM);
iv. the Archiving System.

Figure 3.3.1 - SNIERPA's main elements relations



[35] Council of Ministers Resolution No.20/2015

Furthermore, it identifies the several outputs and formats of reporting to the international bodies, and specifies the functions of the entities making part of SNIERPA:

i. the coordinating entity;
ii. the sectorial focal points;
iii. the entities involved.

The APA, is the coordinating entity responsible for: the overall coordination and updating of the National Emissions Inventory (INERPA); the inventory's approval, after consulting the focal points and the involved entities; and its submission to the European Commission, the UNFCCC and other international bodies under which Portugal has legal reporting obligations, in the several communication and information formats, thus ensuring compliance with the adopted requirements and directives.

APA´s Climate Change Department (DCLIMA) is responsible for the general administration of the inventory and for all aspects related to its compilation, reporting and quality management. In the beginning of 2020, DCLIMA was restructured[36]. The Division for Adaptation and Monitoring (DAM) that was responsible for the National Inventory was extinguished and replaced by the International Inventory and Strategy Division (DIEI), which is now responsible for the coordination of the National Inventory System (SNIERPA) and the annual compilation of the inventories. However, it should be noted that the reorganisation of DCLIMA did not change the previous competences and arrangements regarding the inventory.

Data from different sources is collected and processed by the inventory team, who is also responsible for the application of QA/QC procedures, the assessment of uncertainty and key category analysis, the compilation of the CRF tables and the preparation of the NIR, the response to the review processes and data archiving and documentation.

The sectorial focal points work with APA/DCLIMA in the preparation of INERPA, and are responsible for fostering intra and inter-sectorial cooperation to ensure a more efficient use of resources. Their main task includes coordinating the work and participation of the relevant sectorial entities over which it has jurisdiction. It is also the Focal Points duty to provide expert advice on methodological choice, emission factor determination and accuracy of the activity data used. Focal Points play a vital role in sectorial quality assurance and methodological development. They are also responsible for the production of statistical information and data publication that are used in the inventory estimates.

The involved entities are public or private bodies which generate or hold information which is relevant to the INERPA, and which actions are subordinate to the Focal Points or directly to the Responsible Body. All governmental entities have the responsibility to ensure, at a minimum, co-funding of the investment needed to ensure the accuracy, completeness and reliability of the emissions inventory.

Following the publication of the Council of Ministers Resolution No. 20/2015 of 14 April, which restructured the SNIERPA, a set of implementing procedures were agreed within SNIERPA to

[36] Deliberação n.º 498/2020, 21 de abril de 2020, Diário da República, 2ª Série, Parte C, No. 78

facilitate the good functioning of the national system, defining in more detail some competences, such as the regularity of the meetings and the deadlines for the information´ transmission, among other issues.

More details on the institutional arrangements can be found in the Portuguese 2022 National Inventory Report on Greenhouse Gases, 1990 – 2020, section 1.2 Institutional arrangements for inventory preparation, available at https://apambiente.pt/sites/default/files/_Clima/Inventarios/20221025NIR2022JulyCorrigendum.pdf .

National Registry

This section of the National Communication summarises the national registry of Portugal. Further details can be found in Chapter 14 of the Portuguese NIR.

Directive 2009/29/EC adopted in 2009, provides for the centralization of the EU ETS operations into a single European Union registry operated by the European Commission as well as for the inclusion of the aviation sector. At the same time, and with a view to increasing efficiency in the operations of their respective national registries, the EU Member States who are also Parties to the Kyoto Protocol (26) plus Iceland, Liechtenstein and Norway decided to operate their registries in a consolidated manner in accordance with all relevant decisions applicable to the establishment of Party registries - in particular Decision 13/CMP.1 and Decision 24/CP.8.

The consolidated platform which implements the national registries in a consolidated manner (including the registry of the EU) is called the Union registry and was developed together with the new EU registry on the basis the following modalities:

- Each Party retains its organization designated as its registry administrator to maintain the national registry of that Party and remains responsible for all the obligations of Parties that are to be fulfilled through registries;
- Each Kyoto unit issued by the Parties in such a consolidated system is issued by one of the constituent Parties and continues to carry the Party of origin identifier in its unique serial number;
- Each Party retains its own set of national accounts as required by paragraph 21 of the Annex to Decision 15/CMP.1. Each account within a national registry keeps a unique account number comprising the identifier of the Party and a unique number within the Party where the account is maintained;
- Kyoto transactions continue to be forwarded to and checked by the UNFCCC Independent Transaction Log (ITL), which remains responsible for verifying the accuracy and validity of those transactions;
- The transaction log and registries continue to reconcile their data with each other in order to ensure data consistency and facilitate the automated checks of the ITL;
- The requirements of paragraphs 44 to 48 of the Annex to Decision 13/CMP.1 concerning making nonconfidential information accessible to the public is fulfilled by each Party through a publicly available web page hosted by the Union registry;
- All registries reside on a consolidated IT platform sharing the same infrastructure technologies. The chosen architecture implements modalities to ensure that the

consolidated national registries are uniquely identifiable, protected and distinguishable from each other, notably:

- With regards to the data exchange, each national registry connects to the ITL directly and establishes a secure communication link through a consolidated communication channel (VPN tunnel);
- The ITL remains responsible for authenticating the national registries and takes the full and final record of all transactions involving Kyoto units and other administrative processes such that those actions cannot be disputed or repudiated;
- With regards to the data storage, the consolidated platform continues to guarantee that data is kept confidential and protected against unauthorized manipulation;
- The data storage architecture also ensures that the data pertaining to a national registry are distinguishable and uniquely identifiable from the data pertaining to other consolidated national registries;
- In addition, each consolidated national registry keeps a distinct user access entry point (URL) and a distinct set of authorisation and configuration rules.

The following changes to the national registry have occurred since the last National Communication report.

Table 3.3.1

Reporting Item	Description
15/CMP.1 Annex II.E paragraph 32.(a) Change of name or contact	No change of name and contact occurred during the reported period.
15/CMP.1 Annex II.E paragraph 32.(b) Change regarding cooperation arrangement	There was a change in the cooperation arrangement during the reported period as the United Kingdom of Great Britain and Northern Ireland no longer operate their registry in a consolidated manner within the Consolidated System of EU registries.
15/CMP.1 Annex II.E paragraph 32.(c) Change to database structure or the capacity of national registry	The registry has been updated to version 13.5.2. No changes were applied to the database. No change was required to the application backup plan or to the disaster recovery plan. No change to the capacity of the national registry occurred during the reported period.
15/CMP.1 Annex II.E paragraph 32.(d) Change regarding conformance to technical standards	Each release of the registry is subject to both regression testing and tests related to new functionality. These tests also include thorough testing against the DES and were successfully carried out prior to each release of a new version in Production. Annex H testing is carried out every year. No other change in the registry's conformance to the technical standards occurred for the reported period.
15/CMP.1 Annex II.E paragraph 32.(e) Change to discrepancies procedures	No change of discrepancies procedures occurred during the reported period.
15/CMP.1 Annex II.E paragraph 32.(f) Change regarding security	The mandatory use of hardware tokens for authentication and signature was introduced for registry administrators. In 2020, the use of soft tokens for authentication and signature was introduced for the registry end users.
15/CMP.1 Annex II.E paragraph 32.(g) Change to list of publicly available information	Publicly available information is provided via the Union registry homepage[37].

[37] e.g.: https://ets-registry.webgate.ec.europa.eu/euregistry/PT/public/reports/publicReports.xhtml.

15/CMP.1 Annex II.E paragraph 32.(h) Change of Internet address	No change of the registry internet address occurred during the reporting period.
15/CMP.1 Annex II.E paragraph 32.(i) Change regarding data integrity measures	No change of data integrity measures occurred during the reporting period.
15/CMP.1 Annex II.E paragraph 32.(j) Change regarding test results	Both regression testing and tests on the new functionality are carried out prior to release of the new versions in Production. The site acceptance tests are carried out by quality assurance consultants on behalf of and assisted by the European Commission.

Policies and Measures (4)

Policymaking Process (4.1)

Key strategies, objectives and targets

In 2010, the EU submitted a pledge to reduce its GHG emissions by 2020 by 20% compared to 1990 levels. Portugal as an EU Member State is a part of the EU 2020 emission reduction target.

Implementation of this target is ensured by EU legislation adopted under the "2020 climate and energy package" (2013-2020). The package introduced a clear approach to achieving the EU's 20% reduction of total GHG emissions from 1990 levels, which is equivalent to a 14% reduction compared to 2005 levels. This 14% reduction objective is divided between the EU emissions trading system (ETS) and Effort Sharing Decision (ESD) sectors. These two sub-targets are:

- a 21% reduction target compared to 2005 for emissions covered by the ETS (including outgoing flights);
- a 10% reduction target compared to 2005 for ESD sectors, shared between the 28 Member States (MS) through individual national GHG targets.

While the EU ETS target is to be achieved by the EU as a whole, the ESD target was divided into national targets to be achieved individually by each Member State. Under the Effort Sharing Decision, national emission targets for 2020 are set, expressed as percentage changes from 2005 levels. For Portugal this means a +1% target compared to 2005 levels.

Within the scope of the climate and Energy Package for 2020, this emission reduction target was coupled with the establishment of EU targets of 20% share of renewable energy in final energy consumption (Portugal's contribution to this amounts to a 31% share of renewables in its final energy consumption) and an increase in energy efficiency by 20% (the same objective applies to Portugal and to all other Member States).

A further target has been pledged under the Paris Agreement through the EU's Nationally Determined Contribution, and has been adopted by the EU under the 2030 Climate and Energy Framework (2021-2030). The emission reduction target was a pledge to reduce emissions by at least 40% (compared to 1990 levels) by 2030, enabling the EU to move towards a low-carbon economy and implement its commitments under the Paris Agreement. In order to achieve this target:

- ETS sectors will have to cut emissions by 43% (compared to 2005) by 2030;
- Effort Sharing sectors will need to cut emissions by 30% (compared to 2005) by 2030 – this has been translated into individual binding targets for Member States (for Portugal the target is a reduction of 17% compared to 2005 levels);
- Emissions and removals from the LULUCF sector are included for the first time in the EU climate target through the so-called LULUCF Regulation (2018/841). Each Member State will have to ensure that the LULUCF sector does not create debits ("no debit" rule).

Separate targets on renewable energy and energy efficiency had been set under the 2030 Climate and Energy Framework and updated. For renewable energy a binding target of at least 32% of final energy consumption by 2030 has been set (Portugal committed to a 47% share of renewables in its gross final energy consumption). With regards to energy efficiency it is a headline target of at least 32.5% of final energy efficiency, expressed in primary or final energy consumption (Portugal committed to a 35% reduction in primary energy consumption, as result of an increase in energy efficiency). A target of 15% of interconnection capacity for electricity interconnections, so as to ensure the full participation of all Member States in the integration of the internal energy market (Portugal committed to the same target). These targets are defined in the National Energy and Climate Plan (see below more information).

With the approval of the European Climate Law in 2021 the GEE emission reduction target was revised and a new target was set for 2030, a net reduction of GHG emissions of at least 55% (in relation to 1990 levels). The EU also pledged for carbon neutrality by 2050 in order to contribute to the Paris Agreement objectives and goals.

Since then the European Commission as presented a package, the Fit for 55%, to adapt the current legislations to this new objectives. The revision embraces not only the ESR, ETS and LULUCF framework, but also several other sectorial legislation like renewable energy, energy efficiency, energy performance in buildings, CO2 cars and vans standards, deployment of alternative fuels infrastructure, among others. The overall package is still under negotiation but there was already an agreement on the Effort-Sharing Regulation and the revised contribution expected from Portugal in 2030 will increase from -17% to -28,7% (compared to 2005).

In order to respond to these objectives and goals, Portugal has for many years now a range of strategic documents in the field of climate change mitigation.

The National Program for Climate Change (PNAC 2020/2030)[38], approved in 2015, established a set of sectoral targets and listed a set of policy options and measures to deliver an emission reduction of -18% to -23% by 2020 and of -30% to -40%, by 2030 compared to 2005.

In response to the commitment assumed by Portugal in 2016, to achieve net-zero emissions by the end of 2050, the Carbon Neutrality Roadmap 2050 (RNC 2050)[39] was adopted. It identifies the main decarbonisation vectors in all sectors (energy and industry, mobility and transport, waste and wastewater and agriculture and forests) and the path to reduce emissions of the all economy in order to achieve net zero in 2050, under different scenarios of socio-economic development.

RNC 2050 is the Portuguese Long-term Strategy and was submitted to the UNFCCC, in accordance with the Paris Agreement, on the 20th of September 2019, and to the European Commission, to comply with the EU Energy Union and Climate Action Governance Regulation. It is a forward-looking document of where to go, contributing to the definition of trajectories, not a policy and measures planning document.

Under the RNC 2050 Portugal revised its previous 2030 target (-30 to -40%) to -45% to -55% by 2030. Additionally, a trajectory up to 2050 was established comprising emission reductions of -65% to -75% by 2040, and from -85% to -90% by 2050 compared to 2005.

[38] Approved by the Resolution of the Council of Ministers No. 56/2015, of July 30th
[39] Approved by the Council of Ministers through the Resolution No. 107/2019 of July 1st

Aligned with the long-term strategy Portugal also developed an integrated National Energy and Climate Plan (NECP 2030), that is the main instrument of energy and climate policy for the 2021-2030 decade.. The final NECP was submitted to the European Commission in December 2019, in accordance with EU Energy Union and Climate Action Governance Regulation. All EU Member States NECPs, including Portugal's, are publicly available at https://energy.ec.europa.eu/topics/energy-strategy/national-energy-and-climate-plans-necps_en#final-necps

While maintaining the targets established under PNAC for 2020, the National Energy and Climate Plan (NECP 2030)[40], identifies the main priority areas of action for the next decade, seting ambitious targets for the 2030 horizon concerning the reduction of GHG emissions (45% to 55%, compared to 2005 – already driven by the RNC2050), the incorporation of renewable energies (47%), the energy efficiency (35%) and electricity interconnections (15%) and sets the policies and measures for an effective application of the vision and trajectories foreseen in the RNC2050. It also revises the sectorial targets set for 2030 in the PNAC 2020/2030 and revokes it with effect from January 1, 2021.

The Portuguese Climate Law, which came into force on February 1, 2022, recognizes the climate emergency situation, confirms and reinforces the national commitment to achieve climate neutrality by 2050 and stipulates the study, by 2025, of the anticipation of this target to 2045. It also establishes national emission reduction targets, in line with previously established trajectories, stipulating a reduction of at least -55% by 2030; 65% to -75% by 2040; at least -90% by 2050; and a net CO2 eq sink of the LULUCF sector by at least 13 million tonnes between 2045 and 2050.

The National Climate Law introduces new elements to reinforce climate governance as well as policies and actions, in a very demanding timeframe, reflecting the acknowledgement of the need for urgent enhanced climate action. It establishes the reinforcement os sectorial and regional/local climate action plans, and enhanced transparency and participation, including by:

a) creation of a climate action portal;

b) development of municipal and regional climate action plans (both on mitigation and adaptation);

c) development of sectoral mitigation and adaptation plans;

d) additional monitoring and reporting processes (including in the national budget);

e) introduction of the climate legislative impact assessment;

f) integration of climate risks in the decision-making of public and private institutions and agents.

The Portuguese Climate Law also reinforced the public participation on the development and review of climate policy instruments, including a focus on the organization of information sessions and debates, and for the improvement of the accessibility to clear and systematic information.

[40] Approved by the Resolution of the Council of Ministers No. 53/2020, of July 10th

Autonomous Region of Azores

The Autonomous Region of Azores, in 2011, approved the Regional Strategy for Climate Change (ERAC)[41] focused on both mitigation and adaptation issues. In order to operationalize the ERAC, the Azores Regional Government approved, in 2019, the Regional Programme for Climate Change (PRAC)[42]. The Autonomous Region of Azores is currently preparing the regional roadmap for carbon neutrality by 2050.

On what concerns mitigation issues, the PRAC establishes sectoral evolution scenarios for 2030 in order to carry out the exercise of projection of GHG emissions for scenarios developed for the following sectors of activity: energy, industry, mobility and transport, agriculture, forest and land uses, waste and wastewater, and identifies the policy and measures options to achieve the emissions' reduction target of up to about 340 ktCO2eq in 2030 considering the 2 established GHG emission projection scenarios (high projection and low projection). Based on the latest Regional Inventory of Greenhouse Gas Emission, this target corresponds to a 31% reduction of regional CO2e emissions (without LULUCF) between 1990 and 2030.

Autonomous Region of Madeira

The Autonomous Region of Madeira, in 2015, approved the Regional Climate Change Adaptation Strategy (Estratégia CLIMA-Madeira), focused only in the adaptation issues. Also in 2015, the ARM joined the Under 2 Coalition, a sub-national internationl agreement towards climate action, focusing primarily in mitigation, but also in adaptation.

In summary:

Table 4.1.1
Portugal's targets for 2020

Targets 2020	National Contributions for the Union Targets	Other National Targets
Reduction of CO2e emissions (without LULUCF) (Mt CO2e), compared to 2005	+1%	-18% a - 23%
Strengthen the share of Renewable Energy (% of gross final energy consumption)	+31%	
Increase Energy Efficiency (% reduction in primary energy consumption)	+20% (-25%)	

Table 4.1.2.
Portugal national targets for 2030

Targets 2030	National Contributions for the Union Targets	Other National Targets
Reduction of CO2e emissions (without LULUCF) (Mt CO2e), compared to 2005	-28,7%	-55%
Strengthen the share of Renewable Energy (% of gross final energy consumption)	47% (20% target on transport) (80% target on electricity prodution) (49% target on Heating and cooling)	
% reduction in primary energy consumption (Increase Energy Efficiency, excluding non-energetic uses) Energy Savings (article 7th of Directive EU 2018/2002)	35% 6,7 Mtep	
Electricity Interconnections	15%	

[41] Resolution of the Government Council (RGC) nº123/2011, of October 19th
[42] Regional Legislative Decree nº30/2019/A, of November the 28th

Table 4.1.3.
National sectoral targets (non-EU ETS)

Sectoral GHG Reduction Targets	2020	2030
Services	-65%	-70%
Residential	-14%	-35%
Transports	-14%	-40%
Agriculture	-8%	-11%
Waste and Wastewater	-14%	-30%

Following the approval of the Fit for 55% package, and also taking in consideration the energy crises derived from the war in Ukraine, that showed the need to speed up the energy transition and the deployment of endogenous renewable energy in order to reduce the EU dependence on Russian fossil-fuel products, Portugal started the revision of the national Carbon Neutrality Roadmap (2050) and the National Energy and Climate Plan (2030), work that is ongoing.

Governance for climate mitigation policy

As explained under the section GOVERNMENT STRUCTURE (2.1), the member of the government responsible for the climate mitigation policies is the Minister for Environment and Climate Action (MAAC). Currently, and since October 2018, energy issues are also within the remit of the same Ministry. Furthermore, the mission of the MAAC is to propose, manage, execute and evaluate policies in the areas of environment, urban, suburban and road passenger transport, mobility, climate, forestry, nature conservation, animal welfare, energy, geology and forests, in a development perspective sustainability and social and territorial cohesion, as well as planning in matters within its competence, including the shoreline and rural areas.

The APA remains under the MAAC, and it also retains the competence to propose, develop and monitor the implementation of environmental policies, notably in the fight against climate change, an area for which the MAAC is directly responsible.

In 2016, it was established that a single environmental fund should be created by aggregating resources from existing funds, so as to obtain an instrument with greater financial capacity and more adaptability to challenges. The Environmental Fund (FA) was therefore set with effect from 1st January 2017, thus terminating the FPC, the Environmental Action Fund, the Fund for the Protection of Water Resources and the Fund for the Conservation of Nature and Biodiversity.

As a consequence, the FA takes up all responsibilities inherent to the former funds, aiming to support environmental policies in order to achieve the sustainable development goals, thus helping to meet national and international objectives and commitments, including those related to climate change, water resources, waste and conservation of nature and biodiversity.

In order to address the emerging challenges associated with the commitment to achieving carbon neutrality by 2050, the FA was subject to an amendment to reinforce the role of this financial instrument in pursuing national and international objectives and commitments (such as the Paris Agreement) in several areas of his activity. The Environmental Fund is under the direct responsibility of the MAAC and its day-to-day management is performed by the Secretary General of the MAAC.

The political commitment placed on the transition to a competitive, resilient, low-carbon and circular economy, in a context of full integration with the economic growth objectives, led to the creation in 2015, of the Interministerial Commission on Air, Climate Change and the Circular Economy, in the meanwhile renamed Commission for Climate Action.

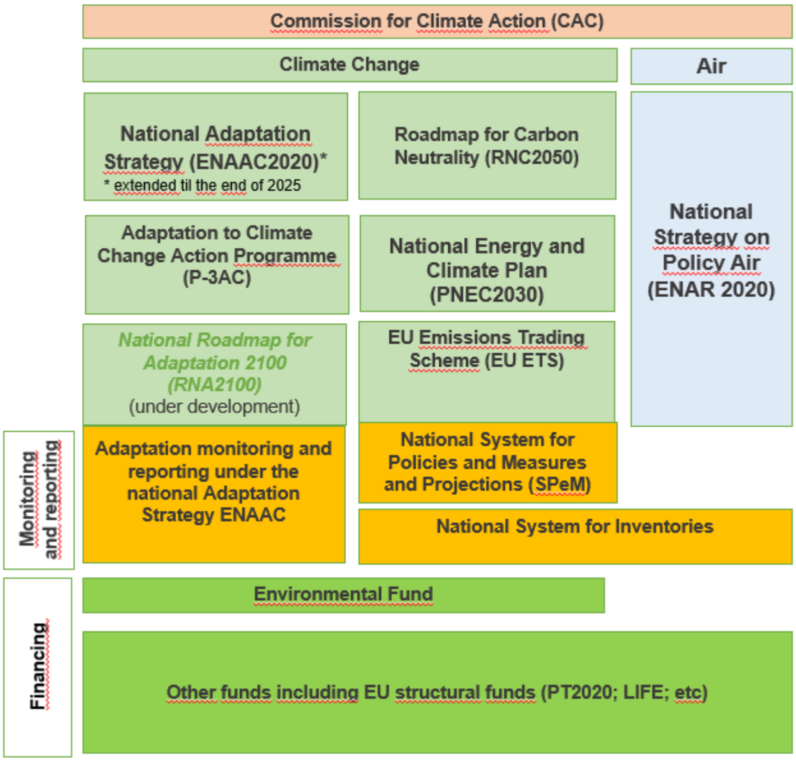


Figure 4.1.1.
Portuguese Climate Change Policy Architecture

The Commission is chaired by member of the Government responsible for the environment and climate action and is integrated by the government departments of energy, spatial planning, finance, agriculture, sea, economy and innovation, transport, health, tourism, civil protection, regional development, local administration, foreign affairs and cooperation, education and science and by representatives of the regional governments of Azores and Madeira.

The Commission for Climate Action[43], provides policy guidance on climate change and air quality issues. It is also responsible for promoting the articulation and integration of climate change policies, sectorial policies and monitor the implementation of relevant sectorial measures, programs and relevant sectorial measures, programs and actions that may be adopted, especially through the national system for policies and measures and projections (SPeM), also created in 2015.

[43] Created by the Resolution of the Council of Ministers No 56/2015, of 30th July

The National System for Policies and Measures and Projections (SPeM)[44], aims to foster the evaluation of progress in the implementation of sectoral policies and mitigation measures, enhancing the involvement and strengthening the accountability of sectors in the integration the climate dimension in sectorial policies, ensuring:

- The management of the process of identifying and designing policies and measures, or groups of policies and measures, to limit or reduce GHG emissions and other air pollutants by sources, or to intensify their removals by sinks, in compliance with national obligations;
- The monitoring and reporting of the implementation of policies and measures and their effects, as well as the reporting of projections in accordance with the European and international requirements and guidelines, and ensure its coherence with the national inventory of anthropogenic emissions by sources and removal by sinks of atmospheric pollutants (INERPA);
- The preparation of national projections of GHG emissions and other air pollutants by sources and their removals by sinks, as well as the expected effects of the policies and measures being implemented and to be implemented, in accordance with the European and international requirements and guidelines, in conjunction with INERPA;
- The assessment of compliance with national obligations, including sectoral targets under the climate and energy package of the European Union and the air quality targets, in the horizons of 2020, 2025 and 2030, as set out in the national strategic documents for climate change and air quality.

The Council of Ministers Resolution, which approved the SPeM includes the institutional, legal and procedural provisions applicable to the assessment of policies and the elaboration of projections of GHG emissions and aims to enhance the involvement and strengthen the accountability of sectors in the integration of the climate dimension into sectoral policies, hereby contributing to the preparation of reports of policies and measures and projections.

In this sense, several focal points have been designated, for the different sectors:

- Agency for Competitiveness and Innovation;
- Directorate General of Energy and Geology;
- Directorate General of Territory;
- Foundation for Science and Technology;
- Institute for Housing and Urban Rehabilitation;
- Institute for Nature Conservation and Forests;
- Institute of Mobility and Transport;
- Planning, Policy and General Administration Office;
- Portuguese Environment Agency (that also coordinates);
- Public Administration Shared Services Entity.

The APA is the entity responsible for coordinating the SPeM and ensuring its implementation in Portugal.

Following the approval of the National Energy and Climate Plan (NECP) for 2030 the existing National System is under revision to better integrate the energy dimension. This revision is

[44] Council of Ministers Resolution n.º 45/2016, of 26th August

justified by the need to include the monitoring of policies and measures and of projections that impact the energy transition in the existing national system (SPeM), which will allow the assessment of progress in the implementation of sectorial policies and mitigation measures.

We will take advantage of existing monitoring structures at national level, adapting them to this new reality which provides for a better integration of energy and climate policies. In order to monitor and report on the impacts of cross-sectoral policies and measures on climate change and energy transition, an e-platform will be developed, together with the sectors, by developing indicators and identifying their respective regulations, funding, taxes and others.

The most recent policies and measures and projections were prepared during the elaboration of the National Energy and Climate Plan (NECP 2030) and of the 2050 Carbon Neutrality Roadmap (RNC 2050).

The process of developing these energy and climate policy instruments for the next decade and for a carbon neutral future, was supported by a broad process of sectoral involvement and mobilization of the Portuguese society. This involvement occurred during the different stages of the process, from the construction of macroeconomic scenarios that served as a basis for the entire foresight and modelling exercise, allowing the collection of contributions from various institutions and national experts, and which gave rise to the three scenarios considered: working sessions dedicated to specific themes with the presence of experts from the most diverse areas, in the search for solutions to meet national goals and objectives; cycles of technical workshops and thematic events around the decarbonisation of society.

Following the above mentioned initiatives, a public consultation was carried out for both instruments, which had a high participation of the public sector, private sector, associations representing sectors of the economy and civil society and which contributions were in their majority incorporated in the respective final versions (both on policies and measures and projections).

As mentioned before the revision of the national Carbon Neutrality Roadmap (2050) and the National Energy and Climate Plan (2030), is ongoing, and the work with the different sectors will continue to be developed as well as the process of civil society consultation and involvement.

In the Autonomous Region of Azores, the Environmental and Climate Change Department of the Regional Government is responsible for coordenating and monitoring the implementation of climate change policies.

The Regional Programme for Climate Change (PRAC), with a 2030 horizon, is a sectoral land-use plan with potential environmental effects[45] and therefore was subjected to a Strategic Environmental Assessment[46] and a public consultation was carried out before its adoption. Also, the course of the work was monitored by a Working Group[47] and the relevant regional entities

[45] As provided for in the Regional Legislative Decree No. 35/2012/A, of August 16th
[46] in accordance with the provisions of Article 3 of the Regional Legislative Decree No. 30/2010/A, of November 15th
[47] Defined by the Resolution of the Council of Government No. 93/2014

were involved in order to ensure the availability of information and the definition and implementation of successful mitigation and adaptation measures.

In the Autonomous Region of Madeira, the Regional Secretariat of Environment, Natural Resources and Climate Change is the responsible for coordinating and monitoring the implementation of climate change policies.

The Regional Climate Change Adaptation Strategy (Estratégia CLIMA-Madeira), with a 2100 horizon, is a multi-sectorial plan with action and indicators, monitored by the Adaptation Community, a working group composed by several stakeholders (public bodies, municipalities, public companies, private companies, etc.).

Climate Change Impact Assessment approaches

<u>Environmental Impact Assessment</u>

Since 2017, the Environmental Impact Assessment[48] legislation started to include the need to identify, describe and assess the potential environmental impacts of the project, weighing its effects in terms of both mitigation and adaptation to climate change, namely:

- Evaluate the impact of the project on the climate — considering the nature and volume of greenhouse gas (GHG) emissions;
- Evaluate the vulnerability of the project itself to climate change, also starting to consider the risks of the environment on the project.

Climate Change is always considered at the screening stage and is frequently identified as a Critical Factor for Decision-Making (CFD) in the scoping phase. When considered a CFD, mitigation and adaptation are addressed and generally recognized as a relevant tool for considering climate change at an early stage of the decision-making process.

Environmental Impact Reports have to take into account the key climate change strategies, objectives and targets and provide an assessment of both mitigation and adaptation impacts, including the adoption of appropriate minimising measures, when applicable.

On the mitigation side, the assessment of the impacts arising from projects subject to EIA is related to the need to calculate the GHG emissions that occur directly or indirectly in the various phases of the project (construction, operation and decommissioning) and that they are analyzed from a perspective of mitigating the climate change. All factors that contribute to the balance of GHG emissions, both in terms of carbon emissions and sinks, when applicable, must be taken into account. Relevant mitigation measures in line with the NECP must be foreseen, when applicable. In the cases of projects that cause desforestation beyond certain limits, projects promoters are required to present a forestation compensation plan in line with the Regional Forest Management Plans – PROF.

[48] Article 5, paragraph a) of Decree-Law no. 152-B/2017

On the adaptation side the EIA reports must consider current and future climatic vulnerabilities through historical data on the climate and the occurrences of extreme weather events. Additionally, EIA procedures consist of environmental, social and economic impacts and consequences, considering Climate Change scenarios; key risks/impacts of Climate Change in the project; assessment if pre-existing vulnerabilities to Climate Change will be exacerbated; alternatives more resilient to climate pressures and/or allowing a more significant climate vulnerability reduction; critical thresholds that compromise the project or the environment, forcing the adoption of adaptation measures; minimisation measures based on P-3AC for the relevant vulnerabilities or impacts.

These procedures are intended to define the information to be included and the scenarios to be considered in the environmental impact report and to establish criteria for assessing climate change and for establishing appropriate measures, so as to enable monitoring impacts throughout the life cycle of the project (construction, operation and deactivation phases).

Strategic environmental assessment

The Strategic Environmental Assessment (SEA) aims to identify, describe and evaluate any significant environmental effects resulting from a Plan or Program prior to its elaboration or during its elaboration and before its approval. This instrument applies to public plans and programs whose implementation may include projects likely to have significant effects on the environment, namely those subject to Environmental Impact Assessment or in areas protected for their interest in conserving biodiversity. Consideration of climate change in SEA procedures follows a similar approach as in EIA procedures by reflecting on projects that may result from the implementation of the plan or programme.

Legislative climate impact assessment

The Portuguese Climate Law establishes that any new legislative procedures will need to follow first a climate impact assessment.

Climate proofing of new legislative acts is being addressed. It started in 2020 with a pilot project that defined a methodology to measure impacts of legislative proposals and sectoral policies on climate action. This was done through an analysis and evaluation tool that has been incorporated in already existing legislative evaluation systems – the "Model of the Pilot Project on Prior Evaluation of Legislative Impact on Climate Action".

This pilot project is being implemented regarding preliminary legislative impact assessment on climate action, both mitigation and adaptation, extending the scope and reach of the assessment, providing more information, promoting alignment with the objectives undertaken by Portugal in terms of climate policy and providing an enhanced legislative procedure and a more transparent legal system. Assessment of the impact on climate action is identified in terms of energy, mobility, agriculture, forests or other land use, water, waste, circular economy, health, protection of people and assets and economic incentives, employment, capacity building and innovation.

Climate action in the State Budget and sustainable finance

In addition to the previous climate-proofing tools, the Portuguese Climate Law introduces new areas to integrate climate action considerations, namely in the areas of taxation and budget process and of sustainable finance.

Regarding the development of the State Budget it will identify the climate policy measures, consolidate the budget allocation and estimate its contributions to the mitigation targets established on the Portuguese Climate Law. The implementation of these elements will later be reported in the State's General Account. Additionally, the reports on tax benefits and expenses will specify the ones addressing adaptation efforts.

This Law also provides a strong support to use the EU taxonomy by stating:

- "Public and private agents and institutions, in their financing decisions, take climate risk and climate impact into account."
- "Failure to consider climate risk and climate impact in the short, medium and long term is considered a violation of fiduciary duties."

The integration of the climate risk in decision-making is therefore extended to the corporate governance. The assessment of the exposure to climate change is now enforced by the Law to figure in the corporate annual exercises.

Key policy measures

The road to a carbon neutral economy requires joint action from the various sectors, with special focus on energy, transport, industry, waste and waste waters, agriculture and forest. The NECP 2030 (section 3.1, page 54 onwards), includes a range of policies and measures foreseen for these different sectors.

The main policy framework relevant for climate change over the last 10 years includes the following plans, strategies and programs:

- Carbon Neutrality Roadmap (RNC2050), Resolution of the Council of Ministers (RCM) 107/2019, of July 1st;
- Nacional Energy and Climate Plan (NECP2030), RCM 53/2020, of July 10th;
- National System for Policy and Measures (SPeM), RCM No. 45/2016, of August 26th;
- National Program Climate Change (PNAC 2020/2030), RCM No. 56/2015, of July 30th;
- National Investment Program 2030 (PNI 2030)[49];
- National Air Strategy (ENAR 2020), RCM 46/2016, August 26th;
- National Hydrogen Strategy (EN-H2), RCM 63/2020, of August 14th;
- Long Term Strategy for the Renovation of Buildings (ELPRE), RCM 8-A/2021, of February 3rd;
- National Renewable Energy Action Plan for 2013-2020 (PNAER), RCM 20/2013, of April 10th;[50]
- National Energy Efficiency Action Plan 2013 -2016 (PNAEE), RCM 20/2013, of April 10th[51];
- Energy Efficiency Program in Public Administration - ECO.AP, created by RCM 2/2011, of January 12th and revised for 2030 by RCM 104/2020, of November 24th;

[49] https://www.parlamento.pt/ActividadeParlamentar/Paginas/DetalheDiplomaAprovado.aspx?BID=21875
[50] Replaced by the Nacional Energy and Climate Plan (NECP2030), RCM 53/2020, of July 10th.
[51] Replaced by the Nacional Energy and Climate Plan (NECP2030), RCM 53/2020, of July 10th

- National Policy Framework for the deployment of alternative fuels infrastructure, RCM 88/2017, of June 26th;
- Circular Economy Action Plan (PAEC), RCM 190-A/2017, of December 11th;
- Sustainable Bioeconomy Action Plan, RCM 183/2021, of December 28th;
- National Program for Spatial Planning Policy (PNPOT), Law 99/2019, of September 5th;
- Strategic Plan for Urban Waste (PERSU 2020+), Ordinance 241-B/2019, of July 31st;
- National Strategy to Combat Food Waste (ENCDA), RCM 46/2018, of April 27th;
- National Waste Management Plan 2014-2020 (PNGR), RCM 11-C/2015, of March 16th;
- Strategic Plan for Water Supply and Wastewater Sanitation (PENSAAR 2020), Official Order 4385/2015, of April 30th;
- Rural Development Program 2014-2020 (RDP 2020), Commission Implementing Decision C (2014) 9896, of December 12th;
- National Strategy for Agricultural and Agro-Industrial Effluents (ENEAPAI 2030), RCM 6/2022, of January 25th;
- Transport and Infrastructure Strategic Plan (PETi3 +) for 2014-2020, RCM 61-A/2015, of August 20th;
- National Strategy for Active Cycling Mobility 2020-2030 (EMNAC) 2020-2030, RCM 131/2019, of August 2nd;
- Fare Reduction Support Programme (PART), Order 1234-A/2019, of February 4th;
- Programme to Support the Densification and Strengthening of the Public Transport Offer (PROTransP), Order 5545-B/2020, of May 15th;
- Sustainable Mobility Program for the Public Administration 2015-2020 - ECO.mob, RCM 54/2015, July 28th;
- National Strategy for Green Public Procurement 2020 (ENCPE 2020), RCM 38/2016, July 29th;
- Strategy Portugal 2030, RCM 98/2020, of November 13rd;
- Recovery and Resilience Plan of Portugal – EU Council Implementing Decision 10149/21, of 6th of July and respective Annex 10149/21, of 5th July.
- POSEUR - Commission Implementing Decision C(2014) 10110, of 16th December, amended by Commission Implementing Decision C(2020) 6256, of 9th of September
- Guidelines to accelerate Sustainable Finance in Portugal, Working Group for Sustainable Finance in Portugal, 8th of June 2019
- Azores Regional Programme for Climate Change (PRAC), Regional Legislative Decree 30/2019/A, of November 28th.
- Climate Change Adaptation Strategy of Madeira Autonomous Region (Estratégia CLIMA-Madeira), Resolution of the Government Council n.º 1062/2015, 26 november;
- Madeira Circular Economy Agenda, Resolution n.º 144/2021, de 4 de março, publicada no JORAM, I Série, n.º 41, de 5 de março
- Regional Waste Strategy, Resolução n.º 80/2021, de 4 de fevereiro, publicada no JORAM, I Série, n.º 24, de 5 de fevereiro, retificada pela Declaração de Retificação n.º 7/2021, publicada no JORAM, I Série, n.º 26, de 10 de fevereiro
- Regional Flood Risk Management Plan (Plano de Gestão de Riscos de Inundações da Região Autónoma da Madeira) 2016-2021, Resolução de Conselho de Governo n.º 805/2017, publicado no JORAM, 1.ª Série, n.º 187, de 27 de outubro.
- Regional Hydrographic Management Plan 2016-2021 (Plano de Gestão da Região Hidrográfica do Arquipélago da Madeira) Resolução de Conselho de Governo n.º 945/2016, publicado no JORAM, 1.ª Série, n.º 221, de 16 de dezembro.

- Regional Civil Protection and Emergency Plan (Plano Regional de Emergência de Proteção Civil da Região Autónoma da Madeira), Resolução de Conselho de Governo n.º 60/2022, publicado no JORAM, 1.ª Série, n.º 20, de 7 de Fevereiro.

The main current and planned policies and measures to accomplish an economy-wide emissions reduction target are identified in CTF Table 3 and are summarised below:

Policy and Measures and their Effects (4.2)

All the mitigation actions which were reported in 7NC/3BR are included in the 4BR and in this 8NC/5BR. They were only renamed or regrouped so as to be more in line with our NECP or other plans. New mitigation actions were also included as they have been developed to respond to the ambition increase of the national targets, such as, for example, the promotion of new energy storage solutions like batteries and hydrogen, promotion of renewable gases, to cease electricity production based on coal by 2021 and 2023, to promote industry decarbonisation through eco-innovation and cleaner production processes and to promote industry digitization, etc. The list of PeM below is structured by sector, as follows (the number of the PeM as listed in table 3 is provided in brackets for ease of reference):

- Energy (PeM 17, PeM 19 to PeM27)
- Industry (PeM 1, PeM 18 and PeM30)
- Transport (PeM 12 to PeM 16)
- Circular Economy (PeM 3)
- Waste (PeM 5)
- Agriculture (PeM 4, PeM 6 to PeM11)
- LULUCF (PeM 8)
- Fiscal Measures (PeM 2 and PeM 28)

Energy

PaM17 - To promote the production and consumption of alternative renewable fuels, namely Hydrogen including through development of alternative fuels infrastructure for clean fuels.

Decree-Law No. 90/2014 establishes the legal regime for electric mobility, applicable to the organization, access and exercise of electric mobility activities, as well as rules for the creation of a pilot network of electric mobility.

Cabinet Resolution No. 88/2017 published the National Policy Framework for the deployment of alternative fuels infrastructure, which has set objectives and targets, as well as measures to promote the use of alternative fuels and development of its supply infrastructure.

Decree-Law No. 152-C/2017 amended Decree-Law No. 117/2010 (amended by Decree-Law No. 6/2012 and Decree-Law No. 69/2016), which established the sustainability criteria for the production and use of biofuels and bioliquids, regardless of their origin, as well as the mechanisms to promote the use of biofuels in transport, also defining the minimum targets for the mandatory incorporation of biofuels for the years 2011 to 2020. It updates the specifications and testing methods for fuels available on the Portuguese market and defines rules for auctioning biofuel bonds.

The Portuguese Innovation Support Fund (FAI) supports innovation and technological development projects, demonstration projects in the areas of renewable energy and energy efficiency, and investment projects in energy savings. FAI call for projects 06/2019 was focused on the thematic of circular economy, more precisely on recovery of waste in the context of the Energy Transition. This call aimed at promoting the use of advanced biofuels produced using innovative technologies, through the sustainable use of residual biomass or with low economic value, from a perspective of circular economy and generation of new value chains around biomass. Five innovation projects were approved and contracted for financing in the amount of 4.7 million euros, with execution deadlines between 2020 and 2023.

This measure could also be linked to PaM4 – "To promote Research and Development (R&D) projects that support the transition to a carbon neutral economy, based on an innovative and competitive industry, sustainable agroforestry management and mobility and minimizing waste production."

PaM19 - To promote energy and resource efficiency, renewables and electrification; Industrial symbioses, resource optimization and resource reuse.

The Management System of Intensive Energy Consumption (SGCIE) aims the promotion of energy efficiency and energy consumption monitoring in intensive energy facilities (consuming more than 500 toe/year). Facilities operators are obliged to conduct an energy audit and elaborate an Energy Consumption Rationalization Plan, establishing targets for energy and carbon intensity and specific energy consumption, including energy rationalization measures.

The Energy Efficiency Fund (EEF) was created by Decree-Law No. 50/2010 with the objective of funding programmes and measures identified in the National Energy Efficiency Action Plan (NEEAP). The EEF, by means of specific calls, supports energy efficiency projects in sectors such as transport, buildings, services, industry and public services. Since 2014, EEF promoted, among others, calls with the following objectives:

<u>Industry sector:</u>

- Implementation of the measures established in Energy Consumption Rationalization Agreements (ARCE) celebrated with DGEG, within the SGCIE;
- Implementation of energy efficiency measures in electric motors, heat and cold production and industrial processes, energy consumption monitoring and management systems and investment support for the execution of mandatory energy audits, within the SGCIE;
- Implementation of projects leading to increased energy efficiency through the energy optimization of manufacturing processes and introduction of new technologies for industries and operators with an ARCE celebrated with the DGEG, within the SGCIE;
- Implementation of measures to improve facilities energy performance by replacing installed equipment with more efficient ones, implementing control devices for optimization of energy consumption, and/or the reformulation and process integration, for agricultural, forestry and fishery facilities, industries and operators with an ARCE celebrated with the DGEG, within the SGCIE;

This measure could also be linked to PaM18 – "To promote decarbonisation of industry through eco-innovation and cleaner production processes and to promote industry digitization."

Transport sector:

- Support for initiatives related with energy management of energy-intensive transport fleets;
- Implementation of measures for the improvement of energy performance in transport infrastructures, through the replacement of existing equipments with more efficient ones, and the implementation of control devices that allow optimizing energy consumption, for transport management operators;

Buildings Sector:

- Execution of energy audits to elevators in existing services buildings with more than 10 years old, with the purpose of issuance of the elevator energy label, with the main objective of the promotion of improvement measures in these equipment's in order to improve their performance;
- Implementation of thermal insulation projects in roofs and/or exterior walls, with the purpose of energy performance improvement of existing residential buildings, prior to 1990, and which, simultaneously, provide a reduction/elimination of constructive pathologies and improvement of hygrothermal comfort;
- Intervention in solar thermal systems installed before December 2005 in existing service buildings, through technical analysis and energy audits and rehabilitation of solar systems, by the supply, installation, replacement equipment's and commissioning of the facility;
- Support for energy efficiency measures that lead to the improvement of buildings energy performance, in existing residential and commercial buildings, at the level of water heating (including solar thermal systems), efficient windows installation, thermal insulation improvement and efficient lighting (efficient lightning only for commercial buildings);
- Support, in existing public buildings, for solutions that promote and improve buildings energy performance, or equipment's replacement with more efficient ones, or through the implementation of control devices that optimize working conditions and energy consumption.

This measure could also be linked to PaM24 – "Promoting energy rehabilitation of buildings, NZEB buildings, the use of more energy efficient equipment and renewables" and to PaM26 – "To improve the management of energy consumption in the various sectors of the national economy.

PPEC - Consumption Efficiency Promotion Plan is a competitive tender mechanism which has been in place since 2007 to improve the efficiency in electricity supply and demand. Electricity suppliers, network operators, government agencies, research centres, higher education institutions and consumer, business and municipal associations can propose energy efficiency measures, which are reviewed and selected for support by the national energy regulatory authority (ERSE) through a competitive process based on a cost-benefit analysis. DGEG also plays a role in approving the funding by examining if proposed projects are aligned with Portugal's overall energy policy goals.

This measure could also be linked to PaM26 – "To improve the management of energy consumption in the various sectors of the national economy."

PaM 20 - Phase-out electricity production based on coal.

There was a sharp decrease in the operation of the two coal-fired power plants existing in Portugal, from 2016 to 2020. This was due in part to the fact that their competitiveness and economic viability had been reduced, due among other factors to the phase-out of the excise duties exemption on oil and energy products (ISP) and carbon tax applicable to coal for electricity production, which began in 2018 (with a reduction in the exemption defined on an annual and gradual basis). In 2020, the electricity production from coal-fired thermal power plants only corresponded to around 4.5% of gross electricity production in Portugal. **The emissions from coal power plants registered a reduction of 80% since 2020. In 2020 they represented 4% of the total national emissions while they totalled 16% in 2016.** As announced by the Portuguese Government in 2020, the decommissioning/closure of coal-fired thermal power plants in Portugal took place in 2021 (anticipating the deadline, that was forecast for 2023).

PaM 21 - Promote new energy storage solutions (batteries and hydrogen).

Decree-Law No. 172/2006, in its amended version, established that the allocation of injection capacity reservation in the Public Service Electricity Network (RESP) may depend of a previous competitive procedure, which may take the form of an electronic auction. In August 2020, a capacity reservation auction for photovoltaic production included a bidding modality applicable to power generation centers that had storage capacity, which included solar photovoltaic combined with batteries and/or concentrated solar power (CSP) technology.

PaM22 - Accelerate national energy transition to renewables.

Decree-Law No. 179/2012 amends Decree-Law No. 5/2011, which establishes measures to promote the production and use of forest biomass for the supply of dedicated forest biomass power plants, in order to extend the deadlines for access to the incentive to the construction and exploitation of such plants.

This measure could also be linked to PaM19 – "To promote energy and resource efficiency, renewables and electrification; Industrial symbioses, resource optimization and resource reuse".

Decree-Law No. 35/2013 amends the remuneration regime applicable to electro-producing centers submitted to the remuneration regime established in Annex II of Decree-Law No. 189/88. It provides the adoption of an alternative remuneration scheme for an additional period of five or seven years after the end of the initial periods of guaranteed remuneration currently underway, by assuming the commitment to contribute to the sustainability of the National Electricity System (SEN) through the payment of a compensation.

Decree-Law No 39/2013 establishes the mechanism for issuing guarantees of origin to electricity produced from renewable energy sources.

This measure could also be linked to PaM17 - "To promote the production and consumption of alternative renewable fuels, namely Hydrogen including through development of alternative fuels infrastructure for clean fuels"

Decree-Law No. 153/2014 lays down the legal regime applicable to the production of electricity, for self-consumption in the installation of use associated with the respective production unit, with or without connection to the RESP, based on renewable or non-renewable production technologies - ”Self-Consumption Production Units” (UPAC). It also lays down the legal regime applicable to the production of electricity, sold in its entirety to the RESP, through small-power installations, from renewable resources - “Small Production Units” (UPP).

This measure could also be linked to PaM26 – “To improve the management of energy consumption in the various sectors of the national economy.”

Decree-Law No. 49/2015 establishes the special regime applicable to the adaptation of mills, watermills or other equivalent hydraulic infrastructure for the production of hydroelectric energy, including the terms and conditions for the allocation of their title for the use of water resources for the purposes of electricity production and their articulation with the regime of access to electricity production activity which is subject to prior reporting or prior registration for production schemes intended for self-consumption.

Ordinance No. 202/2015 establishes the remuneration regime applicable to the production of renewable energy from an ocean source or location by electro-producing centers using experimental or pre-commercial technologies.

Decree-Law No. 166/2015 amends Decree-Law No. 5/2011, amended by Decree-Law No. 179/2012, which establishes measures to promote the production and use of forest biomass, intended for the supply of dedicated plants dedicated to forest biomass, in order to extend the deadlines envisaged, as well as partial integration, redistribution of the powers allocated and not yet installed for the purpose of access to the incentive to the construction and operation of those plants.

This *measure could also be linked to PaM4 – “To promote Research and Development (R&D) projects that support the transition to a carbon neutral economy, based on an innovative and competitive industry, sustainable agroforestry management and mobility and minimizing waste production.”*

Decree-Law No. 64/2017 defines a special and extraordinary regime for the installation and operation, by municipalities or, by their decision, by inter-municipal communities or associations of municipalities of specific purposes, of new biomass recovery plants, while defining support and incentive measures aimed at ensuring their implementation, with the fundamental objective of forest protection, forest planning and preservation, and fire fighting. The injection power in the public service electricity network to be allocated is limited and may not exceed, on the mainland, 60 MW, and for each plant a maximum of 15 MW.
Resolution of the Council of Ministers No. 174/2017 approves the Industrial Strategy and the Action Plan for Ocean Renewable Energies (EI-ERO) and in this context, the Action Plan for Ocean Renewable Energies.

This *measure could also be linked to PaM4 – “To promote Research and Development (R&D) projects that support the transition to a carbon neutral economy, based on an innovative and* *competitive industry, sustainable agroforestry management and mobility and minimizing waste production."*

Ordinance No. 62/2018 approves the regulation for the allocation of production allowances or acceptance of prior communication for the production of electricity in a special regime and in the general remuneration regime.

Resolution of the Council of Ministers No. 161/2019 establishes the annual co-financing, by the Environmental Fund, of the investment value relative to the installation of the submarine cable connecting to the Windfloat project, under the NER300 Programme. It also authorises the Environmental Fund to make transfers of revenue from carbon allowances to the National Electricity System (SEN), in order to mitigate the repercussion of the investment in the Windfloat project on electricity tariffs.

NER 300 is a funding programme pooling together about EUR 2 billion, as a result of the monetization of 300 million allowances from the new entrants reserve of the EU Emissions Trading System, for innovative low-carbon technology, focusing on the demonstration of environmentally safe Carbon Capture and Storage (CCS) and innovative renewable energy technologies on a commercial scale within the EU.

The Windfloat Atlantic project is a PT awarded renewable energy technology project under the first call for proposal of the aforementioned NER300 programme, with a total support of 29,9 million euros. The project consists in the development of a pre-commercial floating offshore wind farm using the WindFloat technology, located in the north Portuguese coast (Viana do Castelo), with an installed capacity of 25 MW that is produced by three platforms of 8,4 MW each.

WindFloat is a so-called semi-submersible floating platform inspired by some of the structures employed in the oil and gas industry. The platform is designed to be sufficiently stable to accommodate standard commercially available wind turbines with only minor modifications.
The first of three turbine platforms has started its operation in late 2019 and the project became fully operational in the mid-2020.

Resolution of the Council of Ministers No. 12/2018 approves a set of measures to update the legal regime of the Pilot Zone for ocean renewable energies. Combine the change in the location and extension of the scope of the Pilot Zone with the Windfloat project, ensuring its compathization with the Industrial Strategy for Ocean Renewable Energies (EI-ERO), within the framework of policies to promote new activities that maximize the use of sea resources.

This *measure could also be linked to PaM4 – "To promote Research and Development (R&D) projects that support the transition to a carbon neutral economy, based on an innovative and competitive industry, sustainable agroforestry management and mobility and minimizing waste production."*

Decree-Law No. 48/2019 is the third amendment to Decree-Law No. 5/2011, which establishes measures aimed at promoting the production and use of forest biomass. It extends the period for the entry into operation of forest biomass thermal power plants that are currently under construction and sets a discount to the tariff.

Decree-Law No. 120/2019 amends Decree-Law No. 64/2017, reformulating the special and extraordinary regime for the installation and exploration of the new forest biomass valorisation plants.

Decree-Law No.76/2019 amended the grid connection process for projects with a capacity higher than 1 MW, with the aim to foster renewables deployment while ensuring that the grid can support the integration of expanding renewable generation. It also established the legal regime applicable to the production of electricity, sold in its entirety to the RESP, through small-power installations, from renewable resources with a capacity up to 1 MW, revoking the Decree-Law No.153/2014.

Under this decree-law, electricity generation projects (including renewable energy) must be granted a network capacity reserve title (TRC) by the relevant network operator (transport or distribution system operator) before the project can apply for a production licence, which is needed to start construction and to deliver electricity to the grid.

Decree-Law No. 162/2019 aims to facilitate self-consumption of energy and renewable energy communities by removing unjustifiable obstacles and creating conditions for the establishment of innovative solutions based on the use of new technologies. It revokes the previous law (Decree-Law No.153/2014) and approves the legal regime applicable to self-consumption, regulating the production activity associated with the facilities for the use of self-consumption of renewable energy and establishes the legal regime for renewable energy communities.

Order No 5532-B/2019 launched the first Electronic Auction, for solar photovoltaic energy, which allowed the allocation of reserve titles for the injection into the 1.292 MW photovoltaic solar energy grid by 2020. This competitive procedure allowed competitors, through an algorithm - VAL, opt for the most favourable remuneration regime, that is, the general regime - at market prices contributing a value to the National Electricity System, or the special regime - guaranteed rate, with highly competitive prices compared to market prices.

Order No. 5921/2020 established a competitive procedure, in the form of an electronic auction, for the allocation of injection capacity reservation at points connecting to the RESP for electricity from the conversion of solar energy. The injection points in the RESP, grouped by lots, add up to a reception capacity of 700 megavolt-ampere (MVA), consisting of the distribution of reception capacity and location of the corresponding injection points of the procedure program.

ERSE Regulation No. 266/2020 approves the Regulation on Self-Consumption of Electricity, laying down provisions applicable to the exercise of the activity of self-consumption of individual or collective renewable energy, when there is connection to the RESP. These rules apply to self-consumption facilities and member installations of a Renewable Energy Community which cumulatively comply with the following conditions: (a) have an intelligent measurement system; (b) are installed at the same voltage level.

This measure could also be linked to PaM26 – "To improve the management of energy consumption in the various sectors of the national economy."

ERSE Regulation No. 1129/2020, the Regulation of Commercial Relations of the Electricity and Gas Sectors, aims at: Identification of gas actors and their activities and functions; general principles and rules of business relationship, including public service obligations; commercial relationship between infrastructure operators and traders, in particular for billing and payment purposes; relationship with customers (obligations of supply, conclusion of the contract, billing and payment, as well as interruption and re-establishment of supply); market regime (arrangements for contracting, registration of agents, regime of organised markets and bilateral procurement, choice and change of trader, framework for supervising the functioning of gas markets); commercial conditions of connection to the network; measurement, reading and availability of consumption data; conflict resolution.

Cabinet Resolution No. 163/2017 establishes the National Plan for the Promotion of Biorefineries. This national plan foresees, as follow-up measures, the preparation by the National Laboratory of Energy and Geology of the proposals for the Annual Action Plans and the monitoring of a set of Key Performance Indicators

Incentives to solar thermal solutions installation. Solar thermal has been supported throughout time, either in a direct way, with targeted notices, or through notices aimed at the different sectors that then in the typology of measures include it. The Energy Efficiency Fund created through the Decree Law no. 50/2010, constitutes a financial instrument able to finance programs and measures of which solar thermal was part of. The operational programmes which manage the structural funds also had several calls in which solar thermal was an eligible measure when integrated in energy efficiency solutions (e.g. in public infrastructures and residential buildings.). Until 2020 the regulation on which these calls were based is the RESEUR established in ordinance no. 57-B/2015.

This measure could also be linked to PaM19 – "To promote energy and resource efficiency, renewables and electrification; Industrial symbioses, resource optimization and resource reuse"

PaM 23 - To promote greater electricity network intelligence and flexibility.

ERSE Regulation No. 610/2019, Regulation of Intelligent Grid Services for Electric Power Distribution, which defines the services to be provided by low voltage electricity distribution system operators and marketers, when electrical installations are integrated into smart grids.

PaM24 - Promoting energy rehabilitation of buildings, NZEB buildings, the use of more energy efficient equipment and renewables.

Decree-Law No. 118/2013 approved the Buildings Energy Certification System (SCE) and established a set of provisions for Nearly Zero Energy Building (NZEB), framing the national definition of NZEB and stating that the buildings sector should progressively be composed of NZEB buildings. Several complementary legislation was published or revised later. Ordinance No. 42/2019 and Ordinance No. 98/2019 were published in order to update the existing legal framework, establishing the application of NZEB requirements to all public buildings or buildings occupied by a public entity (from 1 January 2019) and to all buildings covered by Decree-Law No. 118/2013 (from 1 January 2021). The SCE was revised by Decree-Law no. 101-D/2020, which transposed Directive (EU) 2018/844, on the energy performance of buildings, setting requirements for the design and renovation of buildings with the objective of ensuring and promoting the improvement of their energy performance by establishing requirements for their retrofitting and renovation.

IFRRU 2020 is a financial instrument designed to support investments in urban rehabilitation, providing more market-friendly loans for full building rehabilitation, including adequate energy-efficient integrated solutions for the rehabilitation. It brings together various sources of funding to boost investment, both European funds from "Portugal 2020" and funds from other entities such as the European Investment Bank and the Council of Europe Development Bank, combining them with commercial banking resources. It has been supporting projects on buildings renovation and energy efficiency mainly throught loans.

"Casa Eficiente 2020" Program aims to provide market-friendly loans to operations that promote the improvement of the environmental performance of residential buildings, with a special focus on energy and water efficiency, as well as urban waste management. Interventions can affect the building envelope and its systems. For the period 2018-2021, the total funding amount of the Program was 200 M€.

In the meantime, the Long Term Strategy for the Renovation of Buildings (ELPRE) was published in February 2021, being its main objective to provide incentive and support mechanisms for renovation actions of existing public and private (non)residential buildings, in order to obtain a decarbonised and highly energy efficient building stock, facilitating the transformation of existing buildings into nearly zero energy buildings, in compliance with the national and European objectives of carbon neutrality and energy transition.

PaM25 - Promoting decarbonisation options in the public administration.

Under "Portugal 2020", the Operational Programme for Sustainability and Efficient Use of Resources (POSEUR) has supported several projects for the increase of energy efficiency in public infrastructure within the state's central administration. Also, under "Portugal 2020", the five Portugal Regional Operational Programmes have supported projects for increasing energy efficiency in the social housing sector and in the public infrastructures of local administration, supporting the implementation of integrated measures to promote energy efficiency and rationalising consumption.

In 2020, the Energy Efficiency Program in Public Administration, ECO.AP, which targeted the increase of energy efficiency in public services, equipment and bodies of public administration to 2020, was replaced by the Programme for Resource Efficiency in Public Administration for the period up to 2030 (ECO.AP 2030). ECO.AP 2030 is more ambitious and includes measures for the reduction of energy, water and material consumption, and respective GHG emissions, in the facilities allocated to buildings, equipment, fleets and infrastructures, including electric mobility infrastructures, and to energy production capacity and energy storage solutions, under management or use by direct and indirect Public Administration entities, including central and peripheral services.

In this context, the Ministry of Health's Sustainability Program - ECO@SAÚDE, formerly PEBC & Eco.AP (Low Carbon Strategic Plan and Energy Efficiency Program in Public Administration), has been working since 2011 to improve energy and water efficiency and reduce the production of waste in the public healthcare entities, also with the goal fo contributing to the mitigation of GHG emissions, through increased efficiency in the use of resources. Among the measures implemented in the context of ECO@SAÚDE, the following should be highlighted:

- Establishment of targets for the reduction of energy/water consumption and reduction of waste production in the healthcare sector entities (hospitals, primary health care units and government administration entities);
- Constant monitoring of energy/water consumption and waste production, and publication of the monitoring results through periodic monitoring reports on the evolution of consumption/production according to a baseline year, defined by Portuguese legislation;
- Annual publication of the Energy and Water Efficiency Ranking of the Portuguese NHS, a benchmarking report for hospitals;
- Preparation and dissemination of the Good Practices Guide for the Health Sector, containing measures to improve energy/water efficiency and reduce waste production;
- Dissemination of the Ministry of Health's Sustainability Campaigns with the aim of raising awareness and informing building users about the efficient use of resources;
- Work to identify and take advantage of external financing sources for the installation of more energy-efficient equipment and systems in the buildings of public entities in the health sector;
- Cooperation in the "Operation Zero" project, through the calculation of the carbon footprint of the health sector in Portugal and the study of mitigation actions.

PaM26 - To improve the management of energy consumption in the various sectors of the national economy

RGCEST - Management Regulation of Energy Consumption in Transport Sector, aims to reduce the energy consumption of commercial vehicle fleets. It´s applied to companies that own a vehicle fleet with an energy consumption greater than 500 toe/year. These companies are required to carry out an energy audit every three years to develop an energy consumption rationalisation plan, with specific efficiency measures to be implemented within three years.

PaM27 - To promote the production and consumption of renewable gases

Decree-Law No. 60/2020 establishes the mechanism for issuing guarantees of origin for low-carbon gases and renewable gases. In this regard, it adapts the system for issuing guarantees of origin of electricity from renewable sources, referred to in Decree-Law No. 141/2010, in its current wording, with a view to include, in its object, low carbon gases and renewable gases, with the aim of proving to the final consumer, by issuing electronic certificates, the share or quantity of energy from renewable sources in the energy mix of a particular supplier.

Decree-Law No. 62/2020 establishes the organisation and functioning of the National Gas System (NGS) and the legal schemes applicable to the reception, storage and regasification of Liquefied Natural Gas (LNG). The incorporation of gases of renewable origin and low carbon gases in the NGS networks is foreseen, allowing their decarbonisation in domestic and industrial consumption. The incorporation of gases of renewable origin and low carbon gases also contributes to the fact that the concessionary networks do not become unnecessary, allowing their continued use.

Resolution of the Council of Ministers No 63/2020 approves the National Hydrogen Strategy (EN-H2), setting the targets to be met by 2030, namely: (i) 5% green hydrogen in final energy consumption, road transport and industry; (ii) 15% green hydrogen injected in natural gas networks; (iii) 50 to 100 filling stations for hydrogen; (iv) between 2 and 2.5 GW of production capacity (electrolysers).

Order No 6403-A/2020 determines the opening of a period for the expression of interest in the participation in the future Important Project of Common European Interest (IPCEI) Hydrogen, aimed at entities interested in integrating the resulting value chain. The admission of projects for participation in the future IPCEI Hydrogen respects the principles of equality, transparency, efficiency, impartiality and good faith, valuing coherence with the national and European strategy for hydrogen, the benefits for the economic development of the country, for the creation of jobs and wealth. 74 expressions of interest for projects were received. There was a cross-sectional expression of interest in the area of financing. The 37 expressions of interest selected in this process resulted, depending on their relevance to the EN-H2, PNEC2030 and RNC2050, in different investment paths, in different areas of national incentive, and some of them with integration in the waves of the IPCEI-H2 (Technology, industry, RHATL, Mobility) whose specific processes are all still ongoing.

Additionaly, the total number of national landfills being explored is 32, and in 26 of those, energy recovery is made from the biogas generated, with the production of electricity and injection into the grid. This is aligned with the provisions of the landfilling Directive and nation legislation that establishes that landfills must capture, treat and, if possible, recover landfill gases produced in landfills that receive biodegradable waste. Although we can profit from biogas produced from the degradation of landfilled waste, it is important to notice that the main objective is landfill diversion. Regarding enhance CH4 collection and use from waste management facilities Portugal adopted the aforementioned Biowaste Strategy, which one of the main objectives is to promote biogas recovery from anaerobic digestion facilities, thus substituting other forms of energy. This Strategy includes measures to ensure the collection and treatment of bio-waste, to improve the regulatory framework, and to ensure incentives for its implementation.

In order to reassess the remuneration process for electricity production from municipal waste, Ordinance no. 41/2020, of 13 February, fixed until August 2020 the tariff applicable, in the guaranteed remuneration system, to power plants that use municipal waste as a source of electricity production, namely energy recovery from biogas, in the areas of anaerobic digestion of municipal waste, sludge from wastewater treatment plants, as well as effluents and waste from agriculture and the agri-food industry; landfill gas; of energy recovery in terms of burning mixed municipal waste and RDF.

Strategic Plan for Municipal Waste (PERSU 2030) states that as the organic and energy recovery of bio-waste is one of the fundamental measures for compliance with several European directives, such as the Methane Strategy, or the Farm to Fork Strategy, it is important to align the objectives of decarbonization of the economy and circular economy with the objectives and waste targets, and support schemes for energy production from renewable sources should be created, namely biogas (or biomethane) from anaerobic digestion facilities, or energy produced by other types of waste recycling facilities.

It is also important to explore the possibility of current landfills that do not collect biogas, but for which there is feasibility, can leverage investments for their capture and conversion into bioproducts, such as fuel for automobile fleets or other uses, in industrial symbiosis.

Within the scope of the measure "Creation of a regulatory framework that promotes the use of waste" PERSU 2030 establishes the action "Definition of guidelines for the construction and/or improvement of infrastructure, allowing sustainable biogas production at a local level, ensuring coherence between climate policy, waste policy and the Methane Strategy" and within the scope of the objective "Strengthening economic and financial instruments" establishes the action "Financing equipment for biogas treatment and integration into the grid". Futhermore, a Working Group was set up with elements from the areas of the environment and energy, resulting in a reflection on the "Contribution of Urban Waste to the Decarbonization of the National Economy", which contains proposals for action, namely regarding the remuneration of the biomethane produced in the process of recovery of bio-waste to support the future definition of policies in this area.

This measure could also be linked to PaM5 – "Reduction of waste production and of landfill disposal and promotion of recycling."

Industry

PaM1 - EU ETS Implementation

The European Union Emissions Trading Scheme (EU ETS) is a key instrument in the mitigation policies for GHG established by the Union to tackle climate change.

Created by the ETS Directive 2003/87/EC, of the European Parliament and of the Council, of 13 October 2003, the EU ETS is based on a Cap and Trade mechanism, setting a total amount of emission allowances at EU level that cannot be exceeded and establishing the obligation to surrender 1 allowance for each ton of GHG emitted.

Considered the most cost-effective EU instrument to reduce GHG emissions, the EU ETS is currently applied to stationary installations in the energy and industrial sectors and to the aviation sector. Three phases have taken place so far 2005-2007, 2008-2012 and 2013-2020 - and phase 4, 2021-2030, is currently in place.

The increase in the carbon price, from around 5€/ton CO2 in 2005 to around 90€/ton CO2 in 2021, induced operators to implement new technologies, to change fuels and to take energy efficiency measures, reducing their emissions.

As a Member-State of the EU, Portugal has been implementing the EU ETS since its beginning in 2005. Decree-Law 12/2020, of 6 April (ETS Installations) and 93/2010, of 27 July, amended and republished by Decree-Law 195/2015, of 14 September (ETS Aviation) set the legal framework of the EU ETS at national level.

In general terms, the number of ETS installations in Portugal has been declining over the years, with a peak in 2007. After a gradual increase in phase 1, from 244 in 2005 to 258 in 2007, there was a significant decrease of the number of ETS installations to 209 in 2008, in the beginning of phase 2. As an exception to the general trend, it is noteworthy the slight increase in 2013, in the beginning of phase 3, due to the inclusion of new activities in the scope of the EU ETS Directive. The most recent data show that 148 installations were covered by the EU ETS in 2021, representing a decrease of 9% in comparison to 2020 and a new minimum since in 2005.

It is also noticeable a very significant reduction in GHG emissions from the ETS installations since 2005. In 2021, 16.0 Mt were reported as verified emissions from the ETS installations, corresponding to a 14% decrease in comparison with the previous year (18.7 Mt) and a relevant 56% decrease in comparison with 2005 (36.4 Mt).

This changes are mainly due to the introduction of natural gas in the first years to the detriment of coke and oil use and to the introduction of biomass based fuels in the years after alongside with the implementation of best available technologies and energy efficiency measures in the industry sector. In the most recent years the strong reductions are related essentially with the power sector and with the phasing-down and closing, in 2021, of the two remaining coal-fired power plants.

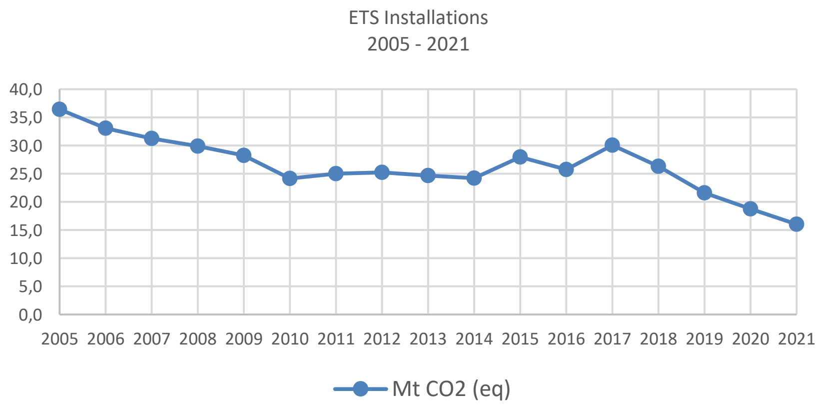


Figure 4.2.1
GHG emissions from ETS installations (2005-2021)

A significant set of policies and measures has been financed through the recirculation of the revenues generated by the EU ETS auctions and by the carbon tax, which constitute resources that were generated by the climate policy themselves. In fact, this logic of revenue circulation to the economy allows additional benefits and constitute an essential tool to manage the transition to a decarbonized and more resilient society and economy.

Additionally, the auction revenues from the EU ETS are allocated to the Environmental Fund, which assumes a prominent role as the main national instrument for financing climate action. Effectively, in Portugal, all revenues from the auction of emission allowances within the scope of the ETS have been used since 2013 in actions that contribute to the decarbonization of the economy, as well as to the fulfilment of national, European and international objectives and commitments, in terms of environmental policy, namely climate change, water resources, waste and nature conservation and biodiversity.

Also in the scope of the EU ETS Directive has been created the Innovation Fund, which is an EU funding programme for the commercial demonstration of innovative low-carbon technologies, aiming to bring to market industrial solutions to decarbonise Europe and support its transition to climate neutrality.

The Innovation Fund is the successor of the NER300 funding programme and aims to support projects related to innovation in low carbon technologies and processes, covering innovative technologies in the field of renewable energy generation and energy storage, in the energy-intensive industry, carbon capture and utilisation (CCU) and construction and operation of carbon capture and storage (CCS).

The Innovation Fund is financed through revenues from the auction of ETS allowances and will provide around 38 billion Euros of support from 2020 to 2030, depending of the carbon price. The first call for large scale projects was launched in 2020 and it is foreseen two annual calls: one for large scale projects and another to small scale projects.

PaM18 -To promote decarbonisation of industry through eco-innovation and cleaner production processes and to promote industry digitization.

In order to promote an innovative and competitive industry, it is necessary to promote the use of renewable resources, energy storage, electrification and the use of renewable gases. With a strongly renewable base electroproducer system, the aim is to promote and strengthen the use of electricity in different sectors of activity and economy, in parallel with the reinforcement of the use of other renewable energy sources such as biomass, biofuels and renewable gases.

Reinforcing the prospects of the circular economy and technology innovation are also key to identifying and creating innovative, efficient and zero-emission solutions, alongside with eco-innovation, digitalization and more sustainable business models.

Portugal has developed an Industry 4.0 Incentive System that aims to support companies in the modernization and innovation of their products, services and business models, making them more competitive in the context of Industry 4.0.

The Incentive Systems made available are divided into three types of action:

R&D: For R&D projects in cyber-physical systems; Virtualization and Simulation; Artificial intelligence; Digitization; Augmented Reality and wearables; Nanotechnology and advanced materials; Energy.

Productive Innovation: For Productive Innovation projects in Connectivity; Intelligent production processes; additive production; intelligent machine; Advanced materials; modular operations; 3D printing; Autonomous robots.

Digital economy: Digital infrastructure, cloud computing and cyber security; Advanced analytics and AI; User-Centered Design; WCM and CRM - Web Content & Customer Relationship Management; E-Commerce and E-Marketplaces; SEO and SEA - Search Engine Optimization/Advertising Social media, content & mobile Marketing; Web Analytics.

The Recovery and Resilience Mechanism, set up at EU level to help recover after the pandemic crisis and prepare a better future for the next generations, also provides an opportunity to get the economy back on track in a sustainable way. Within the scope of this Mechanism, the Portuguese Recovery and Resilience Plan focused 38% of the investments in the climate transition and foresees EUR 715 million for the decarbonization of industry.

This investment, is intended to promote and support financially the national industry and is structured for the development of projects in four areas:

1. Low-carbon processes and technologies in industry, through the introduction of new product processes and business models and the modification of processes to lead to their decarbonisation, including new low-carbon technologies; the incorporation of new raw materials, fuels derived from waste and biomass; the use of industrial symbioses and circular economy measures, incorporating innovation; and the replacement and/or adaptation of equipment and processes for new sustainable technologies and renewable energy sources. Also of note are measures to adopt fluorinated gases with low global warming potential. It is also important to increase the electrification of final energy consumption, particularly in industry, and to increase access to it as well as the quality of service, especially in industrial areas;
2. Adoption of energy efficiency measures in industry, allowing for the simultaneous reduction of energy consumption and greenhouse gas emissions, in parallel with the adoption of consumption monitoring and management systems that allow for the management and optimisation of energy consumption, taking advantage of the potential of digitalisation and automation;
3. Incorporation of energy from renewable sources and energy storage. It is also important to promote the incorporation of hydrogen and renewable gases in industry, particularly where the technological options for decarbonisation through electrification are more limited;
4. Supporting capacity building for enterprises and the development of information and support tools, such as sectoral roadmaps for carbon neutrality in industry, to identify effective, domestic industry-specific and cost-effective technological solutions that incorporate greater innovation and for promoting their dissemination and support for the measures listed.

PaM30 - Implementation of the fluorinated gas regime

Implementation of the provisions laid down in the Fluorinated Gases Regulation[52], in order to promote their substitution by other substances with lower or no GWP. This regulation took into consideration the Kigali Agreement percentage targets for average HFC emissions for the period 2011-2013. Additionally, Portugal also implements the 2006 Directive on Mobile Air Conditioning restrictions (Directive 2006/40/EC), which prohibits the use of fluorinated gases with a GWP value greater than 150 in new types of cars and vans introduced from 2011 and on all new cars and vans from 2017. The implementation of these Regulations are essential, since the fluorinated gases have been increasing their contribution to the GHG emissions.

In order to mitigate those emissions, the Fluorinated Gases Regulation imposes measures, namely in terms of containment, use, recovery and destruction of fluorinated greenhouse gases, as well as imposing conditions on the placing on the market of specific products and equipment that contain fluorinated gases and establishing quantitative limits on the placing of hydrofluorocarbons on the market.

In order to fulfil the obligations defined by the aforementioned Regulation in Portugal, there are two communications that the operators have to submit to the national competent authority in this regime, which is the Portuguese Environment Agency (APA). Those communications are:

a. Communication from the operators who own equipment containing fluorinated gases, indicating the amount of gas installed in the equipment (according to aggregate data, in 2019, operators submitted 10.885 forms; in 2020, operators submitted 11.432 forms);
b. Communication from the operators who purchased and/or sold fluorinated gases.

The following table presents the fluorinated gases data extracted from the operators' submissions (mentioned above in a)) and its variation from 2019 to 2020. Green means that the fluid increased from 2019 to 2020 and red that it decreased in that period of time.

Table 4.2.1
Values of the amounts of fluorinated gases installed in equipment from 2019 to 2020.

Fluids	Installed Quantity in January of 2020 (kg)	Installed Quantity in January of 2019 (kg)	Δ_{2019_2020} (kg)	Δ %
HFC-227ea (FM-200)	168 545	168 481	64	0,04%
R-134A	278 949	275 247	3 702	1,33%
R-23	75 580	75 766	-186	-0,25%
R-404A	620 944	601 014	19 930	3,21%
R-407C	157 893	457 470	-299 577	-189,73%
R-410A	727 823	756 928	-29 105	-4,00%
R-422D	108 851	88 756	20 095	18,46%
R.449A	266 235	170 233	96 002	36,06%
SF6	96 864	177 282	-80 418	-83,02%
Total	2 672 536	2 945 479	-272 943	-10,21%

The assessment of the data shows a great decrease in the installed amount of the fluid R407C (Global Warming Potential (GWP = 1773), a slight increase in the fluid R404A (GWP = 3921)

[52] Regulation (EU) n. º 517/2014 of the European Parliament and the Council, of 16th April 2014

and a great increase in the fluid R449A (GWP= 1397). These variations may be explained due to the restrictions imposed by the implementation of the Fluorinated Gases Regulation, which limits the use of fluids with higher GWP from 1st of January 2020.

Globally the data indicates that the quantity of installed fluids in the Portuguese equipment's decreased more than 10% from 2019 to 2020, in spite the amount of forms submitted to APA increased. This means that there will be less GHG emissions from fluorinated gases and is proof that the implementation of Fluorinated Gases Regulation is having a positive effect.

Transports

PaM12 - Promoting efficiency and expansion of public transport systems.

In 2019, the Portuguese Government established the Fare Reduction Support Programme (PART), that aims to reduce the negative externalities associated with transport, namely GHG emissions, air pollution, congestion, noise, energy consumption and social exclusion, attracting passengers to public transport. PART is a funding programme for transport authorities to develop actions that promote fare reductions in public transport systems, as well as increase the offer of service and expansion of the transport network. The evaluation of the PART showed positive results in increasing the demand for public transport and reducing the negative externalities.

To further expand the financial support to the public transport system, the Programme to Support the Densification and Strengthening of the Public Transport Offer (PROTransP) was established in 2020, with the objective of reinforcing the service level on existing public transport services and promoting the implementation of new public transport services (regular and flexible/on demand).

The renewal of the public passenger transport fleet is also underway with the acquisition of zero or low emission vehicles, namely electric and hydrogen buses through the support of the Operational Programme for Sustainability and Efficiency in the Use of Resources.

The Recovery and Resilience Plan of Portugal supports sustainable mobility with 967 M€ namely through the extension of the metro networks in Lisbon and Porto and also new Bus Rapid Systems. It also include investments dedicated to the decarbonization of public transport, through a program to support the acquisition of clean buses for public road transport and respective charging stations.

To provide a more satisfactory response to a significant part of the population's mobility needs, especially in the interior and in rural areas, due to the development of urban peripheries and the consequent dispersion of the population, Portugal established, in 2016, the specific rules applicable to the provision of Public Service of Flexible Passenger Transport.

PaM13 - Promote freight transport by rail and sea

The Strategic Plan for Transport and Infrastructure 2014-2020 (PETI3+), on which defined a set of priorities, of which the following should be highlighted:

- International connections commitments, including connexions with Spain and those resulting from the Atlantic Corridor;

- Promotion of freight transport, in particular exports;
- Articulation between national ports and the main land borders with Spain.

The National Investment Programme 2030 (PNI 2030), launched during 2020, also seeks to respond to a set of strategic purposes: to reinforce territorial cohesion, in particular by strengthening the connectivity of the territories, economic activity and enhancement of natural capital; to improve competitiveness and innovation, strengthening the infrastructural conditions of the national territory, capitalizing on its Atlantic geographic potential and its insertion in Europe; and to promote sustainability and climate action, decarbonizing the economy, making the energy transition, adapting the territories to climate change and ensuring greater resilience of the infrastructures.

For railway investments, Ferrovia 2020 is the main funding instrument, corresponding to a total investment of 10.510 M€. The National Railway Plan (PFN), which is currently being developed, needs to be highlighted as the instrument that will define the portuguese railway network to ensure communications of national and international interest.

PaM14 - Promoting active and low-impact mobility and more efficient behaviours

Portugal approved, in 2019, the National Strategy for Active Cycling Mobility 2020-2030 (ENMAC 2020-2030), in which the Portuguese Government affirms its commitment to active mobility and, in particular, to cycling, recognizing its definite contribution to achieving the sustainable development goals defined by the United Nations and asserting the country’s great potential for active mobility.

ENMAC’s Targets for 2030:

- Modal share of bicycle trips on national territory of 7.5%;
- Modal share of bicycle trips in cities of 10%;
- Total length of bicycle lanes of 10 000 Km;
- 50% reduction in cyclist road fatalities.

The U-BIKE Portugal Project is a nationwide project wich aims to reduce energy consumption, GHG emissions and atmospheric pollutants through the promotion of soft mobility, particularly the bicycle, in academic communities, by supporting the purchase of bicycles for higher education institutions.

Portugal is now drawing up its National Strategy for Active Pedestrian Mobility (ENMAP) with the aim of promoting soft mobility and active modes of transport, including the guarantee of universal pedestrian accessibility, stressing that it is necessary to adopt a city policy designed on the scale of the pedestrian, which promotes pedestrian mobility in conjunction with public transport and other active modes of transport.

PaM15 - To promote shared mobility and autonomous vehicles

On-demand passenger transport, i.e. transport services with a car and a driver which are provided at the request of the passenger, is and has been an important part of the mobility offer made available to citizens as recognized by the European Commission, namely in terms of promoting car sharing, i.e., the car (shared) use, as opposed to car ownership. These services are usually provided by taxis and/or private hire vehicles with a driver (PHV) and this sector's potential to contribute to the objective of decarbonising transport and foster mobility needs to be fully exploited.

In this sense, within the scope of the Public Transport Service Fund, which supports projects and actions that contribute to the capacity building of Transport Authorities and the improvement of the public passenger transport system, the call "Support for the Decarbonisation of the Taxi Fleet" must be highlited.

In regard to PHV, Portugal has published, in 2018, August 10th, Law 45 , which establishes the legal framework for the activity of individual and remunerated passenger transport in uncharacterized vehicles from an electronic platform, designated as transportation in an uncharacterized vehicle from an electronic platform ("TVDE"), the so-called TVDE Law.

The leap in digitalization, namely arising from the pandemic that has changed the perception of mobility, leading to a broader reimagination of how we view places and spaces in the physical world. In this sense consumers are increasingly turning to new digital services and they now expect mobility players to expand their online offerings.

Also important is the promotion of the use of communication technologies in transport to induce more sustainable behavior (connected vehicles and access to travel information data as a mean to promote a higher efficiency of the transport system). In this area, one of the most relevant actions is the Cooperative-Streets Project thatintends to implement pilots within the Cooperative Intelligent Transport Systems Services (C-ITS) in several urban and metropolitan areas feeding the Trans-European Transport Network (TEN-T), continuing the scope of the C-Roads Portugal project.

PaM16 - To promote and support electric mobility.

In terms of electric mobility, the Incentive for the Introduction of Zero Emissions Vehicles (ZEV), supported by the FA, stands out as one of the most important financial support for electric mobility. This Incentive provides financial support for the introduction to consumption of ZEV - electric vehicles and was designed with a heterogeneous public in mind - individuals and companies - it is materialised through the attribution of incentive units that depends on the typology and target of the ZEV.

In 2020, in addition to an incentive for the introduction of electric light vehicles, electric two-wheel vehicles (two-wheel motorcycles and mopeds) and electric bicycles, as in the previous years, there was also an incentive for the acquisition of cargo bicycles and conventional bicycles.

Within the scope of the Program for Sustainable Mobility in Public Administration 2015-2020 - ECO.mob, the Program to Support Electric Mobility in Public Administration with the purpose of promoting decarbonization and improving the environmental performance of the State's Vehicle Fleet also stands out.

In what concerns electric mobility it should be stressed that, in Portugal, up to 2020 (incl.), 33.749 electric vehicles were registered, of which around 84% were light vehicles (cars+vans). 2020 registered a 42% increase in BEVs compared to the previous year.

To give the adequate support to e-mobility, the Mobi.E Network, or National Electric Mobility Network, is the network of electric vehicle charging stations for universal access, interoperable and centred on the user. By the end of 2020, the MOBI.E network had 3.076 charging points, about twice as many as in the previous year, and in 2021 it grew at an average rate of 31 new charging points per week.

In the context of e-mobility the Operational Programme for Sustainability and Efficiency in the Use of Resources (POSEUR) also needs to be highlighted as an important instrument that over the last years has been providing financial support for the purchase of electric buses and electric charging stations for public transport fleets.

Furthermore, as far as electric mobility is concerned, the National Hydrogen Strategy (EN-H2), approved in 2020, should also be stressed, highlighting its targets for the transport sector to be met by 2030.

Circular Economy

PaM3 - To promote the transition to a circular economy

With a view to decarbonising the economy, the PaM3 - To promote the transition to a circular economy is intended to increase the levels of material use circularity, to lead to a substantial adaptation of (new) business models that replace the provisioning of goods with the provision of services and property by use, and the proximity between production and consumption and reduce consumption by turning waste into (new) resources. Pursue the vision and actions of circular economy that contribute to the reduction of GHG emissions provided for in the Circular Economy Action Plan, by promoting material recirculation, material efficiency of products and streamlining circular business models. Strengthening the outlook for the circular economy, efficient, zero-emission solutions over the next 30 years. Promoting the circular economy in industry, it is possible to develop innovation, develop low-carbon products designed for multiple life cycles, new business models and reduce energy and materials consumption, contributing to the fight against climate change

Portugal adopted in December 2017 a national Circular Economy Action Plan (PAEC - 2018/2020, RCM nº. 190-A/2017). It was set to be reviewed in 2020 but it has been extended to 2021.

This PAEC presents three levels of actions:

- Macro: actions structural in scope that produce transversal and systemic effects which enable society to appropriate the principles of the circular economy;
- Meso (or sectoral): actions or initiatives defined and accepted by all players in the value chain of sectors relevant to raising productivity and the efficient use of the country’s resources, seizing the economic, social and environmental benefits;

- Micro (regional/local): actions or initiatives defined and accepted by all regional and/or local government, economic and social actors which incorporate a local economic aspect and which emphasise this in the approach to social challenges.

The macro level uses the same rationale as the EU's action plan for the circular economy – product, consumption, waste/secondary raw materials – with knowledge as the key element for the development of solutions. The actions in this first cycle foresee: Measures already underway by the ministries involved in drawing up the PAEC and which it is hoped to strengthen (e.g. food waste, sub-products, research and innovation, education); New actions on "key" themes identified, such as reuse and regeneration, and consumer incentives. For each of the seven macro Actions a set of objectives were established.

The PAEC does not set specific targets since it aims to contribute to the attainment of set goals in different plans and strategies that work towards the same end. An example at the national level are the goals and targets set out in the waste plans, water and sanitation plans, climate action plan and energy plan, and also the goals advocated at the European and international level (sectoral directives, Portugal 2020, Paris Agreement and SDGs).

Despite the multiple initiatives that have taken place, the statistical indicators show that the country is, in general, performing below the EU average, maintaining the characteristics of a slow metabolism and low resource productivity. Performance in terms of circular economy shows that there are still many challenges to overcome in order to accelerate the process of transition to a new economic, social and environmental model.

According to the European Commission indicators, published by EUROSTAT we can conclude:
Data for 2019, indicate that 21.4 tonnes of materials per capita were processed, with secondary materials representing 0.48 tonnes. The circularity rate is assessed at 2.2%, while in the EU27 the average is 9.5%. In turn, the output streams (air emissions + waste in landfill), are 4.0 tonnes per capita, equivalent to 18.6% of the materials processed per capita, compared to 45.7% on average in the EU27 (based on the Material Flow Diagram).

As regards production and consumption, there has been an increase in the production of urban waste per inhabitant, and Portugal has recently surpassed the EU average as regards urban waste. The consumption of materials per inhabitant has also shown an increasing evolution in the recent past, with a value above the EU average. The evolution of resource productivity has stabilised, and in Portugal this evolution is below the EU average.

As regards waste management, progress has been limited and Portugal's performance is below the EU average for most of the indicators.

The achievement of the various objectives of the PAEC in Portugal is supported by several policy instruments of more specific and sectoral characteristics, which are largely aligned with the European regulatory framework.

1. Waste policy - in line with the principles of Circular Economy
   As regards the measures oriented towards Extended Producer Responsibility, but also those aimed at a New Life to Waste, they are provided for and framed in the General Waste

Management Regime (GWMR), in the National Waste Management Plan and, of course, in the Regime for the management of specific waste flows subject to the principle of extended producer responsibility:

- Despacho n.º 14724-A/2022 Ambiente Ação Climática - Gabinete do MinistroDecree-Law No. 152-D/2017, of 11 December - Unifies the regime for the management of specific waste streams subject to the principle of extended producer responsibility by transposing Directives 2015/720/EU, 2016/774/EU and 2017/2096/EU.
- Update of the Legal Regime for Specific Waste Streams (DL 102-D/2020, amended by Law 52/2021) - Promotes the application of extended producer responsibility with a focus on intervention at ecodesign level, determining a set of new specific waste streams and objectives relating to the reuse, repair and remanufacturing of products.
- GWMR (DL 102-D/2020, amended by Law 52/2021) - Establishes new obligations, which support the transition to circular economy with focus on prevention and promotion of the waste hierarchy, encouraging selective collection and advocating simpler and more agile waste declassification procedures.
- DL 78/2021, of 24 September which partially transposes the Directive (EU) 2019/904 on reducing the impact of certain plastic products on the environment, and amends the rules on plastic products, promoting collection and specific objectives relating to the reduction of single-use products.
- Plastic bags. The promotion of the Circular Market involves tax incentives, such as encouraging a reduction in the consumption of plastic bags. Creation of a levy on lightweight plastic bags (Law N.º 82-D/2014 of the Green Tax Reform). The value of the contribution on lightweight plastic bags was 0,08 euros, plus VAT (23%), per each plastic bag. In order to avoid the placing on the market of superfluous packaging, the free availability of carrier bags, i.e. bags with or without handle, including pouches and cartons, made of any material, which are intended to be filled at the point of sale for packaging or transport of products to or by the consumer, is prohibited, with the exception of those intended to be filled at the point of sale. (n.º4, artº. 25, DL 102-D/2020).
- Food waste. Measures to reduce food waste, both at the production and consumption level, are detailed National Strategy and Action Plan for Combating Food Waste (Resolution of the Council of Ministers N.º 46/2018).

2. Regenerating resources. With regard to initiatives aimed at Regenerating resources: water and nutrients, the instruments emanate from the policies for agriculture and for Water: The National Strategy for Organic Agriculture (RCM n.º 110/2017, of 27 July); Decree-Law No.º 119/2019, of 21 August establishing the legal regime for the production of water for reuse, obtained from the treatment of waste water, as well as its use.
3. Resource Efficiency in Public Administration. Approval of the Programme for Resource Efficiency in Public Administration for the period until 2030 (Resolution of the Council of Ministers n.º 104/2020). It focuses on energy, water and material consumption, renewable energy production, energy storage solutions as well as GHG emissions.

A new PAEC (PAECII 2023-2025) is currently in development. It will have the European framework as a background, as well as the objectives established in the Thematic Agenda "Climate transition and sustainability of resources" of the 2030 Portugal Strategy:

- Make the economy more efficient;
- Turning waste into resources;
- Make the economy regenerative;
- Promote a more sustainable society.

This *measure could also be linked to PaM5 – "Reduction of waste production and of landfill disposal and promotion of recycling."*

<u>*Waste*</u>

PaM5 - Reduction of waste production and of landfill disposal and promotion of recycling

Regarding waste management strategic documents it is important to point out that Portugal is under a transition phase. The documents described below (both under previous model and new model) set several measures and actions under main policy objectives that contribute for the achievement of PaM3 and PaM5, directed to:

- increase the levels of material use circularity, extend products life time, streamlining circular business models, reduce consumption by turning waste into (new) resources, restrict single used products.
- prevention of waste production and hazardousness, promotion of recovery operations, such as preparing for reuse and recycling and, at the same time, reduction of waste disposal, namely by landfilling and consolidate and optimize the waste management network, establishing new separate collection schemes, for bio-waste and textiles and hazardous household waste.

Previous planning model: National Waste Management Plan (PNGR 2020), Strategic Plan for Municipal Waste (PERSU 2020) and specific waste management plans for Industrial Waste (PESGRI 2015) and for Healthcare waste (PERH 2016); and National Plan for Industrial Waste Prevention (PNAPRI 2015) and Municipal Waste Prevention Program (PPRU).

New planning model: National Waste Management Plan (PNGR 2030), Strategic Plan for Municipal Waste (PERSU 2030), Strategic Plan for Non Municipal Waste (PERNU 2030) and respective prevention programs included and Biowaste Strategy.

<u>**National Waste Management Plan (PNGR 2020)**</u>

Objectives:

- Promote efficient use of natural resources in the economy
- Prevent or reduce adverse impacts arising from waste generation and management

<u>**Strategic Plan for Municipal Waste (PERSU 2020)**</u>

Objectives:

- Prevent municipal waste generation and hazardousness
- Increase prepare for reuse, recycling and quality of recyclables
- Reduce of municipal waste landfilled
- Economic valorization of outputs (recyclables and other materials) from municipal waste treatment
- Reinforce economic and financial instruments
- Increase in effectiveness and operational capacity of the sector

- Reinforce research, technologic development, innovation and the sector internationalization
- Increase sector contribution to other national strategies and plans

Strategic Plan for Industrial Waste (PESGRI 2015)

Objectives:

- Prevent waste generation: Minimization at the level of processes and at the level of products
- Know, adapt and promote the national recycling capacity, in order to forward to this recovery solution the largest technically and economically feasible amount of the waste generated
- Consolidate the national waste management system by adopting solutions aimed at harnessing the energy potential of waste
- Adequate the national waste management system with the necessary infrastructure for its treatment and minimize its referral to disposal solutions
- Environmentally requalify uncontrolled industrial waste deposition sites
- Educate, raise awareness, inform stakeholders (economic agents, technicians and the general public) on the practice of waste management in compliance with the hierarchy of prevention, reuse, recovery and disposal, in strict compliance with the law

Strategic Plan for Healthcare Waste PERH (2016)

Objectives:

AXIS – Prevention:

- Reduce healthcare waste generation
- Reduce hazardousness of healthcare waste
- Minimize adverse impacts resulting from healthcare waste generated

AXIS – Information, Knowledge and Innovation

- Ensure and provide reliable and timely information on healthcare waste
- Encourage research and innovation in the field of healthcare waste

AXIS - Awareness, Training and Education

- Ensure that professionals involved in healthcare waste management have the appropriate qualifications to perform their duties
- Assure that the different stakeholders contribute to the implementation of the strategy in terms of healthcare waste management

AXIS – Operationalization of Management

- Improve logistics and management of healthcare waste at production sites
- Increase reuse and the amount of waste sent for recycling and other forms of recovery
- Mitigate the export of hazardous healthcare waste
- Ensure a better regulation of healthcare waste management
- Ensure the effective application of an economic and financial regime for the management of healthcare waste

AXIS – Monitoring and Control

- Encourage the use of mechanisms that allow for an improvement in the management of healthcare waste
- Ensure compliance with legislation by the different stakeholders

Regarding projections we have the new planning model for the next decade:

National Waste Management Plan (PNGR 2030) (waiting for publication)

Objectives:

- Prevent waste generation in terms of quantity and hazardousness
- Promote resource efficiency, contributing to a circular economy
- Reduce negative environmental impacts through an integrated and sustainable waste management

Strategic Plan for Municipal Waste (PERSU 2030) (in preparation)

Objectives:

Axis I: Prevention

- Reduce municipal waste generation and hazardousness

Axis II: Resources management

- Promote separate collection and proper treatment
- Ensure valorization of municipal waste treatment outcomes

Axis III: Operationalization

- Strengthen economic and financial instruments
- Ensure economic sustainability and capacity of the sector
- Communicate and monitor the strategy

Strategic Plan for Non Municipal Waste (PERNU 2030)

Objectives:

- Prevent waste generation in terms of quantity and hazardousness
- Reduce environmental impacts from waste management
- Raise awareness, train and disseminate, at academic and organizational level, on prevention and waste management
- Increase investment capacity and expenditures on R&D+I directed at prevention and waste management

Biowaste Strategy

Objectives:

- Ensure the transition to bio-waste separate collection and the use of the installed composting and anaerobic digestion capacity, progressively replacing the mixed collection origins
- Promote the use of compost resulting from bio-waste treatment
- Promote biogas recovery from anaerobic digestion facilities

This Strategy includes measures to ensure the collection and treatment of bio-waste, including home and community composting, to improve the regulatory framework and to ensure incentives for its implementation

Targets for reduce GHG emissions from the waste sector set in **National Waste Management Plan**:

Table 4.2.2
PNGR 2020

Target	Indicator	Reference value	Target			Value in 2016	Value in 2018	Value in 2020
			2016	2018	2020			
a) Reduce GHG emissions from the waste sector (including wastewater)	Mt CO_{2eq}. emissions from waste sector	7,9 (year 2010)	7,6	7,3	6,9	4,7	4,6	4,4
b) Reduce GHG emissions from the waste sector	Mt CO_{2eq}. emissions from waste sector	5,1 (year 2012)	4,8	4,4	4,0	3,7	3,6	3,5

Table 4.2.3
PNGR 2030

Target	Indicator	Reference value	Target		
			2023	2027	2030
2. Reduce GHG emissions from the waste sector (including wastewater)	Mt CO_{2eq}. emissions from waste sector	6,50	5,28	4,86	4,55

Regarding waste prevention and management, besides the instruments described above, Portugal has also developed the following strategies contributing to PaM3 and PaM5:

- National Strategy to Combat Food Waste (ENCDA)
- Action Plan to Combat Food Waste (PACDA)
- National Strategy for Environmental Education (ENEA) 2020
- Action Plan for the Digital Transition
- Action Plan for the Circular Economy in Portugal

Furthermore, the following dematerialization measures have also been adopted:

- Information requirements on transboundary shipments of outgoing waste (Green Listed) from PT were dematerialized in 2013, being submitted electronically through the APA's SILIAMB electronic platform, as follows from the publication of Decree-Law No. 23/2013, of 15 of February and the publication of Deliberation no. 12/CD/2013, of 27 February. Also the compliance with the reporting obligations for the notifier, consignee and recovery/disposal facility, for Amber List waste transboundary shipments, have been dematerialized through Siliamb since 2015.
- The document that accompanies the transport of waste within the national territory was also dematerialized, becoming an electronic waste transport guide (e-GAR), issued in Siliamb, since 2017, in compliance with Decree-Law No. 102-D/2020, of 10 December as well as Ordinance No. 145/2017, of April 26, having been amended on 01/18/2019, by Ordinance No. 28/2019, of January 18. These dematerialization measures intend to prevent waste, consume less resources and and enable better traceability, monitoring and control.

In terms of legislation aiming to prevent waste generation, strengthen selective urban waste, promote the biological treatment of biowaste, increase reuse and recycling, and reduce landfilling, Portugal adopted the following:

- Decree-Law No. 102-D/2020, of 10 December that transposes waste Directive, landfill Directive and part of others Directives regarding specific waste streams, introduces important changes aiming at promoting the production and use of secondary raw materials, by simplifying by-products classification procedure (example: it becomes a self-classification procedure verified by collaborative laboratories with no fees associated and it is possible the classification as by-products in experimentation and innovation spaces) and end-of-waste status (a case-by-case approach in specific situations is allowed). We believe this legislative changes will promote the use of by-products and secondary raw materials, and the re-introduction of these materials in the economy, moving forward a more circular economy. Regarding this issue it is important to notice that in addition to European end-of-waste regulations, PT published national end-of-waste legislation for compost, plastic and tyres rubber from 2015 till now that we believe has been positive in increasing the use of this materials. From 2014, 22 by-product case-by-case decisions were published (https://apambiente.pt/sites/default/files/_Residuos/Producao_Gest%C3%A3o_Residuos/Subprodutos%20decis%C3%B5es/Decis%C3%B5es%20de%20classifica%C3%A7%C3%A3o%20de%20subproduto_Lista_ago22.pdf) and also a recent general by-product definition of criteria on soils.

The new Decree-Law also establishes the obligation of separate collection for bio-waste, hazardous, bulky and textiles waste and also used cooking oil. The separation of these fractions, complemented with a reinforcement of the separate collection of already separated fractions, will contribute strongly to better quality of the collected waste, thus promoting easier preparation for reuse and recycling and better quality secondary materials, easier to introduce again in the economy. This measure will contribute to scaling in the waste hierarchy and the use of secondary materials instead of virgin materials.

Another important change is the objectives and measures introduced by Decree-Law No. 102-D/2020 regarding waste prevention and re-use. Ambitious prevention targets for municipal waste per capita, food waste in restaurants, catering and agro-industries, and also for construction and demolition waste were established for 2025 and 2030. Restaurants, catering companies, distribution e.g. supermarkets), agro-industries must take measures to reduce food waste by 2023 and from 2024 forward these establishments and also wholesalers and retail sales are prohibited from disposing food that can still be consumed. They must establish food donation agreements with institutions of the social sector. Also for unsold non-food the entities involved in the chain of production, import, distribution, commercialization should, whenever possible avoid its disposal as waste, giving preference to its use as a product, namely by use as a product, namely by donation to associations of social and solidarity economy.

Public entities shall contribute strongly to waste prevention, by donating equipment or materials they no longer use, distribute tap water instead of bottled water and stablishing, within the scope of public procurement procedures for the acquisition of goods and services, criteria for the valorisation of proposals that foresee the supply and/or use of products that generate less waste or that are reusable, namely unpackaged products, products packaged in reusable packaging, or that can be returned when not used. The legislation also prohibits to the systematic printing and distribution of (a) receipts in sales areas and in establishments open to the public (b) customer loyalty cards provided by stores or commercial chains of stores; (c) tickets by machines and (d) vouchers and tickets that aim to promote or reduce the sales price of products or services. These are "small" measures that aim to set an example and we believe that together they will contribute to reduce the waste generation. "Bigger producers" of hazardous waste have to define in a plan measures to reduce quantities or hazardousness of the waste generated.

Regarding re-introduction of material in the economy, it is mandatory to use in construction sector at least 10% of recycled materials or materials incorporating recycled materials in relation to the total amount of raw materials used and it shall be required for other products or materials a minimum rate of incorporation of recycled material.

Also important to refer that from 2015 until 2022, waste management tax has increased from 5,5 to 22 euros per tonne, and will be 35€/tonne in 2035. From that year onwards, the proposal is to continue to increase annually, so it reaches the values where recycling will have economic advantages over landfilling or incineration, thus promoting a faster transition to a circular economy.

Decree-Law No. 78/2021, of September 24, transposes Directive (EU) 2019/904, on the reduction of the impact of certain plastic products on the environment, and amending the rules on plastic products at points of sale for bread, fruit and vegetables.
Law No. 76/2019, September 2, determines the non-use and non-availability of single-use plastic tableware in the activities of the restaurant and/or beverage sector and in the retail trade.

This measure could also be linked to PaM27 – "To promote the production and consumption of renewable gases."

Agriculture

Until the end of 2022, the policies and measures guidelines for the agricultural sector are essentially set out in the Rural Development Programme for 2014-2020 (RDP), which contains the overriding principle of concentrating aid for the sector and for the production of tradable goods addressed to operators directly involved in value creation from agricultural and forestry activities, based on the efficient management of resources.

The RDP strategic objectives include the "promotion of efficient management and protection of resources," which contributes to "priority 5 – Promoting resource efficiency and supporting the shift towards a low-carbon and climate-resilient economy in the agriculture, food and forestry sectors". The RDP identifies the need to continue improving energy efficiency and to promote the use/production of renewable energy on farms as well as the use of agricultural and forest byproducts for energy purposes. The RDP also provides for action A3: Environment, resource efficiency and climate.

The information available up to 31 December of 2021 shows that the RDP has contributed with 58.52% of programmed support (2,801 M€), 93.6% of that value already committed and 72.1% implemented to the rural development priorities linked to "Climate change objectives".

Furthermore, the available data shows that:

- 58.64% of the Utilised Agricultural Area (UAA) were covered by management contracts to support biodiversity and/or landscape;
- 31.72% of the UAA were covered by management contracts to improve water management;
- 44.12% of the UAA were covered by management contracts to improve soil management and/or prevent soil erosion;
- 57.71% of irrigated area were converted to more efficient irrigation systems;
- There was €77M investment in energy efficiency and €43.6M in renewable energy production.

The need for a contribution from the agriculture sector to meet the economy wide targets defined for 2020 is clear in the extent that it produces emissions, consumes energy and is vulnerable to climate risks and the effects of associated disasters.

The EU and Member States have incorporated grants and incentives for the adoption of measures that favoured sustainability, expressly referring to rural development policies and their funding. In this context, measures were adopted to support production practices that reduce the polluting effects of agriculture, the extensification of plant and animal production, the maintenance of abandoned agricultural and forestry land, long-term agricultural land, for environmental-related purposes and also to farmers' awareness and training, in terms of agricultural production compatible with the conservation of natural space. Changes were made in these agri-environmental measures in each new Community Framework and are supported by the European Agricultural Fund for Rural Development (EAFRD) . Support in this area should:

- Continue to play a prominent role in supporting the sustainable development of rural areas and in responding to society's growing demand for environmental services;
- Encourage farmers and other land managers to serve society as a whole by introducing or maintaining agricultural practices that contribute to climate change mitigation and adaptation to climate change and which are compatible with the protection and improvement of the environment, landscape and its characteristics, natural resources, soils and genetic diversity;
- Contribute to cover the additional costs and loss of income resulting from the commitments made, covering only commitments that exceed the applicable mandatory requirements and standards, in accordance with the polluter pays principle.

In Portugal, the agricultural sector is mainly regulated by regulations linked to the implementation of the Common Agricultural Policy (CAP), which has evolved over the years to adapt to socio-economic and environmental changes within the European Union. Thus, the multifunctionality of agriculture and the interrelationship between agriculture and the environment and, as a consequence, its influence on climate change and its effects on agricultural activities were recognised.

As from January 2023 the new Common Agricultural Policy will enter into force, with the implementation of the Portuguese Strategic Plan (PEPAC 2023-2027), approved on 31 August

2022 under the new CAP legislation, with the following strategic vision: "Active management of the whole territory based on innovative and sustainable agricultural and forestry production".

The new CAP includes as one of its 10 key objectives, Climate Change Action: to contribute to climate change mitigation and adaptation, including by reducing greenhouse gas emissions and enhancing carbon sequestration, as well as promoting sustainable energy.

This objective is translated in the PEPAC 2023-2027, in the case of mitigation, into the aims of reducing greenhouse gas emissions (GHG), increasing atmospheric carbon storage capacity and improving soil organic matter content. In order to achieve these aims support is foreseen, for the implementation of sustainable agricultural and livestock practices; efficient pasture management; cattle feed efficiency (increased digestibility in ruminants); effluent management; organic fertilisation; and support of agricultural activity in areas with high risk of fires; as well as agricultural, forestry and bioeconomy investments with such goals. In terms of forestry, and aiming to increase forest biomass, support is foreseen in terms of afforestation, restoration and sustainable forest management.

With regard to renewable energy, the aim is to increase its production and its use in the context of improving energy sustainability in farms, forestry and agro-industry, with interventions to support investment in the generation of renewable energy in both the agriculture and bioeconomy sectors. Increasing energy efficiency, in particular associated with irrigation, is also an important goal of the PEPAC.

PaM4 - To promote Research and Development (R&D) projects that support the transition to a carbon neutral economy, based on an innovative and competitive industry, sustainable agroforestry management and mobility and minimizing waste production.

The Rural Development Programme for 2014-2020 (RDP) has contributed to promote R&D projects that support sustainable agroforestry management, through investments in innovation and knowledge transfer with impact in the reduction of GHG emissions and increase in carbon storage capacity in soil and biomass, and in the field of decarbonisation and energy and water use efficiency.

PaM6 - To promote the production and use of renewable energy sources in the agricultural and forestry sectors; To adopt agriculture and forestry hydric and energy efficiency measures.

The National Strategy for Livestock and Agroindustrial Effluents 2030 (ENEAPAI 2030) is noteworthy for its expected impact on the production and use of renewable energy sources.

With regard to the adoption of more efficient energy and water practices, the National Irrigation Programme (PNRegadios), approved in 2018, aims to expand, rehabilitate and modernise existing irrigated areas by increasing their water and energy efficiency and by contributing to water savings and to reduce water losses, as well as to create new areas of collective infrastructure. This investment amounted to around 560 million euros financed through the

RDP, the European Investment Bank and the Council of Europe Development Bank, in a total intervention area of around 96 400 hectares and having indirect impacts over a wider agricultural area.

Beyond investments in collective infrastructures, the RDP has also supported increased efficiency in individual infrastructures at farm level, as well as in the sectors of transformation and commercialisation of agricultural products.

PaM7 - Promoting biological, conservation and precision farming.

The RDP 2014-2020 has contributed to fostering precision farming through support of investments. Organic and conservation farming has been promoted through agri-environmental measures.

Also relevant is to note the adoption of the National Strategy for Organic Farming (ENAB) and the Action Plan for the Production and Promotion of Agricultural Products and Organic Food (ActionPlan).

A National Observatory for Organic Production was created within the scope of the ENAB and the ActionPlan. This free-access Observatory aims to collect, process and disseminate (though a web portal dedicated to organic agriculture) available information on the production, processing and marketing of organic products, including on their consumption and various existing markets. An evaluation carried out in December 2020 shows that among the 58 measures foreseen in the ActionPlan 31% were implemented, while 40% are in progress. Further information can be found on https://www.producaobiologica.

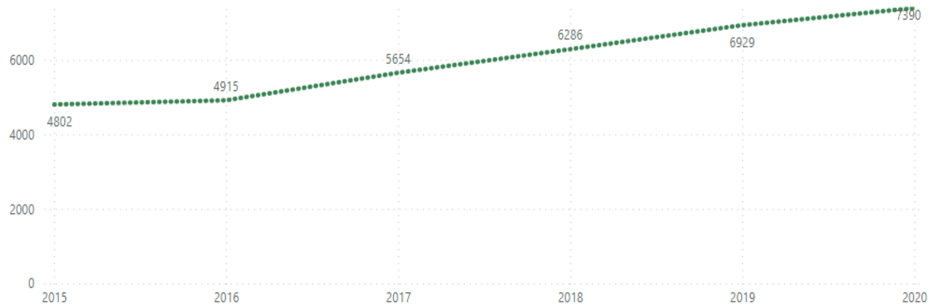


Figure 2.11.3
Organic Production - Number of Operators in Organic Production by 2020
Source: DGADR (2022)

PaM9 - Promoting decarbonisation of livestock activity.

The National Strategy for Livestock and Agroindustrial Effluents 2030 (ENEAPAI 2030) deserves additional mention, as it aims, among other objectives, to promote agricultural valorisation of livestock effluents with an increase in organic matter and its capacity to sink into the soil.

For its part, the RDP 2014-2020 has promoted the increase in soil sink capacity through agro-environmental measures such as: minimum tillage practices, direct sowing, greening; extensive grazing; maintenance of pastures, agro-forestry mosaics; installation, maintenance and recovery of riparian galleries; and support for maintaining activity in areas subject to natural or other constraints.

The ENEAPAI 2030 updates the previous one (ENEAPAI 2007-2013), and aims to correct situations of imbalance between environmental resources and territorial resources, taking into account the specificities of the different regions, in an integrated vision, considering the opportunities and challenges of sustainable development and greater economic and social cohesion at national level, in order to guarantee greater environmental quality and greater opportunities for economic sectors and populations.

The ENEAPAI 2007-2013, covering mainland Portugal, made it possible to identify the contribution and the most relevant sectors of activity in terms of the pollution generated, set and defined guidelines, measures, models and solutions and predicted the allocation of financial resources. However, this strategy did not have the intended practical implementation and that remains, at a high level, the pressures on water bodies caused by these economic activities[53].

ENEAPAI 2030 is also an instrument that aims to ensure compliance with the objectives of the European Ecological Pact and the National Carbon Neutrality Roadmap. It covers relevant areas, namely in terms of agricultural recovery of livestock effluents associated with the prevention and control of soil and water contamination and greenhouse gas emissions.

The interaction of agricultural activity in the field of livestock effluent management, with natural resources: soil, water, air and biodiversity, is inevitable, and the respective impacts are not necessarily negative or positive.

It was based on this principle that the National Strategy for Agricultural and Agroindustrial Effluents 2030 (ENEAPAI 2030), based on five major axes, was established, in order to identify solutions that allow responding to environmental problems, namely those diagnosed in the five critical areas at the national level.

In this context, and in order to achieve its objectives, ENEAPAI proposes the identification, prioritization and promotion of potentially usable solutions in a sustainable management of effluents, adapted to current uses, combined with the promotion and implementation of interoperable information systems that allow an effective traceability of effluents.

It also targets enhanced generation of bioproducts with endogenous and renewable materials (livestock effluents) carrying high agroeconomic and bioenergy interest, associated with the conservation and valorisation of ecosystems with high ecological value (carbon capture, erosion control, water quality improvement, preservation and promotion of biodiversity and fire prevention). Moreover, the ENEAPAI aims to promote energy resilience at national level.

For its part, the RDP 2014-2020 has supported investments in the installation and conversion of effluent management and treatment systems. The new Strategic Plan 2023-2027 (PEPAC) foresees the operationalization of a new measure to promote good practices, namely the

[53] Water National Plan, Decree-Law n.º 76/2016 of 9th of November

"Improvement of digestibility in animal feed" with intended impact on the reduction of bovine CH4 emissions.

PaM10 - Conserving, restoring and improving agricultural and forest soils and preventing their erosion.

The ENEAPAI 2030 is again worth mentioning, as it aims to promote agricultural valorisation of livestock effluents with an increase in organic matter and having effect on reducing soil erosion.

Furthermore, in order to receive support under CAP direct payments (EAGF), beneficiaries are required to respect "conditionality" requirements that translate into a set of "standards of good agricultural and environmental conditions of land" (GAEC) and "statutory management requirements" (SMRs). Beneficiaries are also required to respect conditionality when they make use of support under agri-environmental measures (EAFRD), where standards are applicable.

The following practices are specifically mentioned In this respect: Establishment of buffer strips along watercourses (GAEC1); Minimum soil cover (GAEC4); Minimum land management, reflecting site-specific conditions, to limit erosion (GAEC5); Maintenance of soil organic matter through appropriate practices, including the prohibition of stubble burning, except for phytosanitary reasons (GAEC6); Retention of landscape features, including, where appropriate, hedges, ponds, ditches, trees in line, in group or isolated, and field margins and terraces, including a ban on cutting hedges and trees during the breeding and rearing seasons, and, optionally, measures to avoid invasive plants, which have an impact on sink capacity (GAEC9).

The RDP 2014-2020 envisages to support investments with a positive impact on the soil, through agro-environmental measures such as: minimum tillage practices, direct sowing, greening; extensive grazing; maintenance of pastures, agro-forestry mosaic; installation, maintenance and recovery of riparian galleries; and support for maintaining activity in areas subject to natural or other constraints.

This measure could also be linked to PaM8 – "Improving natural sink potential of agriculture and forest."

PaM11 - Reducing the use of nitrogen fertilisers

Through a number of measures and good agricultural practices, rational fertilisation, sustainable management of livestock effluents and irrigation management, the Code of Good Agricultural Practices for the protection of waters against pollution with nitrates and phosphates of agricultural origin (Order No. 1230/2018) and the Action Programme for areas vulnerable to nitrate contamination (Ordinance No. 259/2012), aim to contribute to the reduction of water pollution caused or induced by nitrogen and phosphorus loss, and to prevent the spread of these nutrients in vulnerable areas. These two instruments define technical standards in fertilisation and equipment use that are intended to reduce N losses by volatilisation and thereby decrease GHG and NH3 emissions.

To receive support under direct payments (EAGF) and agri-environmental measures (RDP 2014-2020), beneficiaries are obliged to comply with Articles 4 and 5 of Directive 91/676/EEC (Nitrates Directive) with an impact on the reduction of nitrogen fertilisers.

The RDP 2014-2020 fosters decreased consumption of nitrogen fertilisers by supporting investments in precision agriculture and a set of agro-environmental measures that promote good fertilisation practices, namely sustainable production methods, such as organic farming and integrated production; and the PEPAC 2023-2027 entails a new measure to promote good practices in this field, namely "Replacing the use of mineral fertilisers with organic fertilisers".

Code of Good Agricultural Practice for the protection of water against nitrate and phosphate pollution

The Code of Good Agricultural Practices for the protection of waters against pollution with nitrates and phosphates of agricultural origin aims to promote the adoption of good agricultural practices by agricultural and livestock producers in Portugal. It identifies a set of cultural measures and techniques for managing the nitrogen and other nutrients to optimize their use and protect water, some of which may simultaneously contribute to protecting the air by reducing the emissions of certain gases. These measures and techniques are associated with rational fertilization, with some aspects of sustainable management of livestock effluents and with irrigation water management. Rational fertilization allows to make a better use of fertilizers, with a consequent reduction in the amount of fertilizers applied, namely nitrogen fertilizers and, consequently, to reduce emissions during and after their application to the soil. The lower use of chemical fertilizers in fertilization will also correspond to a lower need for their production and the consequent reduction in emissions associated with the manufacturing process.

Action Programme for areas vulnerable to nitrate contamination

This programme contains a set of measures and good agricultural practices, within the scope of rational fertilization, sustainable management of livestock effluents and irrigation management, which aim to reduce the loss of nitrogen and phosphorus to the water, in order to reduce the water pollution caused or induced by these nutrients and to prevent the spread of this polluters into vulnerable areas.

With the implementation of the measures included in the action program, associated with rational fertilization, there is a reduction in the use of fertilizers. However, in order to maintain or improve soil fertility, the action programme also makes it mandatory to adopt fertilization techniques and use equipment that reduces nitrogen losses by volatilization, with the consequent reduction of associated GHG emissions.

In Portugal, there has been a decrease in the consumption of fertilizers. Portugal registered the lowest consumption of mineral fertilizers (nitrogen and phosphorus) of the EU27 Member States, recording in 2019 a consumption that is less than half of the EU27 average[54].

[54] Instituto National Statistics - Agricultural Statistics: 2020. Lisbon: INE, 2021. Available at www.ine.pt/xurl/pub/437147278. ISSN 0079-4139. ISBN 978-989-25 -0572-5)

The apparent consumption of fertilizers, expressed in macronutrients Nitrogen (N), Phosphorus (P_2O_5) and Potassium (K_2O), was of 170 thousand tons in 2021 (176 thousand tons in 2020), reflecting a decrease of 3.5% compared to the previous year. The representativeness of macronutrients in fertilizers makes it possible to highlight nitrogen, the macronutrient with the highest expression in the total apparent consumption of fertilizers with 53.8% in 2021 (58.6% in 2020), followed by potassium with 23.2% (19.9% in 2020) and finally phosphorus with 23.0% (21.4% in 2020). Between 2015 and 2021, the highlights are the decrease in the use of nitrogen (-22.5%) and phosphorus (-15.5%) and the increase in the use of potassium (+13.5%). For the decrease in the apparent consumption of nitrogen contributed to the 22.7% reduction in the area of cereals in the period under review. The increase of 11.6% in the permanent area under cultivation will not be unrelated to the increase in potassium consumption.

LULUCF

PaM8 - Improving natural sink potential of agriculture and forest.

Portugal, as a signatory State of the Resolutions of the Ministerial Conference of the Protection of Forests in Europe, is committed to the general principles of Sustainable Forest Management (Helsinki Resolution H1) and to the Criteria and indicators for Sustainable Forest Management (Lisbon Resolution L2) which take in due consideration the carbon balance as well as biodiversity enhancement.

Improving natural sink potential of the forest is therefore an objective that is enshrined in the forest policy instruments in all of the identified dimensions and in a mutually supportive way:

- Conservation of carbon in existing forests
- Enhanced forest management
- Prevention of deforestation
- Strengthening protection against natural disturbances

There is a constant need to adapt forest related institutions, programs and instruments to changes and therefore forest policy development is an iterative process. Briefly, the main instruments developed in relation to this objective are:

- National Forest Strategy (updated in 2015);
- Regional Forest Management Plans – PROF (reviewed/updated in 2019);
- National integrated rural fire management plan (adapted in 2020) and a new system for integrated rural fire management (legislative measure, approved in 2021);
- Forest and Land Use Legislation

While the National Forest Strategy sets the main goals and policy objectives, the regional forest management plans (PROF) are the basic planning instrument that set the mandatory requisites for afforestation and, in general, for forest management practices, aiming at its enhancement and taking into account the multifunctional role of forests. The normative role of these plans include, for instance, rules to prevent soil erosion, increasing productivity of forests, namely by using species and improved sylvicultural models that are more adapted to regional and local conditions. Forest owners that have forest areas above a certain threshold have to present a specific management plan for their property, which has to follow the PROF rules and has to be approved by the national authority for forests (ICNF - Institute for Nature Conservation and Forests).

The excessive fragmentation and small dimension of forest estates constitutes a critical problem. To deal with it, there is the possibility to define Forest Intervention Zones (FIZ), with the objective of overcoming problems connected to it so as to ensure, in those areas, both forest protection and enhanced forest management.

Specific legislation is in place to protect some indigenous species and habitats and to prevent the introduction of invasive alien species in the country. Habitats and Areas of interest for nature Conservation are designated by law as Protected Areas; the introduction, possession and use of Invasive Alien Species in natural environment is also regulated by law.

Deforestation and afforestation follow an authorized/planned procedure:

- Afforestation and re(afforestation) requires a mandatory licensing process
- Environmental Impact Assessment is mandatory for afforestation and reforestation projects with fast growing species, above a certain area, as well as for projects that may entail deforestation.

Portugal also adopted other legislation, like the mandatory declaration of forest harvesting (include traceability) and defined supporting measures under the Plan for Recovery and Resilience aiming at a more resilient rural landscape.

In fact, a new paradigm to address the challenge to prevent increased threats by biotic and abiotic risks is the integrated land use planning. Portugal has a strong planning system in relation to land use change, based on the municipal level: the main objective is to optimize the spatial distribution of several land use categories, classifying and qualifying land use units. The starting point is the identification of restrictions that can limit the use of the soil, like the National Agriculture Reserve and the National Ecological Reserve (about 50% of the territory).

Furthermore, as regards policy planning, it is also important to mention the publication of the National Spatial Planning Policy Programme (PNPOT) in 2019, which is an action program designed for the 2030 horizon, with prospective visions for 2050.

IN PNPOT, the defined Territorial Model establishes the spatial organization based on the territorial systems: Natural, Urban, Social, Economic and the Connectivity. Critical Vulnerabilities are also considered, resulting from the current territorial fragilities, which require an extra effort of adaptation induced by public policies, aimed at strengthening the adoption of measures to promote the resilience of the Portuguese territory, especially to climate change.

This Programme includes a geographical analysis showing the links between territories susceptible to certain hazards and the land uses that occur in these areas. With the macro mapping of natural hazards, the PNPOT aims to give a spatial expression to situations where the hazard conflicts with land use and occupation. It is important to highlight:

- The territories at high and very high risk of rural fire, in which continuous and dense forests occupy at least 60% of the municipality area, need new forest management policies to reduce existing vulnerabilities and to be planned in the face of extreme events of drought, heat and wind;
- In territories traditionally occupied by fragmented urbanization and dispersed construction, where there are extensive and intertwined criss-crossed boundaries between built-up areas and forest (with great vulnerability to rural fire), the management of interfaces and the adoption of adaptation measures are key issues;
- The territories occupied by agriculture in more than 40% of municipality area, located in areas susceptible to drought and soil desertification, it fundamental to reinforce actions for the efficient management of water and for soil protection and enrichment;
- Urbanized and built-up areas subject to flooding and coastal overflow hazards and areas of potential loss of territory, due to the breaking of dunes and the retreat of cliffs are situations of extreme vulnerability. In these areas, the principles of precaution and prevention should be maximized, and solutions to adapt and increase the resilience must integrate coastal protection and valorisation.

Box 4.2.1

Dealing with Rural Fires: PNGIFR - **The national integrated rural fire management plan**

Right after the 2017 catastrophic fires a new rural fire management system was set up, and in 2020 the new PNGIFR established a strategy and measures regarding also the role of wildfire management in climate change.

With regard to national, European and international commitments in terms of CO2 emissions adopted by the Plan, reference should be made to the Roadmap for Carbon Neutrality 2050. In this matter, the Portuguese rural fire management strategy is based on reducing emissions and increasing carbon sequestration by forests, with a critical success factor being the 60% reduction in burnt areas (from an average of 164 thousand ha between 1998 and 2017 to about 70 thousand ha/year in 2050), ensuring that there is no forest loss, that there is an increase in average forest productivity due to improved management, that 8,000 ha/year of non-forested areas are planted with trees and that small ruminants are promoted in fuel management actions, as stated by PNGIFR.

In view of the fact that peak emissions are linked to fire seasons with a larger burned area, it is crucial to design strategies that in the next decades reduce the likelihood of the events like the ones of 2003, 2005 and 2017 (this year with more than 10 Mt of Co2e of emissions).

The progression towards an integrated system, both in terms of governance and operational management, will be decisive for implementing this vision, since minimizing potential damage as a result of extreme wildfire events is the strategy's ultimate goal. Protect Portugal from severe rural fires – the vision outlined in the strategy – is in line with the mission protect people and property from rural fires and ensuring ecosystems are wisely managed, preventing land abandonment. To fulfill this mission, that has two distinct, complementary and interdependent areas and requires different approaches and techniques, the previous system was changed.

As such, the plan is based on two pillars of action. These two pillars, Rural Fire Management (RFM) and Rural Fire Protection (RFP), are a significant difference in relation to the previous plan (PNDFCI – National Forest Fire Protection Plan), in force between 2006 and 2018. They require specialization and the resulting qualifications in order to be able to more effectively manage land and what are becoming increasingly complex events.

The strategic coordination and monitoring of the strategy falls under the responsibility of the new Agency for Integrated Rural Fire Management (AGIF), created by decree-law in 2018. The Institute for Nature Conservation and Forests (ICNF) coordinates prevention efforts on rural lands (RFM) and the National Authority for Civil Protection and Emergencies - ANEPC coordinates prevention in the urban and surrounding areas (population clusters, industrial areas and other infrastructures used by people and typified in specific legislation). These agencies contribute to designing prevention and suppression measures for each land type. ANEPC is tasked with commanding suppression operations. Because of its experience and transversability, the National Gendarmerie (GNR) is entrusted with coordinating inspection, surveillance and detention, and also supports prevention and suppression operations, according to the strategic guidelines of the strategy and the technical needs identified by INCP and ANEPC.

It should also be noted that implementing the system necessarily requires the commitment not only of local authorities, particularly in prevention activities, encouraging the self-protection of towns and villages and people, and reinforcing the responsibility of each citizen and landowner, but also of hundreds of other stakeholders, like utility line managers, armed forces, judiciary police, communal land managers, forest owners associations, private companies, etc.

National Landscape Transformation Program

It is also worth mentioning the Landscape Transformation Program, launched in 2020 that provides for the launch and implementation of concrete measures for intervention in rural areas, through the conclusion of program contracts between the State and the management entities that will promote integrated landscape management operations. Increasing the resilience of territories to risks and valuing the landscape from a multidimensional and carbon sequestration perspective are the objectives that justified this public investment under the PDR2020 and the FA.

The financing of the Landscape Transformation Program, in the current programming period (2014-2020), is carried out in the multi-fund operational modality, channeling financial resources from the Recovery and Resilience Plan (PRR), the European Agricultural Fund for Rural Development, the Environmental Fund and the Permanent Forest Fund. There is however an uncertainty about its funding, which will have to undergo a necessary reinforcement as the from which most of the funding for that program comes, has to be executed by the end of 2023. The implementation of the Landscape Transformation Program is monitored and receives technical support from the Conservation of Nature and Forests Institute (ICNF, I. P.) and the Directorate General of Territory (DGT).

Also within the scope of the Landscape Transformation Programme, the "Emparcelar para Ordenar" Program should be highlighted, as it aims to encourage the increase in the physical dimension of rural ownership in the context of smallholdings and, thus, increase the economic, social and environmental viability and sustainability. This program aims to contribute to the planning and management of territories, by directly stimulating agricultural and forestry producers, with a specific objective also to increase the resilience of the territory to risks, but also to minimize other vulnerabilities in a context of climate change.

Fiscal measures

PaM2 Green tax implementation

In 2014, Portugal introduced a green tax reform as part of a broader fiscal consolidation effort. Law No. 82-D/2014 has introduced several tax amendments, such as expanding the scope of the carbon tax to sectors not covered by the EU ETS (detailed in PaM28), defining vehicle taxes rates according to their carbon dioxide emissions, setting taxation on lightweight plastic bags, as well as revising the taxation of water and waste management.

Combined with lower taxes on diesel and EU vehicle performance standards, vehicle taxation has resulted in lower average CO2 emissions from new passenger cars, in recent years, new car registrations have been progressively shifted to electric vehicles (EVs).

Portugal applies taxes on ownership and use of motor vehicles. The registration tax (*Imposto sobre os Veículos* – ISV) is based on cylinder capacity and CO2 emissions (light passengers) or only on cylinder capacity (other light vehicles, and motorcycles). An additional flat tax is levied on diesel light vehicles without particulate filters. Electric vehicles (EVs) are exempted from ISV and discounts apply to hybrid vehicles.

The annual circulation tax (*Imposto Único de Circulação* – IUC) for light vehicles is tied to the cylinder capacity, CO2 emissions and year of registration. EVs are exempt from IUC but hybrid vehicles pay the normal rate.

In addition to vehicle tax exemption, Portugal promotes EVs through subsidies and investment in charging infrastructure.

The General Regime for Waste Management published by Decree-Law No. 178/2006, of 5 September (Article 58) has created the Waste Management Fee (TGR), in force since 2007, with the intention to contribute to the improvement of the behaviour of economic operators and final consumers, reducing waste production and ensure a more efficient management, in accordance with the waste hierarchy. This fee is calculated annually being applied to facilities that carry out treatment operations such as landfilling (D1), incineration (D10) or waste use as fuel or other means to generate energy (R1).

TGR has undergone several changes since its entry into force, noting in particular the amendment in 2014 with « Green Taxation », namely through the differentiation by waste management operation in compliance with the waste hierarchy (indexed to the landfill operation), and the creation of a Non-Reflectable TGR fraction to the initial waste producer, applicable to Urban Waste Management Systems (SGRU) and indexed to deviations from the individual goals defined by PERSU 2020. Recently, Decree-Law No. 102-D/2020, of 10 December, brought new changes to TGR, namely with the introduction of the concepts of aggravation and relief, related to the % of recoverable waste deposited in landfills and to the % reached of separate collection of bio-waste.

PaM28 Carbon tax for non EU ETS sectors

The carbon tax has been introduced with the green tax reform (detailed in PaM2) that occurred in 2014 in Portugal. This tax has been applied since 2015 to sectors not covered by the EU ETS (through an addition to the Tax on Petroleum and Energy Products - ISP), whose value is indexed to the ETS auctioning. The value of the carbon tax in 2015 was €5.09/tCO2 and in 2021 it was €23,921/tCO2, reflecting the rising of carbon price. This measure promotes a trend towards a low carbon economy, contributing to the fight against climate change. It also allows the majority of national emissions to be currently subject to a carbon price (either through the ETS or through the carbon tax). Achieving a robust carbon price and making use of carbon pricing systems is therefore one of the most important tools we have today in our policy portfolio.

Policies and Measures no Longer in Place (4.3)

All the mitigation actions which were reported in 7NC/3BR are included in the 4BR and in this 8NC/5BR. They were only renamed or regrouped so as to be more in line with our NECP or other plans.

For example, regarding waste, in the previous planning model, the National Waste Management Plan (PNGR 2020), Strategic Plan for Municipal Waste (PERSU 2020) and specific waste management plans for Industrial Waste (PESGRI 2015) and for Healthcare waste (PERH 2016);

and National Plan for Industrial Waste Prevention (PNAPRI 2015) and Municipal Waste Prevention Program (PPRU) were converted into a new set of policy tools for a new planning model that is now composed of the following policy plans and instruments: National Waste Management Plan (PNGR 2030), Strategic Plan for Municipal Waste (PERSU 2030), Strategic Plan for Non Municipal Waste (PERNU 2030) and respective prevention programs included, Biowaste Strategy and Strategy for Management of Sludge resulting from the municipal waste water treatment.

Also, in what concerns agriculture, the PeMs on the Promotion of more eficient livestock effluent management systems and on the Incentive to reduce the use of nitrogen fertilizers have been continued and included in the PEPAC (2023-2027). Furthermore, the PeM Conserving, restoring and improving agricultural and forest soils and preventing their erosion is a measure that was included in the PDR2020 and which is continued under the PEPAC (2023-2027).

Assessment of the economic and social consequences of response measures (4.3)

Portugal's contribution to the minimization of the adverse effects of climate change in other Parties, particularly developing countries, is carried out first of all through a strong commitment to implementing the Convention and the Kyoto Protocol.

By working on the implementation of the Protocol, Portugal is struggling to minimize not only the adverse effects of climate change in specific sectors, industries or other Parties, but also any adverse effects due to the reduction of greenhouse gases. This is due to the development of different actions and implementation of different instruments conceived to promote sustainable development and the commitment to support developing countries.

The policies and measures implemented, adopted or foreseen previously under the National Plan for Climate Change (PNAC), and currenty under the PNEC, targeting the six GHG of the Kyoto Protocol through its broad portfolio of instruments and wide-ranging coverage of all sectors of the economy, make up a significant effort by the Portuguese Government to address climate change, including the minimization of adverse effects of such policies.

The transition to a carbon neutral economy by 2050 relies on the contribution of all sectors. Particularly, in the context of the 2050 Carbon Neutrality Roadmap and the NECP 2030, there is a strong push for the diversification of energy sources and to the increase of endogenous renewable resources. In some cases, measures already implemented pertaining to the diversification of primary energy sources (namely the introduction of natural gas in the economy in the late 1990s), can simultaneously have positive effects on Portugal's emissions reduction and in the economy of some fossil fuel exporting countries.

To ensure that all relevant possible impacts are taken into account, Portugal has established the System for Policies and Measures (SPeM) to assess the economic and social consequences of climate policy measures throughout the different sectors. For the development of new policy initiatives, the members of SPeM (from all the economy sectors) are called to present their policies and measures with the potential of GHG emissions reduction and respective foreseen costs.

Furthermore, Portugal is keen in assisting third countries on a sectoral level, such as for trade agreements, as well as on an overarching political level in regional cooperation with those countries. The action of the Portuguese cooperation is developed on the basis of geographical priorities which are centred in the countries Língua Oficial Portuguesa (PALOP) and East Timor. All these countries are within the group of more vulnerable countries to the variations caused by climate changed either, because they are situated in its majority in Africa, or belong to the set of least developed countries and/or are small insular States. This way, it is ensured that the effects of climate change policies on non-EU countries are taken into account.

The cooperation of Portugal with third countries looks to the integration of the adaptation dimension of climatic assessment of the economic and social consequences of response measures to climate change.

Portugal's Official Development Assistance (ODA) also supports third countries to effectively implement the Paris Agreement in a manner that unlocks socio-economic opportunities and supports climate objectives, by providing capacity building and technology transfer for partner countries.

At a multilateral level, Portugal supports the implementation of adaptation measures in the most vulnerable countries, in particular within the Community of Portuguese Speaking Countries/ Comunidade dos Países de Língua Portuguesa (CPLP) and has made contributions to the Green Climate Fund.

At a bilateral level, Portugal supports projects in in particular within the Community of Portuguese Speaking Countries/ Comunidade dos Países de Língua Portuguesa (CPLP) and promotes the sectoral integration of the adaptation component in the Cooperation Programs, in particular in the scope of higher education and research in the field of Environmental Engineering, Agriculture and Rural Development, and Health.

Projections and Total Effect of Policies and Measures (5)

As mentioned in the 4th Biennial Report, the projections on GHG emissions were prepared during the elaboration of the National Energy and Climate Plan 2030 (PNEC2030) and the Carbon Neutrality Roadmap 2050 (RNC2050).

This modelling exercise, with the 2050 horizon, aimed to identify cost-effective trajectories and the main decarbonisation drivers consistent with the carbon neutrality objective and this are still the most up to date emissions projections available.

Projections (5.1)

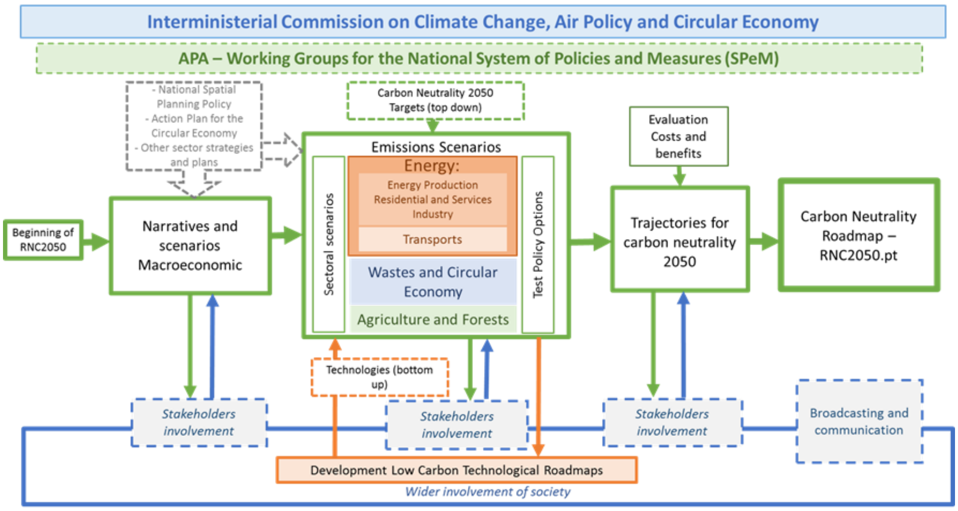


Figure 5.1.1
Workflow of the Carbon Neutrality Roadmap 2050

The Roadmap work had as its starting point for the development of greenhouse gas emission trajectories, the development of coherent socioeconomic scenarios, based on common narratives of possible evolutions of the Portuguese society until 2050, based on the evolution of macroeconomic parameters and demographic trends (which are shown in table 5 of the CTF Tables).

The proposed scenarios were subject to an external consultation and validation process, in particular with entities with responsibilities in the field of economic forecasting in Portugal (such as Portugal Central Bank, GPEARI – Finance Ministry Office of Planning, Strategy, Evaluation and International Relations; INE – Portuguese National Statistics Institute; GEE – Economy Ministry Office for Strategy and Studies; Foresight and Planning Department of the Environment Ministry, among others).

The narratives and their macroeconomic and demographic variables developed allowed, in the later modelling phase, to establish and characterize evolution scenarios for the different activity sectors - energy and industry, transport and mobility, agriculture, forests, and waste and wastewater, namely by the estimation and characterization of demand for energy and services. In this context tree scenarios were developed:

- a scenario that retains the essentials of the economic structure and current trends as well as decarbonisation policies already adopted or in force, but does not include the adoption of additional policies, called the Off-track Scenario (FP);
- two scenarios of socioeconomic evolution compatible with carbon neutrality, however achieved in different contexts, called Platoon Scenario (PL) and Yellow Jersey Scenario (CA).

The Platoon scenario is characterized by the development and application of new technologies that, however, do not significantly change either the production structures or the population's lifestyles. It foresees a modest incorporation of circular economy models and the maintenance of population concentration in the Metropolitan Areas, while the Yellow Jersey Scenario is characterised by a structural and transverse change in production chains, made possible by the combination of a series of technologies of the 4th Industrial Revolution. It foresees a more effective incorporation of circular economy models and greater growth of the importance of medium-sized cities. In the Platoon and Yellow Jersey scenarios, two variants were also considered, one in which the economy evolves without imposing a GHG emission reduction target (called "without neutrality") and a variant in which the economy evolves with the imposition of a GHG emissions reduction target (called "with neutrality").

Thus, for the purposes of this projection report and to fill in Table 3 regarding the parameters used for the projections, the macroeconomic scenario associated with the Platoon (PL) scenario was considered (scenario "without neutrality" – corresponding to a WEM scenario and scenario "with neutrality" – corresponding to a WAM scenario), which translates into a more conservative evolution of GDP, the structure of the economy and the population over the period 2020-2050 (compared to the CA scenario).

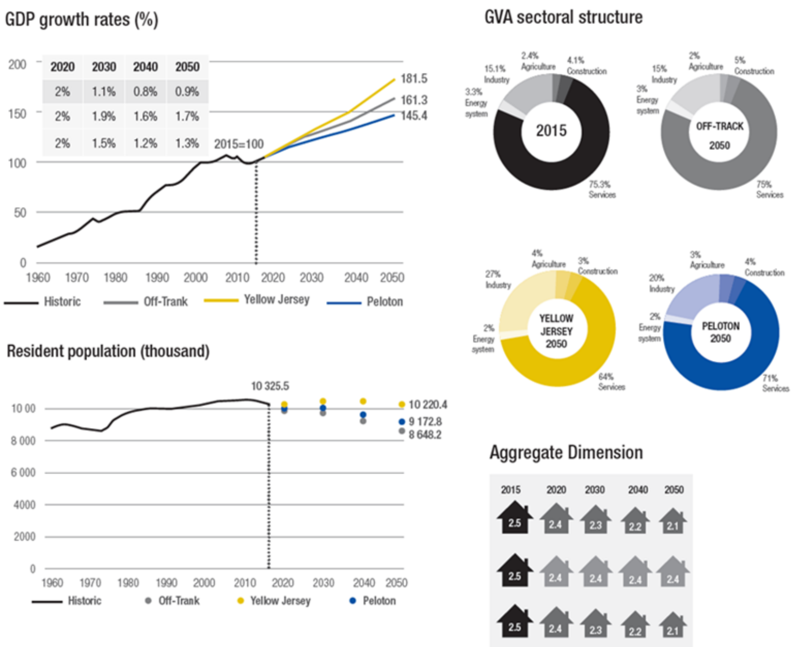


Figure 5.1.2
Macroeconomic assumptions considered in the different scenarios of the Carbon Neutrality Roadmap 2050

The development of the national projections also took into consideration the policies and measures adopted at Union level, namely, the Renewable Energy Directive (Directive 2009/28/EC and Directive (EU) 2018/2001), the Energy Efficiency Directive (Directive 2012/27/EU), EU ETS Directive 2003/87/EC as amended by Directive 2008/101/EC, Effort Sharing Regulation, among others.

More details about the different scenarios, assumptions, sectorial drivers and results can be found in the Carbon Neutrality Roadmap 2050, available at: https://unfccc.int/process/the-paris-agreement/long-term-strategies.

In complement to that reference, socioeconomic details and assumption of the different scenarios can also be found in a specific report that perspectives the country's evolution until 2050, available at: https://descarbonizar2050.pt/uploads/181220_Cenarios_RNC2050.pdf (PT version only).

Assessment of Aggregate Effect of Policies and Measures (5.2)

Main results (5.2.1)

The results of this exercise allowed a review of the potential for national emission reductions, confirming the technical and economic feasibility of pursuing a low carbon pathway to achieve carbon neutrality by 2050.

The sectorial analysis of emissions trajectories confirms that all sectors have significant GHG emission reduction potential in the different analysed scenarios, although the rates of reduction are different.

It is also noted that, for the purposes of the projections presented in the existing policies scenario, account was taken of the policy instruments and measures approved and published by 31st of December 2017, as well as some commitments made by Portugal, such as the end of the production of electricity from coal.

The difference between WAM and WEM scenarios for a given year can be taken as an estimate of the emission reductions from additional measures necessary. For 2030 the most significant policies and measures are already identified in the NECP 2030.

The table 5.2.2.1 below is a summary of the results obtained in terms of sectoral GHG emissions over the 2030, 2040 and 2050 horizon, under existing and additional policy scenarios and more detaild information can be found in tables 5.2.2.1 and tables 6a and 6c of the CTF tables.

Table 5.2.1.1
GHG emission projections by sector and gas (kt CO2eq)

				GHG emission projections					
	Historical GHG emissions and removals			Scenario With Existing Measures			Scenario With Additional Measures		
(kt CO2 eq)	1990	2005	2020	2030	2040	2050	2030	2040	2050
Sector									
Energy	29841.59	44019.31	23701.62	15563,91	13257,77	12484,68	13460,72	7135,18	3844,20
Transport	10819.55	19963.89	14,830.56	11699,11	7882,60	5512,48	10611,10	3190,94	473,35
Industry/industrial processes	6442.43	8592.91	7579.64	5157,46	4416,09	4169,95	5157,46	4416,09	3307,17
Agriculture	7142.02	6721.13	6990.07	6566,02	6647,62	6728,19	6394,81	6313,05	6177,13
Forestry/LULUCF	7126.76	3502.96	-4646.50	-8082,46	-9310,19	-10617,39	-9248,86	-10541,39	-11913,39
Waste management/waste	4554.28	6463.14	4420.62	3316,65	2358,34	1746,15	3316,65	2358,34	1746,15
Gases									
CO_2 emissions including net CO_2 from LULUCF	51030.46	71494.04	36387.58	20144,35	12873,29	8622,42	15834,05	1017,25	-6915,36
CO_2 emissions excluding net CO_2 from LULUCF	45325.29	69717.99	41799.89	30442,78	24282,07	21135,43	27298,87	13657,23	6893,65
CH_4 emissions including CH_4 from LULUCF	10315.96	11859.04	9140.30	8104,82	7069,26	6429,78	7961,55	6777,97	5945,15
CH_4 emissions excluding CH_4 from LULUCF	9585.89	11089.49	9035.50	7977,59	6948,77	6320,93	7834,32	6657,48	5836,31
N_2O emissions including N_2O from LULUCF	4580.20	4826.04	3967.65	5103,14	4793,71	4459,63	5027,90	4561,01	4092,58
N_2O emissions excluding N_2O from LULUCF	3888.69	3868.68	3306.64	3014,42	2815,61	2672,86	2 939,18	2582,92	2305,81
HFCs (1)	NO,NA	1054.29	3333.82	703,11	353,60	352,76	703,11	353,60	352,76
PFCs (2.)	NO,NA	3.31	23.78	15,29	15,29	15,29	15,29	15,29	15,29
SF_6 (3)	NO,NA	NO,NE	NO,NE	149,97	147,07	144,18	149,97	147,07	144,18
NF_3 (4)	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
Total with LULUCF (with indirect)	66012.75	89474.25	53007.95	34 220,69	25252,22	20024,05	29 691,88	12872,20	3634,60
Total without LULUCF (with indirect)	58885.99	85971.29	57654.45	42 303,15	34562,42	30641,44	38 940,74	23413,60	15548,00
Total ETS sectors	NA	37,195.93	18,733.39	12 795,20	10301,10	9363,33	11 135,10	7160,70	3962,25
Total non-ETS sectors	66012.75	48,775.36	38,921.06	29 309,20	24089,30	21127,54	27 606,80	16193,10	11529,32

(1) For base year and 1990: should read NO, NE, NA.
(2) For base year, 1990 and 1995: should read NO, NE, NA.
(3) For base year and 1990: should read NO, NE, NA.
(4) For all time series:should read NO and NA.

With Existing Measures scenario (WEM)

Even in an existing policy scenario, it is already foreseen a sharp reduction in GHG emissions in the coming decades and there is a cost-effective potential for Portugal to achieve total emission reductions of around 51% in 2030 compared to 2005, up to 60% by 2040 and around 64% by 2050 (without LULUCF).

In 2030 this reduction is largely due to the decommissioning of coal-fired power stations and the commitment to strengthening the role of renewable energies in the national energy mix, with boost to solar energy, with the electricity generation sector representing in 2030 a potential GHG emission reduction of about 93% compared to 2005 (and about 97% reduction in 2040).

In the transport and mobility sector, profound changes are foreseen, with large penetration of the electric vehicle, which leads to an emission reduction of about 41% in 2030 compared to 2005, and about 60% in 2040.

The waste sector also have a strong potential to reduce GHG emissions, contributing with reductions of 49% in 2030 and around 64% in 2040, as a result of the increase energy efficiency and the necessary compliance with the Landfill Directive which restricts disposal to only 10% by 2035. Thus, the existing policy scenario already presupposes the achievement of the target set in the Landfill Directive. The projections of this sector are identical in both the existing policy scenario and the additional policy scenario.

The agricultural sector have a lower decarbonisation potential over this time horizon. The figures are around 3% reduction in 2030 and aroud 2% in 2040.

In terms of F-gases, whose relevance in terms of emissions has been increasing in recent years. As with the waste sector, in the F-gases sector, it is assumed that the targets set in the Kigali Amendment are met, and the projections of this sector are identical both in the existing policy scenario and in the additional policy scenario.

However, for most sectors there is a need to consider a set of additional policy measures in order to pursue a more ambitious low carbon path and achieve carbon neutrality by 2050.

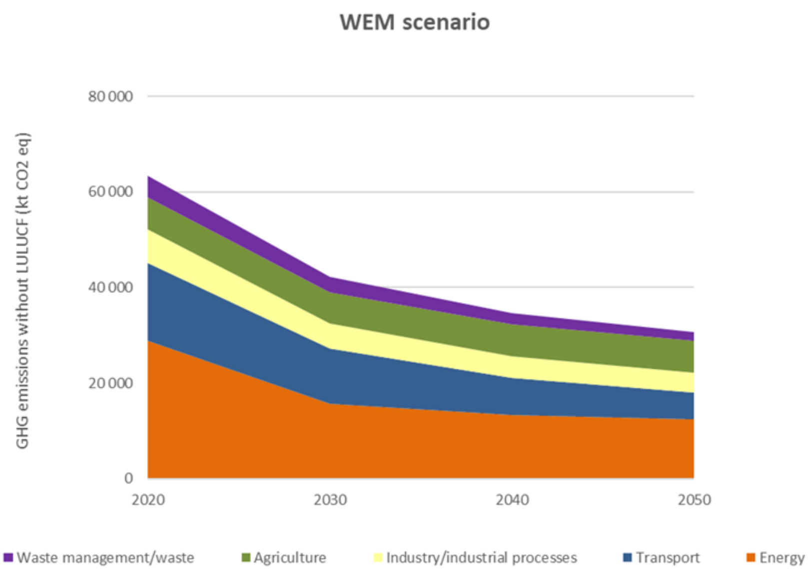


Figure 5.1.3
Sectorial projections with existing measures scenario (kt CO_{2eq})

With Additional Measures scenario (WAM)

With regards to the additional policy scenario (or neutrality scenario), unlike the previous one, emission restrictions consistent with carbon neutrality were imposed in 2050. This scenario thus allows to assess the additional effort required for each sector so that overall achieve neutrality, not accurately translating a typical scenario of policy impact assessment and planned measures.

There is still a cost-effective potential to reduce GHG emissions more sharply compared to the existing policy scenario, around 55% compared to 2005, rising to 73% by 2040 and around 82% by 2050 (without LULUCF), decarbonizing almost entirely electricity production, and strongly reducing emissions from mobility and transport and buildings, over the next decades.

Thus, the electricity generation sector in an additional policy scenario has in 2030 a GHG emission reduction potential of around 95% compared to 2005, the transport sector by 46% and the building sector by 48%, rising to 98%, 84% and 82% respectively by 2040.

As for the industrial processes sector, reductions of around 39% in 2030 to 48% in 2040 are expected, due to the expected improvements in process efficiency and the use of less polluting fuels, with the incorporation of more Fuels Derived from Waste/ RDF (refused derived fuel), biomass and electrification of some subsectors.

The agricultural sector, in this scenario of additional policies could contribute to emission reductions of about 6% in 2030 to 7% in 2040.

Within the waste and F-gas sectors, and given the assumption, respectively, of meeting the targets set in the Landfill Directive and the Kigali Amendment, the evolution is similar to the scenario with existing policies.

In this context, it is still necessary to reinforce the role of forest sink and other land uses, and effective agroforestry management is a determining factor in achieving the goal of neutrality in 2050.

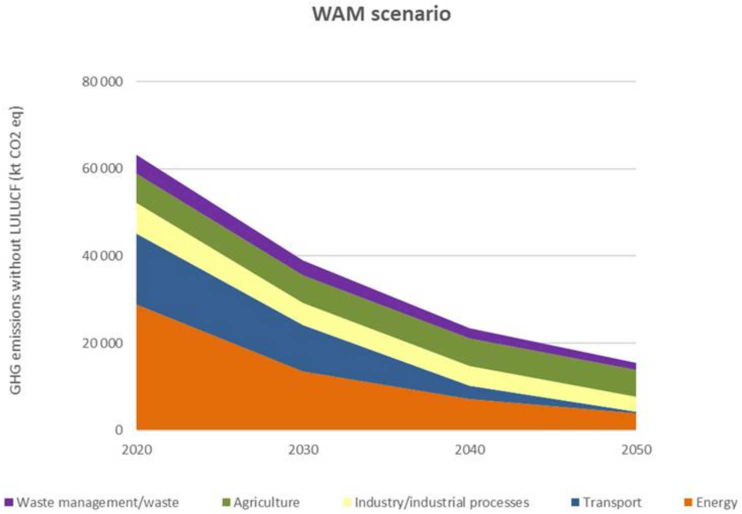
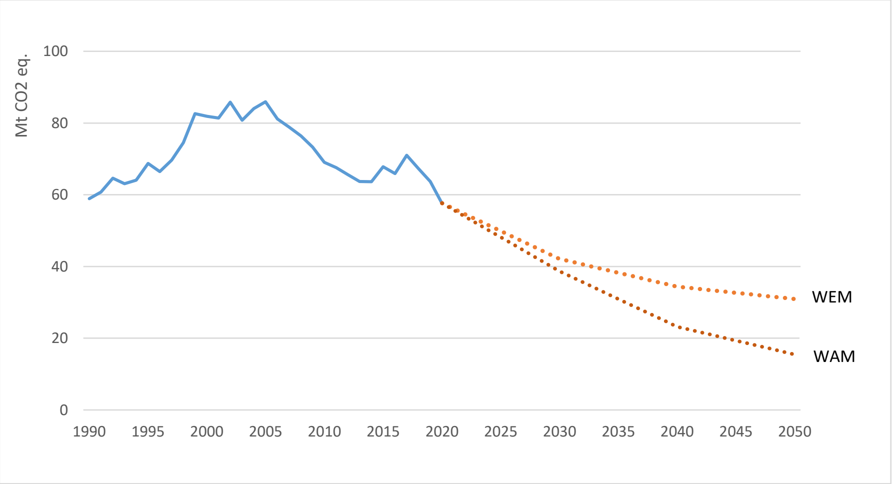


Figure 5.1.4
Sectorial projections with additional measures scenario (kt CO_{2eq})

Table 5.1.1
Potential for GHG emission reductions compared to 2005 (%)

	Potential for GHG emission reductions compared to 2005 (%)					
	Scenario With Existing Measures			Scenario With Additional Measures		
Sector	2030	2040	2050	2030	2040	2050
Energy	-65%	-70%	-72%	-70%	-84%	-91%
Transport	-41%	-60%	-72%	-46%	-84%	-98%
Industry/industrial processes	-39%	-48%	-50%	-39%	-48%	-61%
Agriculture	-3%	-2%	-1%	-6%	-7%	-9%
Waste management/waste	-49%	-64%	-73%	-49%	-64%	-73%
Total without LULUCF	-51%	-60%	-64%	-55%	-73%	-82%

Figure 5.1.4 - Total GHG emissions trajectories (kt CO_{2eq})



This scenario of neutrality served to inform the new greenhouse gas emission reduction targets set for the 2030, 2040 and 2050 horizon, from -45% to -55% by 2030, -65% to -75% by 2040, and from -85% to -90% by 2050 compared to 2005, as mentioned above.

The results also indicate that a trajectory that achieves emission reductions of -85% to -90% in 2050 compared to 2005 levels, will induce significant effects on renewables and energy efficiency, very significant final consumption of final energy consumption reaching 85-90% by 2050, in particular in electricity generation and transport which could reach full electrification by 2050 (road and rail) and a significant increase in economy efficiency.

Other atmospheric pollutants

In the scope of the RNC2050 exercice, projections of other atmospheric pollutants were also performed. They are based on the projection of activity variables that are associated with their origin. These, in turn, result from scenarios of demand for energy and materials services. For the purpose of these projections, the macroeconomic scenario associated with the Platoon Scenario "with neutrality" – corresponding to a WAM scenario in Climate Policy - was selected as the scenario With Existing Measures (WEM) in the context of the new NEC Directive, since it was assumed that the respective measures will be implemented under Climate framework. So the scenario WAM for Air Pollution Policy will be considered and adopted under the NAPCP (National Air Pollution Control Programme) for further reductions taking into account the national emission reduction commitments applicable from 2020 to 2029 and from 2030 onwards. The Table 5.1.2 is a summary of the main results obtained.

Table 5.1.2
Atmospheric emissions (kt), projections and percentage reductions compared to 2005 by sector

Pollutant	Sector	Historical			Projection				
		2005	2010	2015	2020	2030	2040	2050	Δ2030-2005(%)
NOx (as NO2)	Energy	60	18	15	14	7	3	1	-89%
	Industry	46	41	38	32	29	26	26	-38%
	Buildings	45	30	26	18	18	15	12	-60%
	Transport	103	90	69	67	27	9	6	-73%
	Agriculture	6	6	6	3	3	3	3	-49%
	Waste	0	0	0	0	0	0	0	-70%
	TOTAL	260	184	154	134	84	56	48	-68%
VOC	Energy	12	11	11	11	9	3	1	-24%
	Industry	114	102	104	100	95	93	96	-16%
	Buildings	19	15	16	14	9	8	2	-51%
	Transport	37	24	16	15	8	1	0	-78%
	Agriculture	2	3	3	13	13	13	13	447%
	Waste	3	2	2	2	2	1	1	-43%
	TOTAL	187	157	152	156	136	119	114	-27%
SOx (as SO2)	Energy	124	16	8	7	6	2	1	-95%
	Industry	45	31	22	19	18	20	20	-60%
	Buildings	6	4	3	1	1	1	1	-83%
	Transport	2	1	1	1	2	1	1	-30%
	Agriculture	0	0	0	0	0	0	0	31%
	Waste	0	0	0	0	0	0	0	-65%
	TOTAL	176	51	35	29	26	24	23	-85%
NH_3	Energy	0	1	1	1	1	1	0	156%
	Industry	9	7	6	5	6	7	7	-33%
	Buildings	3	2	2	2	3	0	0	1%
	Transport	2	1	1	1	1	0	0	-69%
	Agriculture	42	39	39	37	36	36	36	-14%
	Waste	2	2	1	1	1	1	1	-36%
	TOTAL	57	51	50	48	47	44	43	-17%
$PM_{2,5}$	Energy	2	1	1	1	1	0	0	-66%
	Industry	31	25	22	22	23	24	25	-25%
	Buildings	19	16	17	15	10	8	1	-47%
	Transport	8	7	5	5	3	2	2	-61%
	Agriculture	1	2	2	1	1	1	1	1%
	Waste	1	0	0	0	0	0	0	-38%
	TOTAL	61	50	47	44	38	36	29	-37%

Covid Impacts (5.2.2)

In the scope of the projections presented in this report the impact of the COVID-19 pandemic was not considered.

To analyse the impact of the COVID-19 pandemic on national GHG emissions, a follow-up of emissions from the energy sector is being carried out on a monthly based since March 2020, based on the information provided in the Rapid Estimates of Fossil Fuel Consumption published monthly by the Directorate General for Energy and Geology. These are first estimates and represent only emissions from "fuel combustion", which is the main source of emissions in Portugal, and which accounted for 72% of emissions in the 2016/2019 period.

This monitoring of emissions from the energy sector, allows us to verify that during the confinement period there was a slight reduction of emissions related to the transport sector and that there was no decrease in the production and consumption of electricity or renewables.

This monitoring also allowed us to verify that in periods without confinement or with reduced confinement, the verified changes tend to return to pre-Covid levels.

For this reason, we have not yet seen the need to change the projections up to 2050, as we consider that the impact of COVID-19 may induce temporary changes, that can have limite impact in the medium or long term.

In order to monitor the evolution of the impact of the COVID-19 pandemic in the GHG emission, in 2020, the APA started to produce a monthly report based in the information contained in the Rapid Estimates of Fossil Fuel Consumption published monthly by the General Directorate of Energy and Geology[55]. Monthly reports were published from March 2020 to December 2021.

Even if this exercise was based only on “fuel burning” emissions, it should be noted that these are the main source of emissions in Portugal (the burning of fuels was responsible for 72% of emissions in the 2016/19 period). The Rapid Estimates of Fossil Fuel Consumption published monthly by the General Directorate of Energy and Geology (DGEG) covers consumption of all fossil fuels, aggregated by month and by major consumption sectors. Therefore this data source provided an important indication for the objective of this exercise that aimed to analyze the impact of the COVID-19 pandemic on national GHG emissions.

Each monthly report on the impact of COVID-19 in the national GHG emissions was published at the beginning of month X and the information refers to month X-2. The emission estimates were based on DGEG data and on a distribution of fossil fuels by sector of activity based on the history of consumption in the years 2016 to 2020 under the responsibility of the APA's GHG Inventories Team. Excluded from this information are fuels used to produce energy such as: Urban Solid Waste; Industrial Waste; biomass; biogas; and Liquid Biofuels. For this reason, the variations presented only reproduce the expected changes in emissions resulting from changes in the use of fossil fuels. Sectors whose emissions have a different origin from fuel combustion (eg agriculture, waste, fluorinated gases, land use and forests) were not considered for the production of these reports and it was considered that they would have a pattern similar to that observed in previous years.

[55] The monthly reports are publicly available at https://www.apambiente.pt/clima/impacte-covid-19-emissoes-gee

Methodology (5.3)

Sensitivity analysis (5.3.1)
In the context of the 2050 Carbon Neutrality Roadmap modelling exercise, a series of sensitivity analysis and variants were carried out, which allowed to better understand the impact of specific aspects on the final emission trajectory established. Some examples are the variation on the technology costs, such as hydrogen (for transports and energy sectors), variation on the use of public transport and soft mobility, greater incorporation of renewable gases, balance of electricity imports, etc.

The uncertainty associated with the impact of climate change on water availability also justified the analysis of an alternative scenario that considered the inherent impacts of a RCP8.5 climate scenario.

Additional sensitivity analyses were also carried out, varying some aspects of Circular Economy in the different sectors, in order to increase or decrease its impact, to see what the impact in terms of emissions would be.

As expected, the results were different, but the decarbonisation vectors and the potentials of each sector were substantially the same, which suggests a high degree of robustness in the results achieved.

The methodologies used for the projections (5.3.2)
For the development of projections, a methodologically separate approach was adopted for each of the four main sectors, since there is no single model that makes it possible to project emissions for all sectors and gases in an integrated manner. Thus, for the:

- Energy system: GHG emissions were estimated based on the TIMES_PT optimisation model which includes, in an integrated manner, the entire Portuguese energy system starting from energy generation, transport and distribution through to consumption in the end-use sectors such as industry (including industrial processes), transport, residential, services and agriculture (only energy use) in their multiple uses (heating, cooling, lighting, electrical equipment, passenger and freight mobility, among others).
- Agriculture, forests and other land uses: GHG emissions were estimated based on different assumptions aligned with the narratives of the socioeconomic scenarios, from which the respective evolutionary trends of the crop and animal sector, and their emissions, were established. This sector includes animal emissions and manure management systems, fertiliser use, rural fires, and the emissions or sequestration of different land uses.
- Waste and wastewater: GHG emissions were estimated based on projections of the volume of municipal waste and domestic wastewater generated each year, considering the resident population, and the impact of the policies already adopted. This sector includes emissions from the disposal and treatment of urban and industrial solid waste and wastewater.
- Fluorinated gases: GHG emissions were estimated based on the implications of implementation of the Kigali Agreement and the European Regulations that foresee the phasing out of some of these gases over coming decades. This sector includes emissions

from the use of fluorinated gases in refrigeration and air conditioning equipment, fire protection systems and electrical switches.

Estimated GHG emissions for each sector were subsequently aggregated to calculate national total emissions.

In all sectors, GHG emissions estimation follows the methodologies presented in the national emissions inventories, which comply with the emissions calculation guidelines of the 2006 Intergovernmental Panel on Climate Change and relevant UNFCCC decisions for calculation of emissions and reporting emissions projections. The base year for the modelling in TIMES_PT is 2015.

Sectoral Methodology

Energy system that includes also the industry/industrial processes, the transport and the housing, service and agriculture (only energy use) sectors:

TIMES_PT is a technological model of linear optimization which results from the implementation of a generation of economy – energy – environment optimized models, with a TIMES technology base, in Portugal.

The generic structure of TIMES can be adapted by each user, to simulate a specific energy system, at local system national or multi-regional.

TIMES_PT was initially developed under the European Project NEEDS, integrating a Pan European TIMES model used to estimate total European costs (including externalities) of energy production and consumption. The ultimate goal of any TIMES is to satisfy the demand for energy services at the minor cost. In order to do that, investment options and the operation of some technologies, as well as the primary energy sources and energy exportations and importations, according to the following equation:

$$NPV = \sum_{r=1}^{R} \sum_{y \in YEARS} (1 + d_{r,y})^{REFYR-y} \bullet ANNCOST(r, y)$$

NPV: actualizes net value of total costs; ANNCOST: annual total cost; d: actualization rate; r: region; y: years; REFYR: reference year for the actualization; YEARS: years in which costs exist (all costs for the modelling period + past years when costs where defined for past investments + the number of years after technology life time, in case there are decommissioning costs).

For each year, the TIMES models calculate the current sum of the total costs, expect the income. In the case of TIMES_PT model, the costs taken into account are the investment, operation and maintenance costs (fixed and variable) of the various production technologies and energy consumption. The Income usually considered in TIMES models include subsidies and materials recovery, which are not considered in the TIMES_PT model.

The TIMES_PT model represents the Portuguese energy system from 2000 to 2050, including the following sectors:

1. Primary energy supply (refining and synthetic fuels production, import and local resources);

2. Electricity production;
3. Industry (cement, glass, ceramics, steel, chemical, paper and pulp, lime and other industrials);
4. Residential;
5. Commercial and Services;
6. Agriculture, forestry and fisheries (only the energy consumption);
7. Transport.

In each sector, the monetary, energy and materials fluxes are modelled according to the various production technologies and energy consumption, including mass balances for some industry sectors.

The simplified structure of the TIMES_PT model is shown in the figure below, as well as its main inputs and outputs.

The implementation of TIMES_PT requires a set of exogenous inputs, namely:

1. Demand for energy services;
2. Technologies' technical and economic characteristics for the base year and the future (e.g. efficiency, input/output ratio, availability, investment, operation and maintenance costs and actualization rate);
3. Availability of primary energy sources in the present and in the future, especially the potential for the use of endogenous energy resources;
4. Policy restrictions (e.g. energy production targets or reduction of emissions).

Based on these elements, it is possible to obtain from the TIMES_PT model a series of outputs, such as:

1. Inherent costs to the energy system;
2. Energy flows inherent to each sector;
3. Technological options, including the installed capacity in the electricity production sector;
4. Energy imports and exports;
5. Use of indigenous resources;
6. Emissions by sector.

Presently emissions considered by the model include the GHG emissions generated by combustion and industrial processes, and do not include fugitive emissions associated with the production, storage and distribution of fossil fuels and emissions of F-gases.

It should be noted that TIMES, being a partial equilibrium model, does not consider the economic interactions outside the energy sector, as for instance the implications in the activity of other economy sectors (e.g. impact of wind energy in the metal sector) or the implications in the activity of national sectors dictated by changes in international demand for their goods or services.

Furthermore, TIMES model does not take into account irrational aspects that influence investment in new and more efficient technologies, e.g. motivated by aesthetic preferences or social status which mainly occurs in the acquisition of end-use technologies. Thus, the model assumes that agents have perfect knowledge of the market, present and future. Finally, it should be emphasized that the based technology models such as the TIMES_PT do not accommodate market decisions based on price, instead they make choices based whether technologies or energy resources costs. For this reason, the solutions found show the best options in terms of cost - effectiveness and hence competitiveness, lato sensu.

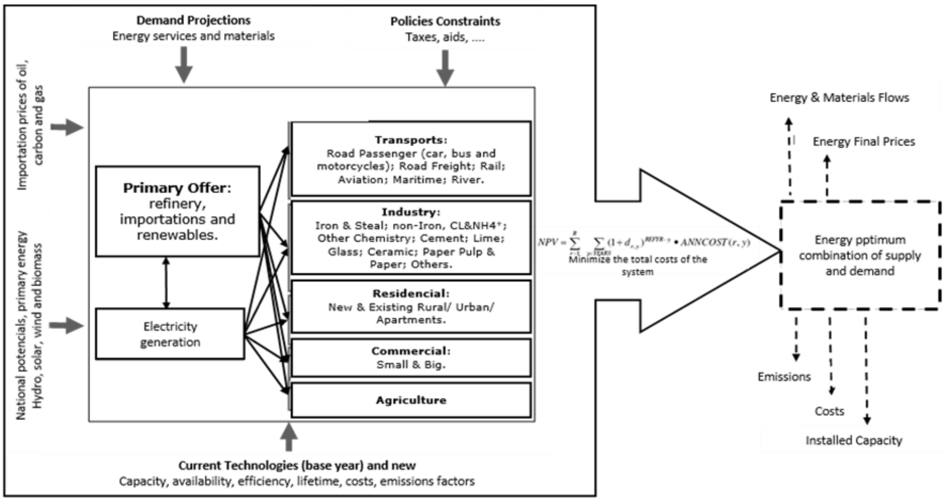


Figure 5.3.2.1
TIMES_PT model simplified structure

Economic policy instruments, such as VAT and the ISP (tax on petroleum products and energy products), have not been considered, since the aim is to identify cost-effective technological solutions, and therefore the whole exercise is based on technology costs. The electricity exchange with Spain is also not included in the modelling exercise, since it is mainly based on market decisions, and TIMES_PT model is not an appropriate tool to account for it. According to the expectations of REN (concession holder of the national network), a zero balance with Spain is assumed as from 2025.

New in relation to similar exercises in the past is the fact that some of the expected impacts of climate change on the horizon of 2050 have been internalized within the framework of the modelling exercise, in particular by considering changes in technology efficiency and in service demand and resource availability (such as reduced water availability or increased cooling needs). It should be noted that the TIMES_PT model, provided an important contribution to the setting of national goals and targets by the 2030 horizon and pointing clear guidelines for the horizon 2050.

<u>Agriculture, forests and other land uses, Waste and wastewater and Fluorinated gases:</u>
For Agriculture, forests and other land uses and for Waste and wastewater and Fluorinated gases, Excel spread sheets based on inventory methodologies were used, and so all categories and different gases were covered.

An advantage of using these models is the fact that a similar approach was already used in previous projections exercises like, for example, in the National Program for Climate Change (PNAC2020/2030) and the National Low-Carbon Roadmap (RNBC2050), so the methodologies are well known and the specific data bases for Portugal are fed in regularly. On the other hand, these more simplified models are not based in a cost-benefit analyses, which can be considered as a disadvantage, however they are based in expert judgments.

Vulnerability Assessment, Climate Change Impacts and Adaptation Measures (6)

Climate modelling, projections and scenarios (6.1)

The climate projections used for climate risk assessments and policy purposes cover many climate indicators which were estimated based on the CORDEX data. This exercise was primarily done under a project that developed the Climate Portal published in 2016, where those climate projections are publicly available. In the context of an ongoing project – the National Roadmap for Adaptation 2100 (RNA2100) – one of its components extends the scope of the climate projections and indicators for Portugal.

The Climate Portal (6.1.1)

The Climate Portal (Portal do Clima) was published in 2016 and constitutes a reference source of information on Portugal's mainland future climate, a platform that includes climate indicators on climate change scenarios based on CORDEX data. The Climate Portal has over 40 climate variables available online, aggregated into the following groups: temperature, precipitation; wind speed; relative humidity; global radiation; temperature range, drought index; aridity index; evapotranspiration; fire risk index, and; climate classification.

This project aimed to produce and publish an internet portal on Climate in Portugal, constituting an easily accessible platform for the public to disseminate the results obtained in the project, namely: historical series, climate change at the regional level and climate indicators for specific sectors in Portugal.

The project used past climate data and the IPCC AR5 climate projection data (CORDEX project) for dissemination through the website. This task involved all necessary calculations for data disaggregation at NUTS III level and different periods and the (eventual) estimation of aggregated indicators (e.g., drought index, meteorological fire risk, etc.). Different global and regional numerical climate models and their main features were analysed. Global climate models (GCMs) are based on general physical principles of fluid dynamics and thermodynamics and originate from numerical weather prediction. GCMs describe the interactions between the components of the global climate system, the atmosphere, the oceans, and a basic description of the earth's surface (i.e., aspects of the biosphere and lithosphere, relevant to the surface and energy balance). Sometimes they may be referred to jointly as Atmosphere-Ocean GCM (AOGCM). Regional climate models (RCM) have higher resolution over a limited area.

A regional climate model is a numerical model for predicting a region's climate; such models are usually determined from GCMs, with horizontal resolutions of tens of kilometres, using the GCMs to define initial time-varying boundary conditions and surface boundary conditions. They include the effect of greenhouse gases and aerosol forcing and are determined statistically or dynamically. RCM, forced by GCM, allow solving physical processes on smaller scales and therefore with increased detail and realism compared to global model results. The global model, which describes the large-scale effects and atmospheric circulation processes, determines the sequence of meteorological events that characterise a particular region's climate.

These features are the result of GHG emissions, variation in solar activity and volcanic eruptions. RCMs, forced with the consequence of GCMs, allow the study of regional processes and generate information at relevant scales for vulnerability, impact, and adaptation studies. Each of the regional climate models, was forced by different model forcers (CNRM-CM5, ICHEC-EC-EARTH, IPSLCM5A- MR, HadGEM2-ES, MPI-ESM-LR). Two RCM (the CCLM and RCA4 models) were forced with three different GCMs, providing information from 1971 to the end of the 21st century.

Using the regional CORDEX simulations performed for the European domain (EURO-CORDEX), we identified the simulations' characteristics, namely spatial and temporal resolution. A set of regional simulations from the CORDEX project, performed for the European domain (EUROCORDEX), with a spatial resolution of 0.11º (~12 km) and a daily temporal resolution: the control period (1989-2008; assessment scenario); the historical period (1971-2005); two emission scenarios from the IPCC AR5 report: RCP 4.5 and RCP 8.5 (2006-2100). For this portal, the following EURO-CORDEX variables were selected: Maximum surface temperature (K); Minimum surface temperature (K); Precipitation (kg/m2/s); Wind speed m/s; Relative surface humidity (%) (not available in all models); Surface downwelling solar radiation (W/m2); Surface upwelling solar radiation (W/m2). These variables were used as the basis for all the indicators provided by the project. Using these data, numerical calculation processes were developed and implemented, allowing the generation of results related to estimating the current climate and future scenarios in Portugal. The results presented reflect the analysis defined in different periods, called "climatological normal", represented by a group of 30 years; 1971-2000, 2011-2040 (Near future), 2041-2070 (Intermediate Future) and 2071-2100 (Far Future). The climate information relating to the observations comes from the matrix information of the Climate Atlas of Continental Portugal 1971-2000.

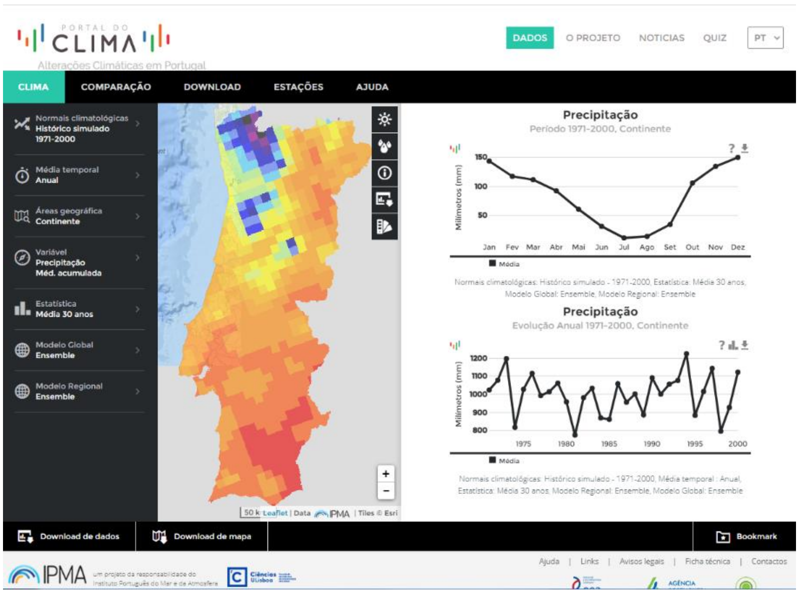


Figure 6.1.1.1

Clima web portal with information from 1971-2000 period, and climate scnarios to 2011-2040, 2041-2070 and 2071-2100

The data used were obtained from the interpolation of the average values in 1971-2000 of the climatological parameters air temperature and precipitation, observed in 61 stations and 260 udometer stations. The multivariate regression method with altitude and distance from the coast and normal kriging of the residuals were used for the average values of minimum, maximum, and average air temperature and total precipitation. Normal kriging was used to interpolate the number of days for the different values indicated in the portal (e.g., minimum, maximum temperature and rain).

The manual modelling of the experimental variogram was aided and optimised using the analysis of several types of error obtained by cross-validation. According to the project requirements and the existing limitations in terms of simulations for climate scenarios, the variables, and indicators to be made available on the climate portal were identified, as well as the associated statistics, covering: temperature; precipitation; wind intensity; relative humidity; global solar radiation; daily temperature range; drought index; aridity index; evapotranspiration; fire risk index. The uncertainty component was analysed by the project team, even considering that the current generation of climate models can faithfully represent aspects of the climate.

However, as the global climate system is overly complex, involving processes in various Spatio-temporal scales, it has become necessary to include different simplifications that give rise to uncertainties in future climate projections. Uncertainty is inherent in all projections of the future and is not peculiar to climate modelling. Climate change and the impacts associated with uncertainties are related to the future trajectory of emissions, resulting from the global development of technology, the energy consumption of the world's population and many other socio-economic factors, as well as the limitation of climate models, due to the limited knowledge of the climate system and the necessary simplifications in climate models.

One way to validate the results obtained using CORDEX data and the calculations performed on them is to compare the modelled data with the observed data. To this end, we used the empirical data in 4 locations on the mainland. This choice was based on meteorological/climatological stations with records for the study period and the territory's spatial representation, considering the known climatological regions. The modelled data were obtained using the same methodology adopted in all processes. For this validation process, the mean value of the 4 points of the matrix around the meteorological/climatological station's location were used. The statistics corresponding to the models (modelled history and projections) are calculated from each of the models' average values according to the period indicated (annual, monthly, or seasonal).

Climate projections under the National Roadmap for Adaptation 2100 (6.1.2)

The ongoing project National Roadmap for Adaptation 2100 (RNA2100) enables a prospective approach and long-term planning of adaptation policies, including an assessment on inaction costs and necessary investments, taking into account Portugal's vulnerabilities to climate change. In order to achieve the established objectives, RNA 2100 project will define narratives and generate a set of projections of the evolution of vulnerabilities and impacts of climate change on the Portuguese Economy until 2100.

This project will compile the results from CORDEX regional climate simulations (EURO and MED), based on the global and regional CMIP5 simulations, and define the ensemble for each of the future concentration scenarios (RCP2.6, RCP4.5 and RCP8.5). This information will be used to calculate sectoral climate indices, to analyse climate extremes (e.g. heat waves, extreme precipitation, extreme wind, etc.), and to characterize the uncertainty associated to the climate change signals. The results will be aggregated at different NUTS and river basin scales and also at different timescales (e.g. monthly, seasonal).

Additionally, the project will also compare and evaluate the accuracy of historical climate projections from the different CMIPs (*Coupled Model Intercomparison Project*) in relation to the observed climate in the last decades.

Box 6.1.2.1.
National Roadmap for Adaptation 2100
Developments in national climate policy and the advancement of knowledge on adaptation to climate change make evident the pressing need to conduct a large-scale exercise to assess the impact, vulnerability and risk of climate change in the national territory, as well as to define methodologies and procedures so that this exercise can be carried out periodically, ideally after each release of the IPCC Impact Assessment report.

In the context of these exercises and having as a purpose updating data on adaptation to climate change, emerges as a response the National Roadmap for Adaptation 2100 - Assessment of the vulnerability of the Portuguese territory to climate change in the XXI century (RNA 2100).

This project is co-funded under EEA Grants Environment Programme 2014-2021, which contributes with 400,000€ in a total of 1,300,000€ (co-financing rate of the EEA Grants is 30.8%), the remaining amount being provided by the APA. APA is the promoter of the pre-defined project of the EEA Grants PDP2 - "National Roadmap for Adaptation to Climate Change 2100 (RNA 2100)". This project began in September 2020 and will end in December 2023.

Achieved results will support the decision-making process regarding adaptation policies. RNA2100 will result in adaptation narratives for Portugal's different regions (NUTS III), in order to revise guidelines on climate change adaptation for territorial planning plans and programmes, including subnational strategies and plans. This project complements the National Roadmap for Carbon Neutrality 2050 (RNC 2050) incorporating objectives of climate resilience in the economy, adding to the objectives of carbon neutrality.

This project integrates different partners to achieve these objectives, in order to cover all relevant areas for adaptation to climate change: the Bank of Portugal (BP), the Directorate General of Territory (DGT), the Faculty of Science of the University of Lisbon (FCUL), the Portuguese Institute of Sea and Atmosphere (IPMA) and the Norwegian Directorate of Civil Protection (DSB).

Climate projections and hazards for Portugal (6.1.3)

For mainland Portugal, climate simulations for the future, which are obtained by the European Consortium ECEARTH and available in “Portal do Clima”, provide projections for the end of the 21^{st} century of an increase in average annual air temperature by 2°C (RCP 4.5 scenario) to 4°C (RCP 8.5 scenario), Figure 6.1.3.2. This heating should be higher in the summer and in inland and southern regions of the country.

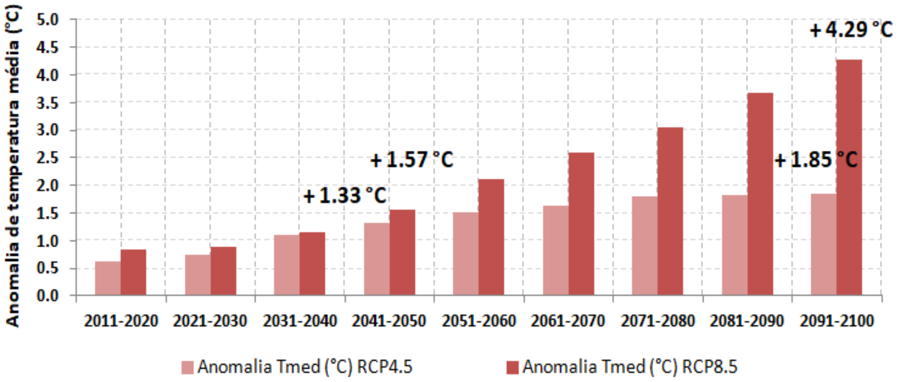


Figura 6.1.3.2

Climate scenarios (RCP 4.5 and 8.5) for Mainland Portugal: annual average mean temperature anomalies in relation to the period 1971-2000

Regarding precipitation, these scenarios show a decline of 15% by 2040 and 30% by 2100, which will be more marked in southern mainland Portugal (Figura 6.1.3.3).

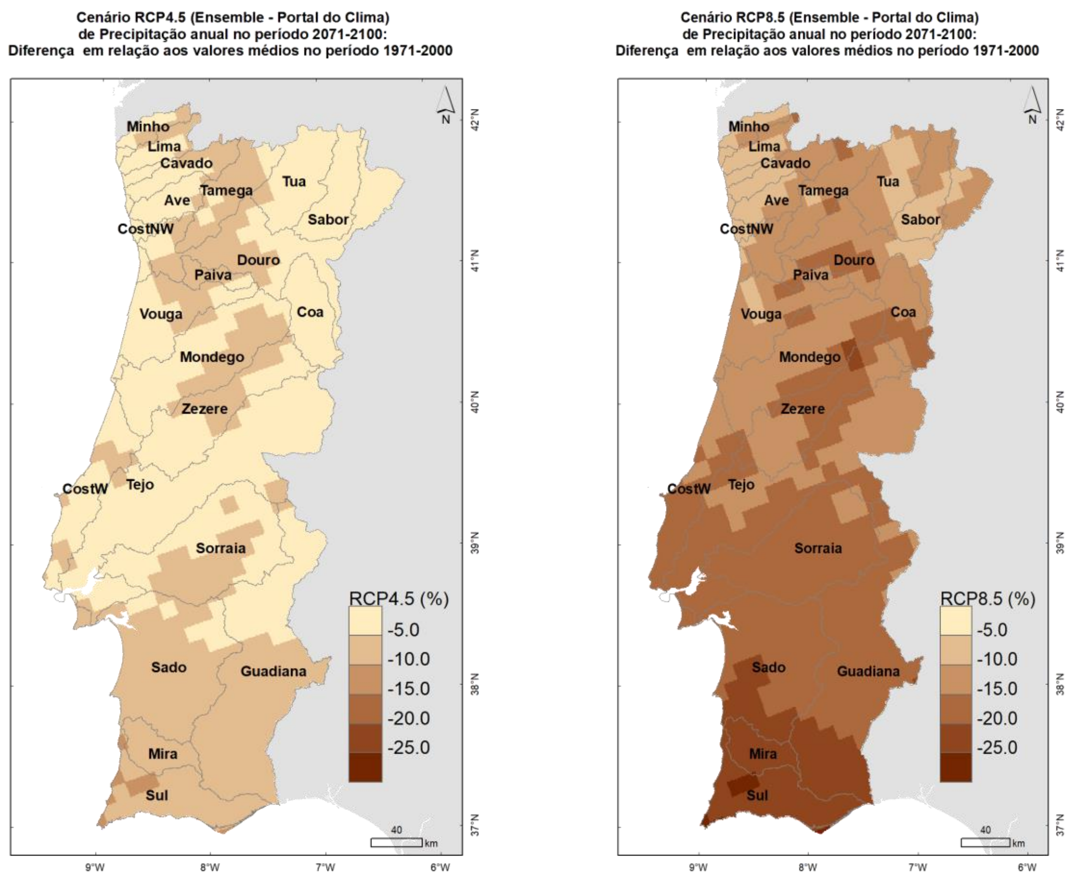


Figura 6.1.3.3

Climate scenarios (RCP 4.5 and 8.5) for Mainland Portugal: annual precipitation anomalies (percentage) in relation to the period 1971-2000

In the island territories, the scenarios used in the SIAM II Project suggest increases in maximum temperature by 2°C to 3°C in Madeira and by 1°C to 2°C in the Azores. In terms of annual precipitation, it could be reduced in Madeira by 20% to 30%. In the Azores, results show small variations.

Climate change tends to increase or accelerate other risks, where natural and anthropogenic factors are combined (e.g. coastal erosion, forest fires). The reduction in annual precipitation, the increase in its variability and the consequent change in the flow regime will reduce river flows, affect the recharge of aquifers, and even dry out the sources of essential rivers in the Iberian Peninsula for longer or shorter periods. These changes may be accompanied by water quality problems, intensification of drought events and increased pressure for desertification, increasing biodiversity loss associated with altered ecosystem structure and dynamics. This reduction in precipitation will also enhance the degradation of the quality of surface and underground water resources. Even so, the territory will remain vulnerable to flooding, given the projections of an increase of the number of days with heavy precipitation.

The new temperature and precipitation regimes associated with climate change imply an increase in the number of heatwave occurrences, their duration and intensity; an increase in the number and intensity of major rural fires, and extreme, unpredictable, intense, and localised meteorological phenomena, such as torrential rain, hail, cyclones and tornados. In addition to the tendency for heatwaves to become more intense and frequent or spatially extensive, it is also predicted that there will be a change in their seasonal distribution. Although heatwaves typically occur in the spring and summer, this phenomenon is expected to gain equal importance in the autumn. In this context, climate change scenarios predict a significant increase in meteorological conditions conducive to large areas of fire across the Iberian Peninsula, namely the whole of Portugal.

The coastline is also particularly vulnerable to coastal erosion and coastal overtopping with very significant and severe effects. This is due to sea-level rise, hourly rotation of the mean wave direction on the west coast, and storm surge regime (despite uncertainty about the future evolution on this last point). These factors aggravate coastal swelling and flooding by allowing waves to break closer to the coast and transfer more energy to the beach, in addition to the deficit in river sediment inputs available for coastal drift. The effects of coastal erosion and overtopping are further aggravated by the characteristics of the anthropogenic occupation of the territory's coastal strip that substantially increases the risk of socio-economic costs of climatic phenomena. Despite the uncertainty, the rise in sea level by the end of the 21st century is expected to be 0.5 meters higher, possibly reaching values in the order of 1 meter above the 1990 level. The rise in sea level also increases the risk of saline contamination of coastal aquifers, estuaries, and the final stretches of rivers, impacting some water supply systems.

Azores Autonomous Region

For the climate projections produced under the PRAC (Climate Change Regional Programme), the RCP8.5 and RCP4.5 scenarios were used.

In general, the methodology adopted in obtaining the climate scenarios consisted of:

- The regionalization for each of the Azores islands of the current climate, through the CIELO model (Azevedo, 1996; Azevedo et al., 1998; Azevedo et al.,1999; Azevedo et al.,1999; Santos et tal. 2004; Miranda et al., 2006) for a regular grid with a resolution of 100 by 100 meters;

- The production of a control climate and the identification of the resulting anomalies developed for the EC_Earth scenarios RCP 4.5 and RCP 8.5, for the time horizons of 2010/2039, 2040/2069, 2070/2099;
- In the regionalization of future climate scenarios and anomalies for the same scenarios and time periods;
- The communication and spatialization of results through WebSIG.

The rainfall patterns modeled in the context of the PRAC indicate a higher concentration of rainfall in winter, which indicates that in the future there will be more episodes of flooding and less retention of surface and groundwater. It is also expected that episodes of extreme wind and storms will occur with greater frequency and intensity, taking into account studies on hurricane frequency and hurricane intensity. Consequently, it is expected that the meteorological sea level rise will be higher and more frequent, which will increase the risk of overtopping events compared to the present. Additionally these overtopping phenomena will be aggravated by the expected rise in the average sea level, which in the case of the Azores could reach one meter by the end of the century. For the Azores it is also expected to see an increase in the number of days with precipitation above 20 mm and the occurrence of more rain less frequently.

Climate projections for the Madeira Archipelago were established during the design of the Regional Adaptation Strategy. They were regionalized by using the emission scenarios from the Special Report on Emissions Scenarios proposed by the IPCC in 2011 (SRES, 2000. A special report on emissions scnearios of working group III of the IPCC, Cambridge University Press, Cambridge.), divided in A1, A2, B1 and B2 scenarios.

In general, the methodology adopted in obtaining these scenarios consisted of:

- Results of project CLIMAAT II, that made use of dynamic regionalization, using the HadCM3 global circulation models for the A2 and B2 scenarios;
- Spatial resolution of 1km for Madeira Island;
- Daily precipitation and temperature data until the end of the 21st century.

The results indicate a general raising in the mean temperature, between 1,3 and 3º Celsius, and an expected decrease in anual precipitation of about 30% by the end of the century.

Assessment of risks and vulnerability to climate change (6.2)

The effects of climate related hazards on the various economic sectors, ecosystems and regions of Portugal lead to the need for effective mechanisms for assessing and managing risks, and the respective reduction of the factors that determine them, in particular in terms of exposure and vulnerabilities.

In this sense, the starting point for dealing with these challenges is a good knowledge base of the risks associated with climate change. The IPCC reports have ensured the systematization and consolidation of our knowledge about climate change. Also the European Environment Agency provides valuable information through its reports, Climate-ADAPT and other platforms that help supporting policymaking.

At national level, the first integrated exercise for climate risk assessment took place in 2002 with the SIAM ("Climate Change in Portugal: Scenarios, Impacts and Adaptation Measures") project, and was later revised in 2006 (http://cciam.fc.ul.pt/prj/siam). Within the scope of the 2010 National Adaptation Strategy (ENAAC), the sectors included in its governance developed their own climate risk assessments, which were duly systematized in the ENAAC progress report published in 2013.

A new transversal assessment of climate risks in Portugal is now being conducted within the above mentioned RNA2100 project, with particular detail in key sectors such as water resources, agroforestry, rural fires and coastal areas. There will be two approaches to assess the climate risks. One with a wider scope where sectoral climate indices will be analysed to provide an overview of the risks, highlighting the geographic areas, sectors and vulnerabilities of higher relevance. The other approach enters in more detail through modelling exercises in key sectors/vulnerabilities and Conversion of physical impacts into associated social and economic impacts.

It's also relevant to mention the many assessments of risks and vulnerabilities conducted within the processes of development of subnational adaptation strategies and plans. The vast majority of these instruments were supported by participatory processes with the local communities, helping in this way to identify the priority climate risks for the respective territorial unit.

According to data from the European Environment Agency (EEA) for Portugal, more than 50% of the Mainland territory is prone to desertification, particularly in the interior of the southern regions of Algarve and Alentejo, due to climate conditions aggravated by climate change and decades of inadequate agricultural practices and cultures.

Portugal has the third largest Exclusive Economic Zone in Europe (1.6 million km^2), expected to expand to almost 4 million km^2 this decade. The coast of Mainland Portugal has an extension of 943km, is densely populated – concentrates three quarters of the Portuguese population and contributes to 85% of the national GDP – and faces a significant threat from the phenomena of coastal erosion, coastal floods, cliffs instability and landslides.

The national economic structure has undergone a progressive process of tertiarization, and, in 2017, 68.9% of the population worked in the tertiary sector. The highest tertiarization rates, above 80%, are registered in the regions of Lisbon and Algarve, mainly due to tourism activity. On the other hand, the secondary sector still has a significant relevance (above the national average) in the Norte and Centro regions (34% and 29% respectively). The primary sector is still relevant in the Centro and Alentejo regions, where the proportion of the active population in this sector is above 10%.

Regarding land use and land cover, the dominant occupations in mainland Portugal are forest (39% of the total area) and agriculture (26% of the total area). The areas of wildwoods, agroforestry systems, and pasture occupy 12%, 8% and 7%, respectively, which attests to the relevance of the rural regions (around 92% of the total area), hence the historical importance of the risk of rural fires in mainland Portugal. Although much less significant in terms of occupied space, urban areas present specific risks and potential human damage higher than those of rural areas.

One of the most vulnerable agriculture and forest systems is the 'montado' (cork oak forest), mostly located in the southern region of Alentejo, an extensive production system that is well adapted to its Mediterranean climate and weak soil conditions, but is endangered by increasing aridity, plagues, and the expansion of irrigation cultures. In the coastal areas to the south of the Tagus river there is also a greater use of greenhouses, which are particularly vulnerable to storms and events of strong winds.

On the other hand, the trade and services sectors have assumed growing importance and weight in the national economy, being equally vulnerable to climate change, as they are mostly located in sensitive areas. The location factor may imply restrictions on citizens' access to certain goods and services, so it is crucial and urgent to safeguard these situations, creating conditions for implementing adequate adaptation to the impacts caused by climate change.

As tourism is an activity subject to intense competition between destinations, which depends on territory and climate as necessary "raw materials", climate change may have an extremely high impact on countries with a strong economic dependence on this sector, such as Portugal. Therefore, the loss of biodiversity, coastal erosion, and consequent landscape degradation, or even the increase in vector-borne diseases, is today a growing concern.

On the supply side, the energy sector value chains have specific areas of risk and vulnerability, both in terms of fixed infrastructures (related to electricity generation activities, the supply of raw materials and production and dispatch of oil products and natural gas) and linear infrastructures (transport and distribution of electricity and fuels). On the demand side, abnormal increases in energy consumption (e.g., electricity demand for heating and cooling for cold and heat waves) may occur. They will also have to be managed in the context of related adaptation measures.

The possibility of an increased frequency of extreme weather events that may hit essential transport, energy, and communications infrastructures in a continuous or untimely manner and sometimes with real catastrophic effects constitutes a significant risk to the safety of people and properties and the functioning of the economy and Society in general. On the coast of mainland Portugal, the most important consequences of climate change are the rise in mean sea level and the modification of sea disturbance regime, meteorological upheaval, temperature, and precipitation.

While there is no clear quantification of the overall costs to the economy of climate change impacts, there are key sectors that are most vulnerable to the effects of climate change, namely:

- Agriculture and food chain
- Rural development
- Biodiversity (including ecosystembased approaches)
- Tourism
- Energy
- Forestry
- Civil protection and emergency management
- Transport
- Marine and fisheries

- Water management
- Buildings
- Urban Areas
- Land use planning
- Business and Industry
- Coastal areas
- Health

A more detailed analysis for each of these sectors is outlined below.

Agriculture and food chain

The main critical factors for the adaptation of agriculture to climate change are: water availability and irrigation capacity, soil fertility and erosion prevention; risk management in the face of extreme events and increased climate variability; changes in phytosanitary and animal health systems; and the availability of animal and plant genetic heritage adapted to new climatic conditions.

Although Portugal is a country with an average rainfall of circa 900 mm, its spatial-temporal distribution may lead to reduced water availability in certain regions and time of year, generating problems of water scarcity, which seriously affect most of agricultural activity, still highly dependent on weather conditions. Irrigation is a fundamental component to ensure the viability of agriculture, without which it is not possible to enhance the vegetative development of spring-summer crops and, consequently, to obtain income levels that fix agricultural populations, and contrary the progressive depopulation of rural regions of the interior. In Portugal, more than half of farms depend on water for agriculture and irrigation accounts for 60% of national agricultural production. Of the 3.7 million hectares of usable agricultural area, 12% are equipped for irrigation (540,000 ha). However, in periods of continued drought, a significant part of these agricultural explorations loses viability. Thus, to summarise:

- The assessment in this sector results from the existing perspectives on specific hazards: increase in temperature, reduction in precipitation and increase in its variability affecting the recharge of aquifers and the river regime with implications on water quality, drought events and desertification, biodiversity loss, floods, heatwaves, large fires, extreme weather events, diseases, plagues and the spread of exotic species.
- The assessment results from the existing perspectives for the sector. The Action Plan for Adaptation to Climate Change 2020-2030 – P-3AC (NAP), based on climate scenarios RCP4.5 and RCP8.5, predicts the worsening of a set of vulnerabilities: maximum temperature; extreme precipitation events; quality/quantity of water resources; susceptibility to desertification and biodiversity loss; floods; heat waves; diseases, plagues, and weeds; rural fires.
- The assessment results from the existing perspectives for the sector: reduction of guaranteed water for irrigation; increase of droughts and floods; destruction of infrastructures; reduction of soil organic matter; desertification, an increase of exotic species and the emergence of diseases and plagues; non-resilience of the current crop and livestock practices; increase of fires and reduction of biodiversity. Relocation of some crops and agricultural activities northwards on the mainland, with reduced production and/or productivity; worsening of desertification in the south of mainland Portugal.

Rural development

The assessment results from the existing perspectives on specific hazards: increase in temperature, reduction in precipitation and increase in its variability affecting the recharge of aquifers and the river regime with implications on water quality, drought events and desertification, biodiversity loss, floods, the occurrence of heatwaves, large fires, extreme weather events, diseases, plagues and the spread of exotic species.

The Action Plan for Adaptation to Climate Change 2020-2030 - P-3AC (NAP), based on climate scenarios RCP4.5 and RCP8.5, predicts the worsening of a set of vulnerabilities: maximum temperatures extreme precipitation events; quality/quantity of water resources; susceptibility to desertification and biodiversity loss; floods; heat waves; diseases, plagues and weeds; rural fires.

The assessment results from the existing perspectives on particular vulnerabilities: water for irrigation (droughts and floods); organic matter in the soil (productive capacity, water and CO_2 retention) desertification; biodiversity (non-preservation of essential ecosystems for the sector); genetic heritage with plants and animals better adapted to climate change (water stress, temperature, diseases and plagues); alien species, emerging plagues and diseases; knowledge on good practices of adaptation to climate change and their adoption; systems of forecasting, warning and response to risks.

The assessment results from the existing perspectives for the sector: Reduction of guaranteed water for irrigation; increase of droughts and floods; destruction of infrastructure; reduction of soil organic matter; desertification; increase of exotic species and the emergence of diseases and plagues; non-resilience of the current crop and livestock practices; increase of fires and reduction of biodiversity. Relocation of some crops and agricultural activities northwards on the mainland, with reduced production and/or productivity; worsening of desertification in the south of mainland Portugal.

Biodiversity (including ecosystembased approaches)

Climate change is forcing a range of pressures on ecosystems. Changes in rainfall patterns and significant increases in maximum temperatures cause drought periods with consequences for land degradation.

A future framework in which the depopulation of territories emerges as a significant threat to biodiversity and the alteration of natural systems is exacerbated by the proliferation of invasive exotic species. Climate change (increased temperature, reduced rainfall) forces an increase in the area susceptible to desertification, putting at risk a wide range of soil resources, with effects on habitat fragmentation and biodiversity loss.

The main environmental threats are climate change processes (temperature increase, precipitation reduction) and biodiversity loss, so articulation is needed for species' objective reality, habitats, and the socio-economic context, creating symbiotic relationships with nature. Simultaneously, the conservation of biodiversity values and nature conservation lead to the preservation of ecosystem services by ensuring the continuity of their functions.

Biodiversity and nature conservation has to be seen as an opportunity or a solution for specific territories, playing a crucial role in climate change adaptation processes (temperature increase, precipitation reduction). At the same time, protected areas are understood as strategic assets, in which sustainable management is essential to maintain the values that characterise them.

Tourism

The following hazards/effects with relevance for the sector are observed: temperature rise/increased drought periods and consequent impact on the attractiveness of the territories; sea-level rise and effects on the territory (changes in coastal erosion dynamics), with relevance for tourism demand; more intense periods of rainfall (alternating with hotter and drier periods). It is considered that, under future climatic conditions, the probability of the main hazards will remain the same. However, it is expected that the sector will have a growing capacity to adapt to those hazards, resulting in a reduction in exposure to them, but still at a medium to shortterm level.

The adaptation capacity of the tourism sector is high. There is intensive work in progress to train economic operators and to create Turismo de Portugal (national tourism board) funding lines. These resources are going to be used to achieve some objectives, such as to increase energy and water efficiency, to reduce waste and to increase sustainable construction, among others that may be identified in the context of environmental sustainability, which should result in an increased capacity of the sector to adapt to climate change.

Despite the focus on capacity building and the financing lines to be created, the country, and the tourism sector in particular, is going through a phase of economic difficulty that may result in a delay in the established timeframe to accommodate the environmental sustainability goals and to ensure a more effective and efficient response to the risks associated with climate change.

According to the above and using an illustrative example, with the rise in the average sea level, "sun and beach" tourism will be strongly affected by the predicted disappearance of beaches and water scarcity, which could make certain activities unviable. In addition to the direct adverse effects that climate change may have on this sector, it should also be ensured that, in the future, it does not compromise its development and economic growth, so it is necessary to consider strategies that incorporate the most appropriate mitigation and adaptation measures as mechanisms to respond to this challenge.

Energy

Based on the experience reported by operators and sectorial agents, in particular, the operators of energy transmission and distribution networks, as well as electricity producers, impacts associated essentially with extreme heatwave events (extreme temperatures and long periods of drought), high precipitation (floods) and storms (strong winds) were observed.

Existing data points out to an increase in the frequency of extreme weather events, namely storms (strong winds) and heat waves (extreme temperatures and long periods of drought), truly relevant and impacting for the sector. These events seem to have a more continuous evolution of their expression, compared with extreme precipitation (floods) that seem to be a more of a one-off nature (which also brings other challenges).

Vulnerabilities are essentially due to operational issues, consequences of extreme weather events, which may damage specific infrastructures (e.g., overhead electricity transmission and distribution networks). Currently, there is a reduction in vulnerability due to the introduction of technological improvements. Still, it is expected that in the future, with the worsening of climatic conditions, an additional effort in adaptation will be necessary.

Future hazards will be identical to the current ones, but with an aggravated risk, ie, higher due to their greater frequency of events expected in the medium and long term. To reduce the risk and respective impact, it is foreseen the need to reinforce protection to reduce the severity of those events that will occur as well as the use of redundancy in the infrastructures to safeguard supply security.

Forestry

The forestry sector is a significant exporter with high added value that generates significant employment. In addition to their economic importance and as promoters of social cohesion, forests play essential roles in protecting soil and water, supporting biodiversity, and combating desertification. However, the majority of forest areas are not actively managed, and extensive areas are abandoned, which contributed to increase the risk of wildfires, and the spreading of invasive species and plagues.

The difficulties in the implementation of forest management policies are aggravated by the fragmentation of rural property, particularly to the North of the Tagus river, where the greater extent of forest is located. About 85% of Portugal's forest is privately owned, and only 3% belongs to the Portuguese State, while the remaining 12% are wastelands and belong to local communities. Currently there are 10 Biomass Thermal Power Plants and 10 Pellet Plants in Portugal dedicated to forest biomass. Together they are responsible for a consumption of more than 2 million tonnes, and make an important contribution to the valorisation of forest waste and the cleaning of forests.

Hence, schematically:

- Fires were recorded with greater frequency and severity, and phytosanitary events also with greater frequency. Extreme weather events occur with strong winds, with impacts on vegetation's stability, such as falling trees. There are also impacts in terms of soil erosion resulting from these extreme events.
- There is a greater probability of extreme events affecting forestry systems. On the one hand, there is a decrease in the productivity of forest systems. On the other hand, there is less willingness to invest in forests due to risk perception. Also of note is the shortage of raw material for forestry industries, creating more favourable conditions for expanding invasive species and greater difficulty to establish stands during planting periods due to droughts and extreme temperatures.
- The systems are highly vulnerable due to their long-life cycle. There may be a reduced adaptive capacity of specific forest systems because of their ecological condition. Based

on climate scenarios, the need to adapt to forest ecosystems is estimated with implications on forest distribution and composition to increase resilience.

- It is necessary to adapt forest management models and to make use of suitable and improved genetic material. These measures may have an impact on the supply capacity of domestic forest-based industries. Adaptation should encompass specific vocational training, particularly at higher levels. In this context, the interconnection between the production and processing sectors and academia, including research, innovation, and development centres would be significant.

Civil protection and emergency management

The National Risk Assessment had it's first version in 2014 that was later revised in 2019, following the "Risk Assessment and Mapping Guidelines for Disaster Management"[56] issued by the European Commission, which aims to promote the better application of the precautionary principle, contributing to the adoption of measures to reduce the risk of major accident or disaster inherent in each activity. In this assessment, the natural, technological, or mixed hazards that may affect the national territory were identified and characterised. The National Risk Assessment took into consideration, for the applicable risks, the impact of climate change and the resulting scenarios, indicating tendencies to worsen or mitigate risks.

The impact of the main hazards is assessed low, considering what is set out in the National Risk Assessment, updated in July 2019, in which some anomalous situations that occurred in mainland Portugal in the recent past were identified, which can be considered to be under the effect of climate change, particularly on natural hazards (extreme weather events), such as heatwaves, floods, coastal overflows and on mixed risks, as is the case of rural fires.

The probability of risks in the sector is assessed on average, considering what was set out in the National Risk Assessment (2019), based on climate models for the most severe scenario (RCP 8.5). An evolutionary analysis of the impacts of climate change has been presented about natural and mixed risks, resulting in an increase in frequency and/or intensity in various types of threats and showing a decreasing trend in other cases, such as in cold waves and snowfalls.

It is expected that the vulnerability to climate change will be reduced through the adaptive capacity and measures planned for the sector. In this context, it is essential to highlight that civil protection is responsible for planning and responding to events resulting from meteorological and other risks. Therefore, it is a priority to make the respective readjustment given the potential impact of climate change.

Transport

From the conclusions of the sector survey conducted within the Transport Working Group – ENAAC2020, in conjunction with the UNECE Group of Experts for Climate Change Impacts and Adaptation for Transport Networks and Nodes regarding the impacts on road infrastructure, the meteorological or climatic factors that affect a broader universe of critical infrastructure are the situations of Precipitation/Flooding, followed by episodes of High Temperatures, Rising/Dropping Flows and Winds.

[56] Document SEC (2010) 1626 final, 21.12.2010

The assessment of the impact of climate change was recognised by the Transport Working Group – ENAAC2020 as an intermediate level problem for transport services and infrastructures in Portugal. However, despite the apparent sensitivity to the impacts of climate change, there is a significant degree of uncertainty regarding the size of the challenge to be faced.

Due to some extreme climate events, these issues have been introduced in the sphere of concern of the concessionaires, and some have adopted measures/actions that, although not structured in a plan/strategy, are somehow related to climate change (e.g. Intensification of Infrastructure Monitoring and Inspection Plans).

According to available information, extreme weather events, some of which increase in intensity and frequency, and slower onset climate change (e.g., sea-level rise) and cumulative effects can produce damage to transport infrastructure, operational disruptions and pressures on supply chain capacity and efficiency.

Marine and fisheries

Portugal is particularly threatened by rising sea levels and increasingly frequent and intense extreme weather events. The coastline's extension, the reduction of dune and marsh systems (and their protective capacity), and the shoreline's occupation by the economic activities that develop there (port activity, recreational boating, maritime transport, among others) justify the implementation of measures to fight climate change.

Changes in seawater temperature, salinity and acidity can be expected from models estimating the impact of climate change, affecting biota, producing changes in the species diversity and abundance of individual taxa or populations. In fishing opportunities, which are established based on specific stocks, the impact already felt tends to multiply.

The sector is highly vulnerable to climate change producing cascading effects that give rise to discontent among all those involved and demand response at the level of measures to prevent and mitigate climate change. The impact of climate change on marine ecosystems will be severe, with increased pressure not only on the fisheries and aquaculture sectors, but also on the other activities of the sea's economy.

The country's marine biodiversity is threatened by climate change and natural phenomena such as coastal erosion and the overexploitation of resources caused by human activities such as fishing, which, if not managed sustainably, can lead to the collapse of stocks and other imbalances in ecosystems. Different activities bring other impacts in terms of oil pollution, such as maritime transport.

Water management

At national level, there has been an increase in extreme precipitation events of extremely high intensity in short periods, impacting the sector. In continental Portugal, it should be highlighted the prolonged hydrological drought in the south of the country and the sharp decrease in annual precipitation in the last two decades, with a consequent reduction in surface and underground water reserves.

Given the climate scenarios available for mainland Portugal, an increase in the frequency and duration of drought events is expected. Water scarcity will be aggravated under future climatic conditions, constituting one of Portugal's major future problems. On the other hand, it is expected an increase of extreme precipitation events, of short duration, which carry increased difficulties for the timely warning of fast flood risks for the population in urban areas.

There is a high vulnerability to both droughts and floods. There is some adaptive capacity. However, it is still necessary to define and implement adaptation measures, including raising awareness among the population and sectors, particularly in terms of behaviour and risk communication.

Since there is a high probability of the main hazards and exposure to them under future climate conditions, it will also imply high future impacts on water management. The need to adopt adaptation measures to minimise the effects arising from extreme events is fundamental.

Buildings

The main hazards affecting the national territory and significantly affecting the buildings sector are increase the frequency and intensity of precipitation, floods, strong winds, droughts and heatwaves. In the municipalities located along the coastline, coastal landslides and floods are also major hazards for this sector. The impacts mainly damage buildings and their contents.

The National Risk Assessment identifies hazards of natural, technological or mixed origin, likely to affect the national territory, and the impact of climate change scenarios (with the parameterisation of the degree of annual probability of occurrence or the associated return period). For the risks affecting the buildings sector, the assessment points to the following scenarios and degrees of probability of occurrence:

i. Heatwaves - In the summer season, heatwaves will occur in most of the area from mainland Portugal, except on the coast between Setúbal and Caminha and the Eastern Algarve (medium-high probability of occurrence);

ii. Strong winds - The incidence of strong winds is random throughout the territory. It may affect geographically widespread areas (typically associated with winter depressions) or reach relatively small areas of the territory, and therefore it is not possible to graduate its susceptibility. For the scenario of strong wind with gusts exceeding 120 km/h in several locations, causing the fall of trees, power cuts in thousands of homes, damage to various structures, unfortunately with some human victims and high economic damage to infrastructures and homes (Medium-High Probability of occurrence);

iii. Floods and flooding - The development of floods and flooding in various parts of the country, as a result of a relatively long period of above-average rainfall during the winter and in several river basins, affecting several urban centres, with the consequent unavailability of some services and causing economic damage to infrastructure and housing (medium-high degree of probability of occurrence, corresponding to a return period between 5 and 20 years).

The sector's guidelines for adaptive capacity are included in national spatial planning policy documents and city policy documents. There is evidence that they are also pursued in regional and local strategies and plans. Some adaptation measures that could reduce vulnerability are raising the costs of insurance premiums for buildings located in higher exposure areas; ii. Improved construction techniques to make buildings and infrastructure more resistant; iii. Adoption of urbanistic solutions designed to reduce the urban heat island; iv. Relocating urban centres and industries to less vulnerable areas; v. Improving the energy efficiency of buildings.

Urban Areas

The main hazards affecting the sector include increases in the frequency and intensity of floods, flash floods, heatwaves, rural fires and coastal overflows. The territory will remain vulnerable to flooding, given the trend towards a more significant contribution to the annual precipitation from heavy rainfall days. New temperature and precipitation regimes associated with climate change bring increased occurrences of extreme weather events such as torrential rain, hail, cyclones and tornadoes. The coastline is also particularly vulnerable to coastal flooding caused by rising sea levels, with high socio-economic costs.

The hazard assessment points out the following scenarios and degrees of probability of occurrence of events affecting the urban sector:

i. Heatwaves - In the summer season, heat waves will occur in most mainland Portugal (medium-high degree of probability of occurrence);
ii. Strong winds - The incidence of strong winds is random through the territory. The scenario of strong wind with gusts exceeding 120 km/h in several locations should cause the fall of trees, power cuts in thousands of homes, cuts in several roads and damage to various structures, with severe economic harm to infrastructure and housing (medium-high probability of occurrence);
iii. Floods and flooding - The development of floods and flooding in various parts of the country, as a result of a relatively long period of above-average rainfall during the winter and in several river basins, affecting several urban centres, with the consequent unavailability of some services and causing economic damage to infrastructure, housing and agriculture (medium-high probability of occurrence);
iv. Coastal flooding and overtopping - For the scenario of very rough sea coinciding with high amplitude high tides (winter equinox), strong swell at high tide with the destruction of protective jetties leading to the overtopping of the sea and consequent flooding, causing damage to several houses, equipment, infrastructure (medium-high probability of occurrence).

Land use planning

The mapping of current hazards and the scenario of their future expression in the context of climate change is one of the objectives of the National Programme for Spatial Planning Policies, which aims, from the established macro approach, to foster the detailed mapping of hazards (coastal erosion, flooding, mass movement on slopes, rural fire, water shortage, heat waves, soil desertification and earthquakes) and to deepen their knowledge, within the scope of territorial plans and special or sectoral programmes of various scales. Downstream of this mapping are the land occupations that can induce management concerns and the need to undertake prevention and adaptation actions to reduce vulnerabilities by their nature. To this end mapping was carried out showing the relationship of territories susceptible to specific hazards with the intensities and forms of land use that occur therein.

National documents on spatial planning policy and urban development policy show that vulnerability exists. Still, they offer a growing concern with the capacity to adapt to climate change, and guidelines have been created that should be pursued in the strategies and plans of local and regional scope, with this objective.

Portugal must be better prepared for extreme events - the risks may be increased and costly both in urban areas (heat waves, floods, coastal erosion) and the rural regions (forest fires, loss of biodiversity, reduced agricultural productivity) - and it is essential to ensure solutions for a territorial organisation with the aim at increasing the resilience of natural systems, agriculture, forestry and communities, safeguarding, namely, the sustainability and connectivity of the landscape and food sovereignty.

Business and industry

The main vulnerability for the areas where the industry is located is flooding due to heavy rainfall events. Another threat appears to be extreme meteorological events of strong wind and storm, by the fall of coating materials and structures on buildings.

The main hazards for industry resulting from climate change are associated with:

i. Availability of water resources - degradation of quantity and quality;
ii. Vulnerability to flooding, and;
iii. Vulnerability to extreme weather events, of strong wind and storm.

The indirect negative impacts (threats) include damage to transport infrastructures, particularly roads. Concerning industry located in the Lisbon Metropolitan Area and due to industrial establishments' concentration, there is a strong potential for generating significant accidents involving hazardous substances, emphasising chemical and fuel establishments. The danger of technological accidents associated with industrial establishments that handle or store hazardous substances has also been identified.

The location of commercial activities, particularly, on the ground floors of buildings, and service activities in the central and consolidated areas are sensitive to the potential occurrence of flash floods, which can result from episodes of intense and concentrated rainfall in a few hours, due to the accumulation of rainwater or deficiencies in drainage systems. The flooding of underground urban structures - with these uses - can also be observed with shortcomings and difficulties in the drainage of urban systems, particularly, during high tide periods. Institutional cooperation and the mechanisms defined between the entities responsible for the planning and executing actions have enabled a globally effective response to the consequences observed in the sector arising from extreme climate events.

It is estimated that the sectors where the incidence of climate change may be felt the most will be in the universe of industrial sectors covered by the following legal regimes: EU-ETS, Industrial Emissions Regime (Environmental Permit) and Prevention of Major Accidents involving hazardous substances, which coincide with the technological risks inherent to the respective activities and the vulnerability resulting from the greater frequency and magnitude of extreme weather events.

Coastal areas

The increase in the magnitude and frequency of the phenomena affecting the low, dune supported coastline induced average retreat rates of 0.5 to 9 m/year between 1958 and 2010, representing an approximate loss of territory of 12 km2. Based on the COSMO programme results, the loss between 2010 and 2018 can be estimated at 1 km2. The retreat is not so relevant on cliff coasts, although instability movements and block falls may induce significant risk.

The available climate modelling indicates a high probability of a change in the wave climate off mainland Portugal's coast, with a rotation of 5-10º in the wave direction for the 2100 time horizon. Regarding the significant wave height, a minor increase is expected. There is also a high probability of sea-level rise between 25 and 110cm by 2080, leading to an increase between 15 and 25% of the current erosion rate. Despite the uncertainty, the rise in sea level by the end of the 21st century is expected to be 0.5 meters higher, possibly reaching values in the order of 1 meter above the 1990 level.

The available forecasts regarding the rise in the average sea level and the modification of the sea agitation regime that reaches the Portuguese coast indicate that the coastal zones present a high vulnerability to climate change, namely in the low sandy sections and in the low rocky coast supported by dunes. The insufficient sediment supply aggravates the coastal vulnerability, which reduces coastal systems' capacity to adapt to the predicted changes.

The potential future impacts of sea-level rise are mainly related to the coast's geological nature and its altimetry. Thus, impacts are expected to be negligible on rocky coastlines and significant on sandy stretches, external elevation, such as the coasts of central Portugal and the eastern Algarve.

These changes have an impact on the sediment balance of the coastal strip. They may result in the establishment or variation of the intensity of erosion, the modification of the frequency and intensity of coastal flooding, and changes in estuaries, lagoons, and coastal aquifers' water quality. The areas of greatest vulnerability in the coastal zone identified with a tendency to erosion or confirmed erosion and with a record of coastal overtopping and flooding are those where climate change impacts will be most evident. Thus, places with a high density of human occupation, protected or not by coastal protection/defence structures, are of additional concern, with relevance to coastal areas whose morphological content is associated with the soft or mobile and low rocky substrate (beaches, dunes, barrier islands, sand barriers, wetlands).

All these current and projected conditions imply higher operating and development costs for the most vulnerable sectors in their normal activity, in order to deal with the extreme and increasingly frequent events that result from climate change, which has major implications throughout the economy, in a country with limited budgets.

Health

The increased frequency, intensity and duration of heat waves and droughts, with extreme temperature warnings, contribute for the records of increased mortality. Also, the increased frequency and intensity of precipitation (floods and storms) and the greater frequency and intensity of phenomena such as hurricanes and storms have repercussions on the health of the population as well as on the response capacity of health services.

The increase in the frequency of heat waves and days with heavy rainfall, droughts and fires, due to the combination of drought and higher temperatures, will have significant impact on the health sector. The degradation of air quality will generate an increase in health problems related to respiratory diseases. The high probability of change in the quality and quantity of water and agricultural production, as well as zoonoses, will also have repercussions on public health and safety, increasing mortality and morbidity.

The increment in diseases associated with air pollution, heat waves and cold snaps, distribution and incidence of vectors, availability and quality of water and food are susceptible to generate greater pressure on health services. On the other hand, vulnerabilities at the level of coastal areas and estuaries, forest areas, saline intrusion, agricultural production dissemination of vectors that transmit diseases and exposure to heat have impacts on mortality and morbidity.

It is expected that there will be a detioration in the living conditions and well-being of the population, in the medium or long term, that potentiating the increase the mortality and morbidity, infectious diseases and respiratory diseases resulting from air pollution. Events with a great capacity to affect populations and ecosystems are expected. The buildings may also be compromised, including at the level of services and health care provision.

Climate change impacts (6.3)

Although there is no exact quantification available to estimate the impacts of extreme weather events and the trends observed in recent years related to climate change, Portugal has estimates of 60-140 million euros in annual costs associated with forest fires, of around 290 million euros associated with the 2005 drought (the most severe this century), and circa 200 million euros from the 2012 drought (mainly in terms of agricultural production losses).

The effects of coastal erosion and overtopping are further enhanced by the characteristics of the anthropogenic occupation of the territory's coastal strip, which substantially increases the risk of socio-economic costs of climatic phenomena. The coastline is also particularly vulnerable to coastal flooding caused by rising sea levels, with high socio-economic costs.

There are some data for Portugal based on data from 2 sources (CATDAT and NatCatSERVICE) used by the European Environment Agency[57]. Values of economic damage caused by extreme weather and climate events are provided below in Table 6.3.1.

[57] https://www.eea.europa.eu/publications/economic-losses-and-fatalities-from

Table 6.3.1

Losses CATDAT (million EUR)	Insured losses CATDAT (million EUR)	Fatalities CATDAT	Losses NatCatSERVICE (million EUR	Insured losses NatCatSERVICE (million EUR)	Fatalities NatCatSERVICE
13,461	478	9,267	8,094	664	3,120

Notes: i) Economic damages, insured economic damages and fatalities for Portugal for all weather- and climate-related hazard types; ii) Based on the damage records from CATDAT of RiskLayer, NatCatSERVICE of Munich Re and the Eurostat structural indicators; iii) Figures in million euros at 2020 prices are based on records from CATDAT provided by RiskLayer (dataset url is not available), NatCatService provided by Munich Re (dataset url is not available) and Eurostat structural indicators.

- Insured losses caused by weather and climate-related extreme events in % based on CATDAT : ≤ 5%;
- Total economic loss caused by weather and climate-related extreme events (1980-2020) - per capita based on CATDAT: 1 000 – 1 500;
- Total economic loss caused by weather and climate-related extreme events (1980-2020) - per sq. kilometre based on CATDAT: 100 000 – 200 000;
- Annual average fraction loss from natural hazards (2005-2014) - in ‰ based on NatCatService: 1.5 – 2.5.

Domestic adaptation policies and strategies (6.4)

Overview of the adaptation strategic framework and objectives (6.4.1)

The main strategic documents at national level comprise: 1) the Portuguese Climate Law; 2) the National Climate Change Adaptation Strategy (ENAAC); 3) the Action Programme for Climate Change Adaptation (P-3AC); and 4) the National Energy and Climate Plan 2021-2030 (NECP 2030).

Additionally, many sectoral policies address climate change adaptation challenges as they are being progressively integrated in planning and in public policies. In addition, almost all Portuguese territory is covered by Intermunicipal Climate Change Adaptation Plans (NUTS 3 level) as well as some Municipal Adaptation Plans.

Portuguese Climate Law

The first Portuguese Climate Law was approved at the very end of 2021 defining the main lines of policy, principles and guidance to be considered in the climate policies. On adaptation matters, it introduces some new elements to integrate in the adaptation policies and governance including some tasks to accomplish within a 1-year / 2-years timeframe, namely:

a. creation of a climate action portal;
b. development of municipal and regional climate action plans;
c. development of sectoral adaptation plans;
d. additional monitoring and reporting processes (including in the State Budget);
e. introduction of the climate legislative impact assessment;
f. integration of climate risks in the decision-making of public and private institutions and agents.

Most objectives are domestically centered, but the law also introduces considerations on climate foreign policy towards an enhanced international cooperation and solidarity to countries of the global south.

National Climate Change Adaptation Strategy (ENAAC)

ENAAC was adopted in 2015, reviewing the previous strategy of 2010. It mainly establishes the governance and responsibilities of the entities involved to address its 3 main objectives:

- Improve the level of knowledge about climate change - basis for the development of the strategy, focusing on the need for research, collect information, consolidate, and communicate accordingly to the target audience;
- Implement adaptation measures – it integrates the prioritization of measures, in harmony with the concerns of the spheres of science, policies and civil society, through benchmarking and participatory mechanisms. Additionally, the identification of funding mechanisms is addressed to support the implementation of adaptation measures.

Promote mainstreaming of adaptation into sectoral policies - the development of adaptation is guided towards its mainstreaming into sectoral policies and territorial management instruments setting a more effective framework. This approach also must rely on proper monitoring mechanisms in order to centralize the progress on adaptation policies.

Other specific responsibilities/ objectives are defined for the sectoral working groups and six thematic areas (see figure 6.4.1.1). No targets and timeframes were defined under ENAAC. Instead, ENAAC provides a framework for the governance structures to conduct their work, which is later explained in the biennial progress reports.

Action Programme for Climate Change Adaptation (P-3AC)

P-3AC was adopted in 2019, complementing and systematizing the work carried out in the context of ENAAC, focusing on its second objective: to implement adaptation measures (domestically). This Action Programme defines 9 adaptation priority areas fostering action: by mobilizing existing financing instruments (short-term objective); and by constituting a guideline for: a) supporting policy-setting exercises and policy instruments; b) definition of references for financing instruments (including the Multiannual Financial Framework 2021-2027); c) promotion of implementation of structural actions to reduce the climate change vulnerability of the territory and economy; and d) structuring and supporting cross-cutting actions.

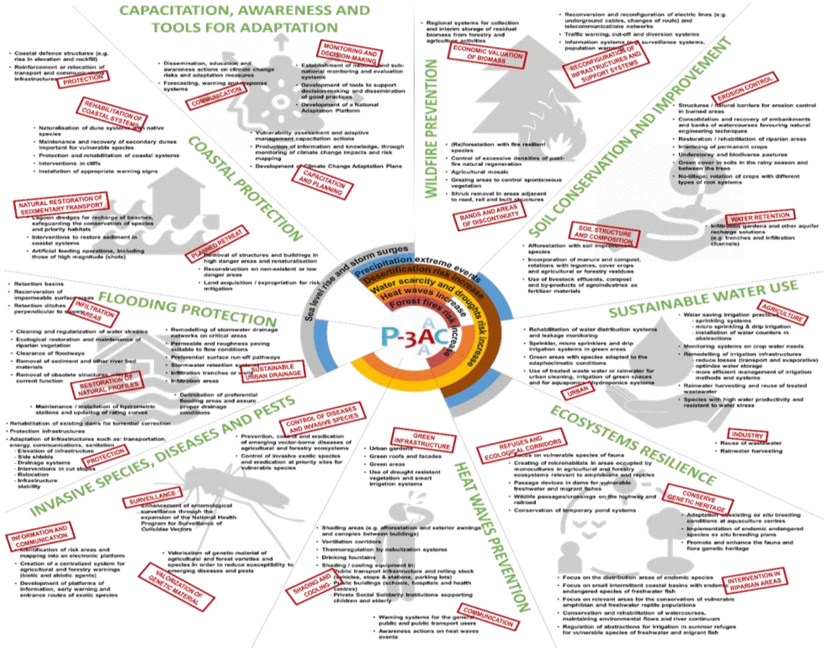


Figure 6.4.1.1 - Climate risks and vulnerabilities, and adaptation measures included in the Action Programme for Climate Change Adaptation (P-3AC).

The above mentioned objectives are not translated in specific targets, but a monitoring system is established with measurable indicators of two kinds – achievement and outcome. The achievement indicators are based on the monitoring framework and respective targets of the financial mechanisms that presently support each of the nine priority areas of P-3AC. The outcome indicators (see table 6.4.1.1) are largely derived from current sectoral planning instruments and aim to measure the contribution of the P-3AC, directly or indirectly (with targets for 2020 and 2030).

Table 6.4.1.1
P-3AC outcome indicators and targets.

Outcome indicator	Target 2020	Target 2030
Municipalities with adaptation plans	60%	100%
Municipalities with Forest fires Prevention Plan (considering climate scenarios)	2%	100%
Urban Water Use Efficiency	80%	85%
Industrial Water Use Efficiency	85%	90%
Agriculture Water Use Efficiency	65%	80%
Awareness and capacity building actions: population targeted	5%	25%
Transport infrastructure companies with adaptation or extreme events contingency plans	10%	50%
Energy companies with adaptation or extreme events contingency plans	25%	100%
Water and wastewater infrastructure companies with adaptation or extreme events contingency plans	50%	100%
Communications infrastructure companies with adaptation or extreme events contingency plans	25%	100%
Mainland Coastline in critical erosion situation	16.5%	10%
Irrigation areas with water precision technologies	10%	50%
Reduction of Number of people affected by flooding in mapped risk areas (Flood Risk Management Plans)	-	25%
Reduction of areas with exotic invasive species	-	10%
Reduction on cases of human diseases caused by climate change related vectors (decade average)	-	10%

National Energy and Climate Plan 2030 (NECP 2030)

The NECP 2030 was adopted in 2020[58] and is the primary national energy and climate policy instrument for this decade. It establishes targets, objectives and related policies and measures on decarbonisation, GHG emissions and renewable energies, energy efficiency, energy security, internal market and research, innovation and competitiveness. Adaptation to climate change is addressed in NECP 2030 within the decarbonisation pillar.

Articulation between the adaptation and the mitigation strategic frameworks (6.4.2)

Looking towards 2030, the first step towards achieving the 2030 European Climate and Energy Package at a national level was taken in 2015 with the approval of the Strategic Framework for Climate Policy (QEPIC), with a vision of decarbonising the economy and placing the country in better conditions to meet the challenges created by the Paris Agreement.

That Strategic Framework established an integrated, complementary and articulated framework of climate policy instruments for the horizon 2020/2030, in liaison with air quality policies, with the approval of the National Climate Change Program (PNAC2020-2030), which had identified the guidelines for policies and measures that can ensure achievement of the new emissions reduction targets for 2020 and 2030, and the National Climate Change Adaptation Strategy (ENAAC 2020).

At a later stage the 2050 Carbon Neutrality Roadmap for Portugal (RNC 2050) was developed to set the pace for the mitigation policies, but including adaptation premises and it constituted the Portuguese Long-term Strategy for Carbon Neutrality by 2050 submitted to the UNFCCC.

RNC 2050 was approved in 2019 and it had recognized the national effort to reduce emissions, as part of a broader global action framework that will help to allow adaptation costs to be reduced significantly, with clear economic savings. Furthermore, It also noted that there is a series of decarbonisation measures and options with clear synergies in adapting to the effects of climate change, such as, for example, measures contributing to forest and agricultural sequestration (increasing soil organic matter and its water retention capacity, combating desertification), natural-based solutions (installing roofs and other green infrastructures in urban areas, renaturalisation of impermeable areas, etc.) but also measures in the area of energy efficiency, as they contribute to reducing total energy consumption and thereby reduce the vulnerability of the energy system to pressures arising from extreme events.

On the other hand, the impacts of climate change were taken into account in mitigation options, notably as regards future water availability, heating and cooling needs and the risk of rural fires. For example, the scenarios analysed under RNC2050 accommodate the decreasing availability of water for electricity production expected in the RCP 4.5 climate scenario. In this context, it has been estimated that water production will, on average, decrease by 9% by 2050, compared to 2020, considering, in particular, a hydraulic index of 0.8. In this regard, it was also particularly important to note that the determining factor in forest carbon sink capacity - a decrease in the annual average burned area - will be hampered in a scenario of worsening of the effects of

[58] In the context of the requirements established under the Regulation (EU) 2018/1999

climate change. Hence, RNC2050 also acknowledged that it is therefore undeniable that the implementation of adaptation measures becomes one of the critical factors for the carbon neutrality.

The NECP 2030 was developed in parallel with the modelling exercise of RNC 2050 and integrated the same premises, since it was recognized that the synergies for mitigation and adaptation that occur in various measures are another sign that integrated action between the two strands in all components of society is effectively needed. Consequently, the mitigation policy was also subject to climate proofing by considering the climate scenarios in the projections and assessment of mitigation options.

The National Adaptation Strategy – ENAAC (6.4.3)

Preparation and adoption of ENAAC (6.4.3.1)

The national adaptation strategy – ENAAC is the main adaptation planning instrument at national level. It was adopted in 2015, reviewing the previous strategy of 2010 based on the conclusions of its 2013 progress report which: 1) identified the sectoral vulnerabilities and barriers for adaptation; 2) identified and prioritized adaptation sectoral measures; and 3) assessed strengths and weaknesses of ENAAC.

For this progress report the contributions of the sectoral groups coordinators was key, bringing some of their sectors insights, some of which from sectoral stakeholders, into the process. The coordination group of the previous 2010's ENAAC continued to follow the development of the 2015 ENAAC commenting on draft versions and discussing in ENAACs coordination group meetings. After this process, a draft version was subject to public consultation prior to its final version being adopted at the Council of Ministers[59].The ENAAC was adopted through a Resolution of the Council of Ministers, which means the decisions there contained have a binding force like a legislative act. However a Resolution of the Council of Ministers does not go through the Parliament and cannot be invoked from a legal point of view. The Resolution planned initially a formal review of ENAAC in 2020, but this procedure was extended to 2025 through the National Energy and Climate Plan 2030 (approved in 2020), since it was considered that ENAAC is still updated and the output of the ongoing project RNA 2100 will be crucial to proceed with the revision of the ENAAC.

Box 6.4.3.1.1 Public participation in the Portuguese Climate Law
The Portuguese Climate Law adopted at the end of 2021 reinforced the public participation on the development and review of climate policy instruments. This includes considerations for the organization of information sessions and debates, and for the improvement of the accessibility to clear and systematized information.

The new Portuguese Climate Law (adopted by the Parliament) envisages the review of the ENAAC every 10 years with an update halfway.

[59] Resolution of the Council of Ministers nº 56/2015

ENAAC's institutional arrangements (6.4.3.2)

The Climate Action Commission seeks to enhance the involvement and promote the accountability of the various sectors to greater integration of climate policy in sectoral policies. It is composed of government departments from relevant sectors, promoting policy coordination, a greater dynamism and sectorial responsibility. It is chaired by the Minister of the Environment and Climate Action and includes government departments from the areas of energy, spatial planning, finance, agriculture, sea, economy and innovation, transport, health, tourism, civil protection, regional development, local administration, foreign affairs and cooperation, education and science, and representatives of the regional governments of the Azores and Madeira.

The Climate Action Commission is responsible for:

a) Providing political guidelines in the context of climate change;

b) Promoting the articulation and integration of climate change policies in sectoral policies;

c) Monitoring the implementation of sectoral measures, programmes, and actions.

The Climate Action Commission provides in this way the Government support and guidance to ENAAC's activities.

The aim of ENAAC governance structure is to promote greater involvement of the relevant authorities ensuring proper vertical coordination (between the various administrative levels), horizontal coordination (between sectors and entities), including development of work of multi-sectoral nature. The ENAAC coordination group is composed by:

a. the Portuguese Environment Agency, which chairs;
b. The coordinators of thematic areas;
c. the coordinators of sectoral working groups;
d. the representatives of the Autonomous Regions of the Azores and Madeira;
e. the representatives of the National Association of Portuguese Municipalities.

The operationalisation of ENAAC required the creation of a flexible and dynamic structure, organised into six thematic areas and nine priority sectors. The nine sectoral working groups correspond to strategic domains for the promotion and implementation of adaptation in Portugal. Each of them is coordinated by the respective central administration entity with sectoral competences. Depending on the sector, the working groups may have a vast array of sectoral stakeholders. These additional entities (including private) and personalities are in this way engaged in ENAAC's activities, contributing to a broader co-responsibility and the co-construction of actions and policies.

The thematic areas cover matters of a more cross-sectoral nature, providing in this way a framework where all sectoral working groups may contribute to the activities held under that specific domain. The coordination of each thematic area is shared between the APA (also ENAAC's general coordinator), and the entities with specific thematic competences, acting as facilitator.

The Figure 6.4.3.2.1 below systematizes ENAAC’s governance structure and respective responsibilities.

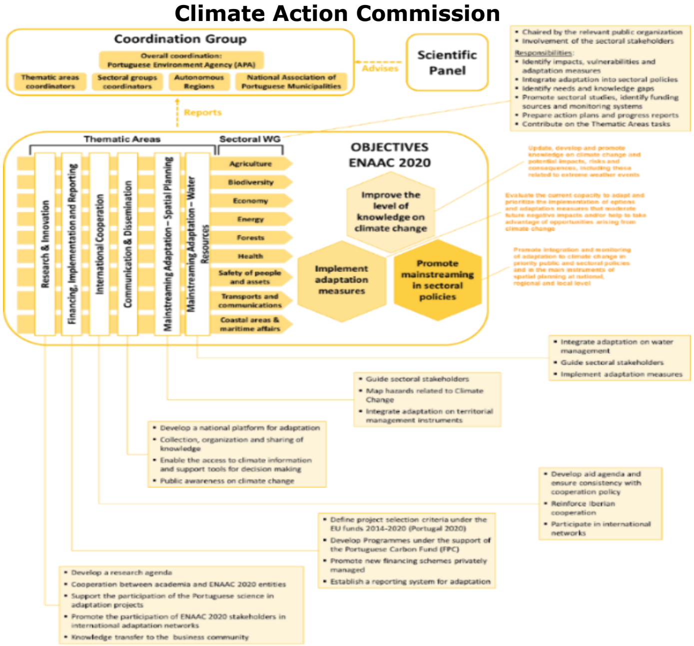


Figure 6.4.3.2.1.1

Portuguese National Adaptation Strategy (ENAAC 2020) governance.

Box 6.4.3.2.1.

Additional elements of governance in adaptation policies

The responsibility to implement and monitor the Action Programme for Climate Change Adaptation (P-3AC) lies with the APA (as ENAAC’s coordinating entity) and the remaining entities that integrate ENAAC’s Coordination Group. Additionally, P-3AC introduces another level of interaction with the entities responsible for the management of financial instruments to improve cooperation, including for reporting purposes.

The Portuguese Climate Law also introduces some new elements to the governance although maintaining ENAAC as the primary policy for adaptation. Among other considerations, it creates the Climate Action Council that will be composed by relevant personalities. This Council will work as an independent and advisory body providing inputs to Parliamentary and Governmental initiatives, such as climate studies and legislative acts. It will also assess the status and progress of the climate policy and its premises, providing recommendations including for the State Budget and State’s General Account. The Portuguese Climate Law also sets the mandatory development (in a 2 year timeframe) of climate action plans for municipalities, for intermunicipal communities and metropolitan areas (NUTS3 level), and for the regional development and coordination commissions (approximate to NUTS2 level). These local and regional plans will have their performance assessed.

Box 6.4.3.2.2 Budget considerations in adaptation policies

ENAAC itself does not include budget allocations. However when P-3AC was developed there was a mapping exercise of consigned public expenditure for adaptation action under the main financial instruments available at the time. It was also included an estimate of available funds within the same financial instruments to support the actions listed in P-3AC.

The Portuguese Climate Law introduced requirements for planning the State Budget. The State Budget will consolidate the allocations for climate policy (mitigation and adaptation) in a dedicated account of the State Budget.

Subnational adaptation plans and strategies (6.4.4)

Climate change adaptation action is very context specific and much dependent of the local specificities. This has been a key issue guiding adaptation action, with very significant efforts building capacity for adaptive management in municipalities and other subnational levels of administration. Many Municipal Adaptation Strategies and Plans have been adopted and almost all the territory is covered by Intermunicipal (NUTS III level) Adaptation Plans. The new Portuguese Climate Law strengthens this process by setting mandatory development (in a 2-year timeframe) of Climate Action Plans (both mitigation and adaptation) for all municipalities, all intermunicipal communities (NUTS III level) and all regional development and coordination commissions (approximate to NUTS II level).

From the adaptation perspective these plans will be the main instrument to support the role of the local governments. The plans seek to promote proper vertical integration (e.g. integration of intermunicipal plans at the municipal scale), to define climate adaptation planning, to strengthen the role of land use planning in adaptation, to establish municipal adaptation action programmes to be implemented until 2030, to empower municipal officials and technical staff, and to prepare communities for the challenges of climate change.

Box 6.4.4.1. The process of development of subnational adaptation plans in Portugal

The Programme AdaPT, supported by the EEA Grants and the Environmental Fund, was the pilot programme for adaptation in Portugal and originated landmark projects in the national adaptation process, in particular the ClimAdaPT.Local project (under which 27 municipal adaptation strategies were developed) and the Climate Portal.

This programme was a driver of adequate action in adaptation to climate change and a significant contribution to raise awareness, increase the ability to assess vulnerabilities, and promote awareness and education on this issue at the local level.

The current Cohesion Policy national support framework – Portugal 2020, in particular the Programme for Sustainability and Efficient Use of Resources (POSEUR) - included several funding opportunities for climate adaptation, and allowed the following of the path initiated by the Programme AdaPT, through support to municipal and inter-municipal adaptation planning, and the implementation of adaptation measures, particularly in the areas of coastline, water resources and nature conservation. As a result, most of the territory is now covered by intermunicipal climate change adaptation plans, including the Lisbon and Porto metropolitan plans, promoted by sub-regional structures (Intermunicipal Communities and Metropolitan Areas), in which there was a broad participation and involvement of municipalities (including capacity building of their technical structures).

The structure of these plans is generally based on 2 phases. According to the climate scenarios previously analysed, a step associated with 'Impacts and vulnerabilities' identifies the territories' adaptive capacity and the current and future vulnerabilities, which allows the prioritisation of adaptation. A phase associated with adaptation options' focused on identifying and planning the realisation of adaptation options and measures, establishing the respective priorities and deadlines, and defining the institutional management, monitoring, and communication models to support their implementation.

There are 295 municipalities in Mainland Portugal, Azores, and Madeira (from a total of 308) that are covered by a municipal, intermunicipal or metropolitan planning instrument (plan or strategy) on climate adaptation. Additional funding is available to prepare several of the missing municipal climate change adaptation plans (EEA Grants).

Local governments are therefore one of the main key actors on adaptation due to their greater knowledge of local specificities and priorities, as well as their direct contact to the local communities and businesses. Municipalities in particular can increase the effectiveness of the actions using their responsibilities in land use planning, by integrating climate risks and adaptation considerations into the municipal land use management instruments. This climate proofing is already taking place in some municipalities.

Climate proofing in government operations (6.4.5)

Environmental impact assessment (6.4.5.1)
The Environmental Impact Assessment (EIA) is a preventive instrument of environmental policy that ensures that the potential effects on the environment of certain projects are studied and evaluated. It also ensures the assessment of climate risks and vulnerabilities for these projects. This procedure applies to public and private projects that are likely to have significant effects on the environment, with a view to concluding on their environmental feasibility. This procedure also ensures public participation and consultation of interested parties in the formation of decisions on the projects.

Climate Change is always considered at the screening stage and is frequently identified as a Critical Factor for Decision-Making (CFD) in the scoping phase. When considered a CFD, adaptation is addressed (e.g. flood risk plans/maps in the context of different land uses) and generally recognized as a relevant tool for considering climate change at an early stage of the decision-making process.

The EIA procedures consider national and territorial adaptation planning instruments; current and future climatic vulnerabilities through historical data on the climate and the occurrences of extreme weather events. Additionally, EIA procedures consist of environmental, social and economic impacts and consequences, considering Climate Change scenarios; key risks/impacts of Climate Change in the project; assessment if pre-existing vulnerabilities to Climate Change will be exacerbated; alternatives more resilient to climate pressures and/or allowing a more significant climate vulnerability reduction; critical thresholds that compromise the project or the environment, forcing the adoption of adaptation measures; minimisation measures based on P-3AC for the relevant vulnerabilities or impacts.

These procedures are intended to define the information to be included and the scenarios to be considered in the environmental impact report and to establish criteria for assessing climate change and for establishing appropriate measures, so as to enable monitoring impacts throughout the life cycle of the project (construction, operation and deactivation phases).

Strategic environmental assessment (6.4.5.2)
The Strategic Environmental Assessment (SEA) aims to identify, describe and evaluate any significant environmental effects resulting from a Plan or Program prior to its elaboration or during its elaboration and before its approval. This instrument applies to public plans and programs whose implementation may include projects likely to have significant effects on the environment, namely those subject to Environmental Impact Assessment or in areas protected for their interest in conserving biodiversity.

Consideration of climate change in SEA procedures follows a similar approach as in EIA procedures by reflecting on projects that may result from the implementation of the plan or programme.

Legislative climate impact assessment (6.4.5.3)
The Portuguese Climate Law establishes that any new legislative procedures will need to follow first a climate impact assessment reinforcing the pilot approach of climate proofing of new legislative acts that is already being addressed.

It started with a pilot project that defined a methodology to measure impacts of legislative proposals and sectoral policies on climate action. This was done through an analysis and evaluation tool that has been incorporated in already existing legislative evaluation systems – the "Model of the Pilot Project on Prior Evaluation of Legislative Impact on Climate Action".

As an experiment, this pilot project is being implemented regarding preliminary legislative impact assessment on climate action, both mitigation and adaptation, extending the scope and reach of the assessment, providing more information, promoting alignment with the objectives undertaken by Portugal in terms of climate policy and providing an enhanced legislative procedure and a more transparent legal system. Note that impact on climate action is identified in terms of energy, mobility, agriculture, forests or other land use, water, waste, circular economy, health, protection of people and assets and economic incentives, employment, capacity building and innovation.

Climate action in the State Budget and sustainable finance (6.4.5.4)
In addition to the previous climate-proofing tools, the Portuguese Climate Law introduces new areas to integrate climate action considerations, namely in the areas of taxation and budget process and of sustainable finance.

Regarding the development of the State Budget it will identify the climate policy measures, consolidate the budget allocation and estimate its contributions to the mitigation targets established on the Portuguese Climate Law. The implementation of these elements will later be reported in the State's General Account. Additionally, the reports on tax benefits and expenses will specify the ones addressing adaptation efforts.

This Law also provides a strong support to use the EU taxonomy by stating:

- "Public and private agents and institutions, in their financing decisions, take climate risk and climate impact into account."
- "Failure to consider climate risk and climate impact in the short, medium and long term is considered a violation of fiduciary duties."

The integration of the climate risk in decision-making is therefore extended to the corporate governance. The assessment of the exposure to climate change is now enforced by the Law to figure in the corporate annual exercises.

Monitoring and evaluation framework (6.5)
The Monitoring, Reporting and Evaluation (MRE) at national level is mainly ensured by the biennial Progress Reports of ENAAC and the monitoring of P-3AC. The Portuguese Climate Law also introduced provisions for monitoring and reporting in particular for the annual provision of information to the Parliament. All adaptation reporting exercises are supported by ENAAC's Thematic Area "Financing, implementation and Reporting" through which is coordinated the

collection and review of information from ENAAC's Coordination Group (in particular the various thematic areas and working groups). The same framework is used to address the international reporting obligations (in particular to UNFCCC and to the European Commission). Presently the main international reporting processes are the following:

a. National Communications (under UNFCCC);
b. provisions on international cooperation within the Biennial Reports (under UNFCCC);
c. Adaptation Communications (under UNFCCC);the forthcoming Biennial Transparency Reports (under UNFCCC);
d. Adaptation biennial reporting to the European Commission[60].

The biennial progress reports of ENAAC are intended to assess (qualitatively) the progress on each of the ENAAC's objectives and to set recommendations for improvement. The reports focus on the various thematic areas and priority sectors, the current state of the art, the degree of integration of adaptation in the various public and sectoral policies, and the implementation of adaptation measures. Since ENAAC's adoption, three biennial reports were produced.

Further annual monitoring of the implementation of adaptation measures is envisaged within the P-3AC and the Portuguese Climate Law. However the monitoring framework is currently becoming operational, so no systemic report has been published yet. The P-3AC first report is planned to be published in 2022. Some adjustments may be made to P-3AC monitoring framework in order to accommodate some of the Portuguese Climate Law provisions (e.g. the State's General Account as another source of information to monitor adaptation action). The progress reports of P-3AC update the indicators (including allocation of funds) stablished for each of its nine lines of action. The indicators and most of the targets of P-3AC come directly from funding programmes (e.g., those funded by the European Structural and Investment Funds) and sectoral plans and strategies (e.g. PNUEA - National Plan for Efficient Water Use). In this way, the management authorities of the financial instruments that provide funding to the adaptation measures have a key role in this process by providing data in an annual basis to the APA (general coordinator of ENAAC and P-3AC).

Monitoring adaptation action faces the challenge of tracking progress among the local governments and communities which are very important actors in the implementation of adaptation measures. To overcome this challenge, it is essential to ensure adequate mechanisms for vertical coordination, in order to allow an effective articulation and communication between local, regional and national authorities on adaptation matters. ENAAC's governance addresses partially this issue by including the National Association of Portuguese Municipalities as part of the ENAAC's coordination group. However, there is a need to significantly strengthen this coordination, as many of the enabling tools to promote climate action are discussed and developed at EU and national level, while it is at the local level that the interventions are intended to take place. This aspect for improvement of the MRE is particularly relevant considering the significant increase of demand for adaptation monitoring and reporting.

Autonomous Region of Azores

[60] Under Art.17 and Art.19 of Regulation (EU) 2018/1999

For the Azores Autonomous Region, the PRAC, approved and published in November 2019, will be subject to systematic follow-up and monitoring[61], namely through a follow-up and evaluation process defined in the program itself, in conjunction with the results of the Strategic Environmental Assessment monitoring report, which will allow deviations from the planned objectives to be detected.

The monitoring of the PRAC is based on a system of indicators assigned to each of the measures, which will allow, in a systematic and objective way, to verify the degree of implementation of the program and the level of achievement of the objectives.Thus, the PRAC monitoring plan is composed of three major monitoring sub-systems, as a result of the two fundamental lines, mitigation and adaptation, in the regional climate policy:

- Climate monitoring sub-system that integrates climate indicators that allow to follow the evolution of the global and regional climate and to make the regular benchmarking of climate scenarios;
- Sub-system for monitoring the approach to reducing emissions and mitigating Climate Change in the Autonomous Region of the Azores, which will be supported by the Regional Inventory of Greenhouse Gas Emissions and by indicators of achievements and results of the defined sectoral mitigation measures;
- Sub-system for monitoring the approach to promote the reduction of impacts and adaptation to Climate Change in the Autonomous Region of the Azores, which will be supported by indicators of achievement of adaptation measures that integrate the Sectoral Strategies for Adaptation to Climate Change.

The PRAC monitoring report will be produced and published every two years.

Autonomous Region of Madeira

For the ARM, the monitoring of the regional climate action, is based on a system of indicators, which will allow, in a systematic and objective way, to verify the degree of implementation and the level of achievement of the objectives.

For this purpose, three major documents must be mentioned:

- Regional Adaptation Strategy (Estratégia CLIMA-Madeira);
- Regional Inventory of Greenhouse Gas Emissions (ERPA);
- Action Plan for Sustainable Energy and Climate of the Autonomous Region of Madeira (PAESC-RAM).

The Regional Adaptation Plan has a set of monitoring indicators, which is being followed by the so-called Adaptation Community, a community of stakeholders, composed by regional government departments, public companies, municipalities, NGO's, private companies and R&I entities. The strategy is now under revision, and the new version is to be presented by the end of 2023.

The Regional Inventory of Greenhouse Gas Emissions is revised and published every year, on an N-2 basis.

[61] Article 176 of the Legal Regime of Territorial Management Instruments of the Azores Autonomous Region

The Action Plan for Sustainable Energy and Climate of the Autonomous Region of Madeira (PAESC-RAM) is aligned with National and European policies and defines the objectives and targets for the horizons timeframes 2030 and 2050 in the areas of Energy and Climate, in accordance with the Regulation (EU) 2018/1999 of the European Parliament and of the Council and with the PNEC, which will allow the Region to effectively monitor and report information on their contributions to the national plan.

Progress and outcomes of adaptation action (6.6)

Major milestones on the progress made (6.6.1)

For each of the three main objectives of the National Adaptation Strategy (ENAAC)[62], a major outcome have been developed in close articulation with ENAAC's governance framework:

- the Research & Innovation Agenda for Climate Change;
- the Programme on National Spatial Planning Policy (PNPOT);
- Action Programme for Climate Change Adaptation (P-3AC).

Addressing the ENAAC objective for knowledge improvement, a Research & Innovation Agenda for Climate Change was developed through a process within ENAAC's Thematic Area "Research and Innovation", focusing on the identification of needs and knowledge gaps and on the establishment of priority areas for research. The Scientific Panel had a major role drafting the Agenda counting also with the contributions of ENAAC's Coordination Group.

Regarding the ENAAC's objective of mainstreaming adaptation, the PNPOT was published and considered climate change as a transversal theme and integrated it into the different themes diagnosed, in the environmental, social and economic areas, assessing the impact of global scenarios applied to the national territory, and seeking to indicate the direction that some variables take in the region. This law is a territorial development instrument of strategic nature that establishes the great options with relevance to the organization of the national territory, consubstantiates the framework of reference to be considered in the elaboration of other Territorial Management Instruments, and constitutes an instrument of cooperation with the other Member States for the management of the territory. The review of PNPOT was the primary priority within ENAAC's Thematic Area "Mainstreaming Adaptation - Spatial Planning".

Particularly aiming the ENAAC objective of implementation adaptation measures, the abovementioned National Adaptation Plan was prepared – the P-3AC.

Progress towards ENAAC's objective for improvement of the level of knowledge (6.6.2)

The action within the domain of knowledge improvement was addressed following different approaches. It was strengthened the citizen's engagement to provide their knowledge and concerns into decision making, complementing the academia role to cover knowledge gaps,

[62] ENAAC's main objectives: 1) improve the level of knowledge; 2) implementation of adaptation measures, 3) mainstreaming of adaptation into sectoral policies.

while improving at the same time the access to information through tools to support adaptation action.

Citizens' participation in decision making is increasingly encouraged. The Portuguese Climate Law includes a dedicated article that defines the citizens' participation rights in the preparation and review of the climate policy instruments, as well as how this participation is operationalized. This requires that information should be available to citizens in a clear and simple way.

As referred previously, the Thematic Agenda for Research and Innovation (R&I) on Climate Change is intended to reflect on the challenges for Research and Innovation activities in the area of Climate Change. The agenda identifies research and innovation challenges and lines of action on climate change that are relevant for Portugal, in a medium and long term perspective (2030), considering multiple chains of complex interactions between natural and human systems. The main objective is to facilitate and enhance the exchange of knowledge between R&I system players, and to foster continuous learning and a better adaptation to the challenges brought by Climate Change.

Not only it has been built an environment for better integration of research products and citizen's concerns into other adaptation actions and processes, but also there has been a focus on other tools to facilitate the dissemination of knowledge and sharing of best practices to support decision-making and adaptation practitioners. An example of are) 1) the climate portal where climate projections for Portugal are published in an user-friendly format (http://www.portaldoclima.pt/en/), the ongoing project that is undertaking a multissectoral assessment of vulnerabilities and setting the National Roadmap for Adaptation, and the sharing of Portugal experience in the UNFCCC fora through its Adaptation Communication.

The climate portal was published to provide climate indicators in climate change scenarios, a key tool for any vulnerability assessment initiative. This user-friendly platform brings together about 40 climate variables, aggregated into the following groups: temperature, precipitation, wind speed, relative humidity, global radiation, temperature range, drought index, aridity index, evapotranspiration, fire risk index and climate classification. This platform is based on CORDEX climate change projections, with multiple information regarding normal climate and scenarios, time period, geographical areas (NUTS I, II and III), statistics (30 year average or anomalies), global models and regional models, constituting a platform of easy access to the public about the results obtained in the project, namely: historical series, climate change at regional level and climate indicators for specific sectors in Portugal. This Climate Portal is a reference source of information of any given adaptation project.

As previously mentioned the National Roadmap for Adaptation 2100 - Assessment of the Portuguese territory's vulnerability to climate change in the 21st century (RNA 2100) project aims to define adaptation narratives for different territorial units considering climate change vulnerabilities and impacts, as well as evaluation of investment needs for adaptation and socio-economic costs of inaction. Hence, RNA 2100 will support and respond to public policy exercises on adaptation to climate change at different levels of territorial intervention, being also supported by several initiatives for dissemination of results, including to the general public, having the ambition to become an important promoter of awareness on the subject of adaptation to climate change. Therefore, it is central for this project a strong communication component. As plenty of information will be produced by the project, with diverse scopes, it will provide adequate information according to the user needs, so narratives and contents will be adapted to the target audience, covering general public, sectoral stakeholders, policymakers and project managers. Furthermore, this will help on the identification of the climate risks and storylines associated to the context of interest of the user (e.g. detail of the outputs, type of user, geographical scope and sectoral domain). Hence the project shall have also a capacity building component in order to guide practitioners and policymakers on the integration of adaptation in their activities.

Portugal is also committed to share information of domestic adaptation policies in international *fora*. In November 2021 Portugal submitted its first Adaptation Communication to the UNFCCC (available here) providing the state of play of the methodologies, policies and measures developed in Portugal as well as Portugal's provision of support to developing countries, in particular within Lusophone community, in particular the Portuguese Speaking African Countries (PALOP) and Timor-Leste.

Progress towards ENAAC's objective for implementation of adaptation measures (6.6.3)

For the ENAAC objective of implementation of adaptation measures, the publication of the P-3AC and the progress on the financial mechanisms were the major milestones.

The first adaptation dedicated financial mechanism was AdaPT Programme (financed by EEA Grants 2009-2014 and PT Environmental Fund) which was built based on the needs identified on the first ENAAC progress report (published in 2013). This Programme kick-started the funding of adaptation projects being of great relevance as it focused on strategic areas, covering a website for climate scenarios (the climate portal), development of local adaptation strategies and training of local officers, integration of climate change in schools activities, and development of small scale sectoral projects. The outcomes of this Programme were important references for the adaptation projects later implemented, in particular within the Common Strategic Framework 2014–2020.

The development of P-3AC, the equivalent to a National Adaptation Plan, was supported on different sources of information namely: from products developed under ENAAC, from other strategic and programmatic instruments, as well as from municipal and intermunicipal adaptation plans.

Furthermore, in recent years there has been relevant progress in the implementation of adaptation measures. EU funds support had contributed significantly to this improvement. It's highlighted the definition of eligibility and development of selection criteria for the financing of adaptation projects through EU funds of Portugal 2020 (particularly in the Operational Programme Sustainability and Efficiency in Use of Resources – POSEUR and in the Rural Development Program – PDR2020).

The Thematic Objective 5 of the Operational Programme for Sustainability and Efficiency in the Use of Resources (POSEUR) included in Portugal 2020, aims to strengthen national adaptive capacity. Its Priority Axis 2 - Adaptation to climate change and risk prevention and management, includes two investment priorities (IP): 5.1. Support for investment for adaptation to climate change; 5.2. Promoting investments to address specific risks, ensure disaster resilience and develop disaster management systems. In 2020, 10 calls for proposals were opened in these two IP. 11 applications were approved, absorbing a total Cohesion Fund amount of €32 million. At the end of 2020, 421 operations were supported, with a total eligible cost of €512 million and a Cohesion Fund allocation of €421 million. The financial implementation rate of Axis 2 at the end of 2020 was 60% of the programmed fund, translating into €300million and Cohesion Fund of €259 million.

In the energy field, POSEUR has supported Energy Efficiency projects in buildings, the same happening with protect energy infrastructures.

In the case of the agriculture and food/rural development sector, the Rural Development Programme (PDR 2020) supported with €1746.5 million the adaptation of agriculture/forest to Climate Change (54.5% of total funding to agriculture and forests). This amount was distributed as follows: 0.5% (Knowledge); 12.2% (Investments); 1.6% (agricultural risks); 13.4% (forestry); 48.8% (agri-environmental measures and climate); 23.5% (Areas with constraints). In the case of the P-3AC relative support translated into 31% (Fires); 16% (Soil); 16% (Water); 18% (Biodiversity); 8% (Diseases/plagues); 6% (Floods); 6% (Knowledge).

The expenditure programmed and committed in the PDR2020 for the priorities of adaptation to Climate Change, between 2018 and 2020 (as of September 30), in the field of agriculture and food/rural development, was increased (15% and 18%, respectively), with an additional execution of €728 million towards the targets set in the P-3AC. The share of investment supporting adaptation to climate change (additional investment making a project - which would have been carried out anyway - climate change resilient) translates in absolute terms to €2.412 million (total programmed for Climate Change Adaptation Priorities), calculated following Reg.

Greater availability of EU funds is noted to increase forests' resilience with particular focus after the fires that occurred in 2015 and 2017. Considering the 2019 implementation report of Mar2020 regarding measures to increase resilience to climate change in the marine and fisheries sector, the significant contribution of the selected operations to the fight against climate change is worth highlighting, translating into €54.7 million. The part of the investment supporting adaptation to climate change (an additional investment that does a project - which would have been carried out anyway - resilient to climate change) translates, in relative terms, into about 26%.

The FA is the main Portuguese Fund created to support environmental policies pursuing sustainable development goals, contributing to the fulfilment of objectives and commitments associated with climate change, supported interventions in urban green spaces that mitigated the effects of heat islands and allowed the intervention of obsolete irrigation systems, leading to water savings.

The FA also finances adaptation operations aimed at implementing material measures recommended in local or regional planning exercises, namely that reduce or minimise climate risks associated with flood events and increase the resilience of infrastructures and ecosystems, species, and habitats.

With the specific objective of rehabilitating and improving buildings' energy and water performance, the support programme "More Sustainable Buildings" was created in 2020 amounting a total of €4.5 million since then, which was scaled up by €135 million under the Recovery and Resilience Plan.

Since 2018, the Environmental Fund financed applications with the objective to implement adaptation measures that guarantee the improvement of the adaptive capacity and increase the territory's resilience to the impacts of climate change focusing the implementation of the ENAAC and the P-3AC. These calls included among others:

- applications made under the "Village Condominium", the Integrated Support Programme for Villages located in forest territories, to ensure the management of fuels around settlements in areas of high forest density and increased number and dispersion of small rural settlements;
- "Valuing the landscape of the Monchique and Silves Mountains" aiming the improvement of adaptive capacity and the increase the territory's resilience to the impacts of climate change as provided in the Program for Reorganization and Landscape Management of the Monchique and Silves Mountains (PRGPSMS);
- Projects to address the pressures of exotic invasive species.

In the private sector, it is worth highlighting investments associated with:

i. emergency plans;
ii. business continuity plans (with the effect of Climate Change);
iii. Identification of infrastructures subject to risks related to climate change and definition of investments.

Portugal is preparing the next EU Multiannual financial framework for 2021-2027 that will be implemented through a new partnership agreement between Portugal and the European Commission (called "Portugal 2030") on the European Regional Development Fund (ERDF), the European Social Fund + (ESF+), the Cohesion Fund, the Fair Transition Fund (FTJ) and the European Maritime, Fisheries and Aquaculture Fund (EMFF).

Its programming is based on five strategic objectives: a smarter, greener, better connected, more social Europe and closer to the citizens. Is included a climate thematic operational programme: Climate action and sustainability and Maritime, which aims to ensure climate transition and actions promoting adaptation to climate change, circular economy and urban mobility.

Following the EU Recovery Plan, launched by the European Commission for a sustainable, resilient and fair recovery, in particular, the recovery and resilience facility, Portugal developed a national Recovery and Resilience Plan. It relies on the objectives of the European Green Deal and aims to stimulate the green and digital transition to achieve a climate-neutral Europe in 2050. To this end, the plan foresees significant resources for adaptation to climate change to increase the hydric management in response to the need to mitigate water scarcity and ensure the resilience of the Algarve, Alentejo and Autonomous Region of Madeira. The projects under this component are: Algarve Regional Water Efficiency Plan (€200 M), Crato multi-purpose hydroelectric plant (€120 million) and Plan for water efficiency and reinforcement of the water supply and irrigation systems of the Autonomous Region of Madeira.

In general, investment and support in climate change are expected to increase in Portugal to meet the overall climate target of 30% of the total expenditure from the EU Multiannual financial framework 2021-2027, which increase to 37% in the Recovery and Resilience Plan.

Box 6.6.3.1 Examples of case studies at local level

Upgrade the drainage network of Lisbon, including drainage tunnels and ancillary infrastructure to reduce the frequency and magnitude of floods in the city. Lisbon has been suffering from intense and more frequent flood events in the past years. These events not only negatively affect the tourism industry, but more importantly, cause long lasting detrimental effects to the city population, as well as to its property and heritage.

The project is intended to minimize the recurring and increasing problem of flooding while increasing infrastructure resilience in specific vulnerable areas of the City of Lisbon, including parts of the historical city centre. The project is part of the Lisbon's Drainage Master Plan 2016-2030, which includes recommendations regarding a number of structural interventions in the city.

In Cascais, the Ribeira das Vinhas trail is a waterbed restoration project complemented by a greenway trail. Through the integration of nature-based solutions, this project has allowed the municipality to address some of the key objectives of its adaptation strategy: reduce flood risk, lower the average temperature of the area and promote biodiversity.

Production of several good practice guides by the Sub-Commission of the National Platform for Disaster Risk Reduction, namely: i. Handbook "Resilient Cities in Portugal 2018" with measures to promote resilience at the local level; ii. Guidance Guide for the Constitution of Local Platforms for Disaster Risk Reduction"; iii. Guide "Good Practices for Resilience of Critical Infrastructures"; iv. Guide Flood Risk Management. Good Practice Support Document.

Progress towards ENAAC's objective for mainstreaming of adaptation into sectoral policies (6.6.4)

As referred above, the National Programme for Spatial Planning Policies ensures a cascading effect mainstreaming adaptation in spatial planning policies. Regional plans now must develop integrated sustainability strategies and approaches at a regional scale, namely in risk and adaptation to climate change. Furthermore, municipal master plans must delimit areas of susceptibility to hazards and risk, considering climate change scenarios and define measures of precaution, prevention, adaptation and reduction of exposure to risks, including the identification of sensitive elements to be managed and relocated, considering their hazard and risk analysis and at the appropriate scale. The Hydrographic Region Management Plans integrate climate change adaptation measures directed to the sectors to manage the existing water scarcity aggravated in periods of drought. Regarding the risk of floods, the implementation of hydrological and hydraulic forecasting models will enable timely warnings to the population and better civil protection actions.

Additional mainstreaming of adaptation can be found in sectoral policies. In the agriculture and food/rural development sector, the sectoral plan, AGRI-ADAPT, which meet the needs felt by the various actors in the sector, develops the monitoring of the integration and implementation of adaptation measures foreseen for the sector and supports the development of studies on climate change on ecosystem services. Terra Futura 2020-2030 integrates an initiative exclusively dedicated to the sectors' adaptation to climate change and other measures that impact it.

In the Biodiversity sector, one line of action is to "promote the integration and monitoring of biodiversity adaptation measures to climate change in the various sectoral policies, plans and programmes". The process of reconfiguring the Protected Areas Management Plans to Special Programmes incorporates structural changes that consider the increase in coastal erosion, the occurrence of extreme weather events or flooding.

Both the Tourism Strategy 2027 and the Sustainable Tourism Plan 20-23 aim to transform climate challenges into opportunities. It contemplates specific actions/projects such as identifying risk areas in terms of climate change and adaptation measures through the definition of the tourist load of the most sensitive territories (coastline, inland waters and classified areas). As part of the monitoring of the preparation of Territorial Management Instruments, indications have been given to incorporate adaptation requirements for the installation of tourist resorts. One of the guiding principles is to act to minimise the impact of climate change. Identifying risk areas in terms of climate change and adaptation measures through the definition of the tourism load of the most sensitive territories (coastline, inland waters, and classified areas) should be highlighted.

In the energy sector, aiming to rehabilitate and make buildings more efficient, in convergence with the adaptation needs, the long-term strategy for the renovation of buildings was approved and published. Regarding the security of supply and resilience of infrastructures, the networks' Development and Investment Plans have particular relevance. Some actions and investments aimed at adaptation to climate change are already defined. In studies such as the Preventive Action Plans and Emergency Plan for the National Gas System, environmental risk factors are considered and studied, namely extreme events, risk scenarios were also defined for the electricity sector related to extreme weather events, and thus infrastructure's protection against such events is assessed.

In Forests, legal frameworks for the forest-fire protection system were amended, national and regional awareness campaigns have been promoted to implement a more resilient forest to fires and plagues, thus changing climate change. The Regional Forestry Management Programmes were revised, with scenarios based on climate models and the integration of measures to prevent and protect forests and population. Guidelines have been produced for municipalities to implement the Aldeia Segura Pessoas Seguras (Safe VIlage Safe People) programmes to adopt acceptable practices when faced with imminent rural fires. Rural fires risk management mechanisms were created, namely the platform for requests registration for burning authorisations and production of weather warnings. In the health sector, it is essential to monitor health state of population, considering diseases transmitted by water, food, vectors and pathologies aggravated by air quality and exposure to extreme climate.

In the National Strategy for Preventive Civil Protection, climate adaptation was integrated into disaster risk reduction. A set of adaptation measures were identified (as for the 17 District Civil Protection Emergency Plans). Disaster risk management strategies are already the "core business" of Civil Protection for various types of risk, where climate risks are included. However, this situation may imply greater responsibility to integrate into planning and with greater detail the potential impacts of climate change. In transport, the vulnerability of projects to climate change has been assessed, changing how project risk is analysed to consider the probability of major accidents or disasters occurring and project's ability to withstand such significant accidents or disasters.

The above mentioned examples demonstrate the degree of integration of adaptation in public policies. But the private sector is also being addressed and making some progress. The private sector is clearly defined in the Portuguese Climate Law as one of the subjects of the climate action. In Portugal, in recent years, several actions have been developed to engage the private sector in adaptation policy measures. According to each sector, different dynamics are in place to involve the private sector within the sectoral working group.

In the agriculture sector, support for innovation and the development of solutions has been strengthened, using participatory approaches and partnership projects between public and private entities. The private sector, supported by its associations and R&D entities, has adopted acceptable management practices (e.g. precision management). Warning systems have been developed (irrigation, among others). Regarding risk management, the Integrated System of Protection against Climate Randomness has been revised and improved, allowing better control of the risk associated with climate change by the private sector.

In the Biodiversity sector, of particular note is the "Best Practices in the Vineyard" project run by Vinhos do Alentejo, which aims to adopt innovative approaches that lead to the conservation of natural resources and biodiversity, contributing to adapting to climate change, generating opportunities for growth and valorisation of the vineyard, and promoting the maintenance of public goods (water, air and soil quality).

Regarding the Tourism sector, several stakeholders have been adopting measures with a view to climate transition. Within the scope of the Plan Turismo + Sustentável 20-23, several partnerships were established, namely with sector associations, with a view to a faster climate transition of the sector, which reflects the direct involvement and concern of the private sector in accommodating/ adopting acceptable practices in terms of adaptation to climate change. The following actions/projects stand out as the most relevant at this level: "AQUA+ Hotéis", through which the aim is to create a national reference for water efficiency in hotel buildings and infrastructures; and, "Plataforma "Por um Turismo sustentável", which aims to monitor the consumption of hotels and disseminate information and good practices for increasingly efficient consumption.

In energy, we essentially highlight the actions and investments defined in the operators' Investment Plans. Besides, we refer to the participation in the consultations carried out by some stakeholders within the scope of their climate change adaptation strategies and plans by identifying potential actions to be implemented for the resilience of the territories and energy networks. The participation of operators as partners in the European project RESCCUE (Resilience to deal with climate change in urban areas, which developed a model for planning urban resilience to climate change) is also worth mentioning. Implementing internal adaptation plans for companies to promote an integrated and transversal action to all activities with identified climate risk is also pointed out.

In the Forestry sector, the private sector contributed to the implementation of discontinuity networks in areas with easements associated with infrastructure (electricity distribution networks) and the Implementation of R&D projects (e.g. REPLANT). On the other hand, there are measures relating to selecting clones and improved plants more resistant to drought by foresters.

In the context of the work developed within the Sub-Commission of the National Platform for Disaster Risk Reduction, a Working Group named "Resilience of Critical Infrastructures of the Private Sector and the State Enterprise Sector" was created, whose main objective is to promote the incorporation of the management of sectorial interdependencies in the increase of resilience of critical infrastructures providing essential care. In this context, the Guide "Good Practices for Critical Infrastructure Resilience" was produced, which aims to promote acceptable practices to reduce risk and increase critical infrastructures' resilience in the Private Sector and the State Business Sector.

Given the high number of flood and inundation situations recorded in the country, the Portuguese Insurers Association and the Faculty of Science of the University of Lisbon developed the CIRAC project to assess flood risk and vulnerability in mainland Portugal. A high-resolution risk analysis was carried out to characterise the potential impacts and damage for Lisbon, Algés, Coimbra and Porto/Gaia, namely in the buildings located there, according to climate change scenarios. This project was an important risk assessment tool for the insurance sector assisting local stakeholders in making strategic decisions.

Finally, it should be noted that the private sector is increasingly concerned with the efficient use of water and the reuse of nutrients, contributing to a circular economy. Also, in terms of water use for reuse in urban services, the application of treated wastewater of urban origin in the irrigation of green spaces, has been developed through the framework of the Lisbon Strategic Plan for Water Reuse, developed by public and private entities.

Financial, Technological and Capacity-Building Support (7)

In light of (national and international) best practices on transparency, accountability and reporting, as well as recommendations from DAC to Portugal and various commitments made by Portugal in this context, Camões – Instituto da Cooperação e da Língua I.P. (Institute for Cooperation and Language), as the coordinating entity for development cooperation, currently provides the Integrated Information System on Portuguese Cooperation.

This involves providing on-line information about Official Development Assistance (ODA), both in aggregate terms (global data) and per project, in Portuguese and English, both in EUR and in USD, relating to a fixed period of time. For a more detailed and in-depth analysis of the Portuguese ODA, please refer to Reporting - Camões - Instituto da Cooperação e da Língua (instituto-camoes.pt)

Finance (7.1)

General Information (7.1.1)

This chapter includes the financial information regarding the support provided by Portugal to developing countries Parties of the UNFCC Convention and Paris Agreement, during the period 2016 – 2021. The information reported in the Annex III, tables 1, 2 and 4, comprises both multilateral and bilateral flows.

In light of best pratices on transparency, accountability and reporting, as well as OECD/DAC (Development Assistance Committee) recommendations and the different commitments made by Portugal in this regard, Camões - Institute for Cooperation and Language P.I., as the coordinating entity for development cooperation, is responsible to provide the Integrated Information System on Portuguese Cooperation.

This involves providing on-line information about Official Development Assistance (ODA) in aggregate terms (global data) as well as per project, in Portuguese and English, both in EUR and USD. For a more detailed and in-depth Portuguese ODA analysis, please refer to https://www.instituto-camoes.pt/activity/o-que-fazemos/cooperacao/atuacao/reportamos/reportamos-2

Althouth from a geographical point of view we continue to prioritize cooperation activities towards the lusophone developing countries, in particular the Portuguese Speaking African Countries (PALOP) and Timor-Leste, new beneficiary countries have been added in the last years, from North and Western Africa and Latin America regions, such as Tunisia, Cote d'Ivoire, Colombia and Argentina

In Portugal, ODA for environment has had limited expression regarding total values by virtue of the sectorial strategic priorities that essentially lie in areas such as Education, Health, Security and Justice, however considerable efforts have been made in order to curve this trend by strengthening mainstreaming guidelines and updating the range of sectoral priorities regarding the alignment to Paris Agreement.

However, despite the last decade difficulties regarding public debt control and fiscal consolidation remains committed to ODA international targets and has been focused on supporting the most vulnerable developing countries such as Fragile States, Least Developed Countries and Small Island Developing States.

Portugal has a decentralized model of cooperation, which means a permanent intergovernmental and institutionally collaboration between Camões – Institute for Cooperation and Language, I.P. (under the scope of the Ministry of Foreign Affairs) in the capacity of co-operation for development coordinator entity and the sectorial Ministries, such as the Ministry of Environment and Climate Action (MAAC), responsible for the thematic areas of environment, including climate change (CC) and energy.

Portugal has just adopted a new cooperation for development strategy fully aligned with the 2030 Agenda for Sustainable Development and the Paris Agreement, in which the climate change and the green just transition issues have a more prominence. The 2030 Cooperation for Development Strategy has innovative aspects that are considered positive and aligned with the international and European context in which we operate.

Rio Markers implementation methodology (7.1.2)

Portugal as OECD/DAC (Development Assistance Committee) Member-State tracks ODA financing flows in compliance with Creditor Reporting System (CRS) directives, and applies the Rio Markers system to qualify and track climate relate finance flows.

As mentioned above CC financial flows are tracked based on Rio markers mitigation and adaptation methodology established by the DAC/OECD to support the implementation of the Convention objectives and as a best practice to promote policy coherence and mainstreaming CC into cooperation for development. The climate markers (definitions and criteria) allow for an assessment of donor's policy objectives in relation to all range of Programs, Projects and Actions (PPA).

According to these methodology definitions, an activity could be considered:

- **mitigation** if contributes to the objective of stabilization greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system by promoting efforts to reduce or limit GHG emissions or to enhance GHG removal by sinks, in line with the goals of the Paris Agreement (art. 2.1a); and

- **adaptation** if enhance adaptive capacity, strengthen resilience and/or reduce vulnerability to CC, with a view to contributing to sustainable development and ensuring an adequate adaptation response, in line with the Paris Agreement (art. 2.1b and 7).

Applying the Rio markers, which include mitigation and adaptation to CC, means the use of a scoring system of three values, according to which the ODA amount reported within the DAC/CRS is screened and marked as:

i. Targeting the Convention as a 'principal' objective (score "2"): when the objective (mitigation or adaptation to CC) is explicitly stated as fundamental in the design of, or the motivation for, the activity, and promoting the objectives of the Convention is thus stated in the activity documentation as one of the principal reasons for undertaking it. In other words, the activity would not have been undertaken that particular way, had it not been for that specific objective.

ii. As a 'significant' objective (score "1"): when the objective (mitigation or adaptation to CC) is explicitly stated but it is not the fundamental driver or motivation for designing or undertaking the activity. The activity has other prime objectives but it has been formulated or adjusted to help meet the relevant climate concerns, particularly in the field of mitigation and adaptation to CC.

iii. Not targeting the objectives of the Convention (score "0"): it means that the activity was examined but found not to target the objective (mitigation or adaptation to CC) in any significant way.

The Rio Markers are quality indicators and were not initially oriented to quantify climate finance but only to qualify the level of mainstreaming of environment and climate change into development cooperation (table 7.1.2.1). However regarding the need to estimate more accurately the climate finance flows and that the activities can have more than one principal and significant policy objective and trying to avoid double counting, we have aligned our approach with the one used by European Commission by adopting recently the same approach and coefficients detailed in the table below.

Table 7.1.2.1

Markers	Mitigation (%)	Adaptation (%)	Cross-cutting (%)	Total (%)
2 M & 0 A	100	0	0	100
1 M & 0 A	40	0	0	40
0 M & 2 A	0	100	0	100
0 M & 1 A	0	40	0	40
2 M & 1 A	100	0	0	100
1 M & 2 A	0	100	0	100
2 M & 2 A	0	0	100	100
1 M & 1 A	0	0	40	40

Despite adopted recently, in this report we have extended the approach to previous years from 2017 to 2021 for the benefit of comparability.

Cooperation – policies, priorities and programmes in Portugal (7.1.3)

As in previous National Communications and Biennial Reports, Portugal continued to prioritize cooperation for development activities towards its partner countries, namely the PALOP and Timor Leste. However, as mentioned before new beneficiary countries and regions have been added in the last years.

The strategic framework and guidelines for development cooperation are aligned with the needs and priorities of partner countries and established by Strategic Cooperation Programs (PEC) signed with each partner country in particularly with longtime partners such as PALOP and Timor-Leste The PEC aims to constitute itself as the guiding document of bilateral cooperation for development with the partner country, which identifies the priority areas should be mentioned and not individual projects that, usually, given the validity of the document, it's impossible to anticipate the projects that will be submitted by the partners.

Considering that Portugal has a decentralized model of cooperation, and complementary to PEC's, sectorial Protocols, Memorandum of Understanding (MoU) or Actions Plans are discussed and agreed with partner countries at institutional level and signed between with homologous Ministries.

It should be stressed that it is the partner country that promotes the Programs, Projects and Actions (PPA) and presents it to Portuguese Cooperation (PtC) for financing and has to demonstrate that and how the PPA contribute to meet its specific policies, priorities and strategies. The partner country is responsible for the selection process of the entity that will execute the PPA. In some areas the private sector is better placed to execute them. Therefore, the PtC has kept an open door to the private sector (from beneficiary and/or donor country) engagement working hand in hand with public institutions and/or local communities of the beneficiary/ partner country.

The main Portuguese cooperation for development financial resource regarding environment and climate change comes from Environmental Fund (FA) established in 2016, by the Decree-Law 42-A/ 2016 of 12th of August, and according the Order No 538-B/ 2017 of 5th of January of the Minister of the Environment, the national public entity in charge of managing the Environmental Fund is the Secretariat-General of the currently designated MAAC.

This instrument supports environmental policies for the pursuit of Sustainable Development Objectives, contributing to the achievement of national and international objectives and commitments, in particular those related to climate change, water resources, waste and nature conservation and biodiversity. International Cooperation, in the field of climate change and in line with our commitments, is one of the action domains clearly identified by this Fund.

As a EU Member State, Portugal made the commitment to mobilise 0.15% to 0.20% of its GNI as ODA allocated to LDC by 2030. It also endorsed the commitment derived from the 2014 ministerial-level meeting of the Development Assistance Committee (OECD/DAC) to focus the support from member countries on countries most in need (which includes Fragile States, LDC and SIDS).

In the absence of an international definition accepted by all Parties of 'new and additional' financing, Portugal considers FA as an additional financial resource compared with conventional ODA. Although mainly focused at environmental domestic level, the FA can also support environmental cooperation for development PPA, in particular climate action aiming to support *"the shift towards a low-carbon competitive economy through funding or co-funding of measures which contribute to meeting the commitments of the Portuguese State under Paris Agreement and other international and Community commitments in the field of climate change*".

In the table 7.1.3.1 the detailed information regarding the Environment Fund ODA flows spent in climate action compared with other conventional CC financial flows. With the exception of the years 2016 and 2019, new and additional Environmental Fund financing flows for climate exceeded 60% of total climate financing ODA.

Table 7.1.3.1

Fundo Ambiental 2016-2021*

	2016			2017			2018			2019			2020			2021*			Total Geral		
	Eur	USD	%	Eur	USD	%	Eur	USD	%	Eur	USD	%	Eur	USD	%	Eur	USD	%	Eur	USD	%
Adaptation	284 464	314 568	*17%*	936 473	1 055 657	*43%*	1 291 951	1 524 786	*70%*	849 630	951 114	*77%*	590 259	672 660	*59%*	255 000	301 561	*15%*	4 207 777	4 820 345	*45%*
Cross-cutting	0	0	*0%*	35 180	39 657	*2%*	68 190	80 479	*4%*	0	0	*0%*	0	0	*0%*	431 133	509 855	*26%*	534 503	629 991	*6%*
Mitigation	1 342 462	1 484 532	*83%*	1 219 251	1 374 423	*56%*	481 627	568 426	*26%*	249 979	279 838	*23%*	413 434	471 150	*41%*	981 312	1 160 492	*59%*	4 688 065	5 338 860	*50%*
Total Geral	**1 626 926**	**1 799 100**	***100%***	**2 190 904**	**2 469 737**	***100%***	**1 841 768**	**2 173 691**	***100%***	**1 099 609**	**1 230 952**	***100%***	**1 003 693**	**1 143 810**	***100%***	**1 667 445**	**1 971 908**	***100%***	**9 430 345**	**10 789 196**	***100%***
**Dados preliminares.*		*1 799 100*			*2 469 737*			*2 173 691*			*1 230 952*			*1 143 810*			*1 971 908*			*10 789 196*	
Fonte: Camões, I.P./GPPE																					

Bearing in mind that financing ODA projects is not a core objective of the FA, Portugal considers that all financing provided by this fund to activities that aim to promote the economic development and welfare of developing countries is new and additional to the conventional sources of ODA.

Regarding the information on table 7.1.3.2, the difference between the total climate financing flows disbursed and the ones disbursed by the Environmental Fund is considered conventional ODA.

Table 7.1.3.2

Financiamento Clima 2016-2021*

	2016			2017			2018			2019			2020			2021*			Total Geral		
	Eur	USD	%	Eur	USD	%	Eur	USD	%	Eur	USD	%	Eur	USD	%	Eur	USD	%	Eur	USD	%
Fundo Ambiental	1 626 926	1 799 100	*60%*	2 190 904	2 469 737	*75%*	1 841 768	2 173 691	*71%*	1 099 609	1 230 952	*58%*	1 003 693	1 143 810	*68%*	1 667 445	1 971 908	*66%*	9 430 345	10 789 196	*67%*
Outros	1 079 292	1 193 511	*40%*	717 584	808 910	*25%*	742 583	876 411	*29%*	786 959	880 957	*42%*	466 683	531 832	*32%*	857 255	1 013 783	*34%*	4 650 356	5 305 405	*33%*
Total	**2 706 218**	**2 992 611**	***100%***	**2 908 488**	**3 278 647**	***100%***	**2 584 351**	**3 050 101**	***100%***	**1 886 568**	**2 111 909**	***100%***	**1 470 376**	**1 675 642**	***100%***	**2 524 700**	**2 985 690**	***100%***	**14 080 701**	**16 094 601**	***100%***
**Dados preliminares.*		*2 992 611*			*3 278 647*			*3 050 101*			*2 111 909*			*1 675 642*			*2 985 690*			*16 094 601*	
Fonte: Camões, I.P./GPPE																					

In addition to the information already mentioned on this report, we would like to highlight that all the PPA financed by Portuguese Cooperation are proposed by the partner countries which are also entirely responsible for their design. As donor we appraise the PPA proposals taking into account their relevance for the sectoral country commitments and strategies including NDC's, efficiency, problems addressed, viability, sustainability, results, accountability and also the adequacy of the technologies supposed to be developed and/or transferred, as well as capacity building components and also the indicators for monitoring and evaluation.

Portugal does not have yet, in terms of development cooperation in the context of climate change, a strong tradition of mobilizing private financing. Hence the amounts of private funding mobilized by projects marked with the Mitigation and Adaptation markers in the 2018-2020 period are the following: 138 824,50 USD in 2018, 15 336,39 USD in 2019. In 2020, there was no mobilization of private financing by climate projects and the data regarding2021 is not available yet.

Technology Development and Transfer (7.2)

In the absence of a specific marker for technology transfer, Portugal has not developed a systematic approach to accounting for this type of financial flows until recently. Therefore, the available information is contained in the table 2 of the Annex III.

Capacity-Building (7.3)

In general, the PPAs supported by the Portuguese cooperation have a strong component of technical assistance targeted at national capacity-building. It is endeavoured to give special attention to the implementation of the aid effectiveness principles enshrined in the Paris Declarations and developed in Accra and Busan, mainly: leadership and control by beneficiaries so that they can strategically allocate their resources; to enhance existing capacities as a starting point, avoiding the creation of parallel structures and using national systems in a systematic manner to implement aid; technical cooperation driven by partner demand.

The area of climate change is no exception to this, with some projects being even exclusively dedicated to institutional capacity-building. This applies to the PPAs exclusively dedicated to this subject as well as to the inclusion of a capacity-building component in the different PPAs as an effort to adapt them to a demand for change, to the beneficiary institutions and to the potentialities and weaknesses of existing national systems in beneficiary countries.

In particular with regard to cooperation projects in the field of climate change, Portugal intends for partners to lead and control, and often uses national systems for the implementation of aid.

Detailed information is provided in table 3 of the Annex III.

Research and Systematic Observation (8)

General Policy on and Funding of Research and Systematic Observation (8.1)

The Foundation for Science and Technology (FCT) is the national agency responsible for public funding of science, technology and innovation. The National Innovation Agency (ANI) also shares some responsibilities in this context.

Therefore FCT aims to achieve the following structural targets:

i. To continuously promote the progress of scientific and technological knowledge in Portugal;
ii. To explore opportunities (in the different scientific and technological areas) towards achieving the highest international standards of knowledge creation;
iii. To encourage the dissemination of the knowledge created so that it contributes to improve education, health and environment;
iv. To improve the quality of life standards and the well-being of the general public;
v. To boost competitiveness and employment.

The provision of funding is the main channel for FCT to achieve the goals as set out above, which from a procedural point of view requires conducting open competitions and implementing a pre-established assessment protocol (according to the merit of the proposals and research teams). In addition to this, FCT establishes cooperation agreements and other forms of support in partnership with universities and other public and private institutions, both in Portugal and abroad. FCT's activities will ultimately result in increased contributions from the individuals, research groups and institutions covered by its funding portfolio.

IPMA (Portuguese Institute for Sea and Atmosphere) is another institution which, besides being responsible for coordinating the implementation of national plans related to climate systematic observation, also contributes to the national effort through the observation of the atmospheric and ocean components, in coordination with other national bodies such as the Hydrographic Institute (ocean observation component) and the APA (atmospheric and terrestrial observation component).

Research (8.2)

National funds

Since there is no original classification of FCT funding in the field of climate change, the following methodology was used to obtain information on FCT support for research in this area: a set of 31 keywords or acronyms were used to select and classify projects, grants and contracts in the field of climate change funded by FCT in 2017-2021. Data was collected from two databases:

a. FCT – National & international Projects, fellowships for PhD students and post-docs, and researcher contracts for PhD holders;
b. European Commission projects – details of H2020/Horizon Europe projects.

<u>Research projects</u>

In the period between 2017 and 2021, FCT funded 401 scientific research projects that may be classified in the field of climate change, with a budget line of over 45.5 M€.

The analysis considered the number of ongoing scientific research projects in the year under review.

Research projects are classified as climate science projects by the occurrence of at least one of the 31 keywords in the presented work plan. As we can see in table 8.2.1. there is a tendency for an increase in funding for projects related to this subject, despite certain decrease in 2019 probably related to pandemic consequences of Covid-19. This increase in funding of climate science projects is especially evident when comparing to the previous analyzed period: between 2010 and 2016, FCT funded 107 projects that dealt with the issue of climate change.

Research grants

Additionally, in the same period, 152 research grants that may be classified in the field of climate change were funded (doctoral and post-doctoral level, among others), with a total value of over 9 M€, although the data is missing for 2020 and 2021. The analysis considered the number of grants awarded in the year under analysis that were classified in the field of climate change. Funding allocated in this period is approved for the total duration of the grant.

Scientific employment contracts

Between 2017 and 2021 FCT financially supported 177 contracts that may be classified in the field of climate change, within the scope of Scientific Employment for PhD graduates, the value of which amounted to over 22.5 M€ (table 8.2.1). The analysis considered the number of Scientific Employment Contracts in progress in the year under analysis that were classified in the area of climate change by the occurrence of at least one of the keywords in the work plan. In comparison to the previous analyzed period, the number of FCT contracts attributed to the area of climate change increased significantly in 2017-2021: between 2010 and 2016, FCT financially supported 32 contracts.

Table 8.2.1

Research projects, grants and scientific employment contracts in the field of climate change funded by FCT in 2017-2021 (N.A.: Data Not Available).

Year	Number of projects	Funding provided	Number of Grants	Funding provided	Number of contracts	Funding provided
2017	125	3,965,990.25 €	36	2,200,767.30 €	75	4,620,210.68 €
2018	231	11,466,952.44 €	40	2,445,297.00 €	71	3,267,886.76 €
2019	184	7,669,317.89 €	76	4,646,064.30 €	99	4,221,960.99 €
2020	243	9,764,956.27 €	N/A	N/A[63]	116	5,215,891.67 €
2021	311	12,660,720.46 €	N/A	N/A[64]	118	5,192,744.64 €
Total	**401**	**45,527,937.31 €**	**152**	**9,292,128.60 €**	**177**	**22,518,694.74 €**

Source: FCT (2022)

In the case of projects and scientific employment contracts, the funding corresponds to the amounts transferred each year by FCT to the ongoing projects/contracts in climate science (which were identified by the presence of specific keywords in their abstracts).

[63] For the scholarships granted in 2020 and 2021 we have no information, since the queries we have do not return information for the contests that were made in the "new application platform".

[64] *Idem*.

In the case of grants, values in table 8.2.1 correspond to total approved funding for grants in climate science (identified by the presence of specific keywords in their abstracts) in the years 2017, 2018 and 2019.

Table 8.2.2

Estimated percentage of FCT projects, scientific employment contracts and grants in climate science (2017-2021)

2017 - 2021				
	Total (N)	**Climate change (N)**	**%**	**Climate change (M€)**
Scientific employment Contracts	1461	177	12.11	22.5
Projects	3740	401	10.72	45.5
Grants	3100	152	4.90	9.2

Source: FCT (2022)

In the above table 8.2.2 we can see ratio of the number of ongoing projects and scientific employment contracts in the field of climate change (identified by the presence of specific keywords) to the total number of ongoing projects/scientific employment contracts each year[65]. Also, we can see ratio of the approved climate science grants (by the presence of specific keywords) to the total number of grants approved in each year.

European funds

Between 2017 and 2021 the European Union (EU) funded, through the Horizon 2020 (H2020) and Horizon Europe, 127 research projects within the field of climate change in which national research teams are (or were) involved (see Table 8.2.3). This represents significant increase comparing to the period of 2010-2016 (with 44 projects funded), essentially related to the EU's climate ambition of becoming carbon neutral by 2050 and 35% of Horizon Europe investment dedicated to tackling climate change.

The total funding allocated in this period to participating national institutions exceeds **55 M€** (Table 8.2.3). It should be clarified that the amounts mentioned for each year refer to the total amounts granted to national participants in competitions during that year.

Table 8.2.3

Research projects in the field of climate change funded by the Horizon2020 and Horizon Europe in 2017-2021

Year	Number of projects	Funding granted to national institutions
2017	20	3,924,997.20 €
2018	17	4,196,559.51 €
2019	26	9,313,375.93 €
2020	29	16,882,692.14 €
2021	35	20,927,234.00 €
Total	**127**	**55,244,858.78 €**

Source: FCT (2022)

[65] Observation: these numbers can be underestimated due to lack of information (FCT platform) on abstracts/work plans for scientific employment contracts and grants.

Out of the 127 projects examined, all are composed of teams from different countries, which makes it impossible to assess the results generated by the national participants. Moreover, it should be noted that it is the responsibility of the European Commission (EC), as the funding and managing authority of the projects under H2020 and Horizon Europe, to inform and publish all results achieved by each of these projects.

Systematic observation (8.3)

Framework

National plans related to climate systematic observation fall under the remits of the Portuguese Institute for Sea and Atmosphere (IPMA) regarding the components of atmospheric and ocean observation, the Hydrographic Institute (IH) for the component of ocean observation and the APA concerning the components of atmospheric and terrestrial observation.

The different networks and systems for observation and data processing which are installed in Portugal and which contribute to the Global Climate Observing System (GCOS), as part of the observation networks defined in the programmes of the World Meteorological Organisation (WMO), are described below.

Atmospheric Climate Observing Systems (8.3.1)

As a member of the WMO, Portugal develops and operates several weather and climate observation networks in the framework of its global programmes, in particular the World Weather Watch (WWW) through the Global Observing System (GOS), but also the Global Atmosphere Watch (GAW) and the World Hydrological Cycle Observing System (WHYCOS), and it follows the recommendations of the Instruments and Methods of Observation Programme (IMOP) and of the World Climate Programme (WCP) of the WMO.

The IPMA is the Portuguese body responsible for carrying out observations for meteorological and climatological purposes and it has therefore pursued and developed relevant scientific and technical activities which began in Portugal in the mid-nineteenth century, focusing on the availability and quality of long time series of climatological data, which are key to conducting studies on climate change, especially in terms of trends and climate extremes.

IPMA has made significant efforts to ensure the operability of is own network of climatological stations, providing for its maintenance and for quality control and subsequent recording of observations.

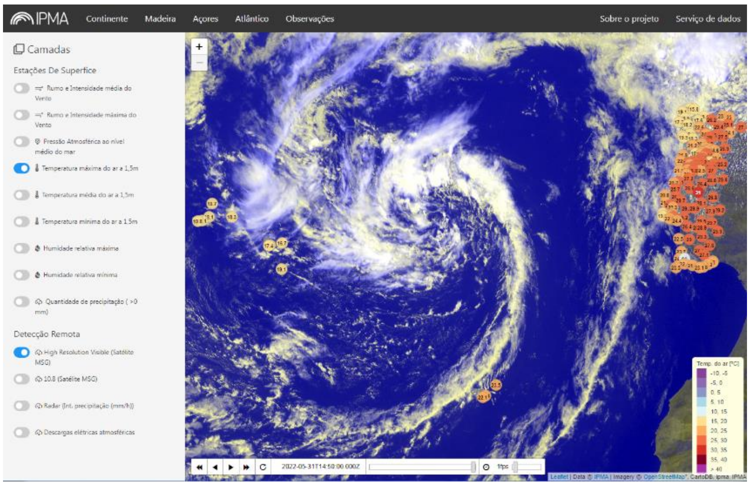


Figure8.3.1.
Web platform with the combination of high resolutions datasets (satellite, radar, AWS and lighthing data.

In 2022 IPMA has 137 automatic climatological stations operating in Portugal, of which 11 are also conventional. All stations measure air temperature, wind speed and direction, air humidity and precipitation, among other climate elements, and almost all also measure global solar radiation, while some also measure atmospheric pressure.

On the mainland there are 105 stations with a density of 1.2/1000 km2, in Madeira there are 20 stations with a density of 25/1000 km2 and in the Azores there are 12 stations with a density of 5.2/1000 km2. Of those stations, 4 prepare and disseminate monthly through the WMO's global meteorological telecommunications system, communicated in the form of CLIMAT code, which contains monthly climatological data.

Portugal continues to participate in the GSN network with 3 surface weather stations, one on the mainland (Lisbon – belonging to the Geophysical Institute of the University of Lisbon), one in Madeira (Funchal Observatory – IPMA) and one in the Azores (Ponta Delgada (Nordela – IPMA).

There are 12 weather stations in the Azores, running under the responsibility of the NWS (IPMA). All 12 of those stations submit SYNOPs reports regularly to the GTS. Only three of these stations performed 24h visual observations with personal. Concerning the GSN, only Ponta Delgada station (08512) has submitted CLIMAT reports.

There are also 12 solar radiation stations in the Azores but only one performs balance measurements as well as other advanced radiation measurements in the scope of the ARM (Atmospheric Radiation Measurement) programme (Graciosa: 08517). There is also a weather station (08514) in Ponta Delgada under the CTBTO Programme.

Table 8.3.1.1.
National contribution to surface-based atmospheric essential climate variables

Contributing networks specified in the GCOS implementation plan	ECVs[a]	Number of Stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2020	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
	Air temperature	3	3	3	3	1

GCOS Surface Network (GSN)	Precipitation	3	3	3	3	1
Full World Weather Watch/Global Observing System (WWW/GOS) surface network	Air temperature, air pressure, wind speed and direction, water vapour	11	10	11	7	1
	Precipitation	11	10	11	7	1
Baseline Surface Radiation Network (BSRN)	Surface radiation	-	-	-	-	-
Solar radiation and radiation balance data	Surface radiation	10	10	10	10	10

Regarding aerological observations, IPMA continued the program of a daily observation at national radiosonde stations in mainland Portugal (Lisbon), Madeira (Funchal) and Azores (Lajes – 08508) which includes measurements resolution of pressure, temperature, humidity and wind, up to more than 30km altitude. Lajes station is part of the GUAN network and Eastern North Atlantic (ENA) station, located at Terceira Island is part of the ARM programme.

Table 8.3.1.2.
National contribution to aerological essential climate variables

Contributing networks specified in the GCOS implementation plan	ECVs[a]	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2020	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
GCOS Upper Air Network (GUAN)	Upper-air-temperature, upper-air wind speed and direction, upper-air water vapour	1	1	1	1	1
Full WWW/GOS Upper Air Network	Upper-air-temperature, upper-air wind speed and direction, upper-air water vapour	2	1	2	1	1

Portugal's contribution to the Global Atmosphere Watch program (GAW) is currently done through two main monitoring programs: total ozone, UV radiation and greenhouse gases. Total ozone measurements are carried out in two stations: Lisboa and ENA/ARM at Gbvg Graciosa Is. (Azores), using Dobson and Brewer spectrophotometers respectively. UV radiation monitoring is also carried out in these stations, using a broadband detector (SL501) and a spectral instrument (Brewer MKII), and in Funchal (Madeira) with a broadband detector (SL501). Weekly air samples are collected in Serreta Lighthouse at Terceira Is. (Azores) and sent to NOAA labs at Boulder (USA) under the NOAA/ESRL/GMD CCGG Cooperative air sampling network.

Dobson and Brewer spectrophotometers have been participated in regional intercomparison campaigns and data has been processed and submitted to the WOUDC data center. Graciosa station is also part of the EUBREWNET network and data is submitted hourly. Daily checks are performed daily to minimize long periods of missing data.

Greenhouse gases data is also processed and submitted to the WDCGG by NOAA CCGG team. IPMA, since 1979, carries out an air sampling program, at Terceira Island currently next to the Serreta lighthouse, for the analysis of greenhouse gases in the atmosphere performed by NOAA labs in Boulder under the Cooperative Global Air Sampling Network.

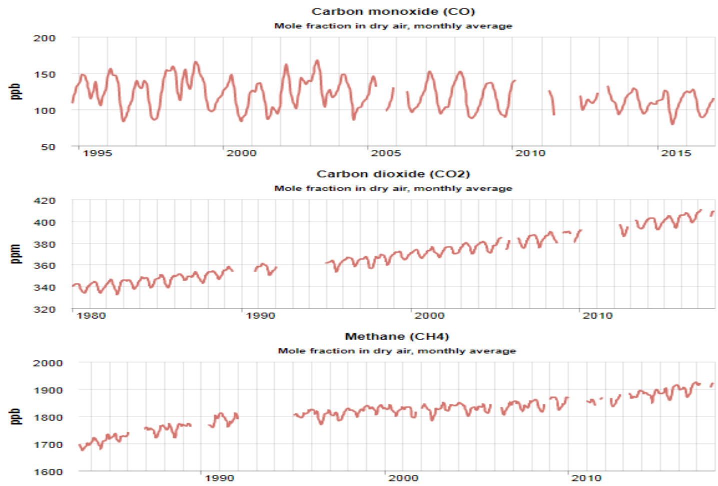


Figure 8.3.1.2.
Carbon dioxide, methane, carbon monoxide month averages - since 1983

Table 8.3.1.3.
National contribution to atmospheric composition

Contributing networks specified in the GCOS implementation plan	ECVs[a]	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2024	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
World Meteorological Organization/ Global Atmosphere Watch (WMO/GAW) Global Atmospheric CO2 & CH4 Monitoring Network	Carbon dioxide	1	1	2	1	1
	Methane	1	1	2	1	1
	Other greenhouse gases	1	1	2	1	7
WMO/GAW ozone sonde network	Ozone	0	0	0	0	0
WMO/GAW column ozone network	Ozone	2	2	3	2	5
WMO/GAW Aerosol Network	Aerosol optical depth	1	1	2	1	2
	Other aerosol properties	1	1	2	1	2

To complement the precipitation observation networks and also for meteorological forecasting and nowcasting purposes, IPMA has also the Atmospheric Electrical Discharge (DEA) network and the Radar network.

The DEA network installed in the national territory allowed a better coverage of the Iberian Peninsula region with regard to the detection and location of DEA that occur between cloud-cloud but also between cloud-ground, and this information allows a better characterization of the temporal and spatial distribution of electrical activity in the atmosphere, as well as monitoring and surveillance of severe weather situations, namely convective weather phenomena's.

The Atmospheric Electrical Discharge detection network is currently composed of 5 VAISALA sensors, model LS7002, installed on the mainland: Braga, Castelo Branco, Olhão, Santa Cruz/Torres Vedras and Bragança and also 4 sensors in the Madeira Archipelago: Porto Moniz, Santana, Porto Santo and Selvagens islands. It is important to note that the IPMA DEA network uses 6 additional detectors from the Spanish Meteorological Service (AEMET) network, close to the border, for the detection and calculation of DEA locations.

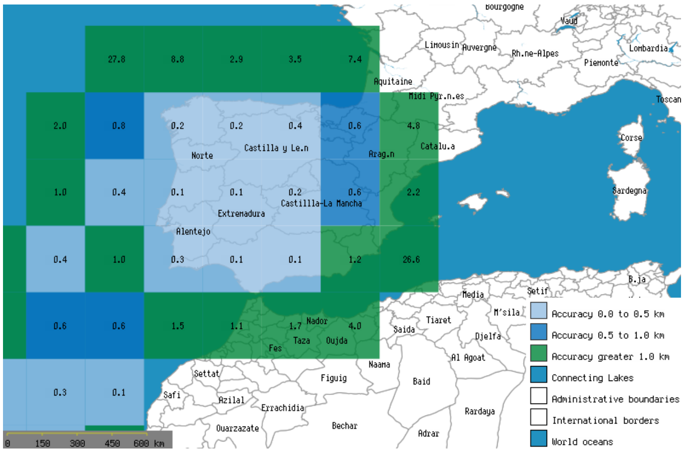


Figure 8.3.1.2
Example from the map accuracy, in km, from the lightning detection network

The national weather radar network comprises five C-Band Doppler systems, three of them installed in mainland (Arouca/Pico do Gralheiro, Coruche/Cruz do Leão and Loulé/Cavalos do Caldeirão), one in the Autonomous Region of Madeira (Porto Santo/Pico do Espigão) and another one in the Autonomous Region of Azores (Terceira/Santa Bárbara). These units, from which the ones in Arouca, Porto Santo and Terceira integrate dual polarization technology, are essential tools for the atmosphere observation system, with a focus on Nowcasting, as has been widely demonstrated.

On the scope of a new project aiming at covering all areas of the Portuguese territory, the installation of two radars in Azores, in São Miguel/Pico dos Santos de Cima and in Flores/ Morro Alto, is foreseen. The technological update of the network in mainland is also foreseen, with the replacement of the current radar systems in Coruche and Loulé by new Doppler systems with dual polarization technology.

Ocean Climate Observing Systems (8.3.2)
As a EUMETNET member the national marine meteorology service maintains active IPMA's participation in the EUMETNET Surface Marine Programme (VOS national focal point) with national commercial, fishing and research vessel, integrating the lack of automatic and systematic atmospheric and oceanic data observations under the North Atlantic sea areas. This programme allows not only obtaining daily meteorological and oceanographic parameters over the sea, but also disseminating through the Global Telecommunication System (GTS). IPMA shares daily in situ meteorological and oceanographic data through the GTS system to International Centres, under different codes (SHIP and BUFR format), including our national oceanic buoys in collaboration with Portuguese Hydrographic Institute (Portuguese navy).

In the case of E-SURFMAR VOS Programme, atmospheric data observations (pressure, wind speed and direction, air temperature and relative humidity) observations were systematically sent to E-SURFMAR VOS database and were subject to quality control and validation and applying atmospheric numerical models.

In the near future an atmospheric and oceanographic automatic network system will be implemented providing an increase of in situ data observations over the North Atlantic Ocean.

IPMA as tha national focal point and member of the ARGO, an oceanographic international program, collects ocean data observations.

In May 2022, the first oceanographic data (e.g. temperature, salinity, chlorophyll, dissolved oxygen, pH and turbidity) was received, measured with the ferrybox (undersea water), sent by N/M Coimbra, from the Grand Banks of Newfoundland.

In 2023, a set of Biogeochemical (BGC) Argo, oceanographic instruments with automatic dissemination of temperature salinity and currents (1000 m), will be implemented.

Table 8.3.2.1
National contribution to oceanic essential climate variables - surface

Contributing networks specified in the GCOS implementation plan	ECVsa	Number of stations or platforms currently operating	Number of stations or platforms operating in accordance with the GCMPs	Number of stations or platforms expected to be operating in 2024	Number of stations or platforms providing data to the international data centres	Number of stations or platforms with complete historical record available in international data centres
Voluntary observing ships (VOS)	All feasible surface ECVs	2	1	4	1	1

Terrestrial Climate Observing Systems (8.3.3)
No available data.

Cryosphere Climate Observing Systems (8.3.4)
No available data.

Support for Developing Countries to Establish and Maintain Observing Systems and Related Data and Monitoring Systems (8.3.5)
An overview of the programmes promoting national scientific cooperation through the FCT, the National Research-funding Agency, is provided below. All listed programmes cover the theme of climate change and include the participation of developing countries:

HORIZON 2020
A. 'ERA-NETs' (*European Research Area Networks*)

ERANETMED – "Euro-Mediterranean Cooperation Through ERANET Joint Activities and Beyond"[66]

The main aim of ERANETMED is to enhance Euro-Mediterranean co-ownership through innovation and competitive research in the societal challenges of the region. The project aims at reducing fragmentation of programming in the Mediterranean region by increasing coordination among national research programs of European Member States, Associated Countries and Mediterranean Partner Countries. Its activities will span from 2013 to 2017, and

[66] http://www.eranetmed.eu/

involve 15 Partner Countries: Algeria, Cyprus, Egypt, France, Greece, Germany, Italy, Jordan, Lebanon, Malta, Morocco, **Portugal**, Spain, Tunisia and Turkey, together with the International Organization CIHEAM IAMB - Mediterranean Agronomic Institute of Bari.

The themes of its three calls for funding of R&I activities were:

- Renewable Energies, Water Resources and their connections for the Mediterranean Region (2015).
- Environmental challenges and solutions for vulnerable communities (2016);
- Fostering sustainable water management for the economic growth and sustainability of the Mediterranean region (2017).

FCT represented Portugal in ERANETMED and has invested a total of 650 K€ in Research Projects approved in the 2015 (500 K€) and 2017 (150 K€) calls. Portugal did not participate in the 2016 call. ERANETMED finalized in the end of 2017.

ERA4CS – "ERA-NET Co-fund for Climate Services"[67]

The ERA-NET Consortium "European Research Area for Climate Services", so-called ERA4CS (time frame 2016-2021), has been designed to boost the development of efficient Climate Services in Europe, by supporting research for developing better tools, methods and standards on how to produce, transfer, communicate and use reliable climate information - including climate adaptation, mitigation and disaster risk management - to cope with current and future climate variability. ERA4CS aims to improve the scientific expertise on Climate Change risks and adaptation options, and to connect that knowledge with decision-making, e.g. by developing and accessing climate adaptation strategies and pathways at different scales (regions, cities, catchments, vulnerable sectors, etc.). It focuses on the development of a "climate information translation" layer, including climate information production for Climate Services (CS), as well as researching and advancing CS as such.

This ERA-NET was implemented in straight articulation with the Joint Programming Initiative "Connecting Climate Knowledge for Europe" or JPI Climate (https://jpi-climate.eu/). The ERA4CS consortium is formed by 45 Organizations (15 Public Research-Funding entities and 30 Research-Performing Organizations) from 18 European Countries: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Romania, Slovakia, Spain, Sweden and the United Kingdom.

Portugal was represented in ERA4CS by FCT, the National Research-funding Agency. Three Research Projects with PT participation were approved in the 2016 Co-fund call of ERA4CS, in a total amount of 649 K€. ERA4CS ended in December 2021.

ERASUSAN - "ERA-NET on Sustainable Animal Production"[68]

Like other agricultural sectors, animal production faces many challenges from projected increases in global demand for food, climate change, competition for natural resources and economic volatility. The European animal production landscape is very complex, consisting of different species farmed within a wide range of different extensive, semi-intensive and

[67] http://www.jpi-climate.eu/ERA4CS
[68] http://www.era-susan.eu/

intensive production systems using multiple resources to produce a diverse range of animal products and other services. Partners in ERASUSAN (of 37 partner organizations from 21 EU Member States and 2 EU Associated Countries) believe that these challenges can be effectively addressed through joint European research within a framework which supports the three pillars of sustainability - economy, environment and society - and targets opportunities for innovative research spanning all areas of animal production such as health and welfare, feeding and nutrition, reproduction, breeding and genetics, housing, nutrient management and economics. The ERASUSAN consortium (2016-2020) consists of: Austria, Belgium, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Latvia, Lithuania, the Netherlands, Norway, Poland, **Portugal**, Slovakia, Slovenia, Spain, Sweden, Turkey and the United Kingdom.

The Portuguese contribution, made by FCT for Projects approved in the 2016 call, was 252K€. ERASUSAN ended in February 2021.

LEAP-AGRI – "A Long-term EU- Africa research and innovation Partnership on food and nutrition security and sustainable Agriculture"[69]

LEAP-Agri is a partnership between 30 partners including 24 funding organizations from nine African countries (i.e. Algeria, Burkina Faso, Cameroun, Egypt, Ghana, Kenya, Senegal, South Africa and Uganda), nine European countries (i.e. Belgium, Finland, France, Germany, Nederland, Norway, **Portugal**, Spain and Turkey) and an international organization (i.e. CIHEAM-Bari based in Italy).

This partnership, which operates under the EU Framework Program for Research and Innovation Horizon 2020 and its EU-Africa High Level Policy Dialogue on science, technology and innovation, aims to support joint research and innovation projects in food and nutrition security and sustainable agriculture. Indicate areas of activities include "climate smart" agriculture practices, sustainable approaches to optimize resource efficiency, more efficient biomass utilization, methods to measure the global impact and performances of agriculture intensification pathways, among others.

The 2017 call for Projects from LEAP-AGI has an overall budget of 27 M€, comprising contributions from Member Countries (18.5 M€) and the European Commission (8.5 M€). The Portuguese contribution, made by FCT, for Projects approved in the 2017 call, was 394 K€. LEAP-AGRI remain active until November 2022.

BiodivClim "Promoting and implementing joint programming to reinforce transnational research at the crossroad between biodiversity and climate change"[70]

The biodiversity-climate change interaction is strong, bi-directional, and often positive. While the main drivers of biodiversity loss are habitat degradation, the syndrome of factors directly & indirectly associated with climate change is the dominant threat to biodiversity. It is therefore imperative to understand with sufficient detail and confidence the interactions between biodiversity & climate change so they can be incorporated into decision-support models & tools.

[69] https://leap-agri.com
[70] https://www.biodiversa.org/1785

BiodivClim is a partnership between 35 funding agencies from 25 countries (Austria, Belgium, Bulgaria, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Israel, Latvia, Lithuania, Norway, Poland, **Portugal**, Romania, Slovakia, South Africa, Spain, Sweden, Switzerland, Tunisia, Turkey). BiodivClim aims to promote coordinated international research on biodiversity & climate change in all environments, incl. agricultural areas. It will strengthen research & research programmes coordination with the aim to provide policy makers & other stakeholders with adequate knowledge, tools & practical solutions to improve the conservation & sustainable use of biodiversity & ecosystems under a changing climate.

FCT has funded Research Projects through the joint call launched in 2019 on the topic "Biodiversity and Climate Change" in a total amount of 100 K€. BiodivClim remain active until 2024.

WaterWorks 2015 "Sustainable water use in agriculture, to increase water use efficiency and reduce soil and water pollution"[71].

WaterWorks2015 aims at pooling resources from the 36 participating research programme owners/managers of 23 countries (Belgium, Canada, Cyprus, Denmark, Egypt, Finland, France, Germany, Ireland, Italy, Moldova, Netherlands, Norway, Poland, **Portugal**, Romania, South Africa, Spain, Sweden, Taiwan, Tunisia, Turkey and United States) to implement a joint call for proposals, with EU co-funding in sustainable water use in agriculture and forestry. It's a collaboration between the Joint Programming Initiatives (JPIs), Water JPI "Water Challenges for a Changing World" and FACCE JPI "Agriculture, Food Security and Climate Change". Achieving a "sustainable water uses in agriculture, to increase water use efficiency and reduce soil and water pollution" is at the intersection of the two JPIs, contributing to the implementation of their respective Strategic Research Agendas. Additional Activities will also be carried out to further support the implementation and strategy of the Water JPI.

FCT has invested ca. 2M€ in Research Projects approved in the 2014 (990 K€) and in 2016 (1 M€) calls. WaterWorks2015 will end in 2022.

Aquatic Pollutants

The ERA_NET co-fund Aquatic Pollutants is a project with the goal of strengthening the European Research Area (ERA) within the domain of aquatic ecosystems, and in the promotion of transnational cooperation between the areas of water, oceans and health. The ERA-NET Co-fund Aquatic Pollutants comprises 32 entities from 26 countries (Belgium, Brazil, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Ireland, Italy, Israel, Moldova, Latvia, Norway, Poland, **Portugal**, Romania, Scotland, South Africa, Spain, Sweden, Taiwan, Tunisia, and Turkey), including Ministries and Funding Agencies. This ERA-NET Co-fund is a collaborative effort between the Joint Programming Initiatives (JPI)[72] [73] and JPI AMR (Antimicrobial Resistance). Its international dimension will be directly translated into close collaboration with other relevant European and international initiatives.

[71] https://www.era-learn.eu/network-information/networks/waterworks2015
[72] https://www.waterjpi.eu
[73] https://www.jpi-oceans.eu

FCT has invested a total of 598 K€ in Research Projects approved in the 2020 call. Aquatic Pollutants will continue active through 2024.

B. Coordination and Support Action (CSA)

LEAP4FNSSA "Long-term Europe-Africa Research and Innovation Partnership for Food and Nutrition Security and Sustainable Agriculture "74

LEAP4FNSSA is a Coordination and Support Action (CSA) whose main objective is to provide a tool for European and African institutions to engage in a Sustainable Partnership Platform for research and innovation on Food and Nutrition Security, and Sustainable Agriculture (FNSSA).

Under the aegis of the High-Level Policy Dialogue (HLPD) and its Bureau, building upon former EU funded projects such as RINEA, CAAST-Net Plus, ProIntensAfrica and linking with the ongoing ERANet Cofund LEAP-Agri, LEAP4FNSSA aims to achieve its main objective through:

- Increased synergies and coherence between actors, research and innovation projects, initiatives, and programmes, through the development of institutional alliances and clusters of projects.
- An enhanced learning environment and large knowledge base, including monitoring and evaluation activities, and established communication and links between different initiatives to improve European-African cooperation in Science, Technology, and Innovation (STI).
- A well-established long term sustainable partnership and co-funding mechanism.

HORIZON EUROPE

C. Co-funded European Partnerships

Sustainable Blue Economy Partnership "A climate-neutral, sustainable and productive Blue Economy"[75]

The partnership started in September 2022. It will contribute to following expected outcomes: In line with the objectives of the European Green Deal and Digital Europe priorities, the successful proposal will contribute to the sustainability and resilience of the blue economy by supporting the establishment of innovative governance models. It will also contribute to strengthening the EU and international science-policy interfaces in marine- and maritime related domains as well as the Global Earth Observation System of Systems (GEOSS) by supporting the further deployment and exploitation of Environmental Observation data and products and of digital and data technologies.

- EU and national multi-level cooperation and alignment across and within regional seas of research and innovation programmes, priorities and investments are enhanced, based on established strategic research and innovation agendas and related cooperation activities, including international agreements and outreach, as well as cooperation with other Horizon Europe initiatives, European partnerships and missions.
- Europe's role in ocean science, research, social and technological developments, innovation, and productivity in the marine domain is clearly strengthened by 2030 and

[74] https://leap4fnssa.eu/

[75] https://www.jpi-oceans.eu/en/sustainable-blue-economy-partnership

transformative governance enables the advances of the role of Europe in business, finance and social developments in the marine/maritime domain.

- By 2030, Europe has contributed significantly and in a measurable way to the climate neutrality of the blue economy, the European Green Deal objectives, and its different strategies.
- The science-based implementation of EU marine-related legislation, regulations and objectives is supported, as well as the advanced sustainability of activities, practices and existing and new products and services of the blue economy value chains throughout European regional seas and the Atlantic.
- Transformative change is promoted and enabled through actionable science and sustainable, fair and just solutions for the blue economy and for communities, involving a participatory and multi-stakeholder approach.
- The deployment of digital, nature-based, and social innovations as well as community-led and purpose-driven technology for the blue economy is supported.
- Ocean literacy in the EU and beyond is increased.
- Sustained ocean and coastal observations and availability of FAIR data for environmental, climate and blue economy purposes are substantially increased.
- Global cooperation with key partners bordering the different EU sea basins is strengthened.

Biodiversa+ "European Biodiversity Partnership"[76]

Biodiversa+ is the new European co-funded biodiversity partnership supporting excellent research on biodiversity with an impact for policy and society. It started in October 2021 and was jointly developed by BiodivERsA and the European Commission (DG Research & Innovation and DG Environment). Biodiversa+ is part of the European Biodiversity Strategy for 2030 that aims to put Europe's biodiversity on a path to recovery by 2030. The Partnership aims to connect science, policy and practice for transformative change. It currently gathers 74 research programmers and funders and environmental policy actors from 36 European and associated countries (Albania, Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Israel, Italy, Latvia, Lithuania, Moldova, Montenegro, Morocco, The Netherlands, Norway, Poland, **Portugal,** Romania, Slovakia, Slovenia, South Africa, Spain, Sweden, Switzerland, Tunisia, Turkey) to work on 5 main objectives:

1. Plan and support research and innovation on biodiversity through a shared strategy, annual joint calls for research projects and capacity building activities
2. Set up a network of harmonised schemes to improve monitoring of biodiversity and ecosystem services across Europe
3. Contribute to high-end knowledge for deploying Nature-based Solutions and valuation of biodiversity in the private sector
4. Ensure efficient science-based support for policy-making and implementation in Europe
5. Strengthen the relevance and impact of pan-European research on biodiversity in a global context

European Partnership Water4all "Water Security for the Planet"[77]

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[76] https://www.biodiversa.org/2
[77] Water4All - EUROPEAN PARTNERSHIP WATER4ALL – WATER SECURITY FOR THE PLANET (water4all-partnership.eu

Water is necessary to all human activities and to life in general. Because of this, it was made central to all components of the EU Green Deal and to several United Nation Sustainable Development Goals (UN SDGs), starting with SDG6 on « clean water and sanitation ». The Water4All Partnership, co-funded by the European Union within the frame of the Horizon Europe programme, aims at enabling water security for all in the long term through boosting systemic transformations and changes across the entire research – water innovation pipeline, fostering the matchmaking between problem owners and solution providers.

Water4All started in September 2022. It brings together a wide and cohesive group of 78 partners from 31 countries (Austria, Belgium, Brazil Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Israel, Italy, Latvia, Lithuania, Luxembourg, Malta, Moldova, Netherlands, Norway, Poland, Portugal, Romania, Slovakia, South Africa, Spain, Sweden, Switzerland, Turkey, United Kingdom) in the European Union and beyond. This consortium gathers a variety of partners from the whole water Research, Development and Innovation (RDI) chain.

- Research and innovation funders,
- thematic authorities in charge of water issues and policy-makers,
- local authorities,
- associations and networks representing the economic sector in the field of water at the European, national or regional level,
- research organisations.

The outputs of Water4All will contribute to:

- Deliver sound knowledge, tools and evidence basis on water for policy and decision-making
- Improve consideration of water impacts in all relevant policies
- Enhance the field/market use of innovative solutions to water challenges
- Increase the awareness and engagement of citizens for an inclusive water governance

Water4All will collaborate with other relevant R&I initiatives in the European Research Area, in particular the European Union (EU) Missions, notably the Mission 'Restore our Ocean and Waters by 2030', or other European Partnerships (such as the Biodiversity Partnership, Sustainable Blue Economy Partnership, or Driving Urban Transition Partnership).

D. CYTED "Programa Iberoamericano de Ciencia y Tecnología para el Desarrollo"[78]

Cyted is the Ibero-American Programme on Science and Technology for Development. CYTED's main objective is to contribute to the harmonious development of the Ibero-American region through cooperation mechanisms that seek scientific and technological results, transferable to production systems and social policies. The CYTED Programme also answers the calling to act as a bridge for interregional cooperation in Science and Technology between the European Union and Latin America.

[78] https://www.cyted.org/en/node/9830

CYTED was created in 1984 through an Interinstitutional Framework Agreement signed by 21 countries of Spanish and Portuguese language (Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Spain, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Portugal, Dominican Republic, Uruguay and Venezuela).

The specific goals of the CYTED Programme are:

- Encouraging the integration of the Ibero-American Scientific and Technological Community, promoting an agenda of shared priorities for the region.
- Strengthening the technological development capacity of Ibero-American countries through the promotion of joint scientific research, the transfer of knowledge and techniques, and the exchange of scientists and technologists among R&D+I groups in the member countries.
- Promoting the participation of business sectors from member countries interested in innovation processes, in accordance with the research and technological developments of the Ibero-American Scientific and Technological Community.
- Promoting the participation of researchers from the Region in other multilateral research programmes through agreements for this purpose.

Since 1995, the CYTED Programme has been formally included among the Cooperation Programmes of the Ibero-American Summit of Heads of State and Government. In Portugal CYTED is followed by FCT.

CYTED's priority scientific areas are: Agri-food, Information and Communication Technologies, Promotion of Industrial Development, Sustainable Development, Global Change and Ecosystems, Health, Science and Society, and Energy. FCT has invested 30k€ in a Research Project approved in the 2017 call, on the topic "Climate change and marine-coastal socio-economic development". National investment in CYTED also includes the payment of an annual fee (by FCT) in the amount of 250 K€.

E. IPBES "Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services"[79]

The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) is an independent intergovernmental body established by States to strengthen the science-policy interface for biodiversity and ecosystem services for the conservation and sustainable use of biodiversity, long-term human well-being, and sustainable development. It was established in Panama City, in April 2012 by 94 Governments. It is not a United Nations body. However, at the request of the IPBES Plenary and with the authorization of the UNEP Governing Council in 2013, the United Nations Environment Programme (UNEP) provides secretariat services to IPBES.

IPBES currently has close to 140 member States (including **Portugal**). A large number of NGOs, organizations, conventions and civil society groupings also participate in the formal IPBES process as observers, with several thousand individual stakeholders, ranging from scientific experts to representatives of academic and research institutions, local communities and the private sector, contributing to and benefiting from our work.

[79] https://ipbes.net/

The work of IPBES can be broadly grouped into four complementary areas:

- Assessments: On specific themes (e.g. "Pollinators, Pollination and Food Production"); methodological issues (e.g. "Scenarios and Modelling); and at both the regional and global levels (e.g. "Global Assessment of Biodiversity and Ecosystem Services").
- Policy Support: Identifying policy-relevant tools and methodologies, facilitating their use, and catalyzing their further development.
- Building Capacity & Knowledge: Identifying and meeting the priority capacity, knowledge and data needs of our member States, experts, and stakeholders.
- Communications & Outreach: Ensuring the widest reach and impact of our work.

IPBES-Portugal's (https://www.ipbes.com.pt/) main objective is to bring together and involve all stakeholders in biodiversity, ecosystems and their services in Portugal, from the scientific community to policy makers and society in general, creating a national network of stakeholders who can contribute to the work program defined by IPBES.

IPBES-Internacional has been progressing in its work to carry out a study to assess biodiversity and ecosystem services on a global scale, with the FCT being involved in this dynamic through the analysis of requests for representation of Portuguese experts in international meetings of working groups, experts chosen, on a competitive basis, by IPBES-Internacional, and subsequently supported by FCT.

F. PRIMA "Partnership for Research & Innovation in the Mediterranean Area"[80]

The PRIMA partnership is one of the latest developments of the Euro-Mediterranean Partnership. Established in 1995, with the aim of fostering peace, stability, prosperity and intercultural dialogue in the region, this process has witnessed the foundation of the Union for the Mediterranean in 2008, comprising all European and Mediterranean states.

This partnership focuses on the fields of agriculture and food and water resources, one of the transversal axes being Research and Innovation on the sustainability of these resources, taking into account, among other aspects, the global climate change. The PRIMA partnership will have a minimum duration of 10 years (2018-2028), benefiting from global funding of around 500 M€, of which 220 M€ are financed by the European Commission, and the remaining by the 19 countries, European and from North Africa involved in the initiative. FCT invested 750 k€ in the 2018 call, 1.3M€ in the 2019 call and 1M€ in the 2020 call.

[80] https://prima-med.org/

Education, Training and Public Awareness (9)

In the European framework IPMA increased the participation in the Commissions and technical WGs and also bilateral meetings, highlight the IPMA-AEMET, IPMA- Meteo France International and IPMA- Join Research Center. The cooperation between Institutions allows us to continue the work of standardizing procedures and also increase cooperation with Portuguese-speaking meteorological services.

Within the scope of the collaboration protocol with Meteo France International, guarantee the collaboration of IPMA, through its human resources, in the INAMET (Angola) capacity building project that the MFI leads. With the Join Research Center /JRC IPMA established cooperation for the European Drought Observatory to exchange information and data in the scope of meteorological drought indicators/indices.

In relation to Portuguese speaking countries, IPMA has developed several initiatives with the meteorological services from that countries, namely technical capability initiatives. In terms of projects, actually IPMA is participating in the EU Project for the Strengthening Food and Nutrition Resilience and Security in Angola (FRESAN), promoted by Instituto Camões. With local partners, INAMET and DNSA, IPMA promotes the: development of web tools for agro-climate monitoring and agro-climate surveillance and forecast; reinforce the capability of meteorological observation of INAMET (installations of automatic agro-meteorological stations); technical training of human resources in provincial and national institutions.

In this project IPMA is responsible for the installations of surface observations system, namely installations of 6 automatic weather stations for agroclimate monitoring and survey activities, development of agroclimate monitoring platform and the elaboration of monthly bulletins with INAMET local partner. Also will be developed a survey climate forecast and climate scenarios for the 3 south provinces, Huíla, Namibe and Cunene. From all the activities from the project that IPMA is involved all the data generated from the observation systems or modelled data will be available for use, aligned with the open data initiative. Also within the IPMA activities in FRESAN project, several workshops were organized, mainly related with the increase of the local capabilities on use of the agroclimate indicators.

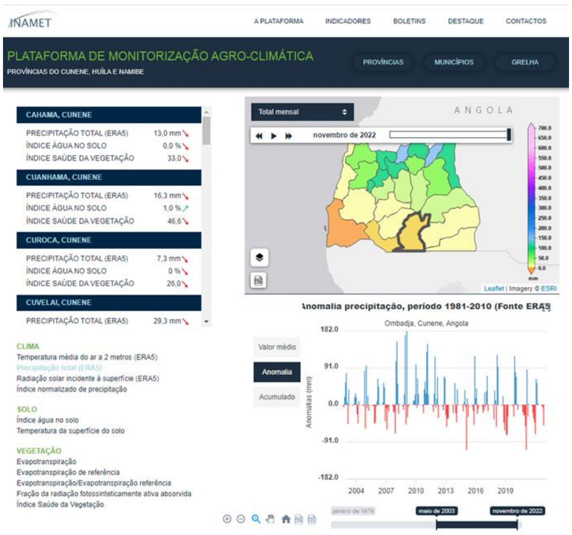

Figure 9.1
Agroclimate monitoring web platform
Source: IPMA (2022)

General policy on education, training and public awareness (9.1)

According to the Education System Act (LBSE)[81], the education system comprises pre-school education, school education and out-of-school education, and public education is free of charge.

School education comprises basic (primary), secondary, and higher (tertiary) education, including special arrangements and leisure time activities.

As a policy instrument, the LBSE sets up the education system so that it contributes effectively to the process of personal fulfilment of the learner, while striving to ensure the necessary balance of values required for an individual development process (personality and citizenship).

In this context, the Ministry of Education (ME) and the institutions under its political and administrative authority, in partnership with other bodies, public institutions and civil society itself, has published documentation serving as reference to approach the different dimensions of citizenship, such as the Framework of Environmental Education for Sustainability, which is now finished and about to be submitted to public consultation. Such reference documents, as well as other guiding documents, are not prescriptive guides or programmes but rather supporting instruments that each educational institution can use and adapt within the scope of their autonomy, depending on the options to be made in each context, in order to frame practices to be undertaken, both in a classroom setting and in project development.

National Strategy for Education for Citizenship – ENEC

According to the Directorate-General for Education DGE, education for citizenship aims to contribute to the formation of responsible, autonomous, supportive people, who know and exercise their rights and duties in dialogue and respect for others, with a democratic, pluralist, critical and creative spirit, with reference to the values of human rights.

The different domains of Education for Citizenship are organised into three groups with differentiated implications: the first is compulsory for all levels and cycles of schooling (because they are transversal and longitudinal areas), the second, at least in two cycles of basic education, and the third is optional for any year of schooling. Each domain should specify how it contributes to the areas of competences defined in the Profile of Students at the end of Compulsory Schooling.

Among the various ENEC domains, we highlight environmental education, to which the Portuguese Environment Agency contributed. The aim is to encourage students to know what the concept of sustainability associated with intergenerational responsibility implies. It also promotes reflection on the causes of climate change, protection of biodiversity and protection of territory and landscape.

Cooperation Protocol Education and Environment Ministries

The Ministries that oversee Education and the Environment have had a Cooperation Protocol since 1996 that is an important instrument for the promotion of environmental education in Portugal. This collaboration has allowed the promotion of several initiatives, recognition of

[81] Law No 46/86, of 14 de October, as amended by Law No 115/97, of 19 de September, and Law No 49/2005, of 30 August.

projects, insertion of contents in school curricula and the creation of a network of teachers with technical-pedagogical competences for the coordination and dynamisation of projects in the communities developed in articulation with Non-Governmental Environment Organisations (NGOs).

In 1996 the Ministries of Education and Environment signed a Cooperation Protocol which, among other initiatives, originated the creation of a network of teachers with technical and pedagogical competences for the coordination and dynamization of projects developed in articulation with Non-Governmental Organizations for the Environment, NGO's, or anchored in support equipments for environmental education.

In December 2005, this Cooperation Protocol was renewed, reinforcing the scope and work of the bodies involved by the two tutelages.

Over the last few years, it has become possible to disseminate innovative practices in the implementation of environmental education projects, embodied in partnerships between schools, local authorities, NGOs and other entities of local and regional scope, under the coordination of education professionals and specialists in the environmental area.

The contribution of these Protocols to the training of teachers at different levels of education and teaching in themes linked to Environmental Education for Sustainability should be highlighted, as well as the widening of environmental education to citizens in general, through intervention work and local, regional and national dynamisation.

The ministries of Education and Environment are thus converging their efforts to promote environmental education, with the deepening of these synergies having reiterated and renewed support for the implementation of projects by NGOsGA, namely those of recognised merit, coordinated by teachers in mobility situations.

These Protocols gave rise to a "Network of Coordinating Teachers of Environmental Education Projects", which is made up of professionals who develop work on a national scale that has guaranteed a capacity for innovation and dissemination of good practices, both at the level of schools at different levels of education and at the level of civil society in general.

GTEAS - Working Group on Environmental Education for Sustainability was created by Order No. 19191/2009 and consists of two representatives of the Portuguese Environment Agency; two representatives of the Directorate General of Education (DGE); a representative of the Directorate General of School Establishments (DGEstE) and a representative of the Institute for Nature Conservation and Forests (ICNF).

It is the responsibility of GTEAS:

- The elaboration of a proposal to define the bases and strategic guidelines of a national policy/agenda for environmental education for sustainability;
- The elaboration of proposals for annual action plans for environmental education for sustainability;

- To support the accomplishment of school projects inserted in the domain of environmental education for sustainability;
- To support the implementation and promotion of projects, at local, regional and national level, of environmental education for sustainability, involving, whenever possible, municipalities, business associations, non-governmental organisations, among other entities.

For the 2021/2022 school year the Network of Coordinating Teachers of Environmental Education Projects was as follows:

- ABAE - Blue Flag Association of Europe - Margarida Gomes
- ASPEA - Portuguese Association for Environmental Education - Joaquim Ramos Pinto
- GEOTA - Group for Spatial Planning Studies and Environment - Carla Pacheco
- QUERCUS - National Association for Nature Conservation - José Janela
- FAPAS - Portuguese Association for Biodiversity Conservation - Isabel Fernandes
- LPN - League for the Protection of Nature - Jorge Fernandes
- SPEA - Portuguese Society for the Study of Birds - Ana Esteves
- Portuguese Botanical Society - Susana Neves
- A ROCHA Portugal - Paula Banza
- O TAGIS - Portuguese Butterfly Conservation Centre - Clarisse Ferreira

Primary, secondary and higher education (9.2)

Curricular autonomy and flexibility, learner's profile, key learnings and National Strategy for Citizenship Education.

In the framework of the priorities set out in the programme of the 21st Constitutional Government for the area of education, the implementation of the project on autonomy and flexibility of curricula in basic and secondary education was approved, as a pedagogical experience, for the 2017/2018 school year (Order No 5908/2017 of 5 July). This project is active in 226 schools with a view to its generalised application in all schools in 2018/2019.

In the context curricular autonomy and flexibility, schools can manage up to 25% of the weekly hours of basic curriculum matrices per school year or, in the case of education and training for young people and vocational courses, of the total hours per training cycle.

In order to support the implementation of the project on curricular autonomy and flexibility, three strategic documents were developed as the project framework: Learner's Profile when Finishing Compulsory Education, Key Learnings, and the National Strategy for Citizenship Education.

The document on the Learner's Profile when Finishing Compulsory Education, recently adopted (Order no. 6478/2017, of 26 July), serves as a reference for curriculum development and for the work to be carried out in each school, addressing social and economic challenges of today's world, in line with the development of 21st century skills. The Principles, Areas of Competence and Values established in the Learner's Profile when Finishing Compulsory Education are combined in order to educate individuals as participating citizens, paving the way towards lifelong citizenship.

The document on Key Learnings, currently being drafted, identifies the knowledge, skills and attitudes to be developed by all learners, leading to the development of competences included in the Learner’s Profile, in the context of promoting curricular autonomy and flexibility.

The National Strategy for Citizenship Education (ENEC), adopted in January 2017, is a reference document to be implemented in the 2017/2018 school year, both in public and private schools which form part of the project on curricular autonomy and flexibility, in line with the Learner's Profile when Finishing Compulsory Education and Key Learnings.

Citizenship education is compulsory in all education levels and cycles and subject to evaluation. The different areas of Citizenship Education are organised in three groups with different implications: the first one is compulsory for all education levels and cycles (since these are cross-sectoral and longitudinal areas). This subject includes Environmental Education, with the Framework of Environmental Education for Sustainability as the reference document for its curriculum, in which climate change is one of the topics, including: Climate change causes, Climate change impacts, Climate change adaptation and Climate change mitigation.

The share of curriculum to be managed by each school (25% of hours of the curriculum matrices) may also become a key tool for developing projects in the area of environment and, more specifically, dealing with climate change.

As already mentioned, the LBSE, in addition to establishing the general framework of the education system, sets up the school education structure, consisting of three levels: basic, secondary and higher education.

Pre-school education is intended for children between 3 years of age and the age of entry into compulsory schooling, it is optional although universal from the age of 5, and delivered in public (free of charge) or private child-care facilities.

Table. 9.2.1
Compulsory Education

Levels		School Years	Age
Basic Education	1st Cycle	1st - 4th	6-10 years
	2nd Cycle	5th - 6th	10-12 years
	3rd Cycle	7th - 9th	12-15 years
Secondary Education	Course type	School Years	Age
	Science and Humanities Artistic, Specialised and Vocational	10th, 11th, 12th	15-18 years

Basic Education

Basic education lasts for nine years, from 6 to 15 years of age, and is organised in three sequential cycles: the first one is four years, the second one two years and the third one three years.

The 1st cycle works within a system of one single teacher, resorting to specialised teachers for certain areas. This cycle aims at global education and the development of basic competences in Portuguese Language, Mathematics, Environmental Studies and Expressive Skills. In the area of Environmental Studies, within the theme "QUALITY OF ENVIRONMENT", on air quality, one of the objectives is to recognise the effects of air pollution, mentioning the increase of greenhouse effect.

The 3rd cycle is organised by subjects. The main objectives of this cycle are the development of skills and competencies which provide a common general preparation to all pupils, enabling them to pursue their studies, whether through courses geared mainly towards entering working life or towards attending higher education.

The 2nd and 3rd cycles involve multiple teachers specialised in the various subject areas. In the 3rd cycle, climate change is addressed in the context of Geography, Physicochemical Science and Natural Sciences.

BOX 9.2.1 - Framework of Environmental Education for Sustainability

The Framework of Environmental Education for Sustainability is not a programme, but rather a curricular document that falls within the set of reference documents prepared by the Directorate-General for Education, in partnership with various entities, within the field of Citizenship Education.

In order to promote Environmental Education for Sustainability in schools, this Framework has been prepared as a guiding document for teachers and a supporting document for educational actions aimed at raising society's awareness on the importance of sustainability.

This Framework, of a flexible nature, may be used in very different contexts, in full or in part, within the crosscutting dimension of Citizenship Education, through the development of projects and initiatives that aim to contribute to learners' personal and social development.

The Framework proposes eight cross-cutting themes for all cycles and levels of education, consisting of subthemes and objectives and using descriptors appropriate to the education level involved, namely: Sustainability, Ethics and Citizenship; Sustainable Production and Consumption; Territory and Landscape; Climate Change; Biodiversity; Energy; Water; Land.

We hereby underline the subthemes of Climate Change, which include: Climate change causes, Climate change impacts, Climate change adaptation and Climate change mitigation.

Secundary Education

Secondary education is compulsory and covers a three-year cycle (10th, 11th and 12th school years) and pupils must have successfully completed the 3th cycle of Basic Education or have equivalent qualifications.

Secondary education is structured in differentiated forms (mainstream and vocational), with course curricula organised within a framework of three school years and essentially divided in the following way:

- Science and humanities courses: intended primarily for continuing studies at higher level;
- Artistic specialised courses: aim at providing specialised artistic training in the areas of visual arts, audiovisual media, dance and music;
- Vocational courses: meant to enable entry into the labour market, also allowing for the continuation of studies in post-secondary non-tertiary education or in tertiary education. They are organised by modules in different training areas.

The specific theme of climate change is addressed directly in the following subjects:

- Geography (3rd cycle of Basic Education)
  Theme 9: Environment and Society: Heating - Climate Change
- Physical and Natural Science (3rd cycle of Basic Education)
  Theme 4: Sustainability on Earth: Global change
  Weather forecast and description; the influence of human activity on the Earth's atmosphere and climate. Activity suggestion: bearing in mind the need to extract, process and use natural resources and the pros and cons associated with these actions, pupils should look ahead and present proposals for rational management of resources, comparing them afterwards with existing documents on this subject, for example, the Kyoto Protocol, signed on 11 December 1997. Discuss the controversy around this.
- Geology (Secondary Education, 12th year)
  Theme: The Earth – Past, Present and Future
  Mankind as an agent of environmental changes; Global Warming. Content related to climate change addressed under this topic involves the role of mankind as an agent of global warming as well as environmental concerns in the context of geological knowledge.
- Biology (Secondary Education, 12th year)
  Unit 5: Environment Conservation and Recovery (greenhouse effect)
- Geography (Secondary Education, 12th year)
  Subtheme: Greenhouse effect and global warming
  It includes proposals for discussions on the resolutions from the global conferences. In the case of vocational training, it is included in the technical courses on Renewable Energy and Environmental Management.

Box 9.2.2 - Environmental education in curricular programmes and documents of Basic and Secondary Education

In the framework of formal education, environmental content and themes have been integrated in school programmes since the late 70's. From the 80's onwards, it has been made possible for schools to be formally involved in project methodologies with a focus on environmental issues from the perspective of study and intervention at local level.

In 2002, programmes for Geography, Natural Sciences and Physicochemical Science in basic education were replaced by curricular guidelines, reinforcing the relationship between Science, Technology, Society and Environment (STS/E) in a critical approach to economic and technological development. Issues related to proper management of natural resources – water, oceans, fisheries, atmosphere, biodiversity and forest – have been included in these curricular guidelines and may be dealt with across all subjects.

In Basic and Secondary Education, Citizenship Education was adopted as a cross-cutting topic in all programmes. In this sense, curricular programmes include the development of cross-cutting skills in various aspects of citizenship education, including Environmental, Road, Consumer, Health, and Media Education. In the specific case of most programmes in the area of science, preference is given to the STS/E approach, where interrelations established between Science, Technology, Society and Environment are integrated in the different curricular themes.

Higher Education

Higher (tertiary) education in Portugal is structured according to a binary system which includes university education and polytechnic education, provided by public and private institutions. Private higher education institutions must be previously recognised by the ME.

Binary system

University education, which includes universities, colleges and other associated institutions, is driven by the promotion of research and knowledge creation, seeking to guarantee a solid scientific and cultural education and to provide technical training for the pursuit of professional and cultural activities, by fostering the development of conceptual, innovative and critical analysis skills.

Polytechnic education, which includes polytechnic institutes and other associated institutions, is driven by a perspective of applied research and development focused on understanding and specific problem-solving, and aims to provide a solid, higher-level cultural and technical education, to develop innovative and critical analysis skills, and to provide theoretical and practical scientific knowledge and its application, enabling the pursuit of professional activities.

Structure of degrees and diplomas in higher education

In 2005, a process to reform the LBSE was initiated in order to implement the Bologna Process, with the introduction of the European Credit Transfer System (ECTS) in study cycles, mobility programmes, diploma supplement, among others.

Higher education then had a three-cycle structure of studies leading to the academic degrees of bachelor, master and doctor. This structure was introduced in 2006 and fully implemented from the 2009/2010 school year onwards.

For each cycle of studies, generic qualification descriptors were also established on the basis of the skills acquired, and the ECTS ranges were set up for the first and second cycles of studies.

In 2014, a cycle of studies in higher education was created which does not lead to an academic degree, the so-called higher vocational technical degree, corresponding to a short cycle of studies linked to the first cycle established in the Framework for Qualifications of the European Higher Education Area.

In higher education, there are several doctoral programmes in climate change, for example the Doctoral Programme on Energy Systems and Climate Change at the University of Aveiro and the Doctoral Programme on Climate Change and Sustainable Development at the Faculty of Science and Technology of the New University of Lisbon together with the Faculty of Science of the University of Lisbon.

This issue is further addressed in several master's degrees such as the Master's in Ecology and Environmental Management and the Master's in Risks, Cities and Spatial Planning.

Likewise, it is included in undergraduate courses, such as the Bachelor's degrees in Environmental Engineering, in Geology, in Geography and in Ecology.

Post-secondary non-tertiary education

Technological specialisation courses (CET) provide specialised training courses in different technological areas, which enable learners to continue their studies at higher education level, due to formal recognition of acquired knowledge, and facilitate their integration in a professional context.

The successful completion of a technological specialisation course grants a diploma in technological specialisation and professional qualification at level 5, which makes it possible to attain a Vocational Training Certificate (CAP). This arrangement includes technological specialisation courses in Environmental Management and in Environmental Quality, where climate change is obviously addressed.

Education and Training for Young People and Adults

Education and training for young people and adults offers a second chance to early school leavers or pupils who are at imminent risk of leaving school early, extending this possibility to all those who have not had an opportunity to attend school while young or who, following the prospect of lifelong enrichment, go back to school seeking answers in terms of professional or personal development. Education and training for young people and adults, in whatever form, enables learners to attain a school certificate and/or a professional qualification, as well as to pursue further studies at post-secondary non-tertiary education or tertiary education.

Education and training for young people and adults covers the following arrangements:

- Second-chance education at basic and secondary levels for learners aged 16 and over, partially or totally on-campus, or 18 years and over either on-campus or not;
- Recognition, validation and certification of competences as well as the pursuit of vocational education and training paths.

This system takes place in 'Qualifica' Centres:

- Education and Training courses (CEF) for learners aged 15 or above;
- Adult Education and Training courses (EFA) and Modular Training courses for learners aged 18 or above;
- National Apprenticeship System, under the responsibility of the Institute for Employment and Vocational Training, for young people aged 15 or above.
- In this context, climate change is addressed through a generic approach within the scope of scientific subjects and, in the case of adult education and training courses (EFA) and the National Apprenticeship System, it is included in the technical courses on Management of Environmental Systems and Environmental Protection.

Box 9.2.3 - Protocol between the Ministry of Education and the Ministry of Environment and Climate Action:

The cooperation protocol between the Ministries responsible for Education and Environment, concluded in 2015, formed an important instrument for promoting environmental education in Portugal, through various partnerships, resulting in multiple Programmes and the establishment of a network of teachers with technical and pedagogical competences to coordinate and launch projects developed in conjunction with NGOs or anchored in environmental education equipment.

This network of teachers, covered by the continuity of these protocols, has allowed, over the past few years, for the dissemination of innovative practices in implementing projects on environmental education, based on partnerships between schools, local authorities, non-governmental organisations and other bodies at local, regional and national level, under the coordination and/or monitoring of education professionals and environmental experts

The teachers involved are crucial players in national and international strategies in this field, as key promoters of active citizenship in the context of school communities.

Furthermore, this initiative contributes to the training of teachers working at different levels of education, on issues of Sustainability Education, and it allows for environmental education to reach citizens in general through activities of intervention and dynamism at local, regional and national level.

For close monitoring of this cooperation, the Working Group on Sustainability Education (GTEAS) was established, involving representatives of the two ministries for each area of cooperation.

It should be noted that, under this Protocol, the GTEAS has organised since 2011 annual seminars for public presentation of the projects developed by the network of teachers, in order to discuss the issue of Environmental Education for Sustainability and promote the sharing of experiences.

The issue of climate change has been present both in the work developed by teachers and in several of these seminars.

In addition to the Programmes/Projects/Actions developed in partnership between the Ministry of Education and other ministries in Portugal, there are different projects involving companies and various entities from both local and central government.

Public information campaigns (9.3)

National Strategy for Environmental Education (ENEA)

Portugal has adopted the National Strategy for Environmental Education 2020 (ENEA 2020) through a unique process of public debate and participation, aimed at promoting effective ownership and accountability of civil society. This process was supported by two events: the first one was public participation, having received statements from 49 entities and individuals; the second one was public consultation, which received 35 contributions.

The delivery of this Strategy focuses on thematic and cross-cutting activities which are able to ensure the fulfilment of national and international commitments undertaken by Portugal in the area of Sustainability and Climate Change. These include, in particular, the Paris Agreement and the Sustainable Development Goals of the United Nations – 2030 Agenda.

The guiding principles of a strategy in the field of Environmental Education for Sustainability should aim for a participatory citizenship, empowering children and young people, but also civil society, economic actors, policy makers and technical staff of central, regional and local administration.

ENEA 2020 provides for 16 actions in the framework of three strategic objectives: Environmental + Crosscutting Education; Environmental + Open Education; Environmental + Participatory Education. These objectives are based on three central pillars of the Government's environmental policy: decarbonisation of society, circular economy, and territory enhancement.

For the period 2017-2020, ENEA 2020 seeks to establish a strategic and collaborative commitment to cohesion, building up environmental literacy in Portugal which, through inclusive and visionary citizenship, leads to a paradigm shift in thinking that translates into sustainable behaviour models in all dimensions of human activity. For the implementation of ENEA 2020, approximately 18 million euros have been allocated for the period 2017-2020 through the FA.

The actions foreseen in ENEA 2010 through one of its thematic axes "decarbonisation of society" aim at contributing to active citizenship in the field of sustainable development and building a low-carbon, rational and resource-efficient society. Therefore ENEA 2020 appears as a means to achieve Portugal's objective of deep decarbonisation of society by 2050.

Projects/Programmes/Competitions

The ME, in partnership with the MAAC, the Ministry of Agriculture, Forestry and Rural Development, various local authorities, universities, governmental institutions and nongovernmental organisations, have developed several Environmental Education projects, both in schools and surrounding communities, with a thematic focus on Sustainability and Climate Change, both in terms of mitigation and adaptation.

i. Education and Climate Change Award under ADAPT programme

   Within the scope of this programme, the competition "Education and Climate Change award", developed under the coordination of the APA and the Directorate-General for Education (DGE), aimed to resort to schools as an excellent vehicle for communication and training, raising awareness of school communities on ways of preventing the effects of climate change and on adaptation measures.

   The winning application was submitted by the University of Porto – Faculty of Arts, with the project "ClimaEdu.Media", which endeavoured to integrate and complement environmental education on climate change, concerning both mitigation and adaptation, in 30 pilot schools. One of the project components consisted of a award (funding) for the best project on the implementation of measures related to climate change in school context.

ii. Campaign "O Clima é Connosco" [Climate is up to us]

   The Communication Plan "O Clima é Connosco" [Climate is up to us] presents a set of communication actions and environmental awareness measures for climate action aimed at the general public, with greater focus on educational communities, enhancing the role of partnerships in the whole process.

   In this sense, the Imprensa Nacional – Casa da Moeda, S.A. (INCM) [Portuguese Mint and Official Printing Office], under the numismatic plan for 2015, minted and marketed a collector coin called "O Clima é Connosco" [Climate is up to us], as part of the series "Uma Moeda Uma Causa" [One Coin, One Cause]. A share of the revenues from the sale of this coin has gone to a non-governmental organisation (NGO), which was selected through a tendering procedure organised by the APA.

   This competition aimed at contributing to the knowledge on climate change and on the impact of choices and decisions made by citizens, as well as to an urgently needed reduction of harmful greenhouse gas emissions into the atmosphere, thus contributing to a resilient low-carbon economy. The promoters of the campaign "O clima é connosco" are ASPEA – Portuguese Association for Environmental Education, a non-governmental environmental organisation, the Imprensa Nacional – Casa da Moeda, S.A. (INCM) and APA.

iii. Cooperation Protocol APA – Carbon Disclosure Project (CDP)

Under the cooperation protocol between the APA and CDP (signed in November 2013), with a view to encouraging businesses and cities to share information and good environmental practices and to increasing the number of companies and cities that monitor and manage their carbon emissions in Portugal, thus contributing to increased transparency in environmental information, CDP promotes annually the dissemination of its report, with the involvement of businesses in Spain and Portugal.

CDP is a non-profit international organisation which provides one of the largest and most comprehensive global systems for environmental disclosure, with more than 4,100 companies and 126 cities around the world, which report on environmental information through its platform.

It works with market operators in order to motivate businesses and cities to measure and disclose their impacts on the environment and natural resources, and thus discover ways to reduce them. CDP also owns the largest corporate databank on climate change, water and forests. Such information generates insights that allow investors, businesses and governments to mitigate risks associated with the use of energy and natural resources, as well as identify opportunities for a more responsible approach to environment. CDP's action moves around different thematic programmes: Companies, Cities, Water, Forests, Supply Chain, etc.

In Portugal, participation has focused on Companies (invitation is addressed to the first 40 companies listed on the Lisbon Stock Exchange) and Cities (invitation is addressed to 40 Portuguese cities, selected by the highest population among the 55 signatories of the Covenant of Mayors).

iv. Competition Mission UP | United by the Planet – Competition Positive Brigades

Mission UP | United by the Planet is an educational project within the framework of the strategy set up by Galp Energia, with a national scope, dedicated to energy use, with a focus on the areas of Sustainable Mobility, Energy Efficiency, Energy Footprint and Energy Sources.

The project is developed in schools through the "Positive Brigades" competition, in which pupils and teachers are challenged to organise teams or "Brigades" with a specific use. It is around energy efficiency and sustainable mobility, both inside and outside the school. mission energy These Positive Brigades must suggest and implement actions among their fellow pupils, friends and parents in order to promote sustainable meant for implementation at national level, in schools of 1st and 2nd cycles of Basic Education, not only for children (between 6 and 12 years old), but also their teachers, parents and guardians.

The ME, the Ministry of Economy and the MAAC in partnership with other entities support, monitor and publicise the project. The jury of the competition consists of technical staff from the different ministries.

v. Power UP Mission

Power UP Mission is a national school project on energy consumption efficiency, organised by Galp Energia for pupils from the 2nd and 3rd cycles of Basic Education. The Power Up

Mission project deals with topics such as energy sources, sustainable mobility and energy footprint, using an online learning platform in an innovative way.

The project is targeted at schools and pupils from the 2nd and 3rd cycles of Basic Education, aged between 10 and 15 years, but also teachers, guardians, parents and other members of the educational and local communities. Power UP Mission aims to promote the creation of multi-disciplinary teams involving pupils and other members of the school community, and to contribute to attitudes and behaviours associated with more efficient energy consumption.

The ME, the Ministry of Economy and the MAAC in partnership with other entities support, monitor and publicise the project. The jury of the competition consists of technical staff from the different ministries.

vi. <u>School – Electron project</u>

The School – Electron project aims to raise awareness among students and their communities on the correct disposal of waste electrical and electronic equipment (WEEE), with a clear impact on emission reduction, combining the effects of dissemination, training and participation in an inter-school competition.

This project is targeted at pupils from the 2nd and 3rd cycles of Basic and Secondary Education, it is promoted by Amb3E (Portuguese Association for the Management of Waste Electrical and Electronic Equipment), with the collaboration of the DGE, and it was carried out annually between 2008/2009 and 2011/2012, having been resumed in 2015/2016.

The ME and the MAAC in partnership with other entities support, monitor and publicise the project. The jury of the competition consists of technical staff from the different ministries.

The ME has promoted the dissemination of the project in schools, as well as its pedagogical supervision, which involved analysing and evaluating support material for the project, including the website, producing news and sending out institutional e-mails, among other related tasks/activities.

During the 5 editions of this competition, in addition to awareness-raising actions, schools collected more than 5 tonnes of waste electrical and electronic equipment (WEEE), mobilising the local school community for the correct WEEE disposal. The Project will run its sixth edition in 2017/2018.

vii. <u>Project "Twist – a tua Energia faz a Diferença" [Your Energy makes the difference]</u>

The project "Twist – your energy makes the difference" is an educational initiative raising awareness on Energy Efficiency, Climate Change, Renewable Energy and Sustainable Development, targeted at pupils and teachers in Secondary Education – 10th to 12th years. This initiative is promoted by EDP (national electricity provider). Each school participates with a group of "twisters" – four pupils and one teacher – with a mission to develop actions in school aiming at identifying measures that make school more energy efficient, raising awareness and involving the whole school community. The Twist project was relaunched for the school year 2017/2018 and continued the methodology applied in previous editions. The MAAC and the

ME, along with other ministries and entities, support, monitor and publicise the project, also including technical staff in the jury.

viii. Project "Ciência na Escola" [Science in School]

The "Science in School" project, organised by the Ilídio Pinho Foundation, aims at stimulating pupils' interest in science by supporting innovative projects. Some of the projects presented are directly or indirectly related to Climate Change[82]. Applications should consist of highly practical and multi-disciplinary projects which mobilise the different subject fields for their development. The competition is open to all pupils in pre-school education, as well as from the 1st, 2nd and 3rd cycles of Basic and Secondary Education, from the different education and training pathways, with the aim of learning about science and choosing technological areas.

The 14th edition of the competition was dedicated to the topic of "Science and Technology working for a better world".

The 15th edition is ongoing and its topic is "Science in School to the Benefit of Development and Humanisation"[83].

The ME and the Ministry of Economy support, monitor and publicise the project. APA, amongst others, is part of the competition jury.

ix. Eco XXI

In line with the principles underpinning Agenda 21, the ECO XXI project aims to recognise the best sustainability practices developed at municipality level, consisting of the implementation of educational activities with the local authorities as key actors in promoting sustainable development. Good practices on sustainability developed at municipality level are directly or indirectly related to climate change.

The main objective of this project is therefore to enhance a range of issues considered key to Sustainable Development, anchored on two pillars: sustainability education and environmental quality.

Different central government bodies, such as the DGE and APA, together with other entities, are part of the National Commission of the Eco XXI project, whose task consists of supporting the implementation of the project through its monitoring within the expertise area of each body, and being established as jury.

x. Programme "Jovens Repórteres para o Ambiente (JRA)" [Young Reporters for the Environment]

Young Reporters for the Environment[84] is an international programme for environmental education developed by an international network of the Foundation for Environmental Education (FEE), which currently comprises 34 countries and it is promoted in Portugal by the

[82] List of projects: https://www.fundacaoip.pt/wp-content/uploads/2017/06/Lista_100-Mostra-2016_2017.pdf
[83] https://www.fundacaoip.pt/ce/
[84] https://jra.abae.pt/plataforma/

ABAE – Associação Bandeira Azul da Europa [Blue Flag association], which has been the Portuguese section of the FEE since 1994.

The project is targeted at Secondary Education pupils, who are supposed to identify a local environmental problem, after which they carry out the respective research, reporting and communication, making use of newspapers, the Internet and other media. This work ends with the presentation of journalistic articles, photographs, videos or PPT presentations on the environmental issues researched by the participating pupils, and the annual participation in competitions is foreseen in order to reward the best performance. Climate Change is an underlying topic of the JRA Programme, and it has been the main theme of the competition more than once.

Different central government bodies, such as the DGE and the APA, together with other entities, are part of the National Commission of the JRA project, whose task consists of supporting directly and indirectly the implementation of the project, carrying out its pedagogical and technical monitoring and being established as a jury in competitions related to it.

xi. Eco-schools project

The Eco-schools project is an international programme of environmental education, which currently involves 49,000 schools across 63 countries, having been promoted in Portugal since 1996 by ABAE, the Portuguese section of the FEE, covering approximately 1,600 schools.

The project aims to encourage schools to develop actions in the field of Environmental Education for Sustainable Development, offering training and support, mainly providing teaching methods and materials and undertaking actions that facilitate the implementation of the programme. Many of the activities developed by pupils take climate change into account[85].

This project also shows recognition for work carried out by schools, by awarding the Eco-Schools label and other prizes meant for schools, teachers and pupils involved. Different ministries, such as the ME and the MAAC, are part of the National Commission of the Eco-schools project, whose task consists of supporting directly and indirectly the implementation of the project, carrying out its pedagogical and technical monitoring and being established as a jury in competitions related to it.

The APA and the DGE are part of the National Commission of the Eco-schools project, and, together with other entities, they support directly and indirectly the implementation of the project, carry out its pedagogical and technical monitoring and are members of the jury in competitions related to it.

xii. Lipor generation +

The competition "Lipor Generation+", promoted by Lipor, aims to promote and support projects and/or initiatives which have at their basis consolidated practices of environmental (including from the perspective of climate change mitigation), social and economic

[85] https://ecoescolas.abae.pt/our_news/abae-integra-projeto-climact/

sustainability, and to recognise the work undertaken by the institutions in this field. The ME and the MAAC monitor the project, publicise it and are part of the national jury.

xiii. YEL project

This is an initiative under the responsibility of RNAE – Association of Energy and Environment Agencies (National Network), and it is targeted at pupils from Secondary Education, aimed at raising awareness and changing behaviour on energy efficiency and climate change. The ME and the MAAC monitor the project, publicise it and are part of the national jury.

xiv. Project "Nós Propomos" [We propose]

Promoted by the Institute of Geography and Spatial Planning, this project aims to promote effective local territorial citizenship, from a governance and sustainability perspective. It seeks to develop partnerships between universities, schools, municipalities, businesses and associations, with whom it tries to establish a cooperation protocol. The ME monitors the project, publicises it and is part of the national jury.

Training programmes (9.4)

Training actions under AdaPT programme

Under the AdaPT programme, the "ClimaEdu.media" project included teacher training in the format 'Massive Open Online Course' on using media to teach about clime change in the classroom. This course was aimed at helping teachers of science and media develop their skills to teach about climate change in the classroom using several media. The course, which had two editions, with a total of over 1,000 people enrolled, was composed of five modules. The first one addresses the concepts of media literacy and scientific literacy; the second one introduces climate change and text news; the third one looks into climate change impacts and the use of infographics; the fourth one examines the mitigation of climate change causes and the use of audio in teaching; and, finally, the fifth module introduces the subject of adaptation to climate change impacts and the use of video.

Still in the context of this programme, the "ClimAdaPT.Local" project, carried out by a consortium led by the Faculty of Science of the University of Lisbon, aimed to initiate Portugal in a continuous process of drawing up Municipal Strategies for Adaptation to Climate Change (EMAAC) and its integration into the municipal planning tools, in particular by empowering municipal technical staff. One of the objectives was the training of 52 municipal technical members of staff on Climate Change Adaptation, with the development of the following actions under specific themes:

- General methodology and current climate vulnerabilities
- Future vulnerabilities and adaptation
- Identification and selection of options for adaptation

3rd International Congress on Environmental Education of Portuguese Speaking Countries and Communities

The 3rd International Congress on Environmental Education of Portuguese Speaking Countries and Communities took place from 8 to 11 July, in Torreira – Murtosa, and focused on the topic of "Environmental Education: crossings and meetings for the common good". Thematic Axis II was dedicated to Climate Change.

The Congress was organised by the Portuguese Association for Environmental Education in partnership with the scientific centre "Fábrica Centro Ciência Viva" of the University of Aveiro and the Municipality of Murtosa. Several ministries, including Education and Environment, were members of the organising committee of this event, which was part of the process of strengthening networks and communities acting in the field of Environmental Education, within the Portuguese Speaking Communities and Galicia.

Building on the Treaty on Environmental Education for Sustainable Societies and Global Responsibility and on the Earth Charter, the 3rd International Congress on Environmental Education of the Portuguese Speaking Countries and Communities covered over 10 fields of work, with different dimensions and approaches, which served as a basis for exchange and debate among participants. The 3rd International Congress on Environmental Education was accredited as training by the Council of continuing training for teachers.

4th International Congress on Environmental Education of Portuguese Speaking Countries and Communities

The 4th International Congress on Environmental Education of Portuguese Speaking Countries and Communities took place in the Autonomous Region of Príncipe, S. Tomé, from 17 to 20 July 2017.

The Thematic Axis 2 addressed exclusively the issue of climate change: "Environmental education in response to climate change and to environmental risks and disasters".

The methodology used for this congress was similar to the previous ones, aiming to contribute to the development of public policies which help to strengthen environmental education in Portuguese speaking countries and in Galicia.

The main goals include: to strengthen joint processes for research, training and information in the field of Environmental Education; to improve scientific production in Portuguese, enhancing initiatives from journals and other means of dissemination of Environmental Education; and to build a permanent learning process which is favourable to the Portuguese-speaking identity in the philosophical structure of Environmental Education.

The structure of the congress was conceived on the basis of suggestions and inputs from the participatory process carried out at REDELUSO, and it was developed around 8 thematic axes. Among these, attention is drawn to the axis "Environmental education in response to climate change and to environmental risks and disasters".

2nd International Congress on Environment and Development

The 2nd International Congress on Education, Environment and Development, organised by OIKOS – Association for Environment and Heritage Protection in the region of Leiria – and by the Polytechnic Institute of Leiria, took place from 9 to 12 November 2016. The congress aimed primarily to foster discussion and dissemination of methodologies used and scientific studies related to the proposed topics; to present and reflect on practices considered relevant from the perspective of sustainability of contemporary societies, in order to minimise environmental disasters and tackle the phenomenon of Climate Change; to promote cooperation between public and private entities in defining new development models; to raise awareness and encourage all actors on the topics under analysis and their strategic, economic, social and environmental importance. The ME and the MAAC, among other ministries and public bodies, were institutional partners in the 2nd International Congress on Education, Environment and Development.

Resource or information centres (9.5)

Environmental Education Equipment for Sustainable Development (EqEA)

Environmental Education Equipment nowadays plays a major role in environmental education. This equipment corresponds, by definition, to every initiative which involves appropriate facilities, specialised educational teams and an educational programme, thereby offering a range of programmes and activities of educational intervention, and providing for relevant resources, complementary to the formal education system. Examples of such equipment are the Environmental Education Centres, Interpretation Centres for Protected Areas, Educational Farms, Eco-libraries and Environmental Parks. EqEA in Portugal constitute a heterogeneous group of initiatives located in a natural, rural and urban context. This heterogeneity is a common feature of Environmental Education Equipment throughout the world.

The basic elements that should be part of Environmental Education Equipment are: having an Educational Project driven by guidelines relating to environmental education, education for sustainable development, the ways to address Climate Change and society's forms of response (mitigation and adaptation); being a physical space with infrastructure and resources to implement activities for the various target groups (school children and other sectors of the population); and operating regularly throughout the year (more than 120 days/year).

Thus, in order to comply with this premise, APA's produced, in 2011, two online surveys: a first Form for Identification of Environmental Education Equipment, with the purpose of identifying/ locating equipment for environmental education (intended only for persons/organisations who are not owners/managers of environmental education equipment), and a second Form for Characterisation of Environmental Education Equipment, intended for entities which are owners/managers of this type of equipment.

It should be noted that the surveys mentioned above, after being submitted and validated by the APA, allow to geo-reference existing equipment in Portugal with SNIAmb, which can be consulted through the geovisualizer, and its related information can also be imported from SNIAmb. By 31 July 2017, 195 EqEA had been validated in accordance with the 16 questions drawn up in that survey (15 open questions and 1 closed question).

The existence of Environmental Education Equipment, its territorial distribution as well as the increased and necessary diversification of the target audience from the perspective of lifelong learning are an indicator of the ability of society to create cultural conditions enabling diversified forms of development which are environmentally sustainable, socially fairer and equitable for all citizens.

Involvement of the public and non-governmental organizations (9.6)

National Registry of Non-Governmental Environment Organisations – NGOs
Associativism is, in Portugal, a fundamental instrument of participation of the populations and intervention in society. Environmental citizenship and the dynamics of civil society organizations is essential in this process.

The Non-Governmental Environment Organisations – NGOs play a fundamental role in the promotion, protection, awareness and valuation of the environment, developing actions of public interest in their communities. The National Registry of NGOs and alike - RNOE is organised in the terms of the Law n.º 35/98, that denounces the statute of the ONGA. All legally constituted NGO organizations may request registration in the RNOE, managed by the Portuguese Environment Agency, which examines the process and issues the final decision. Under Law No. 82-D/2014, ONGAs registered with the RNOE and that have been recognised as a collective person of public utility can enjoy a 0.5% share of the IRS (individual income tax). In 2021, 98 Non-Governmental Environment Organisations were registered.

Besides all related information mentioned along different chapters, all climate policy instruments were subject of public consultation processes. General public, as well as specific stakeholders and NGO's, are also involved in many activities, and dissemination actions Climate Change related, developed by either MAAC, APA or other public and private entreprises, namely the ones involved in institutional arrangements mentioned before (SPeM; ENAAC; SNIERPA; CCV).

APA, being the entity responsible for coordinating national climate policy, and with a view to facilitating access to information related to Climate Change, both in terms of mitigation and adaptation, makes all reports produced within its field of competence publicly available, and submits them to various international bodies[86].

All information related to policies on Climate Change is available in Clima | Agência Portuguesa do Ambiente (apambiente.pt) and it is organised according to the following thematic areas: Planning; Mitigation; Adaptation; EU ETS; Fluorinated Gases; Monitoring and Reporting; Advisory Bodies; Legislation; International Affairs; Financing.

We also highlight the information on climate scenarios provided by the Climate Portal[87] , a project under the AdaPT programme that provides an easily accessible platform for the general public with the aim of disseminating the following information: historical data sets, regional climate change and climate indicators for specific sectors in Portugal. This project contributes, thus, to increased awareness and education on climate change. Under this, past climate data and climate projections data from IPCC AR5 (CORDEX project) were processed for dissemination via the website. This task involved all the calculations required for the breakdown of data at NUTS3

[86] Monitorização e Reporte | Agência Portuguesa do Ambiente (apambiente.pt)
[87] http://portaldoclima.pt

level and for different periods of time, and the (possible) estimation of aggregated indicators (e.g. drought index, meteorological risk of fire, etc.).

Among the different activities undertaken by NGOs, the following are highlighted:

- Quercus – National Association for Nature Conservation:
    a. EEB – Water Working Group – Participation in the Water Working Group in order to exchange information and take part in the actions proposed within the context of water resources.
    b. ClimAdaPT – Municipal Strategies for Adaptation to Climate Change

- LNP – League for Nature Protection:
    a. PRACTICE is a global initiative that brings together scientists and key actors of some of the most affected regions of the world, so as to gather scientific and local knowledge, drawing attention to the challenge of desertification.
    b. LIFE Charcos project, implemented in Sites of Community Interest.

- ABAE – European Blue Flag Association:
    a. The 'Eco-Schools' programme is an international initiative by the Foundation for Environmental Education (FEE), currently present in 64 countries.
    b. The "Green Key" programme is an international label promoting Sustainable Tourism in Portugal by recognising tourist facilities, short-term rental accommodation, campsites and restaurants that implement good environmental and social practices, enhance environmental management in their facilities and promote Environmental Education for Sustainability.

- ASPEA – Portuguese Association for Environmental Education:
    a. The EDUCO2CEAN project seeks to generate an educational model of Science-Technology-Society with the potential to be applied throughout the European Union, and raise society's awareness on the importance of research on the impact and mitigation of oceanic climate change, with a particular focus on the Atlantic Ocean and the Baltic Sea.
    b. Marine Alliance for Science and Technology (Scotland, United Kingdom).
    c. Caretakers of the Environment International (Poland).
    d. International Congress on Environmental Education of Portuguese Speaking Countries and Communities

- GEOTA – Study Group on Spatial Planning and Environment:
    a. Coastwatch Europe is a project on the management of rivers and the implications of human activity on ecosystems and coastal erosion, in coordination with the "Free Rivers" project.
    b. EUropa – The project seeks to trigger the involvement and awareness of citizens on the importance of their role as active players in promoting a sustainable economy.

- OIKOS – Association for Environment and Heritage Protection in the region of Leiria:
    a. International Congress on Education, Environment and Development

➢ ZERO - SUSTAINABLE EARTH SYSTEM ASSOCIATION
   a. Students in Climate Action
   b. Projeto Ativa ClimACT

Box 9.6.1 - Aarhus Convention

The Convention of the United Nations Economic Commission for Europe (UNECE) on Access to Information, Public Participation in Decision-Making and Access to Justice in Environmental Matters (Aarhus Convention) was adopted on 25 June 1998 in the Danish city of Aarhus, at the 4th Environment for Europe Ministerial Conference. It entered into force on 30 October 2001, after ratification by 16 member countries of UNECE and by the European Union. Portugal signed the Aarhus Convention in 1998 and ratified it on 2003.

The objective of this Convention is to ensure citizens' rights regarding access to information, public participation and access to justice in environmental matters, with these three aspects being considered as its three fundamental pillars, assuming that sustainable development can only be achieved with the involvement of all citizens and emphasising the interactions that should be established between the public and the authorities, at all levels, in a democratic context.

In the Portuguese legal system, different pieces of legislation allow, in general, to put into practice the guiding principles of this Convention: Constitution of the Portuguese Republic; Basic Environment Law; Code of Administrative Procedures and Law governing the status of NGOs.

As regards access to justice in environmental matters, an applicant in Portugal – whether an individual or an NGO – who considers that their request for information has been ignored, wrongfully refused, in full or in part, or inadequately answered, or that EU and national law has not been complied with, can challenge the legality of a decision, act or omission in accordance with the general legislation.

With regard to knowledge and information on environment, much progress has been made in recent years in Portugal, notably due to the dynamics set in the first Basic Environment Law, which has since 1986 led to the preparation of an annual report on the state of the environment – to be submitted to the Portuguese Parliament when discussing the broad policy options/national budget for each year, making the Environment one of the areas of government with 'annual accounts', using specific indicators to measure the impact of adopted measures and the extent to which targets have been reached. The revolution of new information and communication technologies also contributed to this, along with their broad dissemination, in particular the Internet.

Equally relevant is the work that has been completed over time by the National Statistical Institute (INE), the reference statistical authority at national level, with particular emphasis on the annual edition of "Environment Statistics" and on the availability of updated monitoring indicators from the National Strategy for Sustainable Development (ENDS).

Participation in international activities (9.7)

Portuguese Non-Governmental Organizations, active in the most diverse thematic areas, such as the environment, development cooperation, human rights and local development, have also been giving increasing importance to the issue of climate change, contributing to greater awareness and information for the general public, including women, youth and children, and for monitoring the actions of companies, public bodies and political decisions in this field.

Considering that bringing the topic of climate change closer to citizens and the civil society is one of the fundamental steps for the success of climate policies, every year the Portuguese Environment Agency has been issuing invitations with a view to integrating representatives of the civil society in the official Portuguese delegation to the Conferences of the Parties under the United Nations Framework Convention on Climate Change and the Paris Agreement. These invitations are addressed to platforms and confederations representing civil society organizations in the fields of environment, development support and entrepreneurship. This initiative contributes not only to a greater awareness of these entities on the subject of climate change, as well as to greater information, aimed at target audiences but also to the general public, about the ongoing work within the United Nations Framework Convention United Nations on Climate Change and the Paris Agreement.

On the other hand, the recognition of the importance of Environmental Education processes in Public Environmental Policies has always been present since their first exercises, both international and national. The dissemination of information, the awareness of challenges and concrete behaviours, the involvement of communities and their active participation in decision making have assumed essential dimensions in the face of globally and urgently required environmental behaviours.

One of the ample examples of available competence and structured determination, involving comprehensive initiative from the associative and academic world allowed, since 2005, the launching of the International Congress on Environmental Education from Portuguese Speaking Countries and Communities, an event promoted biannually and that has been aggregating redoubled support from national authorities, also via CPLP.

<u>IV International Congress on Environmental Education from Portuguese Speaking Countries and Communities:</u>

The 2017 edition of the congress was held on the island of Príncipe, in São Tomé and Príncipe, in July.

The programme of the IV International Congress on Environmental Education of Portuguese Speaking Countries and Communities continued the methodology of previous congresses, contributing to the promotion and formulation of public policies that help strengthen environmental education in Lusophone countries and Galicia.

The structure of the congress was based on the suggestions and contributions resulting from the participatory process in REDELUSO and was developed in 8 thematic axes:

1. Identity(s) of the field and public policies in Environmental Education;
2. Environmental Education in response to climate change and environmental risks and disasters;
3. The Environmental Education in the equipment, interpretation and conservation
4. Environmental Education in the educational system;
5. The boundaries of Environmental Education: ethics, inclusion, gender, peace and justice;
6. Environmental Education in the socio-economic enhancement of local communities;
7. Environmental Education in traditional knowledge and cultural-artistic manifestations;
8. The Environmental Education-Communication in the social networks and information technologies.

<u>V International Congress of Environmental Education of the Countries and Communities of Portuguese Language:</u>

The V Congress took place on the island of Bubaque, Bolama region - Bijagós, Guinea-Bissau, between 14 and 18 April 2019.

The structure of the congress was idealized based on the suggestions and contributions resulting from the participatory process in REDELUSO and was developed in 6 thematic axes:

1. Environmental Education as a response to climate change and environmental risks and disasters.
2. The Environmental Education in the equipments, conservation and environmental management.
3. Environmental Education in the educational system.
4. Environmental Education in the socio-economic development of local communities.
5. Environmental education as a contribution to the conservation of traditional values and knowledge.
6. Environmental education as a strategy to support programs of welfare, health and nutrition.

Monitoring, review and evaluation of the implementation of Article 6 of the Convention (9.8)

Aware of the need to achieve greater citizen involvement in public participation processes and, therefore, in decision making regarding issues that concern them in environmental matters, the Ministry of the Environment has made available the PARTICIPA website in 2015.

Participa.pt aims to facilitate access for citizens and those interested in the public participation process, encourage informed participation and improve efficiency in process management (table 9.8.1).

Table 9.8.1

Numbers participa.pt (2017-2021)

	Number	increase compared to 2020
Public participation processes created	1236	(+22,5%)
Opinions submitted	13 192	(+38,7%)
Participants subscribed and with active registration	12 749	(+46,2%)
Participants with Collective registration;	761	(+37,5%)
Participants with Individual registration	11 988	(+46,8%)
Website accesses	600 725	(+31,7%)

ANNEX I (5th Biennial Report)

Introduction (I)

This Annex I to the Portuguese 8th National Communication under the UNFCCC constitutes the 5th Biennial Report of Portugal drawn up in accordance with the United Nations Framework Convention on Climate Change (UNFCCC) biennial reporting guidelines for developed-country Parties contained in Decision 2/CP.17, and takes into account recommendations formulated by the expert review team in the context of the technical review of the 7th national communication (FCCC/IDR.7/PRT) and the 4th biennial report of Portugal (FCCC/TRR.4/PRT). The majority of the information provided in the Fifth Biennial Report is also reported in the Eighth National Communication.

In line with UNFCCC biennial reporting guidelines for developed-country Parties, the information is structured as follows:

- Information on greenhouse gases (GHG) emissions and trends (Section II);
- Quantified economy-wide emission reduction target (Section III);
- Progress towards the achievement of quantified economy-wide emission reduction targets (Section IV);
- Mitigation actions and their effects (Section V)
- Projections (Section VI);
- Provision of financial, technological and capacity building support to developing-country Parties (Section VII);

As requested per Decision 19/CP.18 (FCCC/CP/2012/8/Add.3), the Common Tabular Format (CTF) (Annex II to this report) has also been submitted to the BR-CTF electronic reporting application.

Information on Greenhouse gas emissions and trends (II)

A. Background information

<u>The Convention, the Kyoto Protocol and National Commitments</u>

The United Nations Framework Convention on Climate Change (UNFCCC) appeared as an answer of the international community to the emerging evidences of climate change and was adopted and opened for signature in Rio de Janeiro in 1992.

The ultimate objective of the Convention is the "stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system." Portugal ratified the UNFCCC on May 31st, 1994.

The Kyoto Protocol (KP), adopted some years later in 1997, represents a deepening in the commitments inscribed in the Convention. The Protocol introduced legally binding commitments for developed countries to reduce their collective emissions of greenhouse gases by at least 5% by the period 2008-2012 (first commitment period of the Protocol), below their 1990 level.

Portugal signed and ratified the KP on the April 29th, 1998, and May 31st, 2002, respectively. The EU as a whole agreed to a -8% reduction. Under the EU burden-sharing agreement Portugal is committed to limiting its emissions during the first commitment period to no more than +27 % compared to the 1990 level.

The KP entered into force on February 16th, 2005, after Russia's ratification in November 2004 which fulfilled the requirement that at least 55 Parties to the Convention, including developed countries accounting for at least 55% of that group's CO2 emissions in 1990.

Detailed rules for the implementation of the Protocol were set out at the 7th Conference of the Parties (in Marrakech) and are described in the Marrakech Accords adopted in 2001. At the first Conference of the Parties serving as the Meeting of the Parties to the Protocol (COP/MOP) held in Canada (December 2005) the rules for the implementation of the Protocol agreed at COP7 were adopted.

In Doha, Qatar, on 8 December 2012, the Doha Amendment to the Kyoto Protocol was adopted. This launched a second commitment period, starting on 1 January 2013 until 2020, with a revised list of GHG to be reported and necessary updates for several articles of the Kyoto Protocol.
For the second commitment period, Parties committed to reduce GHG emissions by at least 18% below 1990 levels in the eight-year period from 2013 to 2020. The EU and its Member States have committed to this second phase of the Kyoto Protocol and established to reduce their collective emissions to 20% below their levels in 1990 or other chosen base years. The target will be fulfilled jointly with Iceland.

The 2015 Paris Agreement, adopted in Paris on 12 December 2015, marks the latest step in the evolution of the UN climate change regime and builds on the work undertaken under the Convention. The Paris Agreement charts a new course in the global effort to combat climate change for the period after 2020.

The Paris Agreement's central aim is to strengthen the global response to the threat of climate change by holding the increase in the global average temperature to well below 2 ºC above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 ºC above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change. It also sets the goal of increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience and low greenhouse gas emissions development, in a manner that does not threaten food production. Finally, it also sets the goal of making finance flows consistent with a pathway towards low greenhouse gas emissions and climate-resilient development.

The Paris Agreement entered into force on 4 November 2016, thirty days after the date on which at least 55 Parties to the Convention accounting in total for at least an estimated 55% of the total global greenhouse gas emissions have deposited their instruments of ratification.

In 2016, following the ratification of the Paris Agreement, Portugal established the national objective to achieve carbon neutrality by 2050. The work under the 2050 Carbon Neutrality

Roadmap outlined a trajectory of -45 % to -55 % GHG emissions´ reduction by 2030, -55 % to -65 % by 2040 and -85 % to -90 % by 2050.

B. National Inventory

i. General InformationHistory of national inventories

Air emission inventories in Portugal were only initiated in the late 80s, early 90s when the first estimates of NOx, SOx and VOC emissions from combustion where made under the development of the National Energetic Plan (PEN - Plano Energético Nacional), and emissions from combustion and industrial processes were made under OECD inventory and under CORINAIR85 programme. A major breakthrough occurred during the CORINAIR90 inventory done during 1992 and 1993 by the General-Directorate of Environment (DGA, presently the APA). This inventory exercise, aiming also to respond to EMEP and OECD/IPCC, extended the range of the pollutants (SOx, NOx, NMVOC, CH4, CO, CO2, N2O and NH3) and emission sources covered, including not only combustion activities but also storage and distribution of fossil fuels, production processes, use of solvents, agriculture, urban and industrial wastes and nature (forest fires and NMVOC from forest). Information received under the Large Combustion Plant (LCP) directive was also much helpful to improve inventory quality and the individualization of Large Point Sources, as well as statistical information received from the National Statistical Institute (INE) allowing the full coverage of activity data for most emission sources. The CORINAIR90 Default Emission Factors Handbook (second edition), updating the first edition from CORINAIR85 was used extensively in the development of the current inventory and it was also a key point in the amelioration of the inventory.

The fulfilment of international commitments under the UNFCCC and CLRTAP conventions, together with the publication of the IPCC Draft Guidelines for National Greenhouse Gas Inventories (IPPC, 1995) and latter of the Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories (IPCC, 1997), resulted in substantial improvement of the methodologies that are used in the inventory, particularly for agriculture and waste, and that were included by the first time in the First National Communication in 1994.

The inventory that resulted from CORINAIR90 (CEC, 1992) and subsequent modifications from IPCC methodology still structures the present day methodology in what concerns activity data and methodology. Under the evaluation of the first communication the inventory was subject to a review made by an international team. All national communications up until the present day (last was the 7th National Communication, submitted in 2017) were also reviewed by international experts. These exercises had an important role in problem detection and contribute to overall improvement.

Since its first compilation, the Portuguese inventory has been continuously amended mainly due to the use of more detailed methodologies, better access to underlying data allowing the development of the comprehensiveness of the inventory, and better database storage and calculation structure. Changes in methodology, source coverage or scope of the data were reflected in the estimation of the emissions for the different years considered, i.e., the inventory is internally consistent.

ii. Global warming potentials

GWP considered are the values proposed by the IPCC Fourth Assessment Report (AR4) (IPCC 2007) as required by the revised UNFCCC reporting guidelines.

Institutional Arrangements for Inventory Preparation

i. Institutional arrangements in place

The national inventory system and the institutional arrangements have not changed since the 7th National Communication and 3rd Biennial Report to the United Nations Framework Convention on Climate.

The legal framework for the Portuguese Inventory System relies on the Council of Ministers Resolution No.20/2015, that was adopted in 2015.

The APA, is the Responsible Body responsible for: the overall coordination and updating of the National Emissions Inventory (INERPA); the inventory's approval, after consulting the Focal Points and the involved entities; and its submission to EC and international bodies to which Portugal is associated, in the several communication and information formats, thus ensuring compliance with the adopted requirements and directives.

APA´s Climate Change Department (DCLIMA) is the unit responsible for the general administration of the inventory and for all aspects related to its compilation, reporting and quality management.

The institutional arrangements are explained in more detail in the Portuguese 2022 National Inventory Report on Greenhouse Gases, 1990 – 2020, section 1.2 Institutional arrangements for inventory preparation.

C. Emission Trends

Overall greenhouse gas emission trends

i. Emissions trends by gases

The most representative greenhouse gas (GHG) is carbon dioxide (CO2) with about 72% of total national emissions, a situation that is related to the importance of the energy sector in Portugal and the predominance of emissions of this gas. as a result of burning fossil fuels. The second most important gas is CH4, followed by N2O, representing, respectively, 16% and 6% of total emissions in 2020. Methane (CH4) and nitrous oxide (N2O) originate mainly from the agriculture and waste sectors.

Portugal has chosen 1995 as the base year for fluorinated gases (F-Gases). In 2020, these gases represented about 6% of total GHG emissions. F-Gases originate mainly from stationary air conditioning and commercial refrigeration systems.
NF3 emissions are non-occurring in Portugal.

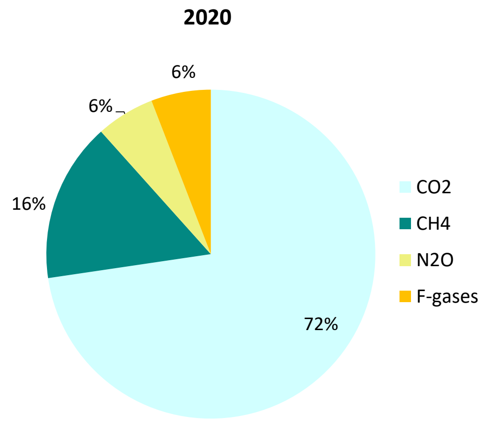

Figure II.c.i.1
Greenhouse Gas Emissions by Gas in 2020 (without LULUCF).

The variation of the three gases CO_2, CH_4 and N_2O between 2019 and 2020 registered a reduction.

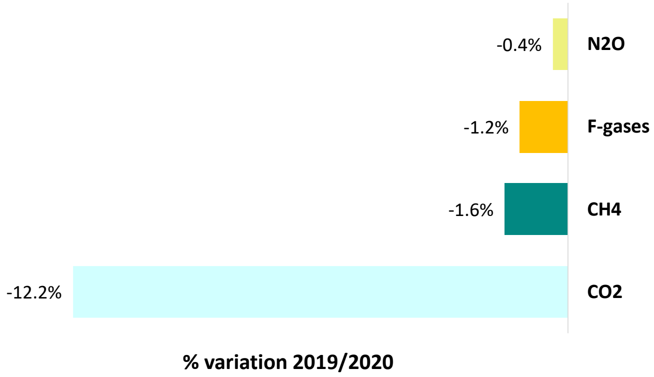

Figure II.c.i.2
Change of GHG emissions by gas between 2019-2020

ii. Emissions trends by main sources and sinks categories

In 2020, the energy sector represents about 67% of national emissions, with energy production and transport beeing the most important sources, representing respectively about 18% and 26% of total emissions.

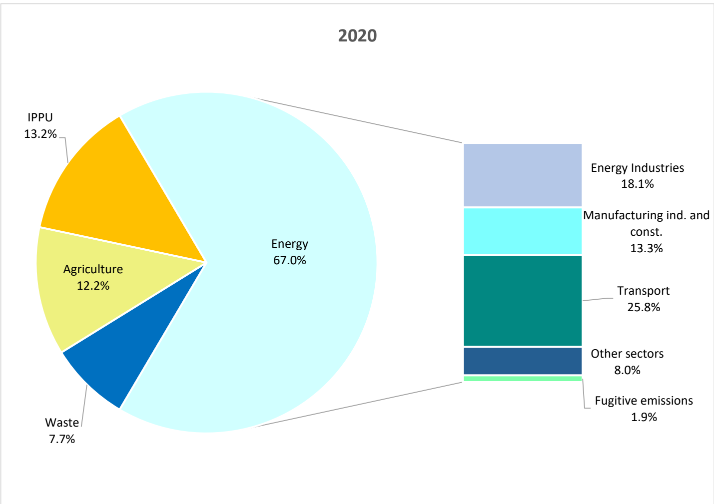

Figure II.c.ii.1
GHG emissions by sector in 2020 (LULUCF excluded)

In 2020, national emissions decreased by 9.5% compared to 2019. As figure below shows, with the exception of the agricultural sector, all sectors present negative variations in 2020 compared to 2019.

The sector that most influenced that downward trend is the energy sector, which globally presents a reduction in emissions of 13.2% compared to 2019. This variation is explained essentially by the decrease of emissions from energy production, which registered a drop of 20.2% of the emissions compared to the previous year and a reduction of 16.4% compared to 2019 in transport. The decrease of emissions in this sector is also associated with the reduction in the refining of fuels and the drop in fugitive emissions due to the lower consumption of liquid fuels, namely in road transport.

With the exception of emissions from electricity production, whose decrease in 2020 is the result of the combined effect of the greater proportion of renewables in energy produced in Portugal (approximately 52.5% in 2020) and a 55% reduction in the use of coal in thermal production compared to 2019, the decline of emissions in the energy sector is mostly related to the consequences of the COVID-19 pandemic outbreak on the activity of companies and individuals. The transport sector, with an emissions reduction of -16% in 2020 compared to 2019, is the sector that has registered the strongest effect of the measures to combat the COVID-19 pandemic.

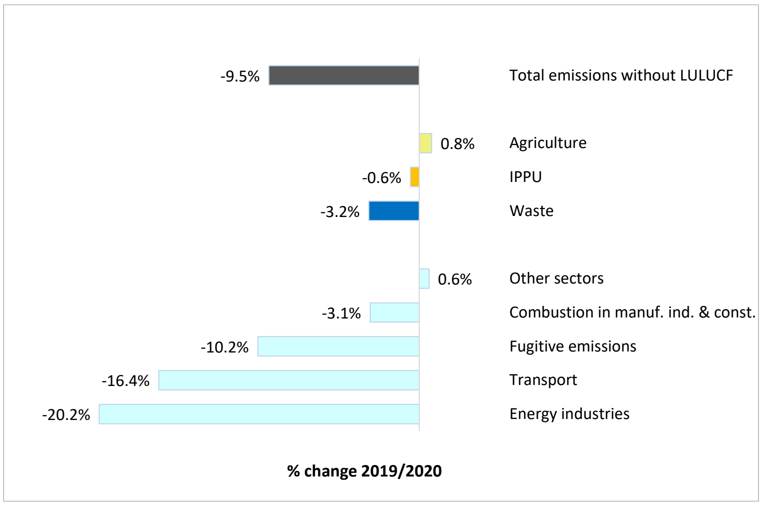

Figure II.c.ii.2
GHGs emissions percentage change (2019-2020) by IPCC category (LULUCF excluded)

Quantified economy-wide emission reduction target (III)

<u>The EU target under the Convention.</u>
Under the UNFCCC, the EU and its Member States committed to achieving a joint quantified economy-wide greenhouse gas emission reduction target of 20% below the 1990 level by 2020

("the Cancun pledge"). It is therefore a joint pledge with no separate targets for Member States under the Convention. The UK remains part of the joint EU 2020 target together with the 27 EU Member States.

The EU target compliance architecture.

The EU has jointly committed to its UNFCCC target and implemented it internally through EU legislation in the 2020 EU Climate and Energy Package. In this package, the EU introduced a clear approach to achieving the 20% reduction in total GHG emissions from 1990 levels, by dividing the effort between the sectors covered by the EU Emissions Trading System (EU ETS) and the sectors under the Effort Sharing Decision (ESD). Binding national targets were set for Member States under the Effort Sharing Decision. The achievement of EU internal compliance under the 2020 Climate and Energy Package including the national targets under the ESD is not subject to the UNFCCC assessment of the EU's joint commitment under the Convention.

CTF Tables 2 outline the assumptions and conditions applicable to the quantified economy-wide emission reduction target.

Within the scope of the European Sharing Decision (ESD), Portugal committed to limiting, between 2013 and 2020, the increase in GHG emissions from sectors not covered by the European Emissions Trading Scheme (non-ETS) to +1% in 2005. For this purpose, annual emission targets (Annual Emission Allocations - AEA) were established for each Member State, representing in practice annual emission ceilings for the period from 2013 to 2020.

Table III.1
Annual emissions allocations for Portugal under the ESD, 2013-2020

Ano	Research projects	2014	2015	2016	2017	2018	2019	2020
AEA (Mton CO2e)	49,3	49,6	49,9	50,1	47,9	48,3	48,7	49,1

In 2015, the main policy instruments in the areas of mitigation and adaptation to climate change were adopted at national level, respectively the National Program for Changes Climate Change (PNAC 2020/2030) and the National Strategy for Adaptation to Climate Change (ENAAC 2020).

The goals established for 2020 point to levels of reduction in national GHG emissions of -18% to -23% compared to 2005 levels (68-72 MtCO2e).

In 2016, following the ratification of the Paris Agreement, Portugal established the national objective to achieve carbon neutrality by 2050. The work under the 2050 Carbon Neutrality Roadmap outlined a trajectory of -45% to -55% GHG emissions reduction by 2030, -55% to -65% by 2040 and -85% to -90% by 2050 compared to 2005 levels.

The Portuguese Climate Law, which came into force on February 1, 2022, recognizes the climate emergency situation, confirms the commitment to achieve climate neutrality by 2050 and stipulates the study, by 2025, of the anticipation of this target to 2045. It also establishes national emission reduction targets, in line with previously established trajectories, stipulating a reduction of at least -55% by 2030; 65% to -75% by 2040; at least -90% by 2050; and a net CO2 eq sink of the LULUCF sector by at least 13 million tonnes between 2045 and 2050.

Progress towards the achievement of quantified economy-wide emission reduction targets and relevant information (IV)

Introduction

The EU has substantially overachieved its reduction target under the Convention, which means that also its Member States and the United Kingdom have fulfilled their emission reduction obligations. As stated in the 2022 EU GHG inventory submission to the UNFCCC, the total GHG emissions, excluding LULUCF and including international aviation, decreased by 34% in the EU-27 + UK compared to the base year 1990 or 1.94 billion tons of CO2e (carbon dioxide equivalent).

For Portugal, the emissions estimated for 2020 confirm the fulfillment of national targets under the European Effort Sharing Agreement to reduce emissions for the 2013-2020 period. Total emissions in 2020 registered a reduction of 33% compared to 2005 levels, also respecting the PNEC[88] target for 2020.

In PNEC 2030 sectoral targets for GHG reduction were established for non-ETS sectors in relation to 2005. The GHG emissions estimates for 2020 confirm a trajectory of compliance established for 2020 for all the sectors with the exception of Agriculture.

Table IV.1
Sectoral emissions in comparison to PNEC targets

Sectors	Emissions 2005 (Kt CO2 eq)	Emissions 2020 (Kt CO2 eq)	Variation 2020 / 2005	Targets 2020 PNAC	Targets 2030 PNEC
Transports	19,964	14,831	-26%	-14%	-40%
Services	3,038	969	-68%	-65%	-70%
Residential	2,766	2,215	-20%	-14%	-35%
Agriculture 1)	8,088	8,341	3%	-8%	-11%
Waste	6,463	4,421	-32%	-14%	-30%
National Total 2)	**85,971**	**57,654**	**-33%**	**-18% a -23%**	**-45% a -55%**

1) Agriculture: includes CRF 3 and combustion in agriculture/forest and fishing (1A4c).
2) National Total: excludes LULUCF.

Mitigation actions and their effects (V)

In 2010, the EU submitted a pledge to reduce its GHG emissions by 2020 by 20% compared to 1990 levels. Portugal as an EU Member State is a part of the EU 2020 emission reduction target.

Implementation of this target is ensured by EU legislation adopted under the "2020 climate and energy package" (2013-2020). The package introduced a clear approach to achieving the EU's

[88] PNEC replaces PNAC as the main policy instrument for climate mitigation policy, maintaining the 2020 economy-wide and sectoral targets adopted under the PNAC.

20% reduction of total GHG emissions from 1990 levels, which is equivalent to a 14% reduction compared to 2005 levels. This 14% reduction objective is divided between the EU emissions trading system (ETS) and Effort Sharing Decision (ESD) sectors. These two sub-targets are:

- a 21% reduction target compared to 2005 for emissions covered by the ETS (including outgoing flights);
- a 10% reduction target compared to 2005 for ESD sectors, shared between the 28 Member States (MS) through individual national GHG targets.

While the EU ETS target is to be achieved by the EU as a whole, the ESD target was divided into national targets to be achieved individually by each Member State. Under the Effort Sharing Decision, national emission targets for 2020 are set, expressed as percentage changes from 2005 levels. For Portugal this means a +1% target compared to 2005 levels.

Within the scope of the climate and Energy Package for 2020, this emission reduction target was coupled with the establishment of EU targets of 20% share of renewable energy in final energy consumption (Portugal's contribution to this amounts to a 31% share of renewables in its final energy consumption) and an increase in energy efficiency by 20% (the same objective applies to Portugal and to all other Member States).

A further target has been pledged under the Paris Agreement through the EU's Nationally Determined Contribution, and has been adopted by the EU under the 2030 Climate and Energy Framework (2021-2030). The emission reduction target was a pledge to reduce emissions by at least 40% (compared to 1990 levels) by 2030, enabling the EU to move towards a low-carbon economy and implement its commitments under the Paris Agreement. In order to achieve this target:

- ETS sectors will have to cut emissions by 43% (compared to 2005) by 2030;
- Effort Sharing sectors will need to cut emissions by 30% (compared to 2005) by 2030 – this has been translated into individual binding targets for Member States (for Portugal the target is a reduction of 17% compared to 2005 levels);
- Emissions and removals from the LULUCF sector are included for the first time in the EU climate target through the so-called LULUCF Regulation (2018/841). Each Member State will have to ensure that the LULUCF sector does not create debits ("no debit" rule).

Separate targets on renewable energy and energy efficiency had been set under the 2030 Climate and Energy Framework and updated. For renewable energy a binding target of at least 32% of final energy consumption by 2030 has been set (Portugal committed to a 47% share of renewables in its gross final energy consumption). With regards to energy efficiency it is a headline target of at least 32.5% of final energy efficiency, expressed in primary or final energy consumption (Portugal committed to a 35% reduction in primary energy consumption, as result of an increase in energy efficiency). A target of 15% of interconnection capacity for electricity interconnections, so as to ensure the full participation of all Member States in the integration of the internal energy market (Portugal committed to the same target). These targets are defined in the National Energy and Climate Plan (see below more information).

With the approval of the European Climate Law in 2021 the GEE emission reduction target was revised and a new target was set for 2030, a net reduction of GHG emissions of at least 55% (in relation to 1990 levels). The EU also pledged for carbon neutrality by 2050 in order to contribute to the Paris Agreement objectives and goals.

Since then the European Commission as presented a package, the Fit for 55%, to adapt the current legislations to this new objectives. The revision embraces not only the ESR, ETS and LULUCF framework, but also several other sectorial legislation like renewable energy, energy efficiency, energy performance in buildings, CO2 cars and vans standards, deployment of alternative fuels infrastructure, among others. The overall package is still under negotiation but there was already an agreement on the Effort-Sharing Regulation and the revised contribution expected from Portugal in 2030 will increase from -17% to -28,7% (compared to 2005).

In order to respond to these objectives and goals, Portugal has for many years now a range of strategic documents in the field of climate change mitigation.

The National Program for Climate Change (PNAC 2020/2030)[89], approved in 2015, established a set of sectoral targets and listed a set of policy options and measures to deliver an emission reduction of -18% to -23% by 2020 and of -30% to -40%, by 2030 compared to 2005.

In response to the commitment assumed by Portugal in 2016, to achieve net-zero emissions by the end of 2050, the Carbon Neutrality Roadmap 2050 (RNC 2050)[90] was adopted. It identifies the main decarbonisation vectors in all sectors (energy and industry, mobility and transport, waste and wastewater and agriculture and forests) and the path to reduce emissions of the all economy in order to achieve net zero in 2050, under different scenarios of socio-economic development.

RNC 2050 is the Portuguese Long-term Strategy and was submitted to the UNFCCC, in accordance with the Paris Agreement, on the 20th of September 2019, and to the European Commission, to comply with the EU Energy Union and Climate Action Governance Regulation. It is a forward-looking document of where to go, contributing to the definition of trajectories, not a policy and measures planning document.

Under the RNC 2050 Portugal revised its previous 2030 target (-30 to -40%) to -45% to -55% by 2030. Additionally, a trajectory up to 2050 was established comprising emission reductions of -65% to -75% by 2040, and from -85% to -90% by 2050 compared to 2005.

Aligned with the long-term strategy Portugal also developed an integrated National Energy and Climate Plan (NECP 2030), that is the main instrument of energy and climate policy for the 2021-2030 decade.. The final NECP was submitted to the European Commission in December 2019, in accordance with EU Energy Union and Climate Action Governance Regulation. All EU Member States NECPs, including Portugal's, are publicly available at https://energy.ec.europa.eu/topics/energy-strategy/national-energy-and-climate-plans-necps_en#final-necps

[89] Approved by the Resolution of the Council of Ministers No. 56/2015, of July 30th
[90] Approved by the Council of Ministers through the Resolution No. 107/2019 of July 1st

While maintaining the targets established under PNAC for 2020, the National Energy and Climate Plan (NECP 2030)[91], identifies the main priority areas of action for the next decade, seting ambitious targets for the 2030 horizon concerning the reduction of GHG emissions (45% to 55%, compared to 2005 – already driven by the RNC2050), the incorporation of renewable energies (47%), the energy efficiency (35%) and electricity interconnections (15%) and sets the policies and measures for an effective application of the vision and trajectories foreseen in the RNC2050. It also revises the sectorial targets set for 2030 in the PNAC 2020/2030 and revokes it with effect from January 1, 2021.

The Portuguese Climate Law, which came into force on February 1, 2022, recognizes the climate emergency situation, confirms the commitment to achieve climate neutrality by 2050 and stipulates the study, by 2025, of the anticipation of this target to 2045. It also establishes national emission reduction targets, in line with previously established trajectories, stipulating a reduction of at least -55% by 2030; 65% to -75% by 2040; at least -90% by 2050; and a net CO2 eq sink of the LULUCF sector by at least 13 million tonnes between 2045 and 2050.

The Autonomous Region of Azores, in 2011, approved the Regional Strategy for Climate Change (ERAC)[92] focused on both mitigation and adaptation issues. In order to operationalize the ERAC, the Azores Regional Government approved, in 2019, the Regional Programme for Climate Change (PRAC)[93]. The Autonomous Region of Azores is currently preparing the regional roadmap for carbon neutrality by 2050.

On what concerns mitigation issues, the PRAC establishes sectoral evolution scenarios for 2030 in order to carry out the exercise of projection of GHG emissions for scenarios developed for the following sectors of activity: energy, industry, mobility and transport, agriculture, forest and land uses, waste and wastewater, and identifies the policy and measures options to achieve the emissions' reduction target of up to about 340 ktCO2eq in 2030 considering the 2 established GHG emission projection scenarios (high projection and low projection). Based on the latest Regional Inventory of Greenhouse Gas Emission, this target corresponds to a 31% reduction of regional CO2e emissions (without LULUCF) between 1990 and 2030.

The Autonomous Region of Madeira, in 2015, approved the Regional Climate Change Adaptation Strategy (Estratégia CLIMA-Madeira), focused only in the adaptation issues. Also in 2015, the ARM joined the Under 2 Coalition, a sub-national internationl agreement towards climate action, focusing primarily in mitigation, but also in adaptation.

In summary:

Table V.1.1
Portugal's targets for 2020

Targets 2020	National Contributions for the Union Targets	Other National Targets
Reduction of CO2e emissions (without LULUCF) (Mt CO2e), compared to 2005	+1%	-18% a -23%

[91] Approved by the Resolution of the Council of Ministers No. 53/2020, of July 10th
[92] Resolution of the Government Council (RGC) nº123/2011, of October 19th
[93] Regional Legislative Decree nº30/2019/A, of November the 28th

Strengthen the share of Renewable Energy (% of gross final energy consumption)	+31%
Increase Energy Efficiency (% reduction in primary energy consumption)	+20% (-25%)

Table V.1.2
Portugal's targets for 2030

Targets 2030	National Contributions for the Union Targets	Other National Targets
Reduction of CO2e emissions (without LULUCF) (Mt CO2e), compared to 2005	-28,7%	-55%
Strengthen the share of Renewable Energy (% of gross final energy consumption)	47% (20% target on transport) (80% target on electricity prodution) (49% target on Heating and cooling)	
% reduction in primary energy consumption (Increase Energy Efficiency, excluding non-energetic uses) Energy Savings (article 7th of Directive EU 2018/2002)	35% 6,7 Mtep	
Electricity Interconnections	15%	

Table V.1.3
National sectoral targets (non-EU ETS)

Sectoral GHG Reduction Targets	2020	2030
Services	-65%	-70%
Residential	-14%	-35%
Transports	-14%	-40%
Agriculture	-8%	-11%
Waste and Wastewater	-14%	-30%

Following the approval of the Fit for 55% package, and also taking in consideration the energy crises derived from the war in Ukraine, that showed the need to speed up the energy transition and the deployment of endogenous renewable energy in order to reduce the EU dependence on Russian fossil-fuel products, Portugal started the revision of the national Carbon Neutrality Roadmap (2050) and the National Energy and Climate Plan (2030), work that is ongoing.

Governance for climate mitigation policy

As explained under the section GOVERNMENT STRUCTURE (2.1), the member of the government responsible for the climate mitigation policies is the Minister for Environment and Climate Action (MAAC). Currently, and since October 2018, energy issues are also within the remit of the same Ministry. Furthermore, the mission of the MAAC is to propose, manage, execute and evaluate policies in the areas of environment, urban, suburban and road passenger transport, mobility, climate, forestry, nature conservation, animal welfare, energy, geology and forests, in a development perspective sustainability and social and territorial cohesion, as well as planning in matters within its competence, including the shoreline and rural areas.

The APA remains under the MAAC, and it also retains the competence to propose, develop and monitor the implementation of environmental policies, notably in the fight against climate change, an area for which the MAAC is directly responsible.

In 2016, it was established that a single environmental fund should be created by aggregating resources from existing funds, so as to obtain an instrument with greater financial capacity and more adaptability to challenges. The Environmental Fund (FA) was therefore set with effect from 1st January 2017, thus terminating the FPC, the Environmental Action Fund, the Fund for the Protection of Water Resources and the Fund for the Conservation of Nature and Biodiversity.

As a consequence, the FA takes up all responsibilities inherent to the former funds, aiming to support environmental policies in order to achieve the sustainable development goals, thus helping to meet national and international objectives and commitments, including those related to climate change, water resources, waste and conservation of nature and biodiversity.

In order to address the emerging challenges associated with the commitment to achieving carbon neutrality by 2050, the FA was subject to an amendment to reinforce the role of this financial instrument in pursuing national and international objectives and commitments (such as the Paris Agreement) in several areas of his activity. The Environmental Fund is under the direct responsibility of the MAAC and its day-to-day management is performed by the Secretary General of the MAAC.

The political commitment placed on the transition to a competitive, resilient, low-carbon and circular economy, in a context of full integration with the economic growth objectives, led to the creation in 2015, of the Interministerial Commission on Air, Climate Change and the Circular Economy, in the meanwhile renamed Commission for Climate Action.

The Commission is chaired by member of the Government responsible for the environment and climate action and is integrated by the government departments of energy, spatial planning, finance, agriculture, sea, economy and innovation, transport, health, tourism, civil protection, regional development, local administration, foreign affairs and cooperation, education and science and by representatives of the regional governments of Azores and Madeira.

The Commission for Climate Action[94], provides policy guidance on climate change and air quality issues. It is also responsible for promoting the articulation and integration of climate change policies, sectorial policies and monitor the implementation of relevant sectorial measures, programs and relevant sectorial measures, programs and actions that may be adopted, especially through the national system for policies and measures and projections (SPeM), also created in 2015.

The National System for Policies and Measures and Projections (SPeM)[95], aims to foster the evaluation of progress in the implementation of sectoral policies and mitigation measures, enhancing the involvement and strengthening the accountability of sectors in the integration the climate dimension in sectorial policies, ensuring:

[94] Created by the Resolution of the Council of Ministers No 56/2015, of 30th July
[95] Council of Ministers Resolution n.º 45/2016, of 26th August

- The management of the process of identifying and designing policies and measures, or groups of policies and measures, to limit or reduce GHG emissions and other air pollutants by sources, or to intensify their removals by sinks, in compliance with national obligations;
- The monitoring and reporting of the implementation of policies and measures and their effects, as well as the reporting of projections in accordance with the European and international requirements and guidelines, and ensure its coherence with the national inventory of anthropogenic emissions by sources and removal by sinks of atmospheric pollutants (INERPA);
- The preparation of national projections of GHG emissions and other air pollutants by sources and their removals by sinks, as well as the expected effects of the policies and measures being implemented and to be implemented, in accordance with the European and international requirements and guidelines, in conjunction with INERPA;
- The assessment of compliance with national obligations, including sectoral targets under the climate and energy package of the European Union and the air quality targets, in the horizons of 2020, 2025 and 2030, as set out in the national strategic documents for climate change and air quality.

The Council of Ministers Resolution, which approved the SPeM includes the institutional, legal and procedural provisions applicable to the assessment of policies and the elaboration of projections of GHG emissions and aims to enhance the involvement and strengthen the accountability of sectors in the integration of the climate dimension into sectoral policies, hereby contributing to the preparation of reports of policies and measures and projections.

In this sense, several focal points have been designated, for the different sectors:

- Agency for Competitiveness and Innovation;
- Directorate General of Energy and Geology;
- Directorate General of Territory;
- Foundation for Science and Technology;
- Institute for Housing and Urban Rehabilitation;
- Institute for Nature Conservation and Forests;
- Institute of Mobility and Transport;
- Planning, Policy and General Administration Office;
- Portuguese Environment Agency (that also coordinates);
- Public Administration Shared Services Entity.

The APA is the entity responsible for coordinating the SPeM and ensuring its implementation in Portugal.

Following the approval of the National Energy and Climate Plan (NECP) for 2030 the existing National System is under revision to better integrate the energy dimension. This revision is justified by the need to include the monitoring of policies and measures and of projections that impact the energy transition in the existing national system (SPeM), which will allow the assessment of progress in the implementation of sectorial policies and mitigation measures.

We will take advantage of existing monitoring structures at national level, adapting them to this new reality which provides for a better integration of energy and climate policies. In order to monitor and report on the impacts of cross-sectoral policies and measures on climate change and energy transition, an e-platform will be developed, together with the sectors, by developing indicators and identifying their respective regulations, funding, taxes and others.

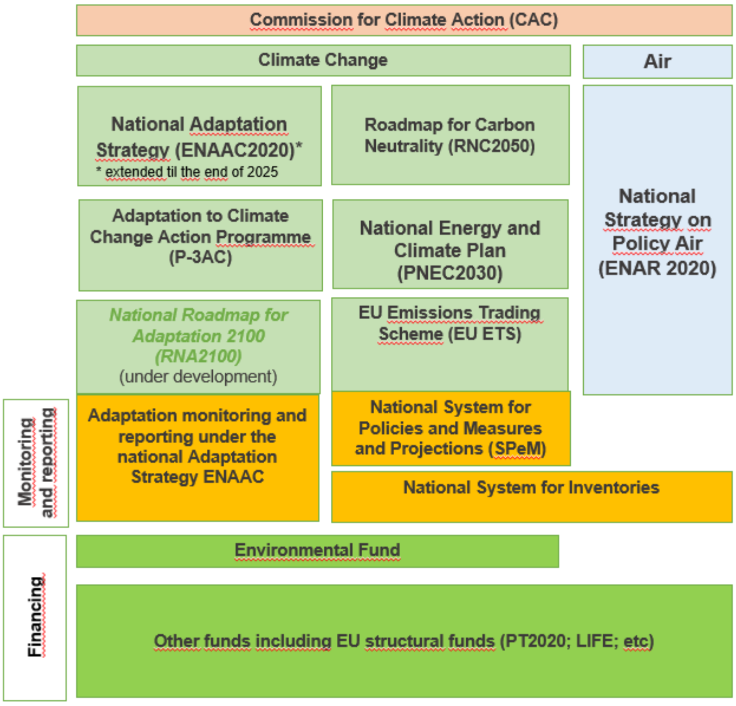

Figure V.1.1.
Portuguese Climate Change Policy Architecture

The most recent policies and measures and projections were prepared during the elaboration of the National Energy and Climate Plan (NECP 2030) and of the 2050 Carbon Neutrality Roadmap (RNC 2050).

The process of developing these energy and climate policy instruments for the next decade and for a carbon neutral future, was supported by a broad process of sectoral involvement and mobilization of the Portuguese society. This involvement occurred during the different stages of the process, from the construction of macroeconomic scenarios that served as a basis for the entire foresight and modelling exercise, allowing the collection of contributions from various institutions and national experts, and which gave rise to the three scenarios considered: working sessions dedicated to specific themes with the presence of experts from the most diverse areas, in the search for solutions to meet national goals and objectives; cycles of technical workshops and thematic events around the decarbonisation of society.

Following the above mentioned initiatives, a public consultation was carried out for both instruments, which had a high participation of the public sector, private sector, associations representing sectors of the economy and civil society and which contributions were in their majority incorporated in the respective final versions (both on policies and measures and projections).

As mentioned before the revision of the national Carbon Neutrality Roadmap (2050) and the National Energy and Climate Plan (2030), is ongoing, and the work with the different sectors will continue to be developed as well as the process of civil society consultation and involvement.

Autonomous Region of Azores
In the Autonomous Region of Azores, the Environmental and Climate Change Department of the Regional Government is responsible for coordenating and monitoring the implementation of climate change policies.

The Regional Programme for Climate Change (PRAC), with a 2030 horizon, is a sectoral land-use plan with potential environmental effects[96] and therefore was subjected to a Strategic Environmental Assessment[97] and a public consultation was carried out before its adoption. Also, the course of the work was monitored by a Working Group[98] and the relevant regional entities were involved in order to ensure the availability of information and the definition and implementation of successful mitigation and adaptation measures.

Autonomous Region of Madeira
In the Autonomous Region of Madeira, the Regional Secretariat of Environment, Natural Resources and Climate Change is the responsible for coordinating and monitoring the implementation of climate change policies.

The Regional Climate Change Adaptation Strategy (Estratégia CLIMA-Madeira), with a 2100 horizon, is a multi-sectorial plan with action and indicators, monitored by the Adaptation Community, a working group composed by several stakeholders (public bodies, municipalities, public companies, private companies, etc.).

Key policy measures
The road to a carbon neutral economy requires joint action from the various sectors, with special focus on energy, transport, industry, waste and waste waters, agriculture and forest. The NECP 2030, includes a range of policies and measures foreseen for these different sectors.

The main policy framework relevant for climate change over the last 10 years includes the following plans, strategies and programs:

- Carbon Neutrality Roadmap (RNC2050), Resolution of the Council of Ministers (RCM) 107/2019, of July 1st;
- Nacional Energy and Climate Plan (NECP2030), RCM 53/2020, of July 10th;
- National System for Policy and Measures (SPeM), RCM No. 45/2016, of August 26th;
- National Program Climate Change (PNAC 2020/2030), RCM No. 56/2015, of July 30th;
- National Investment Program 2030 (PNI 2030)[99];
- National Air Strategy (ENAR 2020), RCM 46/2016, August 26th;
- National Hydrogen Strategy (EN-H2), RCM 63/2020, of August 14th;
- Long Term Strategy for the Renovation of Buildings (ELPRE), RCM 8-A/2021, of February 3rd ;

[96] As provided for in the Regional Legislative Decree No. 35/2012/A, of August 16th
[97] in accordance with the provisions of Article 3 of the Regional Legislative Decree No. 30/2010/A, of November 15th
[98] Defined by the Resolution of the Council of Government No. 93/2014
[99] https://www.parlamento.pt/ActividadeParlamentar/Paginas/DetalheDiplomaAprovado.aspx?BID=21875

- National Renewable Energy Action Plan for 2013-2020 (PNAER), RCM 20/2013, of April 10th;[100]
- National Energy Efficiency Action Plan 2013 -2016 (PNAEE), RCM 20/2013, of April 10th[101];
- Energy Efficiency Program in Public Administration - ECO.AP, created by RCM 2/2011, of January 12th and revised for 2030 by RCM 104/2020, of November 24th;
- National Policy Framework for the deployment of alternative fuels infrastructure, RCM 88/2017, of June 26th;
- Circular Economy Action Plan (PAEC), RCM 190-A/2017, of December 11th;
- Sustainable Bioeconomy Action Plan, RCM 183/2021, of December 28th;
- National Program for Spatial Planning Policy (PNPOT), Law 99/2019, of September 5th;
- Strategic Plan for Urban Waste (PERSU 2020+), Ordinance 241-B/2019, of July 31st;
- National Strategy to Combat Food Waste (ENCDA), RCM 46/2018, of April 27th;
- National Waste Management Plan 2014-2020 (PNGR), RCM 11-C/2015, of March 16th;
- Strategic Plan for Water Supply and Wastewater Sanitation (PENSAAR 2020), Official Order 4385/2015, of April 30th;
- Rural Development Program 2014-2020 (RDP 2020), Commission Implementing Decision C (2014) 9896, of December 12th;
- National Strategy for Agricultural and Agro-Industrial Effluents (ENEAPAI 2030), RCM 6/2022, of January 25th;
- Transport and Infrastructure Strategic Plan (PETi3 +) for 2014-2020, RCM 61-A/2015, of August 20th;
- National Strategy for Active Cycling Mobility 2020-2030 (EMNAC) 2020-2030, RCM 131/2019, of August 2nd;
- Fare Reduction Support Programme (PART), Order 1234-A/2019, of February 4th;
- Programme to Support the Densification and Strengthening of the Public Transport Offer (PROTransP), Order 5545-B/2020, of May 15th;
- Sustainable Mobility Program for the Public Administration 2015-2020 - ECO.mob, RCM 54/2015, July 28th;
- National Strategy for Green Public Procurement 2020 (ENCPE 2020), RCM 38/2016, July 29th;
- Strategy Portugal 2030, RCM 98/2020, of November 13rd;
- Recovery and Resilience Plan of Portugal – EU Council Implementing Decision 10149/21, of 6th of July and respective Annex 10149/21, of 5th July.
- POSEUR - Commission Implementing Decision C(2014) 10110, of 16th December, amended by Commission Implementing Decision C(2020) 6256, of 9th of September
- Guidelines to accelerate Sustainable Finance in Portugal, Working Group for Sustainable Finance in Portugal, 8th of June 2019
- Azores Regional Programme for Climate Change (PRAC), Regional Legislative Decree 30/2019/A, of November 28th.
- Climate Change Adaptation Strategy of Madeira Autonomous Region (Estratégia CLIMA-Madeira), Resolution of the Government Council n.º 1062/2015, 26 november;
- Madeira Circular Economy Agenda, Resolution n.º 144/2021, de 4 de março, publicada no JORAM, I Série, n.º 41, de 5 de março

[100] Replaced by the Nacional Energy and Climate Plan (NECP2030), RCM 53/2020, of July 10th.
[101] Replaced by the Nacional Energy and Climate Plan (NECP2030), RCM 53/2020, of July 10th

- Regional Waste Strategy, Resolução n.º 80/2021, de 4 de fevereiro, publicada no JORAM, I Série, n.º 24, de 5 de fevereiro, retificada pela Declaração de Retificação n.º 7/2021, publicada no JORAM, I Série, n.º 26, de 10 de fevereiro
- Regional Flood Risk Management Plan (Plano de Gestão de Riscos de Inundações da Região Autónoma da Madeira) 2016-2021, Resolução de Conselho de Governo n.º 805/2017, publicado no JORAM, 1.ª Série, n.º 187, de 27 de outubro.
- Regional Hydrographic Management Plan 2016-2021 (Plano de Gestão da Região Hidrográfica do Arquipélago da Madeira) Resolução de Conselho de Governo n.º 945/2016, publicado no JORAM, 1.ª Série, n.º 221, de 16 de dezembro.
- Regional Civil Protection and Emergency Plan (Plano Regional de Emergência de Proteção Civil da Região Autónoma da Madeira), Resolução de Conselho de Governo n.º 60/2022, publicado no JORAM, 1.ª Série, n.º 20, de 7 de Fevereiro.

The 30 main current and planned policies and measures to accomplish an economy-wide emissions reduction target are identified in CTF Table 3 and are further developed in the 8th National Communication and are mainly related with the phase-out of fossil fuels, the promotion of renewables and energy and water efficiency, expansion of public transport systems and electro mobility, decarbonizing industry, changes in agriculture practices, reduction of landfill and promotion of recycling and improving natural sink potential of agriculture and forests. Cross-cutting fiscal measures are also very relevant, namely the green tax reform and the carbon tax applicable for non EU ETS sectors.

All the mitigation actions which were reported in 7NC/3BR are included in the 4BR and in this 8NC/5BR. They were only renamed or regrouped so as to be more in line with our NECP or other plans. New mitigation actions were also included as they have been developed to respond to the ambition increase of the national targets, such as, for example, the promotion of new energy storage solutions like batteries and hydrogen, promotion of renewable gases, to cease electricity production based on coal by 2021 and 2023, to promote industry decarbonisation through eco-innovation and cleaner production processes and to promote industry digitization, etc.

Estimates of emission reductions and removals and the use of units from the market-based mechanisms and land use change and forestry activities (V.2)

Quantified progress to 2020 targets (V.2.a)

The evolution of national GHG emissions (figure V.2.a.1) largely reflects the evolution of the Portuguese economy, which was characterized by strong growth associated with increased demand for energy and mobility in the 1990s. Since 2005 emissions have been on a decreasing trend as a result of technological improvements in pollution control and energy efficiency systems in industry (including the EU-ETS), transport and buildings; the introduction of lower GHG emitting fuels, especially natural gas for electricity production and for use in buildings from the late 1990s onwards; the significant growth in energy from renewable energy sources (particularly wind energy since 2005); the implementation of waste management measures aimed at increasing selective disposal, reuse and recycling.

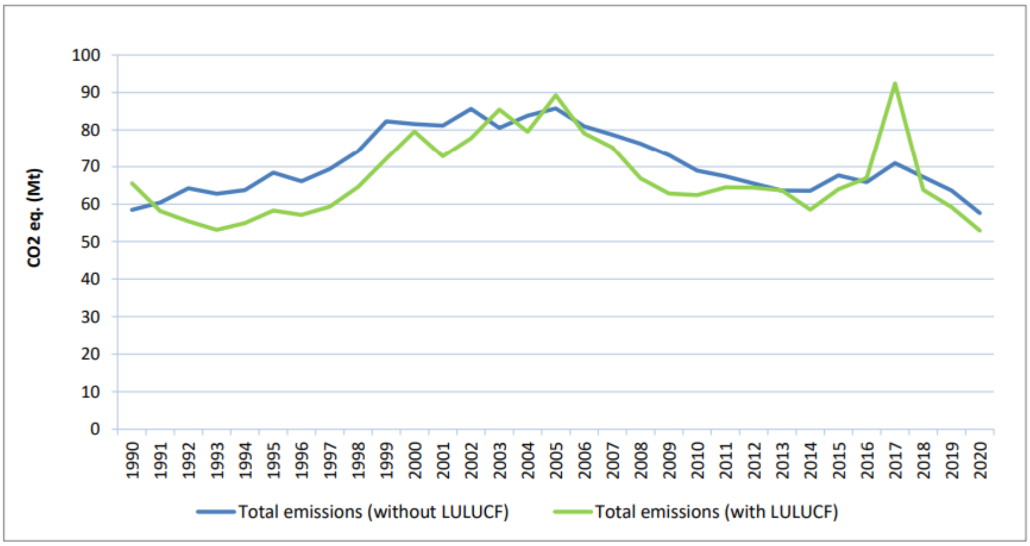

Figure IV.2.a.1 – GHG emissions

In 2020, total Portuguese GHG emissions, including indirect CO2, without land-use, land-use change and forestry (LULUCF) were estimated at about 57.6 Mt CO2e, representing a decrease of 1.5% compared to 1990 levels and a decrease of 9.5% compared to the previous year (2019).

When considering the LULUCF sector, emissions in 2020 totalled 52.9 Mt CO2e, corresponding to a 19.3 % decrease in relation to 1990 and a variation of -10.6% from 2019 to 2020.

In 2020, GDP registered a strong decrease of 8.4% compared to 2019 due to the shutdown measures to contain the COVID-19 pandemic which have plunged the national economy into recession.

In Portugal the emissions estimated for 2020 confirm the fulfillment of national targets under the European Effort Sharing Agreement to reduce emissions for the 2013-2020 period, as presented in the figure below. Total emissions in 2020 registered a reduction of 33% compared to 2005 levels, also respecting the PNEC[102] target for 2020.

[102] PNEC replaces PNAC as the main policy instrument for climate mitigation policy, maintaining the 2020 economy-wide and sectoral targets adopted under the PNAC.

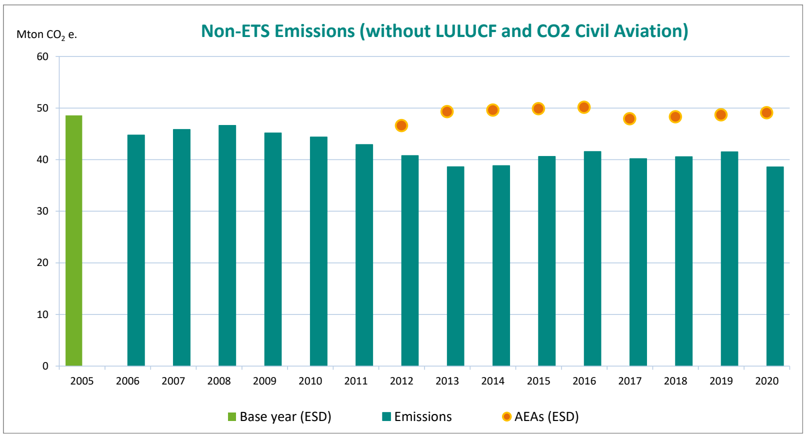

Figure IV.1
Non-ETS Emissions in relation to the ESD targets

Within the scope of the European Sharing Decision (ESD), Portugal committed to limiting, between 2013 and 2020, the increase in GHG emissions from sectors not covered by the European Emissions Trading Scheme (non-ETS) to +1% in 2005. For this purpose, annual emission targets (Annual Emission Allocations - AEA) were established for each Member State, representing in practice annual emission ceilings for the period from 2013 to 2020.

Table III.1
Annual emissions allocations for Portugal under the ESD, 2013-2020

Ano	Research projects	2014	2015	2016	2017	2018	2019	2020
AEA (Mton CO2e)	49,3	49,6	49,9	50,1	47,9	48,3	48,7	49,1

The EU has substantially overachieved its reduction target under the Convention, which means that also its Member States and the United Kingdom have fulfilled their emission reduction obligations. As stated in the 2022 EU GHG inventory submission to the UNFCCC, the total GHG emissions, excluding LULUCF and including international aviation, decreased by 34% in the EU-27 + UK compared to the base year 1990 or 1.94 billion tons of CO2e (carbon dioxide equivalent).

CTF Table 4 includes total emissions without LULUCF from 2010 to 2020 as the contribution of Portugal for the achievement of the EU and its Member States reduction target under the Convention.

No international credits (certified emission reductions (CERs) and emission reduction units (ERUs) are included or used up to this point in time for achieving the targets nor is it expected to be used by the end of 2020. CTF Tables 4(a) and 4(b) are not applicable for the purpose of the EU's and its Member States 2020 target achievement.

Assessment of the economic and social consequences of response measures (V.3)

Portugal's contribution to the minimization of the adverse effects of climate change in other Parties, particularly developing countries, is carried out first of all through a strong commitment to implementing the Convention and the Kyoto Protocol.

By working on the implementation of the Protocol, Portugal is struggling to minimize not only the adverse effects of climate change in specific sectors, industries or other Parties, but also any adverse effects due to the reduction of greenhouse gases. This is due to the development of different actions and implementation of different instruments conceived to promote sustainable development and the commitment to support developing countries.

The policies and measures implemented, adopted or foreseen previously under the National Plan for Climate Change (PNAC), and currenty under the PNEC, targeting the six GHG of the Kyoto Protocol through its broad portfolio of instruments and wide-ranging coverage of all sectors of the economy, make up a significant effort by the Portuguese Government to address climate change, including the minimization of adverse effects of such policies.

The transition to a carbon neutral economy by 2050 relies on the contribution of all sectors. Particularly, in the context of the 2050 Carbon Neutrality Roadmap and the NECP 2030, there is a strong push for the diversification of energy sources and to the increase of endogenous renewable resources. In some cases, measures already implemented pertaining to the diversification of primary energy sources (namely the introduction of natural gas in the economy in the late 1990s), can simultaneously have positive effects on Portugal's emissions reduction and in the economy of some fossil fuel exporting countries.

To ensure that all relevant possible impacts are taken into account, Portugal has established the System for Policies and Measures (SPeM) to assess the economic and social consequences of climate policy measures throughout the different sectors. For the development of new policy initiatives, the members of SPeM (from all the economy sectors) are called to present their policies and measures with the potential of GHG emissions reduction and respective foreseen costs.

Furthermore, Portugal is keen in assisting third countries on a sectoral level, such as for trade agreements, as well as on an overarching political level in regional cooperation with those countries. The action of the Portuguese cooperation is developed on the basis of geographical priorities which are centred in the countries Língua Oficial Portuguesa (PALOP) and East Timor. All these countries are within the group of more vulnerable countries to the variations caused by climate changed either, because they are situated in its majority in Africa, or belong to the set of least developed countries and/or are small insular States. This way, it is ensured that the effects of climate change policies on non-EU countries are taken into account.

The cooperation of Portugal with third countries looks to the integration of the adaptation dimension of climatic assessment of the economic and social consequences of response measures to climate change.

Portugal’s Official Development Assistance (ODA) also supports third countries to effectively implement the Paris Agreement in a manner that unlocks socio-economic opportunities and supports climate objectives, by providing capacity building and technology transfer for partner countries.

At a multilateral level, Portugal supports the implementation of adaptation measures in the most vulnerable countries, in particular within the Community of Portuguese Speaking Countries/

Comunidade dos Países de Língua Portuguesa (CPLP) and has made contributions to the Green Climate Fund.

At a bilateral level, Portugal supports projects in in particular within the Community of Portuguese Speaking Countries/ Comunidade dos Países de Língua Portuguesa (CPLP) and promotes the sectoral integration of the adaptation component in the Cooperation Programs, in particular in the scope of higher education and research in the field of Environmental Engineering, Agriculture and Rural Development, and Health.

Projections (VI)

As mentioned in the 4th Biennial Report, the projections on GHG emissions were prepared during the elaboration of the National Energy and Climate Plan 2030 (PNEC2030) and the Carbon Neutrality Roadmap 2050 (RNC2050), as shown in the figure VI.1.1.

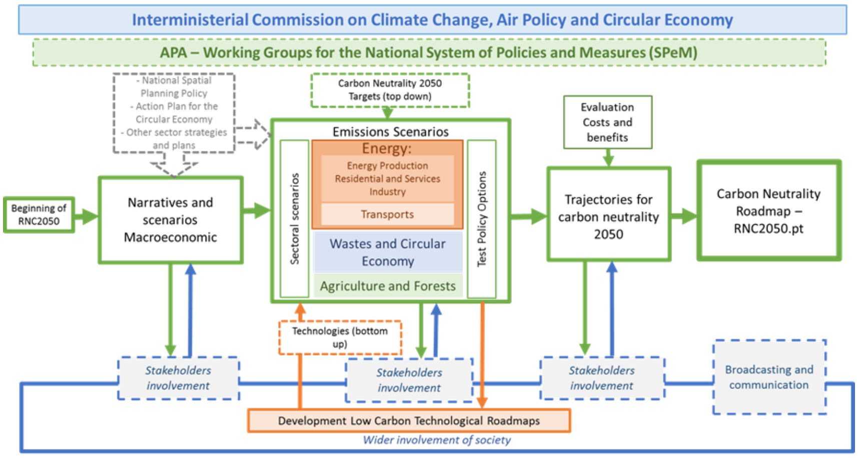

Figure VI.1.1
Workflow of the Carbon Neutrality Roadmap 2050

This modelling exercise, with the 2050 horizon, aimed to identify cost-effective trajectories and the main decarbonisation drivers consistent with the carbon neutrality objective and this are still the most up to date emissions projections available.

General Information (VI.1)

The Roadmap work had as its starting point for the development of greenhouse gas emission trajectories, the development of coherent socioeconomic scenarios, based on common narratives of possible evolutions of the Portuguese society until 2050, based on the evolution of macroeconomic parameters and demographic trends (which are shown in table 5 of the CTF Tables).

The proposed scenarios were subject to an external consultation and validation process, in particular with entities with responsibilities in the field of economic forecasting in Portugal (such as Portugal Central Bank, GPEARI – Finance Ministry Office of Planning, Strategy, Evaluation and International Relations; INE – Portuguese National Statistics Institute; GEE – Economy Ministry Office for Strategy and Studies; Foresight and Planning Department of the Environment Ministry, among others).

The narratives and their macroeconomic and demographic variables developed allowed, in the later modelling phase, to establish and characterize evolution scenarios for the different activity sectors - energy and industry, transport and mobility, agriculture, forests, and waste and wastewater, namely by the estimation and characterization of demand for energy and services. In this context tree scenarios were developed:

- a scenario that retains the essentials of the economic structure and current trends as well as decarbonisation policies already adopted or in force, but does not include the adoption of additional policies, called the Off-track Scenario (FP);
- two scenarios of socioeconomic evolution compatible with carbon neutrality, however achieved in different contexts, called Platoon Scenario (PL) and Yellow Jersey Scenario (CA).

The Platoon scenario is characterized by the development and application of new technologies that, however, do not significantly change either the production structures or the population's lifestyles. It foresees a modest incorporation of circular economy models and the maintenance of population concentration in the Metropolitan Areas, while the Yellow Jersey Scenario is characterised by a structural and transverse change in production chains, made possible by the combination of a series of technologies of the 4th Industrial Revolution. It foresees a more effective incorporation of circular economy models and greater growth of the importance of medium-sized cities. In the Platoon and Yellow Jersey scenarios, two variants were also considered, one in which the economy evolves without imposing a GHG emission reduction target (called "without neutrality") and a variant in which the economy evolves with the imposition of a GHG emissions reduction target (called "with neutrality").

Thus, for the purposes of this projection report and to fill in Table 5 of the CTF tables regarding the parameters used for the projections, the macroeconomic scenario associated with the Platoon (PL) scenario was considered (scenario "without neutrality" – corresponding to a WEM scenario and scenario "with neutrality" – corresponding to a WAM scenario), which translates into a more conservative evolution of GDP, the structure of the economy and the population over the period 2020-2050 (compared to the CA scenario).

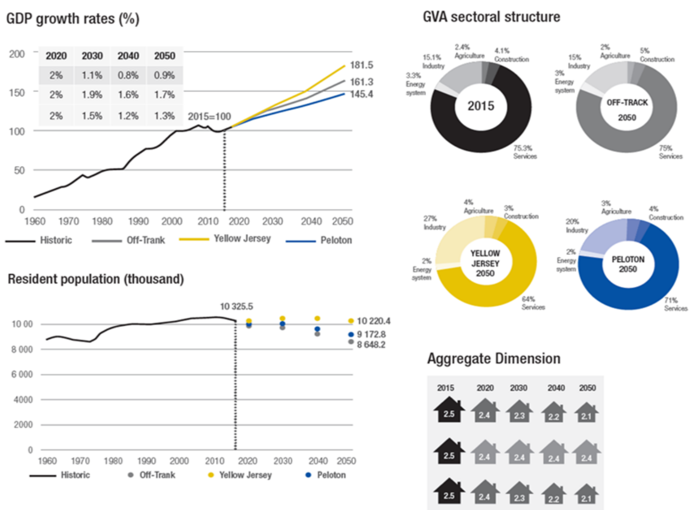

Figure VI.1.2

The development of the national projections also took into consideration the policies and measures adopted at Union level, namely, the Renewable Energy Directive (Directive 2009/28/EC and Directive (EU) 2018/2001), the Energy Efficiency Directive (Directive 2012/27/EU), EU ETS Directive 2003/87/EC as amended by Directive 2008/101/EC, Effort Sharing Regulation, among others.

More details about the different scenarios, assumptions, sectorial drivers and results can be found in the Carbon Neutrality Roadmap 2050, available at: https://unfccc.int/process/the-paris-agreement/long-term-strategies.

In complement to that reference, socioeconomic details and assumption of the different scenarios can also be found in a specific report that perspectives the country's evolution until 2050, available at: https://descarbonizar2050.pt/uploads/181220_Cenarios_RNC2050.pdf (Portuguese version only).

Main results

The results of this exercise allowed a review of the potential for national emission reductions, confirming the technical and economic feasibility of pursuing a low carbon pathway to achieve carbon neutrality by 2050.

The sectorial analysis of emissions trajectories confirms that all sectors have significant GHG emission reduction potential in the different analysed scenarios, although the rates of reduction are different.

It is also noted that, for the purposes of the projections presented in the existing policies scenario, account was taken of the policy instruments and measures approved and published by 31st of December 2017, as well as some commitments made by Portugal, such as the end of the production of electricity from coal.

The difference between WAM and WEM scenarios for a given year can be taken as an estimate of the emission reductions from additional measures necessary. For 2030 the most significant policies and measures are already identified in the NECP 2030.

The table 5.2.2.1 is a summary of the results obtained in terms of sectoral GHG emissions over the 2030, 2040 and 2050 horizon, under existing and additional policy scenarios and more detaild information can be found in table VI.1.1 and tables 6a and 6c of the CTF.

Table VI.1.1

GHG emission projections by sector and gas (kt CO2eq)

				GHG emission projections					
	Historical GHG emissions and removals			Scenario With Existing Measures			Scenario With Additional Measures		
(kt CO2 eq)	1990	2005	2020	2030	2040	2050	2030	2040	2050
Sector									
Energy	29841.59	44019.31	23701.62	15563,91	13257,77	12484,68	13460,72	7135,18	3844,20
Transport	10819.55	19963.89	14,830.56	11699,11	7882,60	5512,48	10611,10	3190,94	473,35

Industry/industrial processes	6442.43	8592.91	7579.64	5157,46	4416,09	4169,95	5157,46	4416,09	3307,17
Agriculture	7142.02	6721.13	6990.07	6566,02	6647,62	6728,19	6394,81	6313,05	6177,13
Forestry/LULUCF	7126.76	3502.96	-4646.50	-8082,46	-9310,19	-10617,39	-9248,86	-10541,39	-11913,39
Waste management/waste	4554.28	6463.14	4420.62	3316,65	2358,34	1746,15	3316,65	2358,34	1746,15
Gases									
CO_2 emissions including net CO_2 from LULUCF	51030.46	71494.04	36387.58	20144,35	12873,29	8622,42	15834,05	1017,25	-6915,36
CO_2 emissions excluding net CO_2 from LULUCF	45325.29	69717.99	41799.89	30442,78	24282,07	21135,43	27298,87	13657,23	6893,65
CH_4 emissions including CH_4 from LULUCF	10315.96	11859.04	9140.30	8104,82	7069,26	6429,78	7961,55	6777,97	5945,15
CH_4 emissions excluding CH_4 from LULUCF	9585.89	11089.49	9035.50	7977,59	6948,77	6320,93	7834,32	6657,48	5836,31
N_2O emissions including N_2O from LULUCF	4580.20	4826.04	3967.65	5103,14	4793,71	4459,63	5027,90	4561,01	4092,58
N_2O emissions excluding N_2O from LULUCF	3888.69	3868.68	3306.64	3014,42	2815,61	2672,86	2 939,18	2582,92	2305,81
HFCs (1)	NO,NA	1054.29	3333.82	703,11	353,60	352,76	703,11	353,60	352,76
PFCs (2.)	NO,NA	3.31	23.78	15,29	15,29	15,29	15,29	15,29	15,29
SF_6 (3)	NO,NA	NO,NE	NO,NE	149,97	147,07	144,18	149,97	147,07	144,18
NF_3 (4)	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
Total with LULUCF (with indirect)	66012.75	89474.25	53007.95	34 220,69	25252,22	20024,05	29 691,88	12872,20	3634,60
Total without LULUCF (with indirect)	58885.99	85971.29	57654.45	42 303,15	34562,42	30641,44	38 940,74	23413,60	15548,00
Total ETS sectors	NA	37,195.93	18,733.39	12 795,20	10301,10	9363,33	11 135,10	7160,70	3962,25
Total non-ETS sectors	66012.75	48,775.36	38,921.06	29 309,20	24089,30	21127,54	27 606,80	16193,10	11529,32

(1) For base year and 1990: should read NO, NE, NA.
(2) For base year, 1990 and 1995: should read NO, NE, NA.
(3) For base year and 1990: should read NO, NE, NA.
(4) For all time series:should read NO and NA.

With Existing Measures scenario (WEM)

Even in an existing policy scenario, it is already foreseen a sharp reduction in GHG emissions in the coming decades and there is a cost-effective potential for Portugal to achieve total emission reductions of around 51% in 2030 compared to 2005, up to 60% by 2040 and around 64% by 2050 (without LULUCF).

In 2030 this reduction is largely due to the decommissioning of coal-fired power stations and the commitment to strengthening the role of renewable energies in the national energy mix, with boost to solar energy, with the electricity generation sector representing in 2030 a potential GHG emission reduction of about 93% compared to 2005 (and about 97% reduction in 2040).

In the transport and mobility sector, profound changes are foreseen, with large penetration of the electric vehicle, which leads to an emission reduction of about 41% in 2030 compared to 2005, and about 60% in 2040.

The waste sector also have a strong potential to reduce GHG emissions, contributing with reductions of 49% in 2030 and around 64% in 2040, as a result of the increase energy efficiency and the necessary compliance with the Landfill Directive which restricts disposal to only 10% by 2035. Thus, the existing policy scenario already presupposes the achievement of the target set in the Landfill Directive. The projections of this sector are identical in both the existing policy scenario and the additional policy scenario.

The agricultural sector have a lower decarbonisation potential over this time horizon. The figures are around 3% reduction in 2030 and aroud 2% in 2040.

In terms of F-gases, whose relevance in terms of emissions has been increasing in recent years. As with the waste sector, in the F-gases sector, it is assumed that the targets set in the Kigali Amendment are met, and the projections of this sector are identical both in the existing policy scenario and in the additional policy scenario.

However, for most sectors there is a need to consider a set of additional policy measures in order to pursue a more ambitious low carbon path and achieve carbon neutrality by 2050.

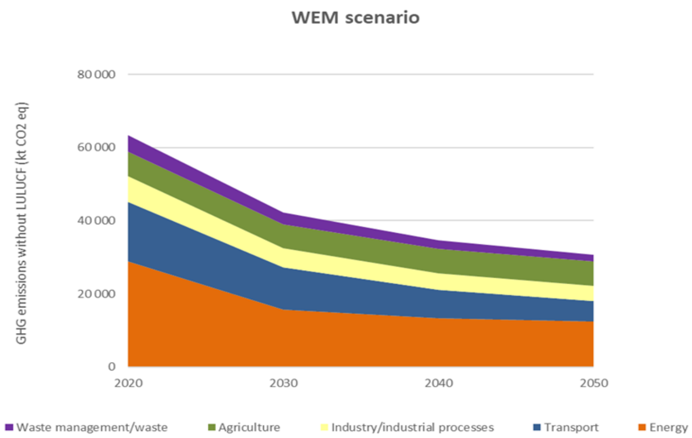

Figure VI.1.3
Sectorial projections with existing measures scenario (kt CO_{2eq})

<u>With Additional Measures scenario (WAM)</u>
With regards to the additional policy scenario (or neutrality scenario), unlike the previous one, emission restrictions consistent with carbon neutrality were imposed in 2050. This scenario thus allows to assess the additional effort required for each sector so that overall achieve neutrality, not accurately translating a typical scenario of policy impact assessment and planned measures.

There is still a cost-effective potential to reduce GHG emissions more sharply compared to the existing policy scenario, around 55% compared to 2005, rising to 73% by 2040 and around 82% by 2050 (without LULUCF), decarbonizing almost entirely electricity production, and strongly reducing emissions from mobility and transport and buildings, over the next decades.

Thus, the electricity generation sector in an additional policy scenario has in 2030 a GHG emission reduction potential of around 95% compared to 2005, the transport sector by 46% and the building sector by 48%, rising to 98%, 84% and 82% respectively by 2040.

As for the industrial processes sector, reductions of around 39% in 2030 to 48% in 2040 are expected, due to the expected improvements in process efficiency and the use of less polluting fuels, with the incorporation of more Fuels Derived from Waste/ RDF (refused derived fuel), biomass and electrification of some subsectors.

The agricultural sector, in this scenario of additional policies could contribute to emission reductions of about 6% in 2030 to 7% in 2040.

Within the waste and F-gas sectors, and given the assumption, respectively, of meeting the targets set in the Landfill Directive and the Kigali Amendment, the evolution is similar to the scenario with existing policies.

In this context, it is still necessary to reinforce the role of forest sink and other land uses, and effective agroforestry management is a determining factor in achieving the goal of neutrality in 2050.

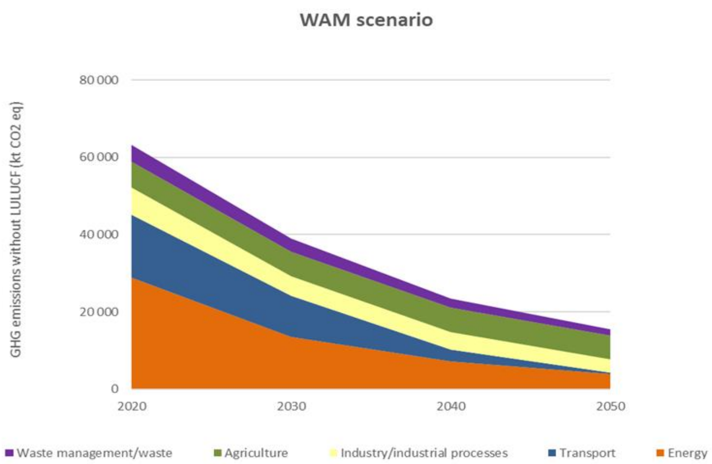

Figure VI.1.4
Sectorial projections with additional measures scenario (kt CO_{2eq})

Table VI.1.2
Potential for GHG emission reductions compared to 2005 (%)

	Potential for GHG emission reductions compared to 2005 (%)					
	Scenario With Existing Measures			Scenario With Additional Measures		
Sector	2030	2040	2050	2030	2040	2050
Energy	-65%	-70%	-72%	-70%	-84%	-91%
Transport	-41%	-60%	-72%	-46%	-84%	-98%
Industry/industrial processes	-39%	-48%	-50%	-39%	-48%	-61%
Agriculture	-3%	-2%	-1%	-6%	-7%	-9%
Waste management/waste	-49%	-64%	-73%	-49%	-64%	-73%
Total without LULUCF	-51%	-60%	-64%	-55%	-73%	-82%

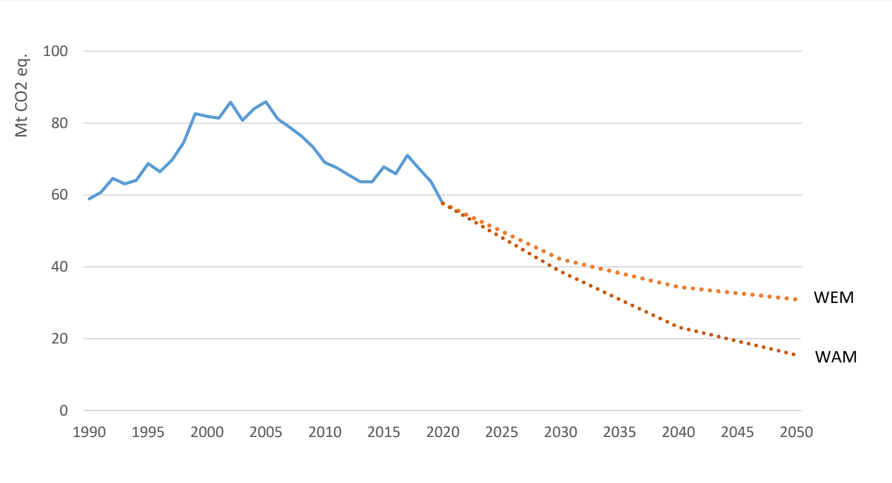

Figure VI.1.5
Total GHG emissions trajectories (kt CO_{2eq})

This scenario of neutrality served to inform the new greenhouse gas emission reduction targets set for the 2030, 2040 and 2050 horizon, from -45% to -55% by 2030, -65% to -75% by 2040, and from -85% to -90% by 2050 compared to 2005, as mentioned above.

The results also indicate that a trajectory that achieves emission reductions of -85% to -90% in 2050 compared to 2005 levels, will induce significant effects on renewables and energy efficiency, very significant final consumption of final energy consumption reaching 85-90% by 2050, in particular in electricity generation and transport which could reach full electrification by 2050 (road and rail) and a significant increase in economy efficiency.

<u>Other atmospheric pollutants</u>
In the scope of the RNC2050 exercice, projections of other atmospheric pollutants were also performed. They are based on the projection of activity variables that are associated with their origin. These, in turn, result from scenarios of demand for energy and materials services. For the purpose of these projections, the macroeconomic scenario associated with the Platoon Scenario "with neutrality" – corresponding to a WAM scenario in Climate Policy - was selected as the scenario With Existing Measures (WEM) in the context of the new NEC Directive, since it was assumed that the respective measures will be implemented under Climate framework. So the scenario WAM for Air Pollution Policy will be considered and adopted under the NAPCP (National Air Pollution Control Programme) for further reductions taking into account the national emission reduction commitments applicable from 2020 to 2029 and from 2030 onwards. The Table VI.1.2 is a summary of the main results obtained.

Table VI.1.2
Atmospheric emissions (kt), projections and percentage reductions compared to 2005 by sector

Pollutant	Sector	Historical			Projection				
		2005	2010	2015	2020	2030	2040	2050	Δ2030-2005(%)
NOx (as NO2)	Energy	60	18	15	14	7	3	1	-89%
	Industry	46	41	38	32	29	26	26	-38%
	Buildings	45	30	26	18	18	15	12	-60%
	Transport	103	90	69	67	27	9	6	-73%
	Agriculture	6	6	6	3	3	3	3	-49%
	Waste	0	0	0	0	0	0	0	-70%

Pollutant	Sector	Historical			Projection				
		2005	2010	2015	2020	2030	2040	2050	Δ2030-2005(%)
	TOTAL	260	184	154	134	84	56	48	-68%
VOC	Energy	12	11	11	11	9	3	1	-24%
	Industry	114	102	104	100	95	93	96	-16%
	Buildings	19	15	16	14	9	8	2	-51%
	Transport	37	24	16	15	8	1	0	-78%
	Agriculture	2	3	3	13	13	13	13	447%
	Waste	3	2	2	2	2	1	1	-43%
	TOTAL	187	157	152	156	136	119	114	-27%
SOx (as SO2)	Energy	124	16	8	7	6	2	1	-95%
	Industry	45	31	22	19	18	20	20	-60%
	Buildings	6	4	3	1	1	1	1	-83%
	Transport	2	1	1	1	2	1	1	-30%
	Agriculture	0	0	0	0	0	0	0	31%
	Waste	0	0	0	0	0	0	0	-65%
	TOTAL	176	51	35	29	26	24	23	-85%
NH_3	Energy	0	1	1	1	1	1	0	156%
	Industry	9	7	6	5	6	7	7	-33%
	Buildings	3	2	2	2	3	0	0	1%
	Transport	2	1	1	1	1	0	0	-69%
	Agriculture	42	39	39	37	36	36	36	-14%
	Waste	2	2	1	1	1	1	1	-36%
	TOTAL	57	51	50	48	47	44	43	-17%
$PM_{2,5}$	Energy	2	1	1	1	1	0	0	-66%
	Industry	31	25	22	22	23	24	25	-25%
	Buildings	19	16	17	15	10	8	1	-47%
	Transport	8	7	5	5	3	2	2	-61%
	Agriculture	1	2	2	1	1	1	1	1%
	Waste	1	0	0	0	0	0	0	-38%
	TOTAL	61	50	47	44	38	36	29	-37%

Covid Impacts

In the scope of the projections presented in this report the impact of the COVID-19 pandemic was not considered.

To analyse the impact of the COVID-19 pandemic on national GHG emissions, a follow-up of emissions from the energy sector is being carried out on a monthly based since March 2020, based on the information provided in the Rapid Estimates of Fossil Fuel Consumption published monthly by the Directorate General for Energy and Geology. These are first estimates and represent only emissions from "fuel combustion", which is the main source of emissions in Portugal, and which accounted for 72% of emissions in the 2016/2019 period.

This monitoring of emissions from the energy sector, allows us to verify that during the confinement period there was a slight reduction of emissions related to the transport sector and that there was no decrease in the production and consumption of electricity or renewables.

This monitoring also allowed us to verify that in periods without confinement or with reduced confinement, the verified changes tend to return to pre-Covid levels.

For this reason, we have not yet seen the need to change the projections up to 2050, as we consider that the impact of COVID-19 may induce temporary changes, that can have limite impact in the medium or long term.

In order to monitor the evolution of the impact of the COVID-19 pandemic in the GHG emission, the APA started to produce a monthly report based in the information contained in the Rapid Estimates of Fossil Fuel Consumption published monthly by the General Directorate of Energy and Geology[103]. Monthly reports were published from March 2020 to December 2021.

Even if this exercise was based only on “fuel burning” emissions, it should be noted that these are the main source of emissions in Portugal (the burning of fuels was responsible for 72% of emissions in the 2016/19 period). The Rapid Estimates of Fossil Fuel Consumption published monthly by the General Directorate of Energy and Geology (DGEG) covers consumption of all fossil fuels, aggregated by month and by major consumption sectors. Therefore this data source provided an important indication for the objective of this exercise that aimed to analyze the impact of the COVID-19 pandemic on national GHG emissions.

Each monthly report on the impact of COVID-19 in the national GHG emissions was published at the beginning of month X and the information refers to month X-2. The emission estimates were based on DGEG data and on a distribution of fossil fuels by sector of activity based on the history of consumption in the years 2016 to 2020 under the responsibility of the APA's GHG Inventories Team. Excluded from this information are fuels used to produce energy such as: Urban Solid Waste; Industrial Waste; biomass; biogas; and Liquid Biofuels. For this reason, the variations presented only reproduce the expected changes in emissions resulting from changes in the use of fossil fuels. Sectors whose emissions have a different origin from fuel combustion (eg agriculture, waste, fluorinated gases, land use and forests) were not considered for the production of these reports and it was considered that they would have a pattern similar to that observed in previous years.

Projections Methodology (VI.2)

Sensitivity analysis

In the context of the 2050 Carbon Neutrality Roadmap modelling exercise, a series of sensitivity analysis and variants were carried out, which allowed to better understand the impact of specific aspects on the final emission trajectory established. Some examples are the variation on the technology costs, such as hydrogen (for transports and energy sectors), variation on the use of public transport and soft mobility, greater incorporation of renewable gases, balance of electricity imports, etc.

The uncertainty associated with the impact of climate change on water availability also justified the analysis of an alternative scenario that considered the inherent impacts of a RCP8.5 climate scenario.

[103] The monthly reports are publicly available at https://www.apambiente.pt/clima/impacte-covid-19-emissoes-gee

Additional sensitivity analyses were also carried out, varying some aspects of Circular Economy in the different sectors, in order to increase or decrease its impact, to see what the impact in terms of emissions would be.

As expected, the results were different, but the decarbonisation vectors and the potentials of each sector were substantially the same, which suggests a high degree of robustness in the results achieved.

The methodologies used for the projections

For the development of projections, a methodologically separate approach was adopted for each of the four main sectors, since there is no single model that makes it possible to project emissions for all sectors and gases in an integrated manner. Thus, for the:

- Energy system: GHG emissions were estimated based on the TIMES_PT optimisation model which includes, in an integrated manner, the entire Portuguese energy system starting from energy generation, transport and distribution through to consumption in the end-use sectors such as industry (including industrial processes), transport, residential, services and agriculture (only energy use) in their multiple uses (heating, cooling, lighting, electrical equipment, passenger and freight mobility, among others).
- Agriculture, forests and other land uses: GHG emissions were estimated based on different assumptions aligned with the narratives of the socioeconomic scenarios, from which the respective evolutionary trends of the crop and animal sector, and their emissions, were established. This sector includes animal emissions and manure management systems, fertiliser use, rural fires, and the emissions or sequestration of different land uses.
- Waste and wastewater: GHG emissions were estimated based on projections of the volume of municipal waste and domestic wastewater generated each year, considering the resident population, and the impact of the policies already adopted. This sector includes emissions from the disposal and treatment of urban and industrial solid waste and wastewater.
- Fluorinated gases: GHG emissions were estimated based on the implications of implementation of the Kigali Agreement and the European Regulations that foresee the phasing out of some of these gases over coming decades. This sector includes emissions from the use of fluorinated gases in refrigeration and air conditioning equipment, fire protection systems and electrical switches.

Estimated GHG emissions for each sector were subsequently aggregated to calculate national total emissions.

In all sectors, GHG emissions estimation follows the methodologies presented in the national emissions inventories, which comply with the emissions calculation guidelines of the 2006 Intergovernmental Panel on Climate Change and relevant UNFCCC decisions for calculation of emissions and reporting emissions projections. The base year for the modelling in TIMES_PT is 2015.

<u>Sectoral Methodology</u>

Energy system that includes also the industry/industrial processes, the transport and the housing, service and agriculture (only energy use) sectors:

TIMES_PT is a technological model of linear optimization which results from the implementation of a generation of economy – energy – environment optimized models, with a TIMES technology base, in Portugal.

The generic structure of TIMES can be adapted by each user, to simulate a specific energy system, at local system national or multi-regional.

TIMES_PT was initially developed under the European Project NEEDS, integrating a Pan European TIMES model used to estimate total European costs (including externalities) of energy production and consumption. The ultimate goal of any TIMES is to satisfy the demand for energy services at the minor cost. In order to do that, investment options and the operation of some technologies, as well as the primary energy sources and energy exportations and importations, according to the following equation:

$$NPV = \sum_{r=1}^{R} \sum_{y \in YEARS} (1 + d_{r,y})^{REFYR-y} \bullet ANNCOST(r, y)$$

NPV: actualizes net value of total costs; ANNCOST: annual total cost; d: actualization rate; r: region; y: years; REFYR: reference year for the actualization; YEARS: years in which costs exist (all costs for the modelling period + past years when costs where defined for past investments + the number of years after technology life time, in case there are decommissioning costs).

For each year, the TIMES models calculate the current sum of the total costs, expect the income. In the case of TIMES_PT model, the costs taken into account are the investment, operation and maintenance costs (fixed and variable) of the various production technologies and energy consumption. The Income usually considered in TIMES models include subsidies and materials recovery, which are not considered in the TIMES_PT model.

The TIMES_PT model represents the Portuguese energy system from 2000 to 2050, including the following sectors:

- Primary energy supply (refining and synthetic fuels production, import and local resources);
- Electricity production;
- Industry (cement, glass, ceramics, steel, chemical, paper and pulp, lime and other industrials);
- Residential;
- Commercial and Services;
- Agriculture, forestry and fisheries (only the energy consumption);
- Transport.

In each sector, the monetary, energy and materials fluxes are modelled according to the various production technologies and energy consumption, including mass balances for some industry sectors.

The simplified structure of the TIMES_PT model is shown in the figure VI.2.1, as well as its main inputs and outputs.

The implementation of TIMES_PT requires a set of exogenous inputs, namely:

1. Demand for energy services;
2. Technologies' technical and economic characteristics for the base year and the future (e.g. efficiency, input/output ratio, availability, investment, operation and maintenance costs and actualization rate);
3. Availability of primary energy sources in the present and in the future, especially the potential for the use of endogenous energy resources;
4. Policy restrictions (e.g. energy production targets or reduction of emissions).

Based on these elements, it is possible to obtain from the TIMES_PT model a series of outputs, such as:

1. Inherent costs to the energy system;
2. Energy flows inherent to each sector;
3. Technological options, including the installed capacity in the electricity production sector;
4. Energy imports and exports;
5. Use of indigenous resources;
6. Emissions by sector.

Presently emissions considered by the model include the GHG emissions generated by combustion and industrial processes, and do not include fugitive emissions associated with the production, storage and distribution of fossil fuels and emissions of F-gases.

It should be noted that TIMES, being a partial equilibrium model, does not consider the economic interactions outside the energy sector, as for instance the implications in the activity of other economy sectors (e.g. impact of wind energy in the metal sector) or the implications in the activity of national sectors dictated by changes in international demand for their goods or services.

Furthermore, TIMES model does not take into account irrational aspects that influence investment in new and more efficient technologies, e.g. motivated by aesthetic preferences or social status which mainly occurs in the acquisition of end-use technologies. Thus, the model assumes that agents have perfect knowledge of the market, present and future. Finally, it should be emphasized that the based technology models such as the TIMES_PT do not accommodate market decisions based on price, instead they make choices based whether technologies or energy resources costs. For this reason, the solutions found show the best options in terms of cost - effectiveness and hence competitiveness, lato sensu.

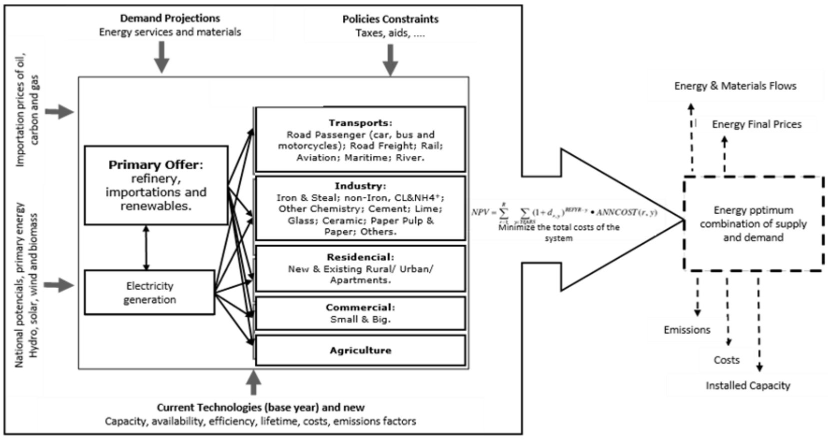

Figure VI.2.1
TIMES_PT model simplified structure

Economic policy instruments, such as VAT and the ISP (tax on petroleum products and energy products), have not been considered, since the aim is to identify cost-effective technological solutions, and therefore the whole exercise is based on technology costs. The electricity exchange with Spain is also not included in the modelling exercise, since it is mainly based on market decisions, and TIMES_PT model is not an appropriate tool to account for it. According to the expectations of REN (concession holder of the national network), a zero balance with Spain is assumed as from 2025.

New in relation to similar exercises in the past is the fact that some of the expected impacts of climate change on the horizon of 2050 have been internalized within the framework of the modelling exercise, in particular by considering changes in technology efficiency and in service demand and resource availability (such as reduced water availability or increased cooling needs). It should be noted that the TIMES_PT model, provided an important contribution to the setting of national goals and targets by the 2030 horizon and pointing clear guidelines for the horizon 2050.

<u>Agriculture, forests and other land uses, Waste and wastewater and Fluorinated gases:</u>
For Agriculture, forests and other land uses and for Waste and wastewater and Fluorinated gases, Excel spread sheets based on inventory methodologies were used, and so all categories and different gases were covered.

An advantage of using these models is the fact that a similar approach was already used in previous projections exercises like, for example, in the National Program for Climate Change (PNAC2020/2030) and the National Low-Carbon Roadmap (RNBC2050), so the methodologies are well known and the specific data bases for Portugal are fed in regularly. On the other hand, these more simplified models are not based in a cost-benefit analyses, which can be considered as a disadvantage, however they are based in expert judgments.

Provisions of financial, technological and capacity-building support to developing country Parties (VII)

This chapter includes the financial information regarding the support provided by Portugal to developing countries Parties of the UNFCCC and Paris Agreement, during the period 2019 – 2020.

The information reported in the Common Tabular Format (CTF) tables 7 comprises both multilateral and bilateral flows.

In light of best pratices on transparency, accountability and reporting, as well as OECD/DAC (Development Assistance Committee) recommendations and the different commitments made by Portugal in this regard, Camões - Institute for Cooperation and Language P.I., as the coordinating entity for development cooperation, is responsible to provide the Integrated Information System on Portuguese Cooperation.

This involves providing on-line information about Official Development Assistance (ODA) in aggregate terms (global data) as well as per project, in Portuguese and English, both in EUR and USD. For a more detailed and in-depth Portuguese ODA analysis, please refer to https://www.instituto-camoes.pt/activity/o-que-fazemos/cooperacao/atuacao/reportamos/reportamos-2

Althouth from a geographical point of view we continue to prioritize cooperation activities towards the lusophone developing countries, in particular the Portuguese Speaking African Countries (PALOP) and Timor-Leste, new beneficiary countries have been added in the last years, from North and Western Africa and Latin America regions, such as Tunisia, Cote d'Ivoire, Colombia and Argentina

In Portugal, ODA for environment has had limited expression regarding total values by virtue of the sectorial strategic priorities that essentially lie in areas such as Education, Health, Security and Justice, however considerable efforts have been made in order to curve this trend by strengthening mainstreaming guidelines and updating the range of sectoral priorities regarding the alignment to Paris Agreement.

However, despite the last decade difficulties regarding public debt control and fiscal consolidation remains committed to ODA international targets and has been focused on supporting the most vulnerable developing countries such as Fragile States, Least Developed Countries and Small Island Developing States.

Portugal has a decentralized model of cooperation, which means a permanent intergovernmental and institutionally collaboration between Camões – Institute for Cooperation and Language, I.P. (under the scope of the Ministry of Foreign Affairs) in the capacity of co-operation for development coordinator entity and the sectorial Ministries, such as the Ministry of Environment and Climate Action (MAAC), responsible for the thematic areas of environment, including climate change and energy.

Portugal has just adopted a new cooperation for development strategy fully aligned with the 2030 Agenda for Sustainable Development and the Paris Agreement, in which the climate change and the green just transition issues have a more prominence. The 2030 Cooperation for Development Strategy has innovative aspects that are considered positive and aligned with the international and European context in which we operate.

Rio Markers implementation methodology

Portugal as OECD/DAC (Development Assistance Committee) Member-State tracks ODA financing flows in compliance with Creditor Reporting System (CRS) directives, and applies the Rio Markers system to qualify and track climate relate finance flows.

As mentioned above climate change financial flows are tracked based on Rio markers mitigation and adaptation methodology established by the DAC/OECD to support the implementation of the Convention objectives and as a best practice to promote policy coherence and mainstreaming climate change into cooperation for development. The climate markers (definitions and criteria) allow for an assessment of donor's policy objectives in relation to all range of Programs, Projects and Actions (PPA).

According to these methodology definitions, an activity could be considered:

- **mitigation** if contributes to the objective of stabilization greenhouse gas (GHG) concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system by promoting efforts to reduce or limit GHG emissions or to enhance GHG removal by sinks, in line with the goals of the Paris Agreement (art. 2.1a) .
- and **adaptation** if enhance adaptive capacity, strengthen resilience and/or reduce vulnerability to climate change, with a view to contributing to sustainable development and ensuring an adequate adaptation response, in line with the Paris Agreement (art. 2.1b and 7).

Applying the Rio markers, which include mitigation and adaptation to Climate Change, means the use of a scoring system of three values, according to which the ODA amount reported within the DAC/CRS is screened and marked as:

A. Targeting the Convention as a 'principal' objective (score "2"): when the objective (mitigation or adaptation to CC) is explicitly stated as fundamental in the design of, or the motivation for, the activity, and promoting the objectives of the Convention is thus stated in the activity documentation as one of the principal reasons for undertaking it. In other words, the activity would not have been undertaken that particular way, had it not been for that specific objective.
B. As a 'significant' objective (score "1"): when the objective (mitigation or adaptation to CC) is explicitly stated but it is not the fundamental driver or motivation for designing or undertaking the activity. The activity has other prime objectives but it has been formulated or adjusted to help meet the relevant climate concerns, particularly in the field of mitigation and adaptation to CC.
C. Not targeting the objectives of the Convention (score "0"): it means that the activity was examined but found not to target the objective (mitigation or adaptation to CC) in any significant way.

The Rio Markers are quality indicators and were not initially oriented to quantify climate finance but only to qualify the level of mainstreaming of environment and climate change into development cooperation. However regarding the need to estimate more accurately the climate finance flows and that the activities can have more than one principal and significant policy objective and trying to avoid double counting, we have aligned our approach with the one used by European Commission by adopting recently the same approach and coefficients detailed in the table below.

Table VII.1

Markers	Mitigation (%)	Adaptation (%)	Cross-cutting (%)	Total (%)
2 M & 0 A	100	0	0	100
1 M & 0 A	40	0	0	40
0 M & 2 A	0	100	0	100
0 M & 1 A	0	40	0	40
2 M & 1 A	100	0	0	100
1 M & 2 A	0	100	0	100
2 M & 2 A	0	0	100	100
1 M & 1 A	0	0	40	40

Despite adopted recently, in this report we have extended the approach to previous years from 2017 to 2021 for the benefit of comparability.

Finance (VII.1)

Cooperation – policies, priorities and programmes in Portugal

As in previous Biennual Reports, Portugal continued to prioritize cooperation for development activities towards its partner countries, namely the PALOP and Timor Leste. However, as mentioned before new beneficiary countries and regions have been added in the last years.

The strategic framework and guidelines for development cooperation are aligned with the needs and priorities of partner countries and established by Strategic Cooperation Programs (PEC) signed with each partner country in particularly with longtime partners such as PALOP and Timor-Leste The PEC aims to constitute itself as the guiding document of bilateral cooperation for development with the partner country, which identifies the priority areas should be mentioned and not individual projects that, usually, given the validity of the document, it’s impossible to anticipate the projects that will be submitted by the partners.

Considering that Portugal has a decentralized model of cooperation, and complementary to PEC’s, sectorial Protocols, Memorandum of Understanding (MoU)or Actions Plans are discussed and agreed with partner countries at institutional level and signed between with homologous Ministries.

It should be stressed that it is the partner country that promotes the Programs, Projects and Actions (PPA) and presents it to Portuguese Cooperation (PtC) for financing and has to demonstrate that and how the PPA contribute to meet its specific policies, priorities and strategies. The partner country is responsible for the selection process of the entity that will execute the PPA. In some areas the private sector is better placed to execute them. Therefore, the PtC has kept an open door to the private sector (from beneficiary and/or donor country) engagement working hand in hand with public institutions and/or local communities of the beneficiary/ partner country.

The main Portuguese cooperation for development financial resource regarding environment and climate change comes from Environmental Fund (FA) established in 2016 and the national public entity in charge of managing the FA is the Secretariat-General of the currently designated MAAC.

This instrument supports environmental policies for the pursuit of Sustainable Development Objectives, contributing to the achievement of national and international objectives and commitments, in particular those related to climate change, water resources, waste and nature conservation and biodiversity. International Cooperation, in the field of climate change and in line with our commitments, is one of the action domains clearly identified by this Fund.

As a EU Member State, Portugal made the commitment to mobilise 0.15% to 0.20% of its GNI as ODA allocated to LDC by 2030. It also endorsed the commitment derived from the 2014 ministerial-level meeting of the Development Assistance Committee (OECD/DAC) to focus the support from member countries on countries most in need (which includes Fragile States, LDC and SIDS).

Mitigation

Table VII.1.1

	2019		2020	
	€	$	€	$
Mitigation	249 979,00	279 838,00	413 434,00	471 150,00

Adaptation

Table VII.1.2

	2019		2020	
	€	$	€	$
Adaptation	849 630,00	951 114,00	590 259,00	672 660,00

<u>Environmental Fund</u>

In 2016, it was established that a single environmental fund should be created by aggregating resources from existing funds, so as to obtain an instrument with greater financial capacity and more adaptability to challenges. The Environmental Fund (FA)[104] was therefore set with effect from 1st January 2017, thus terminating the FPC, the Environmental Action Fund, the Fund for the Protection of Water Resources and the Fund for the Conservation of Nature and Biodiversity.

As a consequence, the FA takes up all responsibilities inherent to the former funds, aiming to support environmental policies in order to achieve the sustainable development goals, thus helping to meet national and international objectives and commitments, including those related to climate change, water resources, waste and conservation of nature and biodiversity.

In order to address the emerging challenges associated with the commitment to achieving carbon neutrality by 2050, the FA was subject to an amendment[105] to reinforce the role of this financial instrument in pursuing national and international objectives and commitments (such as the Paris Agreement) in several areas of his activity. It also integrated the Energy Efficiency

[104] The FA was created by Decree-Law No 42-A/2016, of 12th August
[105] Decree-Law No 114/2021, of 15th of December

Fund, the Permanet Fund for Forests, and the Fund for the Sustainability of the Energy Sector. The Environmental Fund is under the direct responsibility of the MAAC and its day-to-day management is performed by the Secretary General of the MAAC.

Private Financial Flows:
Portugal does not have yet, in terms of development cooperation in the context of climate change, a strong tradition of mobilizing private financing. Hence the amounts of private funding mobilized by projects marked with the Mitigation and Adaptation markers in the 2018-2020 period are the following: 138 824,50 USD in 2018, 15 336,39 USD in 2019. In 2020, there was no mobilization of private financing by climate projects and the data regarding 2021 is not available yet.

Provision of new and additional resources
In the absence of an international definition accepted by all Parties of 'new and additional' financing, Portugal considers FA as an additional financial resource compared with conventional ODA. Although mainly focused at environmental domestic level, the FA can also support environmental cooperation for development PPA, in particular climate action aiming to support *"the shift towards a low-carbon competitive economy through funding or co-funding of measures which contribute to meeting the commitments of the Portuguese State under Paris Agreement and other international and Community commitments in the field of climate change*".

Regarding the Environment Fund, ODA flows spent in climate action compared with other conventional climate change financial flows, new and additional financing exceeded 60% of total climate financing ODA.

Bearing in mind that financing ODA projects is not a core objective of the FA, Portugal considers that all financing provided by this fund to activities that aim to promote the economic development and welfare of developing countries is new and additional to the conventional sources of ODA.

On the other hand, we should consider conventional ODA the difference between the total climate financing flows disbursed and the ones disbursed by the Environmental Fund.

In addition to the information already mentioned on this report, we would like to highlight that all the PPA financed by Portuguese Cooperation are proposed by the partner countries which are also entirely responsible for their design. As donor we appraise the PPA proposals taking into account their relevance for the sectoral country commitments and strategies including NDC's, efficiency, problems addressed, viability, sustainability, results, accountability and also the adequacy of the technologies supposed to be developed and/or transferred, as well as capacity building components and also the indicators for monitoring and evaluation.

Technology Transfer (VII.2)
In the absence of a specific marker for technology transfer, Portugal has not developed a systematic approach to accounting for this type of financial flows until recently. Therefore, the available information is contained in the table 8 of the CTF tables.

Capacity Building (VII.3)

In general, the PPAs supported by the Portuguese cooperation have a strong component of technical assistance targeted at national capacity-building. It is endeavoured to give special attention to the implementation of the aid effectiveness principles enshrined in the Paris Declarations and developed in Accra and Busan, mainly: leadership and control by beneficiaries so that they can strategically allocate their resources; to enhance existing capacities as a starting point, avoiding the creation of parallel structures and using national systems in a systematic manner to implement aid; technical cooperation driven by partner demand.

The area of climate change is no exception to this, with some projects being even exclusively dedicated to institutional capacity-building. This applies to the PPAs exclusively dedicated to this subject as well as to the inclusion of a capacity-building component in the different PPAs as an effort to adapt them to a demand for change, to the beneficiary institutions and to the potentialities and weaknesses of existing national systems in beneficiary countries.

In particular with regard to cooperation projects in the field of climate change, Portugal intends for partners to lead and control, and often uses national systems for the implementation of aid. Detailed information on projects is provided in table 9 of CTF tables.

agência portuguesa do ambiente

Rua da Murgueira, 9
Zambujal - Alfragide
2610-124 Amadora

geral@apambiente.pt
T. (+351) 21 472 82 00

apambiente.pt