1ST BIENNIAL TRANSPARENCY REPORT

SUBMITTED TO THE UNITED NATIONS FRAMEWORK CONVENTION ON CLIMATE CHANGE

2024 Portugal

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1st Biennial Transparency Report

to the United Nations Framework Convention on Climate Change

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1 OVERVIEW CHAPTER

Under the new Enhanced Transparency Framework (ETF), countries that are Parties to the Paris Agreement must submit their Biennial Transparency Reports (BTR) every two years, with the first submission required by December 31, 2024.

Portugal first BTR follows the guiding principles of the modalities, procedures and guidelines (MPGs) of the transparency framework set out in Decision 18/CMA.1. It will be subject to a technical expert review process that will allow it to be improved in subsequent cycles based on areas of improvement identified by the technical expert review team, with which Portugal will fully cooperate.

The BTR is a pivotal part of the Enhanced Transparency Framework, established by Article 13 of the Paris Agreement. The purpose of this BTR is to provide a clear understanding of climate change action in the light of the objective of the Convention and enhanced implementation thereof as set out in Article 2 of the Paris Agreement, including clarity and tracking of progress towards achieving Parties' nationally determined contributions (NDCs) under Article 4, support provided and received by relevant Parties and Parties' adaptation actions under Article 7, including good practices, priorities, needs and gaps, to inform the global stocktake under Article 14.

Outline of the report:

- Chapter 1 - brief introduction to the BTR.
- Chapter 2 - national greenhouse gas (GHG) emissions and removals over the period 1990 – 2022, as described in the annual National Inventory Document of Portugal (submitted as a separate document).
- Chapter 3 - information on national circumstances and institutional arrangements, as well as other related information necessary to track progress made in implementing and achieving the joint EU NDC; policies and measures (PAMs) per sector; main GHG projections results.
- Chapter 4 - information about climate change impacts and adaptation in Portugal.
- Chapter 5 - Portugal support for climate action in developing countries; information on financial, technology transfer and capacity-building support provided and mobilized.

Portugal first Biennial Transparency Report submitted to the United Nations Framework Convention on Climate Change (UNFCCC) includes the present report, the tabular information known as CTF tables, the National GHG Inventory Document and its CRF tables.

2 NATIONAL INVENTORY REPORT OF ANTHROPOGENIC EMISSIONS BY SOURCES AND REMOVALS BY SINKS OF GREENHOUSE GASES

As a Party to the United Nations Framework Convention on Climate Change (UNFCCC), Portugal is required to produce and regularly update its national inventory of greenhouse gas (GHG) emissions and removals and submit a National Inventory Report (NIR) containing detailed and complete information on its inventory, to ensure transparency.

Portugal submitted its latest greenhouse gas inventory to the UNFCCC on 13th December, covering the period from 1990 to 2022, through the National Inventory Document (NID) together with Common Reporting Tables (CRF), the first year with this new format (of Paris Agreement).

The GHG emissions follow the main IPPC sectors: Energy, Industrial Processes and Other Product Use (IPPU), Agriculture, Land Use, Land Use, Land-Use Change and Forestry (LULUCF) and Waste.

2.1 National Circumstances and Institutional Arrangements

In relation to climate change, and its impacts, the current Government's Organic Law maintained in its structure the Ministry of Environment and Energy (MAEn), with responsibility for environmental and energy issues, including climate policy. 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 MAEn, and it retains the powers to propose, develop and monitor the implementation of environmental policies, notably in the field of climate change.

The Climate Change Department (DCLIMA) within the Portuguese Environment Agency is the entity responsible for the coordination and for all aspects related the annual compilation, reporting and quality management of National Emissions Inventory (INERPA).

Portugal has established a National Inventory System of Emissions by Sources and Removals by Sinks of Air Pollutants (**SNIERPA)** with the following main components:

- Calculation and archiving system of the national inventory.
- Quality Control and Assurance System (QA/QC).
- Methodological development Plan (PDM).
- Archiving System.

The legal framework was adopted by 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, as well as reporting and archive all relevant information.

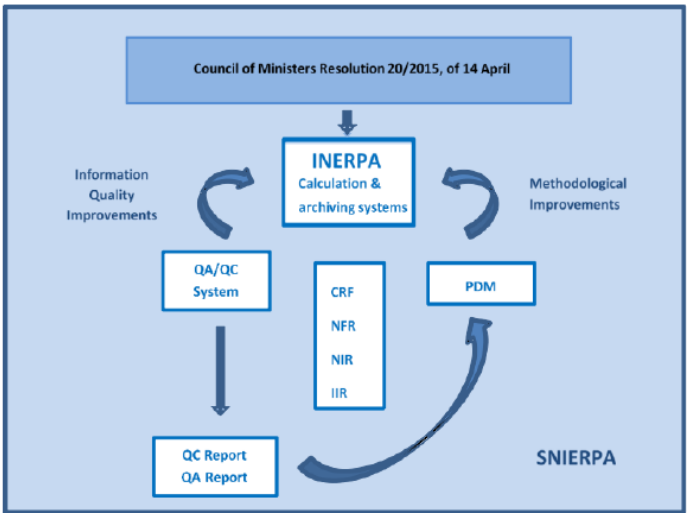

Figure 2.1 – SNIERPA´s main elements relations

2.2 Methods and Metrics

The national inventory uses the methodologies defined in the 2006 IPCC Guidelines and in the 2019 Refinement and used the global warming potential (GWP) values for a 100-year time horizon given in the IPCC Fifth Assessment Report. Guarantees the time-series consistency and identifies the key categories. The QA/QC and the assessment of uncertainty and completeness are also carried out.

The National Inventory Document details all this information.

This chapter summarizes the latest information on Portuguese GHG emissions and removals, including trends in a tabular format. More details are presented in the NID which is submitted as a stand-alone document.

2.3 Trends of GHG emissions and removals (total, by gas and by sector)

This section summarizes the latest information on Portuguese GHG emissions and removals, including trends in a tabular format. More details are presented in the NID which is submitted as a stand-alone document.

In 2022, total Portuguese GHG emissions, including indirect CO2, without land-use, land-use change and forestry (LULUCF) were estimated at about 56.4 Mt CO2 equivalent, representing a decrease of 4.4 % compared to 1990 levels and an increase of 0.1 % compared to the previous year (2021). When considering the LULUCF sector, the national level of in 2022 totalled 50.5 Mt CO2e, corresponding to a 23.6 % decrease compared to 1990 and a variation of +0.3 % from 2021 to 2022 (Table 2.1 – GHG emissions and removals by sector provide an overview by total and sector in the 1990-2022 period).

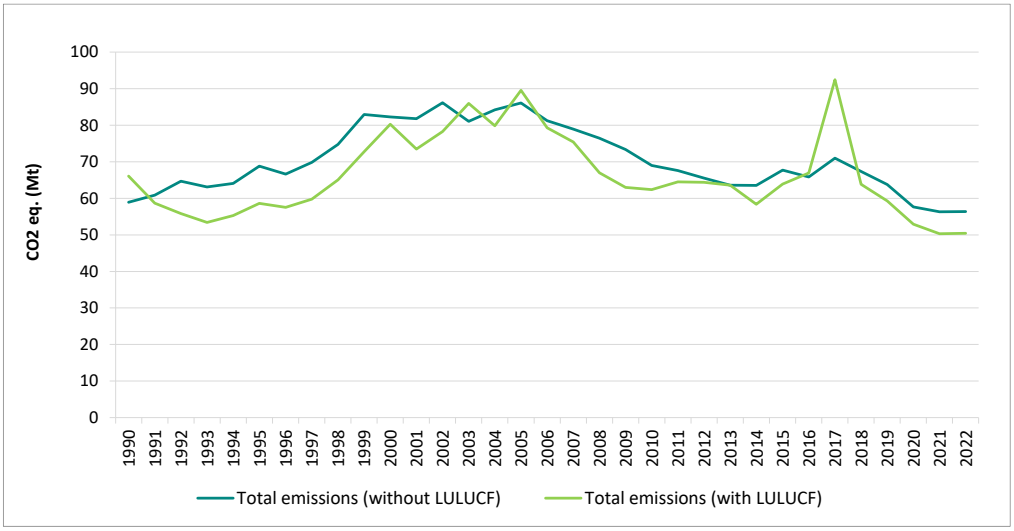

Figure 2.2 – GHG emissions

CO_2 is the primary GHG, accounting for about 72% of Portuguese emissions on a carbon equivalent basis in 2022 (LULUCF excluded). The second most important gas is CH4, followed by N2O, representing, respectively, 18% and 6% of total emissions in 2022. Portugal has chosen 1995 as the base year for fluorinated gases. In 2022, these gases represented about 4% of total GHG emissions. NF3 emissions are non-occurring in Portugal (Table 2.2 provide an overview by gas in the 1990-2022 period).

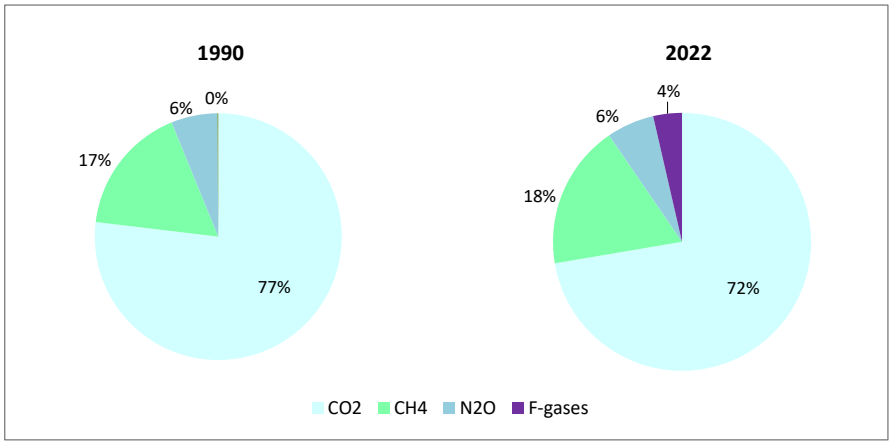

Figure 2.3 – GHG emissions by gas

The largest contributor to the Portuguese emissions is the Energy sector (67.2 % of total emissions in 2022), with the energy industries and the transport activities amounting, respectively, to 14.9 % and 30.3 % of total emissions. These sub-sectors are the primary sources of Portuguese GHG emissions. Combustion in manufacturing industries is the sub-sector registered the biggest decrease (10.3%) from 2021 to 2022.

Fugitive emissions and transports are the sub-sectors registering the greatest increase with approximately 22% and 7% growth from 2021 to 2022. Industrial processes and product use (IPPU) represent about 10 % of the Portuguese emissions in 2022 and have decreased approximately 8 % since 1990. Agriculture is significant source of GHG emissions, responsible for 12.3 % of the Portuguese emissions in 2022, corresponding to a decrease of 5.3 % since 1990. Waste represented approximately 10 % of Portuguese emissions in 2022 and increased 26.2 % since 1990.

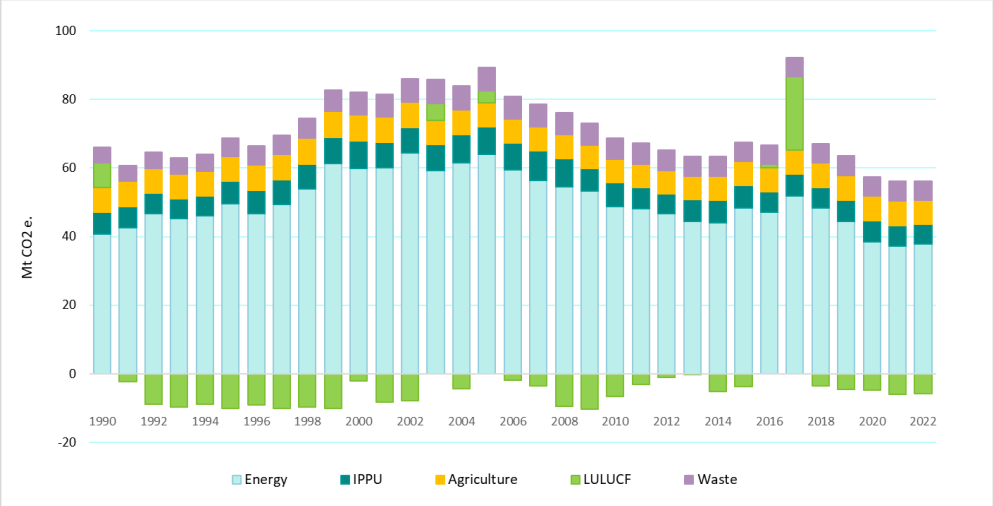

Figure 2.4 – GHG emissions and removals by sector

Table 2.1 – GHG emissions and removals by sector

GHGs SOURCE AND SINK CATEGORIES	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	CO_2 equivalent (Gg)																
1. Energy	40,683	42,613	46,767	45,299	45,996	49,563	46,796	49,366	53,920	61,259	59,870	60,175	64,342	59,242	61,528	63,916	59,528
2. Industrial processes and product use	6,366	6,201	5,856	5,746	5,760	6,637	6,751	7,152	7,293	7,730	8,014	7,288	7,486	7,558	8,224	8,211	7,858
3. Agriculture	7,338	7,368	7,252	7,194	7,221	7,276	7,466	7,493	7,453	7,583	7,697	7,450	7,327	7,048	7,250	6,927	6,878
4. Land use, land-use change and forestry(5)	7,138	-2,231	-8,867	-9,693	-8,826	-10,191	-9,058	-10,097	-9,708	-10,203	-2,046	-8,341	-7,915	4,930	-4,387	3,489	-1,937
5. Waste	4,471	4,616	4,715	4,787	4,963	5,177	5,419	5,663	5,923	6,202	6,520	6,703	6,825	6,982	7,001	6,806	6,731
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO

GHGs SOURCE AND SINK	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	% change 1990-2022
	CO_2 equivalent (Gg)																
1. Energy	56,436	54,459	53,312	48,762	48,166	46,681	44,536	43,963	48,355	47,117	51,792	48,400	44,428	38,563	37,310	37,793	**-7.1**
2. Industrial processes and product use	8,632	8,353	6,562	6,939	6,217	5,854	6,267	6,690	6,669	6,023	6,375	5,960	6,255	6,113	5,931	5,878	**-7.7**
3. Agriculture	6,995	6,943	6,881	6,814	6,770	6,794	6,756	6,889	6,911	6,953	7,068	7,150	7,248	7,271	7,244	6,941	**-5.4**
4. Land use, land-use change and forestry(5)	-3,499	-9,462	-10,361	-6,561	-3,046	-1,185	-18	-5,116	-3,782	1,051	21,472	-3,497	-4,499	-4,707	-6,021	-5,925	**-183.0**
5. Waste	6,631	6,482	6,424	6,260	6,225	6,009	5,875	5,782	5,578	5,580	5,594	5,671	5,702	5,554	5,632	5,643	**26.2**
6. Other	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	NO	**NO**

NA-Not applicable; NE-Not estimated; NO-Not occurring

Table 2.2 – GHG emissions by gas

GHGs EMISSIONS	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
	CO_2 equivalent (Gg)																
CO2 emissions without net CO2 from LULUCF	45,311	47,131	50,957	49,469	50,243	54,503	51,799	54,669	59,211	66,878	65,657	65,187	69,582	64,482	67,302	69,640	64,856
CO2 emissions with net CO2 from LULUCF	51,016	43,995	41,594	39,291	40,799	43,587	42,181	44,099	48,889	56,162	62,723	56,053	60,753	67,574	62,079	71,416	62,081
CH4 emissions without CH4 from LULUCF	9,978	10,125	10,136	10,153	10,299	10,521	10,780	11,032	11,296	11,629	11,894	11,873	11,842	11,813	11,809	11,643	11,541
CH4 emissions with CH4 from LULUCF	10,796	10,534	10,228	10,237	10,485	10,789	10,905	11,072	11,428	11,666	12,203	12,092	12,138	12,805	12,009	12,505	11,707
N2O emissions without N2O from LULUCF	3,568	3,541	3,498	3,404	3,399	3,562	3,759	3,821	3,868	3,974	4,179	4,082	4,003	3,897	4,187	3,767	3,674
N2O emissions with N2O from LULUCF	4,183	4,037	3,902	3,806	3,831	4,017	4,194	4,254	4,350	4,451	4,757	4,655	4,622	4,741	4,823	4,618	4,345
HFCs	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	54	78	136	197	276	354	455	532	613	674	780	892
PFCs	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0	0	1	1	2	2	2	3	3	4
Unspecified mix of HFCs and PFCs	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
SF6	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	14	15	16	16	17	17	18	19	22	27	27	29
NF3	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA
Total (without LULUCF)	**58,857**	**60,797**	**64,591**	**63,026**	**63,941**	**68,653**	**66,432**	**69,674**	**74,589**	**82,775**	**82,102**	**81,616**	**85,980**	**80,829**	**84,003**	**85,860**	**80,995**
Total (with LULUCF)	**65,995**	**58,566**	**55,723**	**53,334**	**55,114**	**58,462**	**57,374**	**59,577**	**64,881**	**72,572**	**80,055**	**73,275**	**78,065**	**85,759**	**79,616**	**89,349**	**79,058**
Total (without LULUCF, with indirect)	**58,950**	**60,889**	**64,688**	**63,123**	**64,088**	**68,836**	**66,604**	**69,873**	**74,781**	**82,969**	**82,285**	**81,810**	**86,172**	**81,038**	**84,218**	**86,064**	**81,199**
Total (with LULUCF, with indirect)	**66,088**	**58,657**	**55,821**	**53,431**	**55,262**	**58,645**	**57,546**	**59,776**	**65,073**	**72,765**	**80,238**	**73,469**	**78,258**	**85,968**	**79,831**	**89,553**	**79,261**

	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	% change
	CO_2 equivalent (Gg)																1990-2022
CO2 emissions without net CO2 from LULUCF	62,380	60,009	57,147	52,890	51,784	49,932	48,146	47,942	52,233	50,311	55,165	51,340	47,583	41,738	40,284	40,687	-10.2
CO2 emissions with net CO2 from LULUCF	58,144	49,871	45,929	45,302	47,888	47,766	47,072	42,127	47,642	50,238	74,285	47,154	42,408	36,326	33,409	33,918	-33.5
CH4 emissions without CH4 from LULUCF	11,368	11,171	11,045	10,809	10,740	10,474	10,268	10,159	10,009	10,052	10,138	10,229	10,306	10,187	10,283	10,188	2.1
CH4 emissions with CH4 from LULUCF	11,439	11,194	11,209	11,104	10,895	10,728	10,578	10,191	10,122	10,426	11,480	10,301	10,384	10,304	10,532	10,447	-3.2
N2O emissions without N2O from LULUCF	3,854	3,784	3,584	3,600	3,290	3,291	3,289	3,429	3,418	3,397	3,508	3,542	3,613	3,548	3,539	3,356	-6.0
N2O emissions with N2O from LULUCF	4,520	4,436	4,277	4,331	3,985	4,018	4,035	4,097	4,113	4,146	4,518	4,160	4,212	4,136	4,143	3,941	-5.8
HFCs	1,055	1,237	1,363	1,433	1,525	1,600	1,688	1,754	1,813	1,873	1,975	2,027	2,085	1,982	1,961	1,968	100.0
PFCs	5	6	7	8	9	10	11	13	14	15	17	19	21	24	27	30	100.0
Unspecified mix of HFCs and PFCs	NO,NA	NO,NA	NO,NA	NO,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	NO,NE,NA	0.0
SF6	32	31	34	36	30	31	32	27	25	25	27	24	24	22	23	25	100.0
NF3	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	NO,NA	0.0
Total (without LULUCF)	**78,694**	**76,237**	**73,179**	**68,776**	**67,378**	**65,338**	**63,434**	**63,324**	**67,512**	**65,673**	**70,830**	**67,181**	**63,633**	**57,501**	**56,117**	**56,255**	**-4.4**
Total (with LULUCF)	**75,195**	**66,776**	**62,819**	**62,214**	**64,332**	**64,153**	**63,416**	**58,208**	**63,729**	**66,724**	**92,301**	**63,684**	**59,134**	**52,794**	**50,096**	**50,330**	**-23.7**
Total (without LULUCF, with indirect)	**78,902**	**76,424**	**73,351**	**68,961**	**67,554**	**65,519**	**63,599**	**63,482**	**67,673**	**65,827**	**70,989**	**67,322**	**63,797**	**57,641**	**56,302**	**56,382**	**-4.4**
Total (with LULUCF, with indirect)	**75,402**	**66,962**	**62,990**	**62,400**	**64,507**	**64,334**	**63,582**	**58,366**	**63,890**	**66,878**	**92,461**	**63,825**	**59,298**	**52,934**	**50,281**	**50,457**	**-23.7**

NA-Not applicable; NE-Not estimated; NO-Not occurring

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

3.1 National Circumstances and Institutional Arrangements

3.1.1 National Circumstances

In terms of the **governance structure**, 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. Politically and administratively speaking, the Portuguese Republic structure is based on a tripartite division of its territory consisting of Districts (total of 20), Municipalities (total of 308) and Parishes (total of 3092).

In terms of **demographic evolution**, 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.

Between 2011 and 2020, Portugal's resident population decreased from 10,558,950 to 10,394,297 people. In 2021, the population was estimated at 10,421,117, marking a slight increase compared to previous years. The population had been declining until 2018, but in 2019, Portugal experienced the greatest population increase of the decade, largely due to net migration outpacing the natural population decrease over the past decade. In 2021, the population grew by 26,820 compared to 2020, corresponding to a crude rate of increase of 0.26%.

In 2022, the population continued to grow, driven by positive net migration that outweighed the negative natural balance. The demographic aging trend persisted, with a decline in the young and working-age populations, and a rise in the elderly population. On December 31, 2022, the resident population was estimated at 10,467,366, representing a crude rate of increase of 0.44%. This growth was a result of a crude rate of natural increase of -0.39% and a crude rate of net migration of 0.83%.

Similarly, in 2023, the population increased due to continued positive net migration, which offset the negative natural balance. The trend of demographic aging continued, with fewer young people

and working-age individuals, and more elderly people. By December 31, 2023, the resident population was estimated at 10,639,726, showing a crude rate of increase of 1.16%. This was the result of a crude rate of natural increase of -0.31% and a crude rate of net migration of 1.47%.

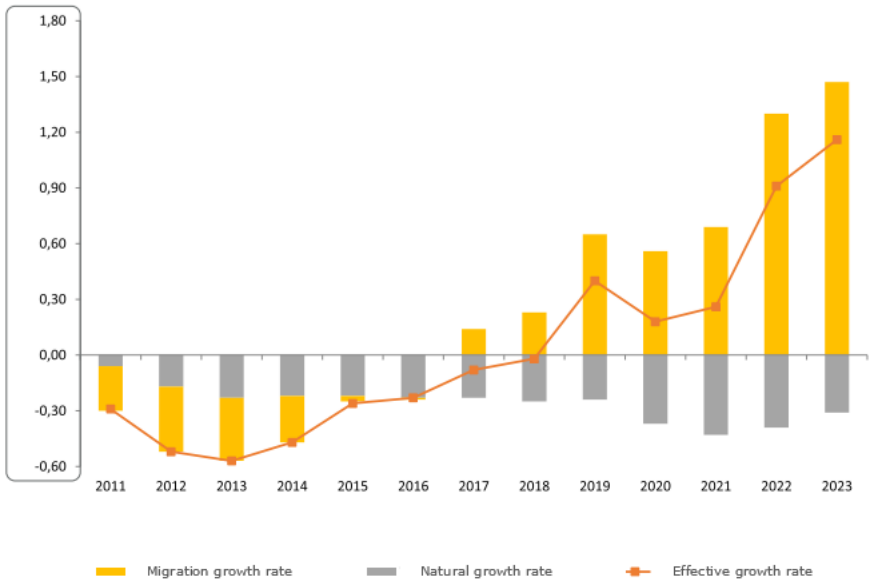

Figure 3.1 – Natural, migratory and effective growth rates in Portugal (Source: APA, REA 2024)

This population increase will have been due to the migration growth rate, which has been positive since 2017 and has surpassed the natural growth rate, which has been negative for more than a decade. The migration balance went from 0.69% in 2021 to 1.47% in 2023, offsetting the population loss due to the negative natural balance, which for the same years was -0.24% and -0.31% respectively.

The imbalances in population distribution and the territorially differentiated age structure justify the different magnitudes of the phenomenon of population loss and population ageing in Portugal, which are observed above all in inland regions in the north and south of mainland Portugal. A positive effective growth rate between 2019 and 2023 has been estimated for most of the territories located on the coast.

Between 2015 and 2023, the proportion of young people (under 15 years old) in the total population decreased from 14.2% to 12.8%. Similarly, the share of working-age individuals (15 to 64 years old) decreased from 65.0% to 63.1%. In contrast, the proportion of elderly people (65 or older) increased by 3.2 percentage points, from 20.9% to 24.1%. As a result, the aging ratio grew from 147.6 to 188.1 elderly people for every 100 young people.

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, the resident population is also concentrated near the city of Funchal.

Regarding the **geographical profile**, Portugal's territory has a total area of 92 225.20 km^2, 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).

Table 3.1 - Area, perimeters, maximum extension and altitudes by NUTS I, 2020 (Source: Directorate-General for Territory, 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

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 km2 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 km2 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).

Regarding the **portuguese economy**, preliminary data for 2023 indicate that the Gross Domestic Product (GDP) registered a volume increase of 7.0% and 2.5% in 2022 and 2023, respectively. Between 2016 and 2023, GDP grew at an average annual rate of 2.2% in volume, with positive variation rates exceeding 2% throughout the period, except in 2020, when it contracted by 8.2% due to the adverse effects of the pandemic on economic activity. During the same period, exports, despite exhibiting positive variation rates, with the usual exception of 2020, were less dynamic than imports. Notably, exports experienced strong growth following the pandemic but saw a significant slowdown in 2023 (3.4%), lower than the performance at the beginning of the period.

Imports, on the other hand, recorded the second-highest average growth rate (4.2%), with variations of 11.3% and 1.7% in the last two years, significantly lower than those of exports (17.2% and 3.4%), which benefited the external balance of goods and services.

Nominal GDP per capita grew by an average of 5.0%, reaching 25,275 euros in 2023 (up from 17,997 euros in 2016). Noteworthy are the strong growth rates observed in 2021 (7.5%), 2022 (12.0%), and 2023 (8.5%). However, it is important to highlight the context of inflation in the last two years, which was much higher than in the rest of the period, as well as the sharp decrease (6.5%) in 2020.

Employment (measured by the number of employed people) always recorded positive variation rates, except in 2020, when it contracted by 2.0%. The average growth during this period was 1.5%, 0.6 percentage points lower than GDP. When considering hours worked, a more suitable indicator for measuring work intensity in the economy, an increase of 1.3% is observed, 0.2 percentage points lower than the variation in the number of employed persons. The dynamics of the two indicators were particularly pronounced during the pandemic year, when hours worked contracted more sharply, and in the following two years, when the opposite was observed with the recovery of economic activity.

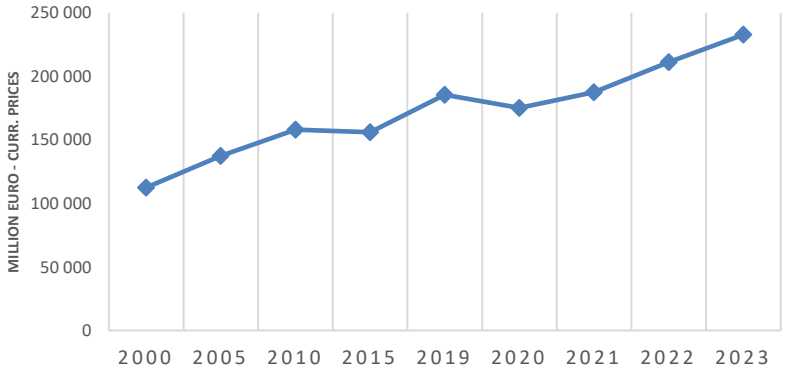

Figure 3.2 – Evolution of the GDP (Source: Office for Strategy and Studies (GEE), Portugal's main economic indicators, 2024)

The **climate profile** 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.

In 2023, the country experienced its second warmest year on record, surpassed only by 2022. The annual average temperature reached 16.59°C, exceeding the 1981-2010 norm by 1.04°C. Extreme heat events were widespread, with seven heat waves occurring throughout the year across spring, summer, and autumn. Notably, there were 102 daily maximum temperature records, including nine absolute records set in August.

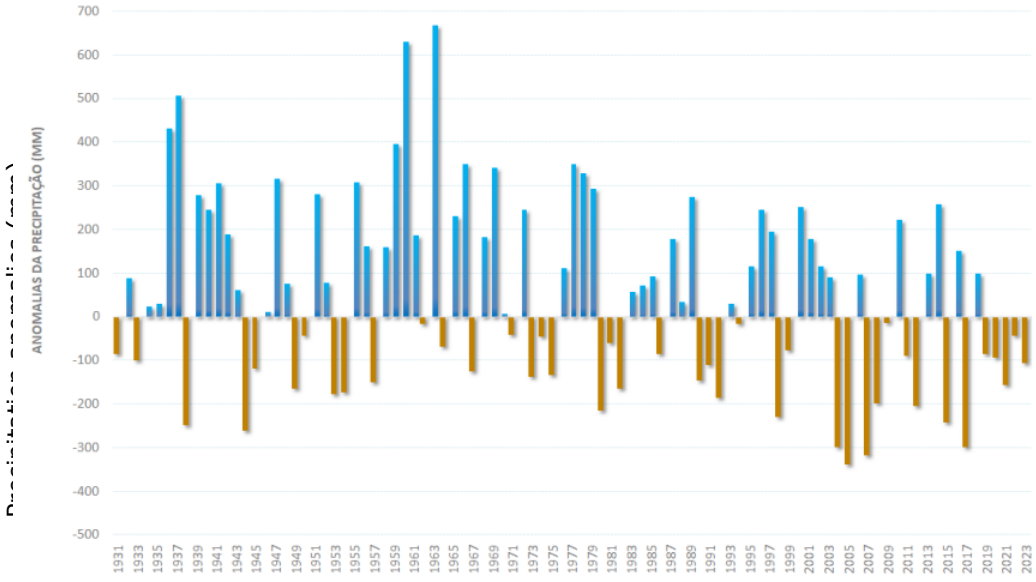

Figure 3.3 – Anomalies in the amount of annual precipitation in mainland Portugal, in relation to the 1981-2010 (Source: IPMA, 2023 Annual Bulletin, 2024)

Precipitation in 2023 remained below average, with a total of 735.8 mm, which is 76 mm less than usual. Remarkably, 60% of the rainfall was concentrated in just three months (January, October, and November), underscoring the increasingly uneven distribution of precipitation. Additionally, 30-40% of the territory endured severe to extreme drought conditions between April and August, primarily in southern regions.

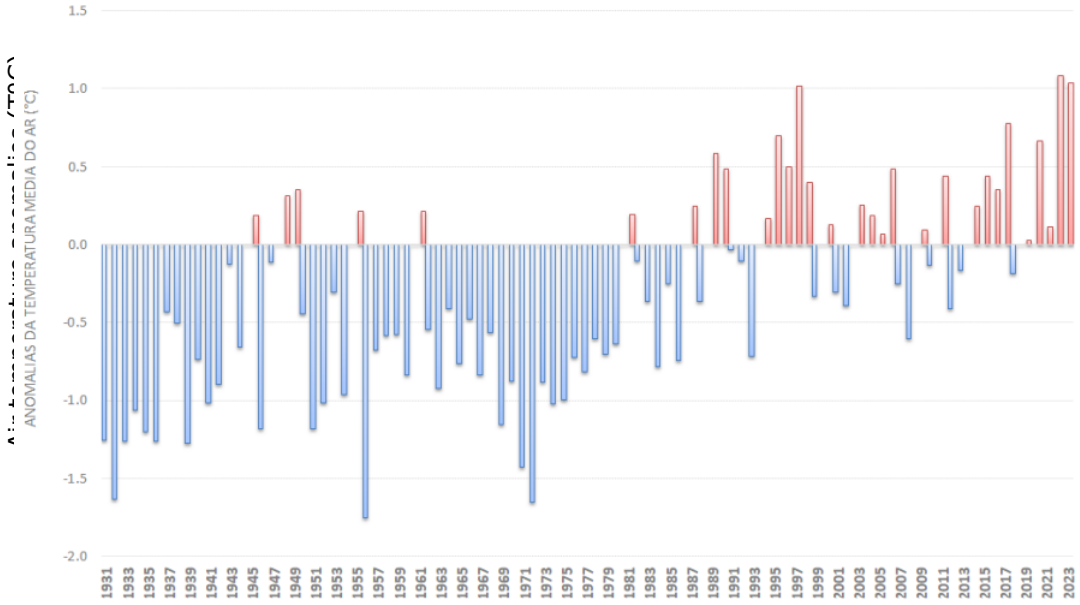

Figure 3.4 – Average annual temperature anomalies in relation to the 1981-2010 normal (Source: IPMA, 2023 Annual Bulletin, 2024)

These recent observations align with longer-term trends. Since the mid-1970s, Portugal's average temperature has been increasing at 0.3°C per decade, with heightened intensity and duration of heat waves. Precipitation has been steadily decreasing, contributing to more frequent and prolonged droughts, particularly in the past two decades. Six of the ten driest years occurred post-2000, with 2005 remaining the driest year on record.

This persistent warming and drying trend pose significant challenges, emphasizing the need for adaptive water management and climate resilience strategies to mitigate impacts on ecosystems, agriculture, and urban areas.

At sectoral level, and regarding the **energy sector**, Portugal has continued its significant progress in the present decade, with an emphasis on renewable energy, energy efficiency, and the security of energy supply, while striving to reduce its dependency on energy imports.

Portugal has advanced towards achieving increasingly higher levels of renewable energy integration across various sectors, in line with the objectives set by the national Climate Law. The country has exceeded the European average with a significant increase in the share of renewable energy in gross final energy consumption, which has risen by 15.2 percentage points since 2005.

In the electricity sector specifically, Portugal ranked as the fourth EU country with the highest level of renewable energy integration in 2022, showing an increase of 33 percentage points since 2005.

As a result, Portugal has significantly reduced its energy dependency on external sources, decreasing by 17.6 percentage points since 2005. The country has also increased domestic energy

production and reduced primary energy consumption by 21.3% compared to 2005, which has contributed to higher levels of energy supply security.

The energy sector has played a key role in the Portuguese economy by creating a new industrial and business sector that generates employment, stimulates regional development, promotes exports of goods and services, drives scientific research and innovation, attracts international investment, and supports the internationalization of national companies.

It is also important to highlight Portugal's trajectory in energy and climate matters over recent years, particularly its ability to decouple Gross Domestic Product (GDP) from CO2 emissions and primary energy consumption - a trend that persisted in 2022. This means that Portugal has been generating wealth with lower emissions and reduced energy consumption, which brings clear benefits to both the economy and society. This path of reducing total CO2 emissions is expected to continue in the coming decades as Portugal focuses on developing a low-carbon economy, especially through the generation of electricity from renewable energy sources and the use of renewable gases. This transformation is expected to span all sectors of activity, both energy and non-energy, considering their respective decarbonization potential, and will be supported by improvements in energy efficiency, optimization, and the integration of production processes.

As of 2022, Portugal's energy resources remain predominantly derived from renewable sources, with renewable electricity accounting for 61% of total electricity consumption. This electricity is generated largely from wind, hydro, and photovoltaic sources, underscoring the country's strong reliance on clean energy. Renewable electricity generation has grown substantially, reflecting the country's investments in expanding its wind and solar energy capacity.

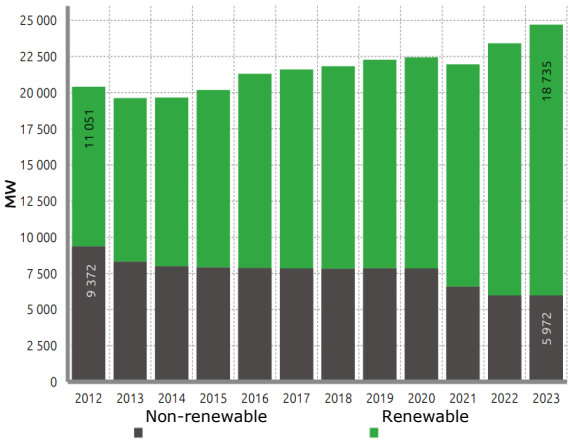

Figure 3.5 – Renewable installed capacity (Source: DGEG, 2024)

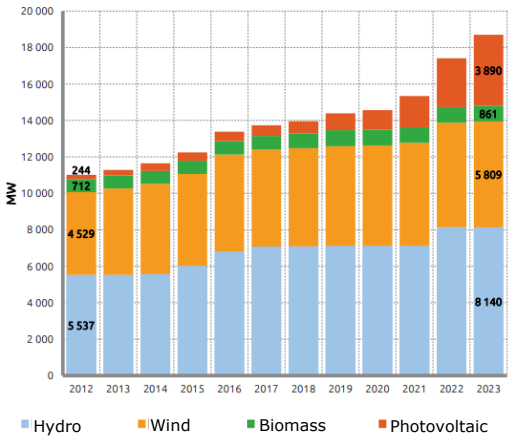

Figure 3.6 - Renewable installed capacity (Source: DGEG, 2024)

Between 2012 and 2023, the installed capacity for electricity production in Portugal increased by approximately 21%, driven largely by the expansion of renewable energy. During this period, the installed capacity of power plants producing electricity from renewable sources raised significantly by 7.7 GW, representing a 69.5% increase. In contrast, the capacity of power plants relying on non-renewable sources decreased by 3.4 GW, equating to a 36.3% reduction.

Photovoltaic technology experienced remarkable growth, with its installed capacity expanding at an average annual rate of 28.6%, reaching 3.9 GW by 2023. Wind power capacity also grew steadily, increasing at an average annual rate of 2.3% over the same period. Approximately 45% of the installed capacity of hydroelectric power stations was accounted for by pumped storage, which plays a crucial role in energy storage and grid stability.

While geothermal power represents a relatively small capacity nationally, with an installed capacity of 34 MW, it is notable for constituting 28.9% of the installed capacity in the Autonomous Region of the Azores, highlighting its regional importance despite its modest contribution at the national level.

In 2022, total primary energy consumption was 21,315 ktoe, 2.4% higher than in 2021, with the main source of primary energy continuing to be oil (42.0%), followed by renewables (30.8%) and natural gas (22.6%).

Final energy consumption in 2022 was 16,521 ktoe (+2.3% compared to 2021), with the main energy source continuing to be oil (45.0%), followed by electricity (25.3%), renewables without electricity (12.6%), natural gas (9.9%) and heat from cogeneration (6.6%).

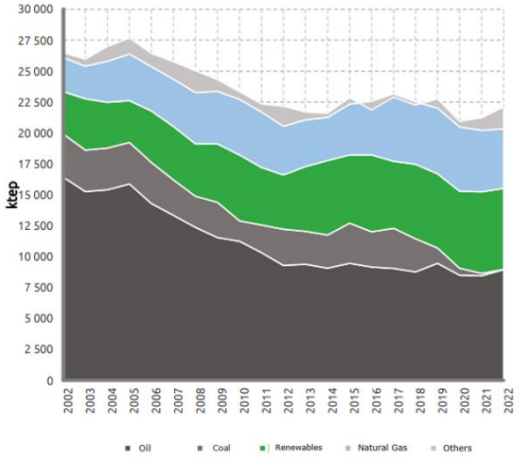

Figure 3.7 - Evolution of total primary energy consumption (Source: DGEG, 2024)

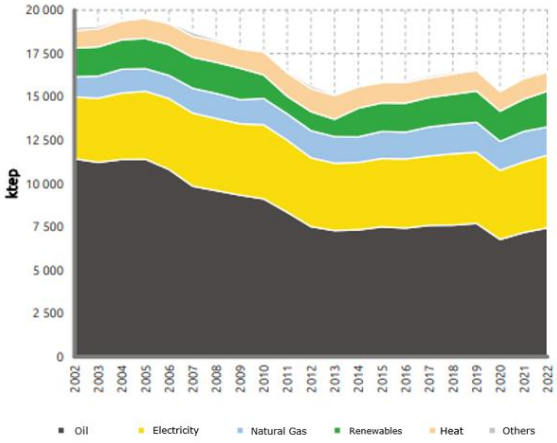

Figure 3.8 - Evolution of total primary energy consumption (Source: DGEG, 2024)

Portugal has maintained its focus on reducing energy import dependency, and the share of renewable energy in the national energy mix has been crucial to this effort. Between 2019 and 2022, the country continued to reduce its energy dependency, with the energy import dependency falling from 74.2% in 2019 to 71.2% in 2022, showing continued progress toward energy autonomy. This reduction has been facilitated by the rapid expansion of renewable energy infrastructure and a growing emphasis on energy efficiency measures.

Despite these progresses, Portugal remains a net importer of crude oil, as there is no domestic production, and all crude oil is imported. The country has committed to reducing its reliance on fossil fuels through the national Climate Law, approved in 2021. Additionally, the phase-out of

coal in electricity generation, completed in 2021, marked a major milestone in the country's transition to cleaner energy sources.

The transport sector continues to be the primary consumer of energy, representing 35.7% of total final energy consumption in 2022, an increase of 1.2% compared to 2021, and slightly below the value recorded in 2012 (36.1%). Over the last 20 years, industry sector reduced its weight in energy consumption (-4.5 p.p.), while the services sector increased (+3.1 p.p.).

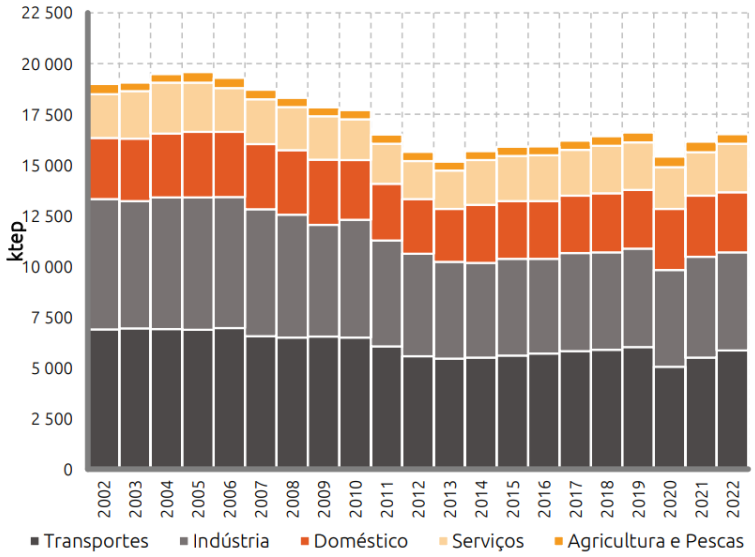

Figure 3.9 - Final energy consumption by sector of activity (Source: DGEG, 2024)

Energy is the most important sector for GHG emissions, accounting for about 67 % of total emissions in 2022 with a decrease of 7 % over the period 1990-2022. The energy industry and transport are the two main sources accounting for 15 % and 30 % of total emissions, respectively.

Within the energy industries, public electricity and heat production represented 12 % of the total emissions in 2022. This sector reduced prominence since 2017 (66 % reduction from 2017 to 2021), due to both the effect of the increased importance of renewable energy in electricity generation and the phasing out of coal-fired electricity generation.

Regarding the **transport sector**, in 2022, Portugal's motorized vehicle fleet grew to over 7.2 million, up 2.2% from 2021, contrasting with the slight decline recorded in 2020 when the fleet was at 7.0 million, dropping by 0.1%. Diesel-powered light passenger vehicles dominance maintained at 56.5% of the fleet, consistent with 2020 figures**,** also similar to 2020 levels. Electric vehicles saw exponential growth, reaching over 80.271 registrations until 2022 - a stark rise from 33,898 until 2020 - representing an increase of 54% on the previous year. In 2022, the Electric Mobility Network reached full coverage of the national territory (308 municipalities).

Despite these advances, the fleet's age profile remains largely unchanged, with a significant proportion of vehicles still over 10 years old.

In 2021, the metropolitan areas of Lisbon and Porto stood out in terms of the use of public transport, with more than 20% of the population opting for this mode of transport. In contrast, the use of walking is more evident in some inland regions.

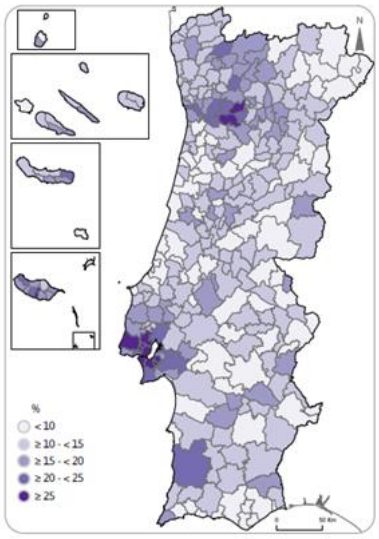

Figure 3.10 - Proportion of the population using public transport for commuting, by municipality, 2021 (Source: DGT, REOT 2024)

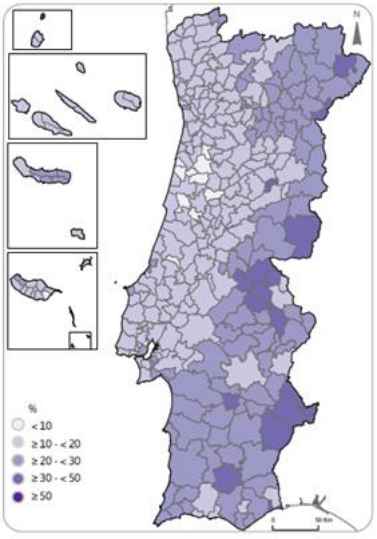

Figure 3.11 - Proportion of the population using the pedestrian mode for commuting, by municipality, 2021 (Source: DGT, REOT 2024)

The road transport is one of the sectors that have risen faster since 1990, due to the steady growth of vehicle fleets (specially with more powerful engines) and road travel from 1990 to the early 2000s, reflecting the increase in family income and the strong investment in the road infrastructure of the country in the 1990s and 2000-10s decades. This trend stabilised in the early 2000s and begin to decline in 2005. However, a reversal of this trend has been observed in recent years, with transport emissions increasing since 2013.

In the **industry sector**, where emissions resulting from physical and chemical processing of raw materials in industrial processes are included, and without considering the 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, 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 SF6 and PFCs, Use of N2O in medical applications); Other (Paper, Pulp, Food and Beverages Industry).

Industrial processes and products use (IPPU) represent about 10 % of the Portuguese emissions in 2022 and have decreased approximately 8 % since 1990.

Emissions from this sector, which are generated as by-products of many non-energy-related activities, have been driven particularly until the mid-2000s by the evolution of the mineral and chemical industry. From the late 2000s onwards, chemical industry contribution has been reduced significantly, mainly due to the end of ammonia production.

On the other hand, Products Uses as ODS substitutes (2F) have progressively gained importance, representing about 34% of total IPPU emissions in 2022, which, together with the mineral industry, are the main sources from industrial processes sector (34% in 2022). It is followed by chemical industry (9% in 2022) and non-energy products from fuels and solvent use, mainly from solvent Uses and asphalt for road paving (3,6%).

Most of the GHG emissions are released directly as CO_2, (64,3% in 2022) while N_2O represents a smaller share of emissions as it is related to the production of nitric acid and the use of N_2O for medical purposes, and CH_4 emissions are not relevant. Fluorinated gases have become a relevant source of GHG emissions (34,4% in 2022).

Mineral industry, mostly clinker production for the manufacture of cement, is the most relevant industrial sector at national level, accounting for 50% of GHG emissions from industrial processes in 1990 and 38% in 2022.

From 2008 to 2012 there was a significant decrease in clinker production (Figure 3.12 – Clinker production (NIR and INE (National Statistic Institute)) 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.

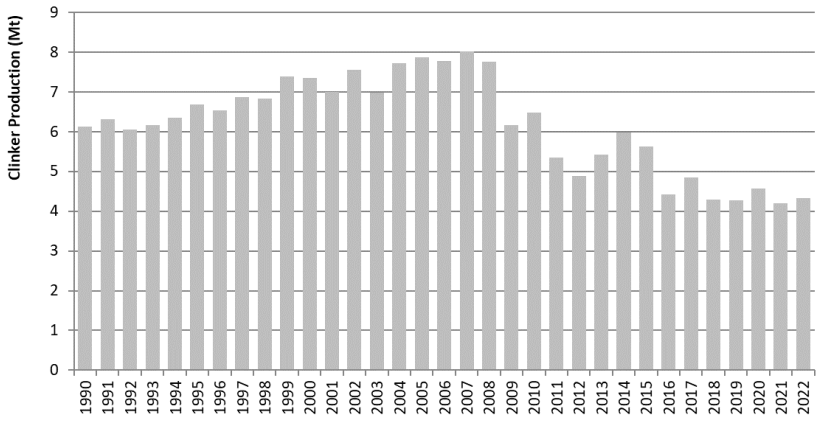

Figure 3.12 – Clinker production (NIR and INE (National Statistic Institute))

In the chemical industry the most relevant in terms of GHG emissions it´s the production of ethylene (petrochemical production), that represents 95% of the total emissions from this sub-sector. The remaining share comes from the production of nitric acid. Since 2011, there has been a substantial reduction in N2O emissions from nitric acid production, due to the installation of a new catalytic converter in one of the plants, the clusure of old facilities and the commissioning of new plants with a lower emission profile.

In Metal Industry, there are two iron and steel production plants operating in Portugal that accounts almost 80% of the total GHG emissions in this subsector.

In terms of Consumption of Fluorinated Gases, there has been a considerable increase in the representativeness of emissions related to the consumption of fluorinated gases when compared to total emissions from industrial processes between 1995 and 2020. 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. In 2022, the most relevant sectors are: Commercial Refrigeration (47%) and mobile Air Conditioning (31%).

In 2022, the Industrial Production Index increased by 0.3%, reinforcing the 3.0% increase recorded in the previous year. The direct entry of materials into the national economy for production or consumption decreased by 8.2%. The main products produced in 2022, considering the sales value, were products from the *Manufacturing of coke, refined petroleum products and fuel agglomerates*, namely *Diesel and Marine Diesel and Gasoline for engines*, followed by *Other parts and accessories for vehicles automobiles, tractors and vehicles for special uses* and by *Passenger motor vehicles*.

The **agricultural sector** is mainly governed 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. According to the 2019 Agricultural Census

conducted by INE, approximately 290,000 farms were registered -15,000 fewer than in 2009 - representing 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 farm size also increased by 13.7%, rising from 12.0 hectares in 2009 to 13.7 hectares of SAU per farm in 2019.

The reform of the Common Agricultural Policy (CAP) for the period 2023-2027 came into effect on January 1, 2023, paving the way for a fairer and more environmentally friendly CAP, aiming to ensure a sustainable future for European farmers in line with the ambitions of the European Green Deal, the Farm to Fork Strategy, and the Biodiversity Strategy.

The new CAP approach, based on performance and results, is more flexible and considers local conditions and needs, while simultaneously raising the EU's sustainability ambitions. It is distributed between two funds (commonly referred to as the "two pillars" of the CAP): the European Agricultural Guarantee Fund (EAGF) and the European Agricultural Fund for Rural Development (EAFRD). The CAP is structured around ten specific objectives, which also form the basis for Member States to design their national strategies – the CAP Strategic Plans for the period 2023-2027 (CSPs). These objectives include ensuring fair income for farmers; increasing competitiveness; improving the position of farmers in the food chain; addressing climate change; protecting the environment; preserving landscapes and biodiversity; supporting generational renewal; promoting dynamic rural areas; ensuring food quality and health; and fostering knowledge and innovation.

Portugal's strategy, outlined in its National CAP Strategic Plan (PEPAC)[1], combines regional and national elements and is based on the active management of the entire territory, with an emphasis on innovative and sustainable agricultural and forestry production. This strategy is implemented through a regulatory framework such as conditionality and CAP instruments funded by the EU through EAGF and EAFRD, via direct payments. These include ecological schemes, sector-specific measures for fruits and vegetables, vineyards, and beekeeping, and rural development instruments, notably agro-environmental and climate measures.

A key innovation in direct payments is the establishment of ecological schemes that incentivize participation in annual commitments with environmental and climate objectives. In this context, a wide range of support measures have been defined, with commitments that have the potential to contribute to decarbonization, either through carbon sequestration or emissions reduction.

These measures include "Organic Farming," "Integrated Production – Agricultural Crops," "Management of Permanent Pastures," "Promotion of Organic Fertilization," "Improvement of Animal Feed Efficiency for GHG Reduction," and "Animal Welfare and Rational Use of Antimicrobials." Within rural development, agro-environmental and climate measures have been established to promote participation in multi-annual commitments with decarbonization potential, such as "Direct Seeding," "Greening of Permanent Crops," "Biodiverse Pastures," "Montados and Wetlands," and "Management of Montados by Results." Furthermore, the PEPAC provides a set of

[1] Approved by the European Commission on August 31, 2022 (C(2022) 6019 final)

investment support measures, particularly for improving the environmental performance of agricultural holdings, which finance initiatives like precision agriculture and livestock effluent management, with direct and significant impacts on the decarbonization of the sector.

Agriculture is a significant source of GHG emissions, accounting for 12.3% of emissions in 2022, a decrease of 5.3% since 1990. This is linked to the reduction in livestock production of some categories of animals (sheep and pigs) and, more recently, dairy cattle. In addition, the intensification of cattle production (non-dairy cattle) and the reduced use of fertilisers, to some extent linked to the conversion of arable land to pasture, also contribute to this trend.

Regarding the **forest sector**, according to the National Forest Inventory (IFN6), mainland Portugal has a forested area of 3.224 thousand hectares, corresponding to more than 36% of the overall land cover, dominated by maritime pine, eucalyptus and cork oak, the latter concentrated in certain regions, while other species are also important, particularly oaks.

In the context of forestry activity, between 1995 and 2018, around 1,706,000 ha of forest, eucalyptus, maritime pine and stone pine, remained without major fluctuations, although with variations in the proportions and territories respectively occupied. Portugal saw an increase in eucalyptus areas and a reduction in maritime pine areas.

The new forest areas resulted essentially from the conversion of scrubland (145,000 ha) and agriculture (127,000 ha). In the same period, forest areas essentially lost area to scrubland (86,000 ha), to artificialized areas (41,000 ha), but also to agriculture (40,000 ha) and agroforestry systems (23,000 ha), for a net balance of 82,000 ha more.

Extensive areas of forest have a high potential for building up a carbon stock, the stability of which is, however, jeopardized by the soil and climate characteristics and the difficulties of integrated management, which lead to high vulnerability to rural fires.

Even the extensive areas of cork oak and holm oak forests and agroforestry systems that cover a significant part of the territory have increased their vulnerability as a result of their exposure to adverse climatic conditions.

The Vulnerable Forest Territories, delimited in 2020, correspond to around 3.3 million hectares of continental territory and include 1279 parishes, with a population of 1.3 million inhabitants, in all or part of 164 municipalities. These territories correspond to Municipalities on the mainland where more than 40% of the territory is at risk from high and very high risk of rural fire, including those that are completely surrounded by parishes that meet the aforementioned criterion.

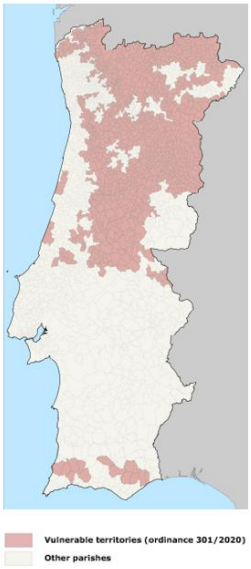

Figure 3.13 - Map of vulnerable territories (Source: DGT, 2024)

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.

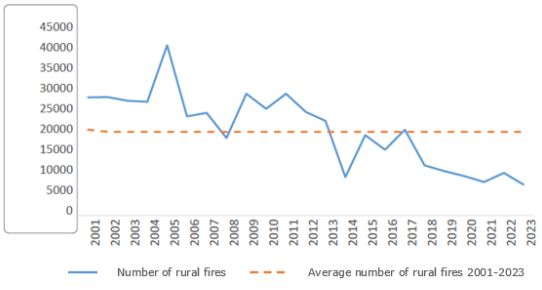

Figure 3.14 - Evolution in the number of rural fires 2021-2023 (Source: DGT, REOT 2024)

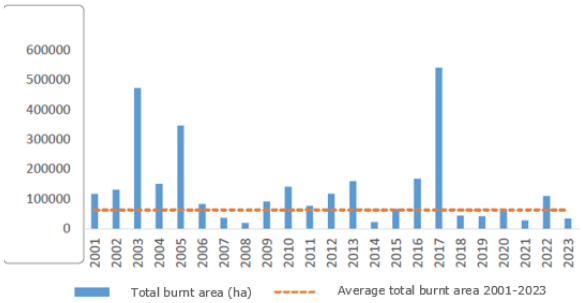

Figure 3.15 - Evolution of the total burnt area in mainland Portugal, 2021-2023 (Source: DGT, REOT 2024)

Within the guidelines of the National Forestry Strategy and the Regional Forest Management Programs, the existence of landowner associations and groups in the territory has proved decisive in promoting the active management, planning and revitalization of forest areas, especially in areas of small landholdings. The creation of Forest Intervention Zones (ZIF) has seen a positive

trend and in 2022 there were a total of 270 ZIF covering an area of 1,933,196 ha. The territorial distribution of the ZIFs has remained relatively constant, although the proportion of the municipality's area has increased in some municipalities in the North, Center and Alentejo regions.

Estimates of emissions and sinks from the Land Use Change and Forestry category show that this sector is a carbon sink in 1992. However, as mentioned above, the emissions in this sector are strongly linked to forest fires. Thus, in 2003, 2005 and most recently in 2017, this sector became a net emitter again due to the severe forest fires in those years. Since 2018, the sector is a sink.

Regarding the **waste sector**, it is important to highlight that 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. Consequently, composting has been growing in importance (except 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 in biodegradable waste in landfills. The recovery of biogas at landfills has been also growing importance along the years.

In 2022, the production of urban waste in Portugal amounted to 5.05 million tons (t), remaining almost unchanged compared to 2021, with a growth of 0.7 percentage points, corresponding to an annual uptake of 507 kg/inhab.year[2] and a daily production of urban waste of 1.4 kg per inhabitant. These figures reflect a steady decline in waste production since 2019, reversing the growth trend that had been observed since 2014.

[2] Value estimated on the basis of the average annual resident population

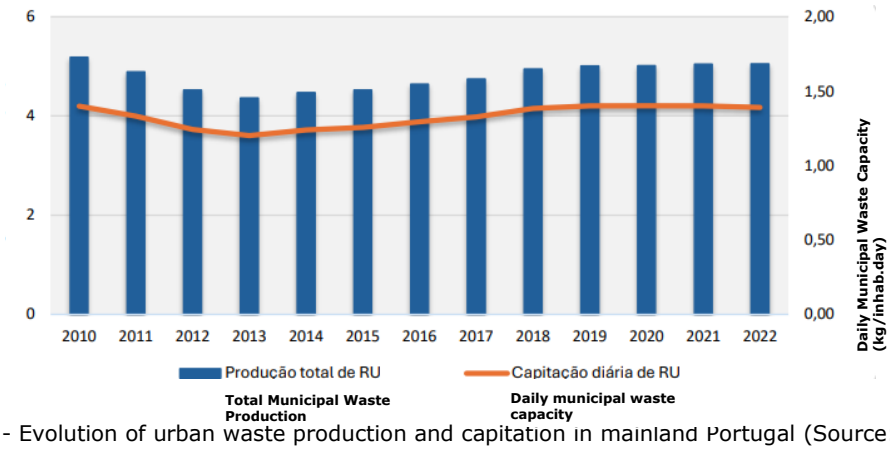

Figure 3.16 - Evolution of urban waste production and capitation in mainland Portugal (Source: APA, REA 2024)

Regarding collection, although there has been a favorable evolution in selective collection over the years, a more significant growth rate was expected compared to the rate of undifferentiated collection. Without prejudice, the slight annual increase in selective collection seems to have been achieved at the expense of a decrease in the collection, as intended.

In the current decade, a significant boost is expected in the weight of selective collection in relation to total collection, following the publication of the Strategic Plan for Municipal Waste 2030 (PERSU 2030)[3], with ambitious targets and the obligation that, by December 31, 2023, bio-waste must be separated and recycled at source, or collected selectively and not mixed with other types of waste, as determined by the Waste Framework Directive[4].

In terms of final disposal, 57% of the waste produced in mainland Portugal was sent to landfills, while 15% was directed to energy recovery. The proportion of waste sent to landfills continues to represent a significant share of total waste production, having increased by 1 percentage point compared to the previous year. Conversely, there was a 4 percentage point decrease in the proportion of waste directed towards energy recovery compared to 2021.

Despite the challenges of this sector, important to highlight the stabilization in municipal waste production between 2019 and 2022, reversing the upward trend observed in previous years. It is also worth noting that, unlike in previous years, Portugal recorded a per capita waste production below the European average.

Waste accounts for about 10% of Portuguese emissions in 2022 and has increased by 26.2% since 1990. The sector recorded a significant increase in emissions up to 2004 (around 57%), which is linked to the increase in waste generation (linked to the development of household income and the increase in urbanization in the country during the 1990s) and the deposition of waste, mainly in landfills. The reduction in emissions in the following years is linked to the

[3] Approved by Council of Ministers Resolution no. 30/2023

[4] Directive (EU) 2018/851 of the European Parliament and of the Council of 30 May 2018

recovery of biogas from waste and the promotion of mechanical and biological treatment with the aim of diverting municipal waste from landfills and increasing recycling. Most recently, emissions have increased by 1.2% from 2015 onwards, mainly due to the increase in the number of wastewater treatment plants with tertiary treatment (N-removal).

3.1.2 Institutional arrangements for tracking progress

As an EU Member State, Portugal contributes to the implementation of the European Union's NDC. To track progress of its implementation and achieving the European target for 2030, institutional arrangements are in place both on the EU-level as on Member State level, as outlined below. As such, those sections regarding specific arrangements at the EU-level may contain common text for the BTRs of the EU and the Member States.

Institutional arrangements in the European Union

The EU's Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action ('Governance Regulation')[5] establishes a governance mechanism and specific arrangements to track the progress of the Union and its Member States towards the implementation and achievement of the EU's climate and energy targets and commitments under the UNFCCC and the Paris Agreement. These arrangements include the monitoring of GHG emissions and removals, the reporting of policies and measures, projections of GHG emissions and removals and progress on adaptation to climate change.

Under the Governance Regulation, the EU has established a Union Inventory System to ensure the timeliness, transparency, accuracy, consistency, comparability and completeness of the data reported by the EU and its Member States. This inventory system includes a quality assurance and quality control program, procedures for setting emission estimates, and comprehensive reviews of national inventory data to enable the assessment of compliance towards climate goals.

Each EU Member State compiles its GHG inventory in accordance with the requirements of the Paris Agreement[6] and the relevant Intergovernmental Panel on Climate Change (IPCC) guidelines[7]. Inventory data on GHG emissions and removals, including information on methods, are submitted electronically using a reporting system managed by the European Environment Agency (EEA). The submitted data are subject to quality control procedures and feed into the compilation of the GHG inventory of the EU. Net GHG emissions, calculated from emissions and removals reported

[5] Regulation (EU) 2018/1999 on the Governance of the Energy Union and Climate Action, http://data.europa.eu/eli/reg/2018/1999/oj

[6] Chapter II of the annex to decision 18/CMA.1, https://unfccc.int/documents/193408; and decision 5/CMA.3, https://unfccc.int/documents/460951

[7] 2006 IPCC Guidelines for National Greenhouse Gas Inventories, https://www.ipcc-nggip.iges.or.jp/public/2006gl/; and on a voluntary basis: 2019 Refinement to the 2006 IPCC Guidelines for National Greenhouse Gas Inventories, https://www.ipcc.ch/report/2019-refinement-to-the-2006-ipcc-guidelines-for-national-greenhouse-gas-inventories/

in the GHG inventory of the EU, are the key information used for tracking progress towards the EU NDC target of at least -55% net emission reduction by 2030 compared to 1990.

Given the scope of the EU NDC related to international aviation and navigation, a specific share of international aviation and navigation emissions as reported in the GHG inventory data is calculated based on the Joint Research Centre's Integrated Database of the European Energy System (JRC-IDEES)[8]. Details on the methodology applied to identify GHG emissions from international aviation and navigation in the scope of the EU NDC, which are added to the national totals from the EU GHG inventory, are given in Annex II to this BTR.

Under Governance Regulation each Member State must report to the Commission biennially on the status of implementation of its integrated national energy and climate plans (NECPs). This process allows the Commission to ensure that the EU and the Member States remain on track to achieve the climate-neutrality objective and progress on adaptation. Under Governance Regulation, Member States further operate national systems for policies and measures and projections and report standardised information, which is subject to quality and completeness checks. Based on the submitted data, the EEA compiles projections of GHG emissions and removals for the EU. The EU-wide information is summarised annually in the Climate Action Progress Report[9] by the European Commission and in the 'Trends and projections' report by the EEA[10]. Both the Union and the national systems are subject to continuous improvements.

The national energy and climate plans (NECPs) were introduced by the Governance Regulation. For Member States, the NECP for 2021-2030 plays a key role in enabling the tracking of progress towards the 2030 climate and energy targets. The update of the NECPs provides an opportunity for Member States to assess their progress, identify gaps and revise existing measures or plan new ones where needed.

Member States were due to submit their final updated NECPs, taking account of the Commission's assessment and recommendations, by 30 June 2024. Member States also report biennially on the progress of implementation of their National Energy and Climate Plan, the so-called "NECP Progress Reports", as required by the Governance Regulation. The progress reports integrate reporting on both the implementation of climate and energy policies, various indicators and the progress towards the achievement of contributions to EU targets.

[8] European Commission, Joint Research Centre, Rózsai, M., Jaxa-Rozen, M., Salvucci, R., Sikora, P., Tattini, J. and Neuwahl, F., JRCIDEES-2021: the Integrated Database of the European Energy System – Data update and technical documentation, Publications Office of the European Union, Luxembourg, 2024, https://publications.jrc.ec.europa.eu/repository/handle/JRC137809

[9] Climate Action Progress Report 2024, https://climate.ec.europa.eu/document/download/d0671350-37f2-4bc4-88e8-088d0508fb03_en?filename=COM_2024_498_F1_REPORT_FROM_COMMISSION_EN_V4_P1_3729454.PDF

[10] Trends and Projections in Europe 2024, https://www.eea.europa.eu/en/analysis/publications/trends-and-projections-in-europe-2024 https://www.eea.europa.eu/en/newsroom/news/eea-trends-and-projections

Institutional arrangements in Portugal

The GHG inventory is used to track progress in implementing and achieving Portugal commitments and other climate related national objectives. To provide the annual GHG emission estimates, a National Inventory System of Emissions by Sources and Removals by Sinks of Air Pollutants (SNIERPA) has been established.

The Ministers Resolution 20/2015, of 14th April, defines the roles of the entities that are part of the SNIERPA, namely the coordinating entity (APA), the sectorial focal points and the other entities involved.

Data from different sources are collected and processed by the inventory team, which is also responsible for the application of QA/QC procedures, the uncertainty assessment 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 cooperate with APA in the preparation of INERPA. They are responsible for promoting intra and inter-sectorial cooperation to ensure a more efficient use of resources. Their main task is to coordinate the work and participation of the relevant sectorial entities under their jurisdiction. The Focal Points are also responsible to provide expert advice on methodology, emission factors and the accuracy of the activity data used. Focal Points play a vital role in sectorial quality assurance and methodological development. They are also responsible to produce statistical information and the publication of data that are used in the inventory estimates.

The units involved are public or private bodies that generate or hold information, relevant to the INERPA and whose actions are subordinated 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 inventory.

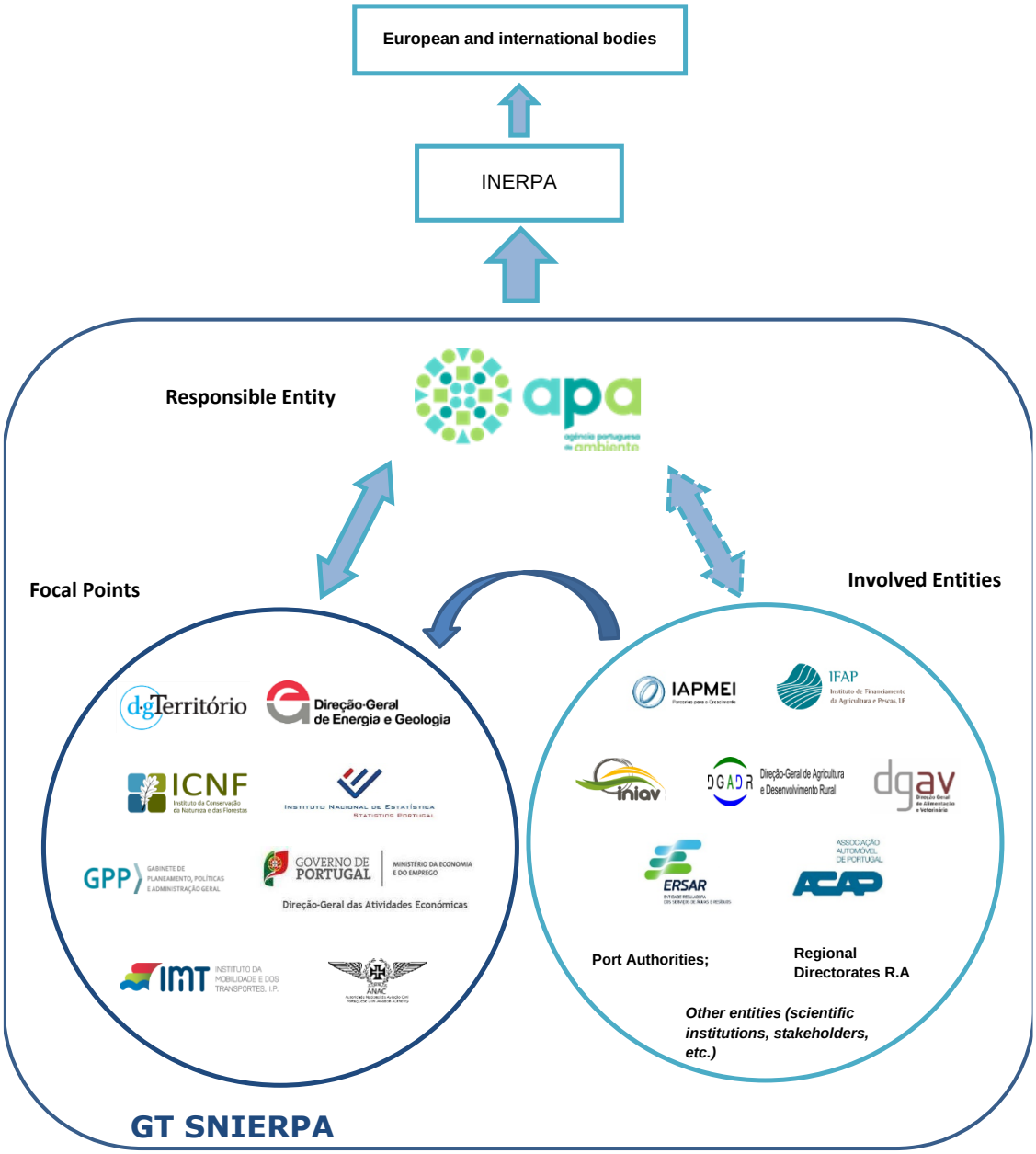

Figure 3.17 – GT SINERPA.

Important to stress that there are no arrangements in place to monitor the progress on **Internationally Transferred Mitigation Outcomes (ITMO's)** as these are not used to achieve national climate targets nor in its contribution to the achievement of the EU's NDC.

3.1.3 Institutional arrangements for implementation of the NDC

Institutional arrangements for implementation of the NDC in the European Union

The EU and its Member States have set up a comprehensive system for the implementation of the EU climate change mitigation targets. The European Climate Law[11] sets the goal of climate neutrality by 2050 and the intermediate target of reducing net greenhouse gas emissions by at least 55% by 2030 compared to 1990 levels. These targets cover emissions and removals that are regulated in the Union law.

To ensure that the EU and its Member States achieve their target, the 2030 Climate and Energy Framework was put in place. The main policies of this framework are the EU Emissions Trading System (EU ETS)[12], which caps GHG emissions in energy, industry, aviation and maritime transport; the LULUCF Regulation[13] which includes national net removal targets for the LULUCF sector; and the Effort Sharing Regulation (ESR)[14] which establishes national reduction targets for GHG emissions not covered by the EU ETS or the LULUCF Regulation i.e. domestic transport (excluding aviation), buildings, agriculture, small industry and waste. The implementation of the ESR is supported by sectoral policies and measures (details can be found in this BTR in the chapter on national mitigation policies and measures). The legislative acts under the 2030 Climate and Energy Framework require the European Commission and the EU Member States to set up institutional arrangements for implementing the specific policies and measures.

The revised EU ETS Directive increases the level of ambition in the existing system from 43% to 62% emissions reductions by 2030, compared to 2005 levels and extends the system to also apply to international maritime transport. A separate carbon pricing system will apply to fuel combustion in road transport and buildings and small-emitting sectors (ETS2) with a 42% emission reduction target compared to 2005 across the sectors covered. The amended Effort Sharing Regulation (ESR) increased, for the sectors that it covers, the EU-level GHG emission reduction target from 29% to 40% by 2030, compared to 2005, which translates in updated 2030

[11] Regulation (EU) 2021/1119 of the European Parliament and of the Council of 30 June 2021 establishing the framework for achieving climate neutrality and amending Regulations (EC) No 401/2009 and (EU) 2018/1999 ('European Climate Law') https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:32021R1119

[12] This refers to the ETS1, i.e. the Emission Trading System for stationary sources (Chapter III of the ETS Directive) and for aviation and maritime transport (chapter II of the ETS Directive). Note that the 'Emissions trading system for buildings, road transport and additional sectors' (ETS2), added in 2023 as Chapter IVa of the ETS Directive, forms an instrument under the Effort Sharing Regulation (ESR).

[13] Regulation (EU) 2023/839 of the European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/841 as regards the scope, simplifying the reporting and compliance rules, and setting out the targets of the Member States for 2030, and Regulation (EU) 2018/1999 as regards improvement in monitoring, reporting, tracking of progress and review https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A32023R0839

[14] Regulation (EU) 2023/857 of European Parliament and of the Council of 19 April 2023 amending Regulation (EU) 2018/842 on binding annual greenhouse gas emission reductions by Member States from 2021 to 2030 contributing to climate action to meet commitments under the Paris Agreement, and Regulation (EU) 2018/1999 https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32023R0857

targets for each Member State. The new LULUCF Regulation sets an overall EU-level objective of 310 Mt CO_2 equivalent of net removals in the LULUCF sector in 2030.

The ESR sets national targets for the reduction of GHG emissions in the Member States by 2030. Member States are also subject to gradually decreasing annual emission limits for each year from 2021 to 2030. The annual progress towards the national targets under the Effort Sharing Legislation is assessed by comparing GHG emission levels from the sectors covered by the ESR with the relevant annual emission allocations under the legislation (AEAs). To achieve compliance under the ESR, Member States are permitted to use flexibility options to a certain extent.

Progress in the implementation of these policies and measures is monitored under the Governance Regulation. Relevant information which is reported regularly and archived at the EEA include GHG inventories, approximated GHG inventories for the previous year, information on policies and measures, projections, and progress towards the implementation of integrated 2030 National Energy and Climate Plans (NECP 2030). This information helps the EU and its Member States to correct their course if progress towards the targets of the 2030 Climate and Energy Framework is behind schedule. As an example, the European Commission assesses the drafts of new or updated NECPs and provides recommendations for improved planning and implementation. In addition, the reported information is subject to quality checks, and the GHG inventories reported by EU Member States are subject to comprehensive reviews in 2025, 2027 and 2032.

All EU legislation, including the legislation under the 2030 Climate and Energy Framework, is subject to a stakeholder engagement process. So-called 'better regulation tools' ensure that policy is based on evidence and the best available practice. During the preparation of legislative proposals, the European Commission invites citizens, businesses and stakeholder organisations to provide their views on the subject of the new legislation. These comments are documented in a dedicated portal, and the European Commission reports on how it takes these comments into account in the development of the legislative proposals. Furthermore, the Governance Regulation sets requirements for Member States to ensure that the public is given early and effective opportunities to participate in the preparation of the NECPs.

Institutional arrangements for implementation of the NDC in Portugal

As mentioned before the member of the government responsible for the climate mitigation policies is the Minister for Environment and Energy (MAEn). Currently, and since October 2018, energy issues are also within the remit of the same Ministry. Furthermore, the mission of MAEn 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.

APA remains under the MAEn, and it also retains the competence to propose, develop and monitor the implementation of environmental policies, notably in the fight against climate change.

In 2016, it was established that a single environmental fund - the Environmental Fund (FA) - should be created by aggregating resources from existing funds, so as to obtain an instrument with greater financial capacity and more adaptability to challenges. Consequently, FA toked 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 MAEn and its day-to-day management is performed by the Secretary General of MAEn.

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.

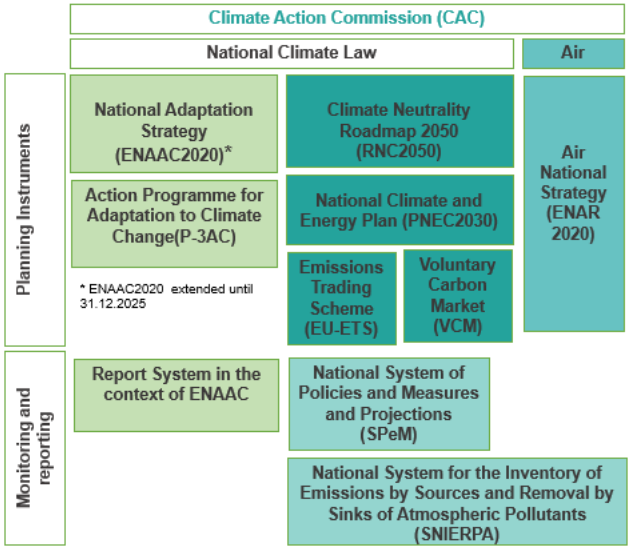

Figure 3.18 - Portuguese Climate Change Policy Architecture.

The Commission is chaired by the 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[15], 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)[16], 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. APA is the entity responsible for coordinating the SPeM and ensuring its implementation in Portugal.

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

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

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

The National Program for Climate Change (PNAC 2020/2030)[17], approved in 2015, established a set of sectoral targets and listed a set of policy options and measures to deliver the GHG emission reduction objectives established at national level for 2020 and 2030. 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)[18] was adopted, identifying 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 GHG emissions under different scenarios of socio-economic development.

RNC 2050 is the Portuguese Long-term Strategy submitted to the UNFCCC on the 20th of September 2019, in accordance with the Paris Agreement, 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.

Aligned with the long-term strategy Portugal developed an integrated National Energy and Climate Plan (NECP 2030)[19], that is now the main instrument of energy and climate policy for the 2021-2030 decade. The first version was submitted to the European Commission in December 2019, in accordance with EU Energy Union and Climate Action Governance Regulation and a revised version was submitted in December 2024.

The challenges ahead call for concerted action between energy and climate policies to chart a feasible path towards a carbon-neutral economy and society that simultaneously promotes economic growth and improves quality of life. In this sense, the NECP is fundamental to ensuring the achievement of the 2030 energy and climate targets and is geared towards the future and Portugal's long-term objectives.

Portugal approved its first national Climate Law in the end of 2021, which consolidates objectives, principles and obligations for the different levels of governance for climate action, through public policies, and establishes new climate policy provisions. Besides recognizing the climate emergency situation, and reinforcing the GHG reductions objectives at national level, it also reinforced the national commitment to achieve climate neutrality by 2050 and establishing the study, by 2025, of the anticipation of this target to 2045.

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 of sectorial and regional/local climate action plans, and enhanced transparency and participation, including by:

- creation of a climate action portal;

[17] Approved by the Resolution of the Council of Ministers No. 56/2015, of July 30th

[18] Approved by the Council of Ministers through the Resolution No. 107/2019 of July 1st

[19] Approved by Resolution of the Council of Ministers no. 53/2020, of July 10

- development of municipal and regional climate action plans, both on mitigation and adaptation;
- development of sectoral mitigation and adaptation plans;
- additional monitoring and reporting processes (including in the national budget);
- introduction of the climate legislative impact assessment;
- integration of climate risks in the decision-making of public and private institutions and agents.

The National 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.

It is also important to mention that the national Climate Law also foresees the creation of a Climate Action Council that 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 numerous developments in recent years that have brought important changes in energy and climate policy, such as the presentation of the European Green Deal[20], the subsequent approval of the European Climate Law[21] and the "Fit-for-55"[22] package presented in 2021, with a view to ensuring the alignment of all EU climate and energy legislation, with the new GHG emissions reduction target set for 2030, among other important milestones at European level or at National level such as the publication of the national Climate Law, triggered the need to review the main strategic climate instruments at national level.

Portugal have exceeded the objectives set under the Kyoto Protocol and the targets set for 2020 in terms of GHG emissions reduction, energy efficiency and renewable energies, and is currently in the process of reviewing its national long-term strategy (RNC2050) in line with the revised version of the NECP.

The main policies and measures and respective projections for the short-term were updated during the revision process of the NECP 2030. This revision was accompanied by a new public consultation process and stakeholders involvement, namely with the support of the sectorial focal points of the existing national system for policies and measures (SPeM).

[20] European Green Deal - COM (2019) 640 final - December 2019

[21] Regulation (EU) 2021/1119 of June 30, 2021

[22] "Fit-for-55" package - COM(2021) 550 final - July 2021

Autonomous Region of Azores

In the Autonomous Region of Azores, the Environmental and Climate Change Department of the Regional Government is responsible for coordinating and monitoring the implementation of climate change policies. In this context, and identifying climate change as one of the main challenges for its development, the Autonomous Region of Azores approved the Regional Strategy for Climate Change (ERAC)[23], and following this, in order to operationalize the regional strategy, the Regional Program for Climate Change (PRAC)[24] was drawn up and approved in 2019, with a 2030 horizon, establishing emission projection scenarios and defining the respective climate measures and actions at regional level, both in terms of mitigation and adaptation. It should also be noted in this context that the respective Roadmap for Carbon Neutrality in the Azores is under development.

Autonomous Region of Madeira

In the case of the Autonomous Region of Madeira, in addition to the Regional Climate Change Adaptation Strategy (CLIMA-Madeira Strategy[25]), that was approved in 2015, and that is expected to be updated in the short term, also have a Sustainable Energy and Climate Action Plan for the Autonomous Region of Madeira (PAESC-RAM)[26], which defines the strategy and actions to achieve the goals set in the medium and long term 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 NECP 2030.

3.2 Description of a Party's nationally determined contribution

Under their updated NDC[27] the EU and its Member States, acting jointly, are committed to a legally binding target of a domestic reduction of net greenhouse gas emissions by at least 55% compared to 1990 by 2030. The term 'domestic' means without the use of international credits.

The NDC consists of a single-year target, and the target type is 'economy-wide absolute emission reduction'. The scope of the NDC covers the 27 Member State of the EU. Details on the EU NDC can be found in Table 3.2 and in Annex I.

[23] Resolution of the Council of Government no. 123/2011, of October 19

[24] Regional Legislative Decree no. 30/2019/A, of November 28

[25] Resolution of the Council of Government no. 1062/2015, of November 26

[26] Resolution of the Regional Government Council no. 1271/2022, of December 9, 2022

[27] Submission by Spain and the European Commission on behalf of the European Union and its Member States: The update of the nationally determined contribution of the European Union and its Member States, https://unfccc.int/sites/default/files/NDC/2023-10/ES-2023-10-17%20EU%20submission%20NDC%20update.pdf

Table 3.2 - Description of the NDC of the EU (Source: Updated NDC of the EU[28]).

Information	Description
Target and description	Economy-wide net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990. The term 'domestic' means without the use of international credits.
Target type	Economy-wide absolute emission reduction.
Target year	2030 (single-year target)
Base year	1990
Base year value	Net greenhouse gas emissions level in 1990: 4 699 405 kt CO_2eq.
Implementation period	2021-2030
Geographical scope	EU Member States (Belgium, Bulgaria, Czechia, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden) including EU outermost regions (Guadeloupe, French Guiana, Martinique, Mayotte, Reunion, Saint Martin (France), Canary Islands (Spain), Azores and Madeira (Portugal)).
Sectors	Sectors as contained in Annex I to decision 5/CMA.3: Industrial processes and product use, Agriculture, Land Use, Land Use Change and Forestry (LULUCF), Waste. *International Aviation:* Emissions from civil aviation activities as set out for 2030 in Annex I to the EU ETS Directive are included only in respect of CO2 emissions from flights subject to effective carbon pricing through the EU ETS. With respect to the geographical scope of the NDC these comprise emissions in 2024-26 from flights between the EU Member States and departing flights to Norway, Iceland, Switzerland and the United Kingdom. *International Navigation*: Waterborne maritime navigation is included in respect of CO2, methane (CH4) and nitrous oxide (N2O) emissions from maritime transport voyages between the EU Member States.
Gases	Carbon Dioxide (CO_2), Methane (CH_4), Nitrous Oxide (N_2O), Hydrofluorocarbons (HFCs), Perfluorocarbons (PFCs), Sulphur hexafluoride (SF_6), Nitrogen trifluoride (NF_3)
LULUCF categories and pools	The included LULUCF categories and pools are as defined in decision 5/CMA.3.

[28] The update of the nationally determined contribution of the European Union and its Member States, https://unfccc.int/sites/default/files/NDC/2023-10/ES-2023-10-17%20EU%20submission%20NDC%20update.pdf

Intention to use cooperative approaches	The EU's at least 55% net reduction target by 2030 is to be achieved through domestic measures only, without contribution from international credits. The EU will account and report for cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA.
Any updates or clarifications of previously reported information, as applicable	The information on the NDC scope contains clarifications/further details compared to the information provided in the updated NDC of the EU.

Note: This table is identical to table 'Description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates, which has been submitted electronically together with this BTR. This table is also annexed to this BTR.

Other national objectives

In addition to the targets set in the EU's NDC, Portugal has also set other goals at national level, as provided for in the main climate policy instruments at national level, such as the Roadmap to Carbon Neutrality 2050 (RNC 2050), the recently revised National Energy and Climate Plan 2030 (NECP 2030) and the national Climate Law. Portugal is thus committed to a goal of reducing GHG emissions by 55% in 2030, compared to 2005. In addition, and despite the equally ambitious targets set for the medium-long term, such as the range of 65 to 75% reduction in GHG emissions in 2040, Portugal has gone beyond the ambition set before by committing to bringing forward the climate neutrality target to 2045, an option that was reinforced in the context of the approval of the 2030 NECP review and which will have to be considered and assessed in greater detail in the context of the ongoing review of the Carbon Neutrality Roadmap.

In addition to these, it is also important to mention the sectoral objectives defined in terms of GHG emission reductions for 2030, for the non-ETS sectors (Table 3.4), as well as other sectoral objectives in the context of renewable energy and energy efficiency, as provided in the Table 3.3.

Table 3.3 - Portugal's other national goals for 2030.

	National Contributions for the Union 2030 Targets	Other National Objectives 2030
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)	51% (29% on transport)	

Increase Energy Efficiency Primary energy consumption[29] Final energy consumption[30]	 16 711 ktep 14 371 ktep
Electricity Interconnections	15%

Table 3.4 - Portugal's non-ETS sectoral goals for 2030.

Sectoral GHG Reduction Objectives	2030
Services	-70%
Residential	-35%
Transports	-40%
Agriculture	-11%
Waste and Wastewater	-30%

3.3 Indicator, definitions, methodologies and progress

3.3.1 Indicators

For the tracking of progress towards implementing and achieving the NDC of the EU, an indicator is used which is in the same unit and metric as the NDC base year and target values. The chosen indicator is 'annual total net GHG emissions consistent with the coverage of the NDC in CO2eq'. Table 3.5 provides more information on this indicator.

Table 3.5 - Indicator for tracking progress towards the EU NDC and national contributions (Source: The reference level is based on the Annual European Union GHG inventory 1990-2022).

Information	EU NDC
Selected indicator	Annual total net GHG emissions consistent with the scope of the NDC in CO2eq.
Reference level and base year	The reference level is total net GHG emissions of the EU in the base year (1990). The reference level value for the EU is 4 699 405 kt CO2eq.
Updates	This is the first time the reference level is reported, hence there are no updates. The value of the reference level may be updated in the future due to

[29] According to the revised Energy Efficiency Directive (EED) (Directive (EU) 2023/1791), the energy efficiency target is expressed in terms of a limit for primary energy consumption in 2030, which in the case of the EU should not exceed 992.5 Mtoe

[30] In accordance with the revised Energy Efficiency Directive (EED) (Directive (EU) 2023/1791), an indicative target has been set for final energy consumption in 2030 in order to contribute to the Union's binding target (EU final energy consumption should not exceed consumption in 2030 in order to contribute to the binding Union target (EU final energy consumption should not exceed 763 Mtoe in 2030)

	methodological improvements to the EU GHG inventory and to the determination of international aviation and navigation emissions in the NDC scope.
Relation to the NDC	The indicator is defined in the same unit and metric as the target of the NDC. Hence it can be used directly for tracking progress in implementing and achieving the NDC target.
Definitions	Definition of the indicator 'annual total net GHG emissions in CO2eq': Total net GHG emissions correspond to the annual total of emissions and removals reported in CO2 equivalents in the latest GHG inventory of the EU. The totals comprise all sectors and gases listed in the table entitled 'Reporting format for the description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates.' Indirect CO2 emissions are included from those Member States that report these emissions.

Note: The information in this table is identical to the information in Common Tabular Format (CTF) tables 1 ('Description of selected indicators') and 2 ('Definitions needed to understand the NDC'), which were submitted electronically together with this BTR.

As part of Effort Sharing Regulation a mandatory emission reduction by Member States (MS) till 2030, has been set, in order to contribute to the EU emission reduction target of 40% by 2030, compared to 2005 levels, in sectors not covered by the EU ETS (non-ETS).

In this context, Portugal is responsible for limiting its GHG emissions by at least -28.7% by 2030 compared to its emissions in 2005, replacing the -17% target in force before. In this case, and for the purposes of assessing the commitment achieved, the total GHG emissions of Portugal in the base year 2005, which fall within the scope of the ESR, will be used as the reference level, corresponding to 48.6 Mt CO2-eq[31].

Under LULUCF Regulation, on the inclusion of GHG emissions and removals from the land use, land-use change and forestry sector, new rules have been laid down. This change is intended to accompany the increased ambition and contribute to achieving the new target of a 55% reduction in net GHG emissions compared to 1990 levels, and to ensure that the LULUCF sector makes a sustainable and predictable long-term contribution to the climate neutrality objective. The rules stipulated in the new Regulation will be applied in two phases. During the first phase, which runs until 2025, the system currently in force is maintained, whereby MS must ensure that emissions resulting from the LULUCF sector do not exceed removals from that sector (known as the "no debit rule"). In the second phase, which runs from 2026 to 2030, the new targets set for 2030 for each MS must be met in order to fulfill the increased ambition and contribute to the EU-specific target of net GHG removals of at least 310 million tCO2eq by 2030.

[31] Commission Implementing Decision (EU) 2020/2126 of 16 December 2020 on setting out the annual emission allocations of the Member States for the period from 2021 to 2030 pursuant to Regulation (EU) 2018/842 of the European Parliament and of the Council

The LULUCF Regulation also establishes the rules for accounting for emissions and removals from the LULUCF sector and for assessing MS compliance with their commitments, defining that accounting for emissions and removals resulting from managed forest land should be calculated as the emissions and removals in the periods 2021 to 2025 minus the value obtained by multiplying the "forest reference level" (FRL) by five. The FRL represents an estimate, expressed in tons of CO2 equivalent per year, of average annual net emissions and is calculated and presented by each MS in the National Forest Accounting Plan for the 2021-2025 sub-period. In response to the obligation of Article 8 of the LULUCF Regulation, Portugal has drawn up its National Forest Accounting Plan, which includes the proposal for a "Forest Reference Level" to be used for the purposes of accounting for forests managed in Portugal in the 2021-2025 period.

3.3.2 Methodologies and accounting approach

The EU uses the following accounting approach for tracking progress towards the joint EU NDC: annual GHG data from the national GHG inventory of the EU, complemented for international aviation and navigation with estimations from the Joint Research Centre's Integrated Database of the European Energy System[32]. The total net GHG emissions are provided in the scope of the EU NDC and are compared to the economy-wide absolute emission reduction target as defined in the NDC. The EU will account for its cooperation with other Parties in a manner consistent with guidance adopted by the CMA.

As far as emissions and removals from the LULUCF sector are concerned, net emissions are used for tracking progress towards the 2030 target of the NDC based on all reported emissions and removals.

Details on methodologies and accounting approaches consistent with the accounting guidance[33] under the Paris Agreement can be found in CTF table 3 ('Methodologies and accounting approaches'), which was submitted electronically together with this BTR. This table is also annexed to this BTR.

3.3.3 Structured summary – status of progress

An important purpose of the BTR is to demonstrate where the EU and its Member States stand in implementing their NDC, and which progress they have made towards achieving it. The most recent information on GHG emissions and removals in the scope of the NDC constitutes the key information for tracking this progress. Table 3.6 summarizes the current status of progress.

[32] European Commission, Joint Research Centre, Rózsai, M., Jaxa-Rozen, M., Salvucci, R., Sikora, P., Tattini, J. and Neuwahl, F., JRCIDEES-2021: the Integrated Database of the European Energy System – Data update and technical documentation, Publications Office of the European Union, Luxembourg, 2024, https://publications.jrc.ec.europa.eu/repository/handle/JRC137809.

[33] Decision 4/CMA.1, Further guidance in relation to the mitigation section of decision 1/CP21, https://unfccc.int/documents/193407.

Table 3.6 - Indicator for tracking progress towards the EU NDC and national contributions (Source: The indicator values are based on the Annual European Union GHG inventory 1990-2022). NA: Not Applicable.

Indicator	Unit	Base year value	Values in the implementation period			Target level	Target year	Progress made towards the NDC
			2021	2022	2030			
Total net GHG emissions consistent with the scope of the EU NDC	kt CO_2eq	4 699 405	3 272 650	3 205 223	NA	(at least 55% below base year level)	2030	The most recent level of the indicator is 31.8% below the base year level

Note that an annual emissions balance consistent with chapter III.B (Application of corresponding adjustment) will be provided in a subsequent BTR upon finalization of relevant further guidance by the CMA, based on the annual information reported under Article 6.2.
Note: More detailed information can be found in CTF table 4 ('Structured summary: Tracking progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement'), which has been submitted electronically together with this BTR.

Based on the GHG inventory data and data on international aviation and navigation for 2022, the EU and its Member States reduced net GHG emissions by 31.8 % compared to 1990. The EU and its Member States made progress towards implementing and achieving their NDC. The legal and institutional framework is in place to make further progress in the years ahead and to achieve the NDC target by 2030.

In relation to the progress of Portugal on the Effort Sharing Regulation, the following annual emissions allocations (AEA) have been set for the period 2021-2025 and for the period 2026-2030 (allocation to be revised).

Table 3.7 - Annual Emissions Allocations by Effort Sharing

year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030
AEA (Mton CO_{2e})	42.53	40.82	40.06	39.30	38.53	40.62*	40.57*	40.52*	40.47*	40.42*

*_ allocation to be reviewed in 2025

For 2021 and 2022, Portugal is below its annual emission allocations with non-ETS emissions of 39.9 and 39.8 Mt CO2eq respectively, underlining that the targets will be verified cumulatively for the period 2021-2025 and then for 2026-2030, considering the overall reduction target for 2030.

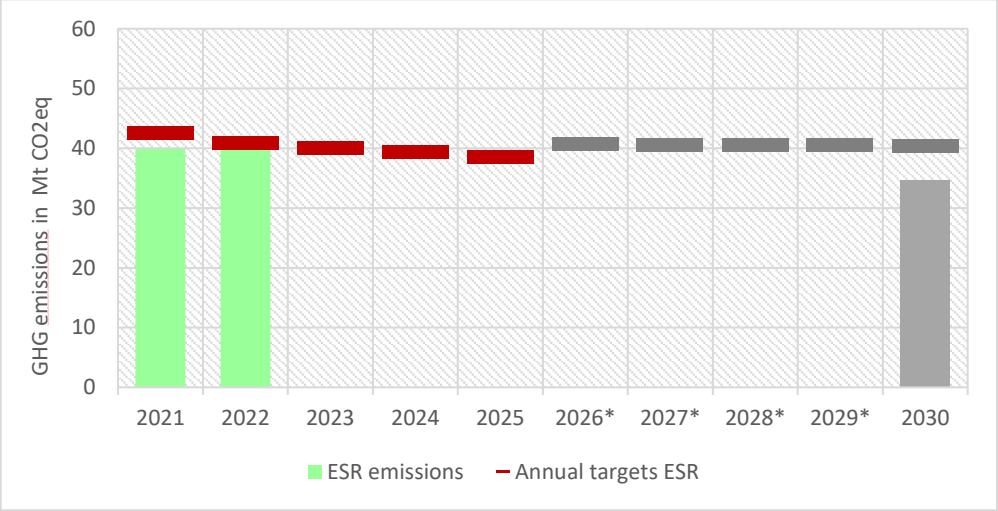

Figure 3.19 - Effort sharing emissions and annual emission allocation

3.4 Mitigation policies and measures

3.4.1 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 103 onwards), includes a range of policies and measures foreseen for these different sectors.

The main cross-cutting 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) No. 107/2019, of July 1st;
- Nacional Energy and Climate Plan (NECP2030), RCM No. 149/2024, of October 30th;
- National Climate Change Adaptation Strategy (ENAAC 2020), RCM No. 56/2015, of July 30th;
- National System for Policy and Measures (SPeM), RCM No. 45/2016, of August 26 th;
- Action Plan for Climate Change Adaptation (P-3AC), RCM No. 130/2019, of August 2nd;
- National Air Strategy (ENAR 2020), RCM No. 46/2016, of August 26th;
- Circular Economy Action Plan (PAEC), RCM No. 190-A/2017 of December 11th;
- National Program for Land Planning Policy (PNPOT), Law No. 99/2019, of September 5th;
- National Program for Territorial Cohesion (PNCT), RCM No. 72/2016, of November 24th;
- National Action Program for Combating Desertification 2014-2024 (PANCD), RCM No. 78/2014, of December 24th;
- National Strategy for Sustainable Cities 2020, RCM No. 61/2015, of August 11th;
- National Strategy for Green Public Procurement (ENCPE 2020), RCM No. 38/2016, of July 29th;
- National Strategy for Nature Conservation and Biodiversity 2030 (ENCNB 2030), RCM No. 55/2018, of May 7th;
- National Strategy for Forests (ENF), RCM n.6-B/2015, published 4th February;
- National Plan for Integrated Rural Fire Management (PNGIFR), RCM.º 45-A/2020, of 16Th June;
- National Strategy for Environmental Education (ENEA 2020), for the 2017-2020 period, RCM No. 100/2017, of July 11th;
- European Emissions Trading Scheme (EU-ETS), Decree-Law No. 38/2013 of March 15th and Decree-Law No. 93/2010, of July 27th;
- National Maritime Spatial Planning Situation Plan, RCM No. 203-A/2019, of December 30th;

- National Strategy for Active Mobility (ENMA), formed by the National Strategy for Active Pedestrian Mobility (ENMA), RCM.º 67/2023, of July 7 and the National Strategy for Active Cycling Mobility (ENMAC), RCM n.º 131/2019, of August 2

Recent Cross-Cutting Policy Framework:

- National Climate Law, Law No. 98/2021, of December 31st;
- Resource Efficiency and Decarbonization Program in Public Administration for the period up to 2030 - ECO.AP 2030, RCM No. 150/2024, of October 30th, amending RCM No. 104/2020 of November 24th;
- National Strategy for Green Public Procurement 2030 — ECO360, approved through Council of Ministers Resolution No. 13/2023, of February 10th;
- Action Plan for Sustainable Bioeconomy (PABS) Horizon 2025, RCM No. 183/2021, December 28th;
- National Waste Management Plan 2030 (PNGR 2030), approved through RCM No. 31/2023, March 24th;
- Strategic Plan for Municipal Waste 2030 (PERSU 2030), approved through RCM No. 30/2023, March 24th;
- Strategic Plan for Non-Municipal Waste 2030 (PERNU 2030), approved through RCM No. 127/2023, October 18th;
- Strategic Plan for Water Supply and Wastewater and Stormwater Sanitation 2030 (PENSAARP 2030), approved through RCM No. 23/2024, February 5th and amended by RCM No. 109/2024, August 22th;
- National Maritime Strategy 2021-2030, RCM No. 68/2021, of June 4th;
- Action Plan for the National Maritime Strategy 2021-2030, approved through Council of Ministers Resolution No. 120/2021, of September 1st;
- Innovation Agenda for Agriculture 2030, approved through RCM No. 86/2020, of October 13th;
- Strategic Plan for the Common Agricultural Policy (PEPAC), approved through Decision C (2022) 6019, of August 31th;
- Green Skills & Jobs Program, a professional training program in the energy sector (Order No. 21/2023, of January 6th);
- Strategic Guidelines for the Valorization of Lithium Minerals Potential in Portugal, RCM No. 11/2018, of January 31st;
- Reform and Simplification of Environmental Licensing, approved through Decree-Law No. 11/2023, of February 10th;
- Voluntary Carbon Market, Decree-Law No. 4/2024, of January 5th;
- Biomethane Action Plan 2024-2040, RCM No. 41/2024, of March 15th.

Still under developement and also relevant for climate action, are the following instruments that arise in the context of the National Climate Law:

- Local and regional level climate action plans, contributing to the objectives and targets set out in the national policy planning instruments on climate action;
- Sectoral climate change mitigation and adaptation plans;
- Green Industrial Strategy, providing a strategic framework that supports companies in the process of climate transition in the industrial sector and in meeting the objectives set forth in the National Climate Law, strengthening their sustainable competitiveness.

The main current and planned policies and measures to accomplish an economy-wide emissions reduction target are identified in CTF Table 5 and are summarised in the following section.

3.4.2 Policy and Measures and their Effects

The main current and planned policies and measures to accomplish an economy-wide emissions reduction targets, namely those related to implementing and achieving the nationally determined contribution at national level, are identified below, alongside with more specific information further developed for each PaM in the CTF Table 5.

These PaMs, most of which have already been explained in 8NC/5BR, are mainly related with the phase-out of fossil fuels, the promotion of renewables energy sources and energy and water efficiency, expansion of public transport systems and electromobility, 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 highly relevant, particularly the green tax reform and the carbon tax applicable for non-EU ETS sectors.

Those policies and measures are linked to the main policy framework and relevant EU policies.

To maintain consistency in national reporting, all mitigation actions reported in the 8NC/5BR are included in this Biennial Transparency Report (BTR). However, these actions have been revised in order to align with the recently updated National Energy and Climate Plan 2030 and other relevant plans.

As a result of that revision, new mitigations actions were included in the existing PaMs and a new PaM has been included (PaM31). New mitigation actions were also included as they have been developed to respond to the ambition increase of the national targets. The list of PaM below is structured by sector, as follows (the number of the PaM as listed in table 5 (CTF) is provided in brackets for ease of reference):

- Energy (PaM17, PaM19 to PaM27)
- Industry (PaM1, PaM18 and PaM30)
- Transport (PaM12 to PaM16)
- Circular Economy (PaM3)

- Waste (PaM5)
- Agriculture (PaM4, PaM6, PaM7, PaM9 to PaM11, PaM31)
- LULUCF (PaM8)
- Fiscal Measures (PaM2 and PaM28)
- Cross-sectoral (PaM 29)

The text below gives a brief description of each PaM, in line with what is reported in table 5 (CTF), where detailed and up-to-date information on the progress of each PaM is provided.

Energy

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

This PaM aims to promote the productions and use of clean alternative fuels, in particular advanced biofuels, hydrogen and renewable fuels of non-biological origin (such as eSAF) which are seen as an alternative and complementary solution to electric mobility in the 2030 and 2040 horizons, in particular for the long-distance heavy goods road transport, heavy passenger transport, maritime freight and aviation sectors, in order to guarantee the energy transition in this sector.

This very significant potential for improving the diversification of energy sources and energy efficiency will be accompanied by the development of the corresponding supply infrastructures, in line with the new European guidelines and legislation, in particular the new Alternative Fuels Infrastructure Regulation (AFIR), and with new national plans, in particular those regarding aviation and maritime transport.

To promote the production of sustainable biofuels, the focus is on valuing endogenous national resources such as residual biomass, urban waste, used cooking oils, and alternative materials of low economic value. This approach involves revising and implementing the National Biorefinery Promotion Plan to foster renewable energy, bioeconomy principles, and the production of advanced biofuels, aligning with the Renewable Energy Directive.

In this context, advancing the phase-out of conventional biofuels is crucial. Directive (EU) 2018/2001 and the revised Renewable Energy Directive (RED III), published in November 2023, mandate that the share of biofuels, bioliquids, and biomass fuels derived from food and feed crops with a high risk of indirect land-use change must gradually decrease to 0% by December 31, 2030. Implementing the necessary measures to comply with this requirement is essential, while simultaneously promoting advanced biofuels as substitutes to ensure a sustainable transition.

To complement these actions, promoting richer bioenergy blends requires evaluating the current national fuel quality legislation. This evaluation should reflect recent EU legislative updates, notably Directive (EU) 2023/2413, which amends Directive 98/70/EC. National strategies

currently set blending targets within the technical specifications of diesel (EN 590), allowing up to 7% (v/v) FAME. However, higher blends, such as B15 and beyond, are viable for heavy mobility and dedicated fleets, aligning with EU directives. To support these richer blends, incentives are necessary to address the economic disparity with fossil fuels.

To promote the installation of refueling stations for 100% renewable liquid and gaseous fuels in public transport and municipal service fleets, the national strategy has prioritized the incorporation of biofuels into conventional fuels, adhering to their technical specifications and leveraging existing infrastructure. However, advancing local solutions for the use of advanced biofuels, biomethane, hydrogen, and other renewable fuels, whether in pure form or at high concentrations in fossil fuels, will require promoting the installation of renewable fuel stations. These stations will prioritize locations near production facilities for renewable alternatives, particularly those tied to the use of residual biomass or materials with low economic value.

At the same time, green hydrogen and biomethane, recognized for their ability to reduce GHG emissions, increase renewable energy shares in final consumption, and offer flexibility in use, can play a key role in decarbonizing the transport sector, where integrating renewables remains challenging. Hydrogen's capacity to store electricity produced from renewable sources further enhances its potential. Expanding the availability of hydrogen and biomethane refueling infrastructure will be essential to promote their adoption. This development will occur in phases, starting with pilot and demonstration projects focused on public transport and logistics fleets, and gradually expanding into a more extensive network. This phased approach aims to ensure significant territorial coverage and support the transition toward renewable gas-based mobility, aligned with the infrastructure targets set by the new Alternative Fuels Infrastructure Regulation (AFIR).

Promoting the use of renewable energy sources for ships docked in ports, such as electricity, hydrogen, or non-biological renewable fuels, will involve providing "on-shore power supply" to replace the use of conventional fossil fuels for onboard power generation. This measure will improve air quality in port areas and reduce GHG emissions, provided the electricity used is renewable. Strengthening electricity supply to ports often requires building substations near terminals, which not only power ships but also stabilize the grid and enable the use of electric cargo-handling equipment. This transition from fossil fuel-powered systems will contribute to decarbonization, reduce noise, and enhance environmental conditions in port areas.

Additionally, Regulation (EU) 2023/1804 of the European Parliament and of the Council of 13 September 2023 on the deployment of alternative fuels infrastructure (AFIR), which repealed Directive 2014/94/EU of the European Parliament and Council, seeks to establish a common framework of measures and minimum requirements for deploying this infrastructure across Europe. Member States will need to draft a new National Policy Framework for the development of the alternative fuels market in the transport sector and ensure the necessary infrastructure is in place, in line with the targets set out in the regulation.

On 6 September 2024, Order No. 10559/2024 was published by the Office of the Minister for Infrastructure and Housing and the Office of the Minister for the Environment and Energy, which established the AFIR Working Group for the development of an infrastructure for alternative fuels under Regulation (EU) 2023/1804.

To complement these measures, the creation of "green corridors" will establish a network of refueling points for biofuel-rich blends, geographically distributed to align with fleet locations and supported by a logistics system for fuel distribution. This focus on local biofuel production solutions can revitalize the national market, which currently operates at only 50% of its installed capacity, and drive further development and innovation in the sector.

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. 84/2022, of December 9, establishes targets for the consumption of energy from renewable sources, transposing partially Directive (EU) 2018/2001. It repealed Decree-Law No. 117/2010, defining mechanisms for the promotion of biofuels and biogas in transport, namely, the sustainability and greenhouse gas emission reduction criteria for the production and use of biofuels, bioliquids and biomass fuels, as well as greenhouse gas emission reduction criteria for renewable fuels of non-biological origin and recycled carbon fuels.

The Portuguese Innovation Support Fund (FAI) supported 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. Decree-Law no. 114/2021 of December 15, ended the Innovation Support Fund and merged it into the Environmental Fund.

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

In the context of the strategic objective of promoting an innovative and competitive industry, the focus will be on the decarbonization of the industrial sector by promoting the use of renewable resources, energy storage, electrification, and the use of renewable gases. With a power generation system primarily based on renewable sources, the goal is to encourage and strengthen the use of electricity across various sectors of activity and the economy, alongside the increased use of other renewable energy sources such as biomass, sustainable biofuels, and renewable non-biological fuels, including renewable hydrogen. The industrial sector will play an essential role in this transformation, serving as a key area for innovation and the creation of new business models. Strengthening the perspectives of the circular economy, "Industry 4.0," and technological innovation will be crucial in identifying and creating innovative, efficient solutions with near-zero emissions over the next 30 years. By promoting the circular economy within the industrial sector, it is possible to foster innovation, develop new products and business models, and reduce the consumption of energy, water, and materials, thus contributing to the fight against climate change.

Promoting and encouraging the adoption and penetration of renewable energy sources, particularly renewable gases, renewable non-biological fuels, fuels derived from waste, and other sustainable fuels, is central to the industrial decarbonization agenda. Replacing highly polluting fuels with those that have lower emission factors - such as renewable sources like biomethane, green hydrogen, synthetic methane, and sustainable aviation fuel (SAF) - alongside the adoption of efficient equipment and optimized consumption management, is crucial for reducing energy costs and GHG emissions. This progressive and feasible transition to cleaner energy sources not only supports decarbonization but also enhances industrial competitiveness. A stronger focus on biomethane and hydrogen as vectors for industrial decarbonization aligns with REPowerEU's objectives to accelerate the transition to electrification and renewable hydrogen, increasing production capacity and reducing GHG emissions.

Leveraging industrial and business decarbonization involves promoting a paradigm shift in resource utilization, meeting national medium- and long-term goals, and expediting the transition to a carbon-neutral economy. Power-to-X (P2X) strategies, with their versatility in producing diverse energy vectors or molecules derived from renewable hydrogen, are pivotal to achieving this goal sustainably and carbon-neutrally. P2X provides carbon-neutral alternatives to fossil fuels, addressing emissions from hard-to-electrify, carbon-intensive sectors that account for roughly 30% of global emissions. Furthermore, these technologies are instrumental in implementing the Renewable Energy Directive and advancing circular economy principles. P2X also offers efficient storage and use of excess renewable energy while producing diverse energy and industrial products, contributing significantly to the global energy transition. This approach seeks to bolster the competitiveness of businesses in the manufacturing sector, equipment goods industries under the implementation of the NZIA Regulation (EU) 2024/1735 of June 13, and other sectors, by supporting innovative investment, particularly in low-carbon technologies and processes.

Encouraging efficient resource use, renewable energy adoption, and decarbonization roadmaps is vital to this transformation.

Ensuring the implementation of the Carbon Border Adjustment Mechanism (CBAM), established by Regulation (EU) 2023/956 of May 10, 2023, is another critical step. This mechanism imposes a carbon price on imported goods based on embedded emissions, ensuring equivalence with products produced in the EU and mitigating carbon leakage risks. Gradually replacing current carbon leakage prevention measures, such as free emission allowances under the EU Emissions Trading System (ETS), CBAM will phase in alongside the progressive reduction of free allocations to align with World Trade Organization (WTO) rules. This mechanism applies to industries such as cement, fertilizers, iron and steel, aluminum, chemicals (hydrogen), and imported electricity.

In the context of the RPP reprogramming, the inclusion of the "REPowerEU Chapter" (Component 21) aims to strengthen Recovery and Resilience Plan (RPP) ambitions and maximize its impact, considering Europe's geopolitical context. This initiative increases funding for climate-related measures, such as investment RP-C21-i05, supporting the development of a green industry. This investment, aimed at businesses, focuses on expanding renewable energy technology production, decarbonization, and energy efficiency. To ensure swift and technically rigorous decision-making, the Coordinating Committee for the RP-C21-i05 investment was established by Order No. 3759/2024 of April 8, tasked with developing, coordinating, and monitoring the planned actions under this initiative.

Approving and regulating access to the electro-intensive customer status, particularly through measures eliminating distance restrictions to self-consumption production centers, is essential to fostering remote self-consumption via public grids. Developing regulatory mechanisms will enable electro-intensive consumers to install renewable production capacity, whether near consumption sites or farther away, facilitated by strengthened grid infrastructure.

Promoting the circular economy, efficient resource use (including water) and waste prevention is a vital part of this strategy. This can be achieved by utilizing residual materials as raw inputs, fostering industrial symbiosis, extending the lifecycle of goods and equipment, broadening product-service business models, and adopting eco-design principles, particularly for low-carbon products.

Encouraging industrial symbiosis at urban, local, and regional levels leverages material flows, such as by-products and waste, to replace raw materials while harnessing thermal energy through the recovery and reuse of industrial heat and cold. This approach not only enhances resource circularity and energy efficiency but also significantly reduces energy consumption and emissions across industrial and urban systems.

Simultaneously, fostering the development of low-carbon products and services requires adopting tools for assessing and classifying circularity. These include life-cycle assessments, certifications like ISO, EMAS, and eCIRCULAR, as well as labeling initiatives such as eco-labels. Additionally, promoting innovative product design alongside research, development, demonstration, and innovation (R&D&I) activities supports these goals. By aligning their operations with circular

economy principles, resource efficiency, and sustainability, businesses can play a pivotal role in accelerating the transition toward a low-carbon future.

This measure could also be linked to other PaM such as:

- PaM18 – "To promote decarbonisation of industry through eco-innovation and cleaner production processes and to promote industry digitization", (industry sector);
- PaM24 – "Promoting energy rehabilitation of buildings, NZEB buildings, the use of more energy efficient equipment and renewables" (buildings sector)
- PaM26 – "To improve the management of energy consumption in the various sectors of the national economy" (transports sector).

PaM21 - Promote new energy storage solutions (batteries and hydrogen)

For a better management of the national energy system across its various subsectors, the existence of adequate storage systems in their different forms is considered fundamental and plays a crucial role as a tool for system flexibility and stability. It is therefore important to maintain and further invest in pumped storage systems at hydroelectric power plants, as well as to explore and develop other technological solutions, such as battery systems and hydrogen technologies. The focus on the production and consumption of renewable gases, shifting from an exclusive reliance on imports to a situation with a significant percentage of national production, must be backed by the implementation of storage systems that ensure the flexibility and stability of the national energy system. Additionally, it is essential to both capitalize on existing assets and manage the transition to a 100% renewable gas infrastructure. Thus, creating conditions to reduce risks to gas supply security and adapting storage infrastructures to support 100% renewable solutions becomes crucial.

Developing and implementing a National Energy Storage Strategy is essential to define the pathways for the integration of storage systems aligned with renewable energy and decarbonization objectives. This strategy should provide a practical, independent, and objective analysis of the different technological trajectories available, considering supply security, service quality, and economic sustainability. It must include an economic assessment and explore the interaction between storage systems and the development of energy networks, identifying short- and medium-term storage needs. The approach should remain technologically neutral, evaluating available options based on criteria such as unit cost, response times, storage capacity, and availability. To ensure its relevance, the strategy should be updated every five years to reflect technological advancements and cost developments, while also integrating new directives from the ongoing electricity market reform process led by the European Commission. Portugal has already taken steps in this direction, publishing its first energy storage potential study in 2021 and updating it in May 2024.

Supporting the development of pilot projects is another vital step to promote innovative and underdeveloped storage technologies, improving their technical and economic feasibility. These initiatives should emphasize the integration of renewable energy with storage solutions to enhance efficiency and system reliability. Simultaneously, expanding and facilitating access to energy networks is essential to accommodate increased production and storage capacity. The solar auction in 2020 demonstrated this potential by allowing storage capabilities, with several winning bids incorporating battery systems.

Subsequent regulatory advancements, such as Decree-Law No. 62/2020 for the gas sector and Decree-Law No. 15/2022 for the electricity sector, have established a legal framework for storage activities, but further efforts are necessary to drive projects that link renewable production to robust storage solutions.

Increasing storage capacity through various technologies - such as reversible hydropower, batteries, and hydrogen - will provide the flexibility needed to address challenges arising from the growing penetration of intermittent renewable energy sources and the anticipated rise in electricity consumption.

To enable the effective deployment of storage systems, particularly battery technologies, it is crucial to establish robust regulatory frameworks. This involves creating targeted incentives and simplifying environmental licensing procedures to support storage development. Mechanisms like capacity markets and system services must ensure market-based contracting and fair remuneration for critical services such as Frequency Containment Reserve (FCR), mFRR capacity, inertia, and voltage control. These measures will foster the widespread adoption of battery storage systems, enhancing the resilience and stability of the energy system and contributing to a successful energy transition.

A tender procedure (Notice No. 01/C21-i08/2024) was opened, as part of the Recovery and Resilience Plan (RRP), for Grid and Storage Flexibility, which aims to install at least 500 MW of energy storage capacity in the electricity grid (both at the transmission and distribution levels) by the end of 2025. The tender was launched through the Environmental Fund, and had about 2GW in expressions of interest.

Decree-Law No. 172/2006, that has been repealed by Decree-Law No. 15/2022, establishe 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.

Important also to highlight the measure "Energy Transition in the Azores", in the context of the Autonomous Region of Azores, which has been created within the scope of the RRP, aiming to develop state-of-the-art electrical infrastructures and execute projects with innovative technical solutions to increase energy self-sufficiency. Among other subinvestments, it includes the installation of new electrical energy storage systems on the islands of Santa Maria, São Jorge,

Pico, Faial, Flores and Corvo corresponding to at least 20 MW. These electrical energy storage systems will increase the capacity for renewable energy integration and make it possible to reinforce electrical systems with solutions that allow system and auxiliary services to be provided with grid-forming capacity (voltage and frequency control) to the network, with the aim of significantly reducing the use of thermal groups (fossil fuels) and allowing a greater integration of renewables, safeguarding security of supply and quality of service.

In the context of the RRP "REPowerEU Chapter", investment RP-C21-i10 has been also created, aiming to promote the energy transition in the Azores, contributing to increasing the archipelago's energy independence. The investment consists of a system of incentives for the purchase and installation of storage systems designed to store electricity from renewable sources for personal consumption by families, companies, cooperatives, non-profit organizations and charitable institutions, with a total electricity storage capacity for self-consumption of at least 8.75 MW. The investment must comply with Regional Legislative Decree No. 12/2023/A, which introduced an incentive of up to 85% for the acquisition and installation of energy storage systems, when these are intended to complement photovoltaic systems purchased under the SOLENERGE, an incentive program financed by the RRP (C14-i03-RAA).

The Autonomous Region of Madeira is moving ahead with the implementation of its battery plant construction program, which includes the installation of four units: two on the island of Porto Santo and two on the island of Madeira. Currently, one unit is already in operation on each of the islands, with the completion of the second unit on Madeira scheduled for the end of 2025. This program is part of the regional strategy to maximise the use of renewable energy sources, improve the efficiency of the electricity generation system and reduce carbon dioxide (CO_2) emissions. To this end, batteries based on lithium-ion technology are used, together with advanced power electronics systems. These solutions provide significant active power and usable storage capacity, optimising own production assets and enabling greater integration of renewable energy into the regional electricity system. This increases the share of renewable energies in RAM's electricity production mix.

The region's commitment to energy storage solutions is crucial to the transition to a low-carbon economy, by favoring the production and distribution of energy from renewable sources. This effort contributes directly to the decarbonisation of the regional electricity generation system. In addition, the ability of these batteries to respond quickly to variations in the electricity grid allows them to be used as a spinning reserve. This feature makes it possible to switch off at least one thermal unit continuously, further reducing emissions of polluting gases into the atmosphere.

PaM22 - Accelerate national energy transition to renewables

The contribution of endogenous renewable energy sources to electricity production has grown significantly in recent years, playing a critical role in reducing GHG emissions, lowering the country’s energy dependence, and fostering wealth, employment, and economic development. Despite this progress, Portugal possesses vast untapped potential

for clean energy production, particularly in solar and offshore wind resources. It is imperative to strengthen and revise the current mechanisms promoting renewable energy to ensure the achievement of the 2030 targets.
Reaching at least 80% renewable energy in the electricity sector by 2025 requires a substantial effort, including doubling the installed renewable capacity between 2021 and 2030. This ambitious expansion requires not only policy reinforcement but also technological advancements, investment mobilization, and streamlined administrative processes to unlock the full potential of renewable resources and deliver on national and European climate commitments.

The promotion of new renewable capacity development is being actively pursued, notably through the implementation of a system of periodic auctions for the allocation of grid injection capacity. In a context of strong demand for production licenses and limited grid reception capacity, auctions provide one of the most efficient mechanisms to address this demand, accelerating investments in new capacity. This system prioritizes projects with lower costs and higher execution guarantees, fostering better alignment between licensing processes and grid investment. The auction mechanism offers several advantages, including reducing investor risk, ensuring economic efficiency, and supporting the achievement of energy policy objectives.

The auction design reflects market dynamics, aiming to meet its needs without jeopardizing compliance with the targets set out in the National Energy and Climate Plan 2030 (NECP 2030) or imposing additional costs on consumers. Given the energy intensity and anticipated growth of the renewable hydrogen industry, auctions also include capacity dedicated to projects focused on hydrogen production and its derivatives, aligning installed capacity growth with the gradual deployment of electrolyzers. The frequency, number of auctions each year, targeted technologies, and formats are defined annually, considering installed capacity targets, NECP 2030 goals, and grid development.

To date, several auctions have been conducted, including photovoltaic (PV) solar auctions in 2019 and 2020, and a floating PV solar auction in 2021. Additionally, a competitive process in 2021 allocated grid capacity previously used by the Pego coal-fired power plant to a hybrid solar-wind project featuring storage and renewable gas production. Looking ahead, offshore wind energy auctions are planned for the 2030 horizon. Beyond auctions, new renewable electricity production licenses can also be obtained through alternative mechanisms: (i) when grid capacity is available, via general scheme capacity reservation (RESP); or (ii) through agreements between the applicant and the RESP operator, with the applicant assuming the financial costs for necessary grid construction or reinforcement to accommodate the energy produced. These modalities for securing capacity reservation titles (general regime, competitive procedure, or direct agreement) are governed by Decree-Law No. 15/2022 of January 14. This regulatory framework ensures a structured and adaptable approach to fostering renewable energy development while maintaining transparency and alignment with national objectives.

The implementation of hybrid energy systems enhances flexibility and resource efficiency by enabling complementarity between forms of energy, reducing production costs, and maximizing

grid connection capacity without requiring necessarily significant additional grid investment. To support these solutions, a suitable legal and technical framework has been developed, which will enable the implementation of these solutions.

This measure was implemented through Decree-Law No. 15/2022, which establishes the organisation and functioning of the National Electricity System. It transposes Directive (EU) 2019/944 on common rules for the internal electricity market and partially transposes Directive (EU) 2018/2001 on the promotion of renewable energy use.

To increase onshore wind production, it is essential to encourage repowering and over-equipping existing wind farms, alongside exploring untapped wind potential in Portugal. This approach supports the modernization and competitiveness of operational wind farms. Over-equipping involves installing additional capacity at existing facilities, where environmental impacts have already been mitigated and unused grid capacity can be efficiently utilized. Repowering, similarly, upgrades or replaces aging equipment with more efficient technologies as wind farms reach the end of their operational life. Both strategies boost energy production and enhance availability factors, optimizing the use of existing grid connection points.

The regulatory framework provided by Decree-Law No. 15/2022 establishes favorable conditions for implementing over-equipping and repowering, with current limitations, such as the additional 20% connection capacity, open to future revisions. Such updates aim to unlock the full potential of onshore wind production while integrating these enhancements with investment and development plans for transmission and distribution networks.

In parallel, fostering renewable cogeneration and gradually reducing incentives for fossil-fuel-based cogeneration are critical measures for advancing energy efficiency and reducing GHG emissions. Cogeneration systems efficiently produce electricity, heat, and cooling, making them a cornerstone for energy optimization. Additionally, their proximity to consumption points minimizes energy losses and reduces infrastructure investment needs. Promoting renewable-based cogeneration systems and transitioning existing fossil fuel systems to renewable sources harnesses domestic resources and aligns with decarbonization goals. This dual approach - scaling up renewable cogeneration and modernizing wind capacity - ensures a robust contribution to the national energy transition, driving efficiency, and sustainability.

Promoting the development of ocean renewable energies in Portugal is a strategic priority, leveraging the country’s vast and unique potential in this area. These resources offer significant opportunities for creating an export-oriented industrial sector for innovative energy technologies. Ocean-based renewable energies, such as offshore wind and wave energy, not only contribute to decarbonization but also facilitate the sustainable growth of a blue economy, fostering the development of high-value products and services for global markets. The ecological development of a sustainable blue economy ensures the protection of marine ecosystems, guided by the Maritime Spatial Plan (OEM), a critical tool for integrated maritime space management.

Portugal’s considerable offshore wind energy potential, primarily harnessed through floating platform turbines, is complemented by opportunities in wave energy. A strategic approach to

multi-use applications of ocean space is being developed, combining technologies beneficial to the energy system and broader blue economy objectives. To support this vision, a multidisciplinary and interministerial working group was established in 2022. Its efforts focus on identifying potential offshore renewable zones in the Atlantic, integrating them into the National Maritime Spatial Plan. These zones align with planned expansions of the National Electricity Transmission Network (RNT), port infrastructure developments, and energy interconnections to meet project demands.

Regulatory mechanisms are also advancing to facilitate the allocation of connection capacity to the electricity grid, including auction-based processes. These efforts are informed by recommendations from the working group and public consultations. A dedicated Technological Free Zone off the coast of Viana do Castelo is fostering the development of less mature and innovative offshore energy technologies, supporting their demonstration and subsequent commercialization.

The Autonomous Region of the Azores, rich in high-enthalpy geothermal resources, will continue investing in this renewable energy source to maximize productivity by leveraging existing resources and advanced technologies. Portugal also aims to promote pilot projects in emerging renewable energy technologies, including dispatchable solar thermal power plants with storage, floating solar, agrivoltaics, wave energy, renewable synthetic gas production, and other ocean-based energy technologies. These initiatives are supported by Decree-Law No. 15/2022, which created three Technological Free Zones: one in Abrantes for renewable energy projects tied to the transition from coal power, another offshore at Viana do Castelo for renewable energy projects at sea, and a third in the Mira Irrigation System for projects that harmonize agricultural use with electricity generation.

To ensure transparency and build trust in renewable energy, Portugal is advancing a Guarantees of Origin System, which provides electronic certificates to verify the renewable energy content in suppliers' portfolios. The Energy Services Regulatory Authority (ERSE) has updated this system to include renewable and low-carbon gases through Public Consultation and Directive No. 17/2023. This initiative aligns with Decree-Law No. 84/2022, which transposed EU Directive 2018/2001, and Decree-Law No. 60/2020, which supports guarantees for low-carbon and renewable gases. In addressing the challenges of energy grid capacity, particularly in high-demand areas, Portugal is investing in reinforcing and expanding infrastructure to enable decentralized renewable energy production, self-consumption, and Renewable Energy Communities (CERs). These efforts include implementing dynamic grid management models to optimize energy production, consumption, and storage. Additionally, a call for projects under the 2024 Environmental Fund allocates €99.75 million to support battery energy storage systems, enhancing the grid’s flexibility.

To meet the demands of a growing offshore renewable energy sector, specialized training programs will develop expertise in installation, operation, maintenance, and decommissioning of offshore facilities. This training is vital for meeting both national and European targets and addressing the skills gap identified by international organizations like ETIP Wind and IRENA. The

regulatory framework is also being strengthened to promote renewable energy Power Purchase Agreements (PPAs), providing price stability and facilitating long-term investments. This effort is guided by EU Regulation 2024/1747, which addresses barriers to implementing PPAs while maintaining competitive and liquid electricity markets.

Port infrastructure development is another key focus area, ensuring the logistics of offshore wind projects are adequately supported. This includes defining connection conditions, offshore interconnection points, and upgrades to the electricity transmission network to integrate with European systems, particularly Spain.

In parallel, regulatory sandboxes are being expanded to support a wider range of innovative pilot projects, fostering industry engagement and facilitating the transition from pilot to market-ready technologies.

In addition to these developments, it is also important to highlight the publication of the following legislative acts relevant to the fulfillment of the objectives of this PaM, some of which are older but still quite relevant:

- 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.
- Decree-Law No. 64/2017, amended by Decree-Law No. 120/2019, 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.
- 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 Program. 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.
- The Windfloat Atlantic project is a PT awarded renewable energy technology project under the first call for proposal of the aforementioned NER300 program. 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. 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 compatibilization 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. Meanwhile, Order No. 11404/2022, of September 23, created the Working Group for the planning and operationalisation of power stations based on renewable energy sources of ocean origin or location. In order to realise all the expected potential and achieve an installed offshore wind capacity of 10 GW, allocated through competitive procedures, it is crucial to define an approach for planning and implementing projects based on RES-offshore, which will reduce risks for promoters while leveraging all the economic value for society. A report was therefore drawn up with a preliminary proposal of the spatialised areas for the Offshore Renewable Energy Allocation Plan (PAER).
- 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 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 license, which is needed to start construction and to deliver electricity to the grid.

- 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 favorable 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.
- Decree-Law no. 15/2022, of January 14, incorporates the provisions on renewable self-consumption and provides for the Self-Consumption Regulation (RAC), to be approved by ERSE, covering matters such as the commercial relationship between the entities involved, measuring, reading and making data available or the ways in which energy is shared between self-consumers. The RAC was approved by Regulation no. 815/2023, of July 27.
- Regulation no. 827/2023, of July 28, approves the Commercial Relations Regulations for the Electricity and Gas Sectors and repeals Regulation no. 1129/2020, of December 30, 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. Declaration of Rectification no. 830/2023, of October 31, rectifies Regulation no. 827/2023.
- Order No. 11740-b/2021, of November 26, determines the opening of a competitive procedure for the allocation of reserve injection capacity at connection points to the public service electricity grid for electricity from the conversion of solar energy by floating photovoltaic power plants to be installed in reservoirs.

- Decree-Law No. 30-A/2022, of April 18, which establishes exceptional measures aimed at ensuring the installation and entry into operation of power plants from renewable energy sources, storage facilities, production units for self-consumption (UPAC) and respective lines of connection to the Public Service Electricity Grid (RESP); Hydrogen production plants by electrolysis from water; and Electricity transmission and distribution infrastructures.
- Resolution of the Council of Ministers No. 50/2024, of March 14, creates the Mission Structure for the Licensing of Renewable Energy Projects 2030 (EMER 2030) with the mission of ensuring compliance with the objectives of the National Energy and Climate Plan 2030.
- Order No. 6757-A/2024, of June 17, creates the Working Group for the transposition of Directive (EU) 2023/2413 (GT-RED III) considering the extent and complexity of the provisions provided for in the RED III Directive, the impact on the legislative framework in force, as well as the need for adequate coordination with the agents of the sectors covered.

Important also to highlight the measure "Energy Transition in the Azores", in the context of the Autonomous Region of Azores, which has been created within the scope of the RRP, with an allocated budget of 116 M€. This investment aims to develop state-of-the-art electrical infrastructures and execute projects with innovative technical solutions to increase energy self-sufficiency. In the Azores, electricity production from renewable sources currently represents around 40% of the region's global value, of which around 24% comes from geothermal energy present on the islands of São Miguel and Terceira. The remaining 60% of electricity is produced from fossil fuels (fuel oil and diesel), with high GHG emissions, and which represent a high annual bill, not only due to the purchase price of the fuels, but also due to their transport, by sea, from the continent to the islands and inter-island distribution. This type of production, in addition to having a high associated cost, represents a strong external dependence which, in situations of national or international crisis, can jeopardize the ability to respond to the archipelago's energy needs. This investment will be made up of the following sub-investments:

- Increase in installed renewable energy production capacity, mainly geothermal, by 12 MW, and revitalization of the already installed geothermal power plant by 5 MW;
- Increase by 850 kW in the installed capacity to produce electricity from renewable sources on the island of Corvo through the installation of a photovoltaic park and a wind farm;
- Installation of new electrical energy storage systems on the islands of Santa Maria, São Jorge, Pico, Faial, Flores and Corvo corresponding to at least 20 MW; and
- Installation of new small photovoltaic electricity production units, for decentralized production and consumption, totaling 11.2 MW.

For the operationalization of this last subinvestment, Regional Legislative Decree No. 12/2022/A, in its amended version, established the system of financial incentives for the acquisition of solar photovoltaic systems for self-consumption, to be installed in the Autonomous Region of the Azores (RAA), within the scope of the Recovery and Resilience Plan, hereinafter referred to as Solenerge. Solenerge aims to increase installed capacity by 11.2 MW, through electrification, decentralized

production and distributed storage. To this end, it provides for the granting of financial incentives for the acquisition an installation of photovoltaic solar systems.

The Autonomous Region of Madeira is launching a tender procedure to make 60 megawatts (MW) of injection capacity available on the Madeira Public Service Electricity Grid (RESPM), distributed at various points on the island and intended exclusively to produce electricity from solar sources. This tender, which is open to all interested individuals and organizations, aims to strengthen the regional strategy for energy diversification and reducing carbon emissions. This investment is part of the region's strategic objectives for energy transition, allowing Madeira to reduce its dependence on fossil fuels and significantly increase local production of renewable energy. Currently, the annual production of electricity in the Autonomous Region of Madeira is around 935 gigawatt hours (GWh). Considering that 1 MW of installed solar energy capacity can generate an average of 1.5 GWh per year, the additional 60 MW could produce around 90 GWh per year.

This increase represents approximately 9.6 per cent of total electricity production in 2023, which is a significant advance in renewable energy generation capacity in the region. As well as diversifying the energy matrix, this increase reinforces Madeira's commitment to environmental sustainability and the promotion of a low-carbon economy.

This measure could also be linked to other PaM such as:

- 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";
- PaM17 – "To promote the production and consumption of alternative renewable fuels, namely Hydrogen including through development of alternative fuels infrastructure for clean fuels";
- PaM19 – "To promote energy and resource efficiency, renewables and electrification; Industrial symbioses, resource optimization and resource reuse";
- PaM26 – "To improve the management of energy consumption in the various sectors of the national economy".

PaM23 - To promote greater electricity network intelligence and flexibility

Promoting the widespread adoption of distributed energy production - where energy is generated either at or very near the point of consumption - results in multiple benefits. It reduces transportation and distribution costs, minimizes energy losses, and optimizes production solutions. This approach not only enhances efficiency but also supports a more resilient and decentralized energy system. For improved management of the national electricity system, it is essential to establish a flexible framework that balances supply and demand through aggregation, ensuring the stability of the grid. The active participation of consumers and small producers in developing an aggregation market to provide system services is crucial.

Developing a roadmap for flexibility in Portugal aims to provide a practical, independent, and objective analysis of the various pathways for advancing aggregation and addressing the need for local and system-wide flexibility services. This initiative will align with renewable energy and decarbonization goals while ensuring supply security. Periodic assessments of the system's flexibility needs, involving network operators, will be conducted in accordance with the new EU electricity market design. These assessments will help refine the Union's electricity market framework and support its optimization. This roadmap will be divided into two segments. The first will address system-wide services under the responsibility of the Grid System Operator (GSO), while the second will focus on local flexibility services managed by distribution network operators. Effective coordination between these entities is essential, as the two markets serve distinct purposes and requirements. This structured approach will enhance the compatibility and efficiency of Portugal's energy system, ensuring it meets evolving demands for flexibility and resilience.

Emphasizing local electricity generation, particularly through solar energy, plays a crucial role in empowering consumers as active participants in the energy sector, fostering the growth of energy communities, and reducing the need for centralized production and network reinforcement. This approach also encourages the development of new markets and technological solutions. Legislative updates, such as the repeal of Decree-Law No. 162/2019 by Decree-Law No. 15/2022, have already led to a significant increase in installed self-consumption units. Adjusting production-to-consumption rules to maximize the potential of specific installations could further enhance renewable energy integration at the local level.

It is also essential to promote not only distributed but decentralized renewable energy production and self-consumption - whether individual, collective, or via energy communities. These efforts align with the principles outlined in the European Green Deal and concepts such as collective self-consumption (ACC) and citizen energy communities (CCE). Establishing technical and safety standards for licensing behind-the-meter energy storage systems, connected to self-consumption or energy-sharing setups, will support this transformation.

Energy communities play a pivotal role in driving social innovation, empowering citizens in energy-related matters, and fostering local social and economic development, while significantly addressing energy poverty. Following the legal framework established under Decree-Law No. 15/2022, the promotion of energy communities must include information campaigns and support programs to reduce information asymmetries and assist municipalities and citizens in forming these communities. Flexibility in financing criteria and streamlined licensing procedures are also necessary to facilitate their growth.

Supporting the establishment of energy communities through municipal partnerships is another priority. Public entities, in collaboration with qualified agencies and local partners, can provide technical and financial assistance to kick-start these projects. Simplifying access to self-consumption for public entities, including municipalities, is equally important, as existing procurement rules often hinder their participation. A dedicated program addressing these challenges could unlock the potential of public entities to champion collective self-consumption and renewable energy communities.

Integrating self-consumption and energy storage with Portugal's electric mobility model is another critical step. Reviewing existing frameworks to enhance compatibility with renewable energy sources and aligning with EU regulations - such as the AFIR Regulation, EPBD Directive, and RED III Directive - will enable the creation of complementary markets and credit systems for renewable energy in the transport sector.

Capacity building is fundamental for all stakeholders in the energy system. A targeted program for training and awareness, supported by comprehensive guides, can strengthen technical, administrative, economic, and legal expertise on individual and collective self-consumption and renewable energy communities.

Promoting energy storage alongside self-consumption and energy-sharing systems can lead to a more efficient and dynamic energy system. Behind-the-meter storage solutions protect consumers - be they residential, industrial, or commercial - from price volatility while enabling active market participation. Such storage solutions allow excess renewable energy to be used during peak demand, optimizing the use of renewable energy sources and reducing reliance on the public grid. To maximize these benefits, financing lines are essential to make storage systems accessible to all consumers. This will not only shield users from price fluctuations but also ensure a more stable and efficient grid, capable of handling variations in demand.

Finally, a comprehensive strategy for renewable energy production by energy communities and self-consumption should be developed, with clear objectives and trajectories for installed capacity and renewable energy generation by 2030. This strategy will ensure alignment with distributed production goals, fostering a resilient and sustainable energy future.

ERSE Regulation No. 610/2019, which regulated services related to smart electricity distribution networks, has been repealed by Regulation No. 817/2023, of October 31, which approves the Regulation of Services of Smart Electricity Distribution Networks.

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

Reducing the carbon intensity of buildings requires a comprehensive approach that prioritizes energy efficiency, promotes greater electrification of the sector, and replaces fossil fuels with renewable energy sources. Encouraging the use of low-carbon materials, fostering behavioral changes, and enhancing the sharing economy are also critical components. A particular focus should be placed on rehabilitating buildings to improve both energy and water efficiency, as well as thermal comfort. These measures not only contribute to environmental sustainability but also play a key role in addressing energy poverty, ensuring that households have access to affordable and sustainable energy solutions. This holistic strategy enhances resilience while aligning with broader decarbonization goals.

Promoting building rehabilitation as the primary strategy for improving the built environment enhances the lifespan of structures while optimizing the environmental resources already invested. This approach reduces GHG emissions, minimizes construction waste, and supports the conservation of nature and biodiversity. Central to this effort is the establishment and promotion of one-stop citizen support centers, accessible via digital platforms or physical spaces, to disseminate information and catalyze both small- and large-scale rehabilitation projects aimed at resource efficiency and the adoption of alternative energy sources.

Sustainable construction practices and resource-efficient, sustainable buildings must also be prioritized. This involves the incorporation of secondary and bio-based raw materials, local or native materials, and innovative techniques like bioclimatic architecture, passive housing, and modular, multifunctional designs. Reusing construction components, integrating recycled materials, and advancing construction material recycling processes are essential steps toward sustainability. Certification of water and material efficiency in buildings should serve as a distinctive marker of resource-efficient and sustainable practices. Efforts should also focus on improving energy and water efficiency in construction, reducing embedded energy and water use, and incorporating renewable energy sources. Initiatives such as the New European Bauhaus highlight the importance of coupling decarbonization with social inclusion.

Electrification of buildings, supported by increased integration of renewable energy, is a key driver of decarbonization. This transformation should target both new and existing buildings, ensuring the optimal use of the solar potential of the built environment through cost-effective investments in thermal and photovoltaic solar technologies. These solutions should align with varied energy needs, including electricity, heating, and cooling, to facilitate the replacement of fossil fuels in buildings. To achieve this, it is necessary to encourage the adoption of renewable energy systems and focus investment on the electrification of residential and service buildings.

Nearly Zero-Energy Buildings (NZEBs) and Zero-Emission Buildings (ZEBs) represent pivotal advancements in this context. NZEBs achieve a high level of energy performance with minimal energy needs covered largely by on-site or nearby renewable energy sources. ZEBs take this further, ensuring that any residual energy requirements are met entirely by renewables, with no on-site carbon emissions from fossil fuels. The EU's Directive (EU) 2024/1275 (recast EPBD) sets the target of achieving a zero-emission building stock by 2050, accounting for external and local climatic conditions, interior climate requirements, and cost-effectiveness. Transitioning to the ZEB paradigm demands active engagement from construction sector stakeholders, supported by measures to encourage adoption and the development and dissemination of technical solutions.

For existing buildings, guidelines and support mechanisms are essential to guide rehabilitation projects, emphasizing consumption monitoring, efficient and durable equipment, and sustainable optimization of energy use. These measures should ensure that existing structures align with ZEB goals while addressing their unique characteristics and untapped potential, fostering a gradual, sustainable transformation of the building sector.

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). Decree-Law No. 118/2013 was repealed 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 through loans. As of the second half of 2023, the program has facilitated 474 financing contracts, amounting to a contracted investment of €1.5 billion. This investment has led to the rehabilitation of 2,610 housing units, the accommodation of 5,292 new residents, and the creation of 5,158 jobs. Additionally, these projects have contributed to an annual reduction of 34,727 tonnes of CO_2eq.

"Casa Eficiente 2020" Program aimed 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 2023, a new program has been launched, the Support Program for More Sustainable Buildings 2023 – an investment included in Component 13 of the PRR – Energy Efficiency in Buildings, aiming to finance measures that promote rehabilitation, decarbonisation, energy efficiency, water efficiency and the circular economy, contributing to improving energy and environmental performance. Specifically, it was intended to support measures that lead, on average, to at least a 30% reduction in primary energy consumption in the buildings undergoing renovation.

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.

Order No. 8023/2024, of July 19, creates the Working Group for the transposition of Directive (EU) 2024/1275 of the European Parliament and of the Council, of 24 April 2024, into the Portuguese legal system (GT – EPBD).

National Long-Term Strategy to Combat Energy Poverty 2023-2050 (ELPPE), approved by Council of Ministers Resolution No. 11/2024, of January 8.

The Autonomous Region of Madeira has been implementing a set of measures and programs aimed at promoting the energy rehabilitation of buildings, energy efficiency and the adoption of renewable energies, in line with global sustainability and energy transition goals. These initiatives reflect the region's commitment to improve the energy performance of homes and buildings, reducing carbon emissions, and encouraging the use of more efficient and sustainable technologies. One of the main initiatives is the "Casa + Eficiente" Program, which provides non-repayable financial support for the rehabilitation and improvement of permanent homes owned by economically and financially fragile households. The main aim of this program is to improve the energy performance of homes, reducing energy consumption and, consequently, household energy costs. As well as promoting better living conditions, it contributes to mitigating greenhouse gas emissions and combating energy poverty in the region. Another important initiative is the "Reabilitar Madeira" Support Program, which provides financial support for building rehabilitation. This program focuses on improving the energy performance of buildings, promoting rehabilitations that ensure greater energy efficiency and enhance their residential use. Its implementation has helped to increase the sustainability of RAM's housing stock, bringing it into line with the best energy management practices.

Both programs are in line with the concept of Nearly Zero Energy Buildings (NZEB), which consists of designing or rehabilitating buildings in such a way as to guarantee extremely low energy consumption, with a large part of the energy required coming from renewable sources. This approach allows the Region to take important steps in the transition to a more sustainable construction model, reducing the environmental footprint and reinforcing the use of clean and efficient resources.

At the same time, the Autonomous Region of Madeira has been promoting the installation of systems based on renewable energies through the PRIAPER-RAM program - Incentive for the Production and Storage of Energy from Renewable Sources. This program encourages the adoption of solutions such as photovoltaic and thermal solar panels, heat pumps and other energy-efficient equipment. The aim is to reduce external energy dependence, cut carbon dioxide emissions and encourage more conscious and sustainable production and consumption patterns.

PaM25 - Promoting decarbonisation options in public administration

This PaM aims to decarbonize public administration in the areas of transportation and mobility, infrastructure, equipment, and buildings, as well as public procurement, by leading the way in the adoption of innovative and ambitious policies. Equip public

administration with low-carbon mobility options, reduce energy intensity, and increase the efficiency of its transportation fleet, while promoting a low-carbon built environment and adopting low-carbon requirements in public procurement.

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), approved by the Council of Ministers Resolution No. 104/2020. 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 order to define new goals and objectives for ECO.AP 2030, as well as align its scope of application, including its universe, and considering the Directive (EU) 2023/1791 and the Climate Framework Law, this program has been revised. This revision was approved by the Council of Ministers Resolution No. 150/2024 and named it "Energy Efficiency and Decarbonization Program in Public Administration for the period up to 2030 (ECO.AP 2030)". Thus, ECO.AP 2030 also becomes the decarbonization program for Public Administration, applying to the management bodies of the services of the direct and indirect administration of the State, independent administrative entities, as well as the executive bodies of local authorities and public associations, which must promote the preparation of Decarbonization and Efficiency Plans under ECO.AP 2030.

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.

In 2022, Order No. 10473/2022, of August 29, was published to regulate the Environmental Sustainability Program in the Ministry of Health (ECO@SAÚDE), clarifying and determining the implementation strategy of this program within the Ministry of Health, which includes:

- Goals for reducing energy and water consumption, waste production, increasing self-consumption from renewable energy sources, and improving the energy and water renewal rate of buildings within public health entities;
- The responsibilities of Energy and Resource Managers (GER);
- Other aspects inherent to ECO@SAÚDE, including chronological intermediate reporting targets, the preparation of Monitoring Reports, and the Energy and Water Efficiency Ranking of NHS Hospitals.

Worth also mentioning in the context of this PaM, the Program for Sustainable Mobility in Public Administration 2015-2020 - ECO.mob mentioned in PaM16, with the purpose of promoting decarbonization and improving the environmental performance of the State's Vehicle Fleet.

Promoting green public procurement (GPP) aligns with the New National Strategy for Green Public Procurement 2030 – ECO360 is also an important measure in the context of this PaM. It involves incorporating sustainability and circularity requirements in public procurement of energy goods and services, equipment and buildings, public vehicle purchases and transport services, as well as road construction contracts and other goods and services. Construction significantly contributes to GHG emissions, with public buildings and civil engineering projects such as schools, hospitals, roads, and railways being particularly energy and material-intensive. Following the Council of Ministers Resolution No. 13/2023, which approved the National Strategy for Green Public Procurement 2030 - ECO360, the aim is to strengthen the inclusion of ecological criteria in public procurement procedures by entities under direct and indirect State administration and the State's corporate sector. This approach seeks to position the Public Administration as a driver of positive change in the transition to a more environmentally sustainable, competitive, and resilient economy, directly contributing to environmental policy goals related to climate change, resource use, and sustainable consumption and production.

The same strategy identifies as one of its Strategic Objectives the stimulation of the Portuguese economy toward climate neutrality, comprising three specific goals, each associated with targets for 2025 and 2030:

1. Systematically integrating energy efficiency criteria into the procurement of public products, services, buildings, and works - This integration can significantly reduce the

energy consumption of public administration, aligning with the goals of ECO.AP 2030. This objective is particularly important within the European "Renovation Wave" initiative aimed at increasing the energy efficiency of buildings across Europe.

2. Increasing the share of renewable energy and sustainable mobility within public administration entities - GPP should promote the procurement of electricity services produced from renewable energy sources for public administration entities and encourage the adoption of renewable energy-based production systems, aligning with ECO.AP 2030 and NECP 2030 targets. Additionally, GPP should promote sustainable mobility in public administration entities, favoring the use of electric vehicles, public transport, and soft mobility options (e.g., bicycles).
3. Integrating carbon accounting throughout the lifecycle in the procurement of products, services, and works - This involves using indicators such as carbon footprints. This goal is especially relevant in product and service categories with high embedded carbon content, such as construction, buildings, food, and others. Public entities are expected to include carbon footprint information in pre-contractual procedures, favoring suppliers that provide this data.

GPP is being progressively incorporated across various policy areas, extending beyond environmental policies to include economic, agricultural, and digital transition policies, with increasing levels of stringency. An example of this trend is the integration of GPP as a key component of the European Green Deal, including the Circular Economy Action Plan. At the EU level, GPP has been integrated into several regulatory initiatives with binding provisions, such as Regulation (EU) 2023/1542 on Batteries; Directive (EU) 2023/1791 on Energy Efficiency; Regulation (EU) 2024/1781 on Ecodesign; and Regulation (EU) 2024/1735 on the Net Zero Industry, among others.

At the national level, Council of Ministers Resolution No. 132/2023 of October 25 establishes ecological criteria for public contracts by State entities, particularly for the following product and service groups, some of which are mandatory:

- Electricity procurement contracts, including for public electric mobility charging stations.
- Contracts for energy certification, energy audit, and design services, and for the procurement and installation of self-consumption photovoltaic systems.
- Vehicle procurement and operational leasing contracts.
- Public works contracts.

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

Significantly improving energy consumption management by reducing consumption and costs associated with running businesses and managing the domestic economy significantly

contributes to increasing the competitiveness of the economy and sectors by freeing up resources to boost domestic demand and new markets investments.

To improve the monitoring and management of energy consumption, it is essential to promote the creation of an Energy Consumption and Efficiency Management System (SGCEE) in energy-intensive installations and fleets within the industry and transport sectors. This system would integrate existing frameworks, such as the Energy Intensive Consumption Management System (SGCIE) and the Energy Consumption Management Regulation for the Transport Sector (RGCEST), and create a common reporting and monitoring system based on a defined threshold for energy consumption in both sectors. The system would also include a performance evaluation and classification methodology, supporting organizations in their continuous improvement efforts. By introducing reporting obligations, audits, and action/optimization plans that vary by sector and energy consumption level, this initiative will streamline and harmonize procedures across sectors.

In parallel, it is important to develop a cross-sectoral monitoring system that consolidates the information reported under various instruments, such as Directive (EU) 2023/2413 on promoting renewable energy sources and Directive (EU) 2023/1791 on energy efficiency. This system will provide a comprehensive and complementary perspective, allowing for a unified view of the implementation status of sectoral initiatives in industry, buildings, and transport. This integrated approach ensures that the energy consumption and efficiency management efforts are aligned, up-to-date, and reflective of the broader policy goals.

PaM27 - To promote the production and consumption of renewable gases

The use of renewable gases is recognized as a viable alternative for achieving a low-carbon economy, promoting the replacement of fossil fuels and reducing the country's energy dependence.

Regulating and promoting the injection of renewable gases into the Public Gas Network (RPG) is a critical step in advancing the transition to renewable energy. The regulation of the National Natural Gas System (SNG), as outlined in Decree-Law No. 62/2020 of August 28, 2020, is essential to facilitate the introduction of renewable gases, particularly hydrogen and biomethane, into both the gas transportation and distribution networks, as well as for use in vehicles, while eliminating existing barriers.

As part of the reforms approved in the 2023 revision of the Recovery and Resilience Plan (PRR) both the regulations governing the National Gas Transmission Network (RNTG) and the National Gas Distribution Network (RNDG) are set to be updated. Specifically, the RP-C21-46 reform - the regulatory framework for renewable hydrogen, as part of the REPowerEU chapter - aims to revise the regulatory framework for the national gas transmission and distribution networks to support the use of renewable gases, with a focus on hydrogen, as part of a broader strategy for transitioning to a decarbonized economy.

To further this transition, goals will be set to define the incorporation of renewable gases, such as renewable hydrogen and biomethane, into natural gas networks and other sectors of the economy where their integration can contribute to decarbonizing energy consumption. This process will involve studying, re-evaluating, and updating the targets for renewable gas integration, building on the existing framework set out in Council of Ministers Resolution No. 63/2020 and Order No. 806-B and 806-C/2022. In addition, Portugal has developed the National Hydrogen Strategy (EN-H2), which is included in the annex to Council of Ministers Resolution No. 63/2020, and the Biomethane Action Plan, approved by Council of Ministers Resolution No. 41/2024 on March 15, 2024.

To ensure renewable gases meet the necessary quality standards and do not compromise energy supply security or service continuity, a certification system will be implemented. This will allow for the verification of renewable energy sources used in the production of renewable gases. Additionally, consumers will be informed about the origin of the renewable gases they use, through the implementation of a guarantee of origin system, which will issue electronic certificates to confirm the proportion or quantity of renewable energy in the energy mix of a particular supplier.

Promoting the production, transportation, distribution, and consumption of renewable hydrogen is also a priority. Efforts will focus on developing and implementing technologies for the production of green hydrogen from renewable energy sources, in line with the European Renewable Energy Directive and associated delegated acts. This aims to harness local renewable energy sources, diversify energy supplies, and reduce energy dependence. The national strategy also seeks to minimize pressure on water resources, prioritizing the use of alternative water sources, such as treated wastewater, to produce renewable hydrogen. In this context, Portugal is developing an industrial policy to establish a renewable gas production cluster, particularly focused on green hydrogen. The goal is to position Portugal as a major player in the European green hydrogen market, initially leveraging solar energy for competitiveness, along with other established renewable sources like wind and hydropower. This initiative will accelerate the decarbonization of various sectors, especially those harder to decarbonize. The creation of a collaborative hydrogen lab, Hylab, is part of this strategy, aiming to develop a world-class R&D cluster with a focus on hydrogen competitiveness and the creation of new products and services.

In 2019, funding programs for renewable gas production were launched (POSEUR), followed by additional funding in 2021 and 2023 (C14 of the RRP), which supported small-scale decentralized green hydrogen projects. The national hydrogen strategy envisions injecting renewable gases into existing SNG networks, recognizing the importance of both reconverting existing networks and constructing new networks dedicated to renewable gases, especially renewable hydrogen. The proximity of production and consumption sites, which reduces transportation needs and enhances system efficiency, has fostered the development of hydrogen production and consumption clusters, leading to the emergence of several "H2 Valleys." In 2023, an R&D project for a hydrogen valley in Alentejo was funded by the European Clean Hydrogen Joint Undertaking, under Horizon Europe.

To increase renewable gas production, support mechanisms for expanding the installed capacity of biodigesters will be introduced. Portugal has favorable conditions for leading the decarbonization of the renewable gas sector, with significant potential for both green hydrogen production and biomethane. This potential extends across various sectors, including wastewater treatment plants, urban waste treatment units, landfills, and agricultural, livestock, industrial, and forestry production units. These technologies are well-established and can be utilized after purifying biogas to remove carbon dioxide and contaminants, producing biomethane, which plays a key role in replacing natural gas. There is a clear need for incentives to support the increased production and purification of biogas, especially to enhance the country's energy self-sufficiency and renewable gas supply.

The Biomethane Action Plan for Portugal, approved by Council of Ministers Resolution No. 41/2024, outlines a comprehensive strategy to develop the domestic biomethane market and achieve its production goals. The first phase focuses on establishing a regulatory framework and supporting policies to foster an internal biomethane market, while the second phase aims to scale up production, reduce costs, and develop new value chains regionally.

To support the renewable gas sector, the simplification of licensing procedures will be accelerated. The complexity of regulatory processes, which involve various sectors such as waste management, agriculture, industry, and transport, can hinder renewable gas projects. Efforts will be made to streamline administrative procedures for the construction and licensing of renewable gas production units, including biogas, biomethane, green hydrogen, and synthetic fuels. Additionally, there will be investments in training technical staff to better assess and approve renewable gas projects.

A review of the National Hydrogen Strategy (EN-H2) is foressen in order to implement mandatory incorporation targets for renewable hydrogen (and its derivatives) in the transport and industry sectors, in alignment with the REDIII Directive. This review will ensure that Portugal continues to progress in its efforts to decarbonize and develop a sustainable, low-carbon economy. The creation of a green 100% hydrogen corridor ('H2Med') to connect the Iberian Peninsula with the rest of Europe is one of the pillars of the (future) *European Hydrogen Backbone*, which aims to accelerate Europe's decarbonisation by creating the hydrogen infrastructure needed to enable the development of a competitive, liquid and pan-European hydrogen market.

In addition to these developments, it is also important to highlight the publication of the following legislative acts relevant to the fulfillment of the objectives of this PaM, some of which are older but still quite relevant:

- 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 repealed by Decree-Law no. 84/2022, of December 9. Decree-Law no. 84/2022 of December 9 establishes the mechanisms for issuing guarantees of origin for electricity from renewable energy sources, heating or cooling energy from renewable energy sources, low-

carbon gases and for gases of renewable origin and energy production in high-efficiency cogeneration facilities.

- Decree-Law No. 62/2020 establishes the organization 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 decarbonization in domestic and industrial consumption. The incorporation of renewable origin and low carbon gases also contributes to the fact that 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 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.
- Ordinance No. 15/2023, of January 4, establishes the system for the centralized purchase of biomethane and hydrogen produced by electrolysis from water, using electricity from renewable energy sources, through a competitive procedure for 150 GWh/year (higher calorific value basis PCS) of Biomethane and 120 GWh/year (higher calorific value base PCS) of Hydrogen.
- Order No. 5971-A/2024, of May 27, opens a competitive procedure, in the form of an electronic auction, for the centralized purchase of biomethane and hydrogen produced by electrolysis from water, using electricity from renewable energy sources.

Additionally, and with regard specifically to the waste sector, in the majority of the landfills being explored currently at national level, 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 national 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

This PaM aims to ensure the proper implementation of the European Union Emissions Trading Scheme (EU ETS) by adapting it to the new EU rules to promote GHG reduction under cost-effective and economically efficient manner.

The EU ETS was created by the ETS Directive 2003/87/EC, of the European Parliament and of the Council, of 13 October 2003 and has become a key instrument in the mitigation policies for GHG established by the Union to tackle climate change. Considered the most cost-effective EU instrument to reduce GHG emissions, 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.

Currently, it is applied to stationary installations in the energy and industrial sectors, as well as the aviation (since 2012) and to maritime sector (since 2024). 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 approximately 100€/ton CO2 in 2023, 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, staring with a total of 244 ETS installations. After reaching its peak in 2007, with 258, this number generally declined. The most significant exception to this trend was observed in 2013, at the start of phase 3, due to the inclusion of new activities in the scope of the EU ETS Directive. The data from 2023 show that 144 installations were covered by the EU ETS, a reduction of 2.7 % when compared to 2021, continuing a downwards trend since 2018, and reaching a new historical minimum since 2005.

As illustrated in Figure 3.20, there is a very significant reduction in GHG emissions from the ETS installations since 2005. In 2023, 12.8 Mt CO2eq. were reported as verified emissions from the ETS installations. This corresponds to a 21% decrease when compared with 2022 (16.2 Mt CO2eq.), becoming the highest recorded annual decrease since 2005, and a relevant 65% decrease in comparison with 2005 (36.4 Mt).

In the first years, these changes were mainly due to the introduction of natural gas to the detriment of coke and oil use. In the years after, reduction in GHG emissions resulted from the introduction of biomass based fuels alongside with the implementation of best available technologies and energy efficiency measures in the industry sector, as well as the phasing-down and closing, in 2021, of the two remaining coal-fired power plants. In 2022, there was a slight increase in GHG emissions (<1 %), due to a prolonged drought, which led to a reduction in hydropower generation, and a consequential increase in natural gas consumption. In 2023 reductions in emissions were mostly due to a reduction of natural gas consumption for power

generation, to the lowest level since 2014, which resulted from an increase in renewable energy production, especially hydropower (the highest value since 2016) and solar energy.

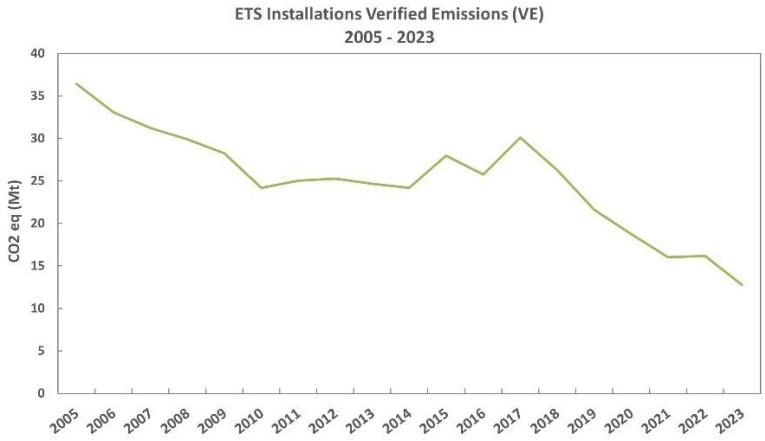

Figure 3.20 - GHG emissions from ETS installations (2005-2023).

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.

In addition, EU ETS Directive has established 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.

This PaM aims to promote eco-innovation, cleaner production processes, and the digitalization of industry (Industry 4.0). The paradigm shift in the industrial sector required for energy transition and carbon neutrality is expected to follow a more incremental path compared to other sectors. Eco-innovation, digitalization, and more sustainable business models are key drivers of decarbonization, offering a competitive edge. Promoting these elements can lead to both economic and environmental gains, contributing to the broader goal of achieving a low-carbon economy.

Given that industrial activity is a key area for achieving GHG emissions reduction targets, both European and national policies include strategic frameworks to facilitate the industry's transition. In line with the National Climate Law, a green industrial strategy will be developed to support companies in the transition to a low-carbon economy. This strategy will guide the industrial sector through climate and energy transformations, ensuring compliance with emissions reduction targets while strengthening its competitiveness.

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 (RRP) also provides an opportunity to get the economy back on track in a sustainable way. Within the scope of this Mechanism, the RRP focused 41% of the investments in the climate transition and foresees EUR 837 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 GHG 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

This PaM aims to prohibit the placing on the market of equipment containing fluorinated gases with a high Global Warming Potential (GWP), thereby preventing the release of these gases into the atmosphere. It further seeks to promote the use of natural refrigerants as substitutes for fluorinated gases and to encourage alternatives to sulphur hexafluoride (SF6), a gas with an exceptionally high GWP.

Implementation of the provisions laid down in the Fluorinated Gases Regulation aimed 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 2021-2033. Additionally, Portugal has also implemented 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 is 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.

Thus, to fulfil the obligations defined by the aforementioned Regulation in Portugal, there are two mandatory communications that the operators must submit to the national competent authority in this regime, which is the Portuguese Environment Agency (APA). Those communications are:

- Communication from the operators who own equipment containing fluorinated gases, indicating the amount of gas installed in the equipment, as well as the amount of gas related to interventions on the equipment and its destruction (according to aggregate data, operators submitted 11.832 forms in 2021, 12.478 forms in 2022 and 13.155 forms in 2023).
- Communication from the operators who purchased and/or sold fluorinated gases.

Table 3.8 reflects the fluorinated gases data extracted from the operators' submissions (mentioned above in a)) and its variation from 2021 to 2023. Green means that the fluid quantities decreased from 2021 to 2023 and orange that it increased in that same period.

Table 3.8 - Values of the amounts of fluorinated gases installed in equipment from 2019 to 2020 (Source: APA, 2024).

Fluids	Installed Quantity in January of 2023 (kg)	Installed Quantity in January of 2022 (kg)	Installed Quantity in January of 2021 (kg)	Δ_{2022_2023} (kg)	Δ %	Δ_{2021_2022} (kg)	Δ %	Δ_{2021_2023} %
HFC-227ea (FM200) (GWP = 3220)	169 533	167 392	173 259	2 141	1,28%	-5 867	-3,39%	-2,15%
R-134A (GWP = 1430)	359 631	312 965	344 470	46 666	14,91%	-31 505	-9,15%	4,40%
R-23 (GWP = 14800)	81 406	81 010	77 242	396	0,49%	3 768	4,88%	5,39%
R-404A(GWP = 3922)	253 282	299 596	428 982	-46 314	-15,46%	-129 386	-30,16%	-40,96%
R-407C (GWP =2107)	162 593	209 192	204 948	-46 599	-22,28%	4 244	2,07%	-20,67%
R-410A (GWP = 2088)	592 401	751 050	813 198	-158 649	-21,12%	-62 148	-7,64%	-27,15%
R-422D(GWP =2729)	2 394	30 443	32 715	-28 049	-92,14%	-2 272	-6,94%	-92,68%
R-449A (GWP =1397)	391 713	447 642	326 498	-55 929	-12,49%	121 144	37,10%	19,97%
SF6 (GWP = 22800)	86 288	85 737	83 304	551	0,64%	2 433	2,92%	3,58%
Total	**2 301 518**	**2 530 033**	**2 633 340**	**-228 515**	**-9,03%**	**-103 307**	**-3,92%**	**-12,60%**

Comparing 2022 vs 2023, the data assessment points out a great decrease in the installed quantity of R422D (GWP = 2729), surpassing 90%, followed by a significant decrease in R407C (GWP = 2107) and R410A, both over 20% of the base year. Furthermore, if taken in account the evolution from 2021 to 2023, the diminish of R404A quantity is also quite relevant along with the described trend.

On the other hand, it shows a slight increase in the quantity of the top fluids with higher GWP, R23 and SF6, mostly between the 2021 to 2022 - in 2023, the amount of incrementation has come near to null.

Therefore, the new European Regulation 2024/573 which is already in force, targeting a wider range of gases such as SF6 and strengthening the total phase out of the elder generation gases, alongside with the trend revealed in an annual basis, will predictably invert, leading to a lesser amount of these gases.

In conclusion, the global data reveals a significant 9% decrease in the quantity of installed fluorinated fluids in Portuguese equipment from 2022 to 2023. Despite this decline, the continuous rise in the number of equipment containing fluorinated gases, as reported by the operators to the APA through Fgas forms, underscores a crucial shift. This trend not only indicates a reduction in greenhouse gas emissions from fluorinated gases but also highlights the positive impact of the

Fluorinated Gases Regulation. These findings reinforce the importance of ongoing regulatory efforts in mitigating environmental impacts and promoting sustainability.

Transports

PaM12 - Promoting efficiency and expansion of public transport systems.

Improving public transportation and promoting intermodality will reduce urban congestion, enhance mobility efficiency, and lower energy consumption, while providing greater comfort and quality of life. The goal is to offer a high-quality, accessible, and convenient public transport system, fostering social cohesion and reducing reliance on individual transport for daily commuting. Decarbonizing the transport sector is essential for meeting the short and long term energy and climate goals. This requires ensuring an effective energy transition and efficiency gains by using clean energy sources like electricity, advanced biofuels, renewable hydrogen, biomethane, and renewable non-biological.

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 POSEUR).

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.

The publication of Decree-Law No. 21/2024, which establishes the legal framework for the Public Transport Passenger Incentive Program (Incentiva+TP), marks a significant step forward in public transport policy. This program replaces the previous Public Transport Fare Reduction Support Program (PART) and the Public Transport Supply Enhancement and Strengthening Program (PROTransP), integrating as well the additional funds previously allocated under the Extra PART scheme.

By merging these initiatives, Incentiva+TP ensures a more robust financing for public transport systems, eliminating strict conditions that constrained the allocation of funds to fare reductions and service improvements. These changes allow for greater adaptability to the specific needs of each territory, fostering a more effective approach to promoting and strengthening public transport services.

The decree-law is particularly important for the sector, as its timely approval is critical to maintaining and advancing policies that support public transport services, avoiding significant detriment to the public interest. Thus, ensuring that the prices of public transport fares in force in 2023 remain the same, as an exceptional measure to mitigate the effects of inflation.

In addition to the +TP Incentive Program, the Fund for the Public Transport Service also supported and financed the Modernization of Ticketing and Operation Support Systems, the Development of Communication and Information Strategies for the Public in Public Transport, and the Decarbonization and digitalization of the Sector Taxi, with project financing worth around 2 million €.

It is important also to mention the Green Mobility Package recently approved by the government in October 2024, reflecting the country's commitment to safe, integrated, intelligent and sustainable mobility, in line with the goals of decarbonization and modernization of the transport sector. This package aims to transform passenger and freight mobility in Portugal through 13 innovative measures, among which the following can be highlighted in order to meet the objectives of this PaM:

- Creation of Circula.pt, with the aim of extending the social and geographical coverage of the Social Pass + to cover 2.5 times more citizens. The Social Pass + covered the Lisbon and Porto Metropolitan Areas, citizens covered by the A and B brackets and by the Solidarity Supplement for the Elderly and Social Insertion Income and pensioners, the unemployed and households with an average monthly income of up to 1.2 times the IAS. The new Circula.pt includes, in addition to these citizens, those with a degree of disability equal to or greater than 60%, the long-term unemployed and the rest of mainland Portugal.
- Creation of the Green Rail Pass, that came into force on octover 21, 2024, with a total cost of €20 per user for each 30 days. It gives access to Intercidades, Regional, Inter-regional and Urban services to Coimbra, Lisbon and Porto outside of those covered by metropolitan intermodal passes. The pass is not valid on the Alfa Pendular and Internacional Celta services, nor in first class on the Intercidades and Inter-regional services. On Intercidades you can reserve a seat, free of charge.

- Extending the free youth pass to non-students, investing more than 40 million euros a year to extend the free youth pass to all young people up to the age of 23, regardless of whether or not they are studying, resulting in more than 241,000 potential beneficiaries.
- Accelerating the development of Sustainable Urban Mobility Plans (SUMPs): Support of 3 million euros will be given to municipalities, inter-municipal communities and the Lisbon and Porto Metropolitan Areas to develop their SUMPs. To this end, the "Guidelines for Drawing Up SUMPs" guide were published, in order to harmonize the criteria throughout the territory and speed up their development at national level.
- Developing intelligent mobility, improving the experience of using public transport and promoting the interoperability and modernization of the ticketing platforms of the different transport operators.
- Reinforcing the Public Transport Service Fund, by investing 10 million euros in this Fund to support decarbonization measures, digitalization and the use of Artificial Intelligence, passenger information and communication and the promotion of green mobility.

In this context, it is also important to highlight the contribution that could arise from the development of sectoral mitigation plans, as required by the National Climate Law. Furthermore, as also outlined in the National Climate Law, the development of Municipal and Regional Climate Action Plans should similarly contribute to supporting this PaM, with a specific impact on the transport sector.

In the Autonomous Region of Madeira (RAM), various measures have been implemented to improve mobility and promote public transport as a sustainable and accessible alternative. One of the most important advances is the integrated ticketing system, which will allow the use of a single ticket throughout the SIGA network (RAM's road passenger transport network management system), simplifying the user experience and making public transport more attractive.

Also noteworthy is the acquisition of 129 new, low-polluting, and comfortable buses, reinforcing the regional commitment to reducing emissions and improving transport conditions. At the same time, policies have been implemented to facilitate financial access, such as reducing the prices of social passes and making them progressively free for students, the elderly and other vulnerable groups.

These initiatives reflect an integrated strategy for the region, aimed at promoting sustainable mobility, significantly improving the population's quality of life and reducing dependence on individual transport, contributing to the decarbonisation of the region's transport sector.

PaM13 - Promote freight transport by rail and sea

Freight transport is one of the main contributors to fossil fuel consumption and GHG emissions within the transport sector, largely due to the high modal share of road transport.

Promoting rail, maritime, and inland waterway freight transport significantly enhances the energy and environmental efficiency of goods transportation. At the same time, it improves air quality and reduces road congestion, particularly in major urban agglomerations.

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 connections 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.

The National Railway Plan is also under development, serving as a framework to define the railway network that will ensure national and international communications in Portugal, with a medium- to long-term perspective.

It is also important to mention in this context the government's recent approval in October 2024 of the Green Mobility Package, including several measures to support the decarbonization of freight transport:

- Support for freight railroads based on avoided external costs, allocating 9 million euros per year between 2024 and 2028 to national freight rail operators, based on avoided external costs. The support will be allocated on the basis of the volume of tons/km transported and will be managed and financed by the Institute for Mobility and Transport.
- Establishes the limit for the increase in the Infrastructure Utilization Charge in 2024.

PaM14 - Promoting active and low-impact mobility and more efficient behaviours

Prioritizing active mobility over individual motorized transport is an increasing trend in developed societies, due to its excellent cost-benefit ratio and significant advantages in key areas that enhance quality of life for everyone - even those who do not yet engage in active travel. The promotion of bicycle use, in particular, should be approached in a structured, systematic, and ambitious manner. With the growing availability of electric-assisted bicycles, which broaden the reach of benefits from adopting active mobility patterns, there are strong reasons to embrace new mobility solutions and improve the use of transportation systems. The aim is to encourage active mobility and more efficient behaviors, increasing the modal share of cycling and walking.

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.

The National Strategy for Active Pedestrian Mobility 2030 (ENMAP) was also approved in the meantime by Council of Ministers Resolution 67/2023 of July 7, 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.

The National Strategy for Active Cycling Mobility 2020-2030 (ENMAC), together with the National Strategy for Active Pedestrian Mobility (ENMAP), forms the overarching National Strategy for Active Mobility in Portugal (ENMA).

Approved in 2019, ENMAC outlines key objectives such as: (i) increasing the modal share of bicycle trips nationally; (ii) boosting the share of bicycle trips in urban areas; (iii) raising the combined active mobility (cycling and walking) share; (iv) expanding the total length of cycling lanes while ensuring safe pedestrian zones; and (v) reducing road accidents involving pedestrians and cyclists.

Meanwhile, ENMAP aims to ensure conditions for walking are universally accessible, safe, and reliable, promoting walking as the preferred mode for daily trips. It emphasizes integration with cycling and public transport to improve citizens' quality of life. ENMAP's 2030 targets include (i) raising the modal share of walking trips from 16% to 35%; and (ii) increasing public spaces usable by all by 50%.

Complementing these strategies, the Portugal Cycling Program 2030 serves as an incentive to develop dedicated cycling infrastructure, establishing bicycles as a sustainable transport solution capable of addressing urban mobility needs. This program plans to construct 1,000 km of cycling lanes by 2030, ensuring the expansion and requalification of cycling and pedestrian networks

while improving connectivity. Special attention is given to the relationship between expanding cycling infrastructure and securing pedestrian safety in shared urban spaces.

The Incentive for the Introduction of Zero-Emission Vehicles into Consumption, a commitment of the Environmental Fund since 2017, aims to continue implementing measures to accelerate the adoption of alternative and environmentally friendly traction energies, such as 100% electric propulsion. This mechanism is structured around four distinct key areas, one of which focuses on active mobility, specifically promoting the use of bicycles - both conventional and electric - among other sustainable transportation options.

The U-BIKE Portugal Project is a nationwide project which 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. The funding granted by POSEUR ended in 2023, but the academic entities involved continue to support the project and promote cycling mobility among university students.

Following the publication of the revision of the Regulation of the Trans-European Transport Network (TEN-T) (Regulation (EU) 2024/1679 of the European Parliament and of the Council of 13 June 2024), which establishes as mandatory the existence of Sustainable Urban Mobility Plans (SUMP) in the urban nodes that make up the network, the Guidelines for the Preparation of SUMP in Portugal were published and a call of financial support for the SUMPs was launched, in order to leverage the development of this instrument for planning sustainable mobility throughout all the national territory.

The Normative Document for application to Urban Roads, developed by IMT and LNEC as part of the Strategic Road Safety Plan (PENSE 2020 - measure A25.92), and the National Strategy for Active Cycling Mobility 2020-2030 (ENMAC - Measure E1 -1 Develop and apply a guide to national standards for physical interventions), organized in 4 fascicles, is also worthy of mention:

- Fascicle I - Fundamentals on users and the road network
- Volume II - Geometric characteristics for roads with motorized traffic
- Volume III - Geometric characteristics for roads with non-motorized traffic
- Section IV - Traffic calming measures and other traffic devices

The aim of this document is to define the standards intended to guide planners and municipal managers in actions related to the planning and design of municipal roads, or the hierarchization of the road network, with the aim of standardizing the criteria applied, as well as minimizing road accidents, the proportion of which on municipal roads is significant.

Also as part of the Green Mobility package launched in October 2024 by the government, a 3 million euro support line was created to speed up the construction of cycle paths as part of Portugal Ciclável 2030. In addition, support for the purchase of bicycles and bicycle parking

systems by the public administration was reinforced, thus contributing to the implementation of the National Active Mobility Strategy.

PaM15 - To promote shared mobility and autonomous vehicles

Alongside the promotion of public transport, it is essential to encourage other urban mobility formats that help reduce road traffic pressure, lower GHG emissions, and enhance the well-being and quality of life of the population. Therefore, the aim is to promote vehicle-sharing services, with a focus on electric mobility and active mobility. This approach seeks to foster more sustainable and flexible transportation options, contributing to cleaner cities and more efficient use of resources.

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.

With regard to PHV, Portugal has published, in 2018, August 10th, Law n.º 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.

This measure could also be linked to PaM14 – "Promoting active and low-impact mobility and more efficient behaviours."

PaM16 - To promote and support electric mobility.

Electric mobility is a key factor in ensuring the progressive replacement of fossil fuels with renewable electricity in road transport, contributing to a significant reduction in GHG emissions. Therefore, it is crucial to promote and support electric mobility by encouraging the adoption of electric vehicles and strengthening the charging infrastructure. This will facilitate the transition to cleaner, more sustainable transportation, while also supporting climate goals.

Portugal has established an innovative management model for the electric vehicle charging network, which has brought significant benefits to users since 2014, particularly for fast-charging stations. This model needs to be expanded to the entire public access network. It is crucial to assess its benefits and the progress in promoting electric mobility, as well as to re-evaluate it in light of market developments, the evolution of the electricity system (especially distributed production), and the flexibility offered by electric vehicles for temporary energy storage. The new directives from EU legislation, such as the Alternative Fuels Infrastructure Regulation (AFIR) and the Energy Performance of Buildings Directive (EPBD), should also be considered.

Since 2015, Portugal has provided a competitive incentive framework for purchasing electric vehicles, offering up to €4,000 for light passenger vehicles and €6,000 for light freight vehicles, alongside exemptions from vehicle taxes, autonomous taxation, and vehicle licensing fees. As long as the purchase cost of an electric vehicle remains higher than its fossil fuel equivalent, it is essential to maintain and even expand these incentives, including for electric vehicle charging infrastructure. These incentives will remain in place in 2024, according to Dispatch No. 341/2024, which continues to provide financial support through the Environmental Fund to Electricity Suppliers for Electric Mobility (CEME).

Promoting the development of the public access charging network is essential to support the growing number of electric vehicles in Portugal. With the increase in electric vehicle sales, it is necessary to ensure that the charging network expands to maintain an adequate ratio of vehicles to charging stations. Key initiatives include: (i) mandating the installation of charging stations in residential and commercial areas (both public and private), in coordination with network operators to identify investment needs for network reinforcement; (ii) requiring the installation of charging stations in public infrastructures, in line with the EPBD; and (iii) supporting investments to expand rapid charging networks, particularly in line with the AFIR, and to strengthen the electrical grid.

Further, Portugal has supported the installation of chargers in private buildings since 2022, with grants of up to €1,800 for condominiums. To promote smart charging with bidirectional energy flows, legislation should be developed to enable this functionality, which would enhance system stability and increase renewable energy penetration, especially in isolated areas (e.g., islands).

The ECO.mob Program for Sustainable Mobility in Public Administration (2015-2020) has been pivotal in promoting electric mobility and improving the environmental performance of the state vehicle fleet. To build on this success, it is crucial to continue driving the adoption of low-emission vehicles and sustainable mobility within public institutions. Public entities should lead by example, implementing innovative policies that encourage sustainability. This can be done through mandatory electric vehicle acquisition quotas for public administration and incentives for integrating electric vehicles into the state fleet, as demonstrated by ECO.mob.

Furthermore, a new program should be developed to assess and classify public sector bodies and their fleets based on sustainable mobility performance, continuing the objectives of ECO.mob. Additionally, promoting mobility management practices, such as increasing public transport use, car-sharing, and car-pooling, is vital. Encouraging behavioral changes, including training in eco-driving, will further contribute to achieving national sustainability goals.

In terms of electric mobility, the Incentive for the Introduction of Zero Emissions Vehicles (ZEV), supported by the Environmental Fund, 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.

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.

In the meantime, two important measures have been promoted with a view to encouraging the purchase of electric vehicles, in particular:

- Introduction of zero-emission vehicles in 2024 - Green Mobility Passengers
- Introduction of zero-emission vehicles in 2024 - Green Goods Mobility

In the same way, several support measures were promoted with a view to decarbonizing public transport through component C15 of the Recovery and Resilience Plan, one of which was aimed at acquiring 145 electric or hydrogen buses, including the respective charging infrastructure.

As part of the Green Mobility package launched in October, there is new support for the purchase of zero-emission vehicles, following on from the work carried out in the past, in this case through support of 20 million euros for the purchase of electric vehicles (passenger cars, electric and conventional bicycles, motorcycles and mobility devices, electric vehicle chargers). One of the new features of this notice is that support for the purchase of passenger cars requires the scraping of a fossil fuel vehicle that is more than 10 years old, which must have taken place after January 1, 2022.

In the same direction, and in the context of the same package, support for the purchase of zero-emission goods vehicles to the value of 3.5 million euros has also been promoted, including electric light goods vehicles and electric or conventional cargo bikes.

In addition to this, financial support of 2 million euros will also be given to training local authorities in urban logistics, in particular municipalities, inter-municipal communities and the Lisbon and Porto metropolitan areas, and the Sustainable Urban Logistics Guide will be launched to share good practices between transport authorities.

The Autonomous Region of the Azores has created the Regional Legislative Decree No. 21/2019/A, of August 8, which defines the strategy for the implementation of electric mobility in the Autonomous Region of the Azores, considering its geographic, physiographic and environmental characteristics. This strategy is implemented through measures and actions, including the granting of incentives for the adoption of electric mobility, as well as the installation of charging infrastructures. In this way, the system of financial incentives for the acquisition of electric vehicles and charging points emerged, which was enshrined in Regional Regulatory Decree no. 2/2020/A, of January 27, amended by Regional Regulatory Decree no. 15/2020/A, of July 3, in order to include measures aimed at promoting the «Graciosa – Ilha Modelo» project.

Regional Regulatory Decree No. 4/2021/A, of April 26, in its amended version, made fundamental changes to this incentive system, with the aim of helping to achieve the goals defined for the massification of mobility electricity in the Azores, with the amounts of the increases having been adjusted. In this way, the scrapping of internal combustion vehicles was valued and an increase was created for people with a degree of disability greater than 60%. With this new diploma, eligibility was also extended to new light electric vehicles introduced on the market in the Autonomous Region of the Azores using a financial leasing contract, with other forms of leasing not being permitted.

The Autonomous Region of Madeira (RAM) is implementing concrete and ambitious measures to promote electric mobility and the decarbonisation of transport sector. To this end, the Proposal for a Regional Legislative Decree establishing the legal framework for the Incentive System for Decarbonisation of Land Transport in the Region, known as 'DESCARBONIZAR_RAM', was approved. This programme aims to accelerate the transition to a more sustainable transport model, significantly reducing emissions associated with the road sector, one of the main contributors to GHG emissions in the region.

This programme consists of a financial support system designed to encourage the purchase of zero-emission buses, specifically for regular public road passenger transport. In addition, it promotes the installation of charging or refueling stations for clean buses, as well as the scrapping of old vehicles as long as they are replaced by electric vehicles. These measures aim not only to renew and modernize the regional vehicle fleet, but also to create the necessary infrastructure to ensure an effective and sustainable transition to electric mobility.

This measure could also be linked to PaM25 – "Promoting decarbonisation options in the public administration."

Circular Economy

PaM3 - To promote the transition to a circular economy

With a view to decarbonising the economy, this PaM is intended to increase the levels of material use circularity, to lead to a substantial adoption of (new) business models that replace the provisioning of goods with the provision of services and property by use, to promote proximity between production and consumption, and to reduce consumption by reducing material demand and 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 prolonging existing products' lifespans, promoting material recirculation, material efficiency of products and streamlining circular business models. Strengthening the transition to a circular economy, and efficient, zero-emission solutions over the next 30 years. Promoting the circular economy in industry, by developing innovation, low-carbon products designed for multiple life cycles, new business models and reducing energy and material consumption, contributing to mitigate climate change.

Portugal adopted, in December 2017, the first Circular Economy Action Plan (PAEC) for the period 2017/2020 (Resolution of the Council of Ministers nº. 190-A/2017, of November 23th) later amended by Resolution of the Council of Ministers No. 108/2019, of June 6th. The Plan acted at three levels, macro (aiming transversal and systemic measures, such as policy instruments), meso (such as promoting the creation of industrial symbiosis) and micro (developing circular cities or circular companies).

Despite this Plan and the multiple initiatives that have taken place, the performance of Portugal, 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.

As regards to material consumption, Portugal´s trend is in line with the EU 27, presenting a decrease in the period from 2008 to 2013, and then showing a stabilization with a slight positive slope until 2023. This shows that there is a modest increase in the total amount of raw materials extracted to meet the Portuguese final consumption demand, meaning that Portugal needs complementary actions in order to invert this trend. In terms of resource productivity, Portugal´s trend is in line with EU 27, presenting a slight positive slope, which indicates that is moving towards decoupling economic growth from resource use at a rate similar to the one observed in the EU 27.

Portugal presents similar values for waste generation per capita in 2008 (1,599 kg per capita) and in 2020 (1,612 kg per capita), showing that in those 12 years there was no significant change and meaning that complementary and more effective efforts should be made in order to achieve the targets. EU 27 shows a similar trend.

Regarding waste management, the recycling rate of municipal waste in Portugal follows, from 2000 to 2016, the same trend of the EU 27, which corresponds to a continuous growth. However, in the subsequent years (2017-2021), Portugal diverged from the EU 27, due to the stabilization of this indicator (30.4% in 2021). It is important to mention that in 2023 the Strategic Plan for Municipal Waste (PERSU 2030) was approved, which will contribute to the improvement of the recycling of this waste.

In terms of secondary raw materials, Portugal presented in 2010 a circular material use rate of 1.8%. From 2012 to 2014 a sharp increase (2.5% in 2013) was registered, mostly due to the reduction of the domestic material consumption. In the subsequent years, until 2017 (the year in which the first Portuguese Circular Economy Action Plan was approved), a stagnation was observed. From then to 2022, even with the COVID-19 pandemic and the war in Ukraine, Portugal managed to register a smooth increase of nearly 0.1% per year, reaching the value of 2.6% in 2022. This trend, with lower values, is similar to the one observed for the EU 27.

During the period from 2012 to 2021, Portugal increased the private investment in circular economy sectors by about 20 M€, representing, in 2021, the 0.8% of GDP, i.e. the same value of the EU 27.

Aiming to pursue an effective transition for a circular economy, a new Circular Economy Action Plan 2024-2030 (PAEC 2030) was constructed and it is set to adopted in the beginning of 2025. The vision of PAEC 2030 is to develop both an economic and social development model which is regenerative, efficient, productive and inclusive. Regenerative, by consuming less resources, preventing and, where that is not feasible, compensating the pollution, promoting carbon neutrality and eliminating wastage. Efficient, by producing more with less and extending the product´s lifetime. Productive, by decoupling the economic growth from the use of resources and maximizing the economic value per amount of resources used. These three pillars for the

sustainable growth of the economy not only will contribute respecting the limits of the planet, but will also promote social inclusion, guaranteeing that everyone is involved in the transition towards a more circular economy.

The main objectives of PAEC 2030 are: i) avoid the over-exploitation of non-renewable resources, preserving the natural capital; ii) reduce waste generation; iii) prevent pollution and regenerate ecosystems; iv) create opportunities and socio-economic benefits; and v) promote communication and raise awareness.

As in the previous Action Plan, PAEC 2030 assumes the same levels of action:

- Macro - Transversal to all sectors and regions, divided into seven dimensions: i) Policy Instruments for Circularity, ii) Funding for the Transition to a Circular Economy, iii) Education, Training and Awareness Raising for Circular Economy, iv) Technology, Research and Innovation on Circularity, v) Circularity in Organizations, vi) Partnership for a Circular Economy, and vii) Life Cycle);
- Meso - Targeted at priority sectors: i) Agri-food, ii) Construction, iii) Distribution and Retail, iv) Electric and Electronic, v) Plastics, vi) Tourism, and vii) Textile and Clothing); and
- Micro - To stimulate strategies at regional / local level.

The achievement of the various objectives of PAEC 2030 is framed by several policy instruments of more specific and sectoral characteristics, which are largely aligned with the European regulatory framework, some examples are:

1. Climate and Sustainability
    - Nacional Energy and Climate Plan – Provides the promotion of the transition to a circular economy, defining three specific measures, namely: promoting the recirculation of materials, the material efficiency of products, and boosting circular business models;
    - National Climate Law - Defines the basis of climate policy, which includes as one of its objectives the promotion of the circular economy, improving energy and resource efficiency and establishing a set of guidelines, namely, for the design of products, packaging, infrastructures and buildings.
2. Agriculture
    - Strategic Plan for the Common Agricultural Policy - The European Union has defined three general objectives for the Common Agricultural Policy divided into nine specific objectives, including the development in rural areas, including the circular bioeconomy;
    - Innovation Agenda for Agriculture 2030 – Defines the strategy and policies of the Portuguese agricultural sector, having as one of its 15 initiatives, a "Circular Agriculture", for which five lines of action are defined: organic fertilizers, animal production, biogas, biorefineries and small biomass and by-product plants.

3. Water and sea
    - National Maritime Strategy 2021-2030 – One of the 10 strategic objectives defined in this strategy is "Fostering Employment and the Circular and Sustainable Blue Economy";
    - Strategic Plan for Water Supply and Wastewater and Stormwater Sanitation 2030 - Defines the strategy for the water supply sector and wastewater and rainwater management.
4. Health and Nutrition
    - National Strategy to Combat Food Waste (ENCDA) – The Action Plan identifies 14 measures aimed at combating food waste.
5. Education, Research and Innovation
    - National Strategy for Environmental Education - It aims to establish a collaborative, strategic and cohesion commitment in the construction of environmental literacy in Portugal. "Making the Economy Circular" is one of the pillars and includes measures such as: (i) dematerialization, collaborative economy and sustainable consumption; (ii) product design and efficient use of resources; and (iii) waste recovery.
6. Waste
    - National Waste Management Plan 2030 – One of the three strategic objectives defined in this plan is "Promoting efficiency in the use of resources, contributing to a circular economy";
    - Strategic Plan for Municipal Waste 2030 –Is the national urban waste management policy, guiding all agents to for implementation of actions that allow the country to be aligned with community policies and strategies, namely through circular economy principles.
7. Other
    - National Strategy for Green Public Procurement 2030 — Complementary instrument for environmental policies, contributing to promoting the reduction of pollution, reducing the consumption of natural resources and increasing the efficiency of public systems;
    - Action Plan for Sustainable Bioeconomy - Horizon 2025 - Aims to accelerate the transition to a sustainable and circular bioeconomy. One of the five axes of action defined in this plan is "Developing circular and sustainable bioindustry: Innovation in the value chain and processes";
    - National Program for Land Planning Policy - Territorial development instrument that establishes the priorities for the organization of the national territory. One of the measures included in this Program is "Organizing the territory for the circular economy".

The Autonomous Region of Madeira has been implementing a strategic and structured set of measures and policies aimed at promoting the transition to a circular economy, in line with global sustainability goals and the principles of resource efficiency. These initiatives, consolidated in the 'Madeira Circular Agenda', approved in 2021, aim to accelerate the adoption of circular practices in various economic sectors, promoting a reduction in material consumption, an increase in economic productivity and keeping resources in the economy for as long as possible.

The 'Circular Madeira Agenda' is established as a strategic instrument for the region, identifying clear objectives and priority lines of action involving the public administration, the business community, the academic sector and civil society. Its areas of action include the protection and enhancement of resources, territorial development, communication and awareness-raising, and the promotion of research and innovation. Its vision is based on a regional economy capable of generating wealth while adopting more sustainable development models based on circularity and efficiency.

One of the most important projects within this strategy is the 'Madeira Circular Platform', launched in June 2021 as a flagship project. This digital platform, administered by the Regional Directorate for the Environment and the Sea, serves as a central channel for communication and cooperation between economic agents and stakeholders in the region. By providing examples of good practice, the platform promotes the adoption of circular solutions in regional business models, highlighting the ongoing efforts of companies and organisations to align themselves with the principles of the circular economy.

In addition, Madeira has been promoting new solutions for the management of construction and demolition waste, integrating the principles of the circular economy into industrial processes in the construction sector.

In 2022, another significant milestone was reached with the publication of Ordinance 101/2022, which establishes fees and procedures related to marine waste management. In 2023 and 2024, the implementation of measures contained in the 'Madeira Waste Strategy' reinforces the commitment to closing the resource cycle, promoting more conscious consumption patterns, and preventing waste generation. These actions are perfectly integrated into the 'Madeira Circular Agenda', demonstrating the continuity and evolution of the work towards a regenerative economy.

This measure could also be linked to:

- PaM5 – "Reduction of waste production and of landfill disposal and promotion of recycling."
- PaM18 "To promote decarbonisation of industry through eco-innovation and cleaner production processes and to promote industry digitization"
- PaM19 "To promote energy and resource efficiency, renewables and electrification; Industrial symbioses, resource optimization and resource reuse".

Waste

PaM5 - Reduction of waste production and of landfill disposal and promotion of recycling

Decarbonizing the waste sector prioritizes reducing waste generation and, where prevention is not feasible, reintegrating waste into the economy with higher added value. In alignment with EU regulations and national strategies, it is crucial to promote higher-value waste management practices within the waste hierarchy. Efforts focus on minimizing landfill disposal and significantly increasing the selective collection of recyclable materials. This approach aims to strengthen recycling streams, including organic recycling, thereby enhancing resource efficiency and contributing to climate and environmental goals.

Regarding waste management strategic documents it is important to point out that during 2023, Portugal published the three main documents that define the waste strategy for the period until 2030 – National Waste Management Plan (PNGR 2030), Strategic Plan for Municipal Waste (PERSU 2030) and Strategic Plan for Non-Municipal Waste (PERNU 2030). These waste plans include the respective Waste Prevention Programs and the Biowaste Strategy.

These documents set 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.

PNGR 2030 sets as Strategic Objectives:

- SO1 - Prevent waste generation in terms of quantity and hazardousness
- SO2 - Promote resource efficiency, contributing to a circular economy
- SO3 - Reduce negative environmental impacts through an integrated and sustainable waste management

And for each objective defines specific targets/goals as presented in Table 3.9.

Table 3.9 – Targets and goals of each strategic objective foreseen in PNGR 2030.

Strategic Objective 1 - Prevent waste production in terms of quantity and hazardousness			
Target	**Indicator**	**Reference value (2018)**	**Target 2030**
1. Reduce waste generation	Waste generation (Mt)	15,9	13,6
2. Reduce generation of hazardous waste compared to total waste generation	Hazardous waste generation/Waste generation (%)	7,0	4,4
Strategic Objective 2 - Promote resource efficiency, contributing to a circular economy			
Target	**Indicator**	**Reference value (2018)**	**Target 2030**
1. Improve material productivity of the economy	Gross domestic product/Domestic consumption of materials (k€/t)	1,18	1,68
2. Decouple economic growth from waste generation	Wate generation/Gross domestic product (t/k€)	0,080	0,059
3. Increase the availability of waste for the economy	Recovery (non-energy)/Waste generation (%)	65,0	80,5
Strategic Objective 3 - Reduce negative environmental impacts through an integrated and sustainable waste management			
Target	**Indicator**	**Reference value (2018)**	**Target 2030**
1. Reduce the amount of waste sent for disposal	Waste sent for disposal (Mt)	4,2	1,7
2. Reduce GHG emissions from the waste sector (including wastewater)	Mt $CO_{2eq.}$ emissions from waste sector	6,50	4,55

PERNU 2030 estabishes 4 Operational objectives in line with PNGR' strategic objectives:

- OP1 - Prevent waste generation in terms of quantity and hazardousness
- OP2 - Reduce negative environmental impacts from waste management
- OP3 – Raise awareness, train and disseminate, at academic and organizational level, on prevention and waste management
- OP4 – Increase investment capacity and expenditure on R&D+I directed at prevention and waste management

And specific targets, to track compliance, as shown in Table 3.10.

Table 3.10 – Targets of each operational objectives foreseen in PERNU 2030.

Objectives	Target	Indicator	Reference value 2019	Target 2030	Unit
OP1, OP2, OP3	Reduce non-municipal waste generation	Non-municipal waste generation	11 427 435	**9 320 010**	t
	Decrease in quantity and representativeness the generation of non-municipal hazardous waste	Non-municipal hazardous waste generation	1.066.055	**599 261**	t
OP2, OP3	Decouple economic growth from domestic material consumption	Gross Domestic Product/Domestic material consumption	1,181	**1,666**	k€/t
	Decrease the ratio between non-municipal waste generation and Gross Domestic Product	Non-municipal waste generation/Gross Domestic Product	0,056	**0,040**	t/k€
	Reintroduction of non-municipal waste into the economy	Recovery (non-energy) of non-municipal waste/Non-municipal waste generation	1.751.501	**811 087**	t
	Maintain the growing trend in the representativeness of recovery operations	Recovery (including energy) of non-municipal waste/Non-municipal waste generation	82,7%	**90,2%**	%
OP2, OP3	Decrease the amount of non-municipal waste sent to disposal operations	Non-municipal waste sent to disposal	84,7%	**91,3%**	%
OP4	Increase total expenditure and respective representativeness of R&D investments with environmental socio-economic objectives	Expenditure on R&D with environmental objectives/Total expenditure on R&D	6,4%	**17,1%**	%

PERNU approach aims at establishing transversal measures but also specific measures for some waste sectors as shown in Figure 3.21. Sectoral specific measures development will require the intervention of the sectors and the respective administration bodies, and will allow, expectantly, better results.

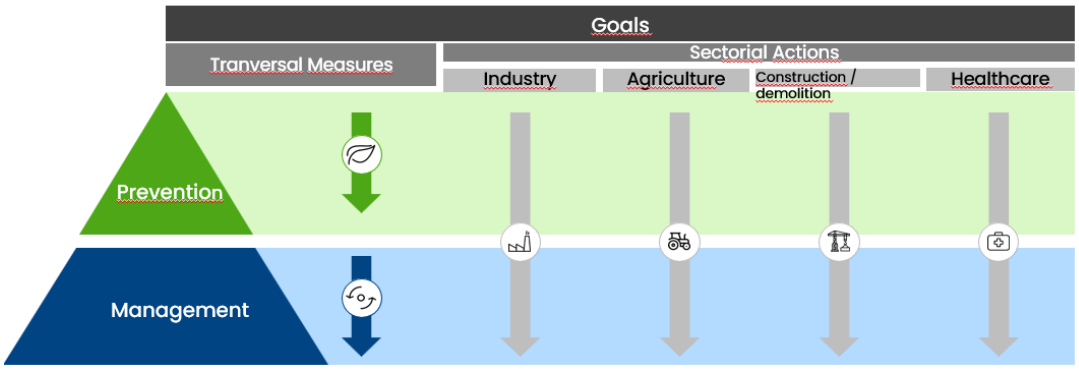

Figure 3.21 – PERNU 2030 goals.

Finally, PERSU 2030 strategy is supported by the following main pillars, described by Axis/Objectives:

- AXIS I - PREVENTION
    - OB1.Reduction of municipal waste generation and hazardousness
- AXIS II - WASTE MANAGEMENT
    - OB2.Promotion of separate collection and proper treatment

- OB3. Economic valorization of municipal waste treatment outcomes

- AXIS III - OPERATIONALIZATION
  - OB4.Strengthening of economic and financial instruments
  - OB5.Sustainability and capacity of the sector
  - OB6.Strategy communication and monitoring

PERSU 2030 intents to significantly drive changes to the municipal waste strategy aimed at move towards an alignment with EU waste policy and strategies, including target compliance. As main goals, the Plan defines waste generation stabilizing, achieving preparing for reuse and recycling and landfilling targets and also packaging and other waste stream targets. Targets are presented in Table 3.11.

Table 3.11 – PERSU 2030 targets.

	2019	2020	2025	2029	2030	2035
Municipal waste prepared for reuse or recycled	41%	50%	55%		60%	65%
Municipal biodegradable waste landfilled	45%	35%				
Separate collection for recycling	48 kg/inhab .year	47 kg/inhab .year				
Reduction of municipal waste landfilled						10%
Packaging waste recycling			65%		70%	
Separate collection of single-use plastic beverage bottles			77%	90%		
Reduction of food waste generation (indicative)			30%		50%	

For that purpose, the effort to achieve targets is distributed among the entities responsible for municipal waste collection and treatment, namely municipalities and municipal waste management systems (SGRU). In accordance with their responsibilities, objectives for collecting and recycling material and bio-waste were assigned for each municipality/SGRU that allow the overall achievement of national goals. Municipalities and SGRU presented an Action Plan, which is approved by the Portuguese Environment Agency and where the entity undertakes to fulfill the objectives that have been established and indicates the measures that will be adopted in the

period up to 2030 and respective needs of investment. Only entities with an approved Action Plan can apply for waste funding. The municipalities that achieve annual objectives as defined in the Action Plan, will have a discount on "Waste Management Tax".

Financing calls for collection are being open by the 5 regional waste entities, to support the expansion of collection systems and the introduction of new systems and also for waste treatment at source (home composting). In the beginning of 2025, calls will open for improving waste treatment.

At a national level, the Portuguese Environment Agency is developing a communication and awareness campaign with a broad scope, but with an emphasis on bio-waste separate collection, aiming ate increasing citizen awareness and participation in the waste strategy.

Important also to highlight that the Autonomous Region of Madeira has adopted strategic measures to reduce waste production, minimize landfill and promote recycling, in line with European targets and guidelines for sustainable waste management. These actions are part of comprehensive policies, such as the 'Madeira Waste Strategy', approved in 2021, which establishes strategic objectives until 2030. The strategy aims, in an integrated way, to minimize waste production and its environmental impacts, increase the reintroduction of materials into the regional economy and promote the efficiency of the waste sector as a lever for the region's economic development.

One of the most significant initiatives is the amendment to the legal regime for the regional levy on lightweight plastic bags, implemented in 2019, which extended the scope of this levy to include all plastic bags, regardless of their thickness. This measure has had a direct impact on reducing the use of single-use plastics, incentivizing more sustainable alternatives and aligning with the goal of reducing consumption of single-use materials.

As part of the management of construction and demolition waste, the introduction of waste into the manufacturing processes of construction companies was implemented, promoting the reuse of waste and integrating the principles of the circular economy.

In 2022, Ministerial Order 101/2022 was approved, approving the taxes and respective amounts to be charged for the procedure for analyzing and approving the waste reception and management plan provided for in Article 10(1) of Decree-Law 102/2020 of 9 December, and for carrying out audits under Article 9(9) and Article 10(6) of the Decree-Law.

Another crucial step was taken in 2023 with the publication of a study assessing the technical and economic feasibility of implementing a bio-waste management system in the region. This study proposes solutions for the selective collection and valorization of bio-waste.

To complement prevention actions, in 2024 the Region published the 'Programme for the Prevention of Food Waste in the Autonomous Region of Madeira', entitled 'Do not Waste to Sustain', with an implementation horizon until 2030. This programme represents a pioneering

effort to combat food waste, raising awareness in society and promoting more responsible practices throughout the food production and consumption chain.

Agriculture

Until the end of 2022, the policies and measures guidelines for the agricultural sector were 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 2022 shows that the RDP has contributed with 58.52% of programmed support (2,801 M€), 100,3% of that value already committed and 88,6% implemented to the rural development priorities linked to "Climate change objectives".

Furthermore, the available data shows that:

- 59,18% 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;
- 58,96% of irrigated area were converted to more efficient irrigation systems;
- There was € 82,5M investment in energy efficiency and € 47,9M 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 favored 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 recognized.

Beginning in January 2023 the new Common Agricultural Policy 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 GHG 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 GHG emissions, 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.

This measure could also be linked to PaM27 – "To promote the production and consumption of renewable gases."

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.

Supporting the development of carbon-neutral technologies, practices, products, and services across all sectors is a key priority for advancing the decarbonization of the Portuguese economy. This involves fostering active participation by companies and national organizations in research and innovation programs aligned with these objectives. Specialized support for innovative start-ups and scale-ups is essential to drive growth and market integration. Dedicated forums, targeted guidance, and the promotion of synergies will help these entities scale effectively while contributing to sustainable economic transformation. These measures aim to position Portugal as a leader in innovative, low-carbon solutions.

Research, development, and innovation (R&D&I) are pivotal in achieving a carbon-neutral economy, encompassing several key dimensions. They accelerate the implementation of national and EU policies, enhance national competitiveness, and address the societal challenges of the green and digital transitions. Aligning national priorities with EU strategies through synergies between research programs - such as Horizon Europe, cohesion programs, and national initiatives - maximizes the quality and impact of investments. Tools like Smart Specialization Strategies (S3) and the Thematic Agendas of the Foundation for Science and Technology (FCT) are crucial in identifying long-term challenges and opportunities across sectors, integrating efforts from research institutions, businesses, and public entities.

Portugal's commitment to eco-innovation and low-carbon technologies underpins these efforts. Supporting the development of innovative products and services, fostering living labs for the co-creation of solutions, and encouraging collaboration between academia, research centers, and industry are critical pathways to advance the energy transition. Collaborative Laboratories (CoLABs), including initiatives like BIOREF, HYLAB, Smart Energy LAB, and Green CoLAB, are central to addressing energy and sustainability challenges. With €96.6 million allocated for CoLABs between 2022 and 2026, Portugal has already mobilized 12% of this funding, directly supporting projects aligned with the National Energy and Climate Plan 2030 (NECP 2030).

Portugal's participation in Horizon Europe exemplifies its integration into EU R&D&I efforts. Between 2021 and 2023, Portugal secured €821 million in funding, with 1,411 approved projects, 10% of the total projects financed. Key areas of interest include energy, sustainability, and

circular economy, with private entities such as SMEs playing a significant role in advancing collaborative innovation and technological progress.

Innovation extends to the recirculation of carbon and renewable gas management. Projects focusing on capturing CO_2 emissions from biogas purification and converting them into synthetic gases or industrial inputs demonstrate the circular economy's potential to reduce emissions and enhance renewable energy use. Efforts to manage renewable gases in networks, such as accommodating diverse gas qualities (e.g., hydrogen, biogas) and dynamically balancing production and consumption, ensure efficient energy distribution while maximizing local production capacity.

The creation of Technological Free Zones (ZLTs) to foster innovation are also envisioned to be implemented. These zones provide real-world environments for testing and demonstrating new technologies, products, and business models in renewable energy production, energy storage, mobility, and self-consumption. Such zones are designed to facilitate collaboration among stakeholders, enable regulatory flexibility, and fast-track solutions to market, aligning with the priorities of the energy transition.

Together, these initiatives represent a cohesive strategy to achieve decarbonization, leveraging R&D&I to reduce transition costs, foster economic growth, and position Portugal as a leader in sustainable innovation. Through the integration of eco-innovation, collaborative research, and targeted technological advancements, Portugal ensures that the energy transition is both impactful and inclusive.

The Rural Development Programme for 2014-2020 (RDP) has contributed until 2022, and the Portuguese Strategic Plan (PEPAC 2023-2027) is contributing, since January 2023, 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.

Enhancing the production and use of renewable energy sources in the agriculture and forestry sectors plays a vital role in advancing sustainability and reducing GHG emissions. One effective approach is to adopt energy recovery solutions that simultaneously manage rural areas by addressing their existing fuel loads. By implementing interventions that justify and monetize these efforts, it is possible to establish locally based and managed business models. These models can be further strengthened through the creation of a national biomass market or, alternatively, self-sustaining regional markets. In parallel, encouraging the adoption of resource-efficient and regenerative agricultural and forestry practices is crucial. These practices not only contribute to reducing GHG emissions but also

improve energy and water efficiency, fostering a more sustainable and resilient sector overall. Together, these measures create a comprehensive strategy that supports environmental goals while driving economic opportunities in rural areas.

The promotion of renewable energy solutions in agricultural, livestock, and forestry operations is a priority to enhance sustainability and reduce GHG emissions. Encouraging the installation and conversion of equipment and infrastructure to produce and use thermal and electrical energy from renewable sources can transform these sectors into key contributors to energy transition goals. Technological solutions, such as solar panels, surface geothermal systems, and wind energy, are particularly well-suited for agricultural and forestry applications, including intensive livestock farming and irrigation systems. Agrovoltaic systems and floating photovoltaic plants on reservoirs and dams offer additional opportunities for renewable energy integration, although careful attention must be given to potential impacts on water quality when implementing such systems on water bodies.

Promoting the adoption and increased penetration of renewable energy sources like biomass and biofuels is equally vital. By harnessing these resources, agricultural and forestry sectors can contribute to the circular economy while meeting their energy needs sustainably. Additionally, fostering the use of advanced management tools and more efficient technologies is essential for improving resource use. Precision and measurement equipment, such as systems for monitoring crop water needs and optimizing irrigation, play a critical role in this effort. The deployment of efficient technologies - ranging from optimized engines, pumping and ventilation systems, and compressed air systems to heat and cold recovery systems and efficient lighting - further enhances energy efficiency.

Best practices in irrigation management are also prioritized, focusing on techniques such as water balance monitoring, evaluating the efficiency of irrigation systems, and applying organic matter to improve soil water retention. Supporting the adoption of water-efficient crops and those resilient to drought stress, along with initiatives for hydric certification of irrigation farms, will reinforce sustainable water use and resource management, ensuring long-term resilience and environmental integrity.

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 modernize 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

commercialization of agricultural products. The Portuguese Strategic Plan (PEPAC 2023-2027) that has started in January 2023 will also support the increase of the production of renewable energy and improving of energy efficiency in farms through measure C.2.1.2 - Agricultural Investment to Improve Environmental Performance and D.3.2 - Improvement of the sustainability of existing irrigation systems.

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"
- PaM22 "Accelerate national energy transition to renewables".

PaM7 - Promoting biological, conservation and precision farming.

Promoting the adoption of fertilisation techniques that minimise nutrient losses, through the expansion of organic, conservation and precision agriculture, and promoting the increase in carbon sequestration resulting from increases in soil organic matter content.

To address biotic risks in agriculture and forestry, the *Forest Health Operational Program* and associated Action, Contingency, and Control Plans for harmful biotic agents will be implemented. Efforts will include executing the "Action Program for the Control of Invasive Woody Species" and strengthening controls on the import and movement of woody material and agricultural and forest reproductive materials. Building sector capacity for effective monitoring and control, reinforcing early detection capabilities for invasive biotic agents, and managing emerging pests and diseases in agricultural and forest systems are critical to maintaining ecosystem health and productivity.

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), which approved by Resolution of the Council of Ministers no. 110/2017.

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 available information on the production, processing and marketing of organic products, including on their consumption and various existing markets. According to data from 2021, among the 58 measures foreseen in the ActionPlan 33% were implemented, while 38% are in progress. Further information can be found on the dedicated website.

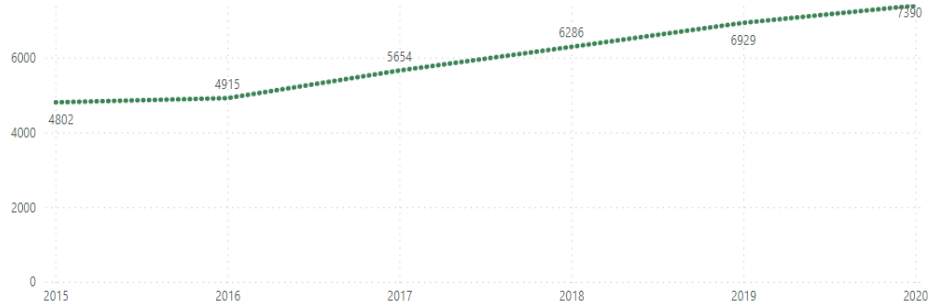

Figure 3.22 - Organic Production - Number of Operators in Organic Production by 2020 (Source: DGADR, 2022)

The ENAB was defined with a time horizon of 10 years, and its evaluation and mid-term review was scheduled for the 5th year (2022), coinciding with the end of the implementation period of the 1st Action Plan for the production and promotion of organic products.

At the end of 2022, and at the same time as the mid-term review of the ENAB, a proposal was drawn up for the second Action Plan, for the period 2023-2027, coinciding with the new rural development program and submitted for public consultation until April 30, 2023. At the last meeting of the National Observatory for Organic Production on July 20, 2023, the second action plan was validated by its members.

This plan aims to continue expanding organic production areas in the agriculture, livestock and aquaculture sectors, thus contributing to the Farm to Fork Strategy, which aims for 25% of the EU's agricultural land to be used for organic farming by 2030.

The actions to be developed include, among others, in addition to the reinforcement of the financial support scheme already included under PEPAC, the intention to promote technical support for organic farming production, namely through the establishment of networks of demonstration fields that promote technical knowledge and include innovative techniques in this mode of production and the increase in the supply of plant material needed for this mode of production.

Also from the point of view of consumption, actions are planned to make consumers aware of the added value of organic products in promoting a sustainable diet. As a result of the public consultation, comments were received focusing mainly on farmers' concerns, which are generally safeguarded in the current PEPAC.

The Strategy therefore necessarily incorporates the principles and guidelines that underpin the definition of the Rural Development Program in this area, and the targets set cannot fail to reflect this reality, namely:

- Doubling the area of organic farming to around 12% of the national UAA

- Triple the area of fruit, legume, protein and nut gardens, cereals and other vegetable crops intended for direct consumption or processing
- Double livestock and aquaculture production in PB, with a particular focus on pig, poultry, rabbit and bee production
- Double internal processing capacity for organic products
- Increase consumption of organic products by 50%
- Triple the availability of national organic products on the market
- Strengthen technical capacity in organic products by doubling the number of accredited technicians and strengthening the state's specific technical capacity
- Increase training capacity by at least 20%
- Create a network for experimenting with AB, with the installation of at least one certified experimental unit in each of the country's agricultural regions.
- Create a "BIO" Portal to disseminate, promote innovation and disseminate specific technical and scientific information

The Portuguese Strategic Plan (PEPAC 2023-2027), which began in January 2023, supports Organic Farming through the Eco-scheme A.3.1 - Organic Farming (Conversion and Maintenance). The Eco-scheme A.3.2 - Integrated Production (PRODI) - Agricultural Crops supports farming under a national regulation for sustainable farming. The eco-schemes: A.3.3.1 - Soil management - Management of permanent pasture and A.3.3.2 - Soil Management - Promotion of Organic Fertilization, along with the environmental and climate measures C.1.1.1.1.1 - Soil Conservation - Direct Sowing, C.1.1.1.1.2 - Soil Conservation - Maintenance of Cover Crops Between Rows of Permanent Crops, and C.1.1.1.1.3 - Soil Conservation - Biodiverse Pastures, will support conservation farming. Lastly, Precision Farming will be supported under Measure C.2.1.1 - Agricultural Productive Investment - Modernization.

PaM9 - Promoting decarbonisation of livestock activity.

This PaM aims to reduce the carbon intensity of livestock activity through better digestibility of the diet of animals produced in intensive and extensive systems and the treatment systems management of livestock effluents.

Effluent management and treatment systems are critical in reducing GHG and ammonia emissions in the agricultural sector. The promotion of the installation or conversion of such systems is a key priority to mitigate these emissions effectively. Developing and adopting advanced livestock effluent management systems is fundamental to achieving these environmental goals while supporting sustainable agricultural practices.

Complementing this, the promotion of dietary strategies that enhance digestive efficiency is essential. These strategies aim to minimize the potential pollutant load, particularly concerning GHG and ammonia emissions, by optimizing feed utilization. Such integrated approaches not only contribute to emission reductions but also improve overall agricultural efficiency and sustainability.

The National Strategy for Livestock and Agroindustrial Effluents 2030 (ENEAPAI 2030) approved by Council of Ministers Resolution no. 6/2022, deserves additional mention, as it aims, among other objectives, to promote agricultural valorization 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[34].

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 GHG 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 valorization 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 Portuguese Strategic Plan (PEPAC 2023-2027) that has started in January 2023, supports a new measure to promote good practices, namely the eco-scheme A.3.4 - Improving efficiency animal feed to reduce the GHG emissions " with intended impact on the reduction of bovine CH4 emissions.

PaM10 - Conserving, restoring and improving agricultural and forest soils and preventing their erosion.

The aim of this PaM is to promote the installation, conservation and recovery of riparian galleries that conserve the water regime and prevent erosion, as well as the adoption of agricultural and forestry techniques that promote an increase in soil organic matter levels and carbon sequestration in the soil. Also important in this area is the application of fertilisers resulting from the recovery of agricultural and livestock waste, wastewater treatment sludge, bio-waste or other materials, which will help to increase the percentage of organic matter in the soil, with benefits in terms of soil structure and fertility, as well as reducing water erosion. Additionally, it supports optimizing irrigation practices and the application of compost in order to promote a high level of organic matter in the soil. To further align with decarbonization goals, this PaM encourages the development of value chains within the bio-based economy by increasing the use of by-products/waste materials from agriculture, livestock, forestry and marine resources, with new products and new business areas that contribute to circularity and the reduction of GHG emissions.

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 has supported 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.

The new Portuguese Strategic Plan (PEPAC 2023-2027), which began in January 2023, supports the eco-schemes A.3.3.1 - Soil Management - Management of Permanent Pasture and A.3.3.2 - Soil Management - Promotion of Organic Fertilization, along with the environmental and climate measures C.1.1.1.1.1 - Soil Conservation - Direct Sowing, C.1.1.1.1.2 - Soil Conservation - Maintenance of Cover Crops Between Rows of Permanent Crops, and C.1.1.1.1.3 - Soil Conservation - Biodiverse Pastures, all contributing to conservation farming with a positive impact on soil health. Additionally, the eco-scheme A.3.6 - Practices Promoting Biodiversity includes support for the maintenance and recovery of riparian galleries. Furthermore, the environmental and climate measures C.1.1.3 - Agroforestry Mosaic and C.1.2.1 - Support for Areas with Natural Constraints aim to maintain agricultural activity in regions facing 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 fertilizers

This PaM aims to reduce the use of nitrogen fertilizers and replace them with organic fertilizers, thereby reducing the emissions arising from this type of agricultural practice, in line with the Code of Good Agricultural Practice (Order no. 1230/2018, of 5 February), the Code of Good Practice for Reducing Ammonia Emissions (2022), the National Emission

Ceilings Directive (Decree-Law no. 84/2018, of 23 October) and the EU Fertilizer Regulation.

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 fostered the 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 new Portuguese Strategic Plan (PEPAC 2023-2027) starting in January 2023, continues to support this measures and establish a new measure to promote good practices in this field, namely new eco-scheme A.3.3.2 - Soil Management - Promotion of Organic Fertilization that supports the Replacing the use of mineral fertilisers with organic fertilisers.

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.

The Action Programme for areas vulnerable to nitrate contamination 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.

PaM31 - To promote a low-carbon diet (new PaM)

This PaM aims to promote a diversified diet, including reducing the consumption of animal proteins and promoting the consumption of plant-based protein alternatives, in order to reduce GHG emissions from the agricultural sector.

The objective is to establish a national strategy to promote the production and consumption of plant-based proteins, particularly vegetables, as an integrated approach to ensure self-sufficiency in protein crops and reinforce food sovereignty. In this context, the National Plan of Sustainable and Balanced Food has been developed, with the following main goals:

- Promote the consumption of national, regional and local products, in balance with the principles of the Mediterranean Diet;
- Improve the nutritional quality of the food supply and combat food insecurity;
- Increase the level of adherence to the Mediterranean Diet by 20% by 2030;

Important also to highlight the following planned concrete measures:

- Supporting the production of plant-based proteins to boost supply chains.
- Promoting educational initiatives and training to encourage the adoption of plant-based diets, particularly in public catering services.
- Expanding the availability of plant-based meals in public canteens.
- Launching awareness campaigns highlighting the nutritional and environmental benefits of plant protein consumption.

Additionally, the above metioned strategy seeks to enhance the implementation of short agri-food supply chains as part of a broader effort to rethink the food system. This involves fostering sustainable dietary shifts, minimizing food waste, and transforming production methods. Short supply chains contribute to reduced energy consumption and lower pollutant emissions by decreasing the need for extensive packaging, transportation, and refrigeration. Replicating successful local food circuit models will further support these goals, encouraging proximity-based marketing and sustainable consumption patterns.

Within this context, Portugal has already adopted initiatives to promote healthier eating habits, such as the National Strategy for the Promotion of Healthy Eating (ENPAS), implemented by the Directorate-General for Health (DGS), aiming to reduce consumption of ultra-processed foods,

sugar, salt and saturated fats, while encouraging more fruit, vegetables, legumes and fresh produce. This reflects an effort to guide the population towards a more balanced and healthy diet.

Interest in alternative food networks, such as local farmers' markets and organic stores, has increased. This movement is linked to the demand for fresher, more sustainable and locally sourced food. There is a greater awareness of the importance of product origin, proximity and environmental sustainability in food production, which also led to the growth of urban gardens promoted by local authorities, so that citizens can grow their own food.

At the same time, several schools have joined the School Scheme. The School Scheme is an initiative of the European Union, established by Regulation (EU) No. 1308/2013 and subsequent amendments, which allows Member States participating in this EU aid scheme to distribute fruit, vegetables and milk in schools, to be given to primary school children between meals a few days a week. This EU-supported scheme aims to raise awareness of healthy eating habits, but also to increase this target group's knowledge of agriculture and how food is produced.

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PaM8 - Improving natural sink potential of agriculture and forest.

This PaM aims to increase the carbon sink capacity of agriculture and forestry, reduce emissions and/or enhance soil sequestration. Support the establishment of permanent biodiversified grassland, the maintenance of permanent crops, as well as other soil fertility and soil structure improvement operations and the use of crops/species suited to soil characteristics and improve landscape resilience to rural fires and reduce their incidence.

Forests

In order to increase the natural sink potential of the forest the national forest policy instruments consider actions in a mutually supportive way:

- Conservation of carbon in existing forests;
- Enhanced forest management;
- Prevention of deforestation;
- Strengthening protection against natural disturbances.

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. Other forms of promoting co-management of forest areas are the Forest management Entities and Forest Management Units.

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 regulated by law:

- 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 (see bellow).

Land use change planning

As regards Land Use 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 crisscrossed 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 valorization.

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 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 and the technical needs identified by ICNF 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.

Concrete measures are essential to reduce abiotic risks and enhance rural fire management. This includes the implementation of a primary fuel management strip network, fuel management mosaics, and a secondary network of fuel management strips, among other strategies outlined in the National Plan for Integrated Rural Fire Management. These actions align with the strategic objective to "Care for Rural Spaces" by promoting landscape resilience. Additionally, supporting the operations of Forest Sapper Teams, improving their efficiency, and equipping the ICNF with a dedicated force of forest firefighter-sappers will strengthen fire prevention and response capabilities. The implementation of the "National Controlled Fire Plan and the National Program to Reduce Rural Fire Ignitions" will further mitigate wildfire risks.

Enhancing forest productivity and increasing the economic value of forest stands are key goals. This will be achieved through professional, active management that maximizes site potential by using improved plant species, promoting multifunctionality, and adopting more demanding technical solutions. Sustainable forest management certification, consolidation, and reconversion of existing forests will be pursued alongside the restoration of degraded or understocked systems. This framework also involves a new territorial specialization, encouraging forest-based industries to invest in higher-value products while ensuring fair pricing for producers, thereby creating a value chain that benefits stakeholders from production to final product commercialization.

National Landscape Transformation Program

The Landscape Transformation Program, initiated in 2020 provides for 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.

The implementation of the Landscape Transformation Programme (PTP) is critical for addressing the vulnerabilities of forest territories with high fire hazard levels. This long-term strategy, aligned with the PNPOT, the National Forest Strategy 2030 (ENF 2030), and the National Strategy for Nature Conservation and Biodiversity 2030 (ENCNB 2030), as well as the Interior Enhancement Programme, encompasses four key programmatic intervention measures:

1. Landscape Reordering and Management Programmes (PRGPs): These programmes aim to redesign rural landscapes, fostering a multifunctional, biodiverse, and resilient forest economy. By promoting profitability, enhancing carbon sequestration capacity, and optimizing ecosystem services, the PRGPs serve as a blueprint for sustainable rural development.
2. Integrated Landscape Management Areas (AIGPs): Aimed at specific micro-territorial contexts, often within the PRGP framework, the AIGPs establish a collective management model executed through Integrated Landscape Management Operations (OIGPs). These are designed for active and rational management at an appropriate scale.
3. "Condomínios Aldeia" Programme: This initiative supports villages in forested regions, ensuring effective fuel management around population clusters, particularly in areas with dense forests and a high number of dispersed rural settlements.
4. "Emparcelar para ordenar" Programme: Focused on mitigating the challenges of fragmented land ownership, this programme encourages the enlargement of rustic property sizes in areas dominated by smallholdings, enhancing economic, social, and environmental sustainability.

By addressing critical challenges such as fire risk, land fragmentation, and the economic viability of rural areas, the PTP not only fosters landscape resilience but also aligns with broader national objectives for sustainable development and territorial cohesion. Its integration into strategic national frameworks ensures a cohesive approach to enhancing rural forested areas while promoting ecological and socio-economic sustainability.

The programmatic measures of the PTP have been implemented since 2021, when 70 AIGPs were set up. With the signing of the program contracts, the process of drawing up the respective OIGPs began, which include the definition of land use proposals and intervention units, accompanied by the involvement of stakeholders through public consultation and meetings with landowners.

By 2022, 73 programs "Condomínio de Aldeia have been approved and in 2023, the Monchique and Silves Mountains PRGP was the only approved PRGP, with 9 currently in preparation and 7 in a final stage.

In the context of this PaM, it is equally important to ensure alignment with the National Nature Restoration Plan. The development of this plan must be coordinated with the National Energy and Climate Plan 2030 (NECP 2030), as stipulated by Regulation (EU) 2024/1991 of the European Parliament and of the Council of 24 June 2024. This alignment is crucial to harmonize objectives and measures, recognizing that the energy transition must not exacerbate ecosystem degradation or biodiversity loss. It is also essential to develop more appropriate tools for compensating the impacts on socio-ecological systems, ensuring that nature restoration and energy transition goals are mutually reinforcing rather than conflicting.

Another measure foreseen within this PaM is to continue to support and develop Ecosystem Services Remuneration Programs in Rural Areas. The first phase of the Ecosystem Services Remuneration Program in Rural Areas, launched in 2019, aims to enhance the competitiveness of rural territories and ensure a model of greater environmental sustainability, with reduced exposure to risks, particularly wildfires. The remuneration of ecosystem services seeks to promote the biodiversity of territories, reflecting a shift in how these areas are utilized—transitioning from a short-term profitability model to one that requires a longer time horizon but ensures greater value and resilience for these territories. The goal is to continue fostering mechanisms that compensate for contributions not valued by the market, including efforts to control erosion, sequester carbon, regulate the hydrological cycle, conserve biodiversity, reduce fire susceptibility, and improve landscape quality.

The Autonomous Region of Madeira (RAM) has been implementing several actions to increase its resilience to the challenges posed by climate change, especially forest fires. One of the main initiatives was the creation of a firebreak in Funchal, the region's largest urban centre, which is frequently affected by fires. This strip, which represented an investment of around €500,000, aims to establish a buffer zone made up of low-combustibility vegetation, thus reducing the risk of fires spreading to residential areas.

To complement this action, a tank with a capacity of 1,500 cubic meters of water was built in the same area, and 25 fire hydrants were installed along a 10.5-kilometre-long road. The hydrants, strategically positioned every 500 meters, aim to guarantee a quick and effective response by the fire department in the event of a fire, thus increasing the safety of the population and infrastructure. In addition, the RAM has already begun the construction of around 40 km of forest paths, where it is planned to create an ecological park with recreational and leisure areas, reinforcing the region's tourist and recreational potential. In an area previously occupied by highly flammable species such as eucalyptus and acacia, more fire-resistant native species such as laurel, beech, uveira and massaroco have been planted, helping to restore biodiversity and create a more fire-resistant landscape.

To strengthen the prevention and monitoring of natural risks, the RAM has implemented the Integrated Monitoring and Alert System for Natural Risks (SIMARN), which includes the Alluvium Alert Subsystem (SAARAM) and the Forest Fire Detection Subsystem (SDIFRAM). These systems, supported by a network of cameras and other technological equipment, allow for more effective

surveillance, alerting the authorities in good time to risks such as floods and fires, facilitating a rapid and coordinated response.

Fiscal measures

PaM2 - Green tax implementation

This PaM aims to induce more sustainable production and consumption patterns, to promote the reduction of GHG emissions, to foster more sustainable behavior, to promote eco-innovation and efficiency in the use of resources, to foster entrepreneurship and job creation, to reduce energy dependence on foreign sources, to efficiently achieve international goals and objectives and to diversify sources of income. It includes fiscal measures to decarbonise: a) the transport sector and promote sustainable mobility, such as positive discrimination for vehicles with better environmental performance, with taxation based on CO2 emissions, and tax incentives for low carbon transport options, b) the residential and services sectors, such as tax reduction for buildings sector (residential and services) according to its energy eficiency and renewable energy incorporation and c) to promote low-carbon products and services and the use of renewable energies, such as tax reduction for products and services incorporating renewable energy sources and recycled materials.

The aim is to establish a robust system of fiscal incentives to accelerate the adoption of sustainable practices and technologies, particularly in the areas of mobility, energy efficiency, and renewable energy. Measures will include targeted incentives for electric mobility, encompassing personal income tax (IRS), corporate income tax (IRC), VAT, vehicle registration tax (ISV), and autonomous taxation. Additionally, subsidies should be available for the purchase of new electric or plug-in hybrid vehicles. To further support environmentally friendly transportation, ISV and the annual circulation tax (IUC) should also be revised to enhance positive discrimination in favor of vehicles with superior environmental performance, with taxation continuing to be based on CO2 emissions.

In addition to these measures, the potential for fiscal incentives in alternative mobility options will be explored, focusing on hydrogen, bioenergy, and renewable fuels of non-biological origin (RFNBO). These incentives aim to differentiate bioenergy from fossil fuels and promote the adoption of fuel blends with a higher proportion of bioenergy, fostering diversification and innovation in energy use.

Energy efficiency and renewable energy technologies in buildings are another key focus. Fiscal mechanisms will encourage the integration of renewable energy solutions for electricity and thermal energy production. This includes proposing favorable tax regimes, such as property tax (IMI) reductions, for nearly zero-energy buildings (NZEB), aiming to improve building performance while supporting national energy and climate goals.

Additionally, tax incentives will promote low-carbon and renewable energy products and services, including a reduced VAT rate for such goods. Priority will be given to products and services that are certified for low-carbon impact or that incorporate recycled materials, enhancing their market competitiveness and encouraging sustainable consumption and production.

These measures are designed to create an integrated approach to fiscal policy that supports environmental sustainability, drives innovation, and aligns with broader decarbonization objectives.

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

This PaM aims to reboost the Carbon Tax (adopted in 2014), a carbon taxation in sectors not covered by the European Emissions Trading Scheme (EU ETS) with a tax indexed to the carbon price in sectors covered by the EU ETS. It also aims the phasing out of environmentally damaging incentives, namely fossil fuel subsidies, including a review of tax benefits and other incentives linked to the use of fossil fuels.

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.

Regarding policies and practices that lead to greater levels of anthropogenic GHG emissions than would otherwise occur, an example might be given in wastewater sector despite the evident environmental and public health benefits, namely the conversion of primary wastewater treatment systems into secondary and tertiary systems, which is planned for most centralized systems. This measure stems from European Council Directive 91/271/EEC of 21 May 1991, commonly known as the Urban Waste Water Directive, which states that all waste water from agglomerations with a population equivalent greater than or exceeding 2000 must be subject to secondary or more advanced treatment, for agglomerations greater than or exceeding 10000 p.e. (population equivalent) with rejection in sensitive areas.

In the energy and transport sector, in 2022, as a measure to mitigate the inflation rate, along with other fiscal measures aimed at containing the rise in fuel prices, taxes on fuels were reduced, namely the tax on petroleum products (ISP), and the updating of the carbon tax was suspended, a measure that was in force until May 2023, when the update of the carbon tax update began to be gradually implemented. It should be emphasised, however, that this was a circumstantial measure that aimed to deal with the energy crisis resulting from the war in Ukraine.

Also in 2022, the rise in fuel and AdBlue prices, along with the effects of the COVID-19 pandemic that were still being felt, have resulted in increased difficulties for the sector's economic recovery and for maintaining essential freight transport services. In this context, Council of Ministers Resolution no. 29-E/2022, of 18th March, created an extraordinary and exceptional support for

the goods transport sector for hire or reward. The support granted covered freight transport vehicles and was paid in a single instalment in 2022, corresponding to a fuel value and an AdBlue value for each freight transport vehicle, under the terms defined in Annexes I and II to the Council of Ministers Resolution mentioned above and with reference to the period between 1 January 2022 and 31 March 2022. In 2024, and despite the gradual unfreesing of the carbon tax that reconciles environmental protection with the need to support families and businesses in the energy sector, the value of the carbon tax has reached 56.246 €/tonne of CO2 this year, in line with Order no. 244-A/2023, of July 28 and Order no. 352/2023.XXIII, of December 27.

However, it should be stressed that the National Climate Law (Law no. 98/2021, of 31 December) establishes that budgetary and fiscal policies at national level should progressively eliminate subsidies set by national legislation, whether direct or granted through tax benefits, for fossil fuels or their use by 2030, as well as earmarking green tax revenues for decarbonization, the just transition and increasing resilience and adaptability to climate change and strengthening the application of the carbon tax and applying greater taxation on the use of resources.

Cross-sectoral

PaM29 Setting up a Voluntary Carbon Market and establishing the rules for its operation – (new PaM)

This PaM aims to foster the implementation of projects that reduce GHG emissions and enhance carbon sequestration across the national territory, contributing to climate change mitigation while delivering broader environmental and socioeconomic benefits. These initiatives are designed not only to curb emissions but also to support biodiversity protection and safeguard natural capital. By creating a certification framework aligned with European and international principles, the aim is to enable the recognition and trading of carbon credits, promoting a dynamic and market-driven approach to emission reductions. In parallel, efforts will focus on establishing mechanisms to facilitate emission offsetting and financial contributions to climate action, ensuring transparency and accountability. This comprehensive strategy seeks to integrate climate benefits with sustainable development goals, emphasizing a balanced approach that supports environmental resilience and societal well-being.

In addition to central governments, local authorities and companies are also taking steps to make their municipalities or their organizations/services/products more sustainable, committing to emission reduction objectives and targets in order to support the global goal of achieving carbon neutrality. In this context, there has been growing interest from society in general, although with greater emphasis from the private sector, in using voluntary carbon markets as a tool for offsetting emissions. However, the actions taken by the various parties need to be properly framed so that they are credible and transparent, avoiding greenwashing and contributing to national climate action objectives. To make the most of this type of instrument and maximize benefits such as supporting biodiversity and fostering natural capital, it is essential to establish a

regulatory framework at the national level to ensure transparency and quality - compatible with European and international standards for monitoring, reporting, and verification (MRV).

To this end, and after a long period of informal consultations with various stakeholders, including a public consultation process, the legislative framework for the operation of the voluntary carbon market was established through the publication of Decree-Law No. 4/2024 of January 5. In April of this year, following the creation of the voluntary carbon market, the technical supervisory committee for the voluntary carbon market has been establhised (Order n.º 3771/2024) as provided for in Decree-Law No. 4/2024 of January 5. This committee will be responsible, for example, for developing and evaluating carbon methodologies or assessing the market's performance and may propose any changes deemed necessary for its better operation. More recently, Order No. 13808/2024 of November 22 was also published, appointing representatives to the technical monitoring committee.

In addition to these developments, and with a view to enabling the operationalization of this market, three ordinances were also published to establish the amounts of fees to be charged by the supervisory and management entities of the registration platform (Ordinance No. 239/2024/1), define the qualification criteria for carrying out the activity of independent verifier of GHG emissions mitigation projects and identify the managing entity of the qualification system (Ordinance No. 240/2024/1), and establish the general requirements for the electronic registration platform of the voluntary carbon market (Ordinance No. 241/2024/1).

Looking ahead to 2025, key initiatives include the training and certification of verifiers, the development of the registration platform, and a public consultation on the first carbon methodology for afforestation. These steps aim to ensure the effective functioning of the voluntary carbon market, strengthening its role as a credible instrument for emission reductions and a driver of environmental and socioeconomic benefits.

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";
- *PaM5* – "Reduction of waste production and of landfill disposal and promotion of recycling";
- *PaM8* – "Improving natural sink potential of agriculture and forest";
- *PaM9* – "Promoting decarbonisation of livestock activity";
- *PaM10* – "Conserving, restoring and improving agricultural and forest soils and preventing their erosion";
- *PaM11* – "Reducing the use of nitrogen fertilisers";
- *PaM14* – "Promoting active and low-impact mobility and more efficient behaviours";
- *PaM22* – "Accelerate national energy transition to renewables".

Policies and Measures no Longer in Place

All the mitigation actions which were reported in 8NC/5BR are included in this BTR. However, their descriptions has been revised to be more in line with the NECP 2030 revision 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 PaMs on the Promotion of more efficient 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 PaM 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).

Among all the PaMs identified, the only one that is no longer in place is PaM 20, since it has already been implemented.

PaM20 - Phase-out electricity production based on coal

Promote the energy transition of the power sector, with a view to the progressive reduction of the use of fossil fuels, investing heavily in endogenous renewable energy sources, reducing the country's energy dependence.

The gradual phase-out of fossil fuels for electricity generation, particularly coal, is critical for ensuring the energy transition to a carbon-neutral society. In line with this goal, Portugal committed in 2016 to cease electricity production from coal by 2030 at the latest, becoming a member of the Powering Past Coal Alliance (PPCA). This global coalition of governments, businesses, and subnational organizations promotes the transition away from coal-fired power generation, a timely and necessary step to meet the international commitments outlined in the Paris Agreement.

In this regard and considering the factors that strongly disincentivize coal-based electricity production, such as the rising price of CO2 emission allowances, the end of the ISP exemption, and the increasing cost of coal, as well as previously conducted supply security studies, the closure

of the Pego power plant was scheduled for 2021 and the Sines plant for 2023. In this context, the necessary technical assessments were carried out, taking into account the evolution of the electricity grid and the power generation capacity, to evaluate the impacts and anticipate potential mitigation measures for the National Electricity System (SEN). This transition was successfully completed, with the definitive cessation of coal-based electricity generation in Portugal achieved in 2021, well ahead of the initial timeline.

This PaM is, therefore, implemented and no longer in place.

3.4.3 Policies and practices that encourage activities that lead to increased levels of anthropogenic GHG emissions

While Portugal is strongly committed to ambitious climate targets and the transition to a carbon-neutral economy, certain policies and practices, either by design or as unintended consequences, have led to increased greenhouse gas (GHG) emissions. These instances often arise from the intersection of environmental, economic, and social policy objectives, where measures addressing one priority inadvertently create negative impacts on another. This section explores key examples from sectors such as wastewater treatment, state aid mechanisms, carbon leakage measures, and carbon tax temporary exemptions, highlighting their implications for GHG emissions and the ongoing efforts to address these challenges

Waste Management

The emissions of N2O can occur directly in wastewater treatment plants (WWTPs) during the typical nitrification-denitrification processes of biological treatment systems, or indirectly after the release of nitrogen loads into water bodies.

It is worth noting that, with the adoption of the new methodology suggested by the IPCC (IPCC, 2019), direct emissions are now recognized as a significant source of sectoral GHG emissions compared to previous estimates based on the earlier methodology (IPCC, 2006).

In the 2006 methodology, direct N2O emissions were largely undervalued and considered negligible. However, recent scientific research has reversed this perspective, attributing substantial weight to N2O emissions in biological treatments, which are precisely the methods prioritized by water quality management policies.

This reality results in increased GHG emissions as measures are implemented to expand the coverage of biological treatment systems, aligning with the fundamental orientation of European Union policy on urban wastewater treatment. Thus, the greater the number of biological treatment systems, the higher the associated N2O emissions, illustrating a scenario where distinct environmental policies generate conflicting outcomes.

For instance, replacing a primary treatment WWTP with an outfall system with a secondary or tertiary biological treatment system ultimately results in higher overall GHG emissions.

Additionally, the predicted shift towards widespread adoption of secondary/tertiary treatment systems creates a paradoxical increase in GHG emissions. The rise in N2O emissions offsets the reductions achieved in CH4 emissions from other types of treatment, such as anaerobic systems.

State Aid Measures

Rules for state aid measures have been established under the EU Emissions Trading System (EU ETS), in order to address the indirect costs of GHG emissions reflected in electricity prices. They are considered special and temporary measures and have been formalized through Ordinance No. 203/2021, amended by Ordinance No. 231/2021, being applied to indirect costs incurred annually by eligible EU ETS installations from January 1, 2021, to December 31, 2030.

Carbon Leakage Prevention Measures

Under the EU ETS, a significant volume of allowances is allocated for free to sectors exposed to the risk of carbon leakage, based on sector-specific performance benchmarks. This allocation can, in some cases, sustain high GHG emissions that might otherwise have been mitigated.

However, and despite being a temporary measure that will be reduced over time, important to highlight that from 2026 to 2030 free allocation will become conditional on implementing energy efficiency measures (based on audits or energy management systems) and carbon neutrality plans for the least efficient installations to incentivize decarbonization. Additionally, free allocation to specific sectors will be gradually phased out from 2026 to 2034, alongside the gradual phase-in of the EU Carbon Border Adjustment Mechanism (CBAM) for third-country imports, which is intended to replace existing carbon leakage prevention measures, such as free allocation under the EU ETS.

Carbon Tax Reduction Measures

In 2015, the "Green Taxation Law" introduced a carbon tax (applied as an addition to the Tax on Petroleum Products - ISP) for sectors not covered by the EU ETS. This tax aimed to promote a low-carbon economy, combat climate change, and reduce external energy dependence.

However, in 2022, as part of measures to mitigate inflation and rising fuel prices, fuel taxes, including ISP, were reduced, and the carbon tax update was suspended. This measure remained in effect until May 2023, when a gradual unfreezing of the carbon tax update began.

Nevertheless, and despite these temporary and special measures, Portugal remains committed to eliminating environmentally harmful subsidies, reinforcing the application of the carbon tax, and increasing resource-use taxation while redirecting revenues toward decarbonization and just transition.

These examples highlight the complexities of balancing environmental objectives with economic and social considerations, underlining the need for integrated and adaptive policy frameworks to minimize unintended consequences while advancing towards climate neutrality.

3.4.4 Assessment of the economic and social consequences of response measures

Response measures are actions, policies, and programmes that countries, as Parties to the UN Framework Convention on Climate Change (UNFCCC), undertake in response to climate change, mostly for mitigation of greenhouse gas (GHG) emissions. Implementation of response measures can result in social, economic, political, and environmental impacts, which can be both of negative and positive character, the latter of which is also called co-benefits.[35]

By committing to the implementation of the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement (PA), Portugal aims to mitigate not only the adverse effects of climate change at national level, but also on other Parties, particularly developing countries, including any unintended consequences arising from greenhouse gas (GHG) reduction measures. This commitment is underpinned by actions and instruments designed to promote sustainable development and provide support to developing nations.

The policies and measures outlined in Portugal's National Energy and Climate Plan (NECP 2030) represent a significant effort to reduce GHG emissions across all sectors of the economy while addressing the potential negative impacts of these policies. The transition to a carbon-neutral economy by 2050 requires contributions from all sectors, with a particular emphasis on diversifying energy sources and increasing reliance on endogenous renewable resources, as established in the 2050 Carbon Neutrality Roadmap and NECP 2030.

To comprehensively assess the economic and social impacts of climate policies, Portugal has implemented the System for Policies and Measures (SPeM). This system ensures that policy measures with GHG reduction potential, along with their associated costs, are carefully evaluated and presented by stakeholders from various economic sectors.

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 centered 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.

[35] Pocket guide to response measures under the UNFCCC, 2021

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 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.

Achieving the climate objectives implies changes in the economy, territorial model, and society. Therefore, it is crucial that this transition is strategically planned, involving different sectors of society and various regions. It is also important to consider the economic and social impacts of this transition, ensuring that it is fair. Different analyses conducted at the international level show that adopting deep decarbonization policies has positive impacts on the economy, employment, and society. In particular, reducing particulate emissions, ozone precursors, nitrogen oxides, and sulfur has a positive impact on air quality and improves public health, especially in densely populated urban areas.

Investment associated with decarbonizing the economy drives innovation and creates skilled jobs, particularly in green sectors. It is essential to consider the specific needs of different sectors and design support measures for energy-intensive industries, addressing the reconversion of activities and workers, especially in regions most affected by the transition. Therefore, creating skills tailored to future employment needs is of particular importance.

On the other hand, internalizing the environmental impacts associated with fossil fuels and gradually eliminating their fiscal exemptions have differentiated effects on society. It is therefore essential that fiscal revenues associated with these measures are redirected to benefit society, supporting decarbonization projects, including energy efficiency initiatives, reducing the burden on labor, or minimizing associated social impacts.

This transition must contribute to reducing energy poverty and including the most vulnerable regions and populations, ensuring a just transition. Situations of energy poverty and vulnerability must be identified and addressed through measures aimed at urban rehabilitation, promoting energy efficiency in buildings—particularly through insulation measures—and reducing

dependence on fossil fuels. In this regard, ongoing investments in decentralized electricity production based on renewable energy communities and the enhancement of collective systems that reduce maintenance costs help lower energy costs and ease financial burdens on households.

At the national level, Portugal is strongly committed to ensuring a Just Transition as a central pillar of its National Energy and Climate Plan (NECP 2030). Recognizing that the transition to a carbon-neutral economy must be socially fair and inclusive, Portugal has adopted a holistic approach that balances environmental sustainability, economic development, and social cohesion.

The NECP 2030 outlines several key measures to support workers, communities, and industries affected by the decarbonization process. Through targeted investment in clean energy technologies, reskilling and upskilling programs, and the promotion of innovation-driven green sectors, Portugal aims to ensure that no one is left behind in this transition.

Furthermore, financial mechanisms, such as the Just Transition Fund, are being leveraged to support vulnerable regions and communities. These funds are directed towards economic diversification, social protection measures, and infrastructure development, fostering resilience and long-term sustainability, especially in regions that have until then been economically dependent on industries associated with coal or oil-based energy production. Faced with the cessation of electricity production from coal in the country's two largest CO2-emitting power stations—the Sines power station (in the Alentejo Litoral region) and the Pêgo power station (in the Médio Tejo region), both in 2021—and the closure of the oil refinery in Matosinhos in 2020, it is essential to promote the economic development of these three regions and the diversification of their existing economic activities.

Thus, in Alentejo Litoral and Médio Tejo, this fund will make it possible to diversify the local economy by supporting research and innovation in small and medium-sized enterprises (SMEs) in the renewable energy, agri-food, tourism, and sustainable mobility sectors. As such, the Fund is expected to create around 200 new jobs and support the professional reorientation of workers in the region affected by the closure of the coal-fired power stations, through training and retraining. In Matosinhos, the Just Transition Fund will support the creation of a new innovation center with a particular focus on sustainable mobility, clean energy, advanced manufacturing, and the maritime economy. In this region, this fund will make it possible to create 150 new jobs in the supported SMEs and retrain 170 long-term unemployed people.

Additionally, the Compensation Mechanism for a Just Transition, supported by the Environmental Fund, aims to ensure income maintenance for workers directly and indirectly affected by the cessation of electricity production from coal at the Pêgo power station and its subsequent closure, during a transitional phase until these workers find alternative employment.

Acquiring new skills is essential in this transition process, requiring retraining and upskilling in the sectors and activities most impacted, particularly those linked to fossil fuels. In this sense, it will be necessary to create the conditions and competencies required for a just transition, continuing the work already underway through the implementation of the Just Transition Fund, supporting research and innovation in SMEs in renewable energy, agri-food, tourism, and sustainable

mobility, or initiatives such as the "Green Skills and Jobs Program," which aims to retrain workers and upskill unemployed individuals in renewable energy and energy efficiency sectors. It is also worth noting that the obtained estimates do not include quantified impacts at the level of co-benefits resulting from avoided damages, for example, on health and biodiversity, nor the corresponding adaptation costs to climate change.

Another example is the application of the Social Climate Fund, created to support vulnerable households, micro-enterprises, and public transport users in addressing the anticipated rise in energy and public transport costs resulting from the extension of the EU Emissions Trading System (ETS) to the transport and building sectors (ETS BRT). The implementation of this fund will occur between 2026 and 2032, based on a Social Climate Plan that must be developed before the mechanism comes into effect, outlining the measures and investments intended to mitigate the resulting social impacts. These measures and investments aim to reduce dependence on fossil fuels by increasing building energy efficiency, decarbonizing heating and cooling systems, and promoting low- or zero-emission mobility solutions.

3.5 Projections of greenhouse gas emissions and removals

3.5.1 General Information

As mentioned in the 8th National Communication (8NC) and the 5th Biennial Report (5BR), the projections for greenhouse gas (GHG) emissions were initially prepared during the development of the National Energy and Climate Plan 2030 (NECP 2030) and the Carbon Neutrality Roadmap 2050 (RNC 2050).

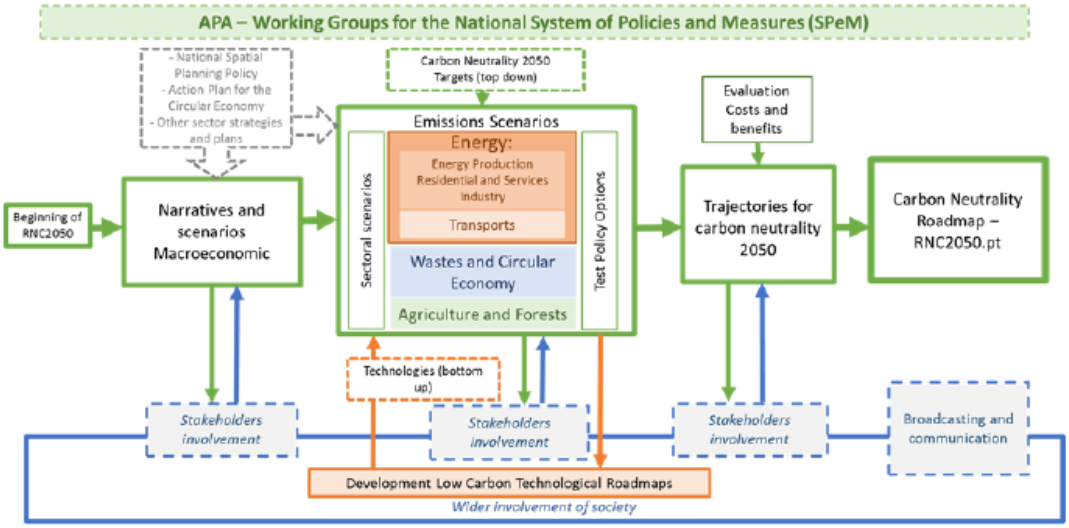

Figure 3.23 - Workflow of the Carbon Neutrality Roadmap 2050.

However, following the recent revision of the NECP 2030, and considering all developments that have occurred since its publication in 2019, the GHG projections have also been revised accordingly. This revision process has been performed in tandem with the RNC 2050 revision, ensuring that short-term trajectories with the long-term perspective towards carbon neutrality. Important to stress that this process as not yet been concluded for the medium-to-long term, beyond 2030, as the review process of the RNC 2050 is still underway.

Like the previous modeling exercise that underpinned the development of the NECP 2030 and the RNC 2050, the new exercise foresees some of the expected impacts of climate change in the 2050 horizon, namely changes in the efficiency of technologies, the demand for services and the availability of resources (such as a reduction in water availability or an increase in cooling needs). The results of this exercise made it possible to re-analyze the potential for reducing national emissions, confirming the technical and economic viability of continuing on a decarbonization path towards 2030.

Macroeconomic forecasts (GDP and population growth)

The narratives and the respective macroeconomic and demographic variables presented have been updated, taking into account the latest data available in terms of GDP and resident

population, and in view of the relevant changes stemming from the effects of the COVID-19 pandemic and the economic crisis that has occurred.

The GDP projections used follow the best information available at the time, namely the (provisional) GDP value of 2021 according to data from the National Statistical Institute (INE) and projections of the state budget for 2022 and 2023. The state budget projections incorporate the impacts of inflation, monetary policy in the euro area and the conflict in Ukraine on the Portuguese economy. According to the Public Finance Council report of September 2024 Portugal is particularly exposed to the economic consequences of the Russian invasion of Ukraine, which continue to manifest itself in the price of energy and food goods, as well as the adverse effects on inflation.

From 2025 onwards, the harmonised values recommended by the European Commission for this purpose have been considered in accordance with Part 2 of Annex I to Regulation (EU) 2018/1999 on the Governance of the Energy Union. These figures are based on GDP per capita of last AgeingReport[36] and Eurostat population growth (EUROPOP2019). Based on these data, the GDP growth potential in the EU and the Euro area is assumed to be on average 1.3 % per year over the whole projection period, differing by MS, considering their specificities including the labour force in Portugal that is expected to decline taking into account population projections. The figures provided by the European Commission do not take into account the current effects of the war in Ukraine and inflation, but it is the only available study with long-term projections thus justifying the decision on their use.

With regard to population growth, the figures recommended by the European Commission on population projections have also been used. The data are derived from Eurostat population projections EUROPOP2019 and include updated values for historical data (2020-2021) from the latest publication of Eurostat's demographic dataset.

Table 3.12 – Main assumptions used in the modelling of the national energy system (GDP and population).

	2020	2025	2030
GDP (rate of change)	0.4 % (' 15- '20)	3.1 % (' 20- '25)	0.8 % (' 25- '30)
Population (million)	10,29	10,27	10,13

Sectoral changes expected to impact the energy system and GHG emissions

With regard to sectoral changes likely to have an impact on the energy system and GHG emissions, for the 2030 horizon, the structure of the GVA is considered to remain broadly unchanged, compared to the base year 2016, in the various industries concerned.

[36] Available for consultation at: https://economy-finance.ec.europa.eu/system/files/2021-10/ip148_en.pdf

Nevertheless, economic growth is expected to be led by traditional industries, in a context of much greater integration of Portugal into international circuits, in line with what has been the case in recent years, and by some new services integrated into the global economy. However, as mentioned above, economic growth does not lead to significant changes in the production structure of goods, and logistics associated with the production, distribution and consumption of goods essentially retain the current characteristics

Table 3.13 – Main assumptions used in the modelling of the national energy system (GVA).

	2020	2025	2030
GVA Construction and Public Works (% of total GVA)	4,7	4,2	
GVA Agriculture, Forestry and Fisheries (% of total GVA)	2,7	2,6	
GVA Extractive industry (% of total GVA)	0,3	0,3	
GVA Manufacturing (% of total GVA)	12,0	13,8	
GVA Services (% of total GVA)	65	78,8	

Contrary to the WEM scenario, a significant restructuring of the national industrial fabric with the emergence of new mainly energy-related industries, notably green hydrogen, and a sharp growth of economic activities linked to digitalisation and data storage was considered in the WAM scenario (*With additional measures*). Although the impact of these projects on national growth and economic structure was not analysed, their demand for energy services was taken into account in the modelling exercise and is subsequently reflected in the increase in primary energy consumption and consequent influence on other components of the national energy system.

Global energy trends, international fossil fuel prices, carbon price in the European Emissions Trading System (ETS)

As regards the value of CO2 allowances, two approaches have been taken: I. up to 2025 the figures recommended by the European Commission for this purpose were considered; II. After that date, no upfront carbon price was imposed, resulting from a 'shadow price' generated by modelling when a compatible restriction was imposed as a 55 % reduction in GHG emissions in 2030 compared to 2005, in order to meet national mitigation objectives and in line with climate neutrality.

The past two years have seen a high degree of volatility in energy prices, largely driven by global instability linked to the war in Ukraine and the ongoing global economic recovery after the pandemic and its impact on supply chains. This will necessarily have to be reflected in the fossil-fuel import price projections, as well as the fact that the degree of uncertainty about future developments in international fuel prices in the coming years remains.

Table 3.14 – Main assumptions used in the modelling of the national energy system (Prices) [European Commission recommendations for reporting projections in 2023].

	2025	2030	2040
CO2 allowances (EUR/ton) [a, b]	80	-	-

Oil (EUR/GJ) [a]	12,4	13,9	15,8
Coal (EUR/GJ) [a]	4,1	4,0	3,8
Natural Gas (EUR/GJ) [a]	9,4	9,0	10,1

[a] Values made available in 2024 to Member States by the European Commission as part of the preparation of their Climate Energy Plans

[b] As Portugal incorporates the CO2 tax through its petroleum product tax, a CO2 rate of EUR78/t was also considered in the non-ETS sectors in 2025. The value of the carbon levy in the ISP is recalculated each year on the basis of the values of the EU ETS allowances of the previous two years (Law No 71/2018, Article 92a).

Technology cost developments

As regards the evolution of technological costs, a wide range of technologies and their investment costs, fixed and variable costs have been taken into account, according to the best information available at national, European and international level. More information regarding the costs considered in modelling for the main technologies as well as their sources of information is available in the Annex of the NECP 2030[37].

Sensitivity analysis

The sensitivity analysis for each sector is being performed in the context of the Roadmap for Carbon Neutrality (RNC 2050) ongoing revision and will be available after this process is concluded in 2025.

3.5.2 Assessment of Aggregate Effect of Policies and Measures

Main results

The results of this exercise allowed the review of the national emission reduction potential, confirming the technical and economic feasibility of pursuing a decarbonisation pathway towards 2030 towards climate neutrality in 2045. Sectoral analysis of emission trajectories confirms that all sectors have significant GHG emission reduction potential, although reduction rates can be differentiated.

The analysis of the behavior of different sectors under the conditions set out in the existing policy scenario (WEM), as well as in the With Additional Measures (WAM) scenario, has made it possible to identify critical factors, trends and behavior of these sectors within the time horizon considered. 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.

[37] NECP 2030 available at: https://apambiente.pt/sites/default/files/_Clima/20241118_pnec2030_para_aprov_ar.pdf

The Table 3.15 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. This information is also reported under table 6a and 6c (CTF)

Table 3.15 - GHG emission projections by sector and gas (kt CO2eq) - without CO2 captured and storage.

		GHG emission projections							
	Historical GHG emissions and removals	Scenario With Existing Measures				Scenario With Additional Measures			
(kt CO2 eq)	2022	2025	2030	2035	2040	2025	2030	2035	2040
Sector									
Energy	20 730,69	14 985,42	11 407,06	7 734,77	4 715,59	12 149,33	7 668,97	5 259,42	3 969,67
Transport	17 062,12	14 865,45	15 857,02	15 056,79	10 620,84	14 511,64	14 048,50	12 446,23	6 932,62
Industry/industrial processes	5 877,65	5 551,55	5 458,59	4 816,56	4 271,39	3 874,23	3 991,19	2 064,66	1 721,68
Agriculture	6 941,30	6 798,82	6 583,02	6 364,46	6 183,56	6 798,82	6 583,02	6 264,56	5 884,21
Forestry/LULUCF	-5 924,96	-7 485,73	-4 226,54	-3 905,55	-3 840,14	-8 656,02	-6 534,58	-4 278,48	-5 046,16
Waste management/waste	5 642,76	5 500,47	4 971,50	4 214,84	3 550,64	5 482,86	4 871,94	4 101,89	3 426,80
Gases									
CO_2 emissions including net CO_2 from LULUCF	33 917,71	24 959,98	25 839,34	21 379,14	13 856,01	20 677,37	18 124,87	14 471,45	6 717,59
CO_2 emissions excluding net CO_2 from LULUCF	40 687,05	32 445,71	30 065,88	25 284,69	17 696,15	29 333,39	24 659,44	18 749,94	11 763,75
CH_4 emissions including CH_4 from LULUCF	NO	NO	NO	NO	NO	NO	NO	NO	NO
CH_4 emissions excluding CH_4 from LULUCF	10 187,89	9 876,67	9 161,93	8 281,01	7 445,55	9 799,86	9 001,82	8 015,28	7 013,31
N_2O emissions including N_2O from LULUCF	NO	NO	NO	NO	NO	NO	NO	NO	NO
N_2O emissions excluding N_2O from LULUCF	3 355,82	3 554,06	3 475,45	3 390,50	3 234,89	3 535,81	3 395,94	3 307,62	3 090,38
HFCs	1 968,47	1 791,19	1 519,56	1 161,94	875,81	113,79	84,26	60,99	63,74
PFCs	29,98	0,05	0,05	0,06	0,06	0,005	0,00	0,00	0,00
SF_6	25,30	34,02	54,32	69,22	89,56	34,02	22,16	2,95	3,81
NF_3	NO	NO	NO	NO	NO	NO	NO	NO	NO
Total with LULUCF (with indirect)	35 941,47	40 215,97	40 050,65	34 281,86	25 501,88	34 160,86	30 629,05	25 858,28	16 888,82
Total without LULUCF (with indirect)	56 254,52	47 701,70	44 277,20	38 187,41	29 342,02	42 816,87	37 163,62	30 136,77	21 934,98

With Existing Measures scenario (WEM)

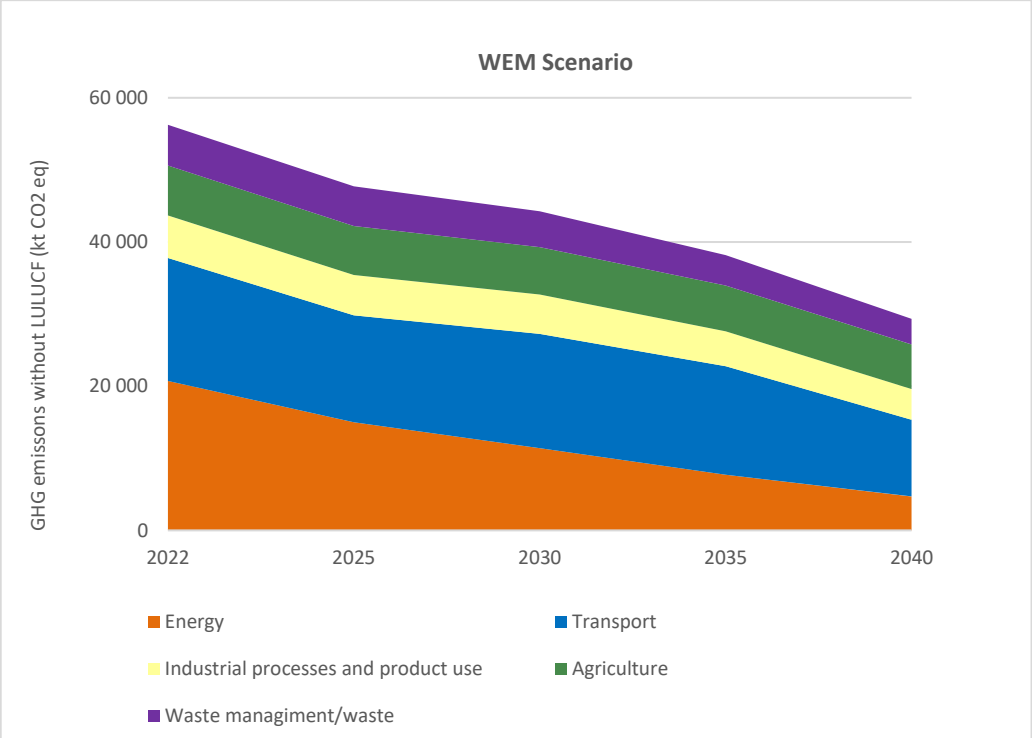

Figure 3.24 - Sectorial projections with existing measures scenario (kt CO2eq).

The Portuguese government committed itself in 2016 to ensuring the neutrality of its emissions by the end of 2050, having by then adopted intermediate reduction targets of at least 55% in 2030 and between 65 and 75% in 2040 compared to 2005, which translate into even steeper reductions for the energy system. In this sense, the existing policies scenario (WEM - With Existing Measures) already incorporates a series of measures aimed at achieving these objectives.

As can be seen, even in the existing policies scenario, there is already a prospect of a sharp reduction in GHG emissions over the coming decades, and there is cost-effective potential for Portugal to achieve total emission reductions of around 50% in 2030 compared to 2005 (without LULUCF).

It should be noted that this evolution does not take into account the contribution from technological carbon sequestration (Carbon Capture and Utilization and Storage - CCUS), which is expected to have more significant effects in the medium to long term and much deeper into the WAM scenario.

In 2030 this reduction is largely due to the closure of coal-fired power plants and the increased role of renewables in the national energy *mix*, with a stronger boost in solar PV. Thus, in 2030 the energy sector (including the transport sector and excluding the energy component associated

with the agricultural sector - has as being reported under the NECP 2030), has a GHG emission reduction potential of around 58% compared to 2005 (and around 77% reduction in 2040).

In the transport and mobility sector (1A3) itself an emission reduction potential of around 21% and 47% is expected in 2030 and 2040, due to a moderate uptake profile of electric vehicles and changes in mobility demand through reduced travel and modal shift. Important also to highlight that other forms of low-carbon energy are expected to be phased in in shipping and aviation.

As regards the services sector (1A4a), there is a strong GHG emission reduction potential, contributing to reductions of 83% and almost 100% in 2030 and 2040 respectively as a result of increased energy efficiency. The trend of reducing the consumption of fossil forms of energy in this sector continues until 2030, with the start of the massive introduction of heat pumps demonstrating their cost-effectiveness in providing energy services such as space heating and cooling.

The residential (1A4b) and manufacturing and construction sectors (1A2) have a lower decarbonisation potential over this time horizon, still pointing to a reduction of 51% in 2030 (around 84% in 2040) and 52% (around 91% in 2040) respectively.

For the agriculture sector (including the energy component 1A4c), a small reduction in emissions is expected by 2030 (-5%), taking into account the measures and targets set in the context of the Common Agricultural Policy Strategic Plan (PEPAC) for the period 2023-2027. Although still not significant, this reduction is expected to double by 2040 (-10%), based on the productive developments in the sector and assuming a continuation of the PEPAC measures along with the consolidation of their scope.

Based on the modelling exercise carried out in the Waste and Waste Water sector (5), and despite the specific characteristics of this sector, the reduction potential is relatively important and mainly based on the evolution of the waste sector in relation to that of waste water. The projection for the sector as a whole in the WEM scenario shows an expected reduction in GHG emissions of around 27% between 2005 and 2030, which is increasing towards 2040 (48%).

In terms of F-Gases (2F), whose importance in terms of emissions has increased in recent years, emissions are expected to increase by 94 % by 2030 compared to 2005 levels, reducing to 12% by 2040, taking into account compliance with Regulation (EU) No 517/2014 on fluorinated gases and Directive 2006/40/EU relating to emissions from air conditioning systems in motor vehicles. Despite the generally positive results on GHG emission reduction potential, there is a need to consider a set of additional policy measures in order to pursue a more ambitious GHG emission reduction trajectory aligned with the short and long-term goals.

With Additional Measures scenario (WAM)

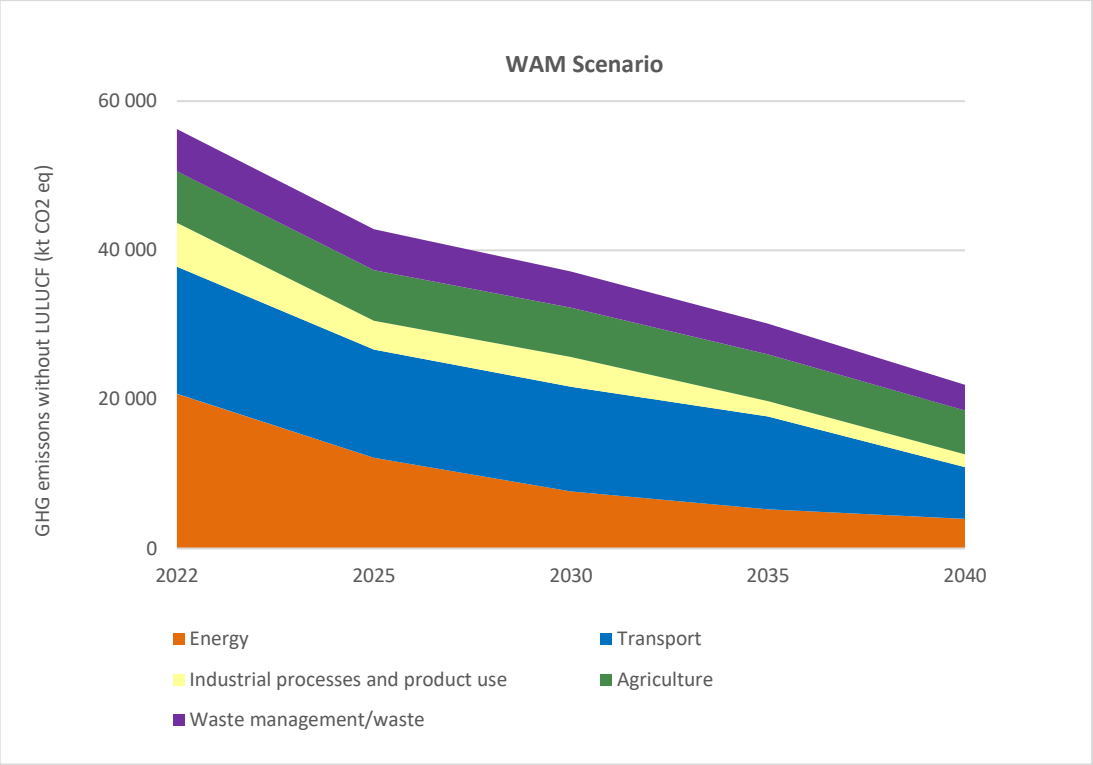

Figure 3.25 - Sectorial projections with additional measures scenario (kt CO2eq).

As regards the additional measures policy scenario and as mentioned above, all policies and measures adopted or planned after 30 June 2022 for the energy sector and the forestry sector were considered. In the Waste and Waste Water and Agriculture sectors, all policies and measures adopted or planned by the end of 2023 were considered in this scenario. It should also be noted that the scenario of additional policies also took into account the frontloading of the 2045 climate neutrality target.

It should be noted, however, that this scenario of additional policies is associated with a very significant increase in energy demand resulting from a number of green and other industrial projects planned to be implemented in Portugal this decade. Thus, the results in terms of reducing GHG emissions from the energy system reflect the achievement of these projects. It should be noted, however, that these projects are based on the use of renewable energy and offer significant gains in terms of diversification of energy carriers towards the *phase* out of fossil fuel use.

In this scenario, GHG emission reduction potential of around 57% compared to 2005 is envisaged, amounting to around 75% in 2040 (no LULUCF), in line with the goals set by the national Climate Law, implying a virtually full decarbonisation of electricity generation, and a strong reduction in emissions from mobility and transport, buildings and services by the end of the next decade.

As mentioned, in the case of the electricity generation sector, its transformation by 2040 is very similar between the two scenarios, as despite higher renewable installed capacity, electricity demand is also higher in the WAM scenario, which constrains the most significant benefits of such penetration.

For the manufacturing and construction industry (1A2), an emission reduction around 75% and 86% for 2030 and 2040, respectively, are expected, given the expected improvements in process efficiency and the use of less polluting fuels, with the incorporation of more CDR and biomass, electrification and renewable gases, including green hydrogen and synthetic and/or bio-sourced methane. In this scenario, there is likely to be competition for electricity in this sector, since there are also others with great needs, such as transport or the new green steel production projects and data centers.

In the case of transport (1A3), in this scenario, GHG emissions reductions of 30% and 65% for 2030 and 2040, respectively, are projected to be significant and realistic given the current state of play. Against this background, the transport and mobility sector requires a more significant change in passenger and freight mobility patterns, notably through reduced travel needs in private vehicles (due to increased support conditions, e.g. teleworking), and increased transfer/use of collective transport and soft mobility. A more optimistic introduction of both passenger and freight electric vehicles is also considered. In the case of shipping and aviation, significant introduction of low-carbon forms of energy is expected in line with compliance with European legislation such as ReFuelEU Aviation and ReFuelEU Maritime. Against this background, it appears that the sector is accelerating towards decarbonisation in the decade 2030-2040. The essence of reducing energy consumption, electrification and wider uptake of technologies such as hydrogen in goods comes from 2035 onwards, reflecting a very rapid and more disruptive decarbonisation in the long term. It should also be noted that the rail component is essential in optimizing decarbonisation in the WAM scenario.

As regards the services sector (1A4a), there is almost total electrification of energy consumption in this scenario, supported by major energy efficiency gains through enhanced insulation of buildings, solar thermal (mostly for water heating) and heat pumps for space conditioning. The consumption of LPG and other petroleum products reduces their contribution to consumption in this sector as early as 2030 and only the contribution of natural gas consumption in combination with renewable gases is maintained. However, in view of the need to decarbonise the sector as a contribution to the 2045 climate neutrality objectives, the consumption of natural gas blends with renewable gases is not a cost-effective solution in 2040.

In the case of the residential sector (1A4b), the reduction in consumption of natural gas and other petroleum products is more pronounced as early as 2030 compared to the WEM scenario, in contrast to a more significant introduction of heat pumps, a difference which is mitigated in 2040 by higher electricity demand in other sectors.

As regards the industrial process and product use sector (IPPU, category 2), in both scenarios there is a significant reduction in process emissions, in particular in the cement and pulp industry,

where there are already operational industrial pilots, but this reduction is expected to be more significant between 2030 and 2040 in the WAM scenario due to the prospect of incorporating alternative fuels into cement production processes.

Also following recent developments at European level and the contribution that technology sequestration technologies could make in a climate neutral context, with particular emphasis on the Hard-to-slaughter *sectors*, and also taking into account the CO_2 demand for the production of renewable fuels of non-biological origin (RFNBO, which include synthetic fuels – efuels *and* hydrogen), Carbon Capture and Use (CCU) technologies are expected to be cost-effective as of 2030 and grow significantly by 2040. Contrary to the WEM scenario, this contribution is envisaged in the already significant WAM scenario in 2035, with an impact on emissions from the manufacturing and construction industry sector (1A2) and Industrial processes and product uses (2), relating to combustion and process emissions from industry respectively. Carbon capture is more representative in the cement industry in the short term, progressively covering also glass, chemistry and pulp and paper sectors (e.g. Bioenergy with Carbon Capture and Storage – BECC). The captured CO2 is transported by pipeline and is destined for cost-efficient use as feedstock in the production of synthetic fuels, namely *jet fuels*. It is important to note that the model used does not have spatial detail to measure capture and sequestration sites and/or to detail competitiveness between forms of CO2 transport. As explained in the WEM scenario, it should be noted the estimates provided and respective emission reductions (as compared to the NECP 2030) does not take into account the contribution from technological carbon sequestration (Carbon Capture and Utilization and Storage - CCUS). This technology is expected to have more significant effect in the medium to long term and much deeper into the WAM scenario, which is expected to reach -3 853 kton CO_2e in 2040. Thus, for an overall reading of the evolution of these two sectors, the net emissions values should be taken into account. However, and for a more transparent reason, following also the exercise from the NECP 2030, these numbers were not included in the final estimates neither for the subsectors or the total GHG emissions.

In terms of F-Gases (2F), this scenario projects the impact of the new F-gas Regulation (EU) 2024/573, with, for example, a more significant reduction in emissions from commercial and industrial refrigeration in 2030. Overall, and given the large projected reduction of around -89% for 2030, only a slight development is expected in the next decade, reaching -92% in 2040.

For the Waste sector (5), the consideration of additional measures compared to the existing measures scenario does not materialize in a particularly relevant emission reduction. The specific characteristics of the sector and the borderline circumstances of the situation in Portugal do not allow for a high reduction potential, which amounts to 28% and 50% respectively for the years 2030 and 2040.

For the agriculture sector (including the energy component 1A4c), the revised figures for 2030 are the same as in the WEM scenario, taking into account the view that the assumptions considered in that scenario do not change, in this case the maintenance of the Common Agricultural Policy Strategic Plan (PEPAC) measures that started in 2023 and end only in 2027. Nevertheless, the contribution of this sector is expected to grow slightly from a medium-term

perspective, reaching emission reduction values in 2040 of -17%, assuming a reinforcement of the targets foreseen for each PEPAC measure, based for example on candidate areas in 2023.

As regards projections on biomass supply for the energy sector, both scenarios demonstrate the need to import biomass at around 11% to 13% respectively in 2030. In 2040, external supply needs reduce in the WEM scenario to 6.2 % and in the WAM scenario to 7.5 %. For other forms of bioenergy, the WAM scenario presents a need for imports of used cooking oil at around 70%, after using the full national potential of this raw material. For biomethane, the results are similar, with the progressive use of the national potential of this resource, but with the need for import levels of around 20% in the decade 2030-2040. It should be noted that in both scenarios the preference for the consumption of endogenous biomass and with prioritization for the use of national biomass potential for residues from forest and/or agricultural processes, and always in line with the cascading principles and sustainability criteria of RED III, is highlighted.

3.5.3 Methodology

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 optimization 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, fertilizer 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.

Estimated GHG emissions for each sector were subsequently aggregated to calculate national total emissions.

In all sectors, GHG emissions estimation follows methodologies from the *National Inventory Report* (NIR). A specific methodology for projecting the respective activity variables has been

adopted for each of the sectors of activity, but is based on the same socio-economic reference framework to ensure the consistency of the projections obtained and to infer the critical factors determining the differences between scenarios. It should also be noted that in the energy sector, for the purposes of the projections presented in the existing policy scenario, the policy instruments and measures adopted and published by 30 June 2022 have been taken into account. In the case of Waste and Waste Water, Agriculture and Forestry, Existing Measures were considered as existing measures until the end of 2023.

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 23, as well as its main inputs and outputs.

The implementation of TIMES_PT requires a set of exogenous inputs, namely:

- Demand for energy services;
- 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);
- Availability of primary energy sources in the present and in the future, especially the potential for the use of endogenous energy resources;
- 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:

- Inherent costs to the energy system;
- Energy flows inherent to each sector;
- Technological options, including the installed capacity in the electricity production sector;
- Energy imports and exports;
- Use of indigenous resources;
- 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.

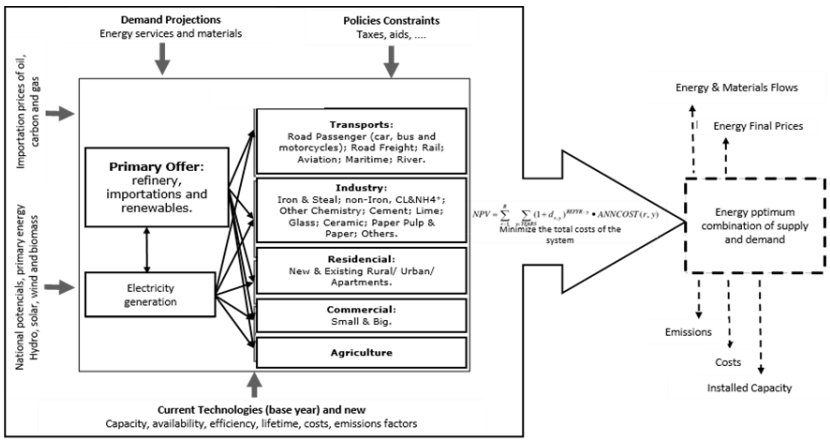

Figure 3.26 - TIMES_PT model simplified structure.

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.

Agriculture, forests and other land uses, Waste and wastewater and Fluorinated gases

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), which were also used as the basis for developing the first version of the PNEC 2030 and the RNC 2050. Therefore, 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.

3.6 Summary of greenhouse gas emissions and removals

Portugal submitted its latest greenhouse gas inventory to the UNFCCC on 13th December, covering the period from 1990 to 2022, through the National Inventory Document (NID) together with Common Reporting Tables (CRF).

The section 2.3 presents a summary of GHG emissions and revals, incluiding data for 1900-2022 period in a tabular format. More details are presented in the NID which is submitted as a stand-alone document.

4 INFORMATION RELATED TO CLIMATE CHANGE IMPACTS AND ADAPTATION UNDER ART.7 OF THE PARIS AGREEMENT

4.1 National circumstances, institutional arrangements and legal frameworks

4.1.1 National circumstances relevant to adaptation actions

Biogeophysical characteristics

Portugal's territory includes both the European mainland and two archipelagos in the Atlantic - the Azores and Madeira -, totaling 92,225.20 km2 of area and 2,612 km of coastal extension.

The climate in mainland Portugal is predominantly influenced by latitude, topography and its proximity to the Atlantic Ocean and Mediterranean Sea.

According to Koppen's classification, Portuguese mainland climate is divided into two regions: one with a temperate climate with rainy winters and hot, dry summers (Csa - Hot-summer Mediterranean climate) and another with a temperate climate with rainy winters and warm, dry summers (Csb - Warm-summer Mediterranean climate). Although the inland regions are less than 220 km from the coast, some are influenced by the Iberian Peninsula's continental mass, which gives them less rainfall and a greater annual temperature range than the coastline.

The Mediterranean influence is felt mainly in the summer and south and east of the territory, causing high temperatures and low rainfall. The Atlantic influence is felt primarily in winter and in the northwest of the country. It is responsible for high precipitation and the attenuation of the effects of dry and cold winds from the Peninsula's interior.

During winter, the northern region is under the influence of subpolar depressions, which circulate to the NE, in a trajectory that follows the axis of the European continent, with frequent weather changes originated by the passage of these depressions. However, their action weakens towards inland, dominated by higher pressures in winter, decreasing, in this sense, precipitation and average temperatures, the number of rainy days, and relative humidity.

There are climatic contrasts that result directly from some relief elements, which accentuates the climatic effects caused by the continental character of the Peninsula. Thus, the higher altitude zones also correspond to higher precipitation values, which, on the other hand, decrease as one moves towards inland. In terms of orography, significant areas in the Norte and Centro that exceed 1000 metres of altitude stand out. South of the Tagus River, the scarcity of essential reliefs allows large air masses to reach the Iberian Peninsula's inland without significant loss of humidity. But even in this region, the areas of most considerable precipitation are determined by the influence of small reliefs.

In 2023 the average annual air temperature of the mainland territory was 16.59ºC, and the average monthly values vary regularly throughout the year, with a maximum in August and a minimum in January. However, there are some regional variations in its distribution. The average annual temperature evolves inversely to precipitation, increasing from North to South and West to East. The highest temperature in mainland Portugal was registered in Amareleja (47.3 ºC on 1/8/2003), and the lowest temperature was recorded in Penhas da Saúde (-16.0 ºC on 5/2/1954 and 12/2/1956).

The general climate conditions in the Azores Archipelago are determined by its geographical situation in the context of the global atmospheric and oceanic circulation and by the effect of the enormous mass of water that surrounds it. Overall, the Azores' climate is temperate maritime, reflected by the low-temperature range, high rainfall, high relative humidity and persistent winds. In 2023 the average annual temperature was 17.2ºC in Ponta Delgada.

The Madeira Archipelago is geographically located in the subtropical region, presenting a mild climate in winter and summer, except in the higher altitude areas, where lower temperatures are observed. In 2023 the average annual temperature was 21.6°C.

In the hydrographic network of Mainland Portugal five international rivers stand out (Minho, Lima, Douro, Tagus and Guadiana) that flow in the largest river basins of the Iberian Peninsula. Its management is coordinated with Spain through an international convention, which conditions the scope of national action in the sustainable management of water resources, considering the existing reservoirs, irrigation and transfer infrastructures in Spanish territory.

More than 50% of the mainland territory is prone to desertification, particularly in inland of the southern regions of Algarve and Alentejo. Expected climate change with higher temperatures, reduced precipitation and higher evapotranspiration, will reinforce susceptibility to desertification, combined with the maintenance of inadequate agricultural practices and cultures, water scarcity associated with dry periods, and land use/cover changes.

Portugal has the third largest Exclusive Economic Zone in EU (1.7 million km2). The coast of Mainland Portugal has an extension of 987 km, is densely populated – 82.5% of the Portuguese population, according to 2021 Census, lives in the coastline – and faces a significant threat from the phenomena of coastal erosion, coastal floods, cliffs instability and landslides.

Demographics

Recent demographic dynamics largely determine the priorities for climate adaptation in the country: concentration of the population along the coast between the largest metropolitan areas, increasing exposure to urban heat islands, flash floods, landslides and coastal risks; depopulation of the inland population and ageing of the age structure, implying a reduction in agroforestry activity and an increase in the risk of forest fires; intense seasonal population movements, which increase vulnerability in the region’s most sensitive to droughts.

Portugal's population reached 10.639,726 million in 2023, with a significant concentration along the coastal metropolitan areas of Lisbon and Porto. Inland regions face depopulation and aging demographics, while coastal regions experience urbanization and seasonal influxes, such as Algarve.

The ageing of mainland Portugal's population has been intensifying, both through the decrease of young people and the increase of the elderly population. The decrease in birth rates and the rise in longevity has led to an inversion of the standard age structure (pyramid structure), with more elderly than young people. In 2023, there were 2,468,825 residents aged 65 or over in mainland Portugal, which corresponds to approximately 24% of the total resident population, while the population under 15 years old represented 13%.

The Azores Archipelago population (241,025 inhabitants in 2023) has decreased in the last decade, in the order of -2%. The population is younger than the national average but is also ageing and has a lower average life expectancy.

With 256,622 inhabitants in 2023, the Madeira Archipelago has high population density (about 320 inhabitants per km²), almost triple of the average of the country and of the EU, especially high on the south of the Madeira Island. In 2023, 42% of the population of Madeira Island lived in the municipality of Funchal (107,562 inhabitants). In the last decade, the population registered a decrease of 2%. Both island regions are experiencing trends of aging populations and migration challenges.

Economy, infrastructures and information on adaptive capacity

The national economic structure has undergone a progressive process of tertiarization, and, in 2021, 72.7% of the population worked in the tertiary sector. The highest tertiarization rates, above 85%, 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 of 25%) in the Norte and Centro regions (33% and 29% respectively). The primary sector (national average is 3%) is still relevant in the Alentejo (9%) and Azores Archipelago (8%) regions.

Regarding land use and land cover, the dominant occupations in mainland Portugal in 2018 are forest and agriculture (39% and 26% of the total area, respectively). The areas of wildwoods, agroforestry systems, and pasture occupy 12%, 8% and 7% of the land, respectively, demonstrating high potential of the land for forestry and agricultural production. Therefore, rural regions are significant (around 92% of the total area), which means that natural capital and landscape exist and must be valorised despite the historical vulnerability to rural fires in mainland Portugal. Urban areas are less significant in terms of the area they occupy but present specific risks and a higher potential for human damage than those of rural areas.

Although Portugal is a country with an average annual rainfall of circa 878 mm (normal between 1971-2000), 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 counteract the progressive depopulation of rural regions of the interior. It is important to adapt irrigation to the best environmental and water management practices, in conjunction with other sectors of activity and safeguarding nature conservation and biodiversity; to increase water efficiency in irrigation networks; to invest in better irrigation methods; and in agricultural crops that consume less water and are better adapted to the soil and climate conditions of the regions, reusing water whenever appropriate, etc.

In Portugal, in 2021, 46% of farms have irrigation systems that accounts for 57% of national Total Standard Production Value. Of the 4.0 million hectares of usable agricultural area, 16% are equipped for irrigation (630,517 ha). However, in periods of continued drought, a significant part of these agricultural explorations lose viability.

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.

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, most 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 91% of Portugal's forest is privately owned, and only 3% belongs to the Portuguese State, while the remaining 6% are managed by local communities, but under a partial forest regime, while the private owned forests average in the EU is only 60%. 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.

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.

For example, with the rise in the average sea level, "sun and beach" tourism will be affected by the eventual disappearance of some beach areas 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.

Regarding the energy sector, risks related to climate change may affect both the supply and the demand side. On the supply side, extreme weather events like windstorms, forest fires, heavy precipitation, floods and extreme drought can directly impact infrastructures related to energy generation, transmission and distribution, but also the supply chain of fuels and other raw materials. On the demand side, atypical increases in energy consumption may occur because of extreme weather events (e.g., increases in electricity and gas demand for heating during cold spells and in electricity demand for cooling during heat waves). As these risks can affect the security of energy supply, they are taken into consideration in the national risk preparedness, preventive action and emergency plans established for the sector and in the system operators' preparedness and contingency plans. Related to the risk of severe drought, which affects hydroelectric production, the Council of Ministers Resolution no. 82/2022 established a strategic water reserve in predetermined hydroelectric plants. A minimum water level was established for each reservoir and the use of water resources in those reservoirs was suspended until those minimum levels are reached. Due to the positive evolution of the water levels in the reservoirs, Order No. 129/2024, of January 9, determined the suspension of this measure, providing that it can be reevaluated quarterly by the competent authority in conjunction with the Global Manager of the National Electricity System.

In what concerns the communications sector (electronic communications and postal sector), there's a higher chance for the unavailability of these services namely due to the breakdown of communications networks / infrastructures (supported by ground infrastructures and, in the case of telecommunications, aerial, such as poles) and power cuts due to forest fires, storms, extreme winds, heat waves, floods or cyclones, among other adverse climate conditions. As an example, forest fires can damage physical infrastructures, heat waves can affect datacentre's performance and storms can threaten the safety of workers. Specifically for the electronic communications sector, there may also be indirect effects resulting, for example, from the impact on the production and distribution chains of equipment and components, as well as on the conditions under which the processes of installing and repairing infrastructure take place (including impacts of climate change on human resources).

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 wave regime and storminess, temperature, and

precipitation. 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).

In particular, the economic and infrastructural situation of the Autonomous Region of Madeira (RAM) plays a crucial role in climate change adaptation actions since the island's resilience depends on both the strength of its economy and the adequacy of its infrastructure. Madeira's economy is heavily dependent on tourism, which accounts for a large share of the region's GDP. This dependence makes the economy vulnerable to climatic impacts that could affect tourism, such as an increase in the frequency of storms, a greater frequency of wind intensity, rising sea levels, which could damage tourist infrastructures, affect air and sea travel and, as a result, cause fewer tourists to come to the region. Agriculture in the RAM, namely banana and wine production, also faces risks due to changes in the rainfall regime and droughts, as well as soil erosion. Madeira, being a mountainous and insular region, faces unique infrastructural challenges. Its road network and access to rural communities are frequently threatened by landslides, floods, and severe storms, all exacerbated by climate change. Investing in resilient infrastructure, such as effective drainage systems, slope reinforcement and coastal protections, is essential to mitigate future damage.

The RAM water network is based on “levadas”, irrigation channels built to capture water from the mountains and distribute it throughout the island. However, changing rainfall patterns are putting this traditional system at risk. Prolonged droughts, interspersed with periods of intense rainfall, can compromise the supply of drinking water and agricultural irrigation, making it necessary to invest in water storage and reducing water losses.

From an energy point of view, Madeira has focused on renewable energies, especially water and wind power. However, climate variability can affect the production of these energies, making it necessary to further diversify the energy matrix and invest in energy storage infrastructures, and due to its energy connectivity. Insularity, coupled with the limited size of the electricity grid, contributes to a technical scenario that differs significantly from that found in mainland Portugal. This geographical isolation makes security of supply a pressing concern, since alternatives and redundancies, which in mainland Portugal can be more easily implemented, are limited in Madeira. The need to guarantee a secure and uninterrupted energy supply is fundamental.

Spatial planning is a vital component of climate adaptation. Uncontrolled urban sprawl or sprawl in areas at risk, such as hillsides or low-lying coastal areas, increases the vulnerability of the

population and infrastructure to climate change. Proper management and planning can minimize these risks, integrating measures such as relocating critical infrastructure to less vulnerable areas and creating environmental protection zones.

Madeira's economic and infrastructural situation poses challenges, but also opportunities for effective climate adaptation. Diversifying the economy, strengthening infrastructure, and properly managing natural resources are key to ensuring the region's resilience in the face of growing climate pressures.

4.1.2 Institutional arrangements and governance

Institutional arrangements and governance regarding climate vulnerability and risk assessment

The first integrated assessment of impacts and adaptation measures in Portugal "SIAM - Climate Change in Portugal – Scenarios, Impacts and Adaptation Measures" was completed in 2002 and revised in 2006.

In 2013, it was published a Progress Report of the NAS which systematised the climate vulnerabilities and adaptation measures for the sectors covered in the NAS. To some extent, climate scenarios have also been integrated in the National Risk Assessment (for Disaster Risk Management) in 2014, 2019 and 2023.

Later, in 2024, the National Roadmap for Adaptation 2100 (RNA 2100), updated the reference climate scenarios for Portugal, as well as the climate risks assessment with a focus on modelling impacts in coastal areas, water resources, agroforestry and in the field of fires. The results, presented for the different regions (NUTS2), generally point to an increase in the frequency and intensity of extreme precipitation and temperature events, such as very hot days and tropical nights, with direct impacts on public health. The RNA2100 also explored the economic component of adaptation and the costs/impacts of inaction, having included the production of a Guide of guidelines and good practices on the integration of adaptation to climate change into territorial planning instruments at municipal level.

Institutional arrangements and governance regarding planning, implementation, monitoring, evaluation and revision of adaptation policy

The Climate Action Commission (CAC), created in 2015, seeks to enhance the involvement and promote the accountability of the various sectors for 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. CAC 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.

At the level of the ENAAC (NAS) governance structure, the aims is promote the involvement of the relevant authorities and articulation with the Autonomous Regions of the Azores and Madeira, increase the interaction between sectoral groups and thematic areas and also between the various administrative levels. The ENAAC (NAS) 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 ENAAC is organized into six thematic areas and nine priority sectors. The coordination of each one is shared between the Portuguese Environment Agency (NAS general coordinator), and the entities with specific thematic competences, acting as facilitators. In addition to the entities that coordinate the sectoral groups of the different priority sectors, other entities or personalities identified as relevant for the implementation of the NAS also participate in the work, contributing to a broader co-responsibility and the co-construction of the priority measures to be developed. The priority sectors correspond to strategic domains for the promotion and implementation of adaptation in Portugal. They are structured in 9 working groups, each one coordinated by the respective central administration organizations with sectoral competences.

The responsibility to implement and monitor P-3AC (NAP) lies on the Portuguese Environment Agency (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 National Climate Law introduces new elements to the governance although maintaining ENAAC (NAS) 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 systematization of the most recent scientific knowledge produced within the scope of the National Roadmap for Adaptation 2100 (RNA 2100), will support the review of the National Strategy for Adaptation to Climate Change (ENAAC) to be completed by the end of 2025.

Institutional arrangements and governance regarding integration of climate change impacts and resilience into environmental assessment procedures

The Environmental Impact Assessment (EIA) procedures consider national and territorial adaptation planning instruments, current and future climatic vulnerabilities through historical data on climate and occurrences of extreme weather events. EIA procedures consist furthermore of

environmental, social and economic impacts and consequences, considering climate changes scenarios; key risks/impacts of climate changes in the project; assessment if pre-existing vulnerabilities to climate changes 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; minimization measures based on NAP 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, to enable monitoring impacts throughout the life cycle of the project (construction, operation and deactivation phases)

The assessment of climate change is also considered at the Strategic Environmental Assessment level.

Thus, an evaluation tool has been developed to measure climate impacts of legislative proposals and sectoral policies that has been incorporated in an existing evaluation system, "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, 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.

With the adoption of the national Climate Law, it is set that the legislative procedures always need to have this climate impact assessment.

Institutional arrangements and governance regarding collection, ownership and re-use of relevant data and access to it

Portugal formally joined the UNDRR DesInventar Project in 2020 and created a taskforce, coordinated by ANEPC, streamlining the interlinkage with 15 different stakeholders, which are owners of data regarding extreme events and its impacts. Since then, efforts have been put in place for the systematic collection and analysis of data related to disaster losses, as well as for the creation of a framework for damage reporting. It is also intended that such database will be replicated at the municipal scale, thus expanding the information available at different territorial levels.

This process also contributes to the report of indicators related to the periodic monitoring of Sendai Framework for Disaster Risk Reduction 2015-2030, namely those related to the number of deaths and injuries attributed to disasters, with the degree of implementation of risk reduction strategies, with international cooperation in risk reduction and with the availability of early warning systems.

Likewise, ANEPC provides a Portal based on a Geographic Information System, which allows the dissemination of information to the general public on the identification and characterization of phenomena of natural, technological or mixed origin, likely to affect the national territory, as a basis for the contents of the National Risk Assessment.

IPMA is one of the main providers of meteorological and climatological data for the National Civil Protection System coordinated by Portuguese National Authority for Emergency and Civil Protection. In this sense, IPMA has developed a set of applications that provide relevant information to support decision-making in situations involving the occurrence of extreme phenomena. The digital platforms incorporate a set of meteorological indicators made available through map services, in the forecast component but also in terms of climatology. The different elements of the National Civil Protection System have differentiated access to the different indicators as well as to the monitoring service provided by IPMA.

Institutional arrangements and governance regarding integration of climate change impacts and adaptation planning into disaster risk management frameworks and vice versa

Based on the lessons taken from the 2017 National Strategy for Disaster Risk Reduction, a second version was adopted in 2021, by Council of Ministers Resolution 112/2021, of August 12th. The National Strategy for Disaster Risk Reduction 2030, valid for the decade 2021-2030, is framed by three relevant global strategies for risk management: the Sendai Framework for Disaster Risk Reduction, the Paris Agreement on adaptation to climate change, and the 2030 Sustainable Development Goals. The 2030 Strategy defines five strategic objectives, aligned with the priorities of the Sendai Framework: Strengthen governance in risk management; Improve knowledge of risks; Establish strategies for risk reduction; Improve preparedness; Engage citizens in risk knowledge.

Under the scope of the National Strategy for Disaster Risk Reduction 2030, the access to information on the risks to which citizens are subject is an essential tool to ensure the population's awareness of self-protection, contributing to the adoption of measures to reduce the risk of accidents or catastrophes. In this context, the National Authority for Emergency and Civil Protection published the National Risk Assessment in 2023, which carries out the identification and characterization of hazards of natural, technological or mixed origin, likely to affect the territory at national level, considering for the applicable risks, the impact of climate change and the resulting scenarios, with an indication of trends towards risk aggravation or mitigation.

Institutional arrangements and governance regarding monitoring, evaluation and reporting of adaptation actions and processes

The Monitoring, reporting and evaluation (MRE) at national level is mainly ensured by the biannual Progress Reports of ENAAC 2020 (NAS) and the Monitoring of P-3AC (NAP). The National Climate Law also introduced provisions for monitoring and reporting for the annual provision of information to the Parliament.

The biannual progress reports of the NAS are intended to respond to the provisions of chapter 2.5 of ENAAC 2020 (NAS). The progress for two years is reported for each of the NAS objectives and includes recommendations to address difficulties or gaps and suggest improvements. The report focuses 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, four biennial reports have been produced.

It is the responsibility of the NAS Coordination Group to ensure the elements for adequate reporting on climate change adaptation to comply with national, Community and international obligations.

All adaptation reporting exercises are developed with the contributions of ENAACs Coordination Group, in particular the various thematic areas and working groups. The same framework is used to address the international reporting obligations (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); c) the forthcoming Biennial Transparency Reports (under UNFCCC); d) adaptation biennial reporting to the European Commission (under Art.17 and Art.19 of Regulation (EU) 2018/1999).

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 starting to become operational, so no systemic report has been published yet.

4.1.3 Legal and policy frameworks and regulations

The main strategic documents at national level comprise: (1) the National Climate Change Adaptation Strategy (ENAAC) - National Adaptation Strategies (NAS); (2) the Action Programme for Climate Change Adaptation (P-3AC) - National Adaptation Plans (NAP) and (3) the Portuguese Climate Law, adopted respectively in 2015, 2019 and 2021.

ENAAC (a revised NAS) mainly establishes the governance and responsibilities of the public entities involved to address its three main objectives: 1) Improvement of the level of knowledge about climate change; 2) Implementation of adaptation measures; and 3) Promotion of the mainstreaming of adaptation into sectoral policies. Other specific responsibilities / objectives are defined for its nine sectoral working groups and six thematic areas.

All the elements recently concluded in the National Roadmap for Adaptation 2100 set the background for a new adaptation policy cycle that will mark the revision of ENAAC in 2025.

P-3AC (NAP) complements and systematizes the work carried out in the context of ENAAC's second objective by defining nine adaptation priority lines of action. This instrument supports the planning and mobilization of financing instruments and other policy-setting exercises, guided by a list of concrete actions on the territory and a dedicated line of action for generic cross-cutting actions. P-3AC also establishes an indicator-based monitoring system to track progress.

The National Climate Law defines the objectives and other considerations for climate policies. On adaptation matters, it introduces some new elements to integrate on the adaptation policies and governance including some tasks to accomplish within a 1 year or 2 years' timeframes, amongst others: 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 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.

4.2 Impacts, risks and vulnerabilities

4.2.1 Current and projected climate trends and hazards

The SIAM projects – Scenarios, Impacts and Adaptation Measures I and II, developed in 2002 and 2006, were the first integrated assessments of impacts and adaptation measures to climate change in Portugal. These studies were based on future climate scenarios obtained from models of general circulation of the atmosphere and focused on a set of socioeconomic sectors and biophysical systems, namely: water resources, coastal zones, agriculture, human health, energy, forests and biodiversity and fisheries. They also included a sociological analysis of the problem of climate change in Portugal.

More recently, the National Roadmap for Adaptation XXI, completed in 2024, updated and deepened for the 21st century the first risk and vulnerability assessment of the Portuguese territory carried out within the scope of the SIAM I and II. The project focused on hazards included on four key sectors: Hydrological Balance & Agroforestry; Droughts; Forest Fires; Sea Level Rise and Coastal Erosion.

As a result of NAS's (ENAAC) work, Progress Reports are produced, which compile the impacts and vulnerabilities of the sectors, the barriers to adaptation and the adaptation measures. This document summarizes the findings of the sectoral reports produced, some of which included stakeholder engagement exercises. Considering the results of these studies and those of the National Risk Assessment (ANEPC, 2023 revision), it is clear that Portugal is quite exposed to a vast array of climate-related hazards (table 1), that become more frequent and intense with the aggravation of climate change.

Table 4.1 - Most significant climate-related hazards in Portugal.

Type	Acute	Chronic
Temperature	Heat wave Forest fires	Changing temperature (air, freshwater, marine water) Temperature variability
Wind	Storms Cyclones	-
Water	Drought Heavy precipitation Flood (coastal, fluvial, pluvial, ground water, flash)	Changing precipitation patterns and types (rain, hail, snow/ice) Precipitation and/or hydrological variability

		Saline intrusion Sea levelrise Water scarcity
Solid mass	Landslide	Coastal erosion Soil degradation, including desertification Soil erosion

Regarding the impact on the distribution of ecosystems, a marked change in vegetation structure and composition is expected with consequences for biodiversity. In the northern and central coastal regions, dominated by mixed hardwood forest, a decrease in species more demanding in moisture is expected, with an increased mortality of older and less resistant trees. The regions of Minho, Douro Litoral and the mountain areas may benefit from a possible increase in biological diversity. The eucalyptus forests in the interior may be abandoned and replaced by wildwoods due to their low capacity for natural regeneration. The pine forests may persist or tend to be replaced by wildwoods due to fires recurrence, in which case preservation of biodiversity is expected. Regarding cork oak forests, a drastic reduction in biological diversity results from crescent desertification processes in the regions with higher aridity index (semi-arid and dry sub-humid classes).

A considerable increase in demand for energy for cooling in the summer months is expected, associated with the projected increase in temperatures and the frequency, duration, and severity of heatwaves and tropical nights. Nevertheless, a significant part of the population - the neediest - may have difficulty adapting to these changes, given the characteristics of a great part of the residential buildings and the lack of financial capacity to invest in their thermal comfort and installation and use of climatization systems.

As for agriculture, a reduction in productivity is expected in any of the projected climate scenarios and in all crops, with activities displacement to the north and coastal areas in the case of mainland Portugal.

While electronic communications can give the means to other sectors to better adapt to climate changes, there is also the risk that this sector will have an increased consumption of natural resources and failure to achieve the targets regarding sustainability. This can happen due to the recurrence in the repair of the network affected by these weather conditions or to improve their resilience, demanding an increase in the consumption of resources and a higher need for the recycling of electronic wastes. In both electronic communications and postal sector, there are challenges regarding the energetic transition - in particular for the postal sector, there is the charging infrastructure and the offer for long-distance freight transport routes, in addition to the fact that green options (e.g. e-fuel, EV) are is still costly compared with other non-environmental options, while the general public is not yet sensitive to pay more for a greener service or there are not public funds.

Regarding migratory movements, climate change may contribute to accentuating the process of population loss in the rural areas of the interior and the progressive concentration of the population on the coastline and in the metropolitan areas of Lisbon and Porto. This trend may also

be reinforced by movements originating abroad, with an increase in the influx of immigrant populations from regions more vulnerable to climate change.

The rise in temperature and the prolonged periods of drought are also likely to be responsible for the increase in the number of rural fires, especially the number of large forest fires (>= 10,000 ha), that spread by canopy and become practically uncontrollable under certain atmospheric conditions. The risk associated with these occurrences has increased dramatically, imposing extremely high social and economic costs on the country. 2017 was a landmark year, recording the largest burnt area since 1995 and becoming the most tragic year ever, with more than 100 human lives lost.

Climate change in Madeira Autonomous Region (RAM) has intensified in recent decades, resulting in significant changes in the region's weather conditions. Among the main climate risks is the increase in average temperature, which has led to a greater frequency of heatwaves.

Changes in rainfall patterns, characterized by greater irregularity between periods of torrential rain and prolonged drought, bring an increased risk of landslides, flash floods and increase the risk of forest fires.

Another significant climate risk is the increasing frequency of extreme weather events, such as storms and strong winds, exacerbated by the rising average sea level.

In recent years, the increase in tourism in Madeira, combined with climate change, such as the rise in average temperature and more frequent droughts, has brought increased challenges for the region's water and energy resource management. During periods of extreme heat, the demand for water and energy increases substantially, driven by the greater consumption of water to meet the needs of the population and the intensive use of cooling systems.

To mitigate the impacts of climate change and safeguard Madeira’s populations and ecosystems, a comprehensive and sustainable approach to managing the territory and its resources is essential. This strategy should prioritize adapting to evolving climate conditions, conserving natural resources, and implementing policies that enhance the resilience of the region and its communities against increasing environmental threats.

4.2.2 Key future climate hazards

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 significant losses related to annual costs associated with forest fires and drought (mainly in terms of agricultural production losses). Climate change tends to increase or accelerate other risks, where natural and anthropogenic factors combine, for example, in terms of coastal erosion or 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 affect aquifers' recharging, enhancing the degradation of the quality of surface and groundwater 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 of mainland Portugal, namely low-lying sandy coast (42 % of a total length of 987 km) is highly vulnerable to coastal erosion and coastal overtopping with very significant and severe effects, and this trend may be aggravated due to climate change effects, namely, sea level rise and modification of wave regime and magnitude of storminess, as well as the current situation of sediment deficit, which is not expected to improve in the future.

The effects of coastal erosion and overtopping are further enhanced 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, sea level is expected to be 0.5 meters higher than the present by the end of the 21st century, 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.

4.2.3 Sectoral impacts of climate change

Portugal faces several climate risks associated with climate change, including an increase in the frequency and intensity of extreme events such as heat waves, droughts, floods and storms. Rising sea levels is a significant threat to coastal areas, intensifying erosion and increasing the risk of flooding in urban areas. These phenomena impact key sectors such as agriculture, forests, water resources and coastal areas, requiring robust adaptation measures.

Considering the main key sectors assessed on the National Roadmap for Adaptation XXI, here are the main findings about the impact modelling exercises:

Hydrological Balance & Agroforestry

The impact of climate change on water resources in the Mediterranean region has emerged as a growing concern for policymakers and water resource managers. According to the latest report from the Intergovernmental Panel on Climate Change (IPCC), there is high confidence in the projection of rising temperatures across Europe and a decline in precipitation in the southern part of the continent. These changes are anticipated to result in reduced availability of river water and groundwater resources, along with an escalation of extreme events such as hydrological and agricultural droughts, as well as floods when excessive and unpredictable rainfall events occur.

This research involves the hydrological and crop modelling of main crops cultivated in mainland Portugal. The aim is to assess the effects of climate change on water availability, crop productivity, and irrigation requirements. The methodology employed to evaluate water resources in climate change scenarios for mainland Portugal is based on the updated version of the SWAT+ model.

The results related to the hydrological impacts include projections of water yield for each distinct river basin district. These encompass data on inflow and volume stored in multiple selected reservoirs (with a volume greater than 10000 m3) with particular emphasis on reservoirs allocated to irrigation purposes whenever feasible. The projections indicate a maintenance of water yield under the RCP2.6 scenario and a decrease considering the remaining climate scenarios, with a more significant decline towards the end of the century for the RCP8.5.

Regarding the reservoirs, there is also a projected decrease in the inflow during the summer months, with a potential increase in some winter months due to more concentrated precipitation events. Nevertheless, the stored volume in the reservoirs is expected to have a decreasing trend throughout the century, mainly in reservoirs used for irrigation. This trend is prominent for the RCP4.5 scenario and even more pronounced considering the RCP8.5 scenario. This situation is a result of both the decrease in total inflow and the increase in irrigation needs, which will be particularly high for the main perennial crops, under the scenarios with the most significant climate impact (i.e., RCP4.5 and RCP8.5).

Concerning the agroforestry component, projected anomalies in the productivity are estimated for some rainfed crops, namely almond, grape, and olive grove, as well as the irrigation needs for apple, vineyard, and olive grove. There is evidence of a slight decline in productivity for rainfed almond and olive grove crops, whereas the losses are more substantial for vineyards, particularly in the southern regions.

Finally, the analysis of the WEI+ suggests the increase of water stress conditions across almost all river basin districts by the end of the century. Only the country's Northern regions will likely remain with low or no water stress conditions. This reflects a combination of a drier climate, reduced flows, and increased abstractions for irrigated agriculture. Overall, these findings underscore the imperative need to implement adaptation measures to guarantee sustainable water availability and address the challenges posed by climate change.

Droughts

Amongst all natural hazards, droughts are one of the costliest, with cross-sectorial concurrent negative impacts, encompassing health, agriculture, vegetation activity/productivity, water resources, forest fires and energy production. Droughts manifest globally with either a rapid onset or a slow development, spreading across large areas, and with impacts that can linger long after the end of the event. As a result of warming and precipitation deficits and the increasing shortage of water resources, droughts have become one of the main drivers of desertification, land degradation and food insecurity, with direct impacts on ecosystems and society, especially in fragile communities. Iberia has been identified for decades as a climate change hotspot, especially due to its vulnerability to temperature extremes, precipitation reductions, and consequent associated droughts. Over Iberia, the occurrence of droughts varies in intensity and severity, making its assessment under present and future conditions an important tool for adaptation measures.

We present a comprehensive analysis of the different plausible evolutions of droughts throughout the 21st century over Iberia on a monthly basis, featuring three different emission scenarios (RCP2.6, RCP4.5, RCP8.5). A multi-variable, multi-model EURO-CORDEX weighted ensemble (explain in detail in WP2 Report) is used to assess future drought conditions using the SPI (Standardized Precipitation Index) and SPEI (Standardized Precipitation Evapotranspiration Index) at 1-, 3-, 6-, 12- and 24-month timescales. All indices were computed using, the 1971 to 2100 period as reference, i.e., the historical period from 1971 to 2000 was merged with the 2011 to 2100 from each RCP scenario.

The results clearly show that Iberia is highly vulnerable to climate change, indicating a significant increase in the intensity and severity of drought occurrences, even for the low-end RCP2.6 scenario. For the RCP4.5 and RCP8.5 scenarios, the increases are more pronounced and enhanced throughout the 21st century, from 3 up to 12 more severe droughts for the shorter timescales with increases in mean duration above 30 months for the longer accumulation periods. The use of all the RCPs data pooled together with a multi-variable weighted ensemble approach allows not only a more accurate and robust projection of future droughts but also ensures comparability among the projections from the three RCP scenarios.

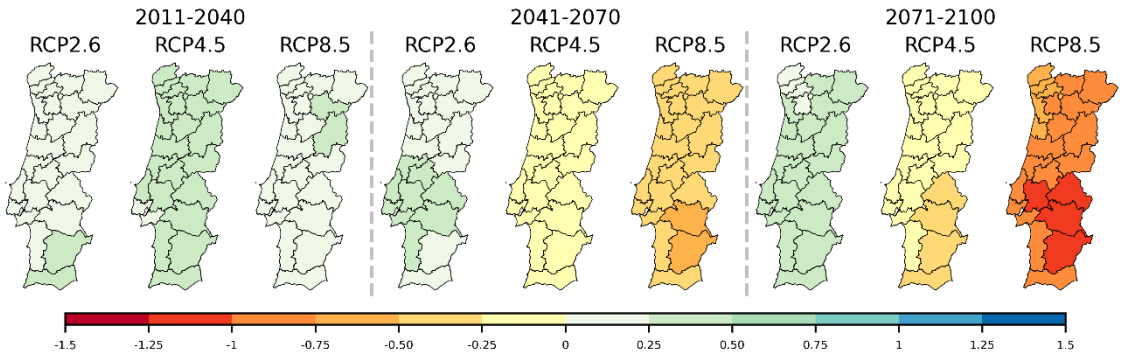

Figure 4.1 - Annual average of SPEI-12 over mainland Portugal for the future periods considering different GHG emission scenarios.

Forest Fires

This report delves into a comprehensive examination of the likely future meteorological fire danger in Portugal, with a primary focus on the potential impacts of climate change. As part of the overarching National Roadmap for Adaptation XXI, the study employs a sophisticated approach, leveraging a multi-model ensemble comprising 13 Regional Climate Models (RCMs). The assessment centres on two key indices, the widely used Fire Weather Index (FWI) and an enhanced version denoted as FWIe, with the implementation of information about atmospheric instability using the Haines index. This investigation serves as a critical component in the development of adaptation strategies for Portugal, contributing valuable insights to the ongoing discourse on climate change mitigation and resilience.

Key Findings and Insights:

- Geospatial Danger: Through meticulous analysis, the study pinpoints the north-eastern region of Portugal, as exhibiting the most significant increases in meteorological fire danger. This geographical specificity enables a nuanced understanding of the localised impact of climate change on fire danger.
- Scenario-dependent Dynamics: A noteworthy aspect of the research lies in its revelation of substantial disparities in meteorological fire danger projections among various emission scenarios. The study systematically contrasts the outcomes under different Representative Concentration Pathways (RCPs), emphasising the nuanced implications of strong mitigation efforts (RCP2.6) versus scenarios with limited or no mitigation (RCP4.5 and RCP8.5). This scenario-specific analysis underscores the importance of tailoring adaptation strategies to the projected climate trajectories.
- Temporal Shifts in Danger Periods: Beyond spatial considerations, the research illuminates temporal shifts in the meteorological danger periods. Projections suggest a noteworthy increase in extreme fire danger days during the summer season. Particularly noteworthy is the extension of the danger period into June and, to a lesser extent, September. This

temporal dimension adds a layer of complexity to adaptation planning, urging a more nuanced and dynamic approach to danger assessment.

- Probability of Having Megafires: This study points to a larger probability of having megafires in the future, with fires with intensities larger than 1000 MW doubling or even occurring 3 to 3.5 more times than those of the historical period.
- Return Periods of Large Burned Areas: The study further investigates the projected return periods of large burned areas in Portugal and NUTS II regions, considering various emission scenarios and future periods. Results, focusing on thresholds of 100,000 ha, 150,000 ha, and 200,000 ha, show a significant decrease in return periods for larger burnt areas, especially for RCP 8.5. For Portugal, return periods of 200,000 ha burnt areas decreased from 6-7 years to 1-2 years for RCP 8.5, a threshold particularly relevant as only three years since 1995 surpassed this value. NUTS II Norte and Centro exhibit similar patterns, with a steep increase in the probability of occurrence for large burnt areas. Return periods decrease, indicating a higher frequency of occurrences in RCP 2.6 and RCP 4.5.

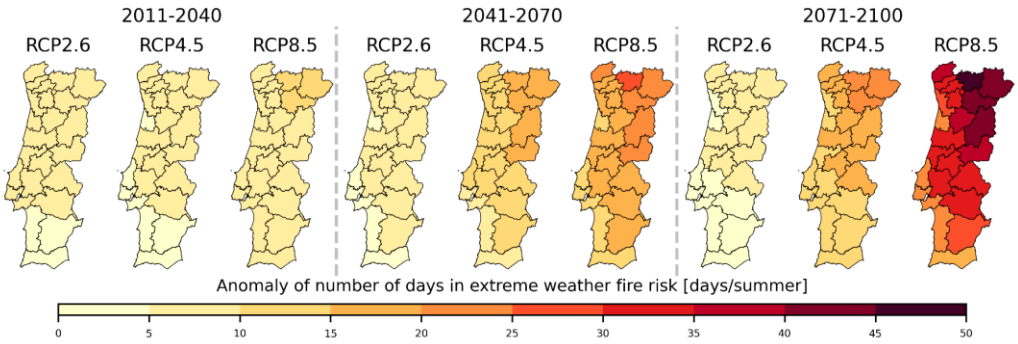

Figure 4.2 - Extended summer average anomaly of number of days with extreme weather fire risk over mainland Portugal for the future periods considering different GHG emission scenarios.

Practical Implications and Recommendations:

- Strategic Adaptation Planning: The study's findings hold profound implications for the formulation of strategic adaptation plans. The identification of regions with heightened danger serves as a crucial guide for directing resources and efforts toward areas where the impact of increased fire danger is anticipated to be most pronounced.
- Scenario-specific Adaptation: The scenario-specific nature of the findings underscores the importance of tailoring adaptation measures to the prevailing emission scenarios. While the heavily mitigated RCP2.6 exhibits relatively modest increases in fire danger, scenarios with less mitigation (RCP4.5 and RCP8.5) demand more robust and targeted adaptation efforts.
- Sensitivity Analysis for Precision: A recommended next step in the research agenda involves a sensitivity analysis, specifically focusing on forest management and understanding the danger of these ecosystems to wildfires. This granular approach aims to enhance the precision of adaptation strategies by accounting for ecosystem-specific dynamics.

- Vegetation Interaction Studies: Acknowledging the pivotal role of vegetation in influencing fire dynamics, future research endeavours should delve into the interaction between meteorological indices (e.g., FWI and FWIe) and vegetation patterns. The incorporation of insights from the latest CMIP6 projections, which include dynamic vegetation components, promises to enrich our understanding of this complex interplay.
- Baseline for Storylines: Integrated into the broader RNA2100 project, this study not only contributes to the scientific discourse but also serves as a practical baseline for the timely preparation of adaptation measures. Its utility extends beyond academia, providing valuable storylines that can be articulated and integrated into the decision-making processes of stakeholders and policymakers.

In conclusion, this research contributes significantly to understanding the intricate dynamics of meteorological fire danger in Portugal. Its multifaceted approach equips stakeholders with actionable insights for effective climate change adaptation and resilience planning, considering both spatial and temporal dimensions, as well as the projected return periods of large burned areas.

Sea Level Rise & Coastal Erosion and Storm Surges

Some of the most disruptive effects of climate change are projected to be felt along the coastlines. From flooding to extreme coastal erosion, future changes in coastal dynamics are particularly feared, especially if combined with sea level rise, tides, storm surges and changes in wave climate. Coastal areas are amongst the most vulnerable regions to climate change, comprising important populational centers and economically relevant hubs. The portion of total population living in coastal areas has rapidly increased in the last decades, being estimated that at least 10% of the current world's population lives near the coast, less than 10 m above sea-level. In Portugal, data from the CENSOS2011 shows that 14% of the national population lives within 2 km of the sea, with the most recent update (CENSOS2021) pointing to increases in the Lisbon and Algarve regions, of 1.7% and 3.7%, respectively, in comparison with 2011.

Rising sea levels, together with the effects of tides, storm surges and extreme waves are considered key drivers of coastal hazards, threatening coastal infrastructures, ecosystems, and communities. The increase in human pressure along the Portuguese coastlines calls for a reliable, long-term coastal vulnerability assessment, paramount for effective coastal management, sustainable development, adaptation, and impact mitigation strategies.

In the context of an increasing need for accurate physical and socioeconomic coastal vulnerability assessments, and incorporated in the National Roadmap for Adaptation XXI, were presented a thorough and comprehensive assessment of future projected hydro-morpho-dynamical changes along the Portuguese coastlines. Future shoreline evolution and extreme coastal flooding projections are obtained, through high-resolution hydro- and morpho-dynamic modelling, for five coastal key-locations, selected due to their higher currently perceived vulnerability to climate change (based on historical records). Ensemble-based projections forced by Coupled Model Intercomparison Project phase 5 (CMIP5) Global Climate Models (GCMs), are used to drive an

innovative methodology, focused on dealing with the multivariate challenges of an accurate coastal vulnerability assessment for Portugal, aiming to accurately assess the extension of future projected extreme coastal flooding. Two Representative Concentration Pathway scenarios are considered, namely the RCP4.5 and the RCP8.5. These baseline results are used to train a parametric approach designed for the complete, national-scale coastal vulnerability assessment, supported by a composed coastal vulnerability index.

At a local scale, National Roadmap for Adaptation XXI results indicate that future nearshore wave action, projected to become more northerly and less energetic, is expected to lead to northward beach rotations especially along the northern and central Portuguese coastal stretches. Nevertheless, the impact of SLR is shown to lead to consistent shoreline retreats throughout all analyzed key-locations. Such results are in agreement with several studies indicating that while wave action is projected to dominate morphological response until the mid-21st century, SLR should become the main driver of shoreline evolution beyond that timeframe. Final projected shoreline retreats are shown to locally reach 100 m (120 m) by 2100 under RCP4.5 (RCP8.5) at Ofir, 200 m (210 m) at Costa Nova, 140 m (150 m) at Cova Gala, 290 m (300 m) along Costa da Caparica, and 65 m (80 m) in Praia de Faro. The projected lost areas between the reference (2018) and future mean shorelines range between 0.088 km2 and 0.184 km2 (0.118 km2 and 0.197 km2) by 2100, under RCP4.5 (RCP8.5), the smallest (greatest) losses expected to take place at Faro and Cova Gala (Costa Nova). Throughout all key-locations (approximately 14 km of coastline), the cumulative amount of projected lost area from 2018 to 2100 ascends to 0.786 km2 (2100 under RCP8.5), relevant when compared to the historical nationwide area lost to the sea between 1958 and 2021, which amounted to 13.5 km2 for over 980 km of coastline.

The synchronized action of extreme total water levels, resulting essentially from SLR, but also from the joint occurrence of high spring tides or storm surge conditions, in the context of weaker natural protection structures due to erosion, is shown to lead to unprecedented coastal flooding in the future. Throughout the five key-locations, the future projected threatened area, expected to become flooded under extreme conditions, is projected to ascend to 0.657 km2 (0.738 km2) by 2070 under RCP4.5 (RCP8.5), and 0.841 km2 (1.47 km2) by 2100 under RCP4.5 (RCP8.5).

Based on the dynamical modelling at the five key-locations, a parametric approach is calibrated to characterize coastal retreat, flooding and the overall vulnerability along the entire Portuguese coastline. The coastal vulnerability index, divided into three levels (low, moderate and high), is inversely related to the projected flooding extent, so that areas under high CVI are the ones showing increased vulnerability to less extreme (more frequent) events, and vice-versa.

Finally, the ocean-facing areas under CVI along Mainland Portugal are projected to ascend to 41.7 km2 (2070 under RCP4.5), 49.7 km2 (2070 under RCP8.5), 54.7 km2 (2100 under RCP4.5) and 55.9 km2 (2100 under RCP8.5). These areas, related to episodically flooded territory, are projected to amount to 3.09, 3.68, 4.05 and 4.14 times the area observed to have been lost between 1958 and 2021 (13.5 km2). However, when considering inland waters, an additional value between 514 km2 and 548 km2 (2070 under RCP4.5 and 2100 under RCP8.5, respectively)

must be considered. Therefore, for all types of coastlines along Mainland Portugal, the future area under CVI is projected to ascend to 604 km2 by 2100, under the RCP8.5 scenario.

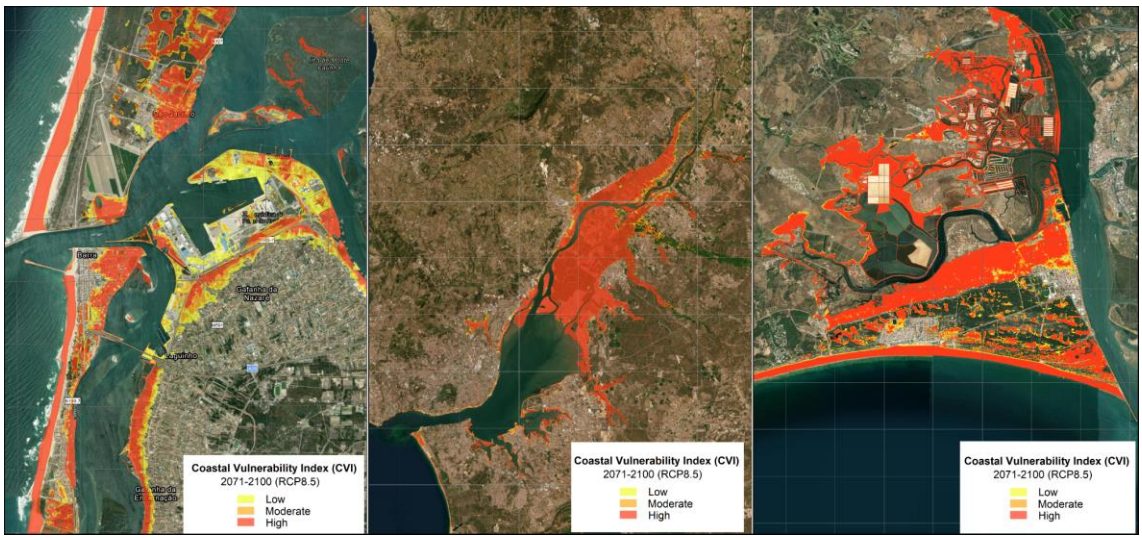

Figure 4.3 - Projected areas under CVI for Aveiro, Lisbon and Vila Real de Santo António regions, by the end of the 2071-2100 future period (2100), under the RCP8.5 scenario.

The combination of coastal retreat with high-frequency flooding could result in loss of coastal ecosystems and fertile soil for agriculture given the potential landward intrusion of saltwater, besides the imminent risks for human life. The results call for the implementation of adequate coastal management and adaptation plans, strategically defined to withstand changes until 2100 and beyond.

4.2.4 Approaches, methodologies and tools

The Portuguese Environment Agency (https://apambiente.pt/) keeps records of historical flood marks and manages a network of meteorological and hydrological monitoring stations (SNIRH - National Information System on Water Resources - https://snirh.apambiente.pt/).

The Portuguese Institute for Sea and Atmosphere (IPMA) (https://www.ipma.pt) is responsible for making observations for meteorological and climatological purposes. IPMA is responsible for deploying, operating, and maintaining the national network of meteorological stations; it is also responsible for archiving and quality control of meteorological observations.

Within the scope of the active provision of climate services on a global scale, IPMA integrates into its mission the collection and exchange of climate data and the research and creation of climate information products for distribution to more differentiated users. Under the guidance of the Global Framework, the IPMA has already established protocols and the exchange of data between meteorological services and other organisations and the development of products and provision of services, driven by the desire to improve the accessibility to and the benefits of users of climate information. With this purpose – and following a policy of gradual opening of meteorological data

to civil society – IPMA is currently creating products and services tailored to users' needs, which will be integrated into its website. Some of the services already provided include the drought monitoring, GHG monitoring in the atmosphere, recording the number of heat waves and the forecast of the fire risk index.

Additionally, there is the New Climate Portal (http://rna2100.portaldoclima.pt/) that provides the climate projections for Portugal with more than 40 climate variables, aggregated into the following groups: temperature, precipitation, wind speed, global radiation, drought index, aridity index and evapotranspiration. This platform is based on CORDEX climate change projections, with multiple information regarding normal climate and scenarios (RCP2.6, RCP4.5 and RCP8.5), time period, geographical areas (NUTS1, 2 and 3), statistics (30 year average or anomalies), global models and regional models, constituting a platform of easy access for the public on historical series, climate change at regional level and climate indicators for specific sectors in Portugal. The indicators of the platform were based on data available in CIMP5 of EUROCORDEX and in CMIP6 and ERA5-based projections for Azores and Madeira islands.

The New Climate Portal was developed within the context of the National Roadmap for Adaptation 2100 project - assessment of the Portuguese territory's vulnerability to climate change in the 21st century, supported by the EEA grants.

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). 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.

Regional climate models (RCM), forced by global climate models (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 greenhouse gas 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, RCM, 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 CODEX simulations performed for the European domain (EURO-CORDEX), it was identified the simulations' characteristics, namely spatial and temporal resolution. A set of regional simulations from the CORDEX project, performed for the European domain (EURO-CORDEX), 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. 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, 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, the empirical data was used 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).

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.

Future climate projections are subject to uncertainties, being its assessment more challenging for climate extremes and especially at regional scales, due to the influence of increased natural climate variability. Improvements on global and regional ESMs have been continuous in the last decades, and the recent phase 6 of the CMIP is expected to promote a further step ahead on the understanding of climate and future associated changes, with emphasis on the regional and local scales.

Climate regionalization in the Autonomous Region of Madeira (RAM) was based on the regionalization of climate models and the production of short-, medium- and long-term climate projections, supported by the latest methodologies and scenarios published by the Intergovernmental Panel on Climate Change (IPCC), namely the SSPs (Shared Socioeconomic Pathways), and the most recent climate models validated by CMIP6. The main objective was to understand the specific climate trends and patterns in the region. Based on extensive studies, analysis and modelling, important results were obtained that provide valuable information on future local climate trends. This activity resulted in the preparation of climate projections for the region in two different scenarios: SSP2-4.5 and SSP5-8.5, where three time horizons were considered: short (2021-2050), medium (2051-2080) and long (2081-2100) with a resolution of 1 km, making it possible to identify climate risks and impacts more precisely, offering a more detailed and informed vision for tackling climate challenges in the region.

Climate regionalization is the process that allows for the representation of information with greater spatial and temporal resolution, usually derived from Global or Regional Circulation Models. This process can be quite complex and remains largely within the realm of research. Although climate

scenarios are in many contexts mandatory in impact studies, access to high-resolution climate projections is generally not available for island systems, as is the case with the ARM. In addition, the representation of extremes, often responsible for high-impact floods and droughts, is still a challenge recognized by the IPCC, especially when climate is only one of the components included in a wide range of variables in impact models.

To materialize the objectives of obtaining climate projections with greater temporal and spatial resolution in RAM, the most recent advances in statistical methods for large data sets with spatial-temporal structures were implemented, exploiting Bayesian statistics through the Integrated Laplace Approximations (INLA) algorithm, in combination with the use of environmental data derived from satellite images[38]. The simulation process resulted from combining several layers of spatial and temporal information, calculated for the nodes of a grid that was then used to estimate the temperature and precipitation variables on a regular grid with 1km resolution for the island of Madeira and Porto Santo

4.3 Adaptation priorities and barriers

In Portugal the main domestic priorities for adaptation are:

1. Strengthen resilience and national capacities through greater involvement of the various sectors, in a logic of integration (mainstreaming) and implementation of concrete measures;
2. Stimulate research, innovation and knowledge production on climate change and develop a knowledge base to support public policy making; Involve society in the challenges of climate change, promoting individual and collective action;
3. Increase the effectiveness of information, report and monitor systems, and ensure the active participation of relevant entities;
4. Secure financing conditions and increase investment levels, ensuring self-sustainability of climate policy funding.

These priorities were defined in the context of NAS and NAP.

Sectoral adaptation priorities and challenges

In Agriculture and rural development, the main challenges are to guarantee water for multiple uses, to reduce the knowledge gap of risks and water availability, to improve the programme coordination and governance and to increase water efficiency to reduce water abstraction.

In Biodiversity the main challenge to halt and reverse the biodiversity decline is to mainstream biodiversity into multiple land-based policies and ensure effective financing measures to this end. Other aspect is the fact that most land is from private owners which creates difficulties to the implementation of large-scale measures.

[38] Garrett, P. *et al.*, 2022

In Forest, the main challenges are lack of financial and human resources specialized in adaptation to face the scale of the climate risks.

In Coastal areas, the flooding risk extends to most of the coastal cities, which will face escalating challenges from sea-level rise and compound flooding events, threatening critical infrastructure and livelihoods. Coastal metropolitan areas and cities such as Viana do Castelo, Esposende, Vila do Conde, Porto, Aveiro, Lisbon, Setúbal, Faro and Vila Real de Santo António are projected to experience more frequent extreme coastal flooding events, which may become particularly challenging in areas without natural protection features (such as dunes and vegetation) as well as in densely urbanized stretches in the vicinity of estuarine areas, where sea level rise will progressively result in permanent inundation.

In Tourism, it is fundamental to improve training of technicians/decision-makers and to produce adequate risk mapping and legislation.

In Energy, new requirements and planning are needed. Screening of policy measures through climate-proofing could be used to test alignment with adaptation. Continue to work on climate-sensitive energy supply and demand models and energy system scenarios on time scales consistent with climate change.

In Communications, to guarantee that physical infrastructures are resilient enough to maintain critical and non-critical communications along the country is one of the main challenges. Plus, this implementation might be costly and have an environmental impact too (due to the need of raw materials and more need for recycling of electrical and electronic equipment). Another challenge is related to the security of the fleet of vehicles and workers, particularly relevant for the postal sector. There are also challenges regarding the energetic transition, since in the case of electronic communications it is expected an increase of the energy consumption and for the postal sector, charging infrastructure and the high cost of greener fuel compared cheaper with non-environmental options. Public funds to promote greener consumption could be a positive measure.

In Health, it is essential the involvement of the relevant entities, the definition of measures by decision-makers, the creation of adequate indicators and the professionals training to establish correlations between risk/preventive measures/mitigation and adaptation measures.

In People and assets' safety, it is essential to promote better coordination and involvement of the relevant entities and in-depth knowledge of data on damage and losses associated with extreme weather events.

Adaptation can occur in anticipation of impacts through spatial planning and by adapting urban spaces to climate events. Urban spatial planning and construction will incorporate adaptation responses: restrictions on new construction, planned setback(s) and accommodation measures, reduction of the urban heat island effect, urban water cycle management and energy and water use efficiency in all activities, buildings and infrastructure.

An increase of sectoral and intersectoral coordination is needed, in the sense of operational articulation to fulfil strategies, programmes and plans, data sharing and systematised and updated information on actions and projects under development. Implementing the measures recommended in the plans and strategies for adaptation requires adequate funding.

4.4 Adaptation strategies, policies, plans, goals and actions

4.4.1 Adaptation goals and objectives

The main strategic documents at national level: 1) the National Climate Change Adaptation Strategy ENAAC (NAS); 2) the Action Programme for Climate Change Adaptation P-3AC (NAP); 3) the National Energy and Climate Plan 2021-2030 (NECP 2030) and 4) the National Climate Framework Law.

ENAAC (NAS), adopted in 2015, proposes to improve the level of knowledge on climate change, promote the integration of climate adaptation in the various public policies and operationalisation instruments, placing greater emphasis on the implementation of adaptation measures. The ENAAC promotes, through working groups and thematic areas, the coherent vertical integration of the different scales necessary for climate adaptation, from international to local, and prioritises its mainstreaming in various sectoral policies and the implementation of adaptation measures, based on technical and scientific knowledge and acceptable practices that are being developed.

NAS is guided by three main objectives:

1. Improving the level of knowledge on climate change - updating, developing, and promoting understanding on climate change and assessing its potential risks, impacts and consequences, including those related to extreme weather events.
2. Implement adaptation measures - assess current adaptive capacity and prioritise the implementation of adaptation options and measures that moderate future negative impacts and/or help take advantage of opportunities arising from climate change.
3. Promote the integration of adaptation into sectoral policies - promote the integration and monitoring of the climate change adaptation component (mainstreaming) in the most relevant public and sectoral policies, including spatial planning and sustainable urban development policies and their territorial planning and management instruments.

Action Plan for Climate Change Adaptation - P-3AC (NAP), adopted in 2019, complements and systematizes the work done in the context of the ENAAC, aiming at its second objective, the implementation of adaptation measures. NAP elects eight direct intervention lines in the territory and infrastructures, complemented by a string of transversal nature, seeking to respond to Portugal's significant impacts and vulnerabilities. The definition of these intervention lines resulted from the screening and prioritization of the various adaptation measures listed in sectoral, municipal, and inter-municipal planning exercises. The lines of action and measures to reduce vulnerabilities to climate change recorded in the NAP constitute the benchmark for national action on climate change adaptation, and among others, the sectoral planning and preparation of

financing instruments under the Multiannual Financial Framework 2021-2027.The NAP also includes 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.

The National Energy and Climate Plan 2030 (NECP 2030) approved by Resolution of the Council of Ministers (RCM) nº. 53/2020, of July 10, is the main instrument of national energy and climate policy for the next decade towards carbon neutrality in 2050 and has extended the validity of the ENAAC until December 31, 2025. Following developments in the national and European legislative context, which have led to the adoption of new targets and the strategic framework for energy and climate, and in compliance with the provisions of Article 14 of the Regulation (EU) 2018/1999, in October 2024 the Portuguese government approved the update of the National Energy and Climate Plan 2030, carried out in conjunction with the Roadmap for Carbon Neutrality 2050 (RNC 2050) and taking into account the results of the National Roadmap for Adaptation 2100 (RNA 2100). This update of NECP was submitted to the Parliament for approval (see RCM 149/2024), as required in the provisions of National Framework Climate Law. The Parliament approved the update of NECP on 3rd December and, after that, the document was submitted to the European Commission. PNEC 2030 has a chapter dedicated to "Resilience and capacity to adaptation to climate change" as a co-benefit of decarbonisation and energy transition and stressing the symbioses between adaptation and mitigation.

4.4.2 Implementation of adaptation actions

The most relevant actions and measures adopted or in progress by each sector to meet the global goals on adaptation are identified in Annex III.

The Autonomous Region of Madeira (RAM) has been implementing several actions to increase its resilience to the challenges posed by climate change, especially forest fires.

As mentioned before, one of the main initiatives was the creation of a firebreak in Funchal, complemented with a tank with a capacity of 1,500 cubic meters of water and 25 fire hydrants, aim to guarantee a quick and effective response. In addition, the RAM has already begun the construction of around 40 km of forest paths, where it is planned to create an ecological park with recreational and leisure areas, reinforcing the region's tourist and recreational potential. In an area previously occupied by highly flammable species such as eucalyptus and acacia, more fire-resistant native species have been planted, helping to restore biodiversity and create a more fire-resistant landscape.

To strengthen the prevention and monitoring of natural risks, the RAM has implemented the Integrated Monitoring and Alert System for Natural Risks (SIMARN), which includes the Alluvium Alert Subsystem (SAARAM) and the Forest Fire Detection Subsystem (SDIFRAM). These systems, supported by a network of cameras and other technological equipment, allow for more effective surveillance, alerting the authorities in good time to risks such as floods and fires, facilitating a rapid and coordinated response.

In addition to fire protection measures, the region has been carrying out remedial work on river basins, especially in areas with a higher risk of erosion and landslides, strengthening the protection of streams and water lines. These interventions aim to mitigate the impacts of natural disasters, such as floods and landslides, which can be exacerbated by climate change.

In short, RAM has adopted an integrated approach to responding to climate change and promoting sustainable development, through a set of measures that range from managing natural risks, such as fires and floods, to the energy transition to renewable sources. These efforts strengthen the region's capacity to face future challenges, while ensuring the protection of its populations, the preservation of its ecosystems and the promotion of a greener and more resilient economy.

4.4.3 Priorities related to climate change adaptation and impacts

Climate-resilient development, which refers to the process of implementing both mitigation and adaptation measures to achieve sustainable development, is a crucial key concept, also considered as a priority. This integrated manner may increase the effectiveness of climate action.

The Sustainable Development Goals (SDGs) represent a collective effort to achieve human and ecological well-being. Hence, the assessment of progress made in achieving the SDG objectives (including the targets), as well as in reporting at the national level can inform the preparation of the A-BTR – not only because of the practice of reporting per se, but also because the process supports synergy and coordination between different areas of government at the national level. At the same time, it can be a helpful way of integrating climate and sustainable development frameworks in accordance with the concept of climate-resilient development.

In Portugal, public policy instruments related to climate change adaptation and impacts directly contribute to a variety of goals, especially, SDG 1: No Poverty, SDG 2: Zero Hunger, SDG 6: Clean Water and Sanitation, SDG 7: Affordable and Clean Energy, SDG 11: Sustainable Cities and Communities, SDG 13: Climate Action, SDG 14: Life Below Water, SDG 15: Life on Land. Some examples of SDG indicators that can be useful when considering progress on implementing adaptation.

It should also be reinforced that one of the most important sectors related to adaptation refers to the planning and management of water resources.

The National Water Plan, drawn up under the Water Law, defines the national strategy for integrated water management and establishes the broad options for national water policy and the principles and rules guiding this policy, to be applied by the River Basin District Management Plans and other water planning instruments.

The River Basin District Management Plans cover the river basins within a river basin district and are the basis for supporting the management, protection and environmental, social and economic development of water, containing the measures and actions to achieve the good status of water bodies.

The main objective of Flood Risk Management Plans is to reduce the risk of adverse consequences, especially for human health and life, the environment, cultural heritage, economic activity and infrastructure associated with floods by implementing a program of measures.

The main objective of the National Programme for the Efficient Use of Water is to promote the efficient use of water, especially in the urban, agricultural and industrial sectors, helping to minimize the risks of water scarcity and improve environmental conditions in water environments, without jeopardizing the vital needs and quality of life of the population, as well as the country's socio-economic development.

The Regional Water Efficiency Plans aim to respond to the structural problem of drought and promote water efficiency. Regional Water Efficiency Plans have been approved for the Algarve and Alentejo regions. The main aim of these plans is to reduce water consumption in the regions concerned, contributing to their sustainable management by defining a set of measures for the various sectors of activity.

The Strategic Plan for Water Supply and Wastewater and Stormwater Management outlines, in line with previous strategic plans, the sector's main guidelines for the next decade, including not only water supply and wastewater management, but also stormwater management, calling for all the sector's players to be aligned.

The Drought and Scarcity Management Plans, which are currently being drawn up, aim, in the context of the Water Law, to mitigate the environmental, economic and social effects of possible episodes of drought and situations of scarcity. These plans also aim to define measures to increase resilience in the face of situations of scarcity, aggravated by prolonged drought, and to operationalize a warning system.

4.4.4 Integrating science into adaptation

Developing successful adaptation strategies, to minimize the human impact on future climate and restrict the unavoidable climate change-driven impacts to societies and the environment, requires accurate quantitative science-based climate information. Numerical models of the Earth’s climate system grounded in sound physical principles are the best available tools to provide this detailed climate information for the past and the future. The need for accurate and detailed high-resolution climate information led to coordinated efforts to dynamically downscale ensembles of global model simulations, using Regional Climate Models (RCMs).

Within the scope of National Roadmap for Adaptation 2100 - Portuguese Territorial Climate Change Vulnerability Assessment for XXI Century, it was carried out a detailed analysis of the available simulations in the EURO-CORDEX dataset for the different relevant climate variables and over the different periods, along with comprehensive evaluation of precipitation, and daily maximum and minimum temperatures over Portugal. The recently released Iberia01 gridded observation dataset (Herrera et al. 2019) was considered as reference. Subsequently, an optimized multi-model ensemble is constructed based on performance-dependent weights for the different available models. Finally, the optimized ensemble is used to obtain high resolution

climate projections for the main climate variables and a large number of climate indices relevant for stakeholders and policymakers.

Three different future Representative Concentration Pathways are considered: the business-as-usual RCP8.5 scenario, the moderate emission RCP4.5 scenario, and the strong mitigation RCP2.6 scenario (see (van Vuuren et al. 2011) for a detailed description of the RCPs). The main climate change signals over Portugal are presented along the reports produced (WP2A) with a quantification of the respective uncertainties.

4.4.5 Adaptation actions leading to mitigation co-benefits

In Portugal, there are some good examples of adaptation actions leading to mitigation co-benefits:

- Prevention of rural fires (for example, economic valorization of biomass; bands or patches of discontinuity; reconfiguration of infrastructure and support systems);
- Conservation and improvement of soil fertility (e.g. erosion control; water retention; soil composition and structure);
- Efficient use of water (e.g. in agriculture; at urban level; in industry);
- Resilience of ecosystems (e.g. refuges and ecological corridors; conservation of genetic heritage; intervention in riparian galleries).

The National Forest Strategy identifies a set of measures that aim to reduce the vulnerability of spaces to the potential impacts of climate change, increasing the sector's response capacity (forestry and socioeconomic systems) and reducing potential impacts. The forest contributes significantly to carbon sequestration and storage. Forest products can play an important role in realizing a development strategy and «green economy», and to this end sustainable forest management and the minimization of the impacts of their processing industries must be promoted. Measures proposed in the strategy:

- Develop and structure new sub-categories and encourage the creation and promotion of new products in traditional categories. Improving the economic value of forest species whose territorial expression is increasing but which still have residual industrial use could contribute to increasing the resilience of the forestry sector. Likewise, non-timber forest products, which include resin, are beneficial for diversifying the income of forestry farms in addition to enhancing employment in rural areas.
- Improve the management and exploitation of forest stands (notably through genetic improvement, forestry techniques and models, experimentation with new species), especially in a context of adaptation to climate change.
- Improve the resilience and environmental value of forests, supporting actions aimed at adapting to climate change and mitigating its effects, promoting ecosystem services (air, water, soil and biodiversity) and improving the provision of public goods through forests.
- Improve the resilience and environmental value of forests supports investments that, through forestry operations, promote the conservation status of habitats, adaptation to climate

change, and increased ecosystem services and public amenities. In this context, the rehabilitation of forest stands is important, focusing on three types of investment: the rehabilitation of forest stands with excessive densities resulting from natural regeneration after fire; the rejuvenation of quercinea forest stands; and the conversion of settlements installed in ecologically unsuitable conditions.

4.4.6 Efforts to integrate climate change into plans and policies

Portugal has made efforts to promote adaptation to climate change in sectoral policies, plans and programmes.

The National Programme for Spatial Planning Policies (PNPOT) identified two relevant adaptation commitments for the territory: "Adapt the territories and generate resilience"; "Ensure the reduction of exposure to risks in Land Management Instruments". Within the (50) measures established in the Action Program of PNPOT, the measure "1.7 Prevent risks and adapt the territory to climate change" also directly contributes to adaptation, aiming to deepen the knowledge about the areas subject to natural hazards, in order to give spatial expression to situations in which land use and occupation increase vulnerability or are affected by it. National Landscape Transformation Programme were as created (PTP), aiming to promote the transformations towards a 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) that are carried out through other programmatic measures of the PTP, namely the Integrated Areas for Landscape Management (AIGP) and Integrated Operations for Landscape Management (OIGP).

In the Agriculture and Food/rural development sector, the sectoral plan, AGRI-ADAPT 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 dedicated to the sectors' adaptation to climate change and other measures that impact it. Additionally, the development of knowledge within the scope of climate change and ecosystem sustainability is being supported by the measure of the Recovery and Resilience Plan- Research and innovation agenda for the sustainability of agriculture, food and agroindustry (support the implementation of Terra Futura).

In the Biodiversity sector, one line of action is "promote the integration and monitoring of biodiversity adaptation measures to climate change in the various sectoral policies, plans and programs". The process of reconfiguring the Protected Areas Management Plans to Special Programs incorporates structural changes that consider the increase in coastal erosion, the occurrence of extreme weather events or flooding.

In the Coastal sector, the territorial model of the special programs designed for coastal areas (POC) identifies set-back lines for coastal risks, aiming at risk prevention and the protection and safeguarding of the territory. In sandy littoral, intended to safeguard and mitigate the impacts

arising from the mobility and dynamics of the coastal area in the time horizons of 50 and 100 years, including the impacts arising from climate change. In cliff areas, these lines were designed considering the evolutionary behaviour of the cliffs as a result of the erosive action of waves, including the rise in sea level resulting from climate change. These lines and the associated regime must be incorporated in the municipal master plans. The POC implements a policy of prevention/adaptation to coastal risks and reduction of vulnerability to climate change, which encompasses a preventive attitude and coastal protection, accommodation and planned retreat/relocation. Also identify critical areas, for which the adaptation strategy to present and future risks consider the susceptibility to them and the exposure of people, assets and natural values, within a framework of optimization of the cost/benefit ratio of the interventions, to be developed by the municipalities in articulation with the various entities with competence in the matter.

Both the Tourism Strategy 2027 and Sustainable Tourism Plan 20-23 aim to transform climate challenges into opportunities. One of the guiding principles is minimise the impact of climate change. Identifying risk areas 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 published (Resolution of the Council of Ministers No. 8-A/2021, of 3rd February). To stress that the follow up of this strategy takes place within the setting of a group, gathering the main public players (DGEG- Direção Geral da Energia e Geologia, ADENE-Agência para a Energia, LNEC-Laboratório Nacional para a Engenharia Civil and IHRU-Instituto da Habitação e Reabilitação Urbana), that produces semi-annual reports following a set of indicators, aiming to steering the strategy and address the bottlenecks. One of the main efforts related to the implementation concern to link the dots between available public funding and the need for rehabilitation (based on data base concerning EPC-Energy Performance Certificates). Efforts are also currently being made to involve the private sector in this endeavour.

Regarding the security of supply and resilience of infrastructures, the electricity and gas Networks' Development and Investment Plans have relevance, by defining some actions and investments aimed at adaptation to climate change. Additionally, the updated versions of the Preventive Action Plan for the National Gas System (March 2023), the Emergency Plan for the National Gas System (March 2023) and the Risk-Preparedness Plan for the Electricity Sector (January 2023), include the assessment of risk scenarios related to extreme weather events and establish measures to prevent, prepare for and mitigate their negative effects. In energy, the actions and investments.

In Electronic Communications, it was implemented the possibility of sharing passive infrastructure (ducts, poles, chambers) and civil work coordination, either under the significant market power regime (e.g. reference offer of access to ducts and reference offer of access to poles) or under the symmetric BCRD regime (Decree-Law 123/2009, of May 21st), and the switch-off and copper migration to VHCN to limit the environmental footprint of telecoms infrastructures. The Electronic

Communications Law (ECL) (Law n. 16/2022, August 16th) also includes provisions aimed at promoting the sharing of mobile network infrastructures, both active and passive, which has benefits in terms of environmental impact. As part of the Public Tender for the installation, management, operation and maintenance of very high capacity electronic communications networks, the tender specifications include a clause stating that the contracting party must give preference to the use of infrastructures suitable for the accommodation of existing electronic communications networks, namely, its own infrastructures or those of other entities and, whenever on the same route there is the possibility to choose between ducts and poles, should be given preference to ducts. The Republic Diary No. 210/2017, of October 31th, encourages (through the promotion of discounts on the wholesale price) the change of the accommodation of electronic communications networks from aerial infrastructures (poles) to underground infrastructures (ducts), namely to the Technical Road Channel (CTR) of Infraestruturas de Portugal (IP, S.A.). In addition, due to the forest fires of 2017, measures are being implemented to prevent forest fires near the main infrastructures. In the context of spectrum planning and management, ANACOM approved the Strategic Plan for Spectrum (PEE) in which among other strategic objectives, states that spectrum management policies should contribute to the mitigation of climate change. In the Postal Sector, the Postal Law (Law n. 17/2012, April 26th, in its current wording) establishes rules that oblige universal service providers to ensure access to their networks in a transparent and non-discriminatory manner (article 38). This type of access can allow for greater efficiency in the use of infrastructure and resources.

In Forests, 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. Rural fires risk management mechanisms were created, namely the platform for the registration of requests for burning authorisations and the production of weather warnings.

In the Health sector, is essential to monitor the state health of the population, considering diseases transmitted by water, food, vectors and pathologies aggravated by air quality and exposure to extreme weather events. The monitoring of vectors that transmit diseases is carried out by the National Vector Surveillance Network (REVIVE). In order to prevent the negative effects of intense cold or heat, Portugal has a Plan for Seasonal Health Response – Winter Module and Summer Module. The Water Sanitary Surveillance Programs in the five health regions cover water for human consumption, mineral, natural and spring waters and bathing areas, and have as objectives the surveillance of the microbiological and chemical quality of the water in accordance with its uses.

Civil protection and climate policies have long been reflecting the convergence between disaster risk reduction and climate change adaptation. The two relevant strategies (on Disaster Risk Reduction and on Climate Change Adaptation) have shown a good alignment, which will certainly continue to be strengthened in the future. Picking on the three main objectives of ENAAC, it is clear that:

- For the purpose of "Improving knowledge on Climate Change", a valid contribution was provided by the update of the National Risk Assessment (carried out in 2023, which includes information on the impacts of climate change) and by the web portal InfoRiscos, where

citizens can access information on susceptibility to different risks, including those associated with climate vulnerability;

- Regarding the objective "Implementing adaptation measures", it was particularly important the adaptation of the civil protection system to manage the consequences of extreme phenomena, in particular rural fires. In this same context, the reinforcement of a Strategic Civil Protection Reserve is also highlighted, as its goal is to have available equipment that could be used to swiftly support the population affected by major emergencies, in particular those with effects that might be exacerbated by climate change;
- In relation to the objective of "Promoting the integration of adaptation into sectoral policies", and in addition to the progress made with the implementation of the National DRR Strategy, it should be noted the implementation of the National Plan for Integrated Rural Fire Management, a particularly relevant sectoral instrument, dedicated to a key risk, which significantly reinforces the prevention dimension in the management of this specific risk. However, this situation may imply a 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 the project's ability to withstand such significant accidents or disasters.

Finally mention, that the River Basin District 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 (Flood Risk Management Plans), the implementation of hydrological and hydraulic forecasting models will enable timely warnings to the population and better civil protection actions.

4.4.7 Nature-based solutions

The Action Program for Adaptation to Climate Change (P-3AC), with the objective of implementing adaptation measures, identified a set of physical interventions with a direct impact on the territory, establishing lines of action and priority adaptation measures, most of them using nature-based solutions:

1. Rural fire prevention — structuring interventions in agricultural and forestry areas;
2. Implementation of techniques to conserve and improve soil fertility;
3. Implementation of good water management practices in agriculture, industry and the urban sector to prevent impacts resulting from drought and scarcity phenomena;
4. Increasing the resilience of ecosystems, species and habitats to the effects of climate change;
5. Reducing the vulnerability of urban areas to heat waves and increases in maximum temperatures;
6. Preventing the installation and expansion of invasive alien species, vector-borne diseases and agricultural and forestry diseases and pests;

7. Reduction or minimization of risks associated with floods and floods;
8. Increased resilience and coastal protection in areas at high risk of erosion, overtopping and flooding.

The financial mechanism Portugal 2020 - Sustainability and Efficient Use of Resources Program (POSEUR), among others, included several opportunities for financing adaptation to climate change, through support for municipal and inter-municipal planning for adaptation, and the implementation of adaptation measures, in particularly in the areas of the coastlines, water resources and nature conservation, with an emphasis on the application of nature-based solutions.

Talking about the rehabilitation projects of rivers with nature-based solutions, Portugal have never done so much. In 2024, the Portuguese Government made a commitment to recovering the original characteristics of almost 215 kilometres of rivers and their surroundings, as one of the aims of the Environmental Restoration Law. The intervention in these 10 rivers and streams lines involves an investment of 11.1 million, coordinated by the Portuguese Environment Agency, will be financed by the Environmental Fund, supervised by the Ministry of Environment and Energy, and by European funds from the REACT EU program, in the axis of Support for Climate Transition – Hydrographic Network Rehabilitation Interventions.

Besides water, sectors are also committed to implementing natural-based solutions. For example, at the communications sector, the adoption of energy is based in renewable sources (solar energy) or biodiesel and the use of geothermal cooling systems to improve infrastructures temperature. Reforestation and algae production are also being promoted to reduce the negative impact of carbon emissions of the sector.

4.4.8 Stakeholders' engagement

The engagement of stakeholders, particularly vulnerable to climate change impacts, are crucial to consider on adaptation policy. In Portugal there are some good examples of measures taken by sectors.

In the agriculture and food/rural development sector, the AGRI-ADAPT was designed in a participatory manner with representatives of the main stakeholders, developing a series of proposals to be implemented, which meet the needs felt by the various actors in the sector, complementing the measures provided by sectoral strategy, which are being implemented, with financial support from the Rural Development Programme. The National Competence Centre for Climate Change in the Agroforestry Sector has been set up, a partnership involving the productive sector, advisory entities, R&D entities and the public sector. Among its objectives are assessing the response capacity and vulnerability to Climate Change and the development and evaluation of adaptation measures given the need to ensure the sustainability of Portuguese agriculture and forestry in productive, environmental and social aspects.

The Sustainable Tourism Plan 20-23 includes over 70 actions/projects that aim, fundamentally, to ensure the empowerment of professionals in the sector as agents of change to make the sector

more resilient to climate challenges. 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).

In the Energy sector, the transmission system operators and other relevant stakeholders cooperate with the competent authority on the establishment of risk scenarios that include extreme weather events, which are evaluated in risk assessment studies. Based on these risk assessments, a set of measures is presented to prevent, prepare for and mitigate their negative effects. These measures are part of the Preventive Action Plan and the Emergency Plan for the National Gas System and the Risk-Preparedness Plan for the Electricity Sector.

The implementation of health sector strategies is also based on the networking of health services with other security, environmental, municipalities and social support entities.

Finally, in a country where water scarcity is increasing, the incentive to use alternative water sources becomes urgent. In this sense, one of the major national issues for reducing quantitative pressures on water bodies is the promotion of water reuse from treated wastewater from any source for multiple purposes. Decree-Law No. 119/2019 of August 21 was published to control the practice, which advocates an approach similar to that provided for Regulation EU 2020/741, supported by the case-by-case definition of quality standards (fit-for-purpose) and risk management on health and environment. Thus, water reuse projects involving irrigation of urban green spaces are defined to maximise the reuse of nutrients and minimise negative impacts on water's respective bodies. There are some pilot projects in Portugal with EU funding.

Public participation was also considered in the River Basin District Management Plans and Flood Risk Management Plans, by organising meetings of the River Basin District Councils, broad discussion meetings with representatives of economic sectors.

The National 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 Climate Law also established a specialized body called Climate Action Council (CAC), which is composed by recognized merit personalities in climate change, supported by a technical support structure and integrating representatives of NGOs and, at least, one young citizen. The CAC aims to speak out, in a consultative capacity, on the planning, execution and effectiveness of climate policy and contribute to the public discussion on its conduct, considering international experiences.

Regarding climate policies, it should also be noted that the recent National Roadmap for Adaptation 2100 (Portuguese Territorial Climate Change Vulnerability Assessment for XXI Century) was concerned with articulating and integrating the opinions of interested parties. Throughout the entire process, workshops were held with the involvement of stakeholders from the different sectors under study, as well as seminars to present and discuss the results of RNA 2100 in different regions.

In Portugal, in recent years, several actions have been developed to involve also the private sector in adaptation policy measures.

In the agriculture and food/rural development 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 Coastal zone sector the implementation of adaptation measures in landscape planning and urban licensing, such as raised constructions and ban on overnight stays on floors affected by coastal flooding, represent some important development in adaptation policy. Also, the demolition of beach support buildings and the removal/relocation of buildings in risk areas and beach profile replacement and dune recovery are other good practice examples.

Regarding the Tourism sector, several stakeholders have been adopting measures with a view to climate transition. Within the scope of the Sustainable Tourism Plan 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; "Por um Turismo sustentável" platform, which aims to monitor the consumption of hotels and disseminate information and good practices for increasingly efficient consumption.

In energy, the actions and investments aimed at adaptation to climate change defined in the operators' Network Development and Investment Plans should be highlighted. Besides, also note 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. From the energy demand side, impacting on the way the energy is consumed we highlight SGCIE (Intensive Energy Consumption Management System), a regulatory framework established by the Portuguese government aimed at promoting energy efficiency in industries that have high energy consumption (annual energy consumption higher than 500 toe), targeting large energy consumers across various sectors, including manufacturing, chemical, and heavy industries, to ensure they adopt more sustainable and efficient energy practices, which is a key component of Portugal's strategy to improve energy efficiency and reduce emissions within its industrial sector. Through a dynamic process of energy audits, energy consumption plans, goals and targets, monitoring

and verification, incentives and penalties the implementation of the SGCIE has led to significant improvements in energy efficiency across various industrial sectors in Portugal. Some notable impacts include:

- Reduced Energy Consumption: Many industries have reported substantial reductions in energy consumption due to efficiency measures implemented under the SGCIE framework.
- Lower Emissions: The framework has contributed to a decrease in greenhouse gas emissions, helping Portugal meet its environmental targets.
- Technological Advancements: Industries have adopted new technologies and innovations, leading to modernization and increased competitiveness.
- Economic Growth: By reducing operational costs and improving efficiency, industries have achieved economic growth and sustainability.

Currently, a total of 1372 installations are registered in the system, corresponding to a decrease of an annual energy consumption of 7% and a related decrease of GEE.

Regarding the Communications sector, some of the main operators have been adopting measures to adapt to climate changes such as increasing the resilience of infrastructure (e.g. by passing poles to ducts, modernizing more energy-efficient equipment and streamlining technological phase-out actions (disconnecting cables and obsolete network equipment), improving the infrastructure air conditioning processes based on nature, using solar panels, cleaning up the surrounding area of infrastructure in rural areas, among others). The analysis of the environmental impact of the suppliers is also another measure implemented. Using electric or biofuel vehicles, the voluntary offsetting of non-avoidable emissions (namely through reforestation or the algae farming) and the reuse/recycling of electrical and electronic equipment and the adoption of recycled material in the offers and the recycling of own equipment are other measures being implemented.

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 sectorial interdependencies management 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 Enterprise Sector.

4.5 Progress on implementation of adaptation

The adaptation actions identified in current and past adaptation communications are reported the biannual progress reports of the NAS. The progress for two years focuses 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, four biennial reports have been produced.

The implementation of adaptation actions identified in progress reports of the NAS are also reported in the other items of the BTR.

4.5.1 National level

In 2010 Portugal approved its National Strategy for Climate Change Adaptation – ENAAC (NAS). The first phase of ENAAC's work took place between 2010 and 2013 with the following objectives: i) Information and knowledge: to keep up-to-date and available scientific knowledge; (ii) reducing vulnerability and increase responsiveness: in an integrated manner, defining measures to minimize the effects of climate change; iii) Participate, raise awareness and disseminate: raise awareness of climate change and its impacts; (iv) International cooperation: supporting the most vulnerable countries, in particular within the framework of the Community of Portuguese-Speaking Countries. The work of the various sectoral groups and a progress report were developed that highlighted the strategic nature of the work carried out, but also identified its limitations.

The first review of ENAAC (NAS) was promoted in 2015, bridging the gaps and capitalizing on the strengths and opportunities identified. The ENAAC 2020 (NAS) defines an organization model that clearly promotes articulation between various sectors and stakeholders, pursuing priorities of certain thematic areas and the three objectives of the strategy: i) Improving the level of knowledge on climate change; (ii) Implement adaptation measures; iii) Promote the integration of adaptation into sectoral policies. ENAAC 2020 (NAS) will be into force until the end of 2025.

The same applies to the Action Programme for Climate Change Adaptation, P-3AC (NAP), which was published in 2019. It complements and systematizes the work carried out in the context of ENAAC 2020 (NAS), focused on its second objective: to implement adaptation measures.

The Portuguese Climate Law, adopted in 2021, envisages the review of the ENAAC (NAS) every 10 years with an update halfway.

In 2024 Portuguese Environment Agency (APA) internally began the review of the ENAAC (NAS). The new ENAAC to be produced should seek close alignment with the Sectoral Adaptation Plans and Regional Climate Action Plans (PRAC), in progress, as well as still align with the next European cycle of adaptation policies. All the process should be based on the evolution of scientific knowledge.

The Monitoring, reporting and evaluation (MRE) system at national level is mainly ensured by the biannual Progress Reports of ENAAC 2020 (NAS) and the Monitoring of P-3AC (NAP). The National

Climate Law also introduced provisions for monitoring and reporting for the annual provision of information to the Parliament.

The biannual progress reports of the NAS are intended to respond to the provisions of chapter 2.5 of ENAAC 2020 (NAS). The progress for two years is reported for each of the NAS objectives and also includes recommendations to address difficulties or gaps and suggest improvements. The report focuses 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, four biennial reports have been produced.

It is the responsibility of the NAS Coordination Group to ensure the elements for adequate reporting on climate change adaptation to comply with national, Community and international obligations.

All adaptation reporting exercises are developed with the contributions of ENAACs Coordination Group, in particular the various thematic areas and working groups. The same framework is used to address the international reporting obligations (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); c) the forthcoming Biennial Transparency Reports (under UNFCCC); d) adaptation biennial reporting to the European Commission (under Art.17 and Art.19 of Regulation (EU) 2018/1999).

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 starting to become operational, so no systemic report has been published yet. Some adjustments may be made to P-3AC monitoring framework to accommodate some of the National 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) established 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 on an annual basis to the Portuguese Environment Agency (general coordinator of ENAAC and P-3AC).

Due to these challenges, currently most of the progress made on adaptation policy is provided in qualitative information.

4.5.2 Sub-national level

The sub-national strategies and plans are relatively recent. Thus, they were not reviewed yet, but it will be important to establish a regular assessment of their implementation to evaluate the need for that revision.

For example, the Autonomous Region of the Azores proceeded with the Regional Programme for Climate Change (PRAC), approved by the Regional Legislative Decree No. 30/2019/A, of November 28, which encompasses mitigation and adaptation. PRAC allowed improving the level of knowledge on climate change in the Region through the studies of current and future vulnerabilities and the definition of adaptation measures for the most relevant sectors. PRAC implementation is ongoing, with the first monitoring report on its implementation, in December 2022, concluding that of the 115 planned adaptation measures, 11 are fully implemented, 65 are being implemented, leaving 39 measures whose implementation has not been started by the end of 2021. Within the scope of the implementation of the adaptation measures planned in the PRAC, the value of execution until the end of 2021 was €5.4 million, with the largest share of the investment, €5.2 million, earmarked for strengthening coastal protection. As part of the PRAC's second monitoring cycle, covering the period 2022-2023, the collection of information from the entities responsible for implementing the measures is ongoing. Currently, the revision of this plan is foreseen in terms of adaptation to climate change.

The Autonomous Region of Madeira created the Regional Climate Change Adaptation Strategy (CLIMA-Madeira Strategy) in 2015. Due to the significant scientific advances that have taken place in climate science, with international convergence around new models and methods for assessing adaptation and mitigation needs, it has become necessary to move forward with its revision, with the aim of helping to update the information. The revision of the strategy was outlined in two distinct phases. The first phase, entitled climate regionalization, has already been completed, with a review of climate trends for the region through the production of new climate scenarios. In the second phase, a detailed analysis of sectoral risks and vulnerabilities will be carried out considering the new climate projections. This process involves adjusting and defining specific measures, indicators, and targets to address the climate impacts identified, with the aim of increasing the region's climate resilience. To achieve this goal, it is essential to involve various stakeholders, such as local authorities, entities, organizations, and civil society. The diverse participation of these stakeholders will be essential to ensure a comprehensive analysis, considering different perspectives and experiences, to incorporate new approaches, whenever justified, with a view to enriching the available information.

The CLIMA Madeira Strategy was very important to improve the level of knowledge of climate change, having implemented, throughout this period, several measures and concluded vital projects to improve adaptation to climate change, making the Region more resilient and better prepared for the challenges, like PAESC-RAM, Action Plan on Sustainable Energy and Climate, a revised PGRI, Flood Risk Management Plan for 2022-2027 or the PREPCRAM, Regional Emergency and Civil Protection Plan.

Every year, a monitoring report is drawn up on Madeira's Regional Climate Change Adaptation Strategy, known as the CLIMA-Madeira Strategy. The main aim of this report is to carry out a

comprehensive analysis of the progress made, while identifying emerging challenges and exploring future opportunities in the field of climate change adaptation.

4.5.3 Local level

At local level (NUT 2 and NUT3), the regions and municipalities continued to develop the Adaptations Strategy and Adaptations Plans. Some of them were supported by EEA grants (for example Local Plans for Climate Change Adaptation of Arrábida and Municipal Strategy for Adaptation to Climate Change of Almodôvar) and also by the Operational Program for Sustainability and Efficient Use of Resources - PO SEUR (EU funds of Portugal 2020)

Under the Portugal Climate Law, started the development of Climate Action Plans (both mitigation and adaptation) for all municipalities, all intermunicipal communities (NUTS3 level) and all regional development and coordination commissions (approximate to NUTS2 level).

For the implementation of adaptation measures the financial support is essential. The Environmental Fund finances adaptation operations aimed at implementing material measures recommended in local or regional planning exercises, namely that reduce or minimize climate risks associated with flood events and increase the resilience of infrastructures and ecosystems, species, and habitats.

For example, in 2021, the Environment Fund fully financed the project "Enhancement of the Monchique and Silves mountains' landscape – support for the rehabilitation and regeneration" with a total investment of €0.3 million, this project aims to improve the adaptation and resiliency territories' ability to the climate change impacts. It continued to supported 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 and applications made under the "Village Condominium", the Integrated Support Program 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.

The EEA Grants Portugal - Environment, Climate Change and Low Carbon Economy Program is also relevant in Portugal supporting measures and projects that are implemented at the local and regional level. For example, it supported the development of Oporto's Municipal Stream Lines Valorization and Rehabilitation Plan and the recovery and enhancement of stream lines, riparian galleries and wetlands in Vila do Conde.

Regarding the efforts on promoting adaptation to climate change at sectorial levels, as mentioned before, national efforts have been made to integrate climate adaptation into regulations, policies and plans. One of the best examples, is the review of the National Programme for Spatial Planning Policies (PNPOT), that identified two relevant commitments related to adaptation: "3 - Adaptation and resilience of territories" and "9 - Ensure that territorial management instruments reduce exposure to risks", to be implemented in the Action programme through measures that directly contribute to the response to climate change (the measure "1.7 Prevent risks and adapt the

territory to climate change" stands out among others in the natural, social, economic and connectivity systems).

On the other hand, the National Climate Law (Law No. 98/2021, of 31 December) introduces new objectives and other considerations on adaptation matters. It strengthens the process by setting mandatory development, in a 2-year timeframe of Climate Action Plans (both mitigation and adaptation) for all municipalities, all intermunicipal communities (NUTS3 level) and all regional development and coordination commissions (approximate to NUTS2 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. The National Climate Law introduces some new other elements to integrate on the adaptation policies and governance:

- creation of a climate action portal;
- development of sectoral adaptation plans;
- additional monitoring and reporting processes (including in the national budget);
- introduction of the climate legislative impact assessment;
- integration of climate risks in the decision-making of public and private institutions and agents.

4.6 Monitoring and evaluation of adaptation actions and processes

4.6.1 Achievements on climate vulnerability, risk assessment and impacts

As mentioned before, the first integrated assessment of impacts and adaptation measures in Portugal was produced within "SIAM - Climate Change in Portugal – Scenarios, Impacts and Adaptation Measures", completed in 2002 and revised in 2006. After that, in 2013, it was published a Progress Report of the NAS which systematised the climate vulnerabilities and adaptation measures for the sectors covered in the NAS. To some extent, climate scenarios have also been integrated in the National Risk Assessment (for Disaster Risk Management) in 2014, 2019 and 2023.

Later, in 2024, the National Roadmap for Adaptation 2100 (RNA 2100), updated the reference climate scenarios for Portugal, as well as the climate risks assessment with a focus on modelling impacts in coastal areas, water resources, agroforestry and in the field of fires.

The results generally point to an increase in the frequency and intensity of extreme precipitation and temperature events, such as very hot days and tropical nights, with direct impacts on public health.

The adaptation narratives produced for the five regions (NUTS 2) highlight the reduction in water availability in most hydrographic regions. Climate change can affect both irrigation needs and the productivity of the main crops grown in the national territory, which can result in non-negligible global economic losses.

Regarding wildfires, the results demonstrate an increase in the number of days with extreme meteorological danger, with global mid-century and end-of-century projections being particularly worrying.

In coastal areas the impact of erosion processes and coastal flooding occurs mainly due to the combination of wave and meteorological forcing during storms, aggravated by the current sediment deficit in several areas. These phenomena put people and property at risk, and several municipalities have been identified with a high incidence of vulnerable buildings and people.

The project RNA 2100 also explored the economic component of adaptation and the costs/impacts of inaction, having included the production of a Guideline and good practices on the integration of adaptation to climate change into territorial planning instruments at municipal level.

Highlight that Portuguese Environment Agency also promoted the Flood Risk Studies, associated with the Flood Risk Management Plans, which allowed updating the information on the susceptibility to flooding risks.

The National Authority for Emergency and Civil Protection published in 2023 the update of the National Risk Assessment, which generally maintains the structure of the previous 2019 assessment and was prepared following the "Risk Assessment and Mapping Guidelines for Disaster Management" issued by the European Commission.

4.6.2 Monitoring methodology

At a national scale

It is the responsibility of the ENAAC (NAS) Coordination Group to ensure the elements for adequate reporting on climate change adaptation to comply with national, Community and international obligation.

The entities that integrate the ENAAC (NAS) Coordination Group, in coordination with the Portuguese Environment Agency, elaborate the monitoring reports and make proposals for the review of actions, indicators and targets and collaborate in the annual monitoring of P- 3AC (NAP), providing relevant sectoral information for indicators and targets, and in the preparation of proposals for coordination mechanisms to be established with third countries.

The entities responsible for the financial instruments that provide funding for the measures identified in P-3AC (NAP) share with the Portuguese Environment Agency information about their implementation, on an annual basis and accordingly with the appropriate indicators.

At a sub-national scale

In the Autonomous Region of the Azores the Regional Programme for Climate Change (PRAC) is ongoing. The first monitoring report on its implementation was concluded in December 2022. Now PRAC is on the second monitoring cycle.

In the Autonomous Region of Madeira every year, a monitoring report is drawn up on Madeira's Regional Climate Change Adaptation Strategy, known as the CLIMA-Madeira Strategy. The main aim of this report is to carry out a comprehensive analysis of the progress made, while identifying emerging challenges and exploring future opportunities in the field of climate change adaptation.

More than simply checking indicators or the implementation of measures, the report is an essential strategic tool. It not only assesses the progress made and any gaps, but also guides the next steps, adjusting strategies to ensure effective and sustainable adaptation for the region.

To ensure the quality and relevance of the analysis, the report brings together the most recent and relevant data from various sectors and sources to provide an integrated and rigorous view of the adaptation process. Each dimension is covered in detail, from the assessment of climate risks, through the concrete implementation of adaptation measures, to the involvement and sensibilization of the local community.

This approach makes it possible not only to monitor the impact of the actions already undertaken, but also to identify new areas for intervention, ensuring that the region is prepared to face climate challenges proactively and efficiently.

At local level (NUT 2 and NUT3), the regions and municipalities continued to develop the Adaptations Strategy and Adaptations Plans. Some of them were supported by EEA grants and by the Operational Program for Sustainability and Efficient Use of Resources - PO SEUR (EU funds of Portugal 2020).

4.6.3 Assessment of adaptation resilience and impacts

Regular in-depth evaluations of adaptive capacity progress have not yet been implemented.

Nevertheless, it is essential to highlight the positive evolution of the national territory coverage by climate change adaptation strategies and plans. Until 2015 only three municipalities had elaborated adaptation plans and strategies. Since then, this coverage has expanded considerably, first because of the ClimAdaPT.Local project funded by EEA Grants and the Environmental Fund, followed by funds provided by the Operational Programme for Sustainability and Efficiency in the Use of Resources, along with strategies and plans funded by the municipalities themselves. At the end of 2024, the number of municipalities covered by climate change adaptation plans or strategies (of municipal and/or inter-municipal or metropolitan scope) was 295, corresponding to 96% of Portuguese municipalities.

4.6.4 Effective implemented adaptation measures

Three major instruments were developed to address the three main objectives of ENAAC (NAS).

For the ENAAC objective on knowledge improvement, a Research & Innovation Agenda for Climate Change was developed through a process within the 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 the ENAAC's Coordination Group.

For the ENAAC objective of implementation of adaptation measures, the publication of the P-3AC (NAP) and the progress on the financial mechanisms were the major milestones. The first financial mechanism dedicated to adaptation was the 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. It was of great relevance as it focused on strategic areas, covering a website for climate scenarios, 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 development of P-3AC (NAP), the equivalent to a National Adaptation Plan, was supported on different sources of information namely: from products developed under ENAAC (NAS), from other strategic and programmatic instruments, as well as from municipal and intermunicipal adaptation plans. Like ENAAC (NAS), the P-3AC (NAP) was developed with contributions of ENAAC's coordination group and scientific panel, being also subject to public hearing.

Regarding the ENAAC's objective of mainstreaming adaptation, the PNPOT - National Programme for Spatial Planning Policies 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".

Other substantial progress was on building the capacity of municipalities and inter-municipalities on adaptive management through local adaptation strategies and/or plans. The importance of this aspect was highlighted within the first ENAAC progress report becoming the major priority on the design of the Programme AdaPT. This capacity building was then kicked-off through a major project under Programme AdaPT that had a great reach within municipalities and other local and regional entities.

4.6.5 Transparency of planning and implementation

Related to transparency, the new Framework Law on the Climate (Law 98/2021 of 31 December) instituted the creation of a new body, the Climate Action Council (CAC). The CAC's mission is to ensure compliance with the new Climate Law, collaborating with the Assembly of the Republic and the Government due to its competences, contributing to the dissemination, transparency and execution of climate action policies and speaking out as consultancy on public policies.

The CAC is an entity of a consultative, independent and specialized nature, which works alongside the Legislative Assembly, and is made up of personalities of recognized merit, with knowledge and experience in the different fields related to climate change, including mitigation and adaptation, acting with strict impartiality and objectivity.

The CAC acts independently in carrying out the powers assigned to it by law, in compliance with technical and scientific criteria, and cannot request or receive instructions from the Assembly of the Republic, the Government or any other public or private entities. The composition of the CAC must include the president of the National Council for Environment and Sustainable Development, a representative of the NGOs and, at least, one young citizen residing in Portugal.

On the other hand, it should be noted that the previous Portuguese Government created a new platform dedicated to transparency: Mais Transparência Portal (https://transparencia.gov.pt/en). It is a platform that allows citizens to access information in a more accessible way, reinforcing their relationship of trust with the Public Administration, and prioritizing the sharing of information and citizen involvement. This portal hosts a section dedicated to Climate Action, linked to the Portuguese Environment Agency website.

This portal allows citizens to monitor systematic and national information on:

- Greenhouse gas emissions and the sectors that most contribute to these emissions;
- The progress of the goals;
- The sources of financing available, at national, European and international level, for actions to mitigate and adapt to climate change, for the public and private sectors, and their respective implementation status;
- The international goals and commitments to which the Portuguese State is bound;
- Research and development studies and projects carried out within the scope of climate change; and
- International cooperation projects in the context of climate change.

4.6.6 Support programmes meeting specific vulnerabilities and adaptation needs

In recent years we have seen important progress in the implementation of adaptation measures supported by financial programmes. EU funds had contributed significantly to this fact. In a first moment, through the definition of eligibility and development of selection criteria for the financing of adaptation projects through EU funds of Portugal 2020 (in the Operational Program for Sustainability and Efficient Use of Resources - POSEUR) and, in a second moment, with the implementation of projects financed by the AdaPT Program (intermunicipal and Local Climate Change Adaptation Plans) and through the implementation of P-3AC (NAP).

Currently, the main sources of financial support for adaptation are:

European Structural and Investment Funds (ESIF)

The ESIF provides significant funding for climate resilience projects in Portugal. This includes the European Regional Development Fund (ERDF), the Cohesion Fund, and the European Social Fund (ESF), which support infrastructure improvements, environmental protection, and social adaptation measures.

Portugal 2030

Portugal concluded the EU Multiannual financial framework (MFF) for 2021-2027 that will be implemented through a new partnership agreement, called "Portugal 2030". Its programming is based on 5 strategic objectives, which includes a greener Europe. It sets a thematic operational programme called Climate action and sustainability and Maritime, which aims to ensure climate transition and actions promoting adaptation to climate change, circular economy and urban mobility. One of the Thematic Programs of "Portugal 2030" is "Sustentável 2030", which is dedicated to Climate Action and Sustainability. This programme is financed by the Cohesion Fund and will have a national scope to respond to the challenges arising from sustainability and climate transition, with particular focus on the decarbonisation of the various sectors of the economy, making a strong contribution to meeting the national goal of achieving carbon neutrality by 2050.

The interventions focus on energy transition, mainly via decarbonisation, energy efficiency and intelligent systems, sustainable urban mobility, transport infrastructures and Trans-European Transport Network (TEN-T), and actions promoting circular economy and sustainability of resources, which contribute to the A Greener Portugal objective. Related to adaptation, the actions are aimed at protecting and integrated management of risks that occur in the territory.

At the regional level, the "Madeira 2030" stands out. This programme is financed by the ERDF and ESF+. It is especially focused on territorial policies, which are reinforced by the decentralisation process underway in mainland Portugal and contributes to most of the Strategic Objectives, particularly "A Closer Portugal", "A Greener Portugal", and "A More Competitive Portugal objectives", playing an important role in adapting to climate change.

Recovery and Resilience Plan

Following 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, Crato multi-purpose hydroelectric plant and Plan for water efficiency and reinforcement of the water supply and irrigation systems of the Autonomous Region of Madeira. The plan also foresees financing for adaptation to climate change in order to improve the territory's resilience to forest fires. The projects under this component which are relevant to achieve this goal are: "Transformation of the landscape of vulnerable forest territories", "Fuel management tracks" nd "Means of preventing and fighting forest fires". In general, investment and support in climate change are expected to increase in Portugal to meet the overall climate target of, at least, 30% of the total expenditure from the MFF 2021-2027, which increase to more than 38% in the Recovery and Resilience Plan.

Horizon Europe

Horizon Europe is the EU's key funding programme for research and innovation. It tackles climate change, helps to achieve the UN's Sustainable Development Goals and boosts the EU's competitiveness and growth.

LIFE Programme

The LIFE Programme supports environmental and climate action projects across the EU. Portugal benefits from LIFE funding for initiatives that enhance biodiversity, improve water management, and increase resilience to natural disasters.

Environmental Fund

The Environmental Fund 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. Thus, finances adaptation operations aimed at implementing material measures recommended in local or regional planning exercises, namely those that reduce or minimize climate risks associated with flood events and increase the resilience of infrastructures and ecosystems, species, and habitats.

EEA Grants Portugal

The EEA Grants Portugal - Environment, Climate Change and Low Carbon Economy Program is also relevant in Portugal supporting measures and projects that are implemented at the local and regional level. For example, it supported the development of Oporto's Municipal streamlines

valorization and rehabilitation plan and the recovery and enhancement of streamlines, riparian galleries and wetlands in Vila do Conde.

Considering the financial mechanisms available, sectors have been trying to do their best to meet specific vulnerabilities and adaptation needs. Some examples are identified:

- In the case of the agriculture and food/rural development sector, the Rural Development Programme (PDR 2020) supported, until 31 December of 2025, with 2,642 million euros of Public Expenditure (execution level as of 12.31.2022) the adaptation of agriculture/forest to Climate Change (46% of total funding to agriculture and forests). This amount was distributed as follows: 0.8% (knowledge); 10.4% (investments in physical assets); 1.7% (agricultural risks); 11.9% (forestry); 52% (agri-environmental measures and climate); 23.2% (areas with constraints).

  The new Common Agricultural Policy enter into force in 1 January 2023, 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**.

  The main measures in terms of adaptation are the Eco-schemes: A.3.2 - Integrated Production (based on national regulation for sustainable farming) and A.3.3.1 - Soil management - Management of permanent pasture; and the Environmental and Climate measures: C.1.1.1.2 – Efficient Use of Water and C.1.1.3 - Agroforestry Mosaic, with a global target of 737 000 hectares with a least one of this measures. Furthermore several investment measures are very relevant for adaption: The B.1.2. – Water management, the C.2.1.2 - Agricultural Investments to Improve Environmental Performance and C.4.1.2 Prevention of calamities and natural disasters

- In the case of biodiversity, two measures shall be stressed: i. Restoration, preservation and enhancement of biodiversity, including in "Natura 2000" areas, and areas subject to natural or other specific constraints, and in the agricultural systems of High Natural Value, as well as the state of European landscapes; ii. Erosion prevention and improved land management supported through the EEA Grants Portugal - Environment, Climate Change and Low Carbon Economy Programme.

- Regarding the Tourism sector, the project "Sustainable Tourism: a better future for [with] everyone" should be highlighted. This project includes 6 actions: "Re-Educar para uma Restauração circular"; Circular economy practices in coastal tourist destinations; Carbon neutrality in tourist resorts; Sustainable construction in tourist resorts; Water efficiency in golf courses in Portugal; and reduction of plastic in hotels.

- In the case of Forests, the Rural Development Programme (PDR 2020) is being implemented, until 31 December of 2025, with forestry actions/operations that contribute to adapting to climate change, namely efforts to prevent and defend forests against fires.

  Since 1 January of 2024 the PEPAC 2023-2027 is being implemented with similar actions/operations.

4.6.7 Influence of adaptation actions on Sustainable Development Goals (SDG)

In Portugal, public policy addressing climate change adaptation are aligned with the Sustainable Development Goals (SDG), influencing them through both direct and indirect pathways. Therefor policies and measures adopted shape many SDG, as identified below:

SDG 1: No Poverty

Adaptation measures, such as disaster risk reduction and resilient infrastructure, mitigate climate-induced economic losses, particularly benefiting vulnerable communities.

Social protection systems, such as subsidies for farmers adapting to drought-resistant crops, prevent poverty exacerbation due to climate impacts.

SDG 2: Zero Hunger

Support for climate-smart agriculture enhances food security in the face of droughts, unpredictable rainfall and new pests and diseases.

Investments in irrigation systems and soil conservation help sustain agricultural productivity.

SDG 3: Good Health and Well-being

Illnesses and mortality related to heatwaves is prevented by health action plans (adaptation sectorial plans), early warning systems, and urban cooling strategies.

Measures to combat vector-borne diseases protect public health in a warming climate.

SDG 6: Clean Water and Sanitation

Policies promoting efficient water management, such as reuse of treated wastewater, reduce water losses and leakage, ensure water availability in drought-prone areas like southern Portugal.

Protection of water quality through integrated river basin management aids sustainable use.

SDG 7: Affordable and Clean Energy

Climate adaptation policies synergize with renewable energy goals, ensuring energy infrastructure is resilient to climate impacts like storms or heatwaves.

Climate and energy policies encourage decentralized renewable energy production.

SDG 11: Sustainable Cities and Communities

Urban planning policies, like municipal adaptation plans, integrate adaptation measures: e.g. green roofs, permeable pavements and flood risk management systems. The implementation of these measures creates climate-resilient cities, reduces vulnerability to extreme weather and enhances the quality of life.

Coastal adaptation protects cities from sea-level rise and extreme weather.

SDG 13: Climate Action

NAS (ENAAC), NAP (P-3AC), Sectorial, regional and municipal climate adaptation plans directly target this goal by fostering resilience.

SDG 14: Life Below Water

Coastal adaptation measures, such as habitat restoration and monitoring ocean acidification, will reenforce protection on marine ecosystems.

SDG 15: Life on Land

Forest management policies mitigate wildfire risks.

Ecosystem-based adaptation approaches, such as reforestation and wetland restoration, combat desertification and biodiversity loss.

4.6.8 Stakeholder engagement

A particular effort has been put in place regarding the awareness and preparedness of communities exposed to wildfire risk, via the implementation of the "Safe Village, Safe People" Programme. Established in response to the devastating wildfires in mainland Portugal during the summer of 2017, the Programme addresses the urgent need for enhanced community resilience, especially in areas where urban and wildland environments intersect.

Launched in 2018, the Programme encompasses multiple layers of action, including the management of fuel in buffer zones around villages, public awareness campaigns on fire risks and prevention, coordinated evacuation plans, and the preparation of shelters and refuge areas. By October 2024, over 2300 villages had joined the initiative, with 2200 Local Safety Officers appointed and almost 3000 shelters or places for refuge installed. The program also conducted

more than 500 evacuation drills and 1000 awareness actions, reinforcing community resilience through direct engagement and education.

Key partnerships have been critical to the success of the "Safe Village, Safe People" Programme. The National Civil Protection Authority provides national oversight, strategic guidelines, and coordinates large-scale awareness campaigns. On the ground, municipalities and civil parish councils play a pivotal role in Programme implementation, working directly with communities to ensure local needs are addressed. Other essential partners include fire brigades, forest services, and the National Guard, all of which assist in organizing drills and awareness actions. The involvement of forest owners also ensures that fuel management measures are implemented efficiently. However, the backbone of the program lies in the volunteers, namely citizens who serve as Local Safety Officers: their efforts in facilitating communication and preparedness operations bridge the gap between local authorities and the broader community, solidifying the Programme.

In the context of the work developed in various working groups under the Sub-Commission of the National Platform for Disaster Risk Reduction, we highlight the preparation of several useful practice guides in recent years, namely the Guide "Resilient Cities", the Guide "Flood Management. Support document for good practices", the Guide "Good Practices for Resilience of Critical Infrastructures" and the Guidelines "Approach to audiences with specific needs within a scope of temporary shelter structure".

To involve the private sector in adaptation policy measures, several actions have been developed in Portugal, in recent years.

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 valorization of the vineyard, and promoting the maintenance of public assets (water, air and soil quality).

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 characterize 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 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.

Regarding the alignment between national and subnational policies, it should be noted that new NAS (ENAAC), to be concluded until the end of 2025, will try to find close arrangement with the Sectoral Adaptation Plans and Regional Climate Action Plans (PRAC), in progress, as well as still align with the next European cycle of adaptation policies. All the process should be based on the evolution of scientific knowledge.

4.7 Cooperation, good practices, experience and lessons learned

4.7.1 Share information and good practices

The rapid rise in climate risks in Mediterranean region and particularity in Portugal, requires new ways of cooperating across governance levels to make tangible and measurable progress in reducing the most urgent climate risks.

In Portugal there are some good examples of collaborative action and innovative approaches in addressing science, planning and policies to adaptation challenges. Table 4.2 systematizes some of these good practices.

Table 4.2 – Good practices on adaptation.

Title	Area of good practices	Good practices and lessons learnt
State Budget to Climate Action	Institutional arrangements and governance at the national level	The National Climate Law introduced requirements for the creation of a State Budget for Climate Action, establishing the need to consolidate allocations for climate policy (mitigation and adaptation). Hence, the first budget exercise took place for the 2022 State Budget and the guidelines for the next State Budget for Climate Action are currently being developed.
Agriculture	Efforts to integrate climate change adaptation into development and sectoral policies, plans and programs	Sector "Agriculture": The definition of adaptation priorities carried out in a participatory manner; the creation of knowledge transfer platforms and the National Competence Centre for Climate Change in the Agroforestry Sector (knowledge coordination and dissemination); the effort made by public actors responsible for the definition of policy and management of community support to improve the quality of monitoring and evaluation of the measures of the funding instruments for adaptation.
Biodiversity	Institutional arrangements and governance at the national level	Sector "Biodiversity": The various sectoral strategic instruments promote an intricate relationship between biodiversity protection and ecosystem restoration, with the achievement of climate change adaptation objectives, halt and reverse biodiversity loss and achieve neutrality in land and soil degradation. Framed by the Nature Restoration Law, Portugal will face a major challenge to overcome mapping and information gaps which is vital for monitoring and reporting, nevertheless, it will be the opportunity to boost efforts that have been made to halt and reverse biodiversity lost.
Tourism	Stakeholder engagement	Sector "Tourism": The dissemination of good environmental practices underway in the sector, and which we hope will be densified in the future, contribute directly towards attracting more sustainable and responsible tourism, which is increasingly demanding and sensitive to these issues, implying a paradigm shift on the part of promoters, private investors and tourism companies. Promote the exchange of experiences with other realities with similar vulnerabilities to the national ones, in terms of the tourism sector and in particular climate change.
Energy	Efforts to integrate climate change adaptation into development and sectoral policies, plans and programs	Sector "Energy": a growing focus on increasing the resilience of infrastructures by operators; greater integration of adaptation in sector emergency planning (risk-preparedness, preventive action and emergency plans, operators' contingency plans, more significant capacity building); consideration and greater visibility of adaptation to climate change in plans and programmes associated with national policies.
Forests	Integration of indigenous, traditional and local	Sector "Forests": following the fires, the development of various actions to produce forest reproductive material, reinforcing the focus on more well adapted native species (strengthening the respective harvest and production in public nurseries); the implementation of fuel management

Title	Area of good practices	Good practices and lessons learnt
	knowledge into climate adaptation	areas; the implementation of initiatives, such as the CELPA Projects: Best Eucalyptus; Clean & Fertilise Programme and the Replant Programme. Also the increasing resilience of the Portuguese forests towards climate change is related to latest developments of specific criteria and forest engineer procedures (dealing with as erosion, wind and drought) and to the biotic agents, as well as investing in a sustainable fire prevention.
Health	Climate risk communication	Sector "Health": Improved risk communication and information to the population. The progressive participation of the various public health services and departments in the National Vector Surveillance Network (REVIVE), in the Plan for Seasonal Health Response – Winter Module and Summer Module and in the Water Sanitary Surveillance Programs, in collaboration with other entities, has allowed gains for the health resulting from knowledge and the better articulation of services.
Land use planning - Landscape Redevelopment and Management Programmes (PRGP)	Efforts to integrate climate change adaptation into development and sectoral policies, plans and programs	Sector "Land use planning": The Landscape Redevelopment and Management Programmes (PRGP)) are sectoral programmes designed to plan and programme the transformation of the landscape in vulnerable forest areas, with the aim of achieving a multifunctional and resilient landscape, new economic activities and remuneration for ecosystem services. The PRGP for Serras de Monchique and Silves was the first to be published, in 2022. By 2025, 20 PRGPs will have to be drawn up; the state of play can be seen at https://www.dgterritorio.gov.pt/paisagem/ptp/prgp
Land use planning - The National Landscape Award 2022	Institutional arrangements and governance at the national level	Sector "Land use planning": The 2022 edition of Award received 22 applications, 17 from local councils, 2 from municipal associations, 2 from non-governmental associations and one from the Autonomous Region of Madeira. The winning project, "Aldeias da Serra da Lousã", The 2022 edition of the National Landscape Award received 22 applications, 17 from local councils, 2 from municipal associations, 2 from non-governmental associations and one from the Autonomous Region of Madeira. The winning project 'Aldeias da Serra da Lousã', located in vulnerable territory, aimed to restore and revitalize a group of five villages with great natural and landscape value.
Land use planning - PDM GO Good practices for Municipal Master Plans	Efforts to integrate climate change adaptation into development and sectoral policies, plans and programs	Sector "Land use planning": the creation of the publication "PDM GO Good practices for Municipal Master Plans", which points out guidelines and methodologies that should be taken into consideration in the planning processes at the local scale, especially in the PDMs, concerning themes such as "the adaptation to climate change".
Land use planning - Guidelines and good practices for mainstreaming climate change	Efforts to integrate climate change adaptation into development and sectoral policies, plans and programs	Sector "Land use planning": guide designed to facilitate the integration into Municipal Master Plans of adaptation measures for the hazards covered by the RNA 2100, namely droughts, water scarcity, rural fires and coastal erosion, flooding and overflow.

Title	Area of good practices	Good practices and lessons learnt
adaptation into Municipal Master Plans		
Safety of people and assets	Disaster risk reduction and management, innovative adaptation solutions and innovative financing mechanisms	Sector "Safety of people and assets": Creating the Sub-Commission of the National Platform for Disaster Risk Reduction, where several good practice guides were produced: i. Handbook "Resilient Cities in Portugal" 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; v. Guidelines "Approach to audiences with specific needs within a scope of temporary shelter structure".
Transport	Disaster risk reduction and management, innovative adaptation solutions and innovative financing mechanisms	Sector "Transport": more focus on increasing the resilience of infrastructures by operators; greater integration of adaptation in the sector emergency planning and maintenance; consideration and greater visibility of adaptation to climate change in plans and programmes associated with national policies.
Communications	Disaster risk reduction and management, innovative adaptation solutions and innovative financing mechanisms	Sector "Communications": more focus on sharing infrastructure, increasing the resilience of those infrastructures and networks and, in the case of electronic communications on technological phase-out (shutdown of obsolete network equipment and cables); investment on lower consumption equipment; adoption of renewable energy or on-site production in all operations where this is possible; detailed mapping of energy consumption and identification of optimization opportunities and the use of backup batteries to ensure the continuity of the services; transition to 100% electrical or biodiesel vehicles to reduce the reliability of fossil fuels; promotion of a circular economy, on a green and transparent supply chain with residuals management, equipment reconditioning and the offer of recycled product; active peer-to-peer sharing of experience and practical knowledge.
Land use planning - Integrated landscape management areas (AIGP)	Disaster risk reduction and management, innovative adaptation solutions and innovative financing mechanisms	Sector "Land use planning": During 2021 and 2022, were set up a total of 71 integrated landscape management areas (AIGP), aimed at the common management and exploitation of agricultural and forestry spaces in small rustic property and high fire risk areas, in order to ensure greater resilience to fire and improve ecosystem services, while also promoting the revitalisation of these territories and adaptation to climate change, the valorisation of natural capital and the promotion of the rural economy.

At the national level, the review of the National Programme for Spatial Planning Policies (PNPOT) identified 10 commitments for the territory, reflecting the public policy priorities for territorial development and the strengthening of territorial approaches. Adaptation to climate change is reflected in the commitments "3 - Adaptation and resilience of territories" and "9 - Ensure that territorial management instruments reduce exposure to risks", to be implemented in the Action programme through measures that directly contribute to the response to climate change (the measure "1.7 Prevent risks and adapt the territory to climate change" stands out among others in the natural, social, economic and connectivity systems).

Within the framework of measure 1.7 and other measures aimed at enhancing the landscape, revitalizing forest areas and compensating for the services provided by ecosystems, the Landscape Transformation Programme (RCM 49/2020 of 24 June) has been established. This is a sectoral territorial management instrument that defines the strategy for vulnerable forest areas with a high fire risk.

Under this programme, specific programmatic measures were created to be applied in rural areas: the Landscape Conversion and Management Programmes (LCMP), the Integrated Landscape Management Areas (ILMA), the Integrated Landscape Management Operations (ILMO) and Village Condominiums.

The LCMPs outline the desired landscape and define a medium- to long-term transition matrix to achieve sustainable growth and territorial cohesion. A financing model to ensure their implementation supports them. The ILMAs aim at an integrated territorial approach to respond to the need to organize and manage the landscape and to increase the area of managed forest on a scale that promotes resilience to fires, the enhancement of natural capital and the promotion of the rural economy. In these areas, the necessary conditions are being created for the development of ILMOs, which will be implemented through a group management model under the responsibility of a management entity and supported by a long-term multi-fund programme that will provide support for initial investment, maintenance and management of actions over time, and remuneration for ecosystem services. The Village Condominium is an integrated support programme for villages located in forested areas. It aims to ensure fuel management around settlements, particularly in areas with high forest density and a high number and dispersion of small settlements, which are more vulnerable to the potential consequences of a rural fire. More information is available at https://www.dgterritorio.gov.pt/paisagem/ptp/.

In order to contribute to the promotion and integration of adaptation to climate change in land-use planning and to build better responses to the expected impacts, DGT conducted a review of the current panorama of adaptation to climate change in land-use plans and programmes as part of the "National Roadmap for Adaptation - RNA2100" project (Pre-defined EEA Grants project) and developed methodologies and criteria for integrating vulnerability to climate change and future impacts into local land-use planning.

The work was carried out in two phases. In the first phase, the relationship between climate adaptation and spatial planning was theoretically contextualized and the experiences of implementing adaptation in adaptation planning instruments (municipal and inter-municipal climate change adaptation plans and strategies) and territorial planning instruments, namely Municipal Master Plans were evaluated (https://rna2100.apambiente.pt/sites/default/files/inline-files/wp7b_eng_2_0.pdf). In the second phase of the work, ways of implementing adaptation in territorial management instruments were specified and guidelines were structured with a view to integrating adaptation to RNA2100 climate hazards (drought, forest fires, sea level rise, coastal erosion and flooding) in the context of the preparation of Municipal Master Plans (https://rna2100.apambiente.pt/sites/default/files/inline-files/wp8d_eng_2_0.pdf).

The municipal level was chosen as the central vehicle for climate adaptation because local government interventions, which are dispositive and binding on individuals, only exist in territorial plans, and because the whole country is covered by PDMs, the level at which the process of planning adaptation to climate change has most developed.

Another contribution to integrating new strategic content into the process of revising the Municipal Master Plans (PDM) was the publication of 'PDM GO - Good Practices for Municipal Master Plans', a document prepared by the National Territorial Commission (https://cnt.dgterritorio.gov.pt/) to support the work of municipalities, technical teams and monitoring bodies involved in the process of revising these plans, identifying and developing content on various themes, including adaptation to climate change.

Regarding nature and biodiversity, the Mediterranean biogeographic region has been identified as an area especially vulnerable to the most severe impacts of climate change and with a consequent lower capacity for adaptation. The operationalization of ENF, with regard to the protection of the forest against biotic agents, is developed in accordance with the following specific objectives, in line with the above: A. 4 Increase knowledge about the presence of harmful biotic agents A. 5 Reduce damage to forest ecosystems and consequent economic losses A. 6 Reduce the potential for introduction and installation of new harmful biotic agents A. 7 Increase scientific knowledge about harmful biotic agents. Increase adaptation capacity and promote active management of forest spaces, through planned interventions that consider the risks associated with climate change. Thus, it is possible to consider the use of practices that reduce impacts and are integrated into an adaptation process that is intended to be dynamic.

Regarding the European Research Infrastructures landscape, collaborations with European Research Infrastructures Consortia (ERICs) such as EPOS (European Plate Observation System), ECCSEL (European Carbon Dioxide Capture and Storage Laboratory Infrastructure), ACTRIS (Aerosols, Clouds and Trace gases Research Infrastructure), ICOS (Integrated Carbon Observation System), AnaEE (Infrastructure for Analysis and Experimentation on Ecosystems), LifeWatch (e-Infrastructure for Biodiversity and Ecosystem Research), EMSO (European Multidisciplinary Seafloor and water-column Observatory) and others with important roles in the study of climate change adaptation and mitigation, have been enabling the access to the respective research infrastructures, to training and sharing of good practices. The EU projects

ResInfra and ResInfraPlus with the participation of FCT, have been promoting EU-LAC relations in the scope of Research Infrastructures with priorities that include biodiversity and climate change.

Portugal participated in the implementation of the Union for the Mediterranean Roadmaps on Research and Innovation, an innovative approach between health, climate change and renewable energies towards future crises management in the Mediterranean. Through the 5+5 Dialogue in research, innovation and higher education, during the Portuguese Presidency 2022-2024, several actions took place to engage multi-stakeholder approach on the implementation of several structures at governmental level between the countries involved. Also in regards to the international cooperation between Europe and Africa, Portugal continues to participate on the policy dialogue on research and innovation and on its implementation of through the "Long-Term Joint EU-AU Research and Innovation Partnership on Renewable Energy" (LEAP-RE) programme for five years (2020-2025) to create a long-term partnership of African and European Stakeholders in a quadruple helix approach: government (programme owners and funding agencies), research and academia, private sector, and civil society. Impact will be sought by creating a framework, methodology, and cooperation model with the aim of reducing fragmentation by aligning existing bilateral and multilateral frameworks. LEAP-RE will establish and jointly implement research, innovation, and capacity-building activities contributing to SDG 7.

Portugal also participates in the Partnership for Research and Innovation in the Mediterranean Area (PRIMA), where during 2022 and 2023 FCT funded 26 research and innovation projects with an investment of 2,25M Euro producing key performance indicators towards climate change adaptation and resilience in food security and water scarcity in a nexus integration with energy in the Mediterranean.

In the frame of the EU-CELAC Common Research Area and its roadmap 2021-2023 where an expert group on research infrastructures discuss deeply three thematic areas health, climate change and biodiversity and EU and CELAC Research Infrastructure managers and experts had the opportunity to visit selected host infrastructures on both sides of the Atlantic and potential develop closer links or joint activities have been reported where Climate Change. A new Strategic Roadmap for the implementation of the Declaration of the EU-CELAC Summit 2023 welcome the existing and new activities, in particular on renewable energy and circular and sustainable bioeconomy, the emerging EU-LAC policy dialogue on the nature-based solutions, and multilateral initiatives, such as the Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services (IPBES) and the Intergovernmental Panel on Climate Change (IPCC), and others, and call for a closer cooperation on these topics across both regions.

FCT represents Portugal in the Joint Programming Initiative Cultural Heritage and Global Change (JPI CH). Considering that research on strategies, methodologies and tools to protect, strengthen, and adapt cultural heritage to climate threats, JPI CH promotes calls for international projects on this topic and launched in 2023 a call on "Climate & Cultural Heritage," in collaboration with JPI Climate and the Belmont Forum. Since 2022, FCT integrates Alliance for Research on Cultural Heritage in Europe (ARCHE), a coordination and support action funded by Horizon Europe aimed at developing a pan-European framework for a holistic approach to cultural heritage research and

innovation for the preparation of the future European Partnership in Resilient Cultural Heritage. Among other activities, the ARCHE consortium held in April 2024 a workshop around "Resilient cultural heritage in times of climate crisis".

FCT's Polar Programme's mission is to promote and support the development of Portuguese polar science and thus contribute to improving our understanding of how the planet works and responds to human pressures, increasing our ability to predict potential effects for the future. Since 2011, has endorsed the implementation of 13 annual Polar Campaigns through the financing of competitive calls to support research projects carrying out field work at the Poles, funding a total of127 projects.

Under the Protocol of Cooperation between the Ministry of Science, Technology and Higher Education of the Portuguese Republic (MCTES) and the Ismaili Imamat, signed in 2016, FCT and Aga Khan have launched two calls for joint projects, tackling topics of global importance (including adaptation to climate change), promoting multidisciplinary collaboration and securing resources of sufficient amount and duration towards the advance in Quality of Life (QOL) in Portugal and in Africa.

Helping developing countries to identify effective adaptation practices, needs, priorities, and challenges and gaps in a way that is consistent with encouraging good practices

Adopted by the Government in December 2022 by the Resolution of the Council of Ministers n.º 121/2022, the 2030 Portuguese Development Cooperation Strategy (PDCS 2030) provides political guidance to the Portuguese Cooperation, integrating the environment and the fight against climate change, prioritizing adaptation practices and needs in developing countries.

The Strategy follows the 5 "P"s architecture of the 2030 Agenda, addressing the "Planet pillar" on its Axis 5 (Strengthening sustainability and resilience). The priority action 5A addresses climate action and just green transition, by supporting developing countries to seize opportunities in the transition towards more sustainable economic development patterns, notably in the energy, agriculture, water and sanitation, waste management and biodiversity sectors in bilateral, triangular and multilateral dimensions. Therefore, Portuguese cooperation's actions in this area prioritise the support for climate mitigation and adaptation processes in partner countries, being also in line with international commitments, especially under the Paris Agreement.

Also a note for the Joint Multiannual Programme for Development Cooperation in the Areas of Environment and Climate Action to 2030 - Adopted by the former Government (Order n.º 9253/2023, September 8th) from the Ministers of Foreign Affairs and Environment and Climate Action, that strengthens the framework of transparency in the area of financing and climate action - as provided for in Article 10(1) of the Paris Agreement – following recommendations for the integration of environment and climate change issues into development cooperation.

Strengthening scientific research and knowledge

Research on climate

CoLABs (Collaborative Labs) and CTI (Technology and Innovation Centres) play an essential role in supporting innovation in several areas, including adaptation to climate change. Both types of institutions aim to promote applied research, knowledge transfer and the creation of technological solutions to address social and economic challenges, such as those caused by climate change.

The Collaborative Laboratories' mission is to stimulate collaboration between scientific research entities, companies and other public and private organizations, focusing on concrete problems and impact on society. In the area of climate change adaptation, CoLABs' activities may include:

- Research and development of technological solutions to mitigate the impacts of climate change in key sectors such as agriculture, energy, and water resources.
- Environmental monitoring projects to predict and reduce the effects of extreme weather events, such as floods, droughts or forest fires.
- Creating new sustainable materials and technologies that reduce the carbon footprint, increase the resilience of infrastructure and promote energy efficiency.
- Training and capacity building programs for companies and communities, allowing effective adaptation to climate change, as well as the incorporation of sustainability strategies.
- Solutions for the circular economy and sustainable use of natural resources, including water reuse and waste reduction.

The Technological Interface Centres (CTI) are focused on the transfer of knowledge and technology between the scientific sector and companies, helping to transform research into practical solutions. In the area of adaptation to climate change, the CTI develop activities such as:

- Development of energy efficiency technologies for buildings and industrial processes, helping to reduce energy consumption and greenhouse gas emissions.
- Innovation in water resources management to address water scarcity, creating solutions for water reuse and efficiency, crucial in a drought scenario.
- Support for companies in the implementation of sustainability and climate resilience measures, with eco-efficiency and resource management projects.
- Creation of intelligent environmental monitoring systems, such as sensors and digital platforms that help predict changes in local climate conditions.

Both CoLABs and CTIs have a key role in creating a more resilient and climate-adapted future by working with businesses and the public sector to implement sustainable and robust innovations.

Moreover, at the institutional level, FCT awards the statute of "Associate Laboratory", to research units or consortia of units. These institutions are formally consulted by the Government on the definition of programs and instruments of the national scientific and technological policy. Within this landscape of relevance are the Centre for Ecology, Evolution and Environmental Changes (Ce3C); Centre for Environmental and Marine Studies (CESAM); Risks and Sustainability in Construction (RISCO); Centre for the Research and Technology of Agro-Environmental and

Biological Sciences (CITAB); Linking Landscape, Environment, Agriculture and Food (LEAF); Mediterranean Institute for Agriculture, Environment and Development (MED).

Furthermore, the AIR Centre, co-founded and financially supported by FCT, serves as an international collaborative framework addressing global challenges and local priorities in the Atlantic Ocean. It promotes an integrative approach to climate and ocean issues, supported by emerging technological innovations and advancements in space, renewable energy and data science.

Research on vulnerability, adaptation, monitoring, and evaluation

The National Roadmap for Adaptation 2100 (RNA 2100), which assessed the vulnerabilities of Portuguese territory to climate change in the 21st century, was a project funded by EEA Grants, coordinated by the Portuguese Environment Agency (APA) which had several institutional partners. One of the most relevant was the Faculty of Sciences of the University of Lisbon (FCUL), which updated the reference climate scenarios for Portugal, as well as the assessment of climate risks with a special focus on modelling impacts on coastal areas, water resources, agroforestry and the field of fires.

The Portuguese National Innovation Agency (ANI) points out to the following: Portugal is the country with the largest number of signatories (48) at the Climate Change Adaptation Mission (303 signatories in total, followed by Spain, France and Greece. Portugal gathers 14 entities that support its objectives.

Within the context of Horizon Europe (HE) projects funded under the Climate Change Adaptation Mission, Portugal has already raised 20.36 M€ out of 371.32 M€ financed by the mission, with a success rate of 33.33% (higher than the European average of 25%); 60 different entities participate in 18 projects funded by the Adaptation mission;13 Higher Education Institution; 3 Large Companies; 7 SMEs;13 Research Centers; 24 other different entities including Municipalities.

The Directorate-General for Territory (DGT), the Portuguese Institute of the Sea and Atmosphere (IPMA), the Bank of Portugal (BP) and the Norwegian Directorate of Civil Protection (DSB) also collaborated on this project.

The FCT funds devoted to PhD students, contract positions and projects for 2023 and 2024, allocated to Vulnerability, Adaptation, Monitoring, and Evaluation reach at least in these categories the following amounts:

- PhD fellowships 0,96 M€;
- Research position contracts 3,9 M€;
- R&D projects 3,4 M€.

5 INFORMATION ON FINANCIAL, TECHNOLOGY DEVELOPMENT AND TRANSFER AND CAPACITY-BUILDING SUPPORT PROVIDED AND MOBILIZED UNDER ART.9–11 OF THE PARIS AGREEMENT

5.1 National circumstances, institutional arrangements

Portugal (PT) adopted the Portuguese Development and Cooperation Strategy 2030 in 2022. This strategy is fully aligned with the 2030 Agenda for Sustainable Development and the Paris Agreement, and it has a whole pillar dedicated to Climate Action and Green Transition which aims to support developing countries to address climate change goals by supporting partner countries to seize opportunities in transition towards more sustainable economic development patterns, notably in the energy, agriculture, water and sanitation, waste management and biodiversity sectors in bilateral, triangular and multilateral dimensions. (PDCS 2030 | https://www.instituto-camoes.pt/images/img_noticias2022_1/ECP2030_Triptico_EN.pdf)

Furthermore, the climate cooperation budget planning in PT is an annual exercise that involves a wide range of institutions, such as Camões - Institute for Cooperation and Language, I.P. (Ministry of Foreign Affairs and the Ministry of Environment and Energy, which plays an important role through the Environmental Fund. The Environmental Fund (FA) is a National Fund that aims to support environmental policies for the pursuit of the Sustainable Development Goals of the United Nations 2030 Agenda, 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.

Through the joint Order n.º 9253/2023, of 8th September, elaborated by the Ministers of Foreign Affairs and Environment and Climate Action, it was adopted the establishment of a Joint Multiannual Programme for Development Cooperation in the Areas of Environment and Climate Action to 2030, that strengthens the framework of transparency in the area of financing and climate action - as provided for in Article 10(1) of the Paris Agreement - and follows up on the DAC/OECD recommendations regarding policy coherence, particularly to concerning the integration of environment and climate change issues into development cooperation.

Regarding the Development cooperation model, Portugal has a descentralized approach which means a permanent intergovernmental and institutionally collaboration between Camões – Institute for Cooperation and Language, I.P. (Ministry of Foreign Affairs), as the portuguese's development coordinator entity, and the Ministry of Environment and Energy as the responsible for the thematic area.

The Portuguese Cooperation (ptCoop) is mainly directed towards geographic territories and sectoral areas where Portugal has greater intervention capacity and can achieve better results, taking into account the interconnection between the needs and priorities of partner countries and the recognized added value of ptCoop action, namely in view of other partners.

Thus, ptCoop focuses on different degrees of geographic prioritization, according to principles of concentration and differentiation, with the first level comprising the Portuguese speaking African countries (PALOP) and Timor-Leste and, in a second level, countries and regions of strategic interest where Portugal has comparative adfed value, namely in Africa and, in particular, in North Africa and West Africa, as well as in Latin America.

When initiatives or activities include several lusophone countries, the Portuguese Speaking Countries Community (CPLP) Climate Change Network is usually consulted about its interest and relevance. Most of these countries are Least Developed Countries (LDC) and/or Small Island Developing States (SIDS).

Annually, a ministerial order establishes the funds to be granted by the FA that same year. These ministerial orders set out the financial contribution of the Environmental Fund to development cooperation projects dedicated to climate change in Portuguese speaking countries and other countries, through the signature of bilateral Protocols or Memorandums of Understanding with recipient countries, in compliance with international obligations under the Paris Agreement.

Consequently, the mainly limitation of the support provided and mobilized by Portugal under the Articles 9 - 11 of the Paris Agreement is based on the budgetary planning which is only made on a yearly basis, both for the development cooperation funds and the Environmental Fund which are the main national sources of funding for development cooperation projects addressing climate change. Moreover, other difficulty from Portugal relies on the absence of monitoring private financing as well as on how to develop a regulatory framework to incentivize further private climate financing and investment and its respective monitoring.

Portugal has made significant strides in enhancing the comparability and accuracy of information reported on financial support provided and mobilized through public interventions. Portugal as member of the OECD, which promotes international cooperation and standards in various areas, including financial reporting bases the statistical information included in this document on the Development Assistance Committee (DAC/OECD), Creditor Reporting System (CRS) directives and on the "Rio Markers" methodology for climate change mitigation and adaptation.

Applying the Rio Markers, which include mitigation and adaptation to Climate Change (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:

1. 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.
2. As a 'significant' objective (score "1"): when the objective (mitigation or adaptation) 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.

3. 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) 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 X1). 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 the same range of coefficients detailed in the Table 5.1.

Table 5.1 – Coefficients considered to estimate climate finance flows.

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

5.2 Underlying assumptions, definitions and methodologies

The financial resources towards the Portuguese Cooperation for climate change comes from Environmental Fund (FA) which was established in 2016, by the Decree-Law 42- A/ 2016 of 12th of August. According to 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 Ministry of Environment and Energy. This instrument supports environmental policies for the pursuit of Sustainable Development Objectives, contributing to the achievement of national and international objectives and commitments, particularly 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.

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".

Portugal does not have yet, in terms of development cooperation in the context of climate change, a strong tradition of mobilizing private financing. Moreover, Portugal is not being able to monitoring the private funding mobilized.

Thereby, in 2021 and 2022, Portugal's public climate finance for programs, projects and actions (PPA) in partner countries was established through Official Development Assistance (ODA). In Portugal, ODA for environment and climate change has had limited expression regarding total values by virtue of the strategic priorities that essentially lies 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.

Currently, and according to national legislation, all the PPA financed by the FA should be account as ODA and must have a previous favorable appraisal and approval by Camões, I.P. as development co-operation national coordinator entity. As a EU Member State, Portugal made the commitment to mobilize 0.15% to 0.20% of its GNI as ODA allocated to Less Developed Countries by 2030.

Thus, the financial flows provided by this Public Fund are additional to conventional ODA sources. Therefore, the financial contribution of the FA counts as ODA but is an independent and new source that relies entirely on the Fund's independent and autonomous revenues.

Bearing in mind that financing ODA projects is not a core objective of FA, Portugal considers that the financing provided by the FA to activities that aim to help developing countries fight climate change and at the same time to have a carbon neutral and resilient development economy is new or additional to the conventional sources of ODA flows (Table 5.2 and Table 5.3).

Table 5.2 - New and additional financial resources (2021).

Source of Flows	**Climate Change Mitigation*** Total Amount (€)/ USD	**Climate Change Adaptation*** Total Amount (€)/USD
Total of disbursements from the Portuguese Environmental Fund	1 160 492.00/ 1 277 463.74	509 855.00/ 560 280.22

Table 5.3 - New and additional financial resources (2022).

Source of Flows	**Climate Change Mitigation*** Total Amount (€)/USD	**Climate Change Adaptation*** Total Amount (€)/USD
Total of disbursements from the Portuguese Environmental Fund	1 475 459.40/ 1 553 115.16	419 843.00/ 441 940

*Only Principal Objective was considered.

As mentioned in the previous chapter 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.

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 (article 2.1a);
- 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 (articles 2.1b and 7).

Since, Portugal has a decentralized model of cooperation, the 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. These bilateral Protocols were aimed to support sectors such as agriculture, water supply and sanitation, reconstruction and disaster prevention.

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.

Furthermore, Portugal has implemented several measures to avoid double counting in its climate financing support, particularly concerning tracking and reporting and coordination and collaboration.

With regards to tracking and reporting Portugal maintains a centralized database to track all climate finance flows. This database is under the responsability of Camões I.P. and ensures that each project is accounted for only once. Moreover, Portugal reports its climate finance activities to international bodies like the UNFCCC, OECD and EU on an annual or biennual basis, using standardized methodologies to ensure consistency and avoid double counting.

On the coordination and collaboration, Portugal has established a mechanism for inter-ministerial coordination between the Ministry of Environment and Energy and the Ministry of Foreign Affairs to ensure that different actors are working together to avoid double counting and maximize the effectiveness of climate finance.

In the case of the finance provided to support climate action by the multilateral institutions such as the UNFCCC, the World Bank and different regional Development Banks, these financing consisted in grants and it was disbursed in the coming months after the signature of the respective Protocol. Besides, the multilateral finance reported by Portugal is fully based on the country's share in the outflow of the multilateral institutions. Furthermore, the amount of multilateral finance reported should be classified as general finance, once the climate finance amount would be transfer into developing on the programming choice of these institutions.

5.3 Information on financial support provided and mobilized under Article 9 of the Paris Agreement

5.3.1 Bilateral, regional and other channels

In 2021, the total bilateral financial flows amounted to 2 153 78.00€, and in 2022 this total reached the amount of 3 213 555,40 €. The fully amount of the bilateral flows disbursed in these years corresponds to grants.

Table 5.4 - Total amount disbursed by country in 2021 and 2022.

Bilateral Cooperation	2021 Value €	2021 Value USD	2022 Value USD	2022 Value €
Guiné-Bissau	11 040.00	12 131.87	48 257.89	45 845.00
Cape Verde	683 216.00	750 786.81	430 693.47	409 158.80
Angola	73 180.80	80 418.46	335 255.20	335 255.20
São Tomé e Príncipe	575 978.00	632 942.86	1 717 884.42	1 631 800.20
Mozambique	178 915.80	196 610.77	429 065.26	407 612.00
East Timor	273 307.00	300 337.36	64 344.00	61 126.80
Senegal	4 000.00	4395.60	9.26	8.80
El Salvador	9 549.20	10 493.63	24 808.42	23 568.00
Colombia	431 133.00	473772.53	104 736.84	99 500.00
Developing countries not specified	NA	NA	199 544,63	189 567.40
LDCs unspecified	132 575.60	145 687.47	NA	NA
Quenia	NA	NA	10 645.47	10 113.20
Cote D'Ivoire	130 000.00	142 857.14	NA	NA
Argentina	200 000.00	219 780.22	NA	NA
Bosnia and Herzegovina	142 000.00	156 043.96	NA	NA
Total	**2 702 895**	**2 970 215**	**3 382 690**	**3 213 555**

Table 5.5 - Climate Change related ODA – Mitigation.

Year	Bilateral ODA Mitigation TOTAL (€)	Bilateral ODA Mitigation TOTAL (USD)
2021	981 312.00	1 078 364.84
2022	1 516 584.80	1 596 405.05

Table 5.6 - Climate Change related ODA – Adaptation.

Year	Bilateral ODA Adaptation TOTAL (€)	Bilateral ODA Adaptation TOTAL (USD)
2021	1 023 575.00	1 124 807.69
2022	1 564 571.40	1 646 917.26

Table 5.7 - Climate Change related ODA – Cross-cutting.

Year	Bilateral ODA Cross-cutting TOTAL (€)	Bilateral ODA Cross-cutting TOTAL (USD)
2021	168 691.00	185 374.73
2022	132 399.20	139 367.37

Table 5.8 - Total amount disbursed by sectors in 2021 and 2022.

Sectors	Amount in 2021		Amount in 2022	
	(€)	(USD)	(€)	(USD)
Agriculture	23 084.00	25 367.03	485 418. 80	510 967.16
Disaster Prevention	36 235.00	39 918.68		
Education			44 597.20	46 944.42
General Environment and Protection	805 128.00	884 756.04	2 000 131.20	2 105 401.26
Multisector	111 557.00	122 590.11	323 880.00	340 926.32
Promotion of Development Awareness	16 434.00	18 059.34	58 252.20	61 318.11
Reconstruction, relief and rehabilitation	41 139.00	45 207.69	131 516.40	138 438.32
Transports			20 800.00	21 894.74
Tourism			22 531.20	23 717.05
Water Supply and Sanitation	734 000.00	806 593.41	85 000.00	89 473.68

5.3.2 Multilateral channels

In 2021, the public financial support provided through multilateral channels amounted 10 234 287 €. In 2022 this amount reached 1 034 442,06 €.

Table 5.9 - Portuguese public financial support provided through multilateral channels in 2021 and 2022.

Year	Multilateral Institution	Title	Provided Core (€)	Provided Core (USD)
2021	UNFCCC	Contribution to UNFCC	54 611.00	60 012.09
	Inter-American Development Bank	Inter-American Development Bank	95 553.00	105 003.30
	World Bank	World Bank	4 850 000.00	5 329 670.33
	African Development Bank	African Development Bank	5 112 000.00	5 617 582.42
	Asian Development Bank	Asian Development Bank	30 000.00	32 967.03
	United Nations Development Programme	United Nations Development Programme	42 123.00	46 289.01
	United Nations Environment Programme	United Nations Environment Programme	50 000.00	54 945.05
2022	UNFCCC	Contribution to UNFCCC	34 432.06	36 244.27
	UNFCCC	UNFCCC Adaptation Fund	1 000 000.00	1 052 631.58

5.3.3 Information on finance mobilized through public interventions

Portugal does not have yet, in terms of development cooperation in the context of climate change, a strong tradition of mobilizing private financing as well as of tracking the private financing mobilized. Hence, all the amounts provided in the BTR are concerned to public finance.

5.4 Information on support for technology development and transfer provided under Article 10 of the Paris Agreement

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 now.

5.5 Information on capacity-building support provided under Article 11 of the Paris Agreement

In general, the PPAs supported by the Portuguese cooperation also have a strong component of technical assistance targeted at national capacity-building. Neverthless, since the methodological approach taken by Portugal is based on CRS directives and "Rio Markers" methodology, is not being possible, until now, to track data by component (capacity-building and/or technology transfer).

ANNEXES

ANNEX I: COMMON TABULAR FORMATS ON INFORMATION NECESSARY TO TRACK PROGRESS

Description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates[a]

Description	
Target(s) and description, including target type(s), as applicable[b, c]	**Economy-wide net domestic reduction of at least 55% in greenhouse gas emissions by 2030 compared to 1990.** **The term 'domestic' means without the use of international credits.** **Target type: Economy-wide absolute emission reduction.**
Target year(s) or period(s), and whether they are single-year or multi-year target(s), as applicable	**Single year target, 2030.**
Reference point(s), level(s), baseline(s), base year(s) or starting point(s), and their respective value(s), as applicable	**Base year: 1990.** **Net greenhouse gas emissions level in 1990:** **4 699 405 kt CO2eq.**
Time frame(s) and/or periods for implementation, as applicable	**2021-2030**
Scope and coverage, including, as relevant, sectors, categories, activities, sources and sinks, pools and gases, as applicable	**Geographical scope: EU Member States (Belgium, Bulgaria, Czechia, Denmark, Germany, Estonia, Ireland, Greece, Spain, France, Croatia, Italy, Cyprus, Latvia, Lithuania, Luxembourg, Hungary, Malta, Netherlands, Austria, Poland, Portugal, Romania, Slovenia, Slovakia, Finland, Sweden) including EU outermost regions (Guadeloupe, French Guiana, Martinique, Mayotte, Reunion, Saint Martin (France), Canary Islands (Spain), Azores and Madeira (Portugal)).** **Sectors covered, as contained in Annex I to decision 5/CMA.3:** **Energy** **Industrial processes and product use** **Agriculture** **Land Use, Land Use Change and Forestry (LULUCF)** **Waste** **International Aviation: Emissions from civil aviation activities as set out for 2030 in Annex I to the EU ETS Directive are included only in respect of CO2 emissions from flights subject to effective carbon pricing through the EU ETS. With respect to the geographical scope of the NDC these comprise emissions in 2024-26 from flights between the EU Member States and departing flights to Norway, Iceland, Switzerland and United Kingdom.** **International Navigation: Waterborne navigation is included in respect of CO2, methane (CH4) and nitrous Oxide (N2O) emissions from maritime transport voyages between the EU Member States.** **Gases:** **Carbon Dioxide (CO2)** **Methane (CH4)** **Nitrous Oxide (N2O)** **Hydrofluorocarbons (HFCs)** **Perfluorocarbons (PFCs)** **Sulphur hexafluoride (SF6)** **Nitrogen trifluoride (NF3)** **The included LULUCF categories and pools are as defined in decision 5/CMA.3.**

Intention to use cooperative approaches that involve the use of ITMOs under Article 6 towards NDCs under Article 4 of the Paris Agreement, as applicable	**The EU's at least 55% net reduction target by 2030 is to be achieved through domestic measures only, without contribution from international credits.** **The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA.**
Any updates or clarifications of previously reported information, as applicable[d]	**The information on the NDC scope contains clarifications/further details compared to the information provided in the updated NDC of the EU.**

Note: This table is to be used by Parties on a voluntary basis.

[a] Each Party shall provide a description of its NDC under Article 4, against which progress will be tracked. The information provided shall include required information, as applicable, including any updates to information previously provided (para. 64 of the MPGs).

[b] For example: economy-wide absolute emission reduction, emission intensity reduction, emission reduction below a projected baseline, mitigation co-benefits of adaptation actions or economic diversification plans, policies and measures, and other (para. 64(a) of the MPGs).

[c] Parties with both unconditional and conditional targets in their NDC may add a row to the table to describe conditional targets.

[d] For example: recalculation of previously reported inventory data, or greater detail on methodologies or use of cooperative approaches (para. 64(g) of the MPGs).

Structured summary: Description of selected indicators

Indicator(s) selected to track progress[a]	***Description***
Annual total net GHG emissions	**Annual total net GHG emissions consistent with the scope of the NDC in CO2eq.**
Information for the reference point(s), level(s), baseline(s), base year(s) or starting point(s), as appropriate[b]	**The reference level is total net GHG emissions of the EU in the base year (1990). The reference level value for the EU is 4 699 405 kt CO2eq.**
Updates in accordance with any recalculation of the GHG inventory, as appropriate	**This is the first time the reference level is reported, hence there are no updates.** **The value of the reference level may be updated in the future due to methodological improvements to the EU GHG inventory and to the determination of international aviation and navigation emissions in the NDC scope.**
Relation to NDC[c]	**The indicator is defined in the same unit and metric as the target of the NDC. Hence it can be used directly for tracking progress in implementing and achieving the NDC target.**

Notes: (1) Pursuant to para. 79 of the MPGs, each Party shall report the information referred to in paras. 65–78 of the MPGs in a narrative and common tabular format, as applicable. (2) A Party may amend the reporting format (e.g. Excel file) to remove specific rows in this table if the information to be provided in those rows is not applicable to the Party's NDC under Article 4 of the Paris Agreement, in accordance with the MPGs. (3) The Party could add rows for each additional selected indicator and related information.

[a] Each Party shall identify the indicator(s) that it has selected to track progress of its NDC (para. 65 of the MPGs).

[b] Each Party shall provide the information for each selected indicator for the reference point(s), level(s), baseline(s), base year(s) or starting point(s) and shall update the information in accordance with any recalculation of the GHG inventory, as appropriate (para. 67 of the MPGs).

[c] Each Party shall describe for each indicator identified how it is related to its NDC (para. 76(a) of the MPGs).

Structured summary: Definitions needed to understand NDC

Definitions[a]	
Definition needed to understand each indicator:	
Annual total net GHG emissions	**Total net GHG emissions correspond to the annual total of emissions and removals reported in CO2 equivalents in the latest GHG inventory of the EU. The totals comprise all sectors and gases listed in the table entitled 'Reporting format for the description of a Party's nationally determined contribution under Article 4 of the Paris Agreement, including updates.' Indirect CO2 emissions are included from those Member States that report these emissions.**
Any sector or category defined differently than in the national inventory report:	
Sector	**Not applicable**
Category	**Not applicable**
Definition needed to understand mitigation co-benefits of adaptation actions and/or economic diversification plans:	
Mitigation co-benefit(s)	**Not applicable**
Any other relevant definitions:	
Any other relevant definitions	**Not applicable**

Notes: (1) Pursuant to para. 79 of the MPGs, each Party shall report the information referred to in paras. 65–78 of the MPGs in a narrative and common tabular format, as applicable. (2) A Party may amend the reporting format (e.g. Excel file) to remove specific rows in this table if the information to be provided in those rows is not applicable to the Party's NDC under Article 4 of the Paris Agreement, in accordance with the MPGs. (3) The Party could add rows for each additional sector, category, mitigation co-benefits of adaptation actions and/or economic diversification plans, indicator and any other relevant definitions.

[a] Each Party shall provide any definitions needed to understand its NDC under Article 4, including those related to each indicator identified in para. 65 of the MPGs, those related to any sectors or categories defined differently than in the national inventory report, or the mitigation co-benefits of adaptation actions and/or economic diversification plans (para. 73 of the MPGs).

Reporting requirement	***Description or reference to the relevant section of the BTR***
For the first NDC under Article 4:[a]	
Accounting approach, including how it is consistent with Article 4, paragraphs 13–14, of the Paris Agreement (para. 71 of the MPGs)	**Net GHG emissions, calculated from emissions and removals from the GHG inventory of the EU and supplemented with data on international aviation and navigation collected in the Joint Research Centre's Integrated Database of the European Energy System (JRC-IDEES), are used to quantify progress towards implementing and achieving of the NDC in respect of the NDC target. This approach promotes environmental integrity, transparency, accuracy, completeness, comparability and consistency and ensures the avoidance of double counting, as described below. Existing methods and guidance under the Convention are taken into account, as described below.**
For the second and subsequent NDC under Article 4, and optionally for the first NDC under Article 4:[b]	
Information on how the accounting approach used is consistent with paragraphs 13–17 and annex II of decision 4/CMA.1 (para. 72 of the MPGs)	**The European Union accounts for anthropogenic emissions and removals corresponding to its NDC consistent with paragraphs 13–17 and annex II of decision 4/CMA.1, as detailed below.**
Explain how the accounting for anthropogenic emissions and removals is in accordance with methodologies and common metrics assessed by the IPCC and in accordance with decision 18/CMA.1 (para. 1(a) of annex II to decision 4/CMA.1)	**The accounting for anthropogenic emissions and removals is based on the data contained in the EU GHG inventory, which is compiled in accordance with the 2006 IPCC Guidelines. The accounting for emissions from international aviation and navigation in the scope of the NDC is based on activity data, emission factors and methods which are in line with the IPCC guidelines. The accounting approach is also in accordance with decision 18/CMA.1 because the EU GHG inventory conforms with the provisions of chapter II of the Annex to decision 18/CMA.1.**
Explain how consistency has been maintained between any GHG data and estimation methodologies used for accounting and the Party's GHG inventory, pursuant to Article 13, paragraph 7(a), of the Paris Agreement, if applicable (para. 2(b) of annex II to decision 4/CMA.1)	**The GHG data used for accounting is based on the GHG inventory of the EU. The methodology used for accounting consists of a balancing of GHG emissions and removals, which is consistent with the methodologies used in the GHG inventory of the EU.**
Explain how overestimation or underestimation has been avoided for any projected emissions and removals used for accounting (para. 2(c) of annex II to decision 4/CMA.1)	**Not applicable. Projected emissions and removals are not used for accounting.**
For each NDC under Article 4:[b]	
Accounting for anthropogenic emissions and removals in accordance with methodologies and common metrics assessed by the IPCC and adopted by the Conference of the Parties serving as the meeting of the Parties to the	

Paris Agreement (para. 12(a) of decision 4/CMA.1 and para 1 of its annex II):	
Each methodology and/or accounting approach used to assess the implementation and achievement of the target(s), as applicable (para. 74(a) of the MPGs)	**The methodology used to assess the implementation and achievement consists of a comparison of the reduction of net GHG emissions from the GHG inventory national total, including a share of GHG inventory international aviation and navigation emissions in line with the NDC scope, with the NDC target. The EU will account for its cooperation with other Parties in a manner consistent with guidance adopted by the CMA.**
Each methodology and/or accounting approach used for the construction of any baseline, to the extent possible (para. 74(b) of the MPGs)	**Progress is tracked by comparing annual net emissions with net emissions in the base year. No baseline is constructed.**
If the methodology or accounting approach used for the indicator(s) in table 1 differ from those used to assess the implementation and achievement the target, describe each methodology or accounting approach used to generate the information generated for each indicator in table 4 (para. 74(c) of the MPGs)	**Progress is tracked by comparing annual net emissions with net emissions in the base year. No baseline is constructed.**
Any conditions and assumptions relevant to the achievement of the NDC under Article 4, as applicable and available (para. 75(i) of the MPGs)	**Not applicable. The NDC is unconditional.**
Key parameters, assumptions, definitions, data sources and models used, as applicable and available (para. 75(a) of the MPGs)	**Net GHG emissions are the key parameter used for tracking progress in implementing and achieving the NDC. The GHG inventory of the EU is the data source used. Details on assumptions, definitions and models used for determining net GHG emissions can be found in the National Inventory Document of the EU.**
IPCC Guidelines used, as applicable and available (para. 75(b) of the MPGs)	**2006 IPCC Guidelines; and 2019 refinement to the 2006 IPCC Guidelines for some source categories.**
Report the metrics used, as applicable and available (para. 75(c) of the MPGs)	**100-year time-horizon global warming potential (GWP) values from the IPCC Fifth Assessment Report.**
For Parties whose NDC cannot be accounted for using methodologies covered by IPCC guidelines, provide information on their own methodology used, including for NDCs, pursuant to Article 4, paragraph 6, of the Paris Agreement, if applicable (para. 1(b) of annex II to decision 4/CMA.1)	**Not applicable.**
Provide information on methodologies used to track progress arising from the implementation of policies and measures, as appropriate (para. 1(d) of annex II to decision 4/CMA.1)	**Progress arising from the implementation of policies and measures is expressed in a reduction of GHG emissions or increase of GHG removals.** **The methodology used to assess such progress is based on the estimation of GHG emissions and removals in the GHG inventory of the EU and on data on international aviation and navigation monitored in the Joint Research Centre's Integrated Database of the European Energy System (JRC-IDEES).**

Where applicable to its NDC, any sector-, category or activity-specific assumptions, methodologies and approaches consistent with IPCC guidance, taking into account any relevant decision under the Convention, as applicable (para. 75(d) of the MPGs):	
For Parties that address emissions and subsequent removals from natural disturbances on managed lands, provide detailed information on the approach used and how it is consistent with relevant IPCC guidance, as appropriate, or indicate the relevant section of the national GHG inventory report containing that information (para. 1(e) of annex II to decision 4/CMA.1, para. 75(d)(i) of the MPGs)	**Not applicable. To determine emissions and removals in the scope of the NDC, the EU does not disaggregate emissions and removals on managed land into those considered to result from human activities and those considered to result from natural disturbances.**
For Parties that account for emissions and removals from harvested wood products, provide detailed information on which IPCC approach has been used to estimate emissions and removals (para. 1(f) of annex II to decision 4/CMA.1, para. 75(d)(ii) of the MPGs)	**The EU accounts for emissions and removals from harvested wood products as an integral part of net GHG emissions and removals in the scope of the NDC. GHG emissions and removals from harvested wood products are determined in accordance with the production approach, as defined in Annex 12.A.1 to Volume 4 of the 2006 IPCC Guidelines for National GHG Inventories.**
For Parties that address the effects of age-class structure in forests, provide detailed information on the approach used and how this is consistent with relevant IPCC guidance, as appropriate (para. 1(g) of annex II to decision 4/CMA.1, para. 75(d)(iii) of the MPGs)	**The EU does not address the effects of age-class structure in forests in the accounting approach for its NDC.**
How the Party has drawn on existing methods and guidance established under the Convention and its related legal instruments, as appropriate, if applicable (para. 1(c) of annex II to decision 4/CMA.1)	**The EU has drawn on existing methods and guidance established under the Convention by using an NDC target which is an advancement of the quantified economy-wide emission reduction target for 2020, which was communicated and tracked under the Convention.**
Any methodologies used to account for mitigation benefits of adaptation actions and/or economic diversification plans (para. 75(e) of the MPGs)	**The NDC does not consist of mitigation co-benefits of adaptation actions and/or economic diversification plans. Hence these co-benefits were not accounted for, and no related methodologies were used.**
Describe how double counting of net GHG emission reductions has been avoided, including in accordance with guidance developed related to Article 6 if relevant (para. 76(d) of the MPGs)	**GHG emissions and removals from the EU's GHG inventory, complemented with JRCIDEES data for determining the share of emissions form international aviation and navigation in the NDC scope, are used for tracking the net GHG emission reductions. Emissions and removals are reported in line with IPCC guidelines, with the aim of neither overnor underestimating GHG emissions. GHG emissions and removals are reported by the EU and its Member States in their respective GHG inventories. For tracking progress towards implementing and achieving the EU NDC, only those net GHG emission reductions are counted which are reported at EU level. For cooperative approaches under Article 6, corresponding adjustments**

	are made in a manner consistent with guidance adopted by the CMA.
Any other methodologies related to the NDC under Article 4 (para. 75(h) of the MPGs)	**Not applicable.**
Ensuring methodological consistency, including on baselines, between the communication and implementation of NDCs (para. 12(b) of the decision 4/CMA.1 and para 1 of its annex II)):	
Explain how consistency has been maintained in scope and coverage, definitions, data sources, metrics, assumptions and methodological approaches including on baselines, between the communication and implementation of NDCs (para. 2(a) of annex II to decision 4/CMA.1)	**The scope, coverage, definitions, data sources, metrics and approaches are consistent between the communicated NDC and its implementation, as described in the BTR.**
Explain how consistency has been maintained between any GHG data and estimation methodologies used for accounting and the Party's GHG inventory, pursuant to Article 13, paragraph 7(a), of the Paris Agreement, if applicable (para. 2(b) of annex II to decision 4/CMA.1) and explain methodological inconsistencies with the Party's most recent national inventory report, if applicable (para. 76(c) of the MPGs)	**The GHG inventory of the EU is the primary source for the GHG data used for accounting.** **The share of GHG inventory emissions from international aviation and navigation in the scope of the NDC have been determined separately based on JRC-IDEES data, using emission factors and methodologies consistent with IPCC guidance. There are no methodological inconsistencies with the most recent national inventory report.**
For Parties that apply technical changes to update reference points, reference levels or projections, the changes should reflect either of the following (para. 2(d) of annex II to decision 4/CMA.1):	
Technical changes related to technical corrections to the Party's inventory (para. 2(d)(i) of annex II to decision 4/CMA.1)	**No technical changes related to technical corrections to the GHG inventory were applied to update reference points, reference levels or projections.**
Technical changes related to improvements in accuracy that maintain methodological consistency (para. 2(d)(ii) of annex II to decision 4/CMA.1)	**No technical changes related to improvements in accuracy were applied to update reference points, reference levels or projections.**
Explain how any methodological changes and technical updates made during the implementation of their NDC were transparently reported (para. 2(e) of annex II to decision 4/CMA.1)	**Methodological changes and technical updates are reported in the chapter entitled 'recalculations and improvements' of the National Inventory Document of the EU.** **GHG emissions from international aviation and navigation in the scope of the EU NDC are reported for the first time in this BTR (see Annex to the BTR).**
Striving to include all categories of anthropogenic emissions or removals in the NDC and, once a source, sink or activity is included, continuing to include it (para. 12 (c) of decision 4/CMA.1 and para. 3 of annex II to decision 4/CMA.1):	
Explain how all categories of anthropogenic emissions and removals corresponding to their NDC were accounted for (para. 3(a) of annex II to decision 4/CMA.1)	**The indicator used for tracking progress towards implementing and achieving the NDC target comprises all categories of anthropogenic emissions and removals corresponding to the NDC.**

Explain how Party is striving to include all categories of anthropogenic emissions and removals in its NDC, and, once a source, sink or activity is included, continue to include it (para. 3(b) of annex II to decision 4/CMA.1)	**The scope of the NDC of the EU covers all categories of emissions and removals reported in the GHG inventory, in line with IPCC guidelines. Member States report some specific source categories as 'not estimated' when the estimates would be insignificant as defined in paragraph 32 of the annex to decision 18/CMA.1. Information on these categories is provided in Common Reporting Table 9 of the respective Member States' GHG inventory submission. Besides including all sectors listed in decision 18/CMA.1, a share of emissions from international aviation and navigation are also included in the NDC scope.**
Provide an explanation of why any categories of anthropogenic emissions or removals are excluded (para. 12 (c) of decision 4/CMA.1 and para. 4 of annex II to decision 4/CMA.1)	**All categories of anthropogenic emissions and removals contained in the national total of the EU GHG inventory are included in the NDC.**
Each Party that participates in cooperative approaches that involve the use of ITMOs towards an NDC under Article 4, or authorizes the use of mitigation outcomes for international mitigation purposes other than achievement of its NDC	
Provide information on any methodologies associated with any cooperative approaches that involve the use of ITMOs towards an NDC under Article 4 (para. 75(f) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA, when applicable.**
Provide information on how each cooperative approach promotes sustainable development, consistent with decisions adopted by the CMA on Article 6 (para. 77(d)(iv) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA, when applicable.**
Provide information on how each cooperative approach ensures environmental integrity consistent with decisions adopted by the CMA on Article 6 (para. 77(d)(iv) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA, when applicable.**
Provide information on how each cooperative approach ensures transparency, including in governance, consistent with decisions adopted by the CMA on Article 6 (para. 77(d)(iv) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA, when applicable.**
Provide information on how each cooperative approach applies robust accounting to ensure, inter alia, the avoidance of double counting, consistent with decisions adopted by the CMA on Article 6 (para. 77(d)(iv) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA, when applicable, when applicable.**
Any other information consistent with decisions adopted by the CMA on reporting under Article 6 (para. 77(d)(iii) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted**

	by CMA1 and any further guidance agreed by the CMA, when applicable.

Notes: (1) Pursuant to para. 79 of the MPGs, each Party shall report the information referred to in paras. 65–78 of the MPGs in a narrative and common tabular format, as applicable. (2) A Party may amend the reporting format (e.g. Excel file) to remove specific rows in this table if the information to be provided in those rows is not applicable to the Party's NDC under Article 4 of the Paris Agreement, in accordance with the MPGs.

[a] For the first NDC under Article 4, each Party shall clearly indicate and report its accounting approach, including how it is consistent with Article 4, paras. 13–14, of the Paris Agreement (para. 71 of the MPGs).

[b] For the second and subsequent NDC under Article 4, each Party shall provide information referred to in chapter III.B and C of the MPGs consistent with decision 4/CMA.1. Each Party shall clearly indicate how its reporting is consistent with decision 4/CMA.1 (para. 72 of the MPGs). Each Party may choose to provide information on accounting of its first NDC consistent with decision 4/CMA.1 (para. 71 of the MPGs).

Structured summary: Tracking progress made in implementing and achieving the NDC under Article 4 of the Paris Agreement[a]

	Unit, as applicable	*Reference point(s), level(s), baseline(s), base year(s) or starting point(s), as appropriate (paras. 67 and 77(a)(i) of the MPGs)*	*Implementation period of the NDC covering information for previous reporting years, as applicable, and the most recent year, including the end year or end of period (paras. 68 and 77(a)(ii–iii) of the MPGs)*		*Target level[b]*	*Target year or period*	*Progress made towards the NDC, as determined by comparing the most recent information for each selected indicator, including for the end year or end of period, with the reference point(s), level(s), baseline(s), base year(s) or starting point(s) (paras. 69–70 of the MPGs)*
			2021	**2022**			
Indicator(s) selected to track progress of the NDC or portion of NDC under Article 4 of the Paris Agreement (paras. 65 and 77(a) of the MPGs):							
Annual total net GHG emissions	**kt CO_2 equivalent[39]**	**4 699 405**	**3 272 650**	**3 205 223**	**2 114 732**	**2030**	**The most recent level of the indicator is 31.8**

[39] Net GHG emissions in the scope of the NDC

							% below the base year level.
Where applicable, total GHG emissions and removals consistent with the coverage of the NDC (para. 77(b) of the MPGs)	**kt CO_2 equivalent**	**4 699 405**	**3 272 650**	**3 205 223**			
Contribution from the LULUCF sector for each year of the target period or target year, if not included in the inventory time series of total net GHG emissions and removals, as applicable (para. 77(c) of the MPGs)	**kt CO_2 equivalent**		**NA**	**NA**			
Each Party that participates in cooperative approaches that involve the use of ITMOs towards an NDC under Article 4 of the Paris Agreement, or authorizes the use of mitigation outcomes for international mitigation purposes other than achievement of the NDC, shall provide (para. 77(d) of the MPGs):							
If applicable, an indicative multi-year emissions trajectory, trajectories or budget for its NDC implementation period (para. 7(a)(i), annex to decision 2/CMA.3)	**kt CO_2 equivalent**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
If applicable, multi-year emissions trajectory, trajectories or budget for its NDC implementation period that is consistent with the NDC (para. 7(b), annex to decision 2/CMA.3)	**Not applicable**		**NA**	**NA**			
Annual anthropogenic emissions by sources and removals by sinks covered by its NDC or, where applicable, from the emission or sink categories as identified by the host Party pursuant to paragraph 10 of annex to decision 2/CMA.3 (para. 23(a), annex to decision 2/CMA.3) (as part of para. 77 (d)(i) of the MPGs)	**kt CO_2 equivalent**		**3 272 650**	**3 205 223**			
Annual anthropogenic emissions by sources and removals by sinks covered by its NDC or, where applicable, from the portion of its NDC in accordance with paragraph 10, annex to decision 2/CMA.3 (para. 23(b), annex to decision 2/CMA.3)	**kt CO_2 equivalent**		**3 272 650**	**3 205 223**			

If applicable, annual level of the relevant non-GHG indicator that is being used by the Party to track progress towards the implementation and achievement of its NDC and was selected pursuant to paragraph 65, annex to decision 18/CMA.1 (para. 23(i), annex, decision 2/CMA.3)	**Not applicable**		**NA**	**NA**			
Annual quantity of ITMOs first transferred (para. 23(c), annex to decision 2/CMA.3) (para. 77(d)(ii) of the MPGs)	**kt CO_2 equivalent**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
Annual quantity of mitigation outcomes authorized for use for other international mitigation purposes and entities authorized to use such mitigation outcomes, as appropriate (para. 23(d), annex to decision 2/CMA.3) (para. 77(d)(ii) of the MPGs)	**Not applicable**		**NA**	**NA**			
Annual quantity of ITMOs used towards achievement of the NDC (para. 23(e), annex to decision 2/CMA.3) (para. 77(d)(ii) of the MPGs)	**kt CO_2 equivalent**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
Net annual quantity of ITMOs resulting from paras. 23(c)-(e), annex to decision 2/CMA.3 (para. 23(f), annex to decision 2/CMA.3)	**kt CO_2 equivalent**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
If applicable, the cumulative amount of ITMOs, divided by the number of elapsed years in the NDC implementation period (para. 7(a)(ii), annex to decision 2/CMA.3)	**Not applicable**		**NA**	**NA**			
Total quantitative corresponding adjustments used to calculate the emissions balance referred to in para. 23(k)(i), annex to decision 2/CMA.3, in accordance with the Party's method for applying corresponding adjustments consistent with section III.B, annex to decision 2/CMA.3 (Application of corresponding adjustments) (para. 23(g), annex to decision 2/CMA.3)	**kt CO_2 equivalent**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
The cumulative information in respect of the annual information in para. 23(f), annex to decision 2/CMA.3, as applicable (para. 23(h), annex to decision 2/CMA.3)	**kt CO_2 equivalent**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			

For metrics in tonnes of CO_2 eq. or non-GHG, an annual emissions balance consistent with chapter III.B (Application of corresponding adjustment), annex, decision 2/CMA.3 (para. 23(k)(i), annex to decision 2/CMA.3) (as part of para. 77 (d)(ii) of the MPGs)	**kt CO_2 equivalent**		**To be reported in subsequent BTR**	**To be reported in subsequent BTR**			
For metrics in non-GHG, for each non-GHG metric determined by participating Parties, annual adjustments resulting in an annual adjusted indicator, consistent with para. 9 of chapter III.B (Corresponding adjustments), annex to decision 2/CMA.3, and future guidance to be adopted by the CMA (para. 23(k)(ii), annex to decision 2/CMA.3)	**Not applicable**		**NA**	**NA**			
Any other information consistent with decisions adopted by the CMA on reporting under Article 6 (para. 77(d)(iii) of the MPGs)	**The EU will account and report for its cooperation with other Parties in a manner consistent with the guidance adopted by CMA1 and any further guidance agreed by the CMA in a subsequent BTR or initial report, when applicable.**						

Notes: (1) Pursuant to para. 79 of the MPGs, each Party shall report the information referred to in paras. 65–78 of the MPGs in a narrative and common tabular format, as applicable. (2) A Party may amend the reporting format (e.g. Excel file) to remove specific rows in this table if the information to be provided in those rows is not applicable to the Party's NDC under Article 4 of the Paris Agreement, in accordance with the MPGs. (3) The Party could add rows for each additional selected indicator.

[a] This table could be used for each NDC target in case Party's NDC has multiple targets.

[b] Parties may provide information on conditional targets in a documentation box with references to the relevant page in their biennial transparency report.

ANNEX II: METHODOLOGY APPLIED FOR THE IDENTIFICATION OF GHG EMISSIONS FROM INTERNATIONAL AVIATION AND NAVIGATION IN THE SCOPE OF THE EU NDC

This annex contains common information for the EU and MS BTRs.

The scope of the EU NDC goes beyond national GHG emissions and removals in the scope of the national GHG inventory; it also includes specific emissions from international aviation and navigation. This annex describes the methodology for identifying these emissions.

International aviation and maritime emissions are estimated by using the Joint Research Centre's Integrated Database of the European Energy System (JRC-IDEES).[40] It allows to split the international transport CO2 emissions into intraEU/extraEU and intraEEA/extraEEA and the departing flights from the EU to the UK and Switzerland, categories backwards in time (i.e. 1990) (i.e. for the time period back to 1990).[41]

For international transport, JRC-IDEES applies a decomposition methodology that reconciles the scopes of available primary statistics and harmonises historical data on international aviation and maritime emissions, energy use, and transport activity. The resulting annual dataset covers 1990-2021 and distinguishes domestic, intra-EU/intra-EEA, and extra-EU/extra-EEA activity for each EU Member State, Norway and Iceland.

In aviation, JRC-IDEES distinguishes passenger and freight modes, with three geographical categories of flight origin/destinations for each mode: domestic, intra-EEA + UK, and extra-EEA + UK. Intra-EU, the UK, and EEA[42] categories are also used internally during calibration but aggregated for reporting. For each mode/category combination, JRC-IDEES estimates activity (as passenger-km or tonnes-km), energy use and CO2 emissions, aircraft stock (expressed as representative aircraft), load factors, and aircraft efficiencies. As country-specific activity statistics are not available, the decomposition first allocates EU-level activity data from the Transport Pocketbook[43] of the European Commission's Directorate-General for Mobility and Transport to each country and flight category.

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[40] European Commission, Joint Research Centre, Rózsai, M., Jaxa-Rozen, M., Salvucci, R., Sikora, P., Tattini, J. and Neuwahl, F., JRC-IDEES-2021: the Integrated Database of the European Energy System – Data update and technical documentation, Publications Office of the European Union, Luxembourg, 2024, doi:10.2760/614599.

[41] The JRC-IDEES analytical database is designed to support energy modelling and policy analysis, by combining primary statistics with technical assumptions to compile detailed energy-economy-emissions historical data for each key energy sector. For aviation, EEA emissions includes emissions related to the UK but not to Switzerland, where total CO2 emissions for the scope are additionally estimated from EUROCONTROL data.

[42] In this annex, EEA stands for European Economic Area, which comprises the 27 EU Member States, Iceland, Liechtenstein and Norway.

[43] Statistical pocketbook 2023, https://transport.ec.europa.eu/facts-funding/studies-data/eu-transport-figures-statistical-pocketbook/statistical-pocketbook-2023_en.

For passenger modes, this allocation calculates average load factors using Eurostat data on total passengers and flights. These load factors and total flight numbers are combined with average flight distances from EUROCONTROL, the pan-European organisation dedicated to air traffic management, to yield an initial estimate for passenger transport activity. For intra-EU activity, a uniform scaling factor is then applied across Member States to match total EU-level Transport Pocketbook data. Freight activity follows a similar process, using a 'representative flight' concept with a common load factor across all Member States to account for mixed passenger-freight flights.

Next, the decomposition estimates fuel use from EUROCONTROL data, by deriving a distance-dependent average aircraft efficiency, then applying it to the country-specific ensemble of flights and routes. The final step scales the estimates to meet Eurostat energy balances for total domestic and international consumption back to 1990 values, maintaining intra-EEA/extra-EEA fuel use ratios derived from EUROCONTROL. JRC-IDEES additionally reports resulting differences with submissions by Parties to the UNFCCC. The above process is followed throughout the entire decomposition period (1990-2021). Data gaps are estimated from the existing indicators as follows:

The process iterates backwards towards 1990, starting from the oldest years in which data is available in each Member State.

Average flight distance is kept constant for early years without EUROCONTROL data (generally before 2004).

If the load factor (passengers per flight) cannot be calculated due to a lack of passenger and/or flight data, it is estimated from the trend of the existing time series.

Missing numbers of flights are calculated from the load factor and the passengers carried.

If no passenger data is available, the total mileage is estimated from the energy consumption, and combined with average flight distance to estimate the number of flights. The number of flights is then combined with the load factor to estimate the total passengers carried.

For early years without data, constant values are assumed for the factors used to *i)* scale intra-EU activity to the Transport Pocketbook, *ii)* adjust the estimated fuel use to EUROCONTROL data for specific routes, and *iii)* scale this adjusted fuel use to Eurostat energy balances (e.g. before 1995 for Transport Pocketbook data; before 2004 for EUROCONTROL data).

For international maritime transport, JRC-IDEES estimates data both for intra-EU/extra-EU and intra-EEA/extra-EEA geographical categories. The emission estimates in the GHG inventory already include CO2, CH4, and N2O gases. Transport activity (tonnes-km) is estimated from Eurostat data on gross weight of transported goods, using port-level and country-level data for intra-EU and extra-EU categories, respectively. Intra-EU activities are then scaled to match the Transport Pocketbook totals, accounting for domestic coastal shipping (calibrated separately in JRC-IDEES). Next, transport activity is combined with data reported under the monitoring,

reporting and verification system for maritime transport under the EU ETS ('THETIS MRV'[44]), namely EU-level mileage data and country-specific vessel sizes to estimate load factors (tonnes per movement). The load factors and resulting annual mileage (km) are calibrated to meet EU-level THETIS MRV mileage. The annual mileage is in turn combined with THETIS MRV average efficiency to yield a total technical energy consumption, with corresponding emissions derived from default emissions factors. This energy consumption is scaled to Eurostat energy balances so as to minimise discrepancy to total intra-EU THETIS MRV emissions. As with aviation, JRC-IDEES reports corresponding differences to submissions under the UNFCCC. Early years with data gaps are estimated from existing indicators as follows:

The process iterates backwards towards 1990, starting from the oldest years in which data is available in each Member State.

Average distance of voyages is kept constant for early years without Eurostat activity data (generally before 1997-2000).

If the load factor (tonnes per movement) cannot be estimated due a lack of activity data, it is kept constant.

If activity data is not available, it is estimated from Eurostat energy consumption.

Missing mileage data is derived from the activity and load factor estimates.

For early years without data, constant values are assumed for the factors used to i) scale intra-EU activity to the Transport Pocketbook, ii) scale estimated mileage to meet EU-level THETIS MRV mileage, and iii) scale domestic and intra-EU CO2 emissions estimated from energy consumption so as to match total THETIS MRV CO2 emissions.

Finally, the ratios between the estimated MRV emissions and the CO2 emissions for the reported transport activity (for intra-EU/EEA and extra-EU/EEA categories) between 2018 and 2021 are used to calculate the MRV compliant estimates back to 1990 levels.

For the year 2022, the international navigation and aviation emissions under the EU NDC scope have been estimated by applying the same share of those emissions on the total international navigation and aviation emissions (as reported in the GHG inventory) as in 2021.

Aviation emissions covered by the EU NDC scope

Table AII.1 - *Aviation emissions covered by the EU NDC scope.*

Emissions	Domestic aviation	Intra-EEA aviation	Extra-EEA aviation

[44] THETIS MRV, https://mrv.emsa.europa.eu/#public/eumrv.

Current NDC commitment	Domestic EU flights (e.g. Palermo Milan)	Domestic "non-EU EEA" flights (e.g. Oslo to Bergen)	Flights between "non-EU EEA" countries (from Oslo to Reykjavik)	Flights within the EEA, departing from EU airports	Flights to/from EU airports to OMRs	Departing flights from EU airports to UK and Switzerland
Current NDC commitment	Yes	No	No	Yes	Yes From Jan 2024	Yes

Maritime navigation emissions covered by the EU NDC

Table AII.2 - *Maritime navigation emissions covered by the EU NDC.*

Emissions	**Domestic maritime navigation**		**International maritime navigation**				**Within ports**	
	Voyages within a MS (e.g. Valencia - Barcelona)	Voyages within NO/IS (e.g. Oslo - Bergen)	Voyages between two EU MS (e.g. Valencia - Rotterdam)	Voyages between a MS and NO/IS (e.g. Rotterdam - Oslo)	Voyages between an EU MS and a third country	Voyages between NO/IS and a third country (or IS/NO)	Emissions within a port of an EU MS (reported under domestic emissions)	Emissions within a port of NO or IS (or another third country)
Current NDC commitment (CO2; CH4; N2O)	Yes	No	Yes	No	No	No	Yes	No

ANNEX III: IMPLEMENTATION OF ADAPTATION ACTIONS

Table AIII.1 – Examples of adaptation measures and actions.

Title of the measure or action	*Key Type Measure (KTM)*	*Sub-KTM*	*Specification*	*Short description*	*Climate threat*	*Sectors affected*	*Status*	*Administrative level*	*Weblink*
Risk management	Economic and Finance	Insurance and risk sharing instruments	Creation / revision of contingency funds for emergencies	This measure, called "Risk management" corresponds to a review of the existing insurance schemes to integrate the risk associated with climate events.	Temperature (acute)	Agriculture and food; Finance and insurance	Being implemented	National	-
Study on adaptation and mitigation measures (Plan for the Adaptation of Water Resources Management to Climate Change for the Agricultural Sector)	Governance and Institutional	Policy instruments	Creation / revision of policies	This action focuses on elaborating a study on adaptation and mitigation measures, integrated into a more comprehensive exercise called "Water Management Adaptation Plan to Climate Change for the Agricultural Sector". Partially included in the study "Knowing to predict the future" Study to assess water needs for the agricultural sector in the context of Climate Change (Plan for the Adaptation of Water Resources Management to Climate Change for the Agricultural Sector)	Water related (acute) Other	agriculture and food; water management	implemented/ completed	Regional (sub-national)	https://inovacao.rederural.gov.pt/37-projetos-rrn/1456-conhecer-para-prever-o-futuro
Forest Risks (includes the actions "Prevention of forests against biotic and abiotic agents and "Restoration of forests damaged by biotic	Knowledge and behavioural change	Capacity Building, empowerment and lifestyle practices	Service / process applications	This "forest risks" measure includes actions associated with the prevention of forests against biotic and abiotic agents and the restoration of forests affected by biotic and abiotic agents or catastrophic events.	Temperature related (acute) Other	biodiversity (including ecosystembased approaches); forestry; land use planning;	being implemented	Regional (sub-national)	-

Title of the measure or action	Key Type Measure (KTM)	Sub-KTM	Specification	Short description	Climate threat	Sectors affected	Status	Administrative level	Weblink
and abiotic agents or catastrophic events")						water management			
Climate change adaptation measures associated with freshwater and coastal species and habitats	Nature based solutions and ecosystem-based approaches	Blue options	-	The aim is to begin implementing 50% of the climate change adaptation measures defined in the sectoral plan, giving priority to those relating to freshwater and coastal species and habitats.	Temperature related (acute) Other	Biodiversity (including ecosystembased approaches)	Being implemented	National	-
Survey of typical native species and establish key reference (indicator) species for arid and semi-arid areas	Nature based solutions and ecosystem-based approaches	Green options	Creation / revision of ministerial coordination formats	Carry out a survey of typical native species and establish key reference (indicator) species for arid and semi-arid areas. This survey will be especially important for better land use management, particularly in terms of forest management.	Water related (acute) Other	Biodiversity (including ecosystem-based approaches)	Planned	National	-
System of sustainability indicators for the sustainable management of destinations	Knowledge and behavioural change. Information and awareness raising	Creation of new/improvement of existing infrastructure to support tourist destinations, particularly those most vulnerable to the effects of climate change.	Development of a communication strategy to disseminate information on the impacts of climate change, as well as good sustainability practices for mitigating and adapting to its effects on the tourism sector.	Promotion and development of a network of Regional Sustainability Observatories integrated into the UNWTO Network of Observatories (INSTO). This network of Observatories guarantees the implementation throughout the country of a system of sustainability indicators of international reference for the sustainable management of destinations, in partnership with the World Tourism Organisation.	Rising temperatures; heat waves; forest fires; Water scarcity - drought situation; Heavy rainfall - floods, flash floods; Coastal erosion	Tourist destinations, their tourist attractions and supporting infrastructure	In progress	National	https://travelbi.turismodeportugal.pt/sustentabilidade/ destination-watch-rede-observatorios-regionais-turismo-sustentavel/ https://travelbi.turismodeportugal.pt/sustentabilidade/ observatorios-regionais-

Title of the measure or action	Key Type Measure (KTM)	Sub-KTM	Specification	Short description	Climate threat	Sectors affected	Status	Administrative level	Weblink
									sustentabilidade/
Inclusion of the sustainability dimension in the enterprise classification system	Governance and Institutional	Policy instruments	Creation / revision of ministerial coordination formats	Inclusion of the sustainability dimension, for example in terms of management of the water resource, as a valuing element in the classification system of the undertakings.	Temperature related (acute) Other	Buildings	Studies ongoing	National	-
Implement mosaics of fuel management plots	Nature based solutions and ecosystem-based approaches	Green options	Creation of new / improvement of exiting green infrastructure	Implement mosaics of fuel management plots in order to improve response capacity and reduce the impact of forest fires.	Temperature related (acute) Other	Forestry	Being implemented	Multilevel	-
Definition and implementation of measures and strategies of adaptation of the health sector	Governance and Institutional	Management and Planning	Natural and/or semi-natural water and marine areas management	This measure focuses on the definition and implementation of various actions and strategies to adapt the health sector to climate change.	Temperature related (acute) Heat wave	Buildings; civil protection and emergency management; health	Studies ongoing	Regional (sub-national)	https://www.insa.min-saude.pt/category/areas-de-atuacao/doencas-infeciosas/revive-rede-de-vigilancia-de-vetores/

Title of the measure or action	*Key Type Measure (KTM)*	*Sub-KTM*	*Specification*	*Short description*	*Climate threat*	*Sectors affected*	*Status*	*Administrative level*	*Weblink*
Update of the National Risk Assessment	Governance and Institutional	Management and Planning	Creation / revision of funding schemes	This action focuses on updating the National Risk Assessment to carry out a current identification and characterisation of hazards of natural, technological or mixed origin, likely to affect the Portuguese territory, considering, for the applicable risks, the impact of climate change and the resulting scenarios, indicating tendencies to worsen or mitigate the risks.	Solid mass-related (acute) Landslide; Temperature-related (acute) Other; Water related (acute) Other	Civil protection and emergency management	Implemented /completed	National	https://prociv.gov.pt/pt/documentacao/avaliacao-nacional-de-risco/
Strengthening risk monitoring and warning systems	Physical and technological approaches	Technological options	Training and knowledge transfer	This measure focuses on strengthening monitoring and warning systems on risks to improve the responsible entities' response capacity and as an essential tool to ensure the population's awareness of self-protection and thus promote the better application of the precautionary principle and anticipation of the response.	Temperature related (acute) Other	Civil protection and emergency management	Implemented /completed	Multilevel	-
Public warning systems	Governance and Institutional	Management and Planning	Creation / revision of technical rules, codes and standards	This measure focuses on the implementation of warning systems for the population, an essential tool for raising the population's awareness of self-protection and thus promoting the better application of the precautionary principle, contributing to the adoption of measures to reduce risk.	Temperature-related (acute) Other; Water-related (acute) Other; Wind-related (acute) Other	Civil protection and emergency management	Implemented /completed	Multilevel	-

Title of the measure or action	Key Type Measure (KTM)	Sub-KTM	Specification	Short description	Climate threat	Sectors affected	Status	Administrative level	Weblink
Water retention systems to be used in periods of drought	Physical and technological approaches	Grey options	Rehabilitation, upgrade and/or replacement of physical infrastructures	This measure comprises actions that consider water retention capacity, safe storage, so that it can be used in periods of drought. Negative environmental impacts downstream of dams must be considered (e.g. interruption of natural water, nutrient and sediment cycles). Optimize the use of existing dams. End-of-the-line solution, to be adopted only when all other available and less impacting solutions prove to be technically and economically unfeasible.	Temperature-related (acute) Other	Civil protection and emergency management	Being implemented	River Basin District	-
Clearance, river regulation and flood control	Physical and technological approaches	Grey options	Rehabilitation, upgrade and/or replacement of physical infrastructures	This measure comprises a set of structural interventions for clearing, river regulation and flood control in areas of frequent flooding and high damage.	-	Water management	Being implemented	River Basin District	-
Good Practice Guidelines for Disaster Risk Reduction and Promoting Resilience	Knowledge and behavioural change	Capacity Building, empowerment and lifestyle practices	-	This measure comprises the development of Good Practice Guides for Disaster Risk Reduction and Resilience Promotion, translating the best lessons from experience to prevent or mitigate disaster risks and their effects, like: i. Handbook "Resilient Cities in Portugal" 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; v. Guidelines "Approach	-	Civil protection and emergency management	Implemented /completed	Multilevel	-

Title of the measure or action	Key Type Measure (KTM)	Sub-KTM	Specification	Short description	Climate threat	Sectors affected	Status	Administrative level	Weblink
				to audiences with specific needs within a scope of temporary shelter structure".					
Adequate management of extreme flows in areas of frequent flooding with high damage	Physical and technological approaches	Grey options	-	The aim of this measure is to provide a framework for the hydraulic works required for the proper management of extreme flows in areas of frequent flooding with high damage.	-	Civil protection and emergency management	Being implemented	Multilevel	-
Resilience of ecosystems, species, and habitats to the effects of climate change	Nature based solutions and ecosystem-based approaches	Green options	Communication and dissemination	This measure comprises a set of actions contributing to increase the resilience of ecosystems, species, and habitats to the effects of climate change.	Temperature-related (acute) Other	Water management	Being implemented	Multilevel	-
Removing constructions	Governance and Institutional	Management and Planning	Decision support tools and databases	Removal of constructions on the coastline, located in flood-critical territories.	Solid mass-related (chronic) Coastal erosion; Water-related (acute) Flood (coastal fluvial pluvial ground water)	Buildings; coastal areas; transport	Studies ongoing	Local	-

Title of the measure or action	*Key Type Measure (KTM)*	*Sub-KTM*	*Specification*	*Short description*	*Climate threat*	*Sectors affected*	*Status*	*Administrative level*	*Weblink*
Monitoring of critical areas, including cliffs, to know the evolution of the territory, its occupation and the state of coastal systems	Knowledge and behavioural change	Information and awareness raising	Decision support tools and databases	Monitoring of critical areas, including cliffs, to know the evolution of the territory, its occupation and the state of coastal systems.	Solid mass-related (chronic) Coastal erosion	Coastal areas	Being implemented	National	-
Maintenance of the coastline, through artificial beach/shoreface nourishment	Nature based solutions and ecosystem-based approaches	Blue options	Communication and dissemination	Maintenance of the coastline, through artificial beach/shoreface nourishment.	Water-related (acute) Flood (coastal fluvial pluvial ground water)	Coastal areas	Studies ongoing	National	-
Sectoral climate change adaptation plans for transport	Governance and Institutional	Policy instruments	Decision support tools and databases	Under the terms of Article 24 of the National Climate Law (Law No. 98/2021, of 31 December), Portugal is developing the Sectoral climate change adaptation plans for transport.	-	Transport	Under development	National	-
Climate Change Resilience Plan for Infrastructures (PRIAC) – Infraestruturas de Portugal	-	-	-	PRIAC will cover the existing and projected (2030) rail and road network in Portugal. Main objectives: - Assess Risks and Vulnerabilities – knowing how where we are in terms of resilience to climate change; envision where we will be in the next years thru different climate scenarios; - Adress project applications' needs on European financial funding; - Develop plans and actions	All climate threats (heat, floods and storms, precipitation, …)	Transport infrastructures (rail and road network)	In course	National	https://www.infraestruturasdeportugal.pt/pt-pt/sustentabilidade-ip/alteracoes-climaticas-ip

Title of the measure or action	Key Type Measure (KTM)	Sub-KTM	Specification	Short description	Climate threat	Sectors affected	Status	Administrative level	Weblink
Adaptation plans or contingency plans for extreme events – APCAP - Portuguese Association of Toll Road and Bridge Concessionaires	Governance and Institutional	Policy instruments	Mainstreaming adaptation into other sectors	Most of the concessionaires/subconcessionaires that are members of APCAP (Associação Portuguesa das Sociedades Concessionárias de Autoestradas ou Pontes com Portagens / Portuguese Association of Toll Road and Bridge Concessionaires) are developing adaptation plans or contingency plans for extreme events. Notwithstanding the existence of plans under development, the concessionaires/subconcessionaires have preventive and response measures for extreme events that have occurred in the network.	-	Transport	Being implemented	National	-
Airports - Risk analysis matrix of infrastructure vulnerability	Governance and Institutional	Management and Planning	Hazard / risk mapping	According to ANA - Aeroportos de Portugal, the company responsible for airport management in Portugal, although there is currently no airport with a completed Climate Change Adaptation Plan, a risk analysis matrix of infrastructure vulnerability to climate change was prepared in 2021. Following this analysis, the preparation of the first Adaptation Plan was started for Faro Airport, considered to be the most sensitive airport.	-	Transport	Being implemented	National	-

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Forest Fires - Protection and Resilience Measures for Electronic Communications Infrastructures	Physical and Technological	Technological options	Early warning systems	Due to the forest fires that occurred in 2017, ANACOM created the WG "Forest Fires - Protection and Resilience Measures for Electronic Communications Infrastructures", which was attended by a wide range of public and private entities, with the mandate to carry out a more in-depth study of the situation and identify the necessary measures to improve the protection and resilience of electronic communications infrastructures. Based on the work of this WG, 27 measures were identified whose implementation would reduce the impact of fires on telecommunications infrastructures. Of these 27 measures, three are related to radio, four to underground routes, twelve to energy or protection and eight to procedures. As a result, ANACOM started to carry out regular supervision actions in radiocommunication stations belonging to electronic communications operators operating in the national territory (mainland and autonomous regions), to qualitatively assess their vulnerability to fires. If vulnerabilities are identified, these are communicated to electronic communications operators to take appropriate measures to minimize the risk of impact of possible rural	-	Telecommu-nications, forests	Implemented / ongoing	National	The final report of the WG (2018) is available https://www.anacom.pt/render.jsp?contentId= 1436120

Title of the measure or action	Key Type Measure (KTM)	Sub-KTM	Specification	Short description	Climate threat	Sectors affected	Status	Administrative level	Weblink
				fires on the said infrastructures supporting their networks and services.					
Suitable Infrastructure Information System (SIIS)	Governance and Institutional	Policy instruments	Creation / revision of (implementing) regulations	The SIIS is the Suitable Infrastructure Information System which assures the provision of information relative to the infrastructures suited for the accommodation of electronic communication networks. The SIIS is managed by ANACOM and should contain the following information: a) Procedures and conditions governing the allocation of rights of way. b) Announcements on the construction of infrastructure suitable for the accommodation of electronic communications networks. c) Records, with geo-referenced, comprehensive and integrated information of all infrastructure suitable for the accommodation of electronic communications networks, including public ITUR infrastructure. d) Procedures and conditions that apply to the access to and use of infrastructure which is suitable for the accommodation of electronic communications networks. The SIIA is of fundamental importance to the country, since it allows the sharing of locations and	-	Telecommunications	Implemented	National	https://siia.anacom.pt/ https://www.anacom.pt/render.jsp?categoryId=384522

Title of the measure or action	Key Type Measure (KTM)	Sub-KTM	Specification	Short description	Climate threat	Sectors affected	Status	Administrative level	Weblink
				resources by electronic communications companies, namely, sharing ducts, poles, manholes, sites and other resources, reducing the impact of the development of these networks in the environment. SIIS is provided in Decree-Law No. 123/2009, changed and republished by Decree-Law No. 92/2017, 31 July. The information contained in the SIIS is binding on the entities responsible for its preparation and availability, and it is also these entities that are responsible for ensuring the permanent updating of this information.					