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Foreword

The principal aim of the OECD Environmental Performance Review (EPR) programme is to help member and selected partner countries improve their individual and collective performance in environmental management by:

- helping countries assess progress in achieving their environmental goals
- promoting continuous policy dialogue and peer learning
- stimulating greater accountability from governments towards each other and public opinion.

This is the fourth EPR of Portugal. It examines the country's environmental performance since the previous review in 2011. Progress in achieving domestic objectives and international commitments provides the basis for assessing Portugal's environmental performance. Such objectives and commitments may be broad aims, qualitative goals or quantitative targets. A distinction is made between intentions, actions and results. Assessment of environmental performance is also placed within the context of Portugal's historical environmental record, present state of the environment, physical endowment in natural resources, economic conditions and demographic trends.

The OECD is grateful to Portugal's Ministry of Environment and Climate Action for providing information and comments, organising the review mission (16-18 May 2022) and virtual policy mission (19 October 2022), as well as for facilitating contacts inside and outside government institutions.

Thanks are also due to the representatives of the two examining countries, Kendal Blanco Salas (Costa Rica) and Eric De Brabanter (Luxembourg), for participating in the review.

The authors of this report are Hélène Blake, Maria Adelaida Rojas Lleras and Frédérique Zegel of the OECD Environment Directorate, under the co-ordination of Frédérique Zegel. Nathalie Girouard and Frédérique Zegel provided oversight and guidance. Maria Adelaida Rojas Lleras and Carla Bertuzzi provided statistical support, while Lydia Servant provided administrative support. Mark Foss copy-edited the report. Natasha Cline-Thomas supported communications activities. Preparation of this report also benefited from inputs and comments from Marta Arbinolo, Ivana Capozza, Kathleen Dominique, Catherine Gamper, Nikki Kergozou and Julia Wanjiru of the OECD Secretariat, as well as Sylvia Beyer of the International Energy Agency.

The OECD Working Party on Environmental Performance discussed the Environmental Performance Review of Portugal at its meeting on 6 December 2022 and approved the Assessment and Recommendations.

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Reader's guide

Signs

The following signs are used in figures and tables:

.. : not available

– : nil or negligible

. : decimal point

Country aggregates

OECD Europe: This zone includes all European member countries of the OECD, i.e. Austria, Belgium, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, the Netherlands, Norway, Poland, Portugal, the Slovak Republic, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

OECD: This zone includes all member countries of the OECD, i.e. the countries of OECD Europe plus Australia, Canada, Chile, Colombia, Costa Rica, Israel*, Japan, Korea, Mexico, New Zealand and the United States.

Country aggregates may include Secretariat estimates.

Currency

Monetary unit: Euro (EUR)

In 2021, USD 1 = EUR 0.845

In 2020, USD 1 = EUR 0.876

Cut-off date

This report is based on information and data available up to November 2022.

Disclaimer

* The statistical data for Israel are supplied by and under the responsibility of the relevant Israeli authorities. The use of such data by the OECD is without prejudice to the status of the Golan Heights, East Jerusalem and Israeli settlements in the West Bank under the terms of international law.

This document and any map included herein are without prejudice to the status of or sovereignty over any territory, to the delimitation of international frontiers and boundaries and to the name of any territory, city or area.

Basic statistics of Portugal

2021 or latest available year (OECD values in parenthesis)[a]

PEOPLE AND SOCIETY					
Population (million)	10		Population density per km²	112	(36)
Share of population by type of region			Population annual growth rate, latest 5 years	-0.1	(0.6)
Predominantly urban (%)	47	(68)	Income inequality (Gini coefficient)	0.31	(0.32)
Intermediate (%)	22		Poverty rate after taxes and transfers, Poverty line 50%	0.11	(0.12)
Rural (%)	31	(32)	Life expectancy	81	(81)
ECONOMY AND EXTERNAL ACCOUNTS					
Total GDP (National currency, billion)	211		Imports of goods and services (% of GDP)	43	(29)
Total GDP (USD billion, current PPPs)	374		Main exports (% of total merchandise exports)		
GDP compound annual real growth rate, latest 5 years	1.0	(1.5)	Petroleum, petroleum products and related materials	27	
GDP per capita (1 000 USD current PPPs)	36	(49)	Non-ferrous metals	22	
Value added shares (%)			Vegetables and fruits	16	
Agriculture	3	(2)	Main imports (% of total merchandise imports)		
Industry including construction	22	(24)	Machinery and transport equipment	29	
Services	75	(74)	Miscellaneous manufactured articles	16	
Exports of goods and services (% of GDP)	44	(29)	Manufactured goods	16	
GENERAL GOVERNMENT Percentage of GDP					
Expenditure	48	(48)	Education expenditure	5.0	(5.3)
Revenue	45	(38)	Health expenditure	7.2	(7.9)
Gross financial debt	144	(125)	Environmental protection expenditure	0.7	(0.5)
Fiscal balance	-3	(-7)	Environmental taxes (% of GDP)	2.4	(1.4)
			(% of total tax revenue)	6.8	(4.6)
LABOUR MARKET, SKILLS AND INNOVATION					
Unemployment rate (% of civilian labour force)	6.6	(6.1)	Patent applications (% of all technologies)[b] Environment-related technologies	8.3	(11.5)
Tertiary educational attainment of 25- to 64-year-olds (%)	31	(40)	Environmental management	3.9	(3.3)
Gross expenditure on R&D (% of GDP)	1.6	(2.7)	Climate change mitigation technologies	6.1	(9.7)
			Climate change adaptation technologies	2.2	(1.3)
ENVIRONMENT					
Energy intensity TES per capita (toe/cap.)	1.9	(3.8)	Road vehicle stock (vehicles/100 inhabitants)	60	(67)
TES per GDP (toe/1 000 USD 2015 PPPs)	0.06	(0.09)	Water stress (abstraction as % of available resources)	6.5	(7.4)
Renewables (% of TES)	29	(12)	Water abstraction per capita (m³/cap./year)	465	(691)
Carbon intensity (energy-related CO_2)			Municipal waste per capita (kg/capita)	518	(534)
Emissions per capita (t/cap.)	4.3	(7.9)	Material productivity (USD, 2015 PPPs/DMC, kg)	1.9	(2.5)
Emissions per GDP (t/1 000 USD 2015 PPPs)	0.13	(0.18)	Land area (1 000 km²)	91.6	
GHG intensity[c]			% of arable land and permanent crops	19.8	(11.2)
Emissions per capita (t CO_2 eq/cap.)	5.6	(10.5)	% of permanent meadows/pastures	22.4	(22.8)
Emissions per GDP (t CO_2 eq/1 000 USD 2015 PPPs)	0.18	(0.26)	% of forest area	36.2	(32.8)
Mean population exposure to air pollution ($PM_{2.5}$), µg/m³	8.2	(13.9)	% of other land (built-up/other land)	7.9	(32.4)

a) Values earlier than 2016 are not taken into consideration. OECD value: where the OECD aggregate is not provided in the source database, a simple OECD average of the latest available data is calculated where data exist for a significant number of countries.
b) Higher-value inventions that have sought protection in at least two jurisdictions.
c) Excluding emissions/removals from land use, land-use change and forestry.
Source: Calculations based on data extracted from databases of the OECD, IEA/OECD, EUROSTAT and the World Bank.

Executive summary

Portugal has made progress towards some Sustainable Development Goals (SDGs)

Portugal has a small, service-based economy that grew steadily between 2013 and 2019. The country was strongly hit by the pandemic but has been recovering fast since mid-2021. Yet the pace of the recovery is easing. Although Portugal has few direct trade links with these countries, Russia's war against Ukraine is driving up energy and food prices.

Over the past decade, Portugal managed to decouple energy consumption and major air pollutant emissions from economic growth. The energy mix has shifted from oil and coal to natural gas and renewables, and air quality generally improved. However, material consumption, municipal waste generation and freshwater abstractions have grown at the same rate or faster than gross domestic product (GDP). Portugal is one of the OECD countries with the highest landfilling rates. The status of habitats and species has deteriorated, and agriculture exerts significant pressures on water bodies.

Overall, the country increased access to clean energy (SDG 7), and clean water and sanitation (SDG 6). Nevertheless, major challenges remain to ensure sustainable consumption and production patterns (SDG 12) and protect, restore and promote sustainable use of marine and terrestrial ecosystems (SDGs 14 and 15).

GHG emissions fell significantly but reaching carbon neutrality calls for sustained and comprehensive action

Portugal met its 2020 climate targets. Greenhouse gas (GHG) emissions decreased by one-third between 2005 and 2020. Following the 2008 crisis, emissions declined due to the reduction in energy demand and increasing renewable electricity generation. With the economic recovery, emissions rebounded in 2014-17, particularly in the transport sector. However, they have since fallen, driven by a strong shift away from coal-fired power generation and reduced energy use during the COVID-19 crisis. Portugal can be commended for its leading role in climate action under its Presidency of the Council of the European Union in 2021, and for enshrining carbon neutrality in national law. The 2021 Framework Climate Law includes many promising provisions to improve climate policy governance.

National projections indicate that additional policies will be needed to reduce emissions by at least 55% from 2005 levels by 2030 and by 90% by 2050 as required by the Climate Law. When revising the National Energy and Climate Plan 2021-2030 (NECP 2030), Portugal should clarify the measures envisaged to achieve its goals, quantify their mitigation impact and specify how they will be financed. It will need to leverage sectoral and cross-sectoral policies to reach carbon neutrality by 2050. This involves accelerating the development of renewable energy, building renovation and low-carbon vehicles, reducing car use and tackling the growing emissions from agriculture; sending consistent carbon prices across sectors and fuels; and prioritising targeted income support over energy price control to fight energy poverty.

Portugal has stepped up its effort to adapt to climate change

Portugal's territory faces multiple threats related to climate change, including coastal erosion, heavy precipitation events and extreme heat days. Droughts also undermine agricultural yield and hydropower generation. Forests are particularly exposed to fire danger.

The government adopted a National Adaptation Strategy in 2015 and an Action programme in 2019 to define priorities and measures. Public information on climate change risks has improved considerably and adaptation is increasingly integrated into sectoral strategies, such as in agriculture. Fundings for adaptation have been scaled up, notably co-financed by the European Union. Portugal has strengthened wildfire risk prevention but faces the challenge of improving forest management practices in abandoned rural areas where land ownership is private and fragmented. Completing the land cadastre and extending payments for ecosystem services can help reduce the risks of forest fires.

Effective use of EU funds is key to boost green investment

The cohesion policy has become the main source of financing public investment. With the Next Generation EU funds, Portugal needs to manage significantly higher amounts over 2021-27. This is an opportunity to address environmental issues but also a challenge in terms of implementing programmes. Over 2014-20, Portugal had a high absorption rate of structural funds allocated to environmental protection and resource efficiency, climate change adaptation and risk prevention. However, projects on improving energy efficiency, and developing clean urban transport infrastructure and railways have been delayed partly due to their complexity. Portugal should ensure the transparent and effective implementation of programmes financed with EU funds, prioritising investments with the highest social return.

The Recovery and Resilience Plan (RRP) aims to boost the economy with Next Generation EU funds over 2021-26. Its investments and reforms are to be supported by grants and loans representing about 8% of 2020 GDP. Portugal devoted 38% of its RRP budget to the climate objectives. The RRP rightly focuses on improving energy efficiency and promoting sustainable mobility. It also includes investments to decarbonise industrial processes and boost the use and production of hydrogen, prevent and fight rural fires, improve water-use efficiency and promote a sustainable bioeconomy. However, concerns have been raised on investment in road network extension, new dams in water-scarce areas or on limited support for biodiversity. Portugal should carefully assess the environmental impacts of RRP and other EU co-funded investments.

Upgrading environmental infrastructure requires better pricing of services

Public expenditure on environmental protection, at 0.7% of GDP in 2020, was below the EU average. Waste management has driven its recent increase, but this is not reflected in the performance of the service provision. Recovering the costs of the service is a prerequisite for financing the sector. In 2020, three-quarters of municipalities did not fully recover the costs of waste service provision through tariffs charged to consumers. Waste charges are included in the water bill and usually linked to water consumption. Portugal has completed the main infrastructure for wastewater management, but investment needs remain significant, including for rehabilitation of existing assets. Despite an apparent good cost-recovery of wastewater services, there is scope to improve the ability of municipalities to assess these costs and to increase tariffs, particularly where they provide the service directly.

The green tax reform should be pursued

In 2014, Portugal introduced a green tax reform, including a carbon tax in sectors outside the EU Emissions Trading System (ETS). It also increased the CO_2 component of the vehicle registration tax, revised the taxation of water and waste management, granted property tax breaks for forest management and introduced a tax on single-use lightweight plastic bags. Revenue from environmentally related taxes increased, mainly driven by rising consumption and tax rates on diesel, until the COVID-19 crisis reduced the purchase and use of cars. However, the carbon tax and the taxes on water and waste management have not provided consistent incentives to curb energy and water use and divert waste from landfills. Fuel and vehicle taxation, as well as road pricing, could better promote decarbonisation and air quality improvements. The Ministry of Finance and Ministry of Environment and Climate Action should complete the evaluation of the green tax reform with a view to applying the polluter pays principle more consistently.

Like other OECD countries, Portugal supports consumption of fossil fuels through tax expenditure; oil and gas attract the bulk of government support. The largest amounts include reduced tax rates for diesel fuel used by agricultural equipment and, since 2017, partial refund of diesel taxes to freight companies; tax exemptions on energy products used for electricity production or by industrial installations under the ETS or an energy-efficiency agreement. Since 2014, forgone revenue from tax relief has increased with consumption and taxes on diesel and natural gas. In 2018, Portugal started to phase out some exemptions, which helped phase out coal power in 2021. However, responding to rising prices, Portugal has introduced new measures supporting fossil fuel consumption. As part of the inventory of tax benefits, Portugal could identify potentially environmentally damaging supports and phase out those unjustified on economic, environmental or social grounds.

Assessment and recommendations

The Assessment and Recommendations present the main findings of the OECD Environmental Performance Review of Portugal. They identify 26 recommendations to help the country make further progress towards its environmental objectives and international commitments. The OECD Working Party on Environmental Performance discussed and approved the Assessment and Recommendations at its meeting on 6 December 2022.

1. Towards sustainable development

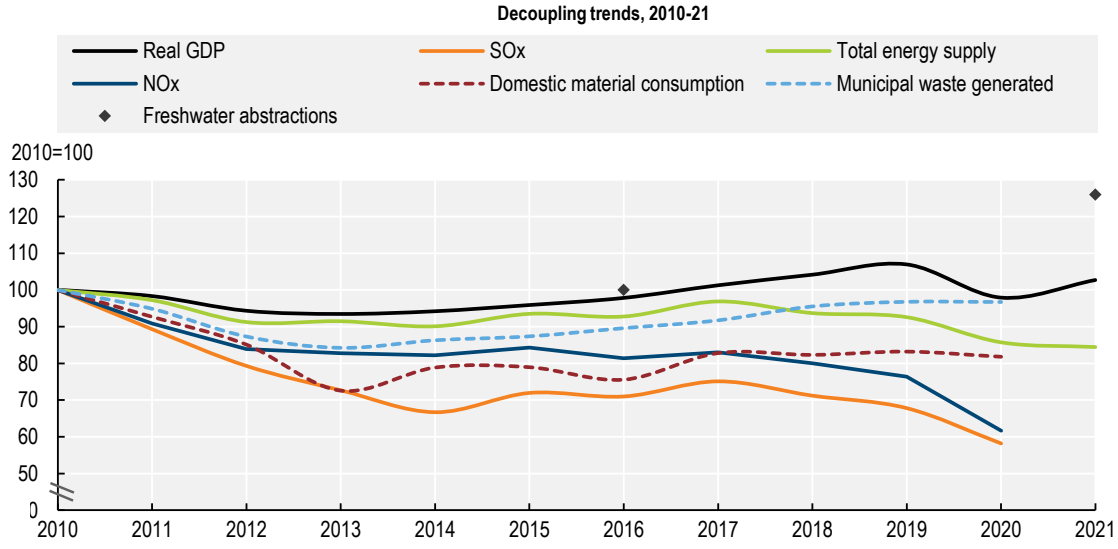
Addressing key environmental challenges

Portugal has made progress on decoupling

Portugal has a small, service-based economy that grew steadily between 2013 and 2019.[1] The country was among the OECD economies most strongly hit by the pandemic but has been recovering fast since mid-2021 (Figure 1). However, growth is expected to slow in 2023 (OECD, 2022a). While Portugal has few direct trade links with these countries, Russia's war against Ukraine is driving up energy and food prices, increasing uncertainty and weighing on activity.

Over 2013-19, Portugal managed to decouple energy consumption, greenhouse gases (GHGs) and air pollutant emissions from economic growth (Figure 1). However, material consumption, municipal waste generation and freshwater abstractions have grown at the same rate or faster than gross domestic product (GDP). Portugal has improved the regulatory framework for environmental services. It has made progress in wastewater treatment and expanded protected areas. However, agriculture, infrastructure development, invasive species, natural processes (such as erosion), as well as climate change and related wildfire risk, are exerting major pressures on biodiversity.

Figure 1. Portugal managed to decouple some environmental pressures from economic growth



Note: Freshwater abstractions: 2016=100, excluding abstractions for electricity cooling; 2021: estimate based on the 2022-27 management plans of the 8 continental river basins.
Source: APA (2022), provisional version of the third RBMPs 2022-27; IEA (2022), IEA World Energy Statistics and Balances (database); OECD (2022), OECD Economic Outlook (database); OECD (2022), Environment Statistics (database).

StatLink https://stat.link/bagkeq

The energy mix has shifted from oil and coal to natural gas and renewables

Portugal's energy intensities per capita and per GDP are below the OECD Europe averages, reflecting its service-oriented economy. The 2008 financial crisis was followed by a significant drop in energy consumption in all sectors. With economic recovery, energy demand in the transport sector increased over 2013-19. However, this increase was offset by lower demand in industry thanks to improved efficiency and a structural shift to less energy-intensive activities. Portugal met its 2020 target under the 2018 EU Directive on Energy Efficiency. This good result was amplified by the decrease in energy demand due to the restrictions linked to the COVID-19 pandemic.

Over the past decade, the energy mix has shifted from oil and coal to natural gas and renewables. Portugal can be commended for closing its last two coal power plants in 2021, two years ahead of schedule. Fossil fuels continue to make the bulk of energy supply, but the share of renewable energy (mostly biomass, wind and hydro) is higher than in most European countries. Annual variations in hydropower generation affect domestic energy production and energy dependency. In terms of fossil fuels, the country relies entirely on imports. However, imports from the Russian Federation represent a relatively small share of its supply (IEA, 2021).

With 34% of renewable energy in gross final energy consumption in 2020, Portugal achieved its binding target of 31% set by the EU Renewable Energy Directive (Eurostat, 2022a), partly due to reduced energy consumption linked to the pandemic (APA, 2021). The country was close to achieving its 2020 sub-targets for electricity (58.0% vs. 60.0%) and transport (9.7% vs. 10.0%); it met the sub-target for heating and cooling (41.5% vs. 41.0%) (Eurostat, 2022a). Portugal has made progress towards Sustainable Development Goal (SDG) 7, ensuring clean energy but affordability remains an issue (Chapter 2).

Air quality has improved, and efforts must be continued

Emissions of major air pollutants have decreased thanks to the shift in the electricity mix, the implementation of desulphurisation systems in large energy plants and stricter vehicle emissions standards (APA, 2022). Portugal achieved its 2020 targets set by the EU Directive on the reduction of national emissions of certain atmospheric pollutants. It missed the target for ammonia (NH_3), whose emissions have grown with the number of poultry. Portugal needs to clarify how it will ensure compliance with its 2030 targets in the national air pollution programme (due in 2022). The application of best available techniques and the publication of the national advisory code of good agricultural practice to control NH_3 emissions is expected to support progress in this area.

People are less exposed to air pollution in Portugal than in other OECD countries. However, air quality remains a concern with regard to concentrations of nitrogen dioxide (NO_2) and particulate matter in urban areas and tropospheric ozone in rural areas. Annual NO_2 limit value has been persistently exceeded in Lisbon, Porto and Braga, mostly due to diesel vehicle traffic. In 2020, with restrictions on mobility, no exceedances were recorded.

Portugal has missed most of its 2020 waste targets

Portugal's material productivity[2] is well below the OECD-Europe average. It improved until 2013 but has remained broadly constant since then (Figure 1). Non-metallic minerals (mostly construction materials) make the bulk of the materials mix. Since 2013, municipal waste generation has grown at a faster rate than the economy. In 2020, Portugal generated more municipal waste per capita than the European average. It was also among the countries with the highest landfilling rates. Circular material use rate is almost six times lower than the EU average (2.2% vs. 12.8% in the European Union in 2020) (Eurostat, 2021). The country improved its regulatory framework for waste management, including a benchmarking system for municipalities. It also increased investment in treatment facilities (Section 1.2). However, the country has

missed most of its 2020 objectives. Ensuring sustainable consumption and production patterns (SDG 12), is a significant challenge.

The National Waste Management Plan for 2030, under discussion, aims to prevent waste generation; promote efficient use of resources; and reduce environmental impacts through integrated and sustainable waste management. The Strategic Plan for Municipal Waste for 2030, under discussion, aims to improve waste prevention and increase preparation for reuse, recycling and other forms of recovery of municipal waste to reduce consumption of primary raw materials. It seeks to ensure compliance with the EU Waste Framework Directive (under revision), which will set more ambitious targets for 2030. Recovering the costs of waste management service is a prerequisite for financing the sector and changing behaviour (Section 1.2).

Progress towards biodiversity targets has been insufficient

Major challenges remain to protect, restore and promote sustainable use of marine and terrestrial ecosystems (SDGs 14 and 15). Over the past decade, the status of habitats and species has deteriorated. Agriculture, infrastructure development, invasive species, natural processes (such as erosion), climate change and wildfires are exerting major pressures on biodiversity (EEA, 2021; ICNF, 2020). About 30% of fish and birds and 20% of mammals and reptiles are threatened (OECD, 2022b).

In 2020, protected areas covered 25% of Portugal's territory and 8.9% of marine areas under its jurisdiction (Tribunal de Contas, 2022). The country thus met the 2020 Aichi target of protecting at least 17% of land area but missed the target of protecting 10% of coastal and marine areas. In 2021, Portugal created Europe's largest marine protected area, a significant step towards the goal of protecting at least 30% of EU sea area by 2030.

Management plans have been developed only for a few Sites of Community Importance in the Natura 2000 network (ICNF, 2020). The European Commission has opened an infringement procedure against Portugal for failure to adopt management plans and conservation measures (EC, 2021a). Mainstreaming biodiversity in agriculture, forestry, fisheries, urban and spatial planning sectors is a major challenge (ICNF, 2020). The National Biodiversity Strategy and Action Plan will be updated in 2023 in line with the EU Biodiversity Strategy 2030 and post-2020 Global Biodiversity Framework.

Agriculture puts significant pressures on water bodies

Portugal has relatively low water stress at the national level (OECD, 2022b). However, seasonal and spatial distribution of freshwater resources and use varies widely. Water scarcity is of serious concern in the Sado and Mira (in the Alentejo region) and the Algarve River basins.

Agriculture is the largest user of freshwater. Agricultural abstractions have increased by about 25% since the mid-2010s, particularly in the southern regions. Irrigated areas increased by the same order of magnitude, reflecting modernisation investments in orchards, vineyards and olive groves (INE, 2021). However, investments focusing on irrigation efficiency, without policies regulating water demand, can increase water consumption or accelerate groundwater depletion (Grafton et al., 2018). Beyond the third River Basin Management Plans, the new National Strategic Plan for Water Supply and Wastewater and Rainwater Management (PENSAARP 2030, to be adopted in 2022) aims at, among other goals, improving water-use efficiency, especially in water-scarce areas.

In 2021, less than half of surface water bodies and two-thirds of groundwater bodies achieved good global (ecological and chemical) status. The most significant pressures on these bodies are diffuse agricultural sources (EC, 2019a). They are followed by other diffuse sources, point sources of pollution and alterations to the natural flow and morphology of water bodies. Compliance rates with the EU Drinking Water Directive requirements are high. Most bathing waters are of excellent quality.

In 2018, 92% of urban wastewater (load generated) was treated according to the requirements of the EU Urban Waste Water Treatment Directive (EC/EEA ETC/ICM, 2021). The country was close to complying in terms of collection (article 3) but not for treatment levels; 93% of wastewater collected underwent secondary treatment[3] (article 4) and 76% more stringent treatment[4] (article 5). The number of small agglomerations with inadequate wastewater treatment has been drastically reduced (APA, 2021). Portugal has made progress towards SDG 6, increasing access to clean water and sanitation. However, challenges remain in using water efficiently and achieving good status of water bodies.

Enhancing policy coherence for sustainable development

Strengthening horizontal co-ordination and evidence-based integration tools

The Portugal 2030 Strategy, adopted in 2020, is the reference framework for public policies in the next decade. It promotes reforms and investment in institutional resilience, the business environment, the green and digital transition, skills and competences (EC, 2021b). The strategy also focuses on reducing social and territorial inequalities. It seeks to ensure coherence of measures financed through the Multiannual Financial Framework 2021-27, the Recovery and Resilience Facility, and other EU and national funds.

Environmental issues are increasingly integrated into sectoral plans as often required by the European Union. For example, the National Energy and Climate Plan 2021-2030 (NECP 2030) seeks to ensure coherence between climate and energy policies (Government of Portugal, 2019). Climate transition and sustainability are priorities of the 2021 Plan to Reactivate Tourism and Build the Future. Several institutional mechanisms, such as the inter-ministerial Commission of the Recovery and Resilience Plan (RRP), chaired by the prime minister, support horizontal co-operation. However, they are not necessarily sufficient to ensure policy coherence. In particular, the balance between environmental and economic objectives is not always clear in the agriculture, transport and tourism sectors.

Strategic environmental assessment (SEA) has been increasingly used in land-use plans, less frequently in sectoral plans (APA, 2021). SEAs are generally developed in line with good practices and national guidance. However, the lack of alternatives considered often hinders the identification of more sustainable development options. Cost-benefit analysis is seldom used.

The environmental impact of recovery measures should be tracked

Responding to the COVID-19 crisis, Portugal provided substantial support to workers and businesses amounting to 2.1% of GDP in 2020 and 3.3% in 2021 (INE, 2022). The government started to phase out pandemic-related support measures in 2022, with a view to containing an inflating fiscal deficit. The outlook remains uncertain due to the geopolitical context and the new measures to address rising prices announced in 2022 (Chapter 2).

Portugal submitted its RRP to boost its economy with Next Generation EU funds over 2021-26. Its 83 investments and 32 reforms are to be supported by grants and loans representing about 8% of 2020 GDP. Portugal devoted 38% of its RRP budget to the climate objectives.[5] This is above the EU requirements (37%) but below the average of 40% of the 22 RRPs endorsed by the end of 2021. The climate part of Portugal's RRP rightly focuses on improving energy efficiency to reduce GHG emissions, dependence on fossil fuels and energy poverty. Sustainable mobility is promoted notably through the extension of the metro networks in Lisbon and Porto but also by the acquisition of clean buses and their charging stations. The RRP also includes investments to decarbonise industrial processes and boost the use and production of hydrogen, prevent and fight rural fires, improve water-use efficiency and promote a sustainable bioeconomy.

The RRP was well-received by most stakeholders, but it was criticised for its contradictions (Heilmann et al., 2021). These include aiming to reduce emissions from transportation while expanding the road

network and considering tourism as a key growth sector; planning the construction of new dams in water-scarce areas, and providing for a limited number of measures to enhance biodiversity (EC, 2021b). The actual share of green measures will only be measurable once the plan is implemented. Portugal is committed to full environmental impact assessments of RRP investments to ensure compliance with the "do no significant harm" principle of the Regulation establishing the Recovery and Resilience Facility (EU 2021/241).

Upgrading environmental infrastructure requires better pricing of services

Public expenditure on environmental protection (current expenditure and investment) decreased until 2016 and has increased since then. It reached 0.7% of GDP in 2020, below the EU average of 0.9% (Eurostat, 2022b). Waste management is the largest expenditure item, driving the recent increase in public investment and spending on environmental protection. However, this trend is not reflected in the performance of the service provision (Section 1.1). Portugal has made little progress in passing on the waste management tax to households through waste charges as recommended in the 2011 Environmental Performance Review. Recovering the costs of waste management service is a prerequisite for financing the sector. However, in 2020, three-quarters of municipalities did not fully recover the costs of waste service provision through tariffs charged to consumers (ERSAR, 2022). Waste charges are included in the water bill and usually linked to water consumption. Indexing of waste charges to amounts of waste collected is essential to encourage behavioural changes. However, this will only become mandatory from the end of 2025.

Public spending on biodiversity has increased since 2016 but accounted for only 0.1% of GDP in 2020, 25% less than in 2010.

Portugal has completed the main infrastructure for wastewater management, but investment needs remain significant: about EUR 5.5 billion for water supply, wastewater and rainwater management by 2030, half of which for rehabilitation of existing assets (MAAC, 2022). Despite an apparent good cost-recovery of wastewater services, there is scope to improve the ability of municipalities to assess these costs and to increase tariffs, particularly where they provide the service directly (ERSAR, 2022). Recovering the costs of water services will also require better reflecting environmental and resource costs in water charges. Although they vary with water scarcity, rates are reduced for irrigation. The ease of licensing new water abstractions in water-stressed areas, the limited capacity to monitor and fine illegal abstractions and low water abstraction charges for non-potable uses have kept levels of water reuse low (about 1%) (Martins et al., 2021).

Part of the public expenditure on environmental protection is incurred by the Environmental Fund. It was created in 2017 from the merger of previous funds to improve efficiency. The Fund's income has increased sevenfold between 2017 and 2021 thanks to increased revenue from auctioning allowances under the EU Emissions Trading System (ETS). However, a small part of its expenditure directly supports environmental protection. Most of the spending is on fare reductions to promote public transport and reverse the decline in demand resulting from the pandemic, and to subsidise the national electricity system. Non-governmental organisations have been criticising the Fund for its lack of transparency, inconsistency with national priorities and low spending on nature restoration (ANP/WWF, 2022; ZERO, 2022). Some have proposed an active role for the National Council for Environment and Sustainable Development in advising on the policy to allocate the financial resources of the Environmental Fund and in evaluating its performance. As an intermediate beneficiary, the Fund also implements some RRP investments.

Effective use of EU funds is key to boost green investment

Over the past decade, subdued public investment has been part of Portugal's fiscal consolidation strategy (OECD, 2021a). At around 2% of GDP, public investment was among the lowest in the OECD in 2019 and 2020. The cohesion policy has become the main source of financing accounting for 60% of total public

investment over 2014-20. With the Next Generation EU funds, Portugal will have to manage significantly higher amounts over 2021-27. This is an opportunity to address environmental issues but also a challenge in terms of designing, approving and implementing programmes.

Overall, Portugal had a higher absorption rate of structural funds than the EU average for 2014-20. This was also true for funds allocated to environmental protection and resource efficiency, climate change adaptation and risk prevention but not for low-carbon economy. Under the Operational Programme for Sustainability and Efficient Use of Resources, projects on improving energy efficiency, developing clean urban transport infrastructure and railways have been delayed partly due to the complexity of projects. Portugal needs to develop administrative capacities to accelerate processes and streamline the public procurement system while ensuring transparency and accountability to prevent risks of fraud (OECD, 2021a). Ensuring coherence between the RRP and operational programmes of the cohesion policy will be a key factor of success. Portugal has created a structure to co-ordinate related funds under the Minister of the Presidency.[6]

Over half of the Rural Development Programme (RDP) 2014-22 budget[7] has been allocated to farmers for adopting environment-friendly land management practices (EC, 2022a). Despite increased areas under contract to preserve biodiversity, improve water and soil management, the impact of the agri-environmental measures could not be assessed due to lack of appropriate indicators (Tribunal de Contas, 2021). Support for the Natura 2000 network has been insufficient to cover the needs identified (EC, 2019b). Despite the large amounts of money allocated to water-use efficiency, the evidence of savings is weak (Atthis Consulting, IESE, 2019). As in other EU countries, Portugal supports water-intensive crops in water-stressed areas through voluntary coupled support and market measures under Pillar 1 of the common agricultural policy (CAP) (ECA, 2021). The new CAP 2023-27 is an opportunity to better mainstream environmental objectives in the agricultural policy.

The green tax reform should be pursued

In 2014, Portugal introduced a green tax reform as recommended in the 2011 Environmental Performance Review. As part of a broader fiscal consolidation effort under the EU economic adjustment programme, Law No. 82-D/2014 introduced a carbon tax in sectors outside the EU ETS. It also increased the CO_2 component of the vehicle registration tax, revised the taxation of water and waste management, granted property tax breaks for forest management and introduced a tax on lightweight plastic bags.

Revenue from environmentally related taxes rose from 2.3% of GDP in 2014 to 2.5% of GDP in 2019, above the OECD Europe average of 2.3%. The increase in consumption and tax rates on diesel explains this increase until the COVID-19 crisis reduced the purchase and use of cars. Most receipts come from taxes on energy products and motor vehicles. Taxes on pollution and resources raise little revenue.

The tax on single-use lightweight plastic bags has significantly reduced their use. However, the carbon tax and the taxes on water and waste management have not provided sufficient incentives to curb energy and water use and divert waste from landfills. The property tax exemption for forest management plans has unclear effects. The Ministry of Finance and Ministry of Environment and Climate Action are evaluating the impact of the green tax reform. They should build on this assessment to pursue reform. A renewed reform could have a positive impact on growth and jobs by 2030 with a slightly progressive effect on real incomes depending on revenue recycling options (Mottershead et al., 2021).

The tax system is complex and many preferential tax treatments blur the price signals. As do other OECD countries, Portugal supports consumption of fossil fuels through tax expenditure; oil and gas attract the bulk of government support. The largest amounts include reduced tax rates for diesel fuel used by agricultural equipment and, since 2017, partial refund of diesel taxes to freight companies; tax exemptions on energy products used for electricity production, and on co-generation or by industrial installations under the ETS or an energy-efficiency agreement. Overall, this tax relief represented 0.3% of GDP in 2020 and 2021. Since 2014, forgone revenue from tax relief has increased with consumption and taxes on diesel

and natural gas. In 2018, Portugal started to gradually phase out some fuel and carbon tax exemptions, which helped to phase out coal power in 2021. However, the 2022 plan to address rising prices sends different signals (Chapter 2).

Portugal is among the few EU countries to have performed a comprehensive stocktake of fossil fuel subsidies in its National Energy and Climate Plan 2021-2030 (EC, 2020a). The 2021 Climate Law provides for their phase-out by 2030. With support from the International Monetary Fund and the European Commission, the country is setting up a unit to regularly monitor and assess tax benefits and streamline the tax system (EC, 2022b). The government could consider mandating this unit to track progress in removing environmentally harmful subsidies.

Vehicle taxation and road pricing could promote decarbonisation and improve air quality

Combined with a fuel tax differential in favour of diesel and EU vehicle performance standards, vehicle taxation has resulted in lower average CO_2 emissions from new passenger cars. However, the share of diesel vehicles has steadily increased to almost 60% of passenger cars in 2020, one of the highest shares in the European Union, with adverse effects on local air pollution. Since the mid-2010s, new car registrations have shifted to petrol and, in recent years, to electric vehicles (EVs) and plug-in hybrid electric vehicles. However, with the increase in the number of cars and distance travelled, and the ageing of the fleet due to imports of used vehicles, GHG emissions from road transport increased over 2013-19 (Chapter 2). Closing the tax gap between diesel and petrol, removing the preferential circulation tax treatment for older vehicles and introducing a NOx component in vehicle taxes, as was recently done by Ireland (OECD, 2021b), would help to rejuvenate the fleet and steer towards cleaner vehicles.

While fuel taxes are effective to reduce carbon emissions, distance-based charges depending on vehicle emissions and the place of driving are the best option to address local air pollution (van Dender, 2019). The shift to taxes based on road use would also help offset the loss of revenue from fuel taxes as EVs become widespread. Portugal has an electronic toll system operating on the motorway network for all vehicle categories. Toll prices vary according to the distance travelled, the height and the number of axles of the vehicles but not their emissions. Since 2011, Lisbon has introduced a low emission zone banning the most polluting vehicles from the city centre during working hours. This has not reduced NOx and $PM_{2.5}$ concentrations significantly, suggesting the need for stricter standards and stronger enforcement (Santos, Gómez-Losada and Pires, 2019).

Recommendations on sustainable development

Addressing key environmental challenges

- Continue efforts to ensure sustainable financing of water services and infrastructure including by improving municipalities' cost accounting capacity and updating tariffs, particularly where they provide the service directly.
- Raise water abstraction charges for agriculture, strengthen capacity to monitor abstractions, enforce water licensing regulations and limit new abstraction permits in over-allocated basins.
- Accelerate the passing on of municipal waste management costs to households through dedicated identifiable charges uncoupled from the water bill, as part of wider awareness-raising campaigns to move up the waste hierarchy; develop separate collection of waste.
- Increase allocations to protected areas management under the new common agricultural policy 2023-27 and assess the environmental impact of measures implemented.

Enhancing policy coherence for sustainable development

- Continue to improve SEA practices through appropriate consideration of alternatives and increased use of cost-benefit analysis.
- Carry on efforts to ensure the transparent and effective implementation of programmes financed with EU funds prioritising investments with the highest social return. Carefully assess the environmental impacts of RRP investments.
- Ensure that the expenditure of the Environmental Fund is aligned with Portugal's environmental and climate objectives, strengthen its links with the managing authorities of EU funds and monitor its performance.
- Complete the evaluation of the green tax reform with a view to applying the polluter pays principle more consistently and supporting a green and inclusive recovery; as part of the inventory of tax benefits, identify potentially environmentally damaging supports and phase out those not justified on economic, environmental or social grounds.
- Gradually close the tax gap between diesel and petrol, remove the preferential circulation tax treatment for older vehicles and consider introducing a NOx component in vehicle taxes to rejuvenate the fleet and steer towards cleaner vehicles.
- Vary toll prices with vehicle emissions; further develop low emission zones with strict standards in cities exceeding air quality limits and ensure their effective enforcement.

2. Carbon neutrality

Mitigating GHG emissions

2030 climate targets are within reach but carbon neutrality by 2050 calls for sustained and comprehensive action

Portugal is a small GHG emitter, accounting for less than 2% of EU emissions in 2020. Two-thirds of its emissions come from energy use, especially in transport and energy production. Portugal's economy is slightly less energy intensive than the OECD Europe average due to the high share of services. The carbon intensity of its energy mix is also lower thanks to renewable energy. Emissions of methane (from agriculture and waste) and fluorinated gas (hydrofluorocarbons from refrigeration and air conditioning equipment) make the country's economy more GHG emission intensive than the OECD Europe average.

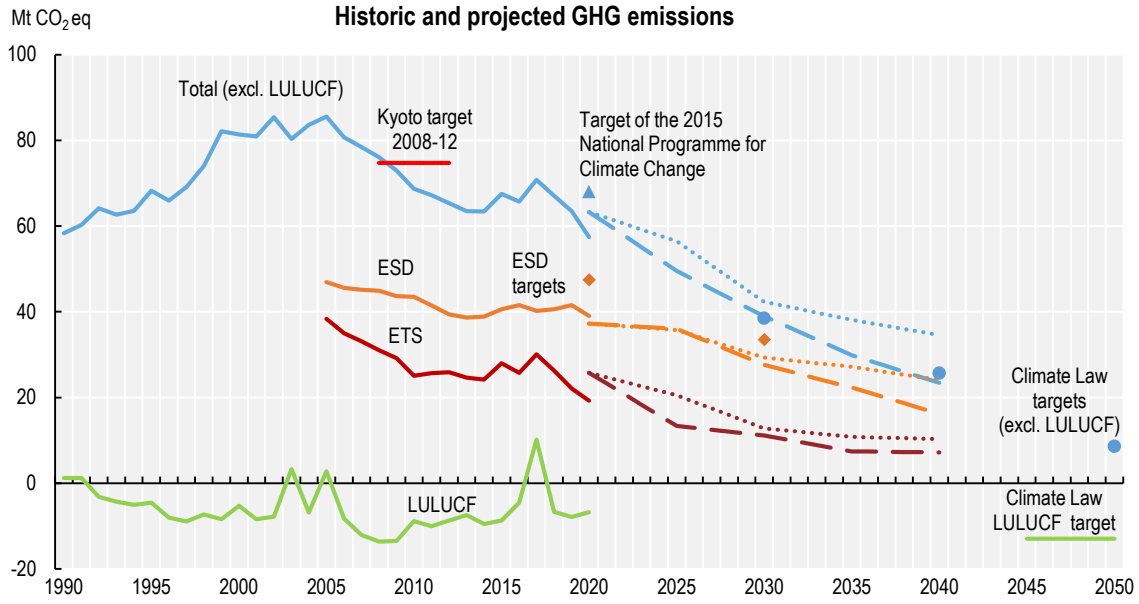
Considering the impacts of the COVID-19 crisis, total GHG emissions (excluding land use, land-use change and forestry, LULUCF) have been reduced by one-third over 2005-20. Portugal is in the top third of European OECD countries in terms of emission reductions over this period. The country reached the 2020 economy-wide objective of the 2015 National Programme for Climate Change (-18% to -23% from 2005 levels) (Figure 2). In the early 2010s, emissions declined due to the reduction in energy demand following the 2008 crisis and increasing renewable electricity generation. With the economic recovery, emissions rebounded in 2014-17, particularly in the transport sector. However, they have since fallen, driven by a strong shift away from coal-fired power generation. LULUCF has been a net sink over the last decades, except in years of extreme forest fires.

In 2019, Portugal approved a Roadmap for Carbon Neutrality by 2050 (RNC 2050). As required by the European Union, it adopted the National Energy and Climate Plan 2021-2030 (NECP 2030)[8] in 2020, setting the main priorities for the coming decade. Portugal can be commended for its active role in the approval of the European Climate Law under its Presidency of the Council of the European Union in 2021, and for enshrining carbon neutrality in national law, in line with EU objectives. Portugal's 2021 Framework Climate Law set the target of reducing total emissions by at least 55% from 2005 levels by 2030 and by 90% by 2050, and to increase removals from LULUCF to 13 $MtCO_2$ by 2050.

Portugal is on track to meet its 2030 targets as set out in the NECP. National projections indicate that additional policies will be needed to meet the more ambitious Climate Law targets for 2030 and 2050 (Figure 2). The 2023 NECP revision should clarify and elaborate the measures envisaged to achieve the targets.

So far, most of the emission abatement has taken place in energy production. Although the country seems on track to reach its 2030 target for non-ETS emissions (from road transport, buildings, agriculture, small industrial installations and waste), the NECP provides limited details on the policies to be implemented. The impact of existing and planned measures is not quantified, and their financing remains unclear. The country will need to tap the decarbonisation potential of all sectors.

Figure 2. Portugal seems on track to meet its 2030 climate targets



Note: LULUCF: land use, land-use change and forestry. Dotted lines refer to projections of the National Energy and Climate Plan with existing measures. Dashed lines refer to projections with additional measures. ESD 2020 target: under the EU Effort Sharing legislation; 2030 target: European Commission's proposal for the revision of the Effort Sharing Regulation COM(2021) 555 final. ETS: emissions under the EU Emissions Trading System.
Source: APA (2022), National Inventory Report 2022, April; EEA (2021), Greenhouse Gas Projections Data Viewer – December; Eurostat (2022), Greenhouse gas emissions in ESD sectors.

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Climate policy governance has improved

The Ministry of Environment and Climate Action (MAAC) defines and supervises environmental policies, including energy and climate, forestry and nature conservation, urban planning and mobility. It is in charge of monitoring and implementation of climate policies with the Portuguese Environment Agency. In 2015, the government instituted the Commission for Climate Action, a positive step towards improving inter-ministerial co-ordination. The Commission is headed by the MAAC and includes representatives of other ministries. It oversaw the development of the RNC, the NECP 2030, the 2015 National Climate Change Adaptation Strategy (ENAAC) and the 2019 Action Program for Climate Change (P-3AC).

Public consultation on climate action has progressed, notably through the Participa portal but could be strengthened. Climate mitigation and adaptation strategies were discussed with experts and stakeholders. Meetings across the country to present the NECP 2030 and the RNC were followed by a public consultation. However, the time span for comments on the NECP 2030 (less than one month) was relatively short (three months for the RNC). Giving advance notice of upcoming consultations and specifying time frames would encourage more active participation.

In line with international good practices, the 2021 Climate Framework Law requires five-year climate budgets, sectoral mitigation plans, municipal climate action plans and an annual government progress report to Parliament. It sets out green budgeting principles requiring the government to specify the resources allocated to climate policy in the state budget. The Law also creates an independent body, the Council for Climate Action, to assess climate action and provide recommendations. It plans a web portal to inform the public. Although promising, the Law remains to be implemented through specific regulations.

Portugal needs to maintain clear carbon price signals while addressing energy poverty

Pricing instruments are key levers in Portugal's strategy to mitigate carbon emissions. However, like in all countries, carbon prices vary across sectors and fuels. Effective carbon rates[9] consist of fuel excise taxes and to a smaller extent of permit prices from the EU ETS and of carbon taxes. In 2021, Portugal priced about 74% of its GHG emissions, of which 28% were above EUR 60 per tonne of CO_2, the midpoint benchmark for carbon costs in 2020. Emissions priced at this level originated primarily from the road transport sector. The majority of unpriced emissions were non-CO_2 emissions. With an average effective carbon price of EUR 74 per tonne of CO_2, in 2021, Portugal ranked in the middle of other OECD European countries (OECD, 2022c).

The government has to strike a balance between maintaining a clear price signal on fossil fuel use and supporting households' purchasing power, particularly in times of energy price surge. Budget surveys show that low- and middle-income households, which spend a larger share of their incomes on energy, carry a heavier burden for higher energy prices, either driven by climate policies or the international conjuncture. Like in many countries, the Portuguese government's response has so far mainly consisted in price support, which weakens the incentive to save energy. Social energy tariffs seek to protect vulnerable consumers, guaranteeing access to this essential service at affordable prices and under conditions of greater tariff stability. Their automatic payment has increased the number of beneficiaries by more than eight times between 2015 and 2021, to reach about 800 000 households, allowing for better coverage of the economically and socially vulnerable population. These tariffs have helped the poorest, but they could better address non-income dimensions of energy poverty by considering the energy performance of housing in the eligibility criteria (MAAC, 2021). Beneficiaries of the social electricity tariff who own their home are also eligible for the energy efficiency voucher programme (*Vale Eficiência,* see below on energy efficiency).

While the 2022 Budget Law confirmed the phasing out of energy and carbon tax exemptions initiated in 2018 (Chapter 1), the government suspended the carbon tax increase at the end of 2021. In September 2022, the plan to address rising prices (*Famílias Primeiro*) involved EUR 2.4 billion in addition to the EUR 1.6 billion already spent throughout the year to mitigate the impacts of inflation (Government of Portugal, 2022a). Overall, EUR 1.5 billion (0.7% of 2021 GDP) was spent in the form of untargeted fuel tax reliefs. Although energy price control and tax cuts are quick and simple to implement, Portugal should shift to targeted income support measures to protect vulnerable populations while encouraging energy savings and fuel switching (OECD, 2022d). Means-tested subsidies uncorrelated to energy consumption and aid for building renovation should be prioritised in the forthcoming national strategy to combat energy poverty.

Aligning investments and skills to decarbonisation will be major challenges

About EUR 1 billion additional annual investment is needed until 2030 and EUR 4 billion over 2030-40 to achieve carbon neutrality by 2050. Sustainable transport and buildings will attract most of it in the next decade although the NECP 2030 does not estimate the costs of specific measures. EU funds, including the Resilience and Recovery Facility, and to a lower extent EU ETS auction revenue, are expected to be the main sources of financing, together with domestic environmental taxation. Beyond 2030, Portugal will need to increase national financing while environmental tax revenue is expected to decrease. The mobilisation of the private sector will be all the more important in the long term, when financing is uncertain.

As Portugal's GDP has a relatively small carbon intensity, the direct negative impact of decarbonisation on activity and the labour force is expected to be mild at the aggregate level. However, local impacts on industries should be anticipated. Skill shortages are high in Portugal, especially in key sectors such as construction, energy and transport (EC, 2022b). Moreover, take-up for on-the-job training is particularly low, which can create rigidities in the labour market and hinder the transition of the workforce to carbon-neutral activities. New skills will be required and need to be integrated into initial and on-the-job trainings to avoid increased shortages on the labour market and to provide the means for the country's transition.

Renewable energy has developed, but there remains potential to tap

Most electricity is produced from renewable sources, the fruit of a strategy in place over the past two decades. It began with tapping hydropower and progressed to development of wind power through feed-in-tariffs. For decades, biomass has also made up the main renewable energy source in residential and industries, in particular through cogeneration in the pulp and paper industry. More recently, Portugal has been encouraging solar energy with the setting of dedicated auctions to access the grid, and feed-in-tariffs for small installations.

Portugal needs to accelerate the development of renewable energy and diversify energy sources to comply with the EU Renewable Energy Directive and reduce its import dependency. Further diversifying of energy sources will be key for a sustainable and stable energy system, all the more when the energy supply is threatened by international tensions. A large part of its electricity production comes from hydropower, which varies greatly from year to year, potentially adding a supply-side risk to the energy system. The country plans an increase in pumped storage hydropower to support development of intermittent sources such as wind or solar but also a stable capacity of non-pumped hydro. As climate change intensifies, Portugal should clarify how its new energy mix will adapt to increased water stress.

Structural changes have been initiated to integrate new renewable sources into the energy system, notably through electrification of the economy. Portugal plans to increase the share of cross-border interconnections to achieve 15% of total capacity in 2030 (national target in NECP 2030 and EU target). The development of hydrogen by electrolysis and of carbon storage are expected to help decarbonise sectors that are hard to electrify (air and maritime transport). Portugal launched a National Hydrogen Strategy to deploy 2.0-2.5 GW of electrolysis capacity and reform regulation. Investments have been initiated for a first project of 1 GW of renewable-based hydrogen in the industrial area of Sines.

Introducing technological-neutral auctions would help Portugal further diversify its renewable energy sources and to discriminate the most cost-efficient projects. A clear auction agenda needs to unfold to provide certainty to investors. This would support the country's ambitions to develop solar photovoltaic, onshore wind (which so far only relies on the repowering of existing turbines) and sustainable biomass use.

Projects for renewable energy have been subject to intense debate regarding their environmental impact (e.g. destruction of ecosystems, coastal erosion). Factoring in non-climate environmental criteria (biodiversity, coastal shore preservation, fight against deforestation, etc.) upstream of auctions would facilitate the processes and encourage the most environmentally friendly projects.

Energy efficiency efforts must be stepped up, notably in the building sector

Portugal has committed to reduce final energy consumption by 35% in 2030. The NECP 2030 presents a large array of new policies and measures for all sectors (EC, 2020b). However, energy policies over the last decade have tended to focus more on energy supply than on demand management and progress on energy efficiency has been modest (CNADS, 2022). Putting energy efficiency first would help to meet the climate objectives and to cushion the adverse impacts on firms and households of strained energy markets.

The building stock is in poor condition, putting a large part of households in energy poverty. About 20% of the population are unable to keep their homes adequately warm in winter and 36% suffer from the heat at home during the summer. The poor insulation of buildings can exacerbate health issues related to heatwaves as they become more frequent and intensify.

The government needs to sharpen its action for energy efficiency in buildings to absorb the existing funds in the short term and then mainstream efficiency works. Portugal has implemented various policies, including building regulations and support to the retrofitting of old dwellings co-financed by EU funds. The design of existing instruments fails to attract liquidities and suffers from a very low take-up. The

accumulation of plans makes the overall policy difficult to read, and the dispersion of actors hinders progress. Developing organisations providing local social and technical supports and putting actors (workers, banks, local administration) together can facilitate the process for households. Moreover, some instruments are not fit for purpose. For example, the energy efficiency voucher programme covers a small share of the renovation costs and only supports low-income owners. This results in low uptake and small coverage of households living in buildings with poor energy performance.

The government can accelerate action with large retrofitting and renovation plans, including a mix of regulation, grants and loans, adapted to specific needs. It should also target rented housing (tenants make up 17% of households), for instance considering specific energy efficiency requirements in rented dwellings. Calls for project should also promote synergies between energy efficiency, climate and the environment, more particularly with renewable energy use or self-production. Assessing the skill needs and adapting the supply of professional training accordingly can be a decisive factor to avoid bottlenecks on the labour market.

GHG emissions from the transport sector grew regularly until the pandemic

Fuel and vehicle taxation did not reverse the growth in GHG emissions from road transport over 2013-19 (Chapter 1). In addition to vehicle tax exemption, the government is encouraging the procurement of low-carbon vehicles through subsidies and investment in charging infrastructure. In 2021, the share of EVs[10] in new car registrations was slightly above the EU average (20% vs. 18%). The number of charging stations has almost quadrupled in ten years, but their density per square kilometre remains less than half the EU average. The deployment of charging infrastructure across the country, including in remote areas where dependence to private vehicles is hard to solve, will be key.

Portugal's railway network density is below that of the EU average as is the modal share of passenger rail transport (Government of Portugal, 2022b). Investment in rail infrastructure has increased in recent years. However, in 2020 it was less than half its 2010 level and remained well below road investment. A shift in investment from road to rail will be needed to reduce the sector's GHG emissions by 40% by 2030 from 2005 levels. Large projects, mainly EU-funded, will enhance access to public transport. Meanwhile, the high-speed train between Lisbon and Porto will simplify travel through the country. Dedicated support to local governments in the institutionalisation of bus lines, with low-carbon vehicles, can address other areas in the short term.

Land and road management are also key to reduce car dependency. As cities build cycling lanes and promote active mobility, roads should also be adapted to reduced car use. Reduced parking zones, including for residents, can increase the space and the safety of these mobility modes. Such strategies call for increased co-operation between the different municipalities within the same agglomeration to ensure lanes' continuity and the organisation of multimodal hubs.

Agriculture is not on track to meet climate goals

Agriculture's contribution to Portugal's decarbonisation strategy is modest but risks being undermined if trends are not reversed. To reduce emissions by 55% in 2030, emissions from agriculture will have to fall by 11%. The NECP 2030 plans that most emission abatement will come from more efficient fertiliser use and enteric fermentation and that, in parallel, pastures become net carbon sinks.

The sector is not on track. Since 2013, GHG emissions have been increasing, driven by livestock emissions. Production is particularly emission intensive by international standards. Thorough reforms are challenging and private financial resources are scarce. A large number of small farms have little income and capacity to invest. This situation is worsened by the consequences of climate change (drought, land desertification, reduced yields, etc.) and the induced uncertainty.

Over 2014-20, Portugal devoted a higher share of agricultural rural development support to climate and environment compared to the EU average. However, few actions support the mitigation of agriculture emissions and target livestock. In addition, the country has among the highest share of coupled supports (i.e. proportionate to production or the number of animal heads), targeting mainly ruminants and incentivising livestock-intensive farming. The proportion of land used for climate purpose (e.g. carbon sequestration) is low and the budget dedicated to land restoration is below the average on the continent. According to national data, the share of organic farming in agriculture land has more than doubled since 2020, reaching almost 18% in 2022. It is a positive development to enhance soils' carbon content. However, further efforts are needed to reach the EU target of 25% by 2030. The Portuguese target (19% in 2027) and planned funding for organic farming (EUR 391 million) in its CAP strategic plan 2023-27 seem unambitious.

Portugal needs to step up action and unfold an integrated food strategy, making climate action a pillar of the agriculture system. Subsidies from the EU common agricultural policy largely consist of direct payments, with minimum environmental standard criteria and sectoral supports. A larger share should be used to promote sustainable practices. Specific payments for sustainable land management and environmental service provision, including agriculture sinks, should be scaled up and mainstreamed. Tighter regulation on input use, animal feed or animal density would complete such payments effectively. Portugal needs to promote further an extensive agriculture sector, particularly for livestock, that would reduce the number of animals, their impact on ecosystems, and methane emissions. Such a comprehensive approach would be even more effective and profitable for farmers if embedded in a larger food strategy promoting sustainable food consumption, made with the co-operation of all components of the food chain. The clauses on the reduction of food waste and promotion of healthy diets in the 2021 Climate Law (article 56) could reduce the environmental footprint of agriculture. They call for concerted efforts to build a detailed and broad strategy with stakeholders belonging to all parts of the supply chain.

Portugal also needs to clarify its strategy for the development of renewable energy from agriculture (sustainable biofuels, cogeneration or biogas) to improve farmers' livelihoods and decrease GHG emissions. Such a strategy should ensure the environmental sustainability of projects. In addition, it should accelerate development of a market for sustainable biogas, notably through adapted legislation and grid connections. Dialogue with stakeholders will be key.

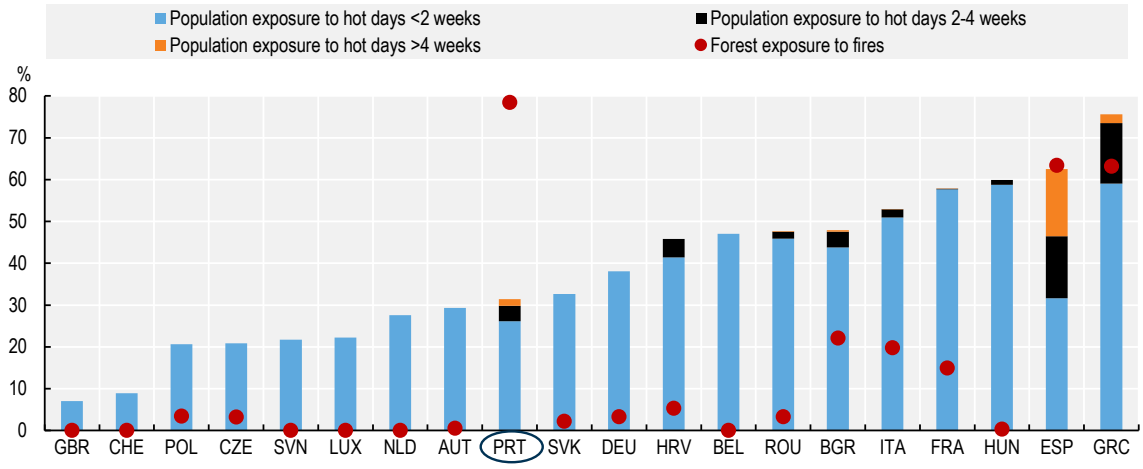
Adapting to the impacts of climate change

Portugal has stepped up action on adaptation

Portugal's territory faces multiple threats related to climate change. Coastal areas, where most of the population and economic activity reside, are threatened by coastal erosion. Rainfall and extreme heat days are becoming more frequent and intense (Figure 3), causing material destruction and health issues. In addition, droughts undermine agricultural yields and hydropower production. Portugal is regularly affected by wildfires in the summer and autumn; an increasing part of its population is suffering from the unprecedented impacts of these fires.

Figure 3. Portugal is particularly exposed to increasing temperatures and forest fire danger

Percentage of population exposed to hot summer days and percentage of tree-covered area exposed to fire danger in selected European countries (2017-21 average)



Note: OECD and IEA calculations allow estimating population exposure to hot summer days where the maximum daily temperature exceeds 35°C using daily temperature data from the Copernicus Climate Data Store (ERA5 reanalysis). The Global Human Settlement Layer population grids allow for the estimation of the residential population target years 1975, 1990, 2000 and 2015 at a 250 m spatial resolution. Further linear interpolation between target years is done to develop annual indicators.
OECD calculations allow estimating forest exposure to very high or extreme wildfire danger based on the Fire Weather Index (a meteorological data-based index that accounts for temperature, relative humidity, wind speed and precipitation levels). This dimensionless index rates the potential fire line intensity given the meteorological conditions in a reference fuel type and level terrain. The Copernicus gridded Land Cover maps at 300 m spatial resolution allow for the identification of tree-covered areas.
Source: Maes et al. (2022), Monitoring exposure to climate-related hazards: Indicator methodology and key results.

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The government stepped up its policy tools to address these challenges, defining institutions in charge of supervising actions, measures to be implemented and a clear budget. The 2015 National Adaptation Strategy establishes the governance and responsibilities, and the 2019 Action Programme for Adaptation to Climate Change sets the measures to be implemented. A large part of EU funds, including from the Recovery and Resilience Plan, is dedicated to investments for adaptation. A broad range of stakeholders take up action in the public and private sectors. The most affected sectors (agriculture, tourism) have developed specific plans. Municipalities are legally required to have their own strategy, possibly within the framework of inter-municipality. Portugal has also commendably sharpened its action for risk prevention, particularly for the management of wildfires.

The information system supporting policy action for adaptation risks lagging behind, notably due to a lack of stable funding in the long term. The adaptation programme set ambitious targets that are to be monitored annually, although the corresponding indicators have not yet been updated. The government has started the National Roadmap for Adaptation 2100 project to update climate projections and assess the physical and economic impacts of climate change in priority sectors. The project also aims to estimate the costs for adaptation and inaction. It is expected to be completed in 2023.

The clear definition of roles and responsibilities for adaptation action will be key. Promoting co-ordination between sectors and stakeholders, including local governments, can prevent conflicting interest (e.g. for resource management) and ensure the dissemination of information and data. The Climate Law establishes the government as responsible for co-ordinating climate action. In the case of coastal

management, responsibility is shared between dozens of entities, local governments and administration (Oliveira, Moura and Boski, 2020). This hinders decision and action, and can even create conflicts. Finally, insurance coverage of vulnerable assets and activities is particularly low regarding climate risks, and public funds are often used as last recourse compensation. Having insurance take on more of the risk would encourage private actors to enhance their investment in the adaptation to climate change.

Sustainable land use in rural areas is a key challenge for climate change mitigation and adaptation

Forests are at the crossroad of mitigation and adaptation efforts in Portugal's climate strategy. The country plans to increase its carbon sink potential by 50% by 2030 and double it by 2050, without strong net expansion. Forest fuel will also be a central renewable energy source, able to compensate for other variable renewable energy sources. On the other hand, forest fires intensified by climate change represent a major adaptation challenge. Forest and rural land management practices should then focus on enhancing the land's productivity and mitigate fire intensities, notably through fuel management and the development of more resilient landscapes.

The structure of forest ownership is a major barrier to government action. Only 3% of forest land is owned by the Portuguese state or other public administration, compared to 40% at the EU level (APA, 2020). Most forest lands are privately owned and small owners are numerous, particularly in the North. As a result, investment in land management is rarely profitable and large-scale action, with possible economies of scale, is difficult. The number of owner associations aiming to enhance land profitability through active land management has been growing. However, only 27% of forests were covered by a long-term forest management plan in 2016 (as compared to 96% in Europe). On top of this, more than half of rural properties do not have a cadastral delimitation and an estimated 20% of forest land has unknown owners.

Rural land is being abandoned in Portugal due to the ageing of the population and migration to cities. This has led to the increase of unmanaged rural land, including a large share of forests, with concentrated fuel loads that are prone to catch and spread fires. This raises a general environmental and social risk but also undermines Portugal's capacity to store carbon and reach carbon neutrality.

The government needs to build an integrated and structural strategy enhancing management of forests and rural land. As a first step, Portugal needs to accelerate its development of the cadastre of rural land, by using all available information, including from owner associations, and establishing strong incentives for land registration. Payment for ecosystem services should also be mainstreamed and used as a basis for rural policies.

In parallel, the government should promote active land management by making it profitable, for landowners and communities. Subsidies and payments for environmental services can bring monetary value to services like carbon sequestration in lands, biodiversity protection or water retention in soils. Sustainable management of forestry resources by the energy sector and the industry could also be enhanced. The government can support investments but also potentially operating costs. Measures like the dissemination of information and training for sustainable land management in rural areas should be broadly implemented and streamlined.

Recommendations on carbon neutrality

Improving the governance of climate policy

- Swiftly implement the Framework Climate Law. Clarify the measures envisaged to achieve the 2030 goals, quantify their mitigation impact and specify how they will be financed.
- Enhance public participation in climate policies by informing the public in advance of upcoming consultations and allowing sufficient time.

Aligning the economy with climate ambitions

- Align economic incentives to climate targets. Set clear milestones to phase out all fossil fuel subsidies by 2030, as committed in the Climate Law. Continue to protect vulnerable groups by shifting from energy price control to targeted income support measures uncorrelated to energy consumption, and by increasing investment in decarbonising buildings.
- Anticipate the labour market needs for green jobs, notably to address an increasing demand for energy renovation, by developing skills and facilitating immigration for workers with requisite skill sets.
- Support private investment for climate by providing long-term visibility to investors on future regulations and carbon prices, developing tailored sector-specific tools (e.g. auctions or third-party payment organisations in sectors where liquidity is strained).

Develop renewable energy sources on a cost-efficient basis

- Increase the use of auctions for renewable energy projects, with a technology-neutral approach. Consider requiring environmental indicators in public tenders to rule out projects with strong detrimental impact on natural capital.
- Encourage private renewable energy producers to sell their production on the grid by reducing the administrative and price barriers.
- Assess and monitor climate impacts on security of supply, including the volatility of hydro generation, as part of the annual security of supply monitoring report for the national electricity system.

Step up action for energy efficiency in buildings

- Accelerate and mainstream retrofitting works with a package of measures adapted to all households' configurations and specific instruments for households unable to contribute to the work such as direct grants or tax cuts. Facilitate access to existing supports, including with information, technical support and a dedicated platform putting actors together.
- Encourage deep retrofits by correlating supports to the energy consumption cut generated, adding premiums for packages of works, more efficient than dispersed measures.

Reduce emissions from vehicles and car dependency

- Continue supporting the purchase of low-carbon vehicles and phase out supports to older vehicles. Accelerate the deployment of charging stations for electric vehicles across the country, supporting their installation in remote areas as planned.
- Reduce private car use. Shift investment from new road building to improving the rail network. Integrate the reduction of private car dependency as a requirement for land and road management in municipal climate plans. Facilitate the access to services and activities by active mobility and public transport in cities.

Accelerate action for reducing GHG emissions from agriculture production

- Increase use of monetary incentives to enhance GHG emission mitigation and sequestration in agriculture. Consider introducing taxes based on the number and type of animals, and on fertiliser use. Mainstream payments for ecosystem services under the new common agricultural policy. Divert public support from emission-intensive activities in the agriculture sector (e.g. energy tax break or support coupled to animal heads).
- Develop a national food strategy encouraging sustainable diets through education campaigns and developing alternatives to meat-intensive diets in public catering, with the co-operation of local stakeholders. Make the fight against food waste a key pillar in this strategy.

Sharpen the country's adaptation strategy

- Improve the information system related to climate change adaptation policies to track their implementation and impacts on risks and exposure. Ensure stable funding to track the progress of the adaptation strategy on a yearly basis; assess the impact of policies on climate change risk.
- Enhance the value of rural lands for the mitigation and the adaptation to climate change. Accelerate development of the land cadastre in rural lands. Encourage the sustainable creation of value from rural land by extending payments for ecosystem services to all rural land, including non-agricultural lands, and setting the rule of a sustainable management of forestry resources by the energy sector and the industry.

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Notes

[1] During the Economic and Financial Assistance Programme (2011-14), Portugal received EUR 78 billion in loans from the European Union and the International Monetary Fund that were conditional on implementation of comprehensive reform programmes.

[2] GDP generated per unit of materials used.

[3] Out of 453 agglomerations, 15 were not considered in calculations of the compliance rate for Article 4 because they have a size of 2 000–10 000 p.e. and discharge into coastal water or less sensitive areas.

[4] Out of 453 agglomerations, 426 were not considered in the calculation of the compliance rate for Article 5 because they have a size <10 000 p.e. or >10 000 p.e. but discharge into normal or less sensitive areas.

[5] Countries assess the impact of the measures proposed in the RRP on climate objectives according to the tagging methodology of the Regulation establishing the Recovery and Resilience Facility (EU 2021/241).

[6] The Minister of the Presidency formulates, conducts and assesses the economic and social development strategies. It also defines and enforces the strategy, priorities, monitoring, assessment and global management of the programmes financed by EU funds, in particular under the cohesion policy.

[7] The RDP for Mainland, Portugal, was formally adopted by the European Commission on 12 December 2014 and modified on 25 January 2022. Its budget amounts to EUR 5.8 billion including EUR 4.8 billion from the European Union and EUR 1 billion of national co-funding.

[8] Council of Ministers Resolution no. 53/2020, 10 July.

[9] Effective carbon rates summarise how countries price GHG emissions through fuel excise taxes, carbon taxes and ETS.

[10] Battery and plug-in hybrid electric vehicles.

Annex 1. Actions taken to implement selected recommendations from the 2011 OECD Environmental Performance Review of Portugal

Recommendations	Actions taken
Chapter 1. Towards sustainable development	
Analyse how environmentally related taxes could contribute to fiscal consolidation, whilst offsetting reductions in more distortionary taxes on labour and corporate activity. Continue to broaden the use of environmentally related taxes by introducing other such taxes (e.g. on air pollutants and pesticides), and by linking a component of fuel taxes to the carbon content of fuels.	In 2014, Portugal introduced a green tax reform as part of a broader fiscal consolidation effort under the EU economic adjustment programme. Law No. 82-D/2014 introduced a carbon tax in sectors outside the EU ETS. It also increased the CO_2 component of the vehicle registration tax, revised the taxation of water and waste management, granted property tax breaks for forest management and introduced a tax on single-use lightweight plastic bags. Revenues from environmentally related taxes increased from 2.3% to 2.5% of GDP between 2014 and 2019, and then fell to 2.4% in 2020 with the decline in car purchase and use due to the COVID-19 pandemic. In 2022, the Ministry of Finance and Ministry of Environment and Climate Action were evaluating the impact of the green tax reform.
Review the current array of tax exemptions and discounts, with a view to phasing out those that are costly and environmentally harmful; ensure that the water and waste management taxes are passed on to final users; provide targeted support for those households adversely affected by energy, water and waste prices. Speed up the introduction of household waste collection charges to provide incentives for better waste management.	Portugal is among the few EU countries to have performed a comprehensive stocktake of fossil fuel subsidies in its National Energy and Climate Plan 2021-30 (NECP 2030). The 2021 Climate Law provides for their phase-out by 2030. The country is setting up a unit to regularly monitor and assess tax benefits and streamline the tax system. ERSAR, the regulatory authority for water and waste services, has established a benchmarking system for waste and water management utilities. It has issued recommendations and established guidelines to harmonise municipalities' practices and ensure the principles of universality, quality, affordability and sustainability of public service obligations. Service provision and tariffs for retail service are a municipal responsibility. The 2017 decree-law 147 provides for social water tariffs for families in economic deprivation. Municipalities are free to adhere to this tariff, which must be financed explicitly from municipal budgets. To ensure affordability of water and waste services, some municipalities have targeted monthly support, others have social tariffs and others have both mechanisms. In 2022, ERSAR issued a new recommendation on water tariffs. Despite an apparent good cost recovery of wastewater services, there is scope to improve the ability of municipalities to assess these costs and to increase tariffs, particularly where they provide the service directly. Recovering the costs of water services also requires better reflecting environmental and resource costs in water charges. Water abstraction fees (components of the water resource tax) vary with water scarcity, but rates are reduced for irrigation. This does not encourage efficient water use and the reuse of treated wastewater for non-potable uses. In 2020, three-quarters of municipalities did not fully recover the costs of waste service provision through tariffs charged to consumers. Waste charges are included in the water bill and usually linked to water consumption. Only as from the end of 2025 will waste charges be mandatorily indexed to the amounts of waste collected.
Progressively decouple environmental expenditure from EU funding, including through private investment and well-designed user charges for environmental services.	Public expenditure on environmental protection (current expenditure and investment) decreased until 2016 and has since increased. It reached 0.7% of GDP in 2020, below the EU average of 0.9%. The cohesion policy has become the main source of financing accounting for 60% of total public investment over 2014-20.
Develop and implement a comprehensive framework for promoting eco-innovation and employment in eco-industries, including increased public support for R&D, improved co-operation among competent authorities	Portugal has low government spending on R&D in environmental and energy fields and limited patenting activity. The country encourages R&D generally through generous tax credits for businesses. It has been a pioneer in developing cutting-edge technologies for large-scale projects of renewable energy, co-funded with EU and

and with universities, the private sector and financial institutions, and investment in higher education and training; and green the jobs in the strategic sectors of the economy.	private funds. There is no strategy guiding energy research, development and demonstration.
Continue to simplify and streamline environmental requirements and reduce associated administrative costs of compliance, particularly for small and medium-sized enterprises; assess the staffing arrangements needed to support an efficient, effective and transparent environmental regulatory system at all levels of government; develop a strategy, with supporting instruments, to address serious non-compliance with environmental requirements.	The decree law no 75/2015 on the Single Environmental Licensing Regime simplifies the procedures. The information regarding all acts of environmental permitting and prior checking applicable to an establishment or activity is condensed in a single permit. Since 2017, Portugal has a National Plan for Environmental Inspection and Enforcement based on a digital platform co-ordinated by the General Inspectorate for Agriculture, the Sea, Environment and Spatial Planning (IGAMAOT). IGAMAOT recently developed a single platform for inspection and monitoring of agriculture, sea and environment (iFAMA) to strengthen interoperability between inspection and permitting agencies.
Establish an effective framework, with supporting capacity, for *ex ante* and *ex post* economic evaluation of environmental policies; use this framework to strengthen priority- and target-setting, and to identify cost-effective policy instruments; strengthen Strategic and Environmental Impact Assessment procedures.	Strategic environmental assessment has been increasingly used in land-use plans, less frequently in sectoral plans. It is generally developed in line with good practices and national guidance. However, the lack of alternatives considered often hinders the identification of more sustainable development options. Cost-benefit analysis is seldom used.
Support NGOs to play an expanded and constructive role in environmental decision-making; strengthen mechanisms for stakeholder consultations; further develop environmental curricula at all levels of education, and for key professional groups such as decision-makers and judges.	Since 2015, the Participa portal allows public information and participation on plans and programmes, environmental impact assessments and strategic environmental assessments.
Strengthen measures to reduce emissions of tropospheric ozone precursors and particulate matter from transport and industry; evaluate air quality improvement plans in large agglomerations in order to strengthen air pollution reduction efforts.	Portugal achieved its 2020 targets set by the EU Directive on the reduction of national emissions of certain atmospheric pollutants, except for ammonia. The national air pollution programme (due in 2022) should clarify how it will ensure compliance with 2030 targets. The low emission zone introduced in Lisbon in 2011 has not reduced NOx and $PM_{2.5}$ concentrations significantly.
Complete River Basin Management Plans; develop a realistic and affordable finance strategy to achieve the target of connecting 90% of the population to public wastewater treatment.	In 2018, 92% of the urban wastewater (load generated) was treated according to the requirements of the EU Urban Waste Water Treatment Directive. The number of small agglomerations with inadequate wastewater treatment has been drastically reduced. Public consultation of the third River Basin Management Plans is to be completed by the end of 2022.
Make payments for Natura 2000 sites conditional on the achievement of specific nature protection and biodiversity outcomes, particularly in the context of agriculture and fisheries policies; consider introducing a tax on pesticides based on toxicity.	Under the Rural Development Programme 2014-20, the impact of agri-environmental measures on biodiversity could not be assessed due to lack of appropriate indicators.
Designate more marine protected areas as part of sea use planning, taking into account implementation of the regulations regarding Natura 2000, and the marine environment, and post-2010 EU Biodiversity Strategy targets.	In 2020, protected areas covered 8.9% of marine areas under Portugal's jurisdiction, below the 2020 Aichi target of the United Nations Convention on Biological Diversity.to protect 10% of coastal and marine areas.
Chapter 2. Carbon neutrality	
Extend the monitoring of the climate and energy action plans to the financial and economic costs of policy measures, with a view to assessing and improving overall cost effectiveness.	The NECP 2030 identifies investment needs by sector. The cost of individual measures and their financing is not specified. The 2021 Climate Framework Law sets out green budgeting principles requiring the government to specify the resources allocated to climate policy in the state budget.
Strengthen efforts to ensure that renewable energy projects are assessed in the framework of the country's energy strategy, taking into account cumulative environmental impacts, alternative options and the impacts of support measures on electricity tariffs; ensure the broadest possible public participation in environmental impact assessment procedures.	Portugal has carried out a strategic environmental assessment of the NECP 2030 and submitted it for public consultation. Environmental impact assessment must be carried out for large renewable energy projects according to the Decree-law 152-B/2017 transposing the EU Directive (2014/52/EU) on the assessment of the effects of certain public and private projects on the environment. Decree-law 30-A/2022 simplifies procedures for the production of electricity from renewable sources. It adopts a case-by-case evaluation approach for renewable projects located outside sensitive areas.

Consider introducing a renewable quota obligation system, linked to tradable green certificates, for technologies that are close to being competitive with fossil fuels (such as on-shore wind or biomass); phase out all support schemes for renewable technologies as they become competitive with fossil fuels.	A large part of renewable energy projects is awarded through competitive auctions. Portugal eliminated feed-in-tariffs for onshore wind energy in 2012. Feed-in-tariffs for small installations remain (photovoltaic, biogas, biomass and hydro projects with a maximum capacity of 250 GW). Energy communities and self-consumption are granted grid access tariff exemptions.
Phase out tax concessions for electricity and fuel use, with a view to encouraging changes in consumption patterns and contributing to fiscal consolidation.	The 2021 Climate Law provides for the phase-out of fossil fuel subsidies by 2030. Since 2018, Portugal has been implementing a progressive elimination of the energy and carbon tax exemptions on energy products used for electricity production, and co-generation or by industrial installations under the ETS or an energy-efficiency agreement. The phase-out is effective for coal since 2022 and planned for fuel oil in 2023 and natural gas (50% in 2024) used for electricity generation and co-generation. The carbon tax exemption on energy products used by industrial installations with an energy-efficiency agreement will be gradually phased out by 2025. Responding to rising prices, the government reduced energy taxes and introduced new reliefs in 2022. Overall, EUR 1.5 billion (0.7% of 2021 GDP) was spent in the form of untargeted fuel tax reliefs.
Phase out the vehicle scrapping programme and introduce better incentives for efficient private vehicle use (e.g. road pricing and congestion charges); speed up implementation of plans for investment in urban public transport infrastructure and multimodal freight transport networks; and significantly upgrade integrated metropolitan mobility management, including integrated ticketing.	The vehicle scrapping scheme was phased out in 2016. Portugal promotes electric vehicles through tax exemptions, purchase subsidies and investment in charging infrastructure. Portugal has an electronic toll system operating on the motorway network for all vehicle categories. Toll prices vary according to the distance travelled, the height and the number of axles of the vehicles but not their emissions. Investment in urban public transport infrastructure is supported by EU funds. Under the Operational Programme for Sustainability and Efficient Use of Resources 2014-20, projects on developing clean urban transport infrastructure have been delayed partly due to their complexity. The PART and PROTransP programmes support fare reductions to promote public transport and reverse the decline in demand resulting from the pandemic. Lisbon and Porto have integrated multimodal ticketing systems.
Develop the electricity network, metering infrastructure and smart grids so as to accommodate the projected large-scale use of renewables, including in residential buildings, and of electric vehicles.	By the end of 2021, 4 million smart meters were installed covering two-thirds of customers in mainland Portugal. Of this total, 3.1 million devices support remote reading. In September 2022, Portugal had more than 5 000 public recharging points for electric vehicles.
Take further steps to address rapidly increasing energy use in the service sector, especially in tourism-related activities and housing (e.g. by extending to commercial businesses the energy audit and negotiated agreements currently used in the industrial sector).	The Sustainable Tourism Plan 2020-23 encourages tourism businesses to reduce energy consumption and adopt circular economy solutions.

Source: OECD secretariat based on country submission and findings of the 2023 Environmental Performance Review.

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Chapter 1. Towards sustainable development

This chapter provides a brief overview of key environmental trends in Portugal and progress towards the Sustainable Development Goals and environmental targets. It assesses the environmental effectiveness and economic efficiency of the environmental policy mix, including regulatory, fiscal and economic instruments, and public and private investment in environment-related infrastructure. It examines the interaction between the environment and other policy areas with a view to highlighting the opportunities and barriers to enhance policy coherence for sustainable development.

Introduction

Portugal, the westernmost country of mainland Europe, is a unitary and centralised state (Box 1.1.). Thanks to its geographical location and geophysical conditions, mainland Portugal and the Azores and Madeira archipelagos host a high diversity of habitats and unique species. Agricultural areas and forests each cover about 40% of its mainland area. Population and economic activity are concentrated on the coastline. The country faces climate risks, including increased frequency and intensity of wildfires, heat waves, drought and extreme precipitation events, increased temperatures and susceptibility to desertification, sea-level rise and coastal erosion (APA, 2021a).

Over the last decade, Portugal's environment performance has been mixed. The shift in electricity generation from coal to natural gas and renewables has reduced emissions of greenhouse gas (GHG) and other major air pollutants. However, with the economic recovery over 2013-19, air emissions in some sectors (e.g. GHG and ammonia emissions from agriculture) and waste generation have increased. Portugal has improved the regulatory framework for environmental services. It has made progress in wastewater treatment. However, efforts are needed to better manage water and waste. Despite the recent designation of new marine protected areas, conservation measures need to be implemented to reverse the deterioration of habitats and species. The demographic decline in rural areas and the fragmentation of private land ownership hamper sustainable forest management, fire prevention and biodiversity protection.

Box 1.1. Institutional framework for environmental governance

Portugal has two layers of government, with the exception of the two autonomous regions of Madeira and Azores, of which the 308 municipalities form the core of the local government.

The Ministry of the Environment and Climate Action (MAAC) drafts, implements and assesses environmental policies, including energy and climate, forestry and nature conservation and urban planning and mobility. MAAC also monitors inter-ministerial measures for implementation of the Portuguese government programme for climate action.

The minister is assisted by three secretaries (environment and energy; nature conservation and forests; and urban mobility). MAAC is supported by subordinated agencies, including the General Inspectorate for Agriculture, the Sea, Environment and Spatial Planning (IGAMAOT), the Portuguese Environment Agency (APA), the Environmental Fund, the Directorate-General for Energy and Geology (DGEG), the Institute for Nature Conservation and Forests (ICNF) and the Directorate-General for the Territory (DGT). The Water and Waste Services Regulation Authority (ERSAR) and the Energy Services Regulatory Authority (ERSE) are independent regulatory bodies.

Other ministries develop and implement policies affecting the environment: the Ministry of the Economy and Maritime Affairs; the Ministry of Agriculture and Food; the Ministry of Infrastructure and Housing, and the Minister of the Presidency, which shares oversight of the Development and Cohesion Agency (in charge of EU funds) with the Ministry of Territorial Cohesion.

Implementation of national policies at the sub-national level is supported by five regional development and co-ordinating committees (CCDRs). Municipalities play an important role in licensing, supervising and enforcing national regulations and land-use planning, as well as delivering public services to citizens and businesses (including water supply, sewerage and municipal waste management).

1.1. Addressing key environmental challenges

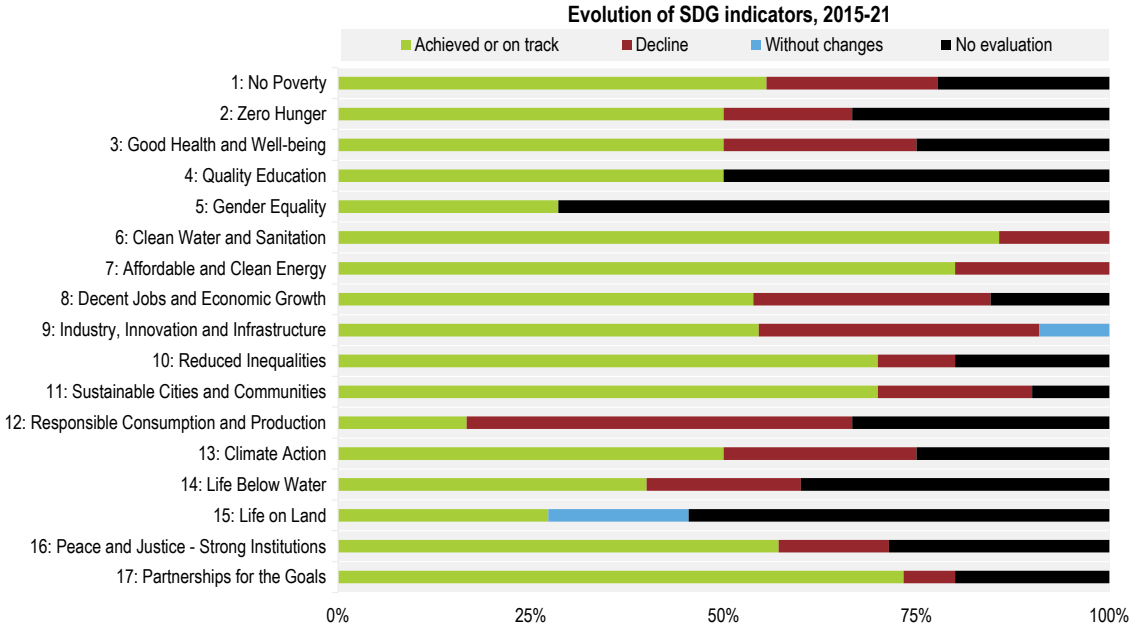
1.1.1. Portugal has made progress towards some Sustainable Development Goals

Portugal has a small, service-based economy that grew steadily between 2013 and 2019.[1] The country was among the OECD economies most strongly hit by the pandemic, but it has been recovering fast since mid-2021 (OECD, 2021a). Activity has been constantly supported by policy measures and rebounded markedly each time when diverse restrictive measures were lifted. Strong private consumption growth and a rebound in tourism supported gross domestic product (GDP) growth in early 2022 (OECD, 2022a). Yet the pace of the recovery is easing. While Portugal has few direct trade links with these countries, Russia's war against Ukraine is driving up energy and food prices, increasing uncertainty and weighing on activity.

Portugal's population density is similar to the OECD Europe average, with a higher proportion of people living in small and medium-sized cities (OECD, 2020a). Population density is higher along the western and south coastlines, as well as in the urban areas of Lisbon and Porto where it can exceed 1 000 inhabitants per square kilometre. According to the Better Life Index, Portugal ranks above the OECD average in housing, safety and air quality. It underperforms average in income, civic engagement and life satisfaction (OECD, 2022b).

Portugal has made progress towards Sustainable Development Goals (SDGs), especially to ensure clean water and sanitation (SDG 6) and affordable and clean energy (SDG 7) (Figure 1.1). Nevertheless, major challenges remain to ensure sustainable consumption and production patterns (SDG 12) and to protect, restore and promote sustainable use of marine and terrestrial ecosystems (SDGs 14 and 15).

Figure 1.1. Progress towards Sustainable Development Goals



Source: INE (2022), Sustainable Development Goals, 2030 Agenda, Indicators for Portugal 2015-2021.

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1.1.2. The economy is more carbon efficient

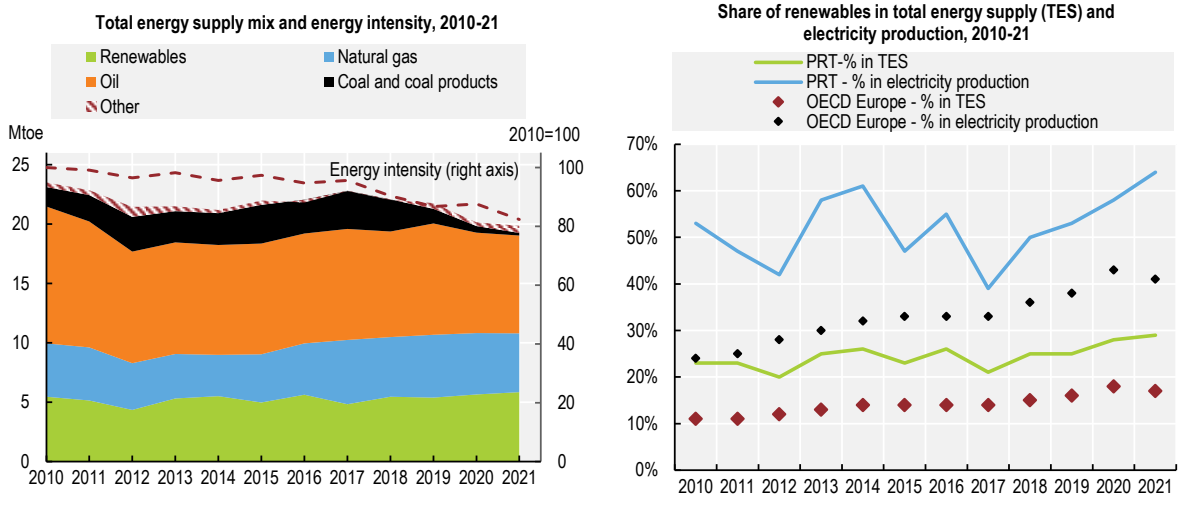
The energy mix has shifted from oil and coal to natural gas and renewables

In 2021, fossil fuels accounted for 68% of Portugal's total energy supply (TES), slightly below the OECD Europe average. The share of renewables (mostly biomass, wind and hydro) was higher than in most European countries. Oil is the largest energy source (42%), followed by renewables and waste (29%), natural gas (25%) and coal (1%) (Figure 1.2). Over the past decade, there has been a shift in the energy mix from oil and coal to natural gas and renewables. In 2021, the last two coal power plants were closed. Portugal relies entirely on imported fossil fuels. However, imports from the Russian Federation represent a relatively small share of its TES. Most gas imports come from long-term contracts with Nigeria and Algeria (IEA, 2021). Annual variations in hydropower generation have a notable impact on Portugal's domestic energy production and energy dependency.

With 34% of renewable energy in gross final energy consumption in 2020, Portugal overachieved its binding target of 31% set by the EU Renewable Energy Directive (Eurostat, 2022a), partly due to reduced energy consumption linked to the pandemic (APA, 2021a). The country was close to achieving its 2020 sub-targets for electricity (58.0% vs. 60.0%) and transport (9.7% vs. 10.0%). It met its sub-target for heating and cooling (41.5% vs. 41.0%) (Eurostat, 2022a). The National Energy and Climate Plan 2021-2030 (NECP 2030) aims to reach 47% of renewable energy in gross final energy consumption by 2030 (Government of Portugal, 2019). The European Commission suggests 48% for Portugal in its proposal for the revision of the directive to achieve climate neutrality in the European Union by 2050 (EC, 2021a).

Portugal's energy intensities per capita and per GDP are below the OECD Europe averages, reflecting its service-oriented economy. The 2008 financial crisis was followed by a significant drop in energy consumption in all sectors. With economic recovery, energy demand in the transport sector increased over 2013-19. This increase was offset by declining demand in industry[2] thanks to improved efficiency and a structural shift to less energy-intensive activities (IEA, 2021). As a result, total final consumption remained broadly stable. In 2019, transport and industry were the largest energy consumers (35% and 34%,[3] respectively) followed by the residential (16%) and service (11%) sectors. Restrictions linked to the COVID-19 pandemic resulted in reduced energy consumption in 2020. Portugal met its 2020 target on energy efficiency.

Figure 1.2. Renewable energy has developed rapidly



Note: 2021: provisional data.
Source: IEA (2022), IEA World Energy Statistics and Balances (database).

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Portugal overachieved its 2020 climate targets

In the early 2010s, GHG emissions (excluding land use, land-use change and forestry) declined due to the reduction in energy demand following the 2008 crisis and increasing renewable electricity generation (Chapter 2). Portugal met its commitments under the first period of the Kyoto Protocol (2008-12). With the economic recovery, emissions rebounded in 2014-17, particularly in the transport sector. However, they have since fallen, driven by a strong shift away from coal-fired power generation. Overall, considering the impacts of the COVID-19 crisis, emissions have been reduced by one-third over 2005-20. Portugal overachieved the 2020 economy-wide objective of the 2015 National Programme for Climate Change and its 2020 target under the EU Effort Sharing Regulation (ESR).

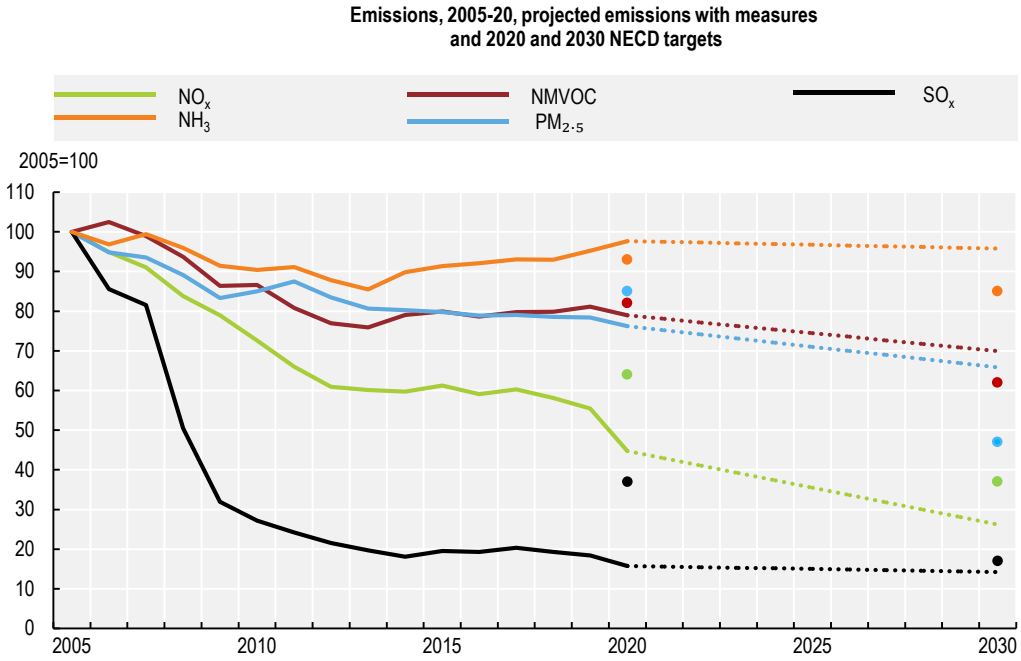
National projections indicate the country is on track to reach the 2030 ESR target proposed by the European Commission to meet its commitments under the Paris Agreement. Additional policies will be needed to reduce total emissions by at least 55% from 2005 levels by 2030 and by 90% by 2050, and to increase removals from land use, land-use change and forestry, as committed in the Portuguese 2021 Framework Climate Law.

Most of the 2020 air pollutant emission reduction targets have been met

In the past decade, emissions of major air pollutants have decreased due to the shift in electricity production from coal to natural gas and renewable energy, the implementation of desulphurisation systems in large energy plants and stricter vehicle emissions standards (APA, 2022). However, the decline has slowed down in the years preceding the COVID-19 crisis and ammonia (NH_3) emissions have grown with the number of poultry (Figure 1.3).

Portugal met its 2020 emission reduction objectives[4] for sulphur oxides (SO_x), nitrogen oxides (NO_x), non-methane volatile organic compounds (NMVOC) and fine particulate matter ($PM_{2.5}$) but not for NH_3. Additional measures will be needed to achieve the 2030 targets for all pollutants and particularly $PM_{2.5}$, NMVOC and NH_3 (APA, 2022). Portugal needs to clarify how it will ensure compliance with its 2030 targets in the National Air Pollution Programme (due in 2022). The application of best available techniques and the publication of the national advisory code of good agricultural practice to control NH_3 emissions is expected to support progress in this area.

Figure 1.3. Portugal met its 2020 emission reduction targets except for ammonia



Note: Emissions exclude Madeira and Azores Autonomous Regions.
Source: APA (2022), National Emission Ceiling Directive (NECD) Submission 2022: 15 March (V2); APA (2021), NECD – Projected emissions With Measures.

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Combustion for domestic heating is a major source of $PM_{2.5}$ emissions, while combustion in manufacturing industries dominates SO_x emissions. Road transport is the main emitter of NO_x and NMVOC emissions mainly come from solvent use. Agricultural activity largely drives emissions of ammonia (NH_3).

Overall, Portuguese people are less exposed to air pollution than in other OECD countries. However, air quality remains a concern with regard to concentrations of nitrogen dioxide (NO_2) and particulate matter (PM_{10}) in urban areas and tropospheric ozone in rural areas. Annual NO_2 limit value has been persistently exceeded in Lisbon, Porto and Braga mostly due to diesel vehicle traffic. Portugal was referred to the Court of Justice of the European Union for failing to adopt appropriate measures (EC, 2021b). In 2020, with restrictions on mobility, no exceedances were recorded (APA, 2021a).

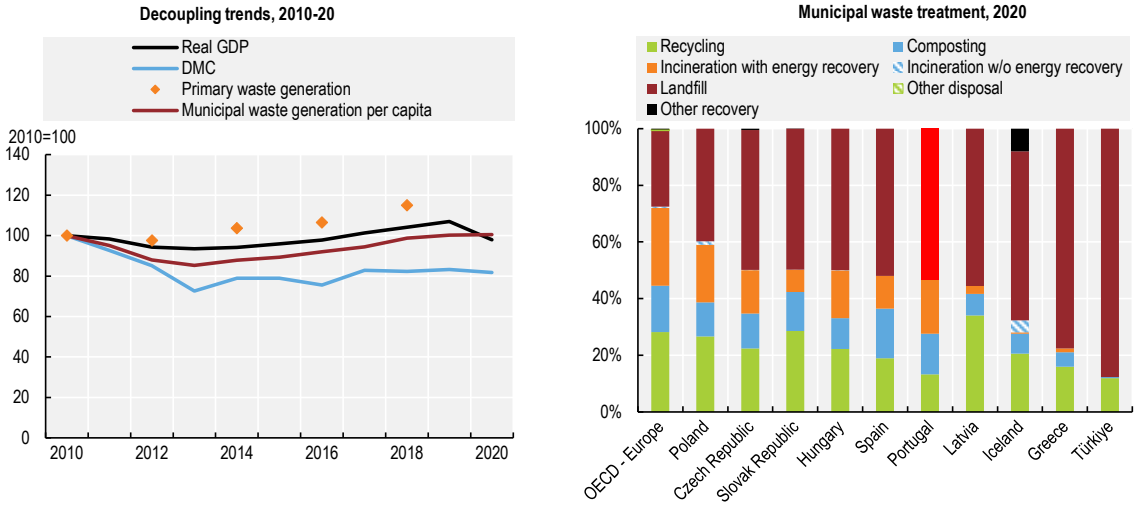
1.1.3. Portugal is lagging behind on the circular economy

Since 2013, municipal waste generation has grown at a faster rate than the economy until 2019 and remained constant in 2020 (Figure 1.4). With more than 510 kg of municipal waste generated per capita in 2020, Portugal exceeded the OECD European average of 500 kg. It was also among the countries with the highest landfilling rates. Portugal has improved its regulatory framework for waste management. This includes introducing a benchmarking system for waste management entities and provisions to vary tariffs according to the waste hierarchy (Section 1.2.4). It has also increased investment in treatment facilities (Section 1.2.3). Despite these measures, the country has not met its 2020 objectives (Table 1.1).

The Strategic Plan for Municipal Waste for 2030, under discussion, aims to improve waste prevention and increase preparation for reuse, recycling and other forms of recovery of municipal waste to reduce

consumption of primary raw materials. It seeks to ensure compliance with the EU Waste Framework Directive (under revision), which sets more ambitious targets for 2030.

Figure 1.4. Waste generation has increased since 2013 and the landfilling rate is high



Note: Left panel: Domestic material consumption (DMC) refers to the amount of materials directly used in the economy, or the apparent consumption of materials. DMC is computed as domestic extraction used minus exports plus imports. Right panel: top ten OECD Europe countries with the highest landfilling rates.
Source: OECD (2022), Environment Statistics (database).

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Table 1.1. Portugal has missed most of its 2020 waste targets

Progress towards selected targets on resource efficiency and waste management

Target	2020 target	2020	Achievement
Decouple GDP growth from material consumption from 2007-11 levels (EUR/kg)	0.98	1.11	Achieved
Decouple GDP growth from waste production from 2008-12 levels (t/kEUR)	0.082	0.089	Not achieved
Reduce waste generation from 2008-12 levels (%)	82%	99%	Not achieved
Reduce municipal waste generation per capita from 2012 levels (%)	90%	112%	Not achieved
Increase the share of municipal waste prepared for reuse and recycling (%)	50%	38%	Not achieved
Reduce biodegradable municipal waste in landfill from 1995 levels (%)	35%	53%	Not achieved
Increase separate collection for recycling (kg per capita)	52	50	Almost achieved
Recycling of overall packaging (%)	55%	63%	(2019) Achieved
Recycling of plastic packaging (%)	22.5%	36%	(2019) Achieved
Recycling of wooden packaging (%)	15%	91%	(2019) Achieved
Recycling of metal packaging (%)	50%	46%	(2019) Not achieved
Recycling of glass packaging (%)	60%	56%	(2019) Not achieved
Recycling of paper/cardboard packaging (%)	60%	71%	(2019) Achieved

Note: Selected targets of the National Waste Management Plan (PNGR 2020) and Strategic Plan for Municipal Waste (PERSU 2020).
Source: APA (2021), State of the Environment Report, 2020/21; national submission.

Portugal's material productivity is well below the OECD-Europe average. It improved until 2013 but has remained broadly constant since then, as domestic material consumption (DMC) has varied in line with GDP. Non-metallic minerals (mostly construction materials) make up the bulk of the materials mix. Compared to other OECD countries, fossil energy materials account for a smaller share of DMC as Portugal makes greater use of renewable energy. Circular material use rate under SDG 12 (responsible consumption and production) is almost six times lower than the EU average (2.2% vs. 12.8% in the European Union in 2020) (Eurostat, 2021). The National Waste Management Plan for 2030, under discussion, aims to prevent waste generation in terms of quantity and hazardousness; promote efficient use of resource and resource security; and reduce environmental impacts through integrated and sustainable waste management.

1.1.4. Natural assets are deteriorating

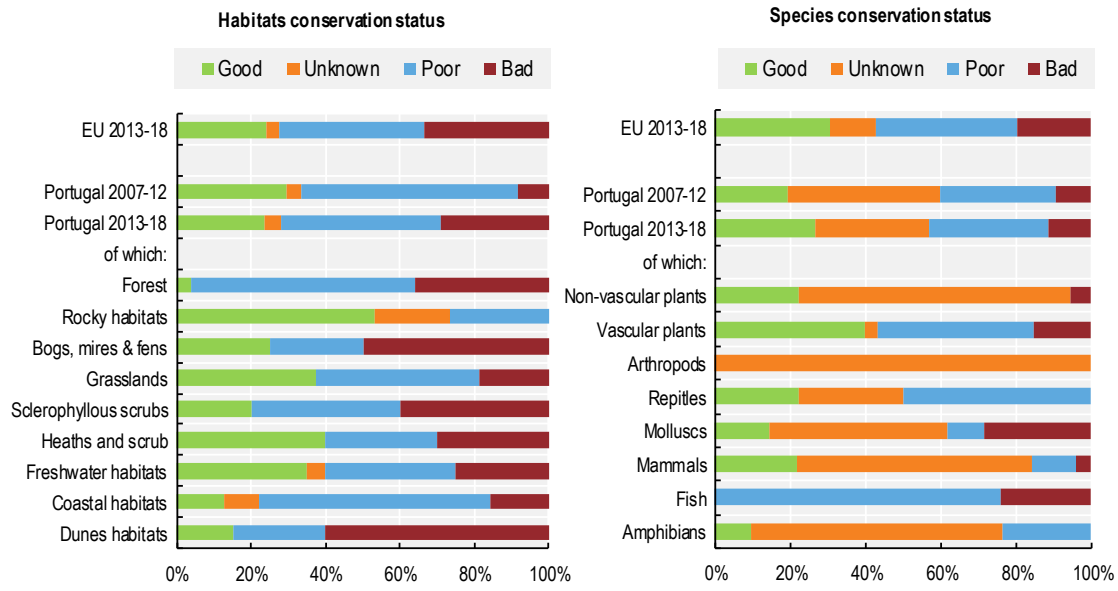
Progress towards 2020 Aichi targets has been insufficient

Portugal possesses a diverse natural heritage thanks to its geographical location and geophysical conditions (ICNF, 2020). The Azores and Madeira archipelagos, in the Macaronesia region, are home to unique habitats. On the mainland, the dune habitats, rocky cliffs, marshes in estuary and lagoon systems are all important as well. Numerous bird populations shelter in estuaries. The Madeira Archipelago hosts some of the most significant seabird colonies in the North Atlantic.

Over the past decade, the status of habitats and species has deteriorated (Figure 1.5). Agriculture, infrastructure development, invasive species, natural processes (such as erosion), climate change and fires are exerting major pressures on biodiversity (EEA, 2021; ICNF, 2020). About 30% of fish and birds and 20% of mammals and reptiles are threatened (OECD, 2022c).

In contrast to the previous decade, agricultural land has increased slightly since 2010; an increase in cropland has offset a decline in grassland (INE, 2020). Forest area remained stable, while artificial land continued to grow, albeit at a slower rate. The demographic decline in rural areas and the fragmentation of private land ownership hamper sustainable forest management, fire prevention and biodiversity protection.

Figure 1.5. The status of habitats and species has deteriorated



Note: Changes between 2007-12 and 2013-18 may reflect methodological variations or better data.
Source: EEA (2021), Conservation status of habitat types and species: datasets from Article 17, Habitats Directive 92/43/EEC reporting.

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In 2020, protected areas covered 25% of Portugal's territory and 8.9% of marine areas under its jurisdiction[5] (Tribunal de Contas, 2022). The country thus met the 2020 Aichi target of protecting at least 17% of land area but missed the target of protecting 10% of coastal and marine areas. In 2021, Portugal created Europe's largest marine protected area by extending the Selvagens Islands nature reserve (2 677 km^2) in the waters of the Madeira Archipelago (Euractiv, 2021). This is a significant step towards the goal of protecting at least 30% of the sea area in the European Union by 2030. Non-governmental organisations (NGOs) also welcomed the decision to designate a wetland in Algarve (Lagoa dos Salgados) as a nature reserve, to protect it from tourist and residential infrastructure development (Birdguides, 2021).

Management plans have been developed only for a few Sites of Community Importance in the Natura 2000 network (ICNF, 2020). Some species and habitats, particularly in the marine environment, are not sufficiently protected (EC, 2021c). The European Commission has opened an infringement procedure against Portugal for failure to adopt management plans and conservation measures (EC, 2021d). Mainstreaming biodiversity in agriculture, forestry, fisheries, and urban and spatial planning sectors is a major challenge (ICNF, 2020). Overall, progress towards 2020 Aichi targets has been insufficient.

The National Strategy for the Conservation of Nature and Biodiversity (ENCNB 2030), adopted in 2018, aims to improve the conservation status of natural heritage; promote recognition of the value of natural heritage; and foster ownership of natural values and biodiversity by society. The ENCNB and Action Plan should be updated in 2023, in line with the EU Biodiversity Strategy 2030, and post-2020 Global Biodiversity.

More needs to be done to achieve good water status

Portugal is more generously endowed with freshwater resources than other southern European countries, resulting in low water stress at the national level (OECD, 2022c). However, seasonal and spatial distribution of freshwater resources and use varies widely. In the last 20 years, water availability has decreased by about 20%. This trend is expected to continue with a further decrease of 10-25% by the end

of the century (Proença de Oliveira, 2022). Drought is structural and water scarcity is of serious concern in the Sado and Mira river basins (in the Alentejo region) and the Algarve river basins.

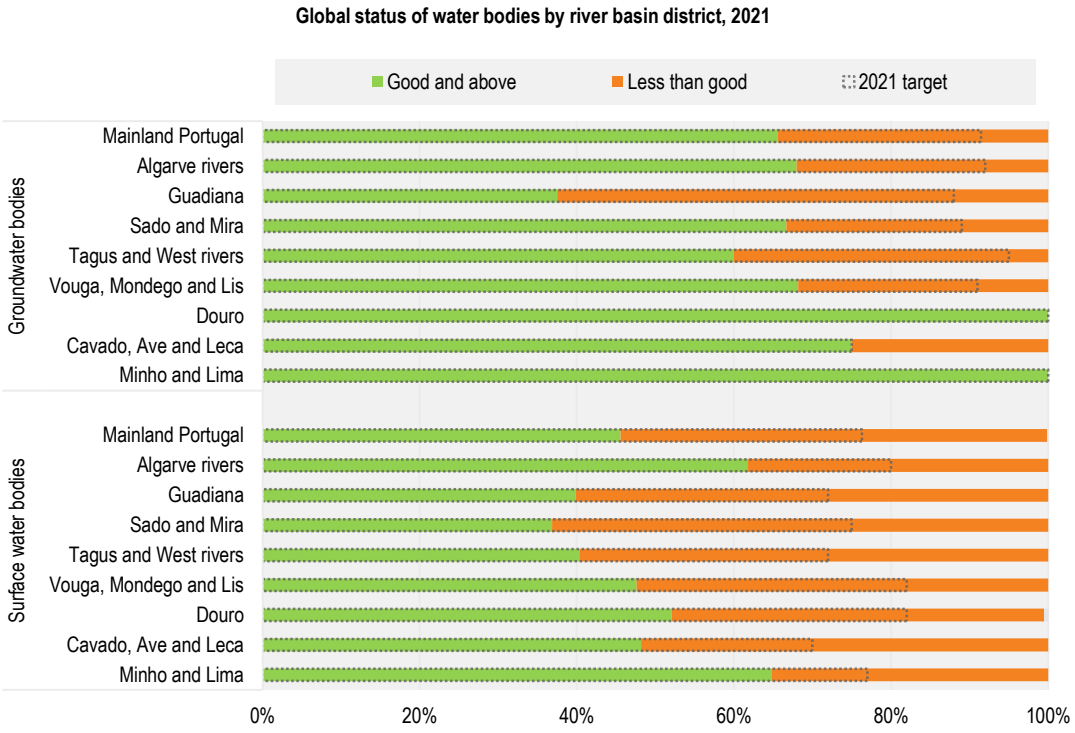
Agriculture accounts for 71% of freshwater abstractions, followed by public water supply (19%), production of electricity (cooling, 6%) and industry (4%) (OECD, 2022c). Estimates from the third River Basin Management Plans (RBMPs) show an increase of about 25% in agricultural water abstractions since the mid-2010s, particularly in the southern regions. Irrigated areas increased by 21% over 2009-19 reflecting modernisation investments in orchards, vineyards and olive groves (INE, 2021). However, investments focusing on irrigation efficiency, without policies regulating water demand, can increase water consumption or accelerate groundwater depletion (Grafton et al., 2018).

Beyond the third RBMPs, the new National Strategic Plan for Water Supply and Wastewater and Rainwater Management (PENSAARP 2030, to be adopted in 2022) aims at, among others, improving water-use efficiency for urban uses, especially in water-scarce areas.

More needs to be done to achieve the targets of good status for water bodies set in the EU Water Framework Directive. The third RBMPs show that in 2021, less than half of surface water bodies and two-thirds of groundwater bodies achieved good global status (Figure 1.6). The most significant pressures on these water bodies are diffuse agricultural sources (EC, 2019a). They are followed by other diffuse sources, point sources of pollution and alterations to the natural flow and morphology of water bodies. Compliance rates with Drinking Water Directive requirements are high. Most bathing waters are of excellent quality.

Portugal has made progress in wastewater treatment. In 2018, 92% of urban waste water (load generated) was treated according to the Urban Waste Water Treatment Directive (UWWTD) above the EU average of 76% and up from 71% in 2012 (EC/EEA ETC/ICM, 2021). The country was close to complying with the UWWTD in terms of collection (article 3) but not for treatment levels; 93% of wastewater collected underwent secondary treatment[6] (article 4) and 76% more stringent treatment[7] (article 5) (EC, 2022a). The number of small agglomerations with inadequate wastewater treatment has been drastically reduced from 77 in 2012 to 2 in 2020 (APA, 2021a).

Figure 1.6. Efforts are needed to use water efficiently and achieve good status of water bodies



Note: 2021 targets of the second RBMPs of the eight river basin districts of mainland Portugal. Global status covers ecological and chemical status of surface water bodies and quantitative and chemical status of groundwater bodies.
Source: APA (2022), Provisional version of the third RBMPs (2022-27).

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1.2. Enhancing policy coherence for sustainable development

1.2.1. Progress in inter-ministerial co-operation

Portugal 2030 Strategy, adopted in 2020, is the reference framework for public policies in the next decade. It aims to address the main structural challenges of the Portuguese economy and society through reforms and investment in several areas. These comprise institutional resilience, the business environment, the green and digital transition, fiscal structure and skills and competences (EC, 2021c). The strategy also has a strong focus on reducing social and territorial inequalities, increasing competitiveness and strengthening internal cohesion. It seeks to ensure coherence of measures financed through the Multiannual Financial Framework 2021-27, the Recovery and Resilience Plan (RRP), and other EU (REACT-EU, Fair Transition Fund) and national funds.

The country has made progress in integrating environmental issues into strategic documents and sectoral plans. Sustainable development, energy transition, sustainable land use and mobility, adaptation to climate change and circular economy feature prominently in the 2022 government's programme. The 2019 Roadmap for Carbon Neutrality and 2020 NECP seek to ensure coherence between the climate and

energy policies. Climate transition and sustainability are priorities of the 2021 Plan to Reactivate Tourism and Build the Future (OECD, 2022d).

Portugal has several mechanisms for horizontal co-operation including the Inter-ministerial Commission of the RRP, chaired by the Prime Minister, the Inter-ministerial Commission for Climate Action and the Inter-ministerial Commission for Water Coordination. However, Portugal's Strategic Plan under the common agricultural policy (CAP) 2023-27 is poorly aligned with environmental objectives (EC, 2022b). Its contribution to climate change adaptation is limited with regard to forest fire prevention, water management, water retention of the landscape, floods and drought prevention. The coherence between environmental and economic objectives is not always clear in the transport and tourism sectors (Tribunal de Contas, 2022).

Strategic environmental assessment (SEA) has been increasingly used, particularly in land-use planning (APA, 2021a). In other domains, SEA has been used for water resources and waste management. However, SEA has been less frequently used for sectoral plans and operational programmes for implementing EU funds. SEAs are generally developed in line with good practices and national guidance. However, the lack of alternatives considered often undermine identification of more sustainable development options.

1.2.2. The Recovery and Resilience Plan promotes the green transition

Portugal was among the OECD economies most strongly hit by the pandemic but has been recovering fast thanks to strong private consumption and the rebound in tourism in 2022 (OECD, 2022a). The pace of recovery has slowed as Russia's war against Ukraine, supply-chain disruptions, elevated energy prices and rising interest rates weigh on activity. Real GDP growth is projected to decline from 6.7% in 2022 to 1.0% in 2023 and 1.2% in 2024. Public investment boosted by EU funds will support growth. The COVID-19 crisis widened the fiscal deficit to 5.8% of GDP in 2020. Thanks to a stronger-than-expected economic recovery and the phasing out of pandemic-related measures, the deficit fell to 2.9% of GDP in 2021. It is expected to decline to 1.8% in 2022 and 0.6% in 2023 (OECD, 2022a). The outlook remains uncertain due to the geopolitical context.

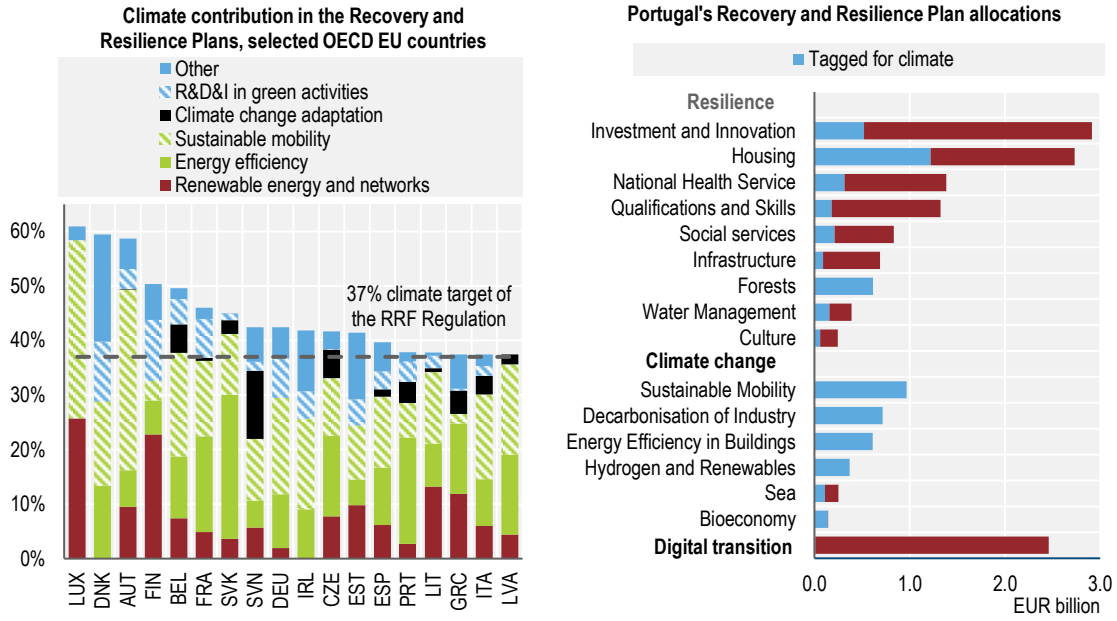
Portugal responded to the COVID-19 crisis with income continuity for workers and liquidity support to businesses in 2020 (OECD, 2021a). The government expanded or re-introduced these measures in early 2021 in the wake of a second national lockdown and in summer 2021 in response to the fourth wave. Measures to stimulate the recovery included extension of income support measures for vulnerable households and firms, an extraordinary tax credit for investment and new credit lines with state guarantees. Like other OECD countries, Portugal has granted rescue loans (equivalent to 0.6% of 2021 GDP) to national and regional airlines with no environmental conditions. Overall, measures related to COVID-19 support amounted to 2.1% of GDP in 2020 and 3.3% in 2021 (INE, 2022). They were planned to decrease to 0.9% of GDP in 2022 (Government of Portugal, 2022a).

In 2021, Portugal submitted its RRP to boost its economy with Next Generation EU funds. It consists of 83 investments and 32 reforms to be supported by EUR 13.9 billion in grants and EUR 2.7 billion in loans over 2021-26 (overall about 8% of 2020 GDP). The RRP could raise GDP by up to 2.4% by 2026 (including 0.4% spillover from other countries' plans) (EC, 2021c). Portugal devoted 38% of its RRP budget to the climate objectives (Figure 1.7). This is above the EU requirements (37%) but below the average of 40% of the 22 RRPs endorsed by the end of 2021.

Compared to other OECD EU countries, the climate part of Portugal's RRP focuses on energy efficiency (Figure 1.7). It supports renovation in residential and non-residential buildings and in social housing (EC, 2022c[]). This is positive to reduce GHG emissions, the dependence to fossil fuels and energy poverty. Sustainable mobility is promoted notably through the extension of metro networks in Lisbon and Porto but also by the acquisition of clean buses and their charging stations. The RRP also includes significant

investments to decarbonise industrial processes and boost the use and production of hydrogen. In addition, it includes measures to prevent and fight rural fires, improve water-use efficiency to adapt to the effects of climate change and promote sustainable bioeconomy.

Figure 1.7. The climate part of the Recovery and Resilience Plan focuses on energy efficiency



Note: Left panel: OECD EU countries with RRPs approved by end 2021. RRF Regulation: Regulation (EU) 2021/241 of the European Parliament and of the Council of 12 February 2021 establishing the Recovery and Resilience Facility. R&D&I: Research and Development and Innovation. Right panel: countries assess the impact of the measures proposed in the RRP on climate objectives according to the tagging methodology of the RRF Regulation.
Source: European Commission (2021), Recovery and Resilience Scoreboard; Government of Portugal (2022), *Mais transparência*.

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The RRP was well-received by most stakeholders, but it was also criticised for its contradictions (Heilmann et al., 2021). Stakeholders took issue with how the RRP aimed to reduce emissions from transportation while expanding the road network. Other areas of concern included how it considered tourism as a key growth sector, and the tension between recognising the need for careful management of water resources while planning construction of new dams. Environmental NGOs have expressed concerns about the environmental impacts of RRP-supported dam construction and call for investments to be directed towards nature-based solutions (WWF, 2022). The European Commission also noted the limited number of measures to enhance biodiversity (EC, 2021c). The actual share of green measures will only be measurable once the plan is implemented. Portugal is committed to full environmental impact assessments of its measures to ensure compliance with the "do no significant harm" principle of the Regulation establishing the Recovery and Resilience Facility (RRF) (EU 2021/241).

1.2.3. Public investment in environmental and low-carbon infrastructure

Public expenditure on environmental protection is below the EU average

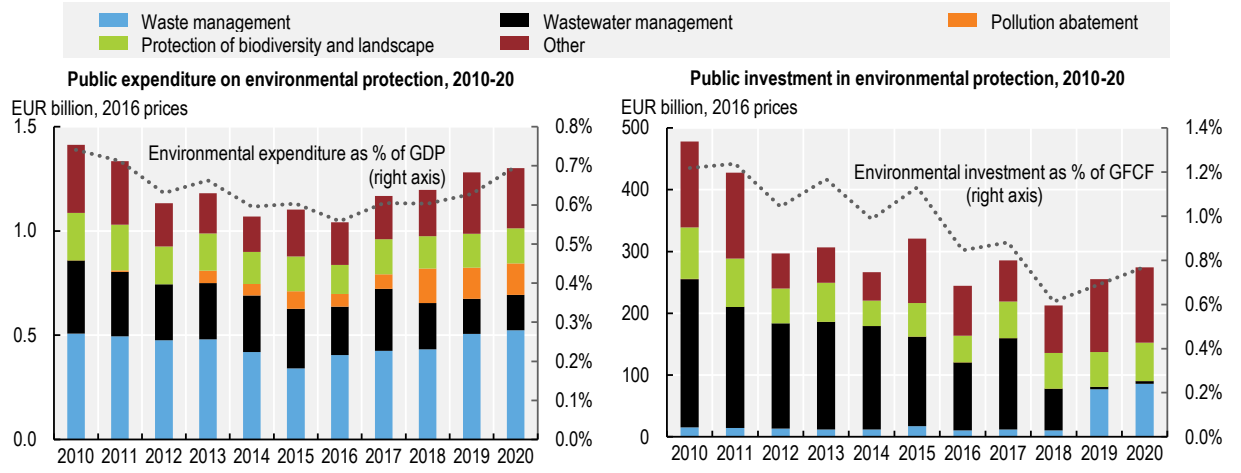
Public expenditure on environmental protection (current expenditure and investment) decreased until 2016 and has increased since then. It reached 0.7% of GDP in 2020 (Figure 1.8), below the EU average of 0.9% (Eurostat, 2022b). As in other OECD countries, waste management is the largest expenditure item. It has

driven the increase in public investment and spending on environmental protection in recent years. However, this trend is not reflected in the performance of the service provision (Section 1.1.3). Portugal needs to step up investment to meet the more ambitious targets set for 2030. Increasing waste treatment capacity and upgrading installations will require about EUR 335 million investment by 2030 (APA, 2021b). Recovering the costs of waste management service is a prerequisite for financing the sector and changing behaviour (Section 1.2.4). Decoupling environmental expenditure from EU funding as recommended in the previous Environmental Performance Review, would support this goal.

Public spending on biodiversity and landscape protection has increased since 2016 but accounted for only 0.1% of GDP in 2020, 25% less than in 2010.

Over the past decade, subdued public investment has been part of Portugal's fiscal consolidation strategy (OECD, 2021a). Despite an increase in response to the pandemic, public investment, at around 2% of GDP, was among the lowest in the OECD in 2019 and in 2020. Public investment in environmental protection also decreased until 2018 (Figure 1.8). The recent drop in investment in wastewater management can be explained by completion of the main infrastructure and by statistical factors (e.g. unclear allocation between the water and waste sectors). PENSAARP 2030 identified about EUR 5.5 billion in investment needs in the sector by 2030, half of which were for rehabilitation of existing assets (MAAC, 2022). The financing needs to comply with the Urban Waste Water Treatment Directive have been estimated at EUR 4.8 billion by 2030 (total cumulative additional expenditures for sanitation) (OECD, 2020b). Despite an apparent good cost recovery of wastewater services, there is scope to improve the ability of municipalities to assess these costs and to increase tariffs, particularly where they provide the service directly (ERSAR, 2022).

Figure 1.8. Public investment in environmental protection has decreased until 2018



Source: OECD (2022), OECD National Accounts Statistics (database).

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Part of the public expenditure on environmental protection is financed by the Environmental Fund (EF), under the Ministry of the Environment and Climate Action. The EF was created in 2017 from the merger of the Portuguese Carbon Fund, the Environmental Intervention Fund, the Water Resources Protection Fund and the Fund for the Conservation of Nature and Biodiversity. The government expected this merger to bring greater efficiency by raising its financial capability and flexibility. In 2021, the EF also incorporated the Permanent Forestry Fund, the Fund for Support for Innovation, the Energy Efficiency Fund and the Fund for Systemic Sustainability of the Energy Sector.

The EF's revenue comes mainly from the auctioning of allowances under the EU Emissions Trading System (ETS). To a lesser extent, it also earns income from partially earmarked receipts from environmentally related taxes. Its income increased sevenfold between 2017 and 2021. A large part of its spending has supported fare reductions to promote public transport and reverse the decline in demand resulting from the pandemic. In recent years, it has also subsidised the national electricity system. Non-governmental organisations have been criticising the EF for its lack of transparency, inconsistency with national priorities and low spending on nature restoration (ANP/WWF, 2022; ZERO, 2022). Some have proposed an active role for the National Council for Environment and Sustainable Development in advising on EF policy for allocation of financial resources and in evaluating its performance. As an intermediate beneficiary, the Fund also implements some RRP investments.

Investment in sustainable transport and energy needs scaling up

About EUR 1 billion in additional annual investment is needed until 2030 and EUR 4 billion over 2030-40 to achieve carbon neutrality by 2050 (Table 1.2). Sustainable transport and buildings will attract most of this investment in the next decade. EU funds will be the main source of financing and, to a lesser extent, revenues from the auctioning of allowances under the EU ETS earmarked to the EF (EC, 2020a) (Chapter 2).

Table 1.2. Investment needs to reach carbon neutrality are high

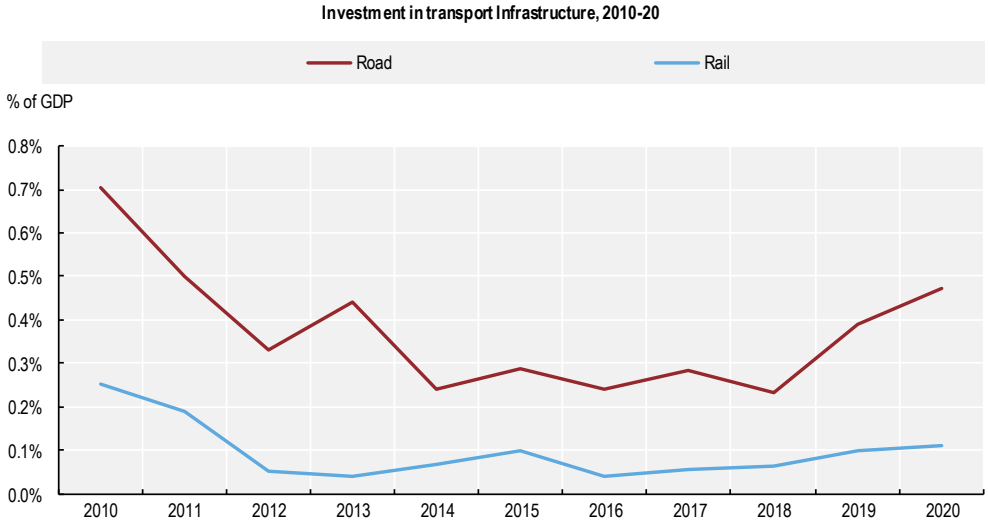
Investment needs to achieve carbon neutrality, 2016-40

	2016-30 (EUR billion)	2031-40 (EUR billion)
Overall investment without neutrality	**395.9 – 416.6**	**229.7 – 235.1**
Electricity	22.4 – 22.1	16.6 – 19.6
Transport	193.7 – 201.3	74.5 – 62.3
Buildings	165 – 176.4	124 – 138.3
Industry	14 – 16	14.4 – 14.7
Other	0.7 – 0.8	0.2 – 0.1
Additional to achieve neutrality	**10.8 – 14.7**	**33.7 – 37.9**
Electricity	1.2 – 2.2	9 – 11.3
Transport	5.1 – 6.2	17.3 – 17.6
Buildings	3.1 – 4.8	5.6 – 6.1
Industry	1 – 1.3	1.2 – 0.9
Overall total	**406.6 – 431.3**	**263.4 – 273**

Source: Government of Portugal (2019) National Energy and Climate Plan 2021-30.

Portugal's railway network density is below that of the European Union as is the modal share of passenger rail transport (Government of Portugal, 2022b). Safety levels are also below EU standards and the network is saturated near the two metropolitan areas, where rail traffic is concentrated. Portugal seeks to modernise and electrify the national railway network, enhance modal transfers in the most densely populated areas and build a high-speed train between Porto and Lisbon. Investment in rail infrastructure has increased in recent years. However, rail investment in 2020 was less than half its 2010 level and remained well below road investment (Figure 1.9). A shift in investment from road to rail will be needed to reduce the sector's GHG emissions by 40% by 2030.

Figure 1.9. Investment in rail infrastructure has increased recently but remains well below road investment



Note: Mainland Portugal.
Source: Ministry of the Economy (2022), Infrastructure Database.

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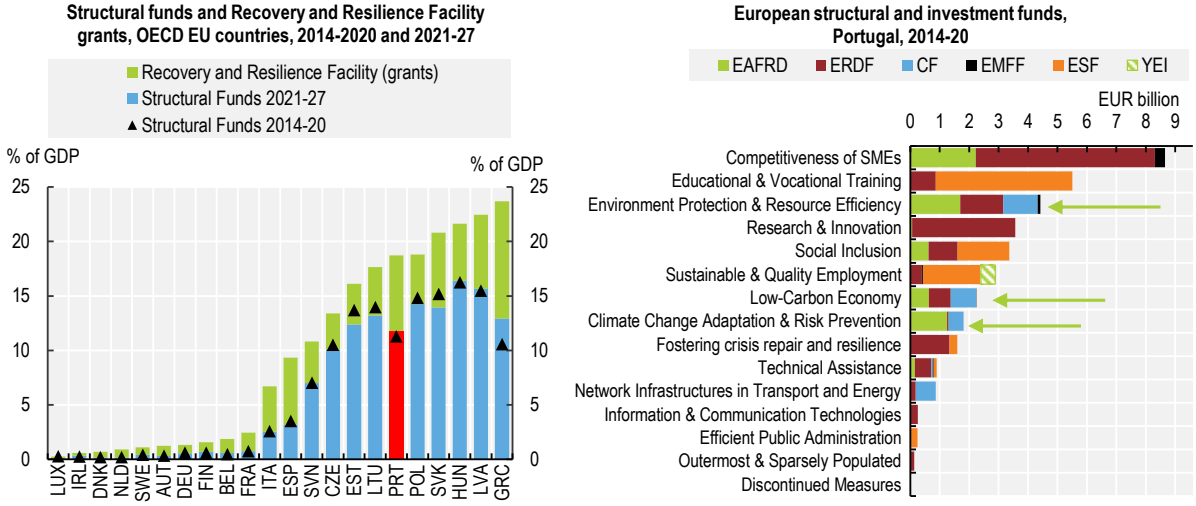
European Funds are a key source of financing

The cohesion policy has become the main source of public investment. The share of cohesion funds grew from 33% to nearly 60% of total public investment from the 2007-13 to the 2014-20 programming period (EC, 2022d). Portugal will receive EUR 52 billion[8] over 2021-27, largely from the RRF and the cohesion funds (Figure 1.10) (Government of Portugal, 2021). It should seize this opportunity to address the long-term environmental challenges.

Figure 1.10. Effective use of EU funds is key to boost green investment



Note: Left panel: Structural funds: European Regional Development Fund (ERDF), Cohesion Fund (CF) and European Social Fund (ESF). Data refer to total allocations (excluding national co-financing) in current prices as a percentage of 2020 GDP. Recovery and Resilience Facility refers to the maximum grant allocations over 2021-26, as a percentage of 2020 GDP. Right Panel: ERDF, CF, ESF, European Agricultural Fund for Rural Development (EAFRD), European Maritime and Fisheries Fund (EMFF) and Youth Employment Initiative (YEI), including national co-financing (EUR 7.6 billion of EUR 36.4 billion).
Source: EC (2022), European Structural and Investment Funds (database).

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Overall, the country had a higher absorption rate of European Structural and Investment Funds than the EU average for 2014-20 (74% spent vs. 60% in the European Union) (EC, 2022e). This was true for those funds allocated to environmental protection and resource efficiency (62% vs. 57%), climate change adaptation and risk prevention (66% vs. 61%) but not for low-carbon economy (49% vs. 57%), and network infrastructure in transport and energy (48% vs. 71%). The significant increase in the amounts allocated for the next period is a challenge in terms of designing, approving and implementing programmes (OECD, 2021a). Portugal needs to develop administrative capacities to accelerate management of the funds. It should streamline processes in the public procurement system, while ensuring transparency and accountability to prevent the risks of fraud. At the same time, it should take sufficient account of the costs and benefits of investments.

Ensuring coherence between the RRP and operational programmes of the cohesion policy will be a key factor of success. Portugal has created a task force, under the Ministry of Planning, [9] to co-ordinate, monitor and report on RRP implementation. The task force will co-operate with the Development and Cohesion Agency (in charge of structural funds), and the Ministry of Finance (in charge of formal interactions with the European Commission) (OECD, 2021a).

The Operational Programme for Sustainability and Efficient Use of Resources was the main Portuguese programme focusing on the environment in 2014-20. It was allocated EUR 2.2 billion in cohesion funds to protect the environment and promote resource efficiency (45%), support the transition to a low-carbon economy (33%) and promote adaptation to climate change (19%). By the end of 2021, EUR 3.8 billion investment had been mobilised. Absorption rates were high in the water sector and for adaptation projects (fight against coastal erosion, identification of vulnerabilities and risks in Madeira) but low for improving energy efficiency, developing clean urban transport infrastructure and railways. This raises concern regarding the implementation capacity in this area.

More than EUR 3 billion, over half the Rural Development Programme (RDP) 2014-22 budget,[10] has been allocated to farmers for environment/climate-friendly land management practices (EC, 2022f). Despite increased areas under contract to preserve biodiversity, and improve water and soil management, the impact of agri-environmental measures could not be assessed due to lack of appropriate indicators (Tribunal de Contas, 2021). Support for the Natura 2000 network has been insufficient to cover the needs identified (EC, 2019b). Significant amounts of funding are linked to water use, but evidence of water savings is weak (Atthis Consulting, IESE, 2019). Like other EU countries, Portugal supports water-intensive crops in water stress areas through voluntary coupled support and market measures under Pillar 1 of the CAP (ECA, 2021). The new CAP 2023-27 is an opportunity to better mainstream environmental objectives in the agricultural policy.

1.2.4. Greening the system of taxes and charges

Portugal is reviewing its green tax reform

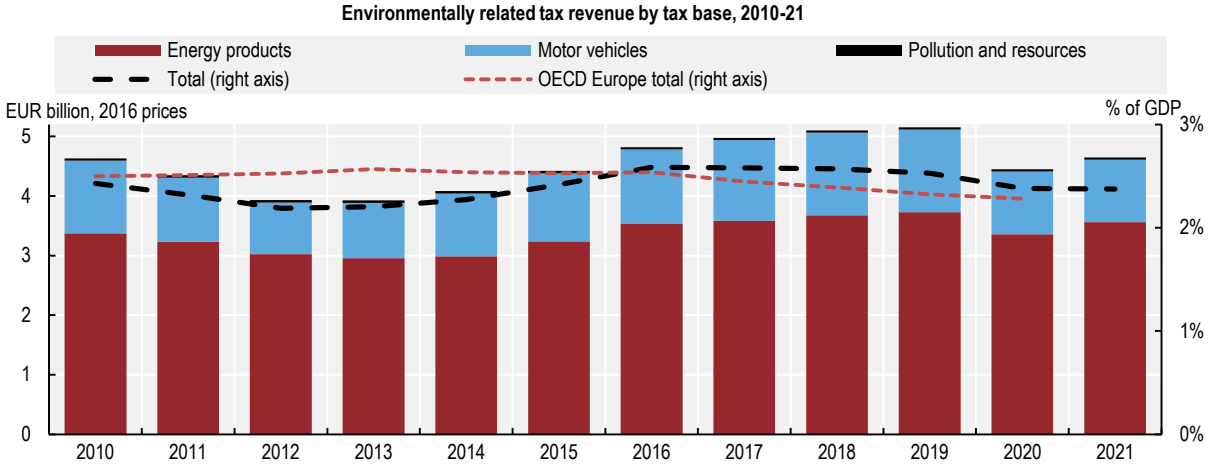
Following the recommendation of the 2011 Environmental Performance Review, Portugal implemented a green tax reform in 2014. This was part of a broader fiscal consolidation effort required by the EU economic adjustment programme. Law No. 82-D/2014 introduced a carbon tax in sectors outside the EU ETS, increased the CO_2 component of the registration tax, revised the taxation of water and waste management, granted property tax breaks for forest management and introduced a tax on single-use lightweight plastic bags.

Revenue from environmentally related taxes represented 2.5 % of GDP in 2019, above the OECD Europe average of 2.3% and up from 2.2% in 2012, the lowest value in the past decade (Figure 1.11). In real terms, this revenue decreased in the early 2010s with declining economic activity. It then rose over 2013-19 due to higher consumption and taxes on diesel. It fell again with the COVID-19 crisis, which led to a decline in the purchase and use of cars. Although the gap has narrowed in recent years, diesel is still taxed at lower rates than petrol. This differential remains despite the greater carbon content in diesel and the fact that diesel engines typically generate a higher local air pollution cost.

As in many countries, most receipts come from taxes on energy products and, to a lower extent, on motor vehicles' purchase and use. Taxes on pollution and resource management such as the tax on effluent discharges and fees for hunting and fishery licences raise little revenue (Figure 1.11).

The tax on single-use lightweight plastic bags has significantly reduced their use. However, the carbon tax and the taxes on water and waste management do not fully internalise environmental costs. The property tax exemption for forest management plans has unclear effects. The Portuguese tax system is complex and the many preferential tax treatments blur the price signals (Sections 1.2.4, 1.2.5). The Ministry of Finance and Ministry of Environment and Climate Action are evaluating the effects of the green tax reform. A renewed reform could have a positive impact on growth and jobs by 2030 with a slightly progressive effect on real incomes depending on revenue recycling options (Mottershead et al., 2021).

Figure 1.11 Until 2019, revenue from environmentally related taxes increased with higher consumption and taxes on diesel



Source: INE (2022), Environmentally related taxes and fees; OECD (2022), OECD Environment Statistics (database).

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Carbon prices vary by sector and fuels

Energy and carbon taxes are levied within the framework of the EU Energy Tax Directive (OECD, 2019). There are four main taxes on energy use. First, the energy tax (ISP) applies to most forms of fossil fuel use. Second, the carbon tax applies to the same fuels subject to the energy tax at a nominal rate tied to the average EU ETS carbon price. This rate increased from EUR 5 per tonne of CO_2 in 2015 to EUR 23.9 per tonne in 2021. Third, the Road Service Tax applies to oil products used in road transport, in addition to the carbon and the energy tax. Finally, an electricity excise tax applies to most forms of electricity consumption. Portugal participates in the EU ETS; facilities covered by the ETS generally do not pay the carbon tax (or receive a full refund). End-2021, as ETS prices were exceeding EUR 60/tCO_2e, the government suspended the carbon tax update.

Carbon prices vary by sector and fuels. In 2021, effective carbon rates (ECR) consisted of fuel excise taxes and to a smaller extent of permit prices from the EU-ETS and of carbon taxes. In 2021, Portugal priced about 74% of its GHG emissions. Of these, 28% were priced at an ECR above EUR 60 per tonne of CO_2, the midpoint benchmark for carbon costs in 2020. Emissions priced at this level originated primarily from the road transport sector. Most unpriced emissions were non-CO_2 emissions (Chapter 2).

Vehicle taxes and road pricing could better support air quality improvement

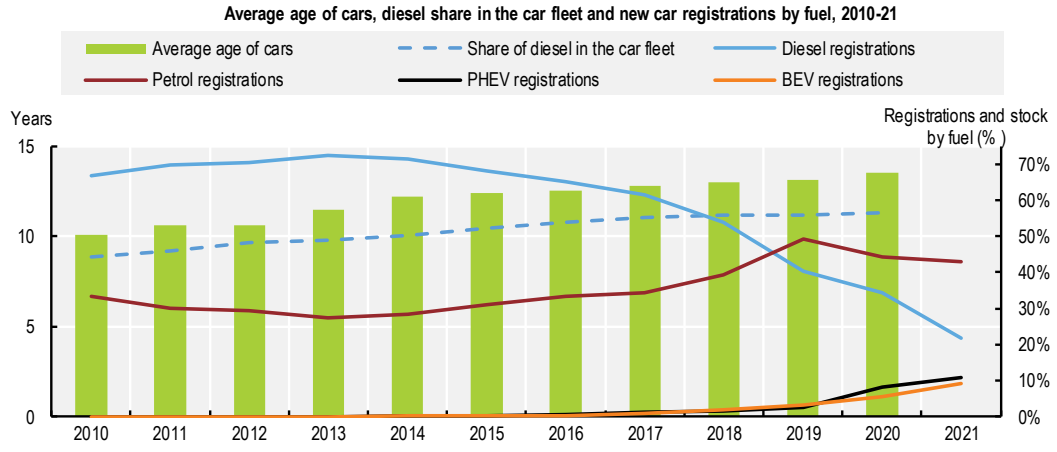
Portugal applies taxes on ownership and use of motor vehicles. The registration tax (*Imposto sobre os Veículo*s – ISV) is based on cylinder capacity and CO_2 emissions (light passengers) or only on cylinder capacity (other light vehicles, and motorcycles) (ACEA, 2022). An additional flat tax is levied on diesel light vehicles without particulate filters. Electric vehicles (EVs) are exempt 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, CO_2 emissions and year of registration. Vehicles registered before 2007 pay a substantially lower IUC than those registered after that date. EVs are exempt from IUC but hybrid vehicles pay the normal rate. Tax expenditure related to the partial ISV exemption (light goods vehicles) and reduced IUC rates for old vehicles amounted to about EUR 700 million in 2021 (Government of Portugal, 2022a).

Combined with lower taxes on diesel and EU vehicle performance standards, vehicle taxation has resulted in lower average CO_2 emissions from new passenger cars. However, the share of diesel vehicles has steadily increased to almost 60% of passenger cars in 2020, one of the highest shares in the European Union, with adverse effects on local air pollution (Figure 1.12). Since the mid-2010s, new car registrations have shifted to petrol and, in recent years, to EVs. However, as car ownership has grown and the fleet has aged due to imports of used vehicles, GHG emissions from transport increased until 2019. Closing the tax gap between diesel and petrol, removing the preferential circulation tax treatment for older vehicles and introducing a NOx component in vehicle taxes, as was recently done by Ireland (OECD, 2021b), would help to rejuvenate the fleet and steer towards cleaner vehicles. In addition to vehicle tax exemption, Portugal promotes EVs through subsidies and investment in charging infrastructure. It offers subsidies of EUR 4 000 in 2022 for light passenger vehicles with purchasing price of up to EUR 62 500 including value added tax (VAT), and EUR 6 000 for light goods vehicles. In 2021, the share of EVs in new car registrations was above the EU average (Chapter 2).

While fuel taxes are effective to reduce carbon emissions, distance-based charges depending on vehicle emissions and the place of driving are the best option to address local air pollution (van Dender, 2019). The shift to taxes based on road use will also help offset the loss of revenue from fuel taxes as EVs become widespread. Portugal has an electronic toll system operating on the motorway network for all vehicle categories. Toll prices vary according to the distance travelled, the height and the number of axles of the vehicles but not their emissions. Since 2011, Lisbon has introduced a low emission zone (LEZ) banning the most polluting vehicles from the city centre during working hours. Despite air quality improvement, the LEZ has not reduced NOx and $PM_{2.5}$ concentrations significantly suggesting the need for stricter standards and stronger enforcement (Santos, Gómez-Losada and Pires, 2019).

Figure 1.12. Diesel dominates the ageing car fleet, but EV registrations are increasing



Note: BEV: battery electric vehicles; PHEV: plug-in hybrid electric vehicles. New car registrations fell by 35% in 2020 due to the COVID-19 crisis and increased only slightly in 2021.
Source: ACEA (2022), New passenger cars by fuel type in the EU; ICCT (2021), European Vehicle Market Statistics; INE (2022), Statistics on road vehicles stock.

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Since 2021, Portugal has been imposing a EUR 2 tax on passengers travelling by air and sea. The tax applies to passengers departing on domestic and international flights, except when flying from/to the Madeira and Azores Islands, or between the islands. However, its rate is low by EU standards (Ricardo, 2021). Furthermore, ticket taxes do not provide the same incentives as direct carbon prices to increase

fuel efficiency and passenger load factors (capacity utilisation), optimise flight routes or switch to fuels with a lower carbon content (Teusch and Ribanski, 2021). While the European Commission has proposed to remove fuel tax exemptions for the aviation and maritime sectors, Portugal may consider better reflecting the climate effects of the flights subject to its ticket tax by varying the rate with the distance travelled. It could also introduce frequent flyers and air miles levies, and tax short-haul flights when high-speed rail alternatives become available.

Taxes on pollution and resource use imperfectly reflects environmental costs

Taxes on pollution and resources represented barely 1% of revenue from environmentally related taxes in 2020, a low rate compared with the OECD Europe average of 5%. Revenue from taxes on pollution mainly comes from the water resources tax (parts related to discharge on effluents and land occupation; other components are considered as environmental charges) and the tax on non-reusable beverage packaging. Fees for hunting and fishery licence make up the bulk of revenue from resources taxes.

The water resource tax

The water resource tax (*Taxa de recursos hídricos* – TRH), established in 2008 and regularly updated with inflation, has several cumulative components. They apply to: (component A) water abstraction of public water for private use by sector, including for energy production (m^3); (E) discharge of effluents (kg of nitrogen or phosphorous); (I) extracted aggregates (sand, gravel, etc.) from the public water domain (m^3); (O) land occupation of the public water resources (m^2); (U) private use (abstraction, deviation or use) of water under public management that may cause significant impact (m^3) (Rodrigues, 2016). A scarcity coefficient applies to abstraction rates (components A and U) according to specific water basin. Since 2017, an additional fee has been applied to the volume of water abstracted for public water supply to compensate for the higher costs incurred in low-density areas.

The TRH seems to have had a limited impact on changing behaviours (Rodrigues, 2016). A study found that with the economic recovery, revenue increased faster than rates, indicating more intense use and degradation of the water resource (Gomes de Gouveia, 2018). The water abstraction fee is significantly cheaper for agriculture and reductions apply to irrigation (ECA, 2021). In the past decade, irrigated areas and agricultural water abstractions increased significantly in the southern regions (Section 1.1.4). This suggests a need to better reflect the environmental costs of water use in the TRH. The ease of licensing new water abstractions in water stress areas, the limited capacity to monitor and fine illegal abstractions, and low water abstraction charges for non-potable uses have kept levels of water reuse low (about 1%) (Martins et al., 2021).

Taxes and charges on waste

Portugal introduced a tax on single-use lightweight plastic bags in 2014 (EUR 0.1 including VAT), which reduced their consumption by 98% in two years (Luís et al., 2018). The tax has led to an increase in the use of thicker, untaxed bags. However, overall plastic bag consumption was reduced by 70% over 2014-16, and the decline continued until 2020. Since 2021, Portugal has banned the free provision of carrier bags of any material (including paper bags) at the point of sale (EC, 2022g). An exemption applies for bags used to pack loose items or bulk products.

The green tax reform has differentiated the waste management tax (*Taxa de Gestão de Resíduo* – TGR) by type of treatment to promote the waste hierarchy. However, this has not proven effective: despite a doubling of the landfill tax between 2015 and 2020, the amounts of municipal waste generated and sent to landfills increased. Between 2020 and 2021, the tax was doubled to EUR 22 per tonne and will gradually increase to EUR 35 in 2025. This remains low compared to other European countries. In France and Spain, for example, landfill taxes were set at or above EUR 40 per tonne in 2022. The 2020 reform (Decree-Law

nº 102-D/2020) will tax municipalities that landfill recyclable materials more heavily and grant relief to those that separate and recycle bio-waste at source from 2022.

Experiences with pay-as-you-throw systems are limited (ERSAR, 2022), largely due to the charging system. Municipal waste charges are included in the water bill and linked to water consumption. Portugal has made little progress in passing on the waste management tax to households through waste charges as recommended in the 2011 Environmental Performance Review In 2020, three quarters of municipalities did not fully recover the costs of waste service provision (ERSAR, 2022). Despite the welcome introduction of a cost accounting system for waste management, problems remain with its implementation by municipalities. As of 2026, in line with the 2020 reform, waste charges will no longer be indexed to water consumption but to the amounts of waste collected. Effective implementation of the user pays and polluter pays principles will be key to achieve more ambitious environmental targets in the sector.

Tax benefits for forest management

The vast majority of forests in Portugal are owned by small private owners. The green tax reform exempted from property taxes those holdings that belong to Forest Intervention Areas (continuous forest areas managed by a single entity, ZIF) or that are subject to forest management plans. ZIF areas more than doubled between 2014 and 2021, but their uptake was lower in the northern and central regions, where small holdings are concentrated. Since 2017, tax benefits have been granted to two other types of associations (Forest Management Entities and Forest Management Units) to promote joint management of small forest holdings. By 2022, the Institute for Nature Conservation and Forests had recognised 13 such associations (ICNF, 2022). The development of these associative models is essential for sustainable forest management and fire protection. Their effectiveness in terms of biodiversity conservation remains to be assessed.

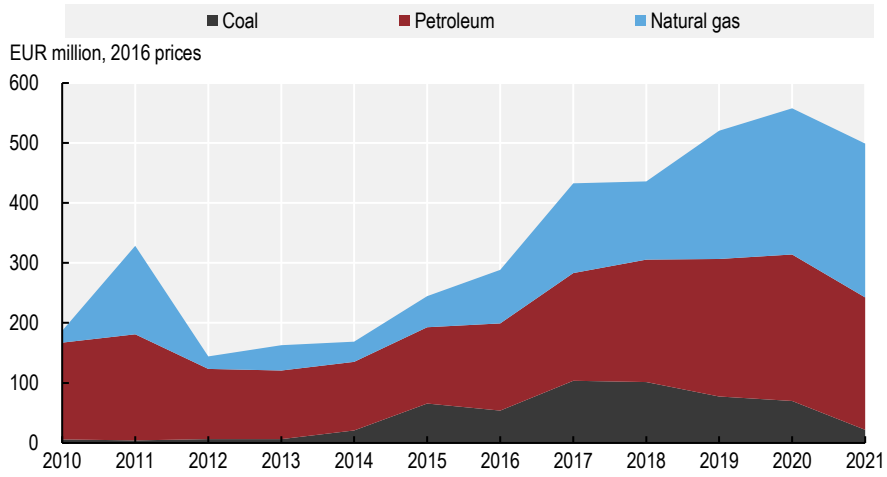
1.2.5. The phase-out of fossil fuel subsidies has stalled

Portugal is among the few EU countries to have performed a comprehensive stocktake of fossil fuel subsidies in its NECP (EC, 2020b). This follows the work of a task force created in 2018 to identify and reform environmentally harmful subsidies. The NECP mentioned 2025 as an indicative deadline for removing fossil fuel subsidies and tax benefits. The 2021 Climate Law (Art. 28) provides for this phase-out by 2030. With support from the International Monetary Fund and the European Commission, Portugal is setting up a technical unit to regularly monitor and assess tax benefits. This aims to streamline the tax system, which is cumbersome and not transparent (EC, 2022c). The unit could also track progress in removing environmentally harmful subsidies.

Like other OECD countries, Portugal supports consumption of fossil fuels through tax expenditure, and oil and gas attract the bulk of government support (Figure 1.13). The largest amounts include reduced tax rates for coloured and marked diesel fuel used by agricultural equipment and, since 2017, partial refund of diesel taxes to freight companies. They also include tax exemptions on energy products used for electricity production and co-generation or by industrial installations under the ETS or an energy-efficiency agreement. Overall, this tax relief represented 0.3% of GDP in 2020-21. Since 2014, forgone revenue from tax relief has increased with consumption and taxes on diesel and natural gas. In 2018, Portugal started to gradually phase out some fuel and carbon tax exemptions, which helped phase out coal power in 2021.

Figure 1.13. Forgone revenue from tax relief rose with consumption and taxes on diesel and natural gas, while support to coal fell

Tax expenditure by fuel type, 2010-21.



Source: OECD (2022), OECD Inventory of Support Measures for Fossil Fuels (database); MoF (2022), State General Account 2021.

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The 2022 Budget Law confirmed the gradual phase-out of energy and carbon tax exemptions for electricity production and co-generation and for industrial installations by 2025. However, at the same time Portugal introduced new measures supporting fuel consumption to address rising prices. This sends conflicting signals.

The government introduced a temporary subsidy on fuel consumption, a reduction in fuel tax, a reimbursement of the additional VAT raised on the higher fuel prices, and a freeze on the carbon tax (EC, 2022c). It also granted a subsidy for the passenger transport sector (buses and taxis), extended benefits under vehicle and fuel taxes for the road haulage sector, and reduced the corporate income tax for the whole transport sector. In September 2022, the plan to address rising prices (*Famílias Primeiro*) involved EUR 2.4 billion in addition to the EUR 1.6 billion already spent throughout the year to mitigate the impacts of inflation (Government of Portugal, 2022c). Overall, EUR 1.5 billion (0.7% of 2021 GDP) was spent in the form of untargeted fuel tax reliefs. Although energy price control and tax reductions are quick and simple to implement, Portugal should shift to targeted income support measures to protect vulnerable populations while encouraging energy savings and fuel switching (OECD, 2022e).

Recommendations on sustainable development

Addressing key environmental challenges

- Continue efforts to ensure sustainable financing of water services and infrastructure including by improving municipalities' cost accounting capacity and updating tariffs, particularly where they provide the service directly.
- Raise water abstraction charges for agriculture, strengthen capacity to monitor abstractions, enforce water licensing regulations and limit new abstraction permits in over-allocated basins.
- Accelerate the passing on of municipal waste management costs to households through dedicated identifiable charges uncoupled from the water bill, as part of wider awareness-raising campaigns to move up the waste hierarchy; develop separate collection of waste.
- Increase allocations to protected areas management under the new common agricultural policy 2023-27 and assess the environmental impact of measures implemented.

Enhancing policy coherence for sustainable development

- Continue to improve SEA practices through appropriate consideration of alternatives and increased use of cost-benefit analysis.
- Carry on efforts to ensure the transparent and effective implementation of programmes financed with EU funds prioritising investments with the highest social return. Carefully assess the environmental impacts of RRP investments.
- Ensure that the expenditure of the Environmental Fund is aligned with Portugal's environmental and climate objectives, strengthen its links with the managing authorities of EU funds and monitor its performance.
- Complete the evaluation of the green tax reform with a view to applying the polluter pays principle more consistently and supporting a green and inclusive recovery; as part of the inventory of tax benefits, identify potentially environmentally damaging supports and phase out those not justified on economic, environmental or social grounds.
- Gradually close the tax gap between diesel and petrol, remove the preferential circulation tax treatment for older vehicles and consider introducing a NOx component in vehicle taxes to rejuvenate the fleet and steer towards cleaner vehicles.
- Vary toll prices with vehicle emissions; further develop low emission zones with strict standards in cities exceeding air quality limits and ensure their effective enforcement.

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Notes

[1] During the Economic and Financial Assistance Programme (2011-14), Portugal received EUR 78 billion in loans from the European Union and the International Monetary Fund that were conditional on implementation of comprehensive reform programmes.

[2] Including non-energy use in the chemical and petrochemical sector (i.e. fuels used as raw materials and not consumed as a fuel or transformed into another fuel).

[3] Including non-energy use in the chemical and petrochemical sector (i.e. fuels used as raw materials and not consumed as a fuel or transformed into another fuel).

[4] Under EU Directive 2016/2284 on the reduction of national emissions of certain atmospheric pollutants.

[5] Exclusive economic zone and extended continental shelf.

[6] Out of 453 agglomerations, 15 were not considered in calculations of the compliance rate for Article 4 because they have a size of 2 000–10 000 p.e. and discharge into coastal water or less sensitive areas.

[7] Out of 453 agglomerations, 426 were not considered in the calculation of the compliance rate for Article 5 because they have a size <10 000 p.e. or >10 000 p.e. but discharge into normal or less sensitive area.

[8] From the cohesion and common agricultural policies, and Next Generation EU funds.

[9] Since 2022, the structure *Recuperar Portugal* is under the Minister of the Presidency, which shares oversight of the Development and Cohesion Agency with the Ministry of Territorial Cohesion (Decree-Law nº 32/2022).

[10] The RDP for Mainland, Portugal, was formally adopted by the European Commission on 12 December 2014 and modified on 25 January 2022. Its budget amounts to EUR 5.8 billion, comprising EUR 4.8 billion from the European Union and EUR 1 billion of national co-funding.

Chapter 2. Carbon neutrality

Portugal has overachieved its 2020 climate mitigation goals thanks to a significant decrease in greenhouse gas (GHG) emissions over the past decade. It has stepped up its efforts to adapt to climate change. The country can be commended for its leading role in climate action under its Presidency of the Council of the European Union in 2021. This chapter reviews progress and identifies remaining challenges regarding climate change mitigation and adaptation. It also examines the effectiveness of sectoral and horizontal policies towards Portugal's 2050 carbon neutrality goal.

2.1. Trends and performance on climate change mitigation

2.1.1. GHG emissions profile, intensity and trends

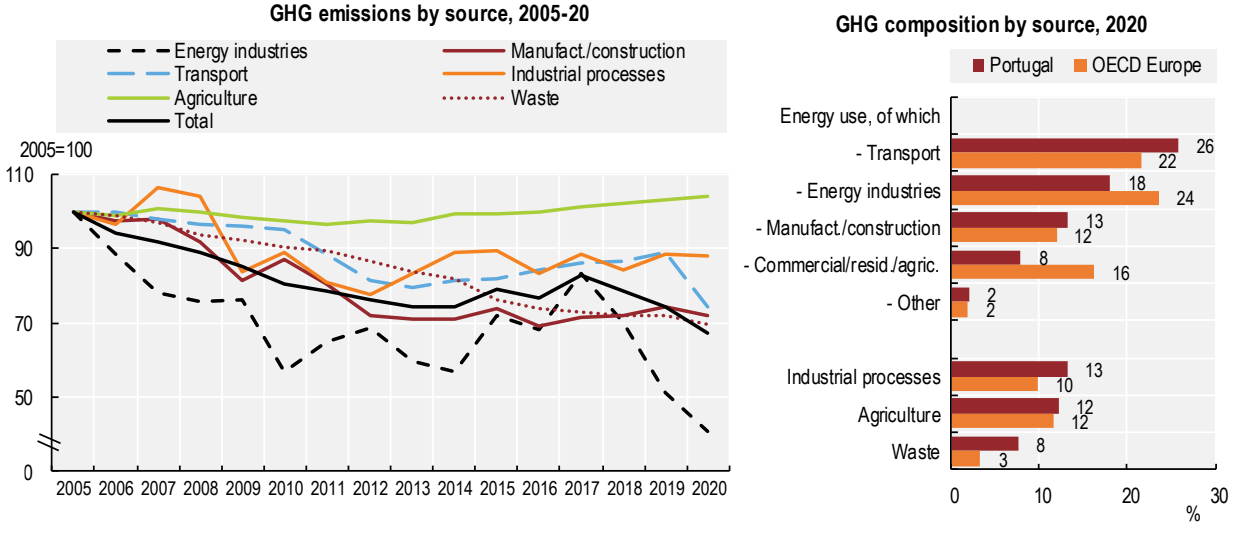
Portugal is a small GHG emitter, accounting for less than 2% of total EU emissions in 2020. Two-thirds of its emissions come from energy use, especially in transport and energy production (Figure 2.1). Compared to the OECD Europe average, Portugal's emissions structure has a higher share of transport, industrial processes and waste and a lower share of energy industries, and residential and commercial sectors. The land use, land use change and forestry (LULUCF) sector is a net sink.

Carbon dioxide (CO_2) emissions account for the largest share of GHG emissions in Portugal, although this share is lower than in OECD Europe (73% vs. 80%). Emissions of methane (mainly from agriculture and waste) and fluorinated gases (hydrofluorocarbons from refrigeration and air conditioning equipment) are more important (16% vs. 11% and 6% vs. 2%, respectively). The share of nitrous oxide emissions (N_2O, mainly from agricultural soils) is the same as the average of European OECD countries (6%).

Portugal's economy is slightly less energy intensive than the OECD Europe average due to the high share of services. The carbon intensity of its energy mix is also lower thanks to renewable energy. Emissions of methane and fluorinated gas make the country's economy more GHG emission intensive than the OECD Europe average.

Considering the impacts of the COVID-19 crisis, GHG emissions have been reduced by one third over 2005-20. Portugal is in the top third of European OECD countries in terms of emission reductions over this period. Since 2005, emissions have decreased in all sectors but agriculture (Figure 2.1). Following the 2008 economic crisis, GHG emissions declined driven by a reduction in energy demand. As renewable electricity production increased, emissions from energy industries fell, with annual variations depending on hydropower generation (IEA, 2021a). The decline in activity, particularly in the construction sector, also pushed down industrial emissions related to energy use and processes. With the economic recovery, emissions rebounded in 2014-17, particularly in the transport sector. They have since fallen, driven by a strong shift away from coal-fired power generation. The last two coal power plants were closed in 2021.

Figure 2.1. Since 2005, GHG emissions have decreased in all sectors but agriculture



Note: Excluding land use, land-use change and forestry.
Source: APA (2022), National Inventory Report 2022, April; OECD (2022), Environment Statistics (database).

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2.1.2. Progress towards climate targets

EU targets and legislation shape Portugal's climate and energy policy. In 2019, the country approved a Roadmap for Carbon Neutrality (RNC 2050) (Government of Portugal, 2019a) (Table 2.1). In 2020, it adopted the National Energy and Climate Plan 2021-30 (NECP 2030) setting the main priorities for the coming decade (Government of Portugal, 2019b). The NECP focuses on increasing the share of electricity generation from renewables, expanding electrification, and reducing energy demand. Portugal can be commended for its active role in the approval of the European Climate Law under its Presidency of the Council of the European Union in 2021, and for enshrining carbon neutrality in the 2021 Framework Climate Law.

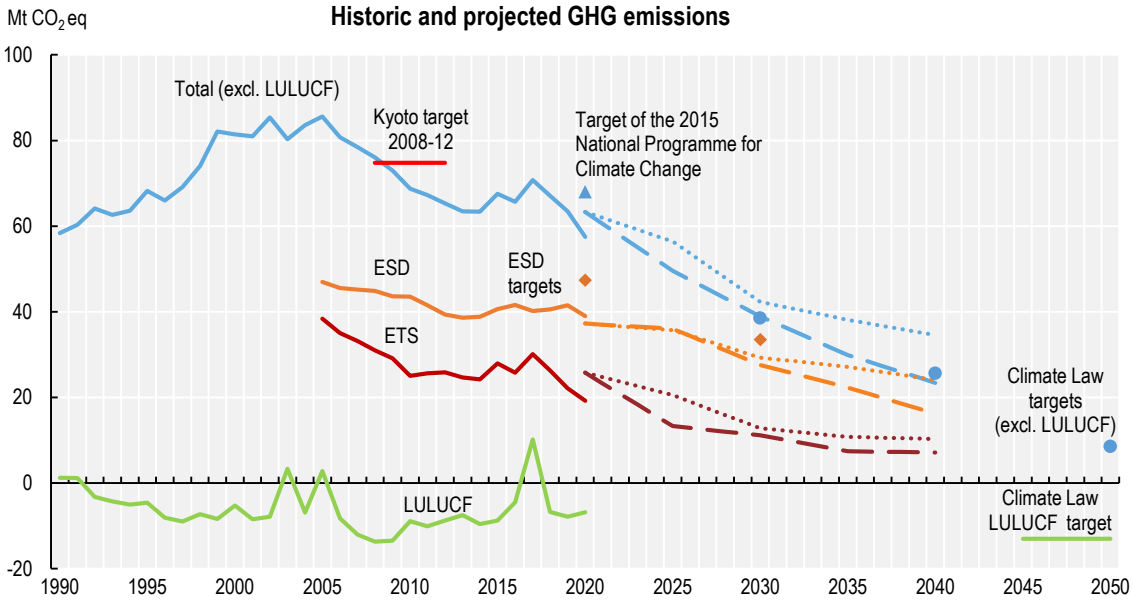
Table 2.1. National climate objectives of Portugal

Law or regulation	Objective variable	Objective	Base year	Objective year
Effort Sharing Regulation	GHG emissions from non-EU ETS sectors	-17%	2005	2030
Roadmap for Carbon Neutrality (RNC 2050)	GHG emissions excluding LULUCF	-85%-90%	2005	2050
		-65%-75%	2005	2040
		-45%-55%	2005	2030
	Carbon sequestration	9-13 Mt CO_2	-	2050
National Energy and Climate Plan (NECP 2030)	GHG emissions excluding LULUCF	-45%-55%	2005	2030
	Energy efficiency (primary energy consumption)	- 35%	2005	2030
	Renewable energy (as a share of final consumption)	47% (20% in transport)	-	2030
	Electricity interconnexion (as a share of energy capacity)	15%	-	2030
	Energy dependence on energy sources (dependency ratio)	65%	-	2030
Climate Law 2021	GHG emissions excluding LULUCF	-55%	2005	2030
	GHG emissions excluding LULUCF	-65-75%	2005	2040
	GHG emissions excluding LULUCF	-90%	2005	2050
	CO_2e sink of the land use and forestry sector	-13 $MtCO_2e$	-	2045-50

Source: Government of Portugal (2019), Roadmap for Carbon Neutrality 2050; Government of Portugal (2019), National Energy and Climate Plan 2021-30; Government of Portugal (2021), Framework Climate Law no 98/2021.

Portugal met its commitments under the first period of the Kyoto Protocol (2008-12), limiting the increase in GHG emissions to 19% compared to 1990 levels (vs a commitment of +27%) (Figure 2.2). It reached the 2020 economy-wide objective of the 2015 National Programme for Climate Change (-18% to -23% from 2005 levels). The country overachieved its 2020 target under the EU Effort Sharing Regulation (ESR). It has already met its ESR target for 2030 and seems on track to meet a more stringent one (-28.7%) proposed by the European Commission to meet commitments under the Paris Agreement (EC, 2021a). National projections show that, with existing measures, total emissions will fall by 51% over 2005-30 (Figure 2.2,Table 2.2).

Figure 2.2. Portugal seems on track to meet its 2030 climate targets



Note: LULUCF: land use, land-use change and forestry. Dotted lines refer to projections of the 2020 National Energy and Climate Plan (NECP) with existing measures. Dashed lines refer to projections with additional measures. ESD 2020 target: under the EU Effort Sharing legislation; 2030 target: European Commission's proposal for the revision of the Effort Sharing Regulation COM (2021) 555 final.
Source: APA (2022), National Inventory Report 2022, April; EEA (2021), Greenhouse Gas Projections Data Viewer – December; Eurostat (2022), Greenhouse gas emissions in ESD sectors; Government of Portugal (2021), Framework Climate Law no 98/2021.

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However, additional efforts will be needed to reduce emissions by 55% by 2030. The country will need to tap the decarbonisation potential of all sectors. So far, most of the emission abatement has taken place in energy production (Table 2.2). The NECP projects that the residential, service and agricultural sectors will not meet the 2030 targets in the scenario with additional measures. In addition, the assumptions underlying the projections for waste and transport could be questioned given the high level of landfilling and the low rate of renewal of the vehicle fleet (Chapter 1).

Emissions of fluorinated gases from industrial processes has increased significantly (Table 2.2). Although they represent a small share of emissions, they need to decline to comply with climate objectives and the 2016 Kigali Amendment of the Montreal Protocol. The Kigali Amendment plans the phasing out of the use of these gases as other options are made available.

The NECP provides limited details on the policies to be implemented. The impact of existing and planned measures is not quantified, and their financing is not specified. Therefore, it is not yet clear how Portugal will deliver on its 2030 targets.

Meeting 2050 targets calls for increased efforts for research and development (R&D). A substantial part of the abatements to be achieved between 2030 and 2050 depends on technologies at demonstration or prototype stage. The share is even higher in hard-to-abate sectors such as heavy industry and long-distance transport (IEA, 2021b). Stepping up R&D efforts (for energy storage, green fuels or carbon capture) will be key to reduce the cost of measures and expand electrification in all sectors. It is also an opportunity to become more competitive in the international market of environmental goods.

Table 2.2. Cutting emissions by 55% in 2030 calls for additional measures

Past and projected GHG emissions compared to 2030 targets

	GHG emission reduction achieved		NECP scenario with existing measures	NECP scenario with additional measures	NECP sectoral targets
	GHG evolution 2005-2020 (in $MtCO_2e$)	GHG evolution 2005-2020 (in %)	2005-2030	2005-2030	2030
1. Energy	-25.5	-40%	-57%	-62%	-
Production of electricity	-15.1	-59%	-93%	-95%	..
Industry	-3.0	-28%	-41%	-51%	..
Transport	-5.1	-26%	-41%	-46%	-40%
Residential	-0.6	-20%	-23%	-26%	-35%
Services	-2.1	-68%	-62%	-66%	-70%
2. Industrial Processes and Use of Products	-1.0	-12%	-39%	-39%	
Product uses as ODS substitutes (F gases)	+2.3	+217%	-20%	-20%	..
3. Agriculture	+0.3	+4%	-3%	-6%	-11%
5. Waste and Wastewater	-1.9	-31%	-49%	-49%	-30%
Total without LULUCF	**-28.1**	**-33%**	**-51%**	**-55%**	**-45% to-55%**
LULUCF*	-9.6		-9.6$MtCO_2e$	-10.7$MtCO_2e$	..

Note: LULUCF = land use, land-use change and forestry. Negative evolution in the LULUCF sector shows an increase in carbon capture. The LULUCF was a net emitter in 2005 following big fires.
Source: APA (2022), National Inventory Report 2022, April; APA (2021), Emission projections under the EU Greenhouse Gas Monitoring Mechanism Regulation (art. 14); Government of Portugal (2019), National Energy and Climate Plan.

2.2. Governance of climate action

The Ministry of Environment and Climate Action oversees Portugal's climate policy. Its mandate covers environment, energy, natural conservation, forests, territorial planning and mobility. It also houses the Directorate General for Energy and Geology, which oversees the energy policy and compliance to EU directives in the field of energy, including on energy efficiency and renewable energy. The Portuguese Environment Agency (APA), under the responsibility of the ministry, provides guidance for environmental and climate policies with recommendations, policy assessments and policy monitoring.

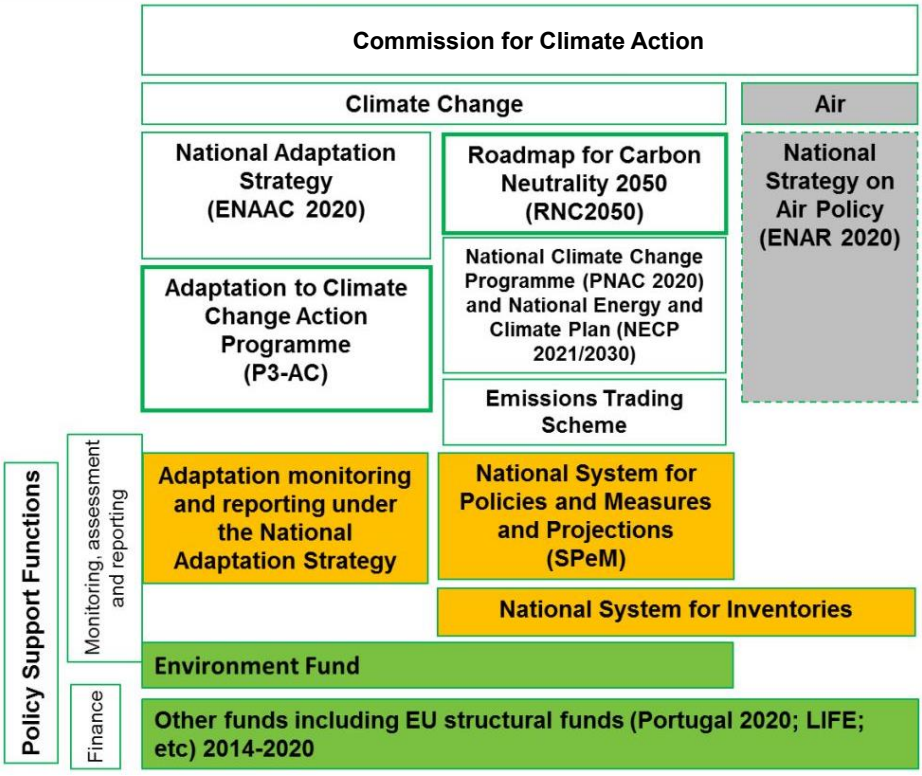
The competent authority for implementation of the climate strategy, both for mitigation and adaptation, is the Commission for Climate Action (CAC), created in 2015 by the Portuguese government (Figure 2.3). The commission is chaired by the minister responsible for climate action and includes government members in charge of key sectors such as energy, tourism, transport, health, agriculture and forest. Representatives of regional governments of Azores and Madeira are also part of the commission. The CAC ensures that Portugal's climate strategy complies with commitments at the national and international level. It provides policy advice and promotes the integration of climate objectives into sectoral measures. It also ensures that regional plans of Azores and Madeira are aligned with national targets. Finally, it supervises the monitoring and reporting of policies and emissions.

The CAC conceived the RNC 2050 and the NECP 2030 as the basis for the climate change mitigation strategy for the coming decades. It also monitors the activity of the National System for Policies and Measures and Projections (SPeM). This system was established in 2015 to streamline the monitoring and assessment of sectoral policies and mitigation measures in light of national climate objectives. For each sector, progress assessment should integrate the results of policies, a cost-benefit analysis and the reporting of synergies and trade-offs (UNFCCC, 2019).

In line with international good practices, the 2021 Climate Framework Law requires five-year climate budgets, sectoral mitigation plans, municipal climate action plans and an annual government progress report to Parliament. It sets out green budgeting principles requiring the government to specify the resources allocated to climate policy in the state budget. The law also creates an independent body, the Council for Climate Action, to assess climate action and provide recommendations. It plans a web portal to inform the public. Although promising, the law remains to be implemented through specific regulations.

The government consulted sectoral experts and segments of society to shape climate mitigation and adaptation policies. Experts took part in working groups as technical support and consultation to define macroeconomic and sectoral scenarios. The groups' work also informed the definition of the RNC 2050 and the NECP 2030 before their publication. The climate strategy was subject to public consultations that lasted several weeks (3 months for the RNC and 30 days for the NECP), with the participation of the public sector, private sector, associations representing sectors of the economy and civil society. Notably, a primary version of RNC 2050 was presented throughout the country in public sessions in Coimbra, Porto, Évora and Faro in continental Portugal and in Funchal in the Autonomous Region of Madeira. Suggestions from the public were integrated into the final draft, mainly through sensitivity analysis (UNFCCC, 2019). Specific stakeholders contribute to the sectoral working groups of the National Adaptation Strategy (NAS) and a scientific panel advises the coordination group (Section 2.4.2).

Figure 2.3. Governance of climate action in Portugal



Source: APA (2020), 4th Biennial Report to the United Nations Framework Convention for Climate Change.

2.3. Policy measures for climate mitigation

2.3.1. Policy tools for decarbonisation

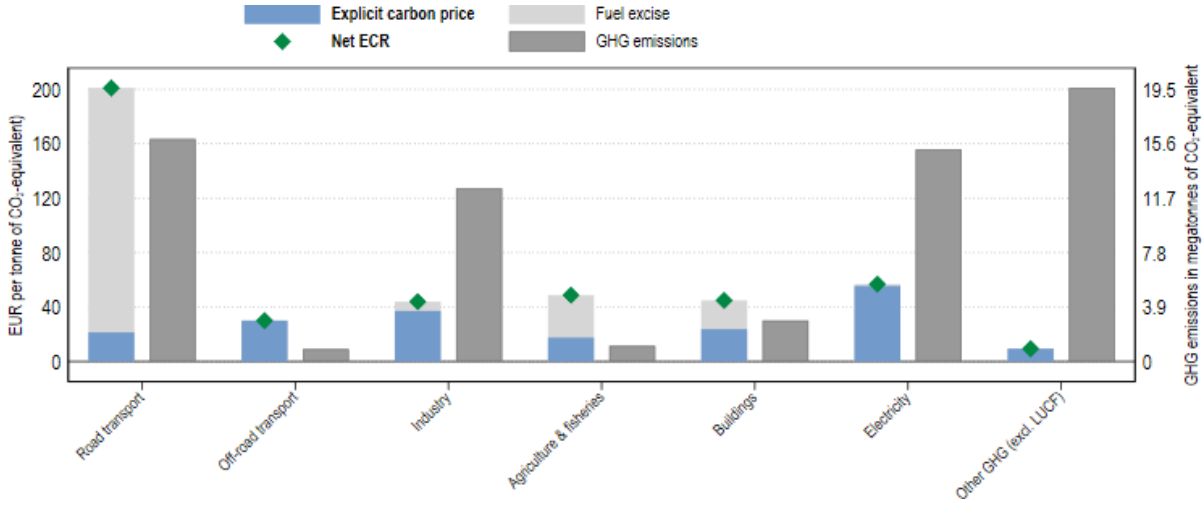
Carbon pricing covers most of carbon dioxide emissions

Pricing instruments make emitters pay in proportion of the damages and compensate for carbon sequestration in proportion of the benefits. Relative to regulation, they have the advantage of encouraging the most cost-effective measures, leaving the possibility to actors to adapt to specific contexts in a decentralised way. Pricing instruments are key levers in the Portuguese decarbonisation strategy. The country prices carbon emissions in three ways: i) energy taxes levied in the framework of the EU Energy Tax Directive, ii) the EU ETS and iii) the carbon tax introduced in 2014, as part of Portugal's green tax reform (Chapter 1).

In 2021, effective carbon rates (ECR) consisted of fuel excise taxes and to a smaller extent of permit prices from the EU-ETS and of carbon taxes (Figure 2.4). Portugal priced about 74% of its GHG emissions, of which 28% at an ECR above EUR 60 per tonne of CO_2, the midpoint benchmark for carbon costs in 2020. Emissions priced at this level originated primarily from the road transport sector. Most unpriced emissions were non-CO_2 emissions. Portugal's average effective carbon rate increased by a third over 2018-21, mainly due to higher EU ETS allowance prices. With an average rate of EUR 74 per tonne of CO_2, in 2021, it ranked in the middle of other OECD European countries (OECD, 2022a). However, as they varied by sector and fuels, effective carbon rates did not provide a consistent carbon price across the economy.

Figure 2.4. Carbon prices vary by sector and fuel

Average effective carbon rates by sector in 2021



Note: Excludes emissions from the combustion of biomass. The explicit carbon price covers the carbon tax and EU ETS permits.
Source: OECD (2022), Pricing Greenhouse Gas Emissions: Turning Climate Targets into Climate Action.

In addition, effective carbon rates are reduced by preferential tax treatments such as reduced rate for diesel used in agriculture, partial refund to freight companies, tax exemptions on energy products used for electricity production or by industrial installations under the EU ETS or an energy-efficiency agreement (Chapter 1). In 2018, Portugal started to gradually phase out some fuel and carbon tax exemptions which helped to phase out coal power in 2021. However, responding to rising energy prices the government froze

the carbon tax at the end of 2021, alongside new support measures for energy and fuel consumption sending different signals (Box 2.1).

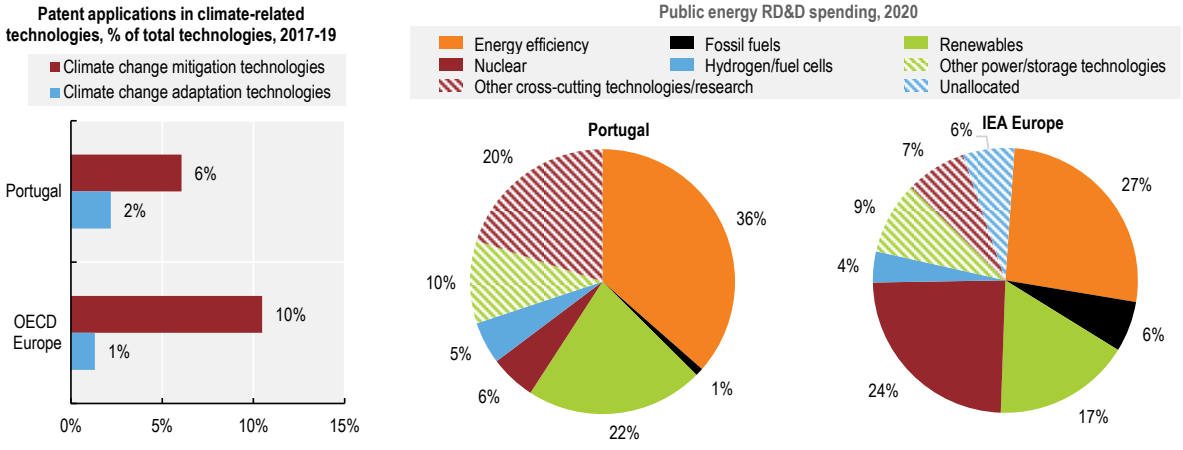
Developing a national innovation strategy for climate

A large part of Portugal's decarbonisation and adaptation strategies relies on technological development, especially for pursuing emission abatement after 2030. Innovation in the sector of transport and energy could accelerate the decarbonisation of the economy in the short term and will be key to reach climate neutrality (IEA, 2021b). Major stakes include, for instance, development of renewable gases, more efficient batteries or the implementation of carbon capture and sequestration at a large scale. Accordingly, the NECP 2030 plans to allocate 0.2% of gross domestic product (GDP) to R&D in the energy sector and 0.2% to R&D for water and climate in 2030.

Portugal has increased its effort for developing green technologies and innovations. It has been a pioneer in experiencing cutting-edge technologies for large-scale projects of renewable energy, co-funded with EU and private funds. It has approved floating offshore farms, renewable gas power stations (Section 2.3.2), as well as research projects to make the most of its solar and hydropower resources (IEA, 2021a). Portugal encourages R&D generally through generous tax credits for businesses, which covered 27% of the business expenditure on R&D in 2019 (as compared to 7% in the European Union) (OECD, 2021a).

However, there is no strategy guiding energy research, development and demonstration (RD&D) (IEA, 2021a). Increased policy co-ordination on energy RD&D is needed to ensure that the numerous RD&D entities, strategies and support measures are aligned with Portugal's decarbonisation goals. The country is considered as a "moderate innovator" in the European Eco-Innovation Scoreboard (EC, 2022a). This is due to low government spending on R&D in environmental and energy fields and limited patenting activity (Figure 2.5), although Portugal holds a relative advantage in terms of technologies for climate adaptation. Public and private spending on energy R&D increased from 0.06% of GDP in 2014 to 0.08% in 2020, remaining well below the NECP target (DGEEC, 2022). Public budget on energy R&D is mostly allocated to energy efficiency, renewable energy and cross-cutting technologies (Figure 2.5).

Figure 2.5. Portugal's climate innovation is modest



Note: Patent applications for higher-value inventions that have sought protection in at least two jurisdictions.
Source: IEA (2022), Energy Technology RD&D Budgets (database); OECD (2022), Environment Statistics (database).

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Financing the decarbonisation: Mobilising the private sector

Accelerating the transition to a low-carbon economy will require substantial investments to develop renewable energies, enhance energy efficiency, electrify the energy sector, reduce the demand for energy, encourage carbon capture and sequestration, and facilitate transitions for workers, consumers and firms. Estimates made in the NECP 2030 show that reducing emissions by 45-55% by 2030 would require EUR 407-431 billion in 2020-30, adding EUR 11-15 billion to current trends (Chapter 1).

A large part of these investments is embedded in specific plans such as the National Hydrogen Strategy. It provides for EUR 7 billion investment for the installation of 2 GW of electrolysis capacity to increase the share of hydrogen in final energy consumption to 5% by 2030. Most of available funds for the decarbonisation of Portugal are from the European Union. Following the downturn of the global economy and restrictions due to the pandemic, the European Union has raised unprecedented amounts of liquidity for the recovery of member states. Climate-related measures account for 38% of Portugal's Recovery and Resilience Plan for 2021-26. They cover substantial efforts to decarbonise the industry, foster energy efficiency in buildings and develop public transport (Chapter 1).

In 2021, the European Investment Bank (EIB) agreed to a Memorandum of Understanding on hydrogen, including financial and advisory support to foster investments in eligible projects. Moreover, a partnership with the Netherlands on green hydrogen will allow the installation of a 1 GW capacity of electrolysis in Sines (Government of Portugal, 2019b).

Domestic funds are much smaller. The Environmental Fund had a budget of EUR 648 million in 2020, mostly coming from the revenues of the auctioning of allowances under the EU ETS. This fund is notably used for the development of low-emission vehicle, public transport, the More Sustainable Buildings Program or the Ecosystem Services Remuneration Program (Government of Portugal, 2021a).

To cover the needs for green investment without digging further into scarce public resources, the Portuguese government also needs to mobilise private capital for green investments. A first step is to ensure visibility to investors through a clear and detailed pathway for carbon pricing and network access for the different technologies. The government uses feed-in tariffs to develop renewable energy in small-scale projects for private consumption. Since 2021, auctions have also supported development of large-scale photovoltaic (PV) projects. However, there is no concrete agenda to develop other energy sources (IEA, 2021a) (Section 2.3.2).

Direct support for financing can also be an option when liquidity is scarce, or the liquidity market is strained. The new Portuguese Bank of Development is required to promote, among other objectives, sustainable infrastructures, transport and climate neutrality. It does this through loans and guarantees to firms, and more particularly small and medium-sized enterprises. It is crucial that these instruments are tailored for the specific needs and difficulties of investors. For instance, take-up for the large programs supporting households' investment in house energy efficiency is still low due to poor targeting of supports (Sections 2.3.1 and 2.3.2).

Labelling public and private investments can help steer funds from carbon-intensive to greener activities. The 2021 Climate Law (article 36) stipulates that the EU green taxonomy should be integrated into public investment and procurement. This implies a disinvestment from activities not considered sustainable before. Moreover, private institutions are required to factor in climate risk and climate impact in their financing decisions, more particularly through risk analysis for finance and insurance actors (article 35).

Aiming for a just transition

The economy's general equilibrium is not expected to be strongly affected by decarbonisation, although sectoral impacts may arise. Portugal does not have a major fossil fuel industry at risk and its energy production is made from renewable sources, mainly bioenergy, wind and hydro (IEA, 2021a). However,

industries that are energy-intensive or related to fossil fuels (refineries) are vulnerable to more stringent climate policies affecting energy prices, like increased carbon pricing, which can slightly hinder GDP growth. For instance, estimates show replacing the Tax on Petroleum and Energy Products (ISP) by a EUR 114 carbon tax would reduce Portugal's GDP by 1.2% relative to the baseline in 2030 (Pereira and Pereira, 2019). Conversely, the ramping up of renewable energy has not boosted the economy so far.

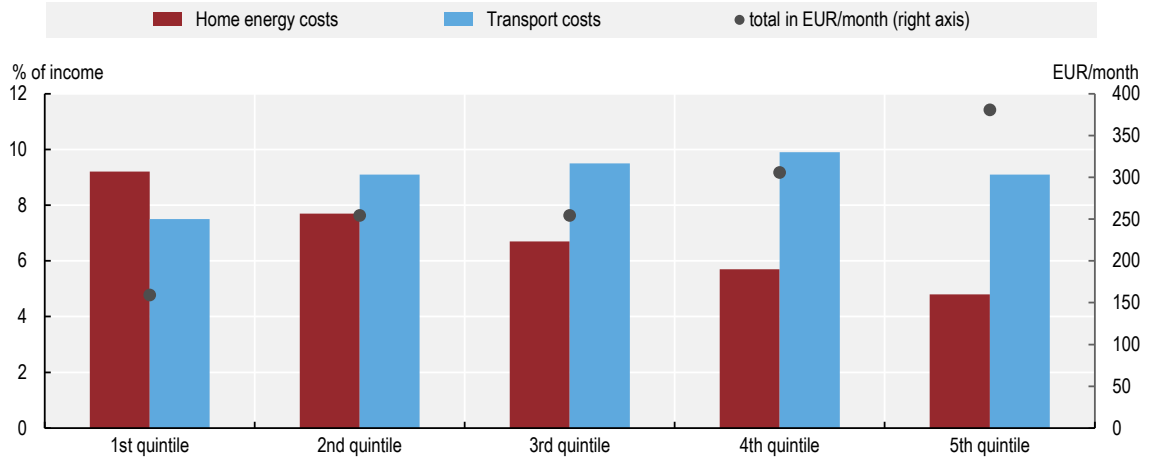
As a result, the impact of the transition on aggregate employment in Portugal is likely to be weak. However, changes in the labour market between sectors should be anticipated to maintain people and skills. Only 2.5% of the Portuguese workforce is employed in energy-intensive sectors and 2.2% in the provision of environmental goods and services (EC, 2022b). This is in line with most countries where both green and emission-intensive jobs only cover a marginal range of the labour market. However, transitions from emission-intensive to green sectors on the labour market might not be straightforward. Key sectors like construction, transport or energy already suffer from labour shortages in Portugal (Eurofound, 2021). Moreover, experience globally shows that skills between different sectors do not automatically match and incoming workers in green jobs from emission-intensive sectors are under-represented (IMF, 2022a).

The accompanying and upskilling of workers from decaying industries will be a challenge, especially in a country where adult education is not yet streamlined (OECD, 2021b). The plan to phase-out coal in power-generation in Portugal comprises an assessment of reskilling needs for workers from coal-fired power plants. The EU Just Transition Fund is also expected to provide EUR 224 million to regions in Portugal affected by the transition (EC, 2022b). However, this will mostly take the form of direct income support; the development of specific training is so far uncertain (Almeida, 2021).

Another issue arises from the price impact of the transition. Without offsetting measures, the transition might amplify purchasing-power inequalities, with lower-income households carrying a heavier weight than one with higher incomes. This is particularly the case for home energy costs (Figure 2.6). In the case of a transport fuel price increase, middle-income households will be the most affected. This is because poor households are less likely to own a car and those with higher incomes spend a smaller share of their income on transport.

Figure 2.6. Low-income households will be the hardest hit by higher home energy prices

Energy costs as a share of income by income quintile (left axis) and as monthly expenses (right axis), 2016



Note: Transport costs include all operational costs for running a car except equipment.
Source: INE (2016), Household Budget Survey.

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While the government has to encourage cuts in energy consumption, it must not worsen energy poverty, which is a major issue in Portugal. Although temperatures in Portugal are relatively mild compared to other countries, many households have difficulties insulating their home against hot or cold weather. Portugal stands out among EU countries with the highest energy poverty share: in 2019, 19% of people in Portugal were unable to keep their home adequately warm vs. 7% of people in the European Union. This share reached 38% among people below the poverty line (MAAC, 2021). In parallel, 36% of people are unable to keep their home adequately cool during the summer.

Portugal has carried out ambitious measures to address energy poverty through price support and, more structurally, energy efficiency work. However, it needs to better target the former measures and strengthen the latter. Social energy tariffs seek to protect vulnerable consumers, guaranteeing access to this essential service at affordable prices and under conditions of greater tariff stability. Vulnerable households benefit from social tariffs for electricity and gas, under social and income criteria. In 2016, the automation of eligibility and broader criteria led to a more than eightfold increase in the number of beneficiaries. In 2020, 787 665 households benefitted from social tariffs (of which only 34 709 benefitting from the natural gas social tariff). They received an average yearly benefit of about EUR 146 for electricity and EUR 51 for gas[1] (i.e. 15.6% and 11.7% of yearly expenses, respectively).[2]

However, these social tariffs fail to cover all dimensions of energy poverty. No dwelling-related criterion for energy poverty is considered and the structural issue of the bad housing conditions is overlooked (Section 2.3.2); they also do not encourage efficient use of energy, particularly since they can be accumulated (but most benefitting households are not concerned). Vouchers for supporting efficiency works by low-income households have also been implemented since 2020 under the More Sustainable Buildings Support Programme (PAE+S) for a total of EUR 135 million. However, average amounts cover a small share of renovation costs. As a result, the energy efficiency work still requires a level of liquidity rarely available for the eligible households. Uptake for this tool is particularly low. As in October 2022, 106 131 households had applied; of which 67 188 were eligible, covering 1.6% of households and 1.9% of those living in buildings with poor performance; unallocated fund amounted to EUR 18 million at this date (CNADS, 2022; Government of Portugal, 2022a). Since mid-2021, beneficiaries of the social electricity tariff who own their home are eligible for the energy efficiency voucher programme (*Vale Eficiência).* The aim is to allocate 100 000 vouchers by 2025. However, the programme covers a small share of the renovation costs (EUR 1 300 plus VAT). By the end of 2022, only 11 000 vouchers had been allocated.

The government needs a comprehensive strategy to encourage energy consumption cuts while improving poor households' well-being, tailored to the needs of households in energy poverty. Promoting energy efficiency in rented dwellings, for instance, is challenging, as owners are not encouraged to undertake the work. New Zealand addressed this issue by allocating specific funds (NZD 18 million) to deliver insulation to low-income rental households with high health needs, including children ("Warm up New Zealand Healthy Homes Extension for Rentals Programme"). Portugal's National Strategy against energy poverty submitted to public consultation in April 2021 includes a broad set of measures that could address many deadlocks such as households' education or liquidity issues. However, the strategy has not been adopted yet. Moreover, itis not entirely funded, including for key measures such as those regarding financial institutions, or professional training.

Box 2.1. Cushioning the impact of higher energy prices

Despite being relatively sheltered from soaring energy prices, the government has launched measures to prevent a purchasing power downturn, with the risk of subsidising fossil fuels

Like most countries, Portugal must cope with an inflation rate at a level unseen for decades as consumer price is to increase by 6.3% in 2022. This inflation is fuelled by the rebound in demand following the COVID-19 pandemic and the recent attack on Ukraine that hampered global markets, and particularly the distribution of energy.

The increase in energy price in Portugal has been milder than in most EU countries so far. This is due notably to Portugal's smaller dependence of energy resources from the Russian Federation or Ukraine. In September 2022, for example, the yearly increase of home energy prices reached 31% in Portugal, compared to 53% in the whole European Union, diesel by 23% and gasoline by 2% (respectively +30% and + 12% in the EU).

The government carried out strong action to compensate households and firms from higher energy prices. These measures include price support like the partial reimbursement of fuel consumption or the refund of bottled gas for beneficiaries of social tariffs. Notably the carbon tax increase is suspended until further notice, along with an extraordinary reduction ISP. These measures will cost the government EUR 1.5 billion in 2022. Other measures support the fuel consumption of specific sectors like public transport (buses, taxis, etc.), the road transport, agriculture or gas-intensive industries. In September 2022, the government approved a EUR 1.4 billion package for companies and the social sector, including grants, credits and tax cuts, along with supports for the energy transition, as well as training for new skills.

To curb the wholesale electricity price rise resulting from higher gas prices, Portugal and Spain agreed with the European Commission to insulate the Iberian peninsula's electricity market from Continental Europe and to cap electricity producers' gas costs. This measure will take the form of a subsidy amounting to the differential between gas market prices and the agreed cap, which is expected to increase. This measure should be phased out on 31 May 2023. It will cost EUR 8.4 billion (EUR 6.3 billion from Spain, EUR 2.1 billion from Portugal). It will be fully funded, notably by a charge on buyers benefitting from the measure.

Source: Bruegel (2022), National policies to shield consumers from rising energy prices; EC (2022), State aid: Commission approves Spanish and Portuguese measure to lower electricity prices amid energy crisis; Government of Portugal (2022), *Familias Primeiro;* Government of Portugal (2022), *Pacote Energia para Avançar mobiliza 1400 milhões para apoiar empresas e setor social*.

2.3.2 Sectoral mitigation measures

Energy production and use

Portugal has made commendable progress in the decarbonisation of the energy generation sector, which is a main driver of recent progress for mitigation. However, energy production and use still accounts for two-thirds of all GHG emissions, and energy production alone for 18% (against 30% in 2005). Portugal's strategy to reduce these emissions relies on development of renewables in energy generation, more particularly in electricity generation; electrification of sectors dominated by fossil fuels; and energy efficiency.

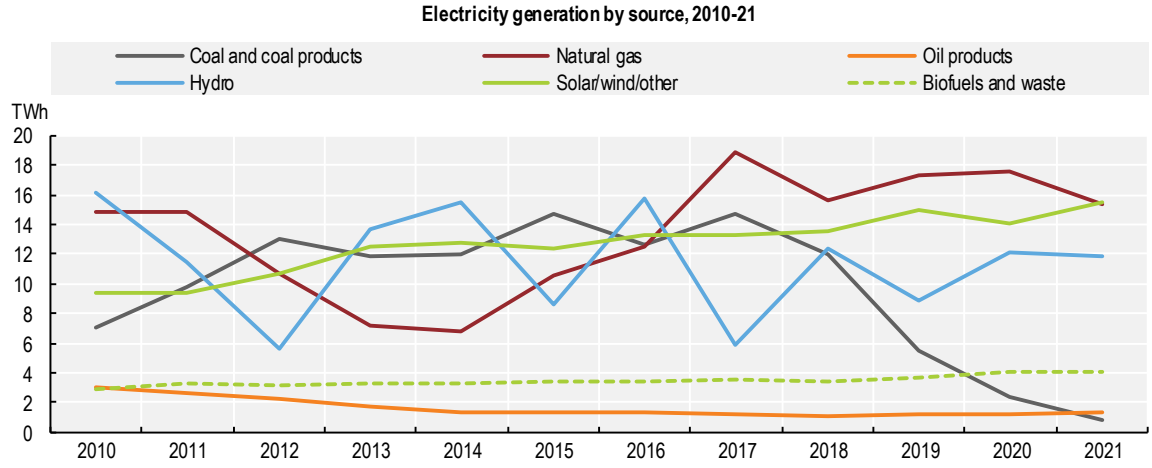
Decarbonising energy generation

Portugal plans to reduce its emissions from energy generation by 93% with existing measures, and by 95% with additional measures by 2030 and 99% by 2050. This trajectory is even more challenging in that it comes with the electrification of the economy and the need to increase generation capacity by 47-54% in a decade according to the NECP (Figure 2.8).

With 34% of renewable energy in gross final energy consumption in 2020, Portugal overachieved its binding target of 31% set by the EU Renewable Energy Directive (Eurostat, 2022). The country has set an ambitious target of 47% by 2030. This is above the 42% required for Portugal by the EU Regulation on Governance of the Energy Union and Climate Action and above the 45% proposed for the European Union in the revised Renewable Energy Directive. This objective translates differently between different sectors:

- Portugal plans to produce 80% of its electricity from renewable sources by 2030. With a rate of 58% in 2020, it was just below its objective of 60%. With the increased taxation of coal (Section 2.3.1), its share in electricity generation fell from 28% to 4% between 2015 and 2020, as renewable energy and natural gas became relatively more competitive (Figure 2.7).
- Portugal successfully developed renewable energy for heating and cooling, meeting its 2020 target under the Renewable Energy Directive. In 2020, renewables made up 41% of energy consumption for heating and cooling, well above the EU average (Eurostat, 2022). This comes mostly from biomass and heat pumps (IEA, 2021a). The deployment of energy efficiency plans and new technologies should allow reaching 49%, as required by EU commitments.
- Renewable energy makes up 9.7% of transport energy consumption, which is below the EU objective of 10% for 2020 and below the EU average (Eurostat, 2022). Almost all renewable energy in the transport sector now comes from biodiesel with sustainability criteria as defined in the Renewable Energy Directive (2018).

Figure 2.7. Electricity generation from coal is declining to the profit of natural gas and renewables



Note: 2021: provisional data.
Source: IEA (2022), IEA World Energy Statistics and Balances (database).

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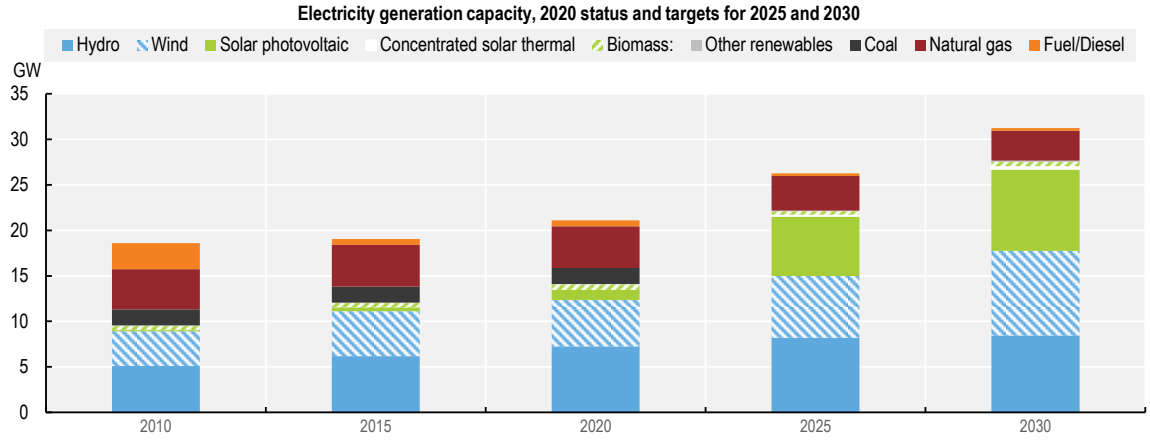
The deployment and diversification of renewable sources is the key pillar of Portugal's energy strategy. All types of renewables are expected to develop. In particular, solar photovoltaic capacity is expected to increase tenfold by 2030 (Government of Portugal, 2019a).

The government does not plan to reduce Portugal's installed capacity of natural gas for electricity generation before 2025, although it is far from carbon neutral. Natural gas supply has so far buffered the variation of hydropower generation. It will be used as a transitionary energy source in the way to decarbonisation. Natural gas still benefits from tax exemptions, due to a decline of 40% by 2023 but with an unclear 2030 horizon. The RNC plans to reduce the natural gas share in electricity generation by 2 by 2040 and by 20 by 2050 (Figure 2.8). Portugal is completely dependent on imports for natural gas, mainly from Algeria (*via* pipeline) and Nigeria (liquified natural gas). The cut of gas supply from the Russian Federation to the European Union did not threaten the security of supply. However, it caused a surge in prices that prompted a EUR 2.1 billion emergency plan to lower input costs for power generation (Box 2.1).

Figure 2.8. Portugal needs to double its renewable capacity by the next decade to meet its target



Note: Projections from the NECP with existing measures.
Source: IEA (2022), IEA World Energy Statistics and Balances (database), Government of Portugal (2019), National Energy and Climate Plan 2021-30.

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Monetary incentives prompted development of renewable energies as early as the beginning of the century, making Portugal a pioneer in green energy. From 2004 to 2012, a feed-in-tariff programme fuelled the development of wind, which became the first renewable source for electricity generation. The financial crisis led to the end of this subsidy; the development of wind energy has been stalled ever since. Since 2014, small-scale installations (below 250 kW) benefit from feed-in-tariffs of EUR 95 per MWh for hydro and PV and EUR 85.5 per MWh for biomass and biogas. Energy communities and self-consumption are also encouraged by partial exemptions of grid access tariffs (IEA, 2021a).

Electricity prices from producers benefitting from feed-in tariffs are heterogeneous according to the energy source. They range from around EUR 90/MWh for onshore wind, waste and hydropower to EUR 147/MWh for offshore wind EUR 290/MWh for PV. In 2019, guaranteed remuneration accounted for 63% of the total installed capacity of renewable energy, 36% of PV and nearly all wind.[3]

The government also provides a general framework for development of renewable energy sources and their integration into the electricity grid, putting a strong focus on solar energy. To adapt to the network's limitation and provide visibility to investors, projects with a capacity greater than 1MW must be granted a network capacity reserve. The access can be subject to an auction where the network capacity is tight, so that investors pay to strengthen it. From June 2019 to March 2020, only 27 projects corresponding to 4.5 GV were granted access to the network, out of 1 472 requests (IEA, 2021a). An auction was held in 2019 for the installation of 1.4 GW of PV dispatched in 24 lots on the network. Winning bids that offered the cheapest final electricity price were allocated to the projects. The government plans to continue holding

auctions twice a year for a total capacity of 1.0 GW and favour projects that will not put further strain on the network.

Decarbonising electricity generation while increasing its capacity calls for massive investment from both the public and the private sector to build the infrastructures and ensure their connection to the grid. The additional investment needs to achieve carbon neutrality of the electricity sector is estimated at EUR 1.2 to 2.2 billion in 2016-30 and EUR 9 to 11.3 billion in 2031-40 (Chapter 1). Solar energy (either centralised or decentralised) will get more than half.

Large infrastructure projects with innovative technologies have been launched to meet needed renewable capacity. Notably, the Tâmega Hydro Complex, made of three hydropower plants with total capacity of 1 158 GW, was launched with a EUR 1.5 billion investment costs. Of this amount, the EIB funded EUR 650 million. Substantial investments were leveraged by EU and national grants and a EUR 60 million loan from the EIB to Windplus SA. These allowed building of a viable cutting-edge floating offshore wind power station near Viana do Castello with a 25 MW capacity. The NECP indicates that floating offshore wind capacity should reach 300 MW by 2030.

No strong policy measure has been carried out for further development of wind generation. The deployment of onshore wind energy stalled by the end of feed-in-tariffs. Government policy is focused on repowering of existing onshore wind farms. The NECP notes that Portugal has significant generation potential to be explored but does not specify which policies or measures will support increasing onshore wind capacity in line with the target for 9 GW in 2030 (IEA, 2021a).

Decree-Law No 162/2019 provides a framework of self-consumption and energy communities, that offer multiple co-benefits to households and communities (highlighted in the NECP). However, it did not prompt the expected ramp up of small-scale generation. This calls for further education for households and municipalities, together with a simplified process and strong monetary incentives (IEA, 2021a).

Electrification and the development of hydrogen

The electrification of energy use in Portugal is the second pillar of the country's decarbonisation strategy. It should be achieved through sectoral policies (e.g. mainstreaming of electric vehicles – EVs). Electricity accounts for 50 TWh and 52.4% of final consumptions. This level has been stable for nearly 15 years but will need to accelerate to comply with climate commitments. This, in turn, entails the replacement of a large part of fossil fuels by electricity from renewable sources, particularly in the transport sector. The NECP projects that the installed capacity from renewable should be increased by about 50% from 2020 to 2025 and by 87% to 2030. To do so, Portugal notably aims to increase the number of international interconnections from the present 10% of total capacity to 15% in 2030.

Fiscal incentives and price signals should be aligned with the objective of a broad electrification of all sectors. The Green Taxation Law, passed in 2014, consistently planned the gradual suppression of tax exemptions for fossil fuels in energy generation. The introduction of a progressive value-added tax on gas and electricity for households also encourages energy savings and the installation of small capacities. However, non-carbon taxation accounts for most of the retail prices. It does not particularly encourage electricity use over gas in households' energy consumption: tariffs and taxes constitute 62% of natural gas final price and 67% of electricity retail price. This level of taxation can be reviewed while electricity is decarbonised to encourage low-carbon energy sources (IEA, 2021a).

Price incentives could encourage off-peak consumption by households and industries and then help manage the risk related to the intermittence of renewable energy. Electricity prices include peak-hour tariffs. By the end of 2021, 4 million smart meters were installed covering two-thirds of customers in mainland Portugal. Peak-hour tariffs for big consumers are only in a pilot phase (IEA, 2021a).

The development of hydrogen by electrolysis will allow decarbonisation of sectors that are hard to electrify (air and maritime transport) and development of carbon storage. Portugal estimates that it can cover 7%

of renewable energy for transport by 2030 and replace 10- 15% of natural gas in the gas network. Portugal launched a National Hydrogen Strategy to ramp up the integration of an untapped energy source and make it cover up to 2% of energy demand by 2030. This would ensure deployment of 2.0-2.5 GW of electrolysis capacity and the required regulation reforms. Investments have been initiated for a first project of 1 GW of green hydrogen from wind and solar power in the industrial area of Sines.

Energy efficiency

Portugal has successfully reduced the energy intensity of its economy, even while it was recovering from the 2008 economic crisis. It has largely met its 2020 target under the EU Energy Efficiency Directive. The country stands among the most energy-efficient in Europe, in terms of energy consumption per capita or GDP unit. Most of this progress has been achieved *via* energy savings in the industrial sector, notably in the non-metallic minerals and in the chemical and petrochemical industry. In contrast, energy consumption rebounded in the transport sector over 2013-19.

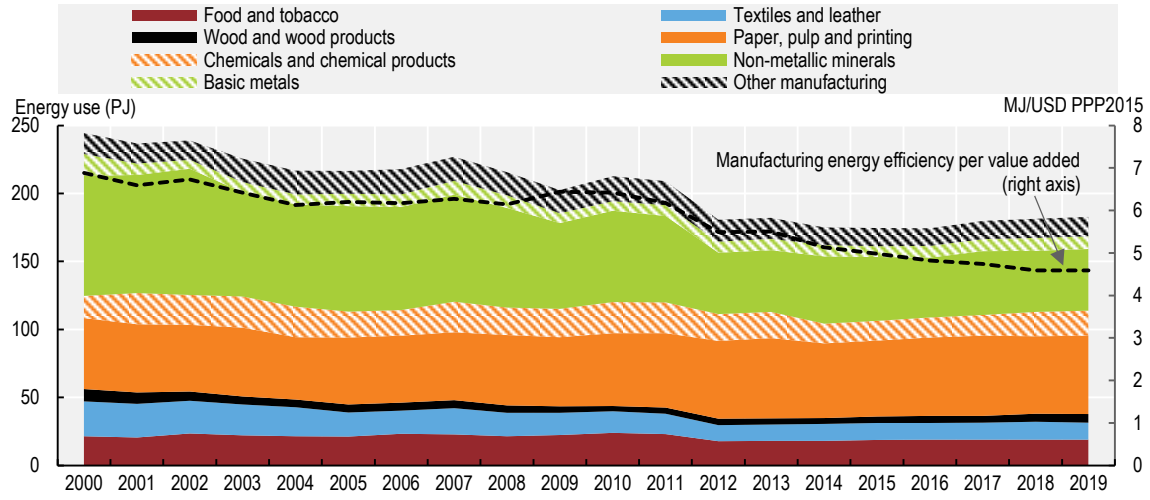
Further efforts will be required to meet 2030 targets, as Portugal committed to reduce its final consumption to 14.9 Mtoe (from 17.1 Mtoe in 2019 and 15.0 Mtoe in 2020), which the European Commission deems modest. Without information on how individual measures will affect energy consumption, it is impossible to assess whether they will suffice to put the country on track to meet its targets (EC, 2020a). The new EU objectives for 2030 calls for more ambitious commitments and accelerated action, particularly for building insulation.

General energy efficiency programmes have been launched to finance projects, mainly in the energy sector. The Portuguese government also created an Energy Efficiency Fund to promote behavioural changes in diverse areas. Between 2012 and 2018, this fund contributed to 20 calls for project by EUR 14 million. It is now integrated into the Environmental Fund.

The industry sector has reduced its energy consumption by 17.5% over 2010-2020, notably driven by strong policy incentives. Energy intensive industries (with an energy consumption exceeding 500 toe per year) are subject to the EU ETS. They must also conduct an energy audit every eight years followed by a plan for optimising energy use. Industries validating an agreement to rationalise their energy consumption are notably exempt from ISP.

Still, they are two reasons why industry uses less energy. Apart from energy efficiency progress, notably in the chemical industry, some sectors like textile and construction have a reduced value added following the 2008 financial crisis. The value added of the cement industry fell due to the 2008 crisis and its production volume has more than halved in less than a decade. In 2019, aggregate manufacturing production far outreached its pre-recession crisis level, while reducing its energy use by 19.4% compared to 2007 (Figure 2.9).

Figure 2.9. Manufacturing sectors have improved their energy efficiency



Source: OECD (2022), Industry Sector Detailed Data and Indicators (database).

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Energy consumption from the residential sector, which made up 16% of final energy consumption in 2019, has not been substantially reduced; it is at the same level of energy consumption as in the late 20th century. Two-thirds of the building stock was built before any energy efficiency requirement existed (IEA, 2021a). Dwellings appear more degraded than in the rest of the Union. A larger share of people lives in a dwelling with a leaking roof, damp walls, floors or foundation, or rot in window frames or floors (25.1% of people in Portugal and 14.8% in the European Union in 2020). More generally, 23% of dwellings that have undergone an energy performance review suffer from low energy efficiency (classification E or F);12.3% are very efficient (MAAC, 2021).

Portugal has taken measures to fight energy poverty (Section 2.3.1) and to ramp up energy efficiency. Following EU legislation, the performance of every building is audited when it is constructed, bought or leased. New buildings must comply with minimum energy performance standards. Furthermore, with funding from the EU, the European Investment Bank and the Council of Europe Development Bank, the Financial Instrument for Urban Renovation and Revitalisation provides co-financing for loans supporting deep renovation of buildings that are older than 30 years (EUR 1.4 billion budget over 2015-2025) (IEA, 2021a). The Recovery and Resilience Plan also notably aims to double the rate of renovation in buildings by 2025. It dedicates EUR 300 million to the improvement of energy efficiency in residential buildings with a programme that refunds part of household works (EUR 135 million) and offers efficiency vouchers (Section 2.3.1) and support to collective self-consumption and energy communities (EUR 35 million).

However, these programmes fail to substantially improve the energy efficiency of either dwellings or buildings, which calls for more resources. Generally, allocated funds fall short of the estimated EUR 110 billion of investment needed (EUR 3.7 billion per year on average), even with the lower estimate of a 15% coverage by public entities. Remaining costs for households are high (CNADS, 2022). It is also crucial that allocated funds are well-distributed for energy efficiency work. Public education, decentralised information available in local communities and training of workers, as planned in the project of a strategy against energy poverty will be key to avoid deadlocks.

Mitigating GHG emissions in transport

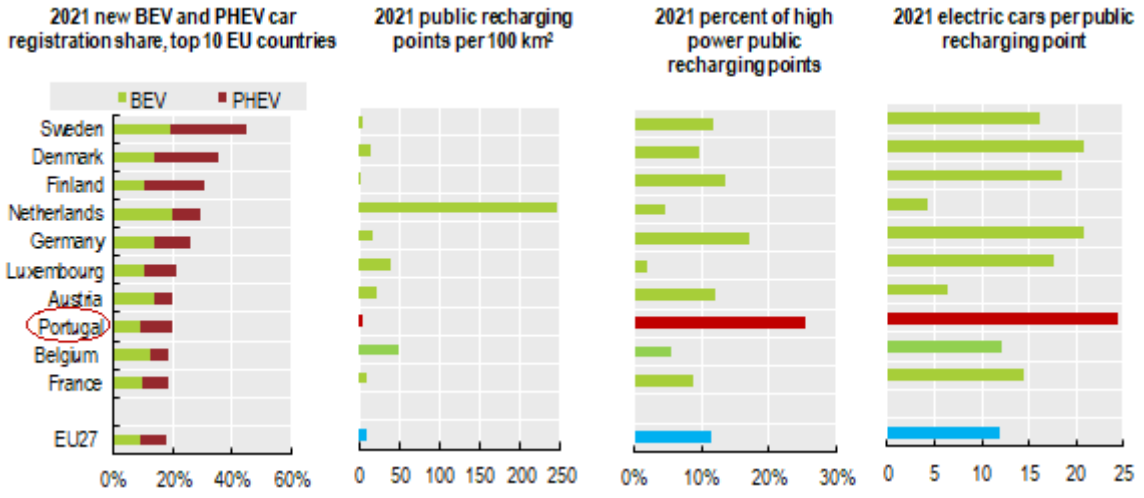
Emissions from the transport sector are at odds with Portugal's climate objectives. They grew steadily from 2013, together with the number of vehicles, until the COVID 19 pandemics halted the trend in 2020. The emission intensity of the sector (in tCO2 per unit of GDP) is high compared to other EU countries, even to south European countries such as Spain, Italy or Greece.

The vast majority (95%) of these emissions come from the road transport, which has been at the centre of the government's strategy to decarbonise the sector. Taxation is a main lever to green the vehicle fleet and discourage the use of emitting fuels. However, fuel and vehicle taxation did not reverse the growth in GHG emissions from road transport (Chapter 1). Closing the tax gap between diesel and petrol, and removing the preferential circulation tax treatment for older vehicle would help to rejuvenate the fleet and steer towards cleaner vehicles.

Since the mid-2010s, new car registrations have shifted to petrol and, in recent years, EVs and plug-in hybrid electric vehicles (PHEVs). The NECP estimates that electricity should cover more than 30% of transport demand in 2030 and 100% in 2050. Portugal promotes EVs through subsidies (EUR 4 000 in 2022 for light passenger vehicles up to EUR 62 500) and vehicle tax exemptions as well as investment in charging infrastructure. In 2021, the shares of EVs and PHEVs in new car registrations (9% and 11% respectively) were above the EU average (Figure 2.10).

However, EVs and PHEVs only make up 1.7% of the car fleet, far below the objectives for 2030 (EAFO, 2022). Direct support for the purchase of an electric passenger car (EUR 5.2 million planned from the environmental fund in 2022) is low compared to the needs. Portugal is also among the countries with the lowest number of charging stations per square kilometre. It should avoid deadlock by promptly stepping up deployment of charging equipment across the country. Large investments for the deployment of charging stations across the countries are included in the NECP. Portugal expects 15 000 public recharging points to be available by the end of 2025, compared to more than 5 000 in September 2022 (EC, 2021b; MOBI.E, 2022).

Figure 2.10. EV registrations are increasing but lack of charging stations risks creating deadlock



Note: BEV: battery electric vehicles; PHEV: plug-in hybrid electric vehicles. New car registrations fell by 35% in 2020 due to the COVID-19 and increased only slightly in 2021. High power recharging point: with power output higher than 22 kW.
Source: EAFO (2022), European Alternative Fuels Observatory.

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The Portuguese government must anticipate the potential impact on public finance of ramping up of EV among the national car fleet. The case of Norway (OECD, 2022b) shows the simultaneous increase of tax exemptions for low-carbon vehicles and decrease of tax revenue from excise duties on oil products can deter public finance. It can also lead to unwanted consequences such as increased congestion. In Portugal, fuel and vehicle taxes made up 4.7% and 1.6% of total tax revenues in 2020. Shifting to distance-based taxation would help to address the loss of fuel tax revenue (Chapter 1).

Portugal needs to reverse the trend towards increasing energy consumption in the transport sector, in parallel of emissions. To that end, it should reduce use of individual vehicles that rebounded after the 2008 crisis. Encouraging a greater use of public transit is a major lever, even more as it makes up a relatively small share of inland transport: trains covered only 5% of land passenger transport in 2019 compared to 8% in the European Union (Eurostat). Public transport also covered 13% of freight compared to 18% in the European Union. Efforts to ramp up public transport should include major infrastructure investment to improve coverage of the territory and the quality of these transport (Chapter 1). The Recovery and Resilience Plan includes EUR 967 million for their development, particularly expansion of Lisbon and Porto metros, and decarbonisation of public transport.

Land management could reduce car dependency and decrease the carbon impact of cities. The NECP embraces sustainability criteria and measures to contain expansion of urban areas and to limit soil sealing or revitalise urban centres. Local climate plans, mandatory under the Climate Law, are opportunities for municipalities and local governments to encourage use of active mobility and reduce urban sprawl that might increase car dependency. The National Strategy for Active Cycling Mobility aims to increase bike lanes by fivefold by 2030 (from 2 000 km in 2018 to 10 000 km in 2030).

International navigation and aviation represent 3% and 4% of Portugal's GHG emissions, respectively. Although they are not included in the national inventory total, these emissions increased by 51% over 2013-19. Flights within the European Economic Area are covered by the EU ETS but incentives to reduce emissions are not sufficient and the European Commission has proposed to remove fuel tax exemptions for the aviation and maritime sectors. In 2021, Portugal introduced a EUR 2 ticket tax on passengers travelling by air and sea. However, its rate is low by EU standards and it could better reflect the climate effects of the flights taxed (Chapter 1). The development of alternative fuels, and more particularly hydrogen, will be key to reduce emissions from international aviation and navigation at the EU level. Meanwhile, international shipping firms like Maersk have been developing new vessels to use biomethane as soon as 2024-2025. This calls for a quick adaptation of ports and infrastructure.

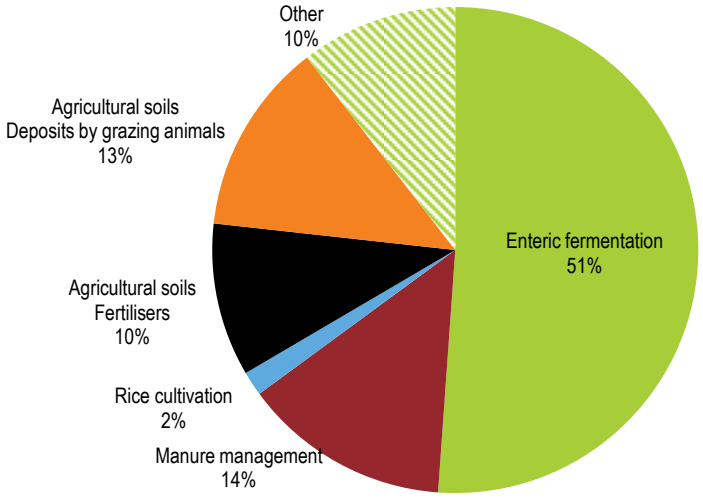
Mitigating GHG emissions in agriculture and promoting carbon sequestration in agriculture lands

Agriculture accounts for 12% of emissions, 2.3% of the country's gross added value and 3.2% of employment. Most of these emissions come from animal breeding, either from enteric fermentation, mainly from bovine livestock, or, from deposits of grazing animals on pastureland (Figure 2.11). Agriculture and agriculture land have the potential to abate emissions and capture carbon and are therefore key components of Portugal's strategy to net zero.

However, Portugal is not on track to meet its objective for 2030 (Table 2.2). GHG emissions from agriculture have increased since 2005, notably driven by the increasing number of animal heads (Figure 2.1). Major efforts are needed to reduce emissions related to the livestock sector and agriculture soils. In parallel, the NECP projects a strong use of grasslands as a carbon sink as early as 2030 (Table 2.3).

Figure 2.11. Most emissions from agriculture in Portugal come from the livestock sector

Breakdown of GHG emissions by the agricultural sector, 2020



Source: APA (2022), National Inventory Report 2022, April.

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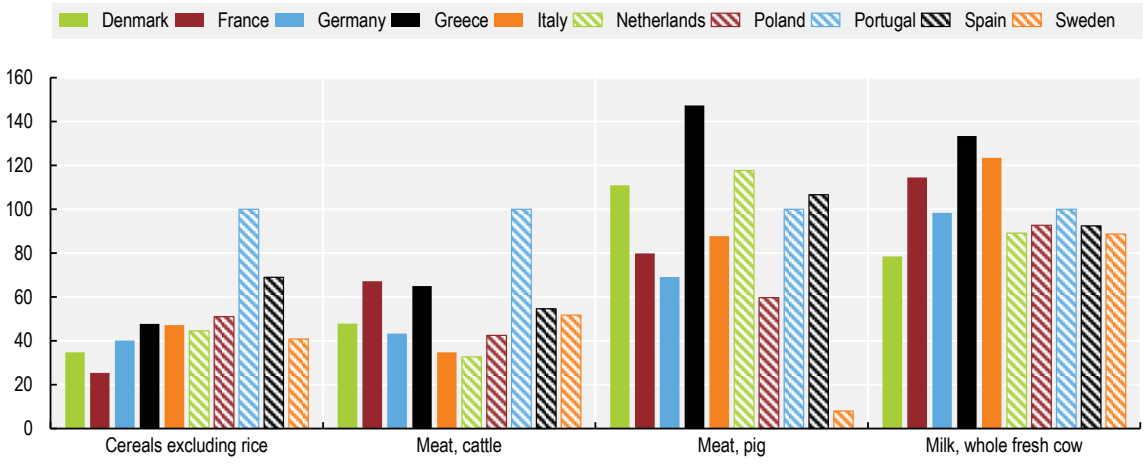
Portugal's agriculture products are more emission intensive than in most countries (Figure 2.12). This is especially the case for grains (excluding rice) and meat cattle, the largest source of GHG emissions from agriculture in the country. In this latter sector, emissions have grown since 2013. This is, driven by the small rebound in the number of heads and the constant increase of emissions per meat produced since the late 1980s. Meanwhile, organic farming has been gaining momentum in Portugal, as dedicated supports (for conversion and maintenance) cover 18% of the agricultural surface in 2021-2022. This represents a significant jump from 7% in 2020. It also puts the country on track for its domestic objective of 19% by 2030 (as the EU-wide objective European Green Deal is 25%).

Portugal's agriculture policy, including for climate change mitigation, is embedded in the EU's Common Agriculture Policy (CAP), of which the next programming period will cover 2023 to 2027. The country's CAP Strategic Plan, approved by the European Commission, has a EUR 6.6 billion budget (of which 9% is national co-financing). EUR 1.1 billion is reserved for environmental and climate objectives under rural development (EC, 2022c).

So far, agricultural policies have not been up to the climate change mitigation challenge. Compared to the EU average, a larger share of Portugal's support to agriculture is dedicated to climate and the environment. Few actions support the mitigation of agriculture emissions and specifically target livestock. In addition, the country has among the highest share of coupled supports (i.e. proportionate to production or the number of animal heads), targeting mainly ruminants and incentivising livestock-intensive farming. The proportion of land used for climate purpose (e.g. carbon sequestration) is low and the budget dedicated to land restoration is below the average on the continent. Finally, the clauses on the reduction of food waste and promotion of healthy diets in the 2021 Climate Law (article 56) could reduce the environmental footprint of agriculture. Theycall for concerted efforts to build a detailed and broad strategy with stakeholders belonging to all parts of the supply chain.

Figure 2.12. Portugal has margins to reduce the emission intensity of its main agriculture products

GHG intensity of agriculture products (CO_2e/kg) relative to Portugal (Portugal=100), 2017



Source: FAO (2022), FAOSTAT (database).

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Table 2.3. Projected emissions from agriculture and lands induce a reverse in current trends

Inventoried and projected emissions from AFOLU in $MtCO_{2e}$

	Level of emissions (in $MtC0_2e$)	Evolution in $MtCO_2e$				
		Observed 2010/2020	With existing measures		With additional measures	
	2020		Projected 2020/2030	Projected 2020/2050	Projected 2020/2030	Projected 2020/2050
Agriculture	**7.0**	**0.4**	**-0.2**	**-0.1**	**-0.4**	**-0.6**
Enteric fermentation	3.6	0.2	-0.1	0.0	-0.2	-0.1
Manure management	1.0	0.1	0.0	0.1	0.0	-0.1
Rice cultivation	0.1	0.0	0.0	0.0	0.0	0.0
Agricultural soils*	2.2	0.2	-0.1	-0.2	-0.2	-0.3
Other	0.1	0.0	0.0	0.0	0.0	0.0
LULUCF	**-6.8**	**2.1**	**-3.9**	**-6.2**	**-5.1**	**-7.5**
Forest land	-9.2	1.8	-4.0	-6.7	-4.0	-6.7
Cropland	0.6	-0.1	-0.2	-0.2	-0.2	-0.2
Grassland	0.1	-0.6	0.3	0.5	-0.9	-0.8
Other	1.7	0.9	0.0	0.2	0.0	0.2

* Nitrous oxide from agriculture soils notably resulting from nitrate fertiliser use.
Note: LULUCF = land use, land-use change and forestry. AFOLU = Agriculture, forestry and other land use.
A negative level of emissions means that additional carbon was sequestrated.
Source: APA (2022), National Inventory Report 2022, April; APA (2021), Emission projections.

Climate plans for 2030 do not include impactful measures for agriculture and even less so for livestock. Despite ambitious targets for the climate performance of agriculture in the RNC 2050 and the NECP 2030, details on implementation are lagging. A strong and legitimate focus is put on carbon capture and on-farm energy generation, but the country lags in emissions abatement measures in agriculture. The national plan for the future CAP has small ambitions for supporting on-farm practices and investments to abate GHG emissions (EC, 2022d).

Only strong and prompt action would help Portugal achieve its climate targets and revert the increasing trends of agricultural emissions. More particularly, there is a strong potential to reduce methane emissions from livestock breeding. Measures could include improved management of manure and cattle housing or culture change. These might require substantial on-farm investment from a population with a smaller income than average and exposed to climate risk (EC, 2020b). In many cases, these investments should be supported by a public fund, taking care to avoid credit-related risk. These supports can take the form of credit support, subsidies or guaranteed payment related to the benefits of the investment for the public. In the longer term, Portugal could promote result-oriented subsidies for ecosystem services in the CAP instead of payments based on land area. This would enhance ecosystem services, and particularly carbon sequestration, in agriculture lands.

Portugal has the potential to improve farmers' livelihoods and decrease GHG emissions by developing in-farm renewable energy (sustainable biofuels, cogeneration or biogas). A broad strategy, such as mentioned in the 2021 Climate Law, should ensure the environmental sustainability of projects by avoiding unwanted pollution, and avoid the use of food crops. In parallel, the market should ensure a profitable environment for developing the market for sustainable biogas, notably through adapted legislation and grid connexions. Dialogue with stakeholders will be key.

Demand-side measures that promote low-carbon diets could help achieve targets by reducing the need for livestock production, but also enhance public health and food security. The 2021 Climate Law enshrines the principle of aligning food taxes and incentives to their social costs. However, it does not provide details on the considered tax or implementation of such a tax system (article 56). Reducing food waste is also a major lever for lowering the impact of agriculture production. In 2018, Portugal launched a comprehensive

strategy for combatting food waste, covering all segments of the supply chain. However, results are so far lagging, notably due to lack of agreements of stakeholders on guidelines (CNCDA, 2021).

Mitigating GHG emissions from waste and wastewater

Portugal has the highest share of waste emissions in the OECD (Figure 2.1). More than three-quarters of these emissions came from solid waste disposal. This is due to the high volume of municipal waste generated per capita and the high share of waste sent to landfill (Chapter 1).

The NECP projects that the sector will meet its 2030 target (Table 2.2). It assumes that Portugal will comply with the EU Landfill Directive, which limits the share of municipal waste landfilled to 10% by 2035 (from 53% in 2020). However, this requires much faster progress than has been made in the last decade. Instruments to reach this objective are still unclear.

New circular economy strategies and projects could reduce emissions from the waste sector and should be accelerated. The strategy for a circular economy aims to drastically reduce the amount of waste produced by the Portuguese economy, from producers to consumers. This will cut both their direct emissions, particularly with the strategy for reduced food waste, and the indirect emissions generated by their management. Revision of the Urban Waste Water Treatment Directive will probably support measures reducing GHG emissions from treatment plants. It is expected to implement stricter rules to smaller agglomerations (now not affected by the directive), promote energy efficiency and prevent leaks.

The potential of bioenergy from waste is still to be harnessed. It amounts for 0.6% of the capacity of renewable energy but could be ramped up to produce biofuels (biomethane) and help decarbonise the transport or residential sectors.

2.4. Policy framework and measures for climate change adaptation

2.4.1. Risks related to climate change have increased in Portugal

Climate change will strongly affect Portugal's environment

Mainland Portugal's position alongside the Atlantic Ocean and close to the Mediterranean Sea puts it amongst the most exposed territories to climate change in Europe. The mainland territory has an overall Mediterranean climate, with rainy winters and dry summers, while the south has the hottest summers. The inland's climate has drier winters than the rest of the country, due to the influence of the Iberian climate.

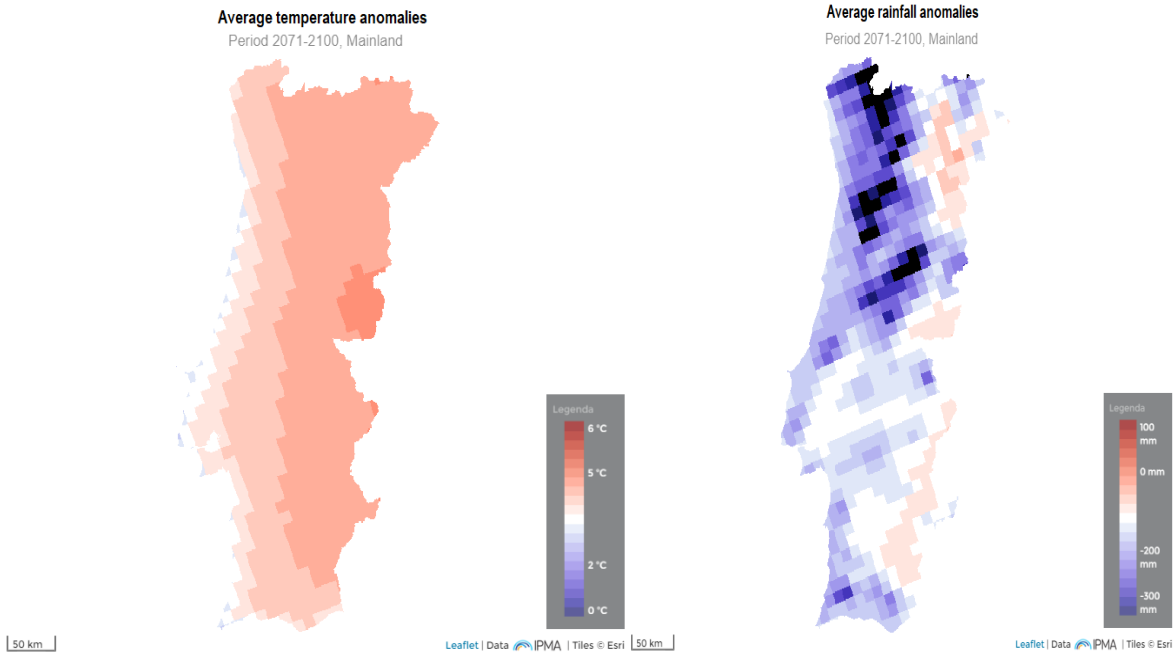
Portugal will likely experience increased average and maximum temperatures, rising sea and more frequent extreme events. Indeed, these impacts are already apparent (Table 2.4). The Intergovernmental Panel on Climate Change projects that if the world succeeds in limiting global warming to 2°C by 2100, temperatures in Portugal would increase by 2-3°C beyond pre-industrial levels by then, with an increased number of very hot days, especially in the southern inlands. More intense and longer heatwave will hit the country more often (Government of Portugal, 2021b), as the number of hot days is expected to double by 2030 (IPMA, 2016). Temperatures have already increased and regularly exceeded the maximum temperatures of the fourth quarter the 20th century (Figure 2.13).

Precipitation is expected to become more erratic and less frequent. Average annual precipitation has already decreased by approximately 15 mm per decade since the 1970s (World Bank Group, 2022). Over the last two decades, rainfall has been particularly low in mainland Portugal. It can be reduced by up to 10-50% by the end of the century, following current emission trends. Periods of drought are to be expected, as well as extreme precipitation and an extended dry season (Government of Portugal, 2021b).

These hazards are expected to be severe but heterogeneous across the territory depending on latitudes and according to proximity to the ocean (Figure 2.13). Notably, the southern inlands will suffer the most

from very hot days. The temperature rise in the Autonomous Regions of the Azores and Madeira is expected to be more subdued than in mainland Portugal (Government of Portugal, 2021b). Regions alongside the Atlantic Ocean will be relatively less affected by increasing temperatures. However, they will have to cope with coastal erosion of which climate change is a major driver. Sea-level rise is expected to reach 0.5 m by the end of the century (even exceeding 1 m above 1990 levels in some estimates). This will increase the risk of salinisation of coastal areas and coastal erosion (Government of Portugal, 2021b). The disruption of wave directions and storm regime, drought and the reduced provision of sediments from rivers to the coast further contribute to the shoreline retreat.

Figure 2.13. Climate change impacts differ across the Portuguese territory



Note: Anomalies compared to observed data in 1971-2000 for 2071-2100, RCP8.5 scenario (high GHG emission scenario by the IPCC). Regional and global model Ensemble.
Source: Climate Change in Portugal Portal, http://portaldoclima.pt/.

Table 2.4. Current and projected impacts of climate change in Portugal

Observed and projected changes relative to 1995-2014 observed data

	Observed change 2014-21	Projected change 2028-32	Projected change 2048-52	Projected change 2090-2100
Mean temperatures	+0.4°C	+0.6°C	+1.2°C	+2.0°C
Maximum temperature	+0.8°C	+0.7°C	+1.3°C	+2.3°C
Nb of hot days (>35°C)	-	+6.1	-	+19.1
Precipitation	-128.1mm	-179.9 mm	-215.5 mm	-257.8 mm
Number of consecutive dry days	-	+5.8	-	+17.5

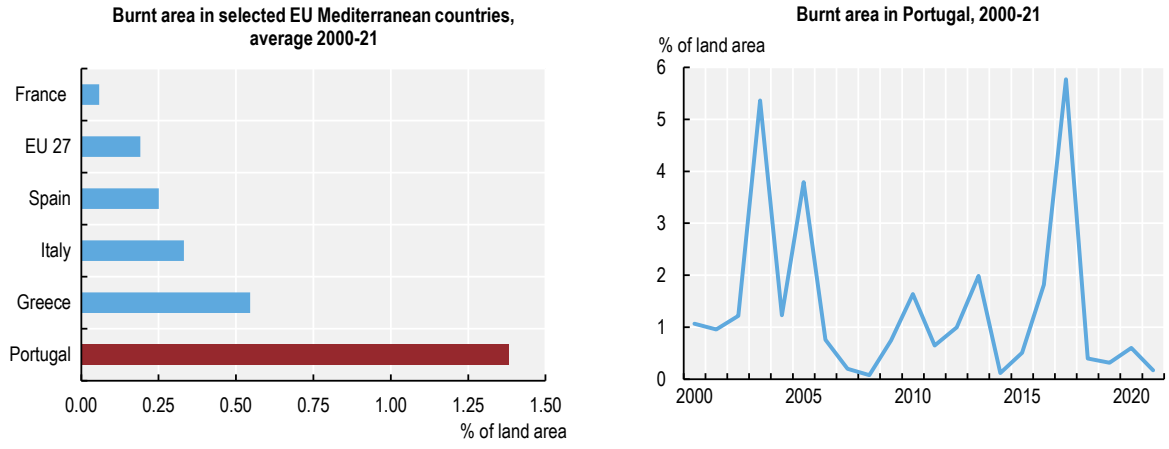
Note: Projections are based on a SSP2-4.5 scenario as defined by the IPCC ("middle-of-the-road" scenario).
Source: World Bank Group (2022), Climate Change Knowledge Portal.

These new climate conditions negatively impact Portugal's natural environment. As precipitation is reduced with a higher variability, water resources have become increasingly scarce, threatening the recharging of aquifers and weakening water flows. In future, major rivers of the Iberian Peninsula could run dry. This could accelerate biodiversity loss and desertification (i.e. land degradation in drylands) in Portugal. Between 2016 and 2020, soil moisture in croplands was 3.3% below the average of 1981-2010 (Maes et al., 2022). The year 2022 has been particularly dry. Volumes stored in reservoirs and groundwater could not be replaced, calling for extensive measures, including abstraction quotas for hydropower generation and irrigation (Government of Portugal, 2022b).

Heat and drought are accelerating soil desertification particularly in southern regions. Such phenomena induce soil degradation, salinization, loss of organic carbon and biodiversity loss. In Portugal, desertification intensified and spread in the last decade. In the future, the risk of aridity might affect most of the country's land in case of an extreme 4.3°C warming scenario[4] (ECA, 2018).

These environmental conditions also increase wildfire hazard. Intense heat and strong winds facilitate the spread of the wildfires, affecting biodiversity and accelerating land erosion, particularly in the northern and central parts of the country. Mainland Portugal experienced its most extreme forest fires in recent decades (Figure 2.14). The areas burnt reached unprecedented levels, even compared to other south European countries, in 2003, 2005 and 2017 (in which year at least 66 people were killed). Between 2017 and 2021, nearly 1.5% of the country's area burnt. This makes Portugal the country most affected by wildfires in Europe and sixth-affected globally (behind Australia, South Africa, Brazil, India and Colombia). Nearly three-quarters of its tree-covered area is exposed to very high or extreme fire danger (Maes et al., 2022). The country also went through intense wildfires in the summer of 2022, although less intense than those experienced by neighbouring countries like Spain or France.

Figure 2.14. Portugal has been the EU country with the highest share of burnt area in the last decades



Source: Maes et al. (2022), Monitoring exposure to climate-related hazards: Indicator methodology and key results.

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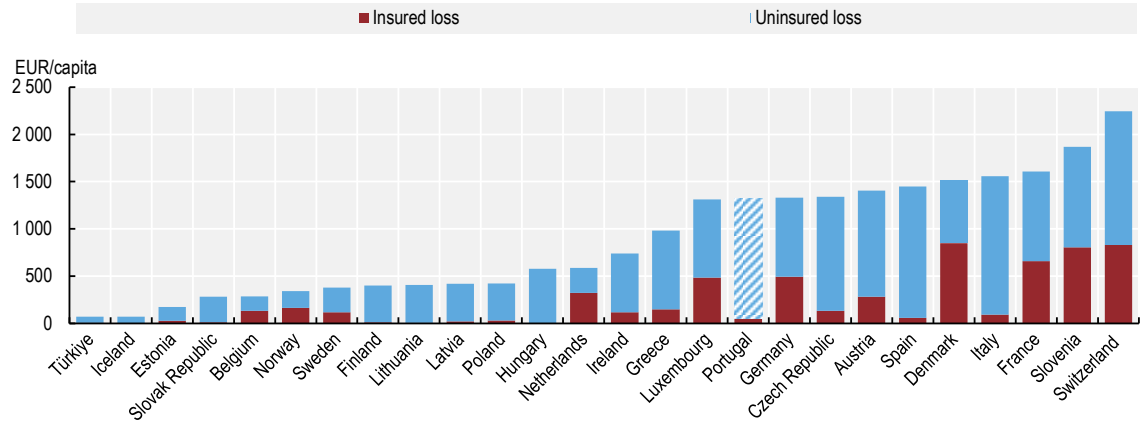
All these factors combined to disrupt environmental balance, putting biodiversity at risk due to climate change. Changes in precipitation, temperatures and soil quality lead to fragmentation of species' habitat and the spreading of invasive species as biodiversity is already in poor condition in Portugal (Chapter 1).

A drop in Portuguese well-being is expected if the country does not adapt to the new context

Without adaptation measures, climate change will strongly undermine the well-being of the Portuguese population. Southern European countries will face a large range of these impacts and are the most affected within the European Union: if no adaptation or mitigation measures are taken, the welfare cost would amount to 2.9% of the region's GDP by the end of the century (compared to 1.8% for the whole European Union). This is mainly related to additional energy costs and health issues (Ciscar et al., 2014).

A precise estimate of the overall economic loss related to climate change in Portugal is challenging; figures are scarce and largely uncertain. This is related to the difficulty of attributing damages to climate change, but also to the scattered consequences of climate events, which makes gathering all information a challenge. Using insurance data and local experts, the European Environment Agency estimated that extreme weather or climate events caused the loss of EUR 13.5 billion to the Portuguese economy and 9 267 deaths (EEA, 2022a). Only 3.6% of damages are insured (Figure 2.15). Portugal also estimated that costs induced by forest fires amounted to EUR 60-140 million yearly and those induced by severe drought to EUR 290 million in 2005 and EUR 200 million in 2012.

Figure 2.15. Few economic losses related to extreme weather and climate events in Portugal are covered by insurance



Note: 1980-2020.
Source: EEA (2022), Economic losses from climate-related extremes in Europe.

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Key elements of Portugal's economy and welfare are exposed to climate change impacts

Large parts of the population and the economy are exposed to the impacts of climate change. Notably, infrastructures and people are exposed to heavy rainfall in the coastline regions where three quarter of the population and 85% of the economy concentrates.

The tourism industry, a major economic driver, may need a thorough overhaul to adapt to new conditions. Portugal is among the European economies most reliant on tourism that is threatened by climate change. The acceleration of tourism from 2010 helped the country recover from the 2008 crisis, as the number of tourists nearly doubled in the following decade. It directly and indirectly accounted for 15% of the GDP and 18% of employment in 2019 (including 9% of direct employment) (IMF, 2022b). As a large majority of tourists stay in coastal areas, rising sea levels and coastline erosion will be a challenge for the industry and a threat for the overall economy. Biodiversity loss and water scarcity damaging the landscape can also undermine inland tourism.

Changes in the natural environment already strongly affects agriculture, forestry and fisheries with lasting effects. Agriculture (2.2% of GDP) will also have to adjust to less precipitation, weather variability, extreme events, desertification, emerging disease and the change in overall climate conditions that can severely impact some cultures. Portugal's cropland productivity will suffer the most from drought among EU countries with 61% of cropland affected (EEA, 2022b). A large part of Portuguese crops is also dependent on irrigation. Estimates from the third River Basin Management Plans show an increase of about 25% in agricultural water abstractions since the mid-2010s, particularly in the southern regions. Irrigated areas increased by 21% over 2009-19 (Chapter 1).

Finally, the increasing number of fires and the spreading of exotic species and plague endangers the forestry economy, which accounts for 10% of total exports (ICNF, 2020). Timber harvesting is also made difficult with forest fires and the induced age variability between trees within the same parcels, as younger trees in burnt areas mix with older vegetation that survived (APA, 2020).

People's health will be affected, and Portugal's ageing population is particularly vulnerable. Increased heat, biodiversity changes and floods worsen both morbidity and mortality. The impact on health is aggravated

by an ageing population, due to increased life expectancy (from 78.4 years in 2004 to 81.8 years in 2019[5]), lower birth rates and emigration. Notably, extreme temperatures kill and generate new pathologies (respiratory, cardiovascular, renal failure). The number of deaths related to climate change might double in the European Union by the end of the century if emission trends persist (+100 000 deaths per year on the continent), with most deaths occurring in central and southern EU (Ciscar et al., 2014). As an illustration, the 2003 heatwave that stroke all Europe caused an excess of mortality of 38% during the summer relative to other years in the same period (which translates into 1 316 excessive deaths) (Nogueira et al., 2005).

Climate change puts at risk the country's energy system and its capacity to reach net zero emissions by 2050.

New climate conditions undermine the country's capacity to meet its objectives for the deployment of renewables. Energy demand is expected to increase in all countries of the southern European Union (+8% in average) by the end of the century. This calls for further renewable generation (Ciscar et al., 2014), but the potential of some renewables is at risk. Indeed, water scarcity weakens the capacity of hydropower, which covers 5% of Portugal's total energy supply. In the case of a 2°C warming, the hydropower potential would be reduced between 10% to 20% (Hoegh-Guldberg et al., 2018; Fortes et al., 2022). In 2022, drought caused officials to close five hydropower power stations. However, details on how the government considers the reduction of water availability in its climate change mitigation are unclear.

Forest fires are directly responsible for CO_2 emissions while compromising forests and soils' capacity to sequestrate carbon. The net-zero objective described in the RNC 2050 entails that carbon sequestration in forest land is doubled from 2020 to 2050. However, the rate has not substantially increased for three decades and, in fact, has been slowly decreasing. In 2017, the massive forest fires made forestry a net carbon emitter by a nearly similar amount of carbon that it usually sequestrates (7 Mt CO_2).

Climate change can also affect the relative cost-effectiveness of different renewable sources like photovoltaic and offshore wind (Fortes et al., 2022). This calls for the integration of thorough climate scenarios into strategic energy plans. Finally, the difficulties faced by the wood industry because of climate change (fires, pests), can undermine the potential contribution of biomass in the decarbonisation of the energy sector (Casau et al., 2021) (Section 2.3.2).

Table 2.5. Portugal's exposure and vulnerabilities to climate change

	Portugal	OECD average	Year
Tourism as a share of direct employment in total employment	9.8%	7.1%	2016
Share of the primary sector in the economy	2.2%	2.5%	2018
Share of agriculture in employment	3.2%	4%*	2020
Population exposed to one or more hot days [Tmax > 35°C]	37.5%	45.2%	2020
Built-up areas exposed to coastal flooding 2010-20	0.2%	1.4%	2020
Population exposed to at least one storm event	56.2%	34.8%	2020
Tree-covered land exposed to wildfire	74.1%	15. 8%	2020
Population over 65 years old	22.7%	17.8%	2021
Projected population over 65 years old	26.5%	20. 9%	2030
Hydroelectricity in the total energy supply	5.3%	3.2%	2020
Renewable energy in electricity production	58.2%	46.4%	2020
Irrigated land as a share of agriculture land	14.5%	..	2019
Land equipped for irrigation as a share of agriculture land	14.6%	11.4%*	2020

*EU 27 average.

Source: Maes et al. (2022), Monitoring exposure to climate-related hazards: Indicator methodology and key results; OECD (2021), OECD Economic Surveys: Portugal 2021; EC (2021), Portugal: Agriculture statistical factsheet; FAO (2022), FAOSTAT (database).

2.4.2. Portugal has ramped up its strategy to adapt to climate change

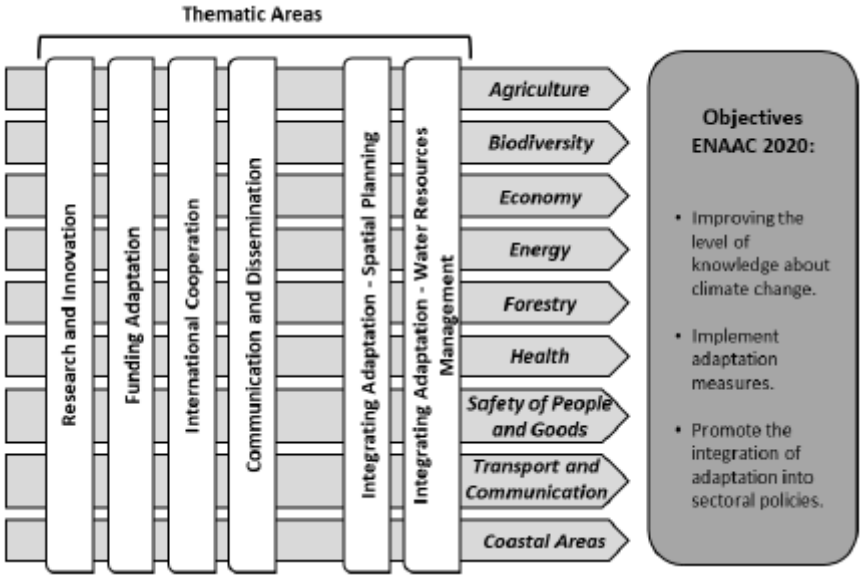
The Ministry of Environment and Climate Action is at the centre of the institutional framework for adaptation

The CAC, headed by the minister, is responsible for Portugal's overall climate strategy, including for adaptation. The APA oversees monitoring action and assessing risks, and manages the working groups (Section 2.2).

Portugal's strategy for adaptation to climate change relies mainly on two structural documents:

The National Climate Change Adaptation Strategy (ENAAC 2020), adopted in 2015, is the update of the 2010 NAS. It establishes governance and responsibilities of Portugal for climate change adaptation and determines the main impacts and vulnerabilities. Its major goals are to improve knowledge on climate change; implement adaptation measures; and promote integration of adaptation into sectoral policies. The foundation of ENAAC for adaptation policies rests on working groups (Figure 2.16). They provide reports and recommend adaptation policies to the coordination group managed by the APA. A scientific panel also advises the co-ordination group.

Figure 2.16. Representative diagram of ENAAC's thematic areas and priority sectors



Source: Government of Portugal (2021), Portugal's Adaptation Communication to the United Nations Framework Convention on Climate Change.

The Action Programme for Adaptation to Climate Change (P-3AC), adopted in 2019, aims to implement the adaptation strategy on the territory. It defines nine priority areas and comprises the actions and budget for the short term. It also provides outcome indicators to monitor the action for climate change adaptation (Government of Portugal, 2021b). P-3AC ensured the funding of public actions for adaptation until 2020 with EUR 372 million. Most of its fundings (96%) came from the Rural Development Programme (PDR) and the Sustainability and Resource Efficiency (POSEUR). Remaining funding came from the Environmental Fund (EUR 14 million).

Portugal will benefit from massive EU funds to scale up its action for climate change adaptation, but not all the P-3AC action lines will benefit. Portugal's Recovery and Resilience Plan includes more than

EUR 1 billion of grants and loans for the preservation of forests or water management. However, it fails to cover other P-3AC areas such as coastal protection or soil conservation. Addressing all priorities in the adaptation strategies will require sound and predictable funding for ambitious action.

Municipal and intermunicipal Climate Action plans are major elements of the country's strategy for adaptation to climate change. They are made mandatory under the 2021 Climate Law and to be delivered within two years. Regional development and coordination commissions, as well as metropolitan areas, must also build their own plans. In 2020, adaptation plans covered a vast majority of municipalities, including in Azores and Madeira. The first phase assesses local risks and needs for adaptation, while the second phase implements adaptation measures, for the coastline, water resources and nature conservation, among other areas.

Portugal's government must adjust to the induced devolution of adaptation measures by both empowering local governments and ensuring overall consistency. Local governments still have minor responsibilities, and the strategy does not have bottom-up processes that could ensure the effectiveness of the strategy. Municipalities are not required to monitor or assess their adaptation plans, although this would contribute to good practices. Furthermore, there is no statutory requirement for policy alignment between the municipalities, inter-municipalities, or sectors, although action in one area can impact vulnerability to climate change risk in others. In the case of coastal management, dozens of entities, local governments and administration share responsibility (Oliveira, Moura and Boski, 2020). Such co-ordination of local action could help enhance synergies, implement measures on a large scale and avoid conflicts of interest, notably regarding land or water use. Sectoral and inter-sectoral co-ordinations also seem to lag behind, although they are crucial for effective action (EC/EEA, 2022).

Box 2.2. Loulé: A pioneer municipality in local climate action

Loulé, a city of 70 620 inhabitants in Algarve region near Faro, has led ambitious climate action, illustrating the role municipalities can play for climate and the environment. Due to its location, Loulé is exposed to rising temperature, increasing sea level, water scarcity and periods of drought.

Loulé was among 26 cities to commit to AdaptLocal, a network of Portuguese municipalities working together for adaptation to climate change as early as 2016. Following the Climate Law, Loulé has defined the priorities of its Municipal Climate Action Plan and built governance to ensure the plan was operational. Notably, it created a council incorporating key stakeholders from civil society and public institutions like APA to monitor and discuss actions for climate. It also works in close co-operation with neighbouring municipalities. This collaboration is either direct for specific measures, or within the framework of the Inter-municipal Community of the Algarve for an intermunicipal plan for adaptation to climate change.

Loulé has been closely monitoring the impacts of climate change to address the challenge of adaptation. It launched a study on the future of sea levels and tides and the associated risks, with a focus on socio-economic vulnerabilities. A municipal observatory on the environment and climate also allows the gathering of information as open data for public and private decision-makers.

The city has taken strong actions to address the numerous challenges of climate change: mitigating the municipality's GHG emissions, adapting to climate change and protecting the environment. Water availability is a particular challenge in this region. The municipality has built a contingency plan for drought period to minimise the impact of scarce water and engaged for a more efficient water use. It encourages the production of renewable energy in public building and places, and allowed a school to be nearly self-sufficient for its energy. To protect its territory and biodiversity, it aims to create a UNESCO Global Geopark together with two neighbouring municipalities. The municipality notably suspended a tourist development plan in wetlands. Following this decision, it approved classification of the area as a local natural reserve in early 2022.

Source: Lemos (2021), Loulé approves the creation of the Foz do Almargem and Trafal Local Nature Reserve; Loulé City Council (2022), Notice of 7 February; www.louleadapta.pt/en.

The ambitious objectives for monitoring of adaptation measures calls for further resources

Monitoring adaptation measures is crucial for good implementation. The P-3AC defines indicators and result targets based on both coverage of measures (e.g. the share of municipalities with an adaptation plan) and the impact of climate change on human activities (e.g. reduction of cases of human diseases caused by vectors related to climate change). These indicators are used as a basis for the annual monitoring report on the P-3AC and gathered by the NAS co-ordination group together with the APA.

Monitoring of action shows good implementation of adaptation measures. Most municipalities have released their adaptation plan (271 of 308 in early 2022). The tracing of EU support shows large disbursements for Portugal's adaptation (notably EUR 1 745 million from the Rural Development Programme to agriculture and forestry) (EC/EEA, 2022).

However, monitoring and evaluation of measures and strategies is challenging. Municipalities do not report on their implemented action in a centralised way. The biannual report of ENAAC provides only qualitative information on progress tracking and P- 3AC indicators have not yet been updated due to lack of stable funding. The first evaluation of the P-3AC is due in 2022, three years after release of the plan. As a

comparison, the United Kingdom's adaptation plans have a five-year cycle, including several steps of monitoring and reforms based on quantitative indicators (OECD, forthcoming). The National Roadmap for Adaptation 2100, expected by the end of 2023, will update the projection of the physical and economic impacts of climate change and assess the impact of adaptation measures, using several climate and policy scenarios.

2.4.3. Actions for adaptation have gained momentum in Portugal

Public information on climate change risks has been substantially improved

Portugal has focused on dissemination of knowledge, fully integrating scientists in the governance system of the ENAAC (EEA, 2020). Information systems have been developed for people, companies and public entities to anticipate climate change. The Portuguese Institute for Sea and Atmosphere (IPMA) used regional climate models to assess the precise geophysical outcome of climate change in the country. Websites like Portal do Clima help disseminate information on vulnerabilities across the country. The IPMA presented 40 indicators on climate vulnerabilities on a single portal (portaldoclimat.pt), as well as real-time detailed information on wildfire risks. Extreme risk scenarios are also assessed to anticipate and protect infrastructure, notably for electricity or transport.

Risk assessment has been increasingly mainstreamed in public work projects, notably for infrastructure. Environmental Impact Assessment, implemented upstream of the decision of launching a project, includes a risk assessment related to climate change scenarios, as well as critical risk thresholds. Climate change is also increasingly factored into spatial planning as a factor of risk and opportunities. Meanwhile, the national programme for Spatial Planning Policies includes a guideline to promote adaptation. A specific ENAAC working group also focuses on the mapping of climate-related risk. The Portuguese Insurers Association and the Faculty of Science of the University of Lisbon, for instance, have developed a high-resolution mapping of flood risks and vulnerabilities in mainland Portugal (Garrett et al., 2014).

Integrating adaptation measures into sectoral strategies: Coastal management and agriculture

The government helps sectors to anticipate and cope with the impact of climate change. This is especially true of agriculture, tourism, buildings, energy and water management. Support measures include sectoral strategies for sharing knowledge and good practices to monitor and mitigate risk.

Coastal areas protection relies on efficient land use planning. Increasing the resilience of coastal zones against the risk of flooding and erosion is a major objective of Portugal's climate strategy and has been mobilising many national and local actors. So far, protection measures have been implemented, together with the rehabilitation of coastal system, the natural restoration of sedimentary transport, or even planned retreat of population an infrastructure. Nature-based solutions have been increasingly used. In Cascais (in the Metropolitan Region of Lisbon), for example, a waterbed restoration and greenway trail help reduce risks related to flooding, increasing temperatures and biodiversity loss.

Governance has also evolved to integrate coastal risks. Portugal has long implemented Integrated Coastal Zone Management in its planning process and complied with EU requirements (Oliveira, Moura and Boski, 2020). The National Planning Strategy includes development of a detailed mapping of hazards that would support local land use decisions and aims to align coastal plans to regional and municipal plans. However, coastal management must respond to multiple challenges (erosion, flooding, increasing sea level) with multiple authorities from municipalities to public administration such as the APA and the central state. The overlapping of authorities on coastal management adds complexity to processes and can stall risk-alleviating measures (e.g. vegetation cleaning processes or destruction of endangered onshore building) (Oliveira, Moura and Boski, 2020; Dal Cin et al., 2020).

The mainstreaming of adaptation measures in agriculture strategies and policies is vital for the sector, which is on the front line of climate change impact. It has been fighting land degradation and managing water scarcity for years to keep productivity high. These threats will amplify in the coming years, including the potential emergence of diseases or pests related to new climate conditions (Government of Portugal, 2021b). Addressing such turmoil will require strong on-farm actions, changes in long-standing practices (e.g. transitioning to mixed farming, agro-forestry or organic agriculture) and substantial investments (e.g. for precision agriculture) (UNDP, 2020). It will be even more challenging for an ageing and relatively poor sector.

The CAP, and more specifically, the Rural Development Plan (RDP), provides the main support for climate change adaptation practices and investment. Portugal has among the highest share of agro-environmental and climate measures (20%) in its RDP budget in 2020. It further plans to dedicate more than EUR 1 billion to such measures in 2023-27 (covering both adaptation and mitigation) (EC, 2022c). This will fund cultural system changes, water management and soil rehabilitation. In parallel, the sector has been developing R&D and notably supported the dissemination of risk information in rural areas.

Getting the private sector on board

Public and private entities have been working together on R&D projects to improve sectors' resilience to climate change, notably in agriculture. Private organisations also build their own instruments such as the Sustainable Tourism Plan 2020-23 for implementation of sustainable practices in tourism.

However, risk-sharing between public and private entities could be rebalanced. The role of private insurance regarding climate change risk is minor. The government and public authorities carry a large part of the risks related to climate change, despite strained public finance. Few losses and damages caused by extreme climate events are insured in Portugal (Figure 2.15). On the other hand, the government and the European Union provide public funds to compensate victims of disasters, notably through the EU Solidarity Fund. Between 2002 and 2017, Portugal received EUR 134 million from the EU Solidarity Fund (with grants amounting from EUR 3.9-50.7 million) to cope with flood and forest fires (EC, 2019). Such unconditional support to affected firms and households can prevent the take-up of private insurance or preventive measures, further weakening the role of the private sector in risk coverage.

2.4.4. Addressing the key challenge of wildfires

Portugal's forest is prone to catching fire because of a dry and hot climate in the summer and early fall. This caused land desertification and biodiversity loss, while undermining the potential of forests as carbon sink. The 2017 wildfires were unprecedented and prompted a strong response of public authorities and the overhaul of rural fire management in the country.

Human activity and poor land management partly explain the intensity of wildfires in Portugal. Most fire ignitions are due to human activity (Meira Castro et al., 2020). They are also more prone to occurring in mixed areas, where forests are close to urban areas or industries (Nunes, Lourenço and Meira, 2016).

Portugal's specific land pattern in rural areas amplifies the intensity of wildfires. Large parts of rural landscapes are poorly managed, if at all, because of unclear ownership. The ageing population in rural areas leads to agriculture land abandonment, specifically in northern regions, to the benefit of forest, grasslands and woody crops in the past decades. This enables the spreading of natural vegetation in sensitive areas and exacerbates the risk of rural fire (Nunes, 2012).

Moreover, the structure of forest land ownership deters consistent forest management that could reduce rural fire risks. A large part of forest land does not have any official owners: only 46% of forest properties have a cadastral delimitation, with 3% being publicly owned (compared to 40% in the European Union) (APA, 2020). Registered parcels are small and divided between 11.7 million different properties inscribed in tax registries. As a result, investment for land management is rarely profitable and large-scale action,

with possible economies of scale, is difficult. Scattered ownership also hampers the building of firefighting infrastructure or access to water. The number of owners associations aiming to make their land profitable with land management rules has been growing, only 27% of forests were covered by a long-term forest management plan in 2016 (compared to 96% in Europe).

The government has carried out a comprehensive strategy to address the multiple factors related to wildfire risk. It first dedicated substantial amounts to address the threat (34% of available funds in the P-3AC). Land management solutions (e.g. discontinuity bands or planting of fire-resistant species) have also been put in place to reduce the risk of spreading (Government of Portugal, 2021b). Furthermore, regulation to avoid fire ignition and reduce their impact has been increasingly stringent, putting rules on activities and built areas to limit fire ignition (Law N°114/2017- article 153). The government has improved its information system, documenting risk of fire and sharing daily monitoring reports with the public.

Portugal has also been implementing a prevention strategy to cope with the structural drivers of wildfire risk. Most additional funding for the fight against wildfire went to preventive measures, which now make up 45% of allocated funds (compared to 20% in 2017). Until 2017, short-term emergencies prevailed at the expense of prevention measures as public authorities dealt with immediate disasters (Collins et al., 2013). In 2021, the Recovery and Resilience Plan of Portugal included a EUR 615 million budget for forest management to prevent rural fires, including establishment of a cadastre and a land-use use monitoring system.

Recommendations on carbon neutrality

Improving the governance of climate policy

- Swiftly implement the Framework Climate Law. Clarify the measures envisaged to achieve the 2030 goals, quantify their mitigation impact and specify how they will be financed.
- Enhance public participation in climate policies by informing the public in advance of upcoming consultations and allowing sufficient time.

Aligning the economy with climate ambitions

- Align economic incentives to climate targets. Set clear milestones to phase out all fossil fuel subsidies by 2030, as committed in the Climate Law. Continue to protect vulnerable groups by shifting from energy price control to targeted income support measures uncorrelated to energy consumption, and by increasing investment in decarbonising buildings.
- Anticipate the labour market needs for green jobs, notably to address an increasing demand for energy renovation, by developing skills and facilitating immigration for workers with requisite skill sets.
- Support private investment for climate by providing long-term visibility to investors on future regulations and carbon prices, developing tailored sector-specific tools (e.g. auctions or third-party payment organisations in sectors where liquidity is strained).

Develop renewable energy sources on a cost-efficient basis

- Increase the use of auctions for renewable energy projects, with a technology-neutral approach. Consider requiring environmental indicators in public tenders to rule out projects with strong detrimental impact on natural capital.
- Encourage private renewable energy producers to sell their production on the grid by reducing the administrative and price barriers.
- Assess and monitor climate impacts on security of supply, including the volatility of hydro generation, as part of the annual security of supply monitoring report for the national electricity system.

Step up action for energy efficiency in buildings

- Accelerate and mainstream retrofitting works with a package of measures adapted to all households' configurations and specific instruments for households unable to contribute to the work such as direct grants or tax cuts. Facilitate access to existing supports, including with information, technical support and a dedicated platform putting actors together.
- Encourage deep retrofits by correlating supports to the energy consumption cut generated, adding premiums for packages of works, more efficient than dispersed measures.

Reduce emissions from vehicles and car dependency

- Continue supporting the purchase of low-carbon vehicles and phase out supports to older vehicles. Accelerate the deployment of charging stations for electric vehicles across the country, supporting their installation in remote areas as planned.
- Reduce private car use. Shift investment from new road building to improving the rail network. Integrate the reduction of private car dependency as a requirement for land and road management in municipal climate plans. Facilitate the access to services and activities by active mobility and public transport in cities.

Accelerate action for reducing GHG emissions from agriculture production

- Increase use of monetary incentives to enhance GHG emission mitigation and sequestration in agriculture. Consider introducing taxes based on the number and type of animals, and on fertiliser use. Mainstream payments for ecosystem services under the new common agricultural policy. Divert public support from emission-intensive activities in the agriculture sector (e.g. energy tax break or support coupled to animal heads).
- Develop a national food strategy encouraging sustainable diets through education campaigns and developing alternatives to meat-intensive diets in public catering, with the co-operation of local stakeholders. Make the fight against food waste a key pillar in this strategy.

Sharpen the country's adaptation strategy

- Improve the information system related to climate change adaptation policies to track their implementation and impacts on risks and exposure. Ensure stable funding to track the progress of the adaptation strategy on a yearly basis; assess the impact of policies on climate change risk.
- Enhance the value of rural lands for the mitigation and the adaptation to climate change. Accelerate development of the land cadastre in rural lands. Encourage the sustainable creation of value from rural land by extending payments for ecosystem services to all rural land, including non-agricultural lands, and setting the rule of a sustainable management of forestry resources by the energy sector and the industry.

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Notes

[1] In 2019, the measure cost EUR 112 million, with EUR 110 million to electricity tariffs and EUR 1.8 million to natural gas tariffs (MAAC, 2021[79]).

[2] This calculation was made using 2015 household budget survey, inflated by the 2015-20 evolution of energy prices (HCIP in Eurostat).

[3] Calculation from ERSE and IEA data.

[4] This global climate scenario, built by the IPCC, corresponds to the case where economic development in the 21st century is based on fossil fuels.

[5] OECD population data.

OECD Environmental Performance Reviews

PORTUGAL

Portugal managed to decouple several environmental pressures from economic growth over 2013-19. It played a leading role in the approval of the European Climate Law and adopted the Portuguese Framework Climate Law in 2021. This needs to be swiftly implemented to achieve carbon neutrality by 2050, improve climate resilience and protect ecosystems. Portugal has stepped up adaptation efforts but needs to do more to address multiple threats, including coastal erosion, floods, droughts and forest fires. The country is lagging behind in waste management. Meanwhile, the increase in freshwater abstractions in water-scarce southern regions is a concern.

This is the fourth Environmental Performance Review of Portugal. It provides an evidence-based assessment of the country's progress towards its environmental goals over the past decade. The 26 recommendations aim to help Portugal improve its environmental performance, giving special focus to carbon neutrality.

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