Energy Policy Review

Portugal 2026

INTERNATIONAL ENERGY AGENCY

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Executive summary

Thanks to steady expansion of hydropower, wind power generation and solar photovoltaics (PV) in recent years, Portugal has one of the lowest carbon intensities of electricity generation among IEA Member countries. Portugal is entering a mid-transition that requires managing two interconnected energy systems that are moving in opposite directions: one is based on renewables and electrification and must scale up rapidly; the other is a legacy fossil fuel system that must decline in an orderly way to avoid stranded assets and price shocks. Electricity is becoming the central pillar of energy security and the main driver of emissions reductions.

Portugal has established an ambitious direction for its energy transition through a series of strategic policy documents centred on the National Energy and Climate Plan (NECP). The NECP sets ambitious 2030 greenhouse gas (GHG) emissions reduction targets that aim to put the country on a pathway to climate neutrality by 2045. It also outlines measures to increase the deployment of renewable electricity and deliver broad end-use electrification. Portugal needs to translate its strategic objectives into co-ordinated delivery across all sectors. Although the NECP sets clear ambitions, the pathways for achieving these goals remain dispersed across separate strategies, regulatory reforms and funding programmes, which make it difficult to align investment planning, infrastructure development, workforce needs and consumer incentives. A national roadmap based on bottom-up sectoral agreements would integrate these efforts, increase transparency, and provide clarity and direction for public authorities, industry and consumers.

Maintaining social acceptance of the energy transition requires ensuring that the benefits of clean, efficient and affordable energy reach all people. In particular, low-income households, which are more exposed to high energy costs, inefficient housing and limited access to affordable, low-carbon mobility options, should be empowered to participate in the energy transition. This is especially important in Portugal, where energy poverty remains well above the European average. Although Portugal has a national strategy on energy poverty, many support programmes do not reach those the most in need. At the same time, electrification, digitalisation and expanded building renovations will require new skills and workforce redeployment. A people-centred approach is essential to ensure that affordability, access, consumer protection and workforce capacity are integrated into energy transition policies. Public support should be targeted to where it delivers the greatest benefit and drives broad participation in the energy transition.

With clear progress on decarbonising electricity supply, the next phase of Portugal's energy transition must focus on the electrification of transport, buildings and industry, which together account for most energy-related GHG emissions (82% in 2024). Electrification is expected to drive a notable increase in electricity demand, requiring a rapid expansion of renewable generation, primarily from solar PV (both utility-scale and distributed) and wind. As electrification accelerates, electricity will become the main driver of energy security. These developments require grids, markets and regulation to evolve so that renewable deployment, electrification and system flexibility can scale in a co-ordinated, affordable and secure manner.

Delivering this transformation will require electricity grids that are ready for rapid growth in renewable generation and electrification. New transmission capacity is needed to integrate solar and wind resources and to strengthen cross-border trade and system balancing with Spain. Distribution networks face rising pressures from rooftop PV, electric vehicles (EVs) and heat pumps, and will require investment in digitalisation and advanced network management. Grid planning needs to become more proactive, with anticipatory investments in areas where renewable resources and electrification are expected to grow. Remuneration frameworks for electricity system operators need to support both large infrastructure investments and improved system flexibility. Stronger co-ordination between the transmission system operator (TSO) and distribution system operators (DSOs) as well as between national and municipal planning processes will be critical to ensure that electricity grids support electrification and the rapid scaling of renewable generation.

Efficient electricity markets with clear price signals will be essential for mobilising investment in renewables, storage, EVs, heat pumps and building renovations. Electricity remains more expensive than gas on a final energy basis, largely because of non-energy, non-network charges, which weakens incentives for households and businesses to electrify. Reforms that deliver price signals supporting electrification while protecting vulnerable consumers are needed to accelerate cost-effective decarbonisation. Investment frameworks for storage and demand-side response should provide predictable revenue opportunities and fair access to markets. Continued development of long-term contracting, power purchase agreements and clear market rules are required to support the needed scale of private investment in Portugal's energy transition. Markets also need to value flexibility, recognise the contributions of distributed energy resources and ensure that system services are procured in ways that reflect actual system needs.

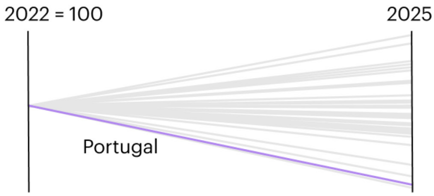
Portugal's natural gas demand is already in structural decline, driven primarily by a large reduction in generation from combined-cycle gas turbines (CCGTs). Total gas demand has already dropped to levels the gas TSO expected in the mid-2030s. Electrification in buildings and industry will further reduce gas consumption. These trends raise important challenges for gas networks, including declining throughput, rising unit costs, tariff pressures and the risk of stranded assets. An orderly and equitable transition will require updated remuneration frameworks for gas system operators that support efficient network operation during contraction and clear planning for decommissioning. The expertise of gas sector workers and companies should be leveraged. These steps are essential for managing the decline of the gas system in a way that protects consumers and ensures system reliability and a people-centred energy transition.

Over half of Portugal's energy-related GHG emissions come from the transport sector, which remains highly reliant on imported oil. Around 95% of the sector's emissions come from road transport, as the vehicle fleet is old and inefficient. Portugal is, however, making progress. In 2025, EVs accounted for 38% of new vehicles sales, higher than the European Union average share. However, the share of EVs in the total fleet was around 6%. Policy supports for the uptake of used EVs is needed to better reflect consumers' limited purchasing power and the structure of Portugal's vehicle market, where around 80% of purchases are used vehicles. Equally important is the expansion of charging infrastructure in urban areas, with specific attention to low-income households. More effort is also needed to shift freight from Portugal's diesel-dependent truck fleet to its highly electrified rail system. Portugal has delivered successful fare-reduction programmes and expanded bus and rail services, but modal shift must remain a central pillar of its transport policy. Urban and regional planning should ensure equitable access to active mobility options, reliable and affordable public transport, and national high-speed rail so that all citizens can benefit from cleaner and more efficient mobility. These actions will help place the transport sector on a trajectory consistent with Portugal's climate targets.

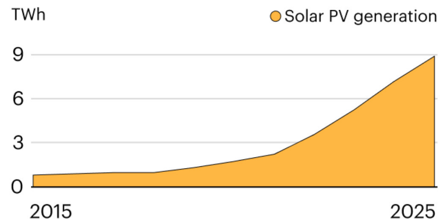
Portugal's industrial emissions have remained broadly flat for more than a decade, even as national climate ambition has increased. The sector now faces two transitions in tandem. Existing industrial facilities must cut emissions rapidly to meet the 2030 climate targets and industry must position itself competitively within global value chains that are shifting toward low-carbon production. These pressures come at a time when electrification and efficiency measures remain uneven across subsectors, and many industries, particularly small and medium-sized enterprises (SMEs), face structural constraints related to scale, skills and access to capital. A clear industrial decarbonisation strategy can provide needed direction by establishing subsector emissions reduction pathways that reflect Portugal's diverse industrial base and by identifying where additional policy, regulatory or financial measures are required. This strategy should focus on leveraging Portugal's low-carbon electricity supply to build new value chains around clean technologies. The strategy can also help target innovation and funding to hard-to-decarbonise processes.

Portugal has made progress in building electrification and is seeing increasing uptake of heat pumps. However, the building stock remains inefficient and renovation rates are low. Many households face financial and administrative barriers to renovating their homes. Energy performance certificates are not yet comprehensive, and existing support schemes do not always reach vulnerable households or deliver deep renovations. Portugal needs to scale up the pace of deep renovations to address high rates of energy poverty and phase-out fossil fuel use in buildings. The network of one-stop shops should be reinforced and expanded to be able to deliver comprehensive renovation support from initial assessment through project delivery. Public funds should be targeted to low-income households. In addition, a broad white certificate programme that rewards energy suppliers, energy service companies (ESCOs), energy communities, SMEs and consumers for verified energy efficiency improvements is needed to mobilise private capital and drive deep renovations across the country. Together these actions would turn the renovation challenge into a cornerstone of social, economic and climate progress and ensure that all people benefit fully from Portugal's energy transition.

In its mid-transition, Portugal has recorded the **second-largest** relative decline in **natural gas** demand among IEA countries...

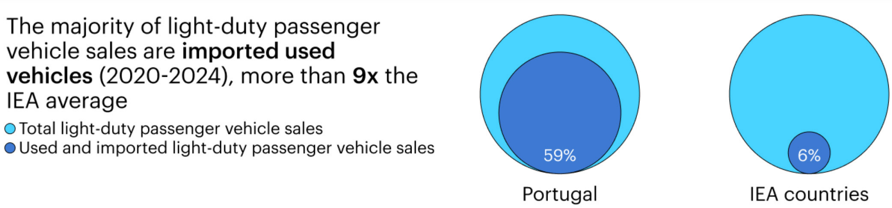


...while rapid **solar PV** growth has been shifting the centre of gravity of the power system

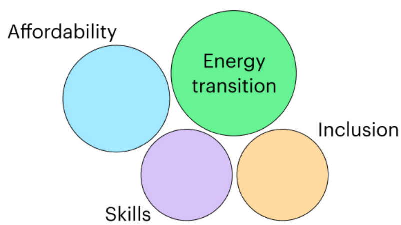


Electricity and heat decarbonised rapidly, while **end-use sectors** lag (2015-2024): end-use sector electrification can drive the next phase of decarbonisation

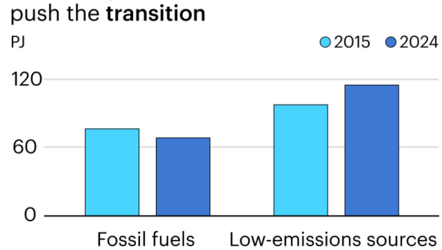
The majority of light-duty passenger vehicle sales are **imported used vehicles** (2020-2024), more than **9x** the IEA average



A **people-centred** focus guides Portugal's transition as energy poverty is a key concern



Low-emissions energy sources dominate in industry, but work remains to further push the **transition**



Sources for this infographic can be found in the annexes.

Policy recommendations for Portugal

Energy policy landscape

1. Adopt a national roadmap based on bottom-up sectoral agreements to support timely and cost-effective emissions reductions.
2. Ensure a fair and effective energy transition by empowering the groups most impacted by, and critical to delivering, the transition.
3. Ensure electricity prices reflect the cost of supply so that consumers can fully benefit from electrification, while protecting vulnerable and low-income households.
4. Accelerate electrification of the transport sector with a focus on support for used electric vehicles, expansion of the urban charging network and renewed measures to increase modal shift.
5. Establish an industrial decarbonisation strategy with subsector emissions reduction pathways, identifying targeted measures to unlock investment and strengthen competitiveness.
6. Accelerate deep renovations through comprehensive one-stop shops, a white certificate programme and targeting those the most in need.

Energy security in the mid-transition

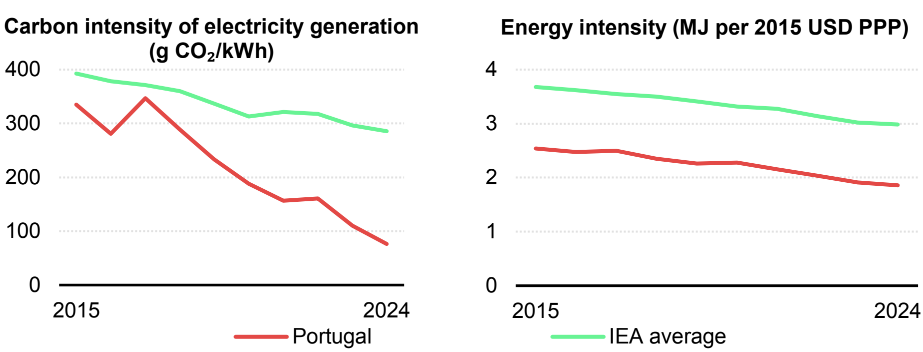
Focus area

7. Establish integrated energy system planning and remuneration mechanisms that support energy security through the mid-transition.
8. Move to proactive grid planning to maintain growth in renewable generation, electrification and distributed energy resources.
9. Prepare a scenario-based electricity flexibility roadmap and extend market-based and technology-neutral solutions to all ancillary services.
10. If adequacy assessments demonstrate need, implement a technology-neutral capacity mechanism to deliver cost-effective electricity security.

Energy policy landscape

Portugal has achieved notable success in its energy transition, with strong growth in renewable generation and improved energy efficiency driving down GHG emissions. Over the last decade, the country has rapidly scaled up solar PV, completed a major pumped hydro storage project, expanded wind capacity and phased out coal-fired generation, giving it one of the cleanest electricity supplies among IEA member countries. From 2015 to 2024, the share of renewable energy in electricity generation increased from 48% to 85%, reducing the carbon intensity of generation to 76 grammes of carbon dioxide per kilowatt hour (g CO_2/kWh), well below the IEA average of 286 g CO_2/kWh. Energy efficiency also improved strongly between 2010 and 2024: economy-wide energy intensity fell 27% to 1.9 megajoules (MJ) per 2015 USD PPP compared to the IEA average of 3.0 MJ per 2015 USD PPP.

Carbon intensity of electricity generation and economy-wide energy intensity in Portugal, 2015-2024



Sources: IEA (2026), World Energy Balances; IEA (2025), Emissions Factors 2025.

As a result, Portugal has decoupled economic growth from GHG emissions. From 2015 to 2024, real gross domestic product (GDP) grew by 21% and population by 2.9%, while GHG emissions fell by 21% from 2015 to 2024. However, the country remains highly dependent on fossil fuel imports, which accounted for 55% of total final energy consumption (TFEC) in 2024. Fossil fuel demand continues to increase, growing 2.9% from 2015 to 2024, driven mainly by higher oil demand from road transport.

Portugal is entering a mid-transition that requires managing two interconnected energy systems moving in opposite directions: a clean energy system based on renewables and electrification, which must scale up rapidly, and a legacy fossil fuel system that must decline in an orderly way to meet climate targets while avoiding stranded assets and price shocks. Completing electricity sector decarbonisation requires phasing out gas-fired generation while rapidly deploying battery storage, demand-side response (DSR) and other flexibility solutions to maintain electricity security. At the same time, renewable generation must expand in tandem with rising electrification, which is the most cost-effective pathway to reduce emissions and fossil fuel use across end-use sectors. As electricity becomes the core of the energy system, maintaining energy security will require a highly flexible, distributed and digitalised electricity grid.

To date, Portugal's energy transition has been driven largely by electricity sector decarbonisation. This progress relied on major projects developed by a relatively concentrated group of large, well-capitalised actors with a strong understanding of energy systems and policy, along with a growing contribution from distributed PV. While large-scale renewable and electricity infrastructure projects are still needed, the next stage of the transition will be different, with a central role for smaller scale distributed and decentralised projects and a greater diversity of participants.

Achieving economy-wide decarbonisation will depend on decisions taken by millions of households and thousands of communities and SMEs on how to renovate buildings, power vehicles and adapt business models. These actors have diverse motivations, less access to capital and relatively limited knowledge of the energy sector. At the same time, the energy system is shifting from fuel-based to capital-intensive supply, meaning that the cost of capital, supply chains, labour availability and system flexibility will shape affordability more than fuel prices. The energy transition offers a path to clean, secure and affordable energy. Policy, regulation and markets must reduce barriers to participation and empower consumers and businesses so they can invest in low-carbon solutions, ensuring that the benefits of the transition are widely shared and support Portugal's economic competitiveness.

Most of the technologies needed to achieve Portugal's ambitious climate targets are already commercially available and are often the lowest cost options. The main challenges now relate to deployment, financing, system integration and accessibility rather than technology readiness. Targeted innovation is still needed for hard-to-decarbonise industrial processes, where the most cost-effective pathways are emerging. Portugal's innovation efforts should focus on decarbonisation solutions that build on domestic industrial and technical strengths and support competitiveness.

Managing the mid-transition also means anticipating structural impacts. Portugal's gas demand will continue to decline, but the gas sector's well-trained workforce, knowledge of retail energy markets and established relationships with millions of consumers are valuable assets for the transition. Demand for installers, technicians and engineers will rise, so training and certification systems will need to be scaled up. Portugal's recent success in deploying distributed PV offers a template for the rapid expansion of heat pumps and other clean energy technologies and services. There is more uncertainty about when Portugal will see the large declines in oil demand needed to meet its climate targets, but the oil sector will face similar challenges as electrification reduces fuel sales; proactive planning for reskilling and business model changes for the oil sector should be undertaken now to ensure an orderly transition.

Finally, maintaining social acceptance of the energy transition is essential. The benefits of clean, efficient and affordable energy must be accessible to all, particularly low-income households, who are the most exposed to high energy costs, inefficient housing conditions and limited access to affordable low-carbon mobility options. This is especially critical as energy poverty in Portugal remains well above the European average. Ensuring that price signals that support electrification and energy efficiency are complemented by well-designed support programmes and clear communication of tangible benefits, such as improved comfort, healthier living conditions and lower energy bills, will be critical to maintain public support and enable broad participation in the transition.

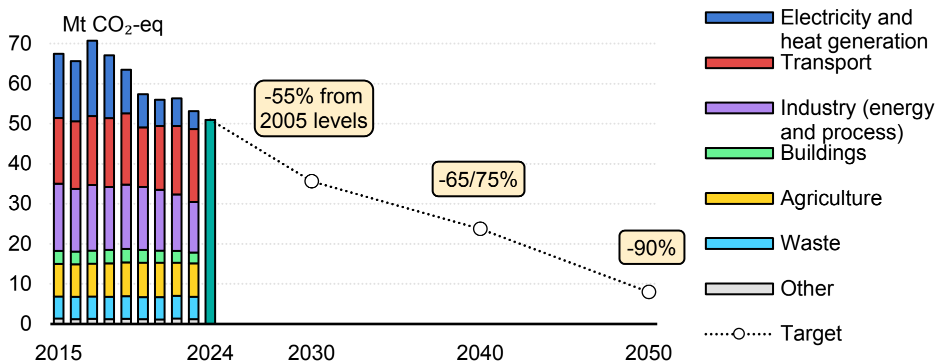
Climate and energy strategy

Portugal sets an ambitious direction for its energy transition through a series of strategic policy documents. The Roadmap for Carbon Neutrality 2050 (2019) defines the long-term vision for a net zero economy. The Basic Climate Law (2021) commits to climate neutrality by 2050. The National Energy and Climate Plan 2030 (2024) increased ambition, defining 2030 targets and priority measures to put Portugal on a path to 2045 climate neutrality. The NECP aims to reduce GHG emissions by 55% by

2030, 65-75% by 2040 and 90% by 2050 (vs. 2005 levels), with remaining emissions offset through carbon sinks in the land use, land-use change and forestry sector. The NECP notes that stronger targets may be needed for 2030-2040 to ensure a smooth and cost-effective transition and avoid crowding emissions reductions after 2040.

Portugal has advanced significantly toward its 2030 goal of cutting GHG emissions by 55% compared to 2005 levels. In 2024, it had already achieved a 43% reduction, largely from decarbonisation efforts in the electricity sector. Portugal's electricity sector GHG emissions fell by 80% between 2015 and 2024 due to rapid growth in solar PV (+5.2 gigawatts [GW]), a large expansion of pumped hydropower storage (+2 GW), continued wind deployment (+0.7 GW) and the phase-out of coal-fired generation in 2021. Solar PV capacity has continued to expand rapidly, strengthening Portugal's progress toward its 2030 targets. However, the transport, industry, buildings, agriculture and waste sectors are not delivering the structural emissions reductions needed to meet Portugal's climate targets. Unlocking progress in these sectors will require a major acceleration of electrification, so that more end uses can take advantage of Portugal's increasingly low-carbon electricity supply.

Economy-wide greenhouse gas emissions and reduction targets in Portugal, 2015-2050



Notes: Mt CO_2-eq = million tonnes carbon dioxide equivalent. Data for 2024 is provisional and full sectoral breakdowns are not yet available.

Sources: IEA analysis based on European Commission (2024), Portugal - Final updated NECP 2021-2030 (submitted in 2024) (accessed November 2025); EEA (2026), EEA greenhouse gases – data viewer (accessed March 2026); EEA (2026), EEA approximated estimate for greenhouse gas emissions (accessed March 2026).

In addition, the climate crisis poses growing risks to the achievement of Portugal's ambitious emissions reduction and climate-neutrality targets. The IEA Portugal Climate Resilience Policy Indicator shows that climate change will increase Portugal's average annual temperature while annual precipitation will decline and become more variable. These trends threaten key energy system components: hydropower generation may be constrained by drought, more frequent heatwaves could reduce electricity generation and grid infrastructure capacity, and electricity demand patterns may shift as air conditioning becomes more widespread.

In 2017, forest fires turned the land use, land-use change and forestry sector into a net source of GHG emissions, demonstrating the risk of reliance on carbon sinks to achieve the 2045 carbon-neutrality goal. Strengthening climate resilience and land-use management and ensuring that adaptation measures are integrated into energy system and infrastructure planning will be central to maintaining energy system reliability and safeguarding carbon sinks.

To remain on track to achieve the 2030 targets and the 2045 climate-neutrality goal, Portugal needs to translate its strategic objectives into co-ordinated delivery across all sectors. Although the NECP sets clear ambitions, the pathways for achieving these goals remain dispersed across separate strategies, funding programmes, and regulatory and market reforms, making it difficult to align investment planning, infrastructure development, workforce needs and consumer participation. Stronger collaboration with stakeholders will also be needed to ensure that sectoral measures address practical implementation challenges and reflect the perspectives of consumers, local authorities and industry. An integrated, cross-sector approach is needed to ensure coherence across policies and provide clarity for all stakeholders. In parallel, a coherent set of cross-cutting fiscal and pricing policies will be essential to shape investment decisions, influence consumer choices, and ensure that the costs and benefits of the transition are fairly distributed.

Cross-cutting fiscal measures and price signals

Several fiscal measures support Portugal's energy transition by encouraging consumers and businesses to invest in electrification, renewables and energy efficiency. These include the EU Emissions Trading System (EU ETS), a national carbon tax and excise duties on fossil fuels. Other fiscal incentives support low-carbon investment, such as tax deductions for renewable energy investments and accelerated depreciation for corporate clean energy investments.

The EU ETS sets an EU-wide carbon price covering fossil fuel power plants and energy-intensive industrial facilities. In 2025, the EU ETS price ranged from roughly 64 EUR/t CO_2 to 88 EUR/t CO_2. Recently completed and ongoing reforms are expected to support a higher and more stable EU ETS, which should maintain a strong incentive to reduce fossil fuel use in electricity generation and industry across the European Union. Revenues from the EU ETS are returned to national governments and at least 50% must be used for climate- and energy-related purposes. The forthcoming EU ETS 2 is expected to extend carbon pricing to the buildings and transport sectors in 2028.

Portugal's national carbon tax applies to emissions from sectors not covered by the current EU ETS, mainly transport, buildings and small industrial installations. The carbon tax is indexed to the EU ETS price and in 2025 was around 67 EUR/t CO_2, the seventh-highest rate among the EU member states that have a national carbon tax. Portugal also applies fuel excise duties (ISP) that act as additional carbon-related price signals across electricity generation, transport, industry and buildings.

Portugal has historically applied reduced ISP and carbon tax rates to certain fossil fuels, mainly to address concerns related to industrial competitiveness and energy affordability. Temporary reductions were also introduced in response to energy price volatility during the Covid-19 pandemic and following the Russian Federation's invasion of Ukraine. These measures are now being gradually phased out, although some reduced rates remain in place for certain fossil fuel uses. Continuing to phase out these reduced rates would strengthen carbon price signals and improve the competitiveness of electrification.

Despite Portugal's robust carbon-pricing architecture (EU ETS, national carbon tax and ISP) and the ongoing phase-out of reduced tax rates for fossil fuels, electricity still bears a higher fiscal burden than natural gas in most consumer pricing bands. Price data for 2021-2025 show that the share of taxes and policy-related charges is consistently higher for electricity than for natural gas. This reflects the presence of numerous non-energy and non-network costs on electricity bills. Essential policy costs should be shifted to the state budget while temporary or distortionary charges should be removed. Removing these charges from electricity bills will strengthen the case for investing in electrification (see Electricity section). A stable and predictable fiscal and carbon-pricing framework will also be critical to give households and businesses the confidence to invest by reducing uncertainty, improving financing conditions and helping to mobilise the private capital required for Portugal's energy transition.

Investment and financing

Meeting Portugal's 2030 climate and energy targets will require unprecedented levels of investment and effective mechanisms to mobilise public and private capital. According to government estimates presented to parliament in 2024, meeting the NECP targets will require at least EUR 60 billion in energy sector investment by 2030, mainly from private sources. This represents annual investments of around EUR 10-12 billion through 2030, roughly two to three times the current investment in energy transition of about EUR 4-5 billion per year, which includes temporary EU support. Actual investment needs may be higher, given the recent increase in NECP ambition and uncertainty around technology costs and financing conditions.

Portugal's investment needs span the entire energy system. Large-scale capital will be required for renewable generation, electricity grids, battery storage, DSR and digitalisation. At the same time, millions of smaller investments will be needed in buildings, transport and industry, including heat pumps, building renovations, EVs and efficiency upgrades for SMEs. This mix of large-scale and consumer-driven low-carbon investment will require accessible financing options for households and businesses alongside clear market signals. Private investment will need to provide the bulk of capital required through 2030 and beyond. However, public funds remain essential to reduce investor risk, mobilise private financing and support activities where the market alone will not deliver sufficient investment, including programmes for vulnerable consumers and early-stage innovation.

Portugal's energy transition is supported by a combination of EU and national funding instruments that aim to reduce investment risk; co-finance strategic projects; and support equitable investment across regions, income groups and business sizes.

Portugal's Recovery and Resilience Plan (RRP) has been one of the largest sources of funding for the energy transition since 2021. Financed through the EU Recovery and Resilience Facility, it provides EUR 22.2 billion in grants and loans, with more than one-third allocated to energy and climate priorities, including renewable generation, grid reinforcement, sustainable mobility, industrial decarbonisation and building renovation. However, all RRP funds must be committed by the end of 2026.

At the national level, the Environmental Fund is Portugal's main instrument for financing environmental and climate-related policies. Funded largely through EU ETS revenues and national carbon-related taxes, it supports programmes such as renewable energy deployment, building renovation and sustainable mobility.

Portugal also receives support through Portugal 2030, the national framework for implementing EU Cohesion Policy Funds. These funds support investments in areas such as building renovation, energy efficiency in public and residential buildings, sustainable mobility, and SME competitiveness. As Portugal's GDP per capita converges toward the EU average, Cohesion Policy allocations are expected to decline.

Additional grant support is provided through the EU Modernisation Fund, which finances industrial decarbonisation, grid investment and renewable energy projects in lower income EU member states. Portugal currently receives around 1.5% of the Fund, with annual allocations varying with EU ETS revenues. As Portugal's per capita GDP converges toward the EU average, its eligibility or allocation share may decline in future funding periods.

The European Investment Bank (EIB) is another important source of long-term financing for Portugal's transition. Through loans, guarantees and risk-sharing instruments, the EIB supports renewable energy, energy efficiency, sustainable mobility and grid infrastructure while helping to mobilise private investment and reduce the cost of capital. Access to EIB financing will become increasingly important as grant-based EU support declines.

Portugal's corporate green bond market, led by the energy and financial sectors, is helping to mobilise private capital for renewable generation, grid investment and sustainable transport, complementing national and EU public funding. Many European countries now issue sovereign green bonds to diversify funding and signal long-term commitment to sustainable investing. Portugal should introduce sovereign green bonds aligned with the EU Green Bond Standard to broaden its investor base and support lower cost financing for strategic clean energy and climate resilience investments.

Portugal has benefited from substantial EU support for its energy transition, particularly through the RRP, Cohesion Policy and the Modernisation Fund. However, much of this support is temporary or variable: RRP disbursements end in 2026, Cohesion Policy allocations are expected to decline as per capita GDP rises, and Modernisation Fund resources depend on variable carbon market revenues and are also expected to decline after 2030. As a result, meeting its 2030 and 2045 targets will require a shift toward mobilising private investment at scale, which depends on predictable policy frameworks, efficient permitting processes, timely grid expansion and well-functioning electricity markets. A coherent and stable regulatory environment is essential to reduce project risk, lower financing costs and support a diversified pipeline of clean energy investments across all regions.

Workforce and institutional capacity

Rapid deployment of renewables, electrification and energy efficiency measures will also require a substantial expansion of Portugal's skilled workforce. Labour shortages are emerging in key professions such as PV installation, building renovation, grid operation, battery storage systems and heat pump deployment. Training capacity has not kept pace with rising demand, particularly outside major urban centres. The integration of green skills into training programmes has also progressed slowly, contributing to a misalignment between training provision and labour market needs.

Workers in gas and related industries possess valuable technical and customer service skills that could support the transition but will require tailored opportunities for retraining and redeployment. At the same time, no comprehensive assessment of workforce needs across the energy sector has been undertaken, limiting the ability to anticipate future skills gaps and align training programmes with sectoral demand. Public bodies responsible for skills and employment programmes also face capacity constraints, while limited public awareness of available training programmes reduces participation in reskilling initiatives.

The OECD report The Green Transition of SMEs and Entrepreneurship in Portugal published in September 2025 highlights broader capability gaps across SMEs and the labour market, including shortages of skilled trades, renewable energy technicians and digital competencies. The share of SMEs in Portugal providing environmental or energy efficiency training remains below the EU average, and many firms report difficulties in attracting workers with green skills.

A co-ordinated workforce strategy that aligns vocational training, higher education pathways and sectoral planning will be essential to ensure that the energy transition can proceed at the necessary scale and speed. Lessons from Portugal's recent industrial transitions, including the closure of the Matosinhos refinery and the retirement of coal-fired plants, highlight the importance of early planning, co-ordinated regional support and clear pathways for worker redeployment.

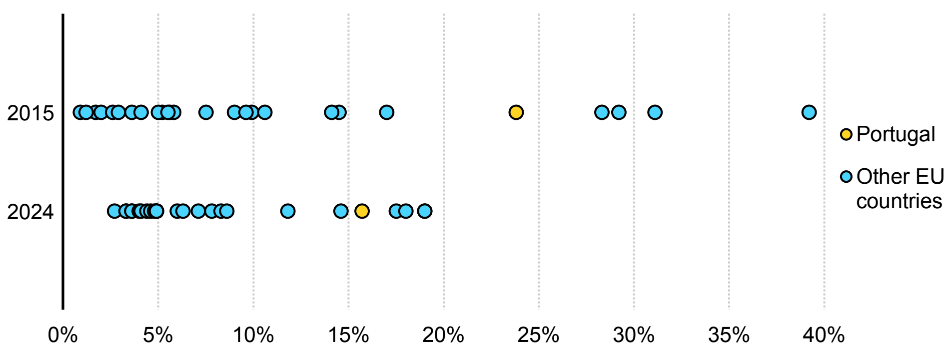
Delivering Portugal's transition will depend on the capacity of the institutions implementing it. Municipalities, regional agencies, regulators and public bodies face rising demands as they administer grants, permitting, renovation schemes and new market frameworks, yet many report skills shortages and administrative bottlenecks.

Strengthening institutional capacity and energy literacy across these actors will be essential to ensure that growing levels of investment translate into effective delivery and equitable access to the benefits of the transition.

Energy poverty and affordability

Maintaining social acceptance of the energy transition requires ensuring that the benefits of clean, efficient and affordable energy reach all people, particularly low-income households, who are the most exposed to high energy costs; inefficient housing conditions; and limited access to affordable, low-carbon mobility options. Policy design and funding priorities need to reflect Portugal's economic and social context. In 2024, average salaries in Portugal were around EUR 1 900 per month, 40% below the EU average and well below other Western European countries. Portugal also continues to face relatively high rates of energy poverty. In 2024, 16% of Portugal's population reported being unable to keep their home adequately warm, well above the EU average of 9.2%. This represents an improvement from 24% in 2015, but energy poverty remains a significant social challenge.

Share of the population that is unable to keep their home adequately warm across EU countries, 2015 and 2024



Source: IEA analysis based on Eurostat (2025), Population unable to keep home adequately warm by poverty status (accessed in February 2026).

In 2023, the government adopted the National Long-Term Strategy for Combating Energy Poverty 2023-2050, which sets reduction milestones for 2030, 2040 and 2050 and creates the National Observatory for Energy Poverty to support monitoring and policy design. The Strategy emphasises improving building performance, scaling targeted renovation programmes, strengthening social protection and improving access to consumer information.

Supporting low-income households will become increasingly important as carbon pricing expands to the buildings and transport sectors under the forthcoming EU ETS 2. In line with this, the European Union established the Social Climate Fund (2026-2032), which will provide targeted financial assistance to households, transport users and microenterprises. The draft Social Climate Plan foresees a budget of around EUR 1.6 billion, focused on energy efficiency renovations, clean heating solutions and affordable clean mobility. It is expected to be submitted to the European Commission in 2026.

Coherence between the Social Climate Plan, the National Strategy for Combating Energy Poverty, and other fiscal and sectoral measures will be essential. Clear communication of tangible benefits – such as improved comfort, healthier living conditions and lower energy bills – can help sustain public support. Ensuring that scarce public resources are directed toward low-income households is critical to avoid widening inequality and enable broad participation in the transition.

People-centred policies ensure that households, workers and communities can participate in and benefit from new opportunities, manage structural changes and contribute actively to the transition. Such an approach will be critical for Portugal's transition. The IEA's people-centred transition framework emphasises fairness, inclusion and active engagement as core conditions for successful transitions and provides guidance relevant to Portugal's social and workforce challenges. Broader international experience and analytical resources are available through the IEA People-Centred Clean Energy Transitions Programme and the IEA Global Observatory on People-Centred Transitions.

Electricity

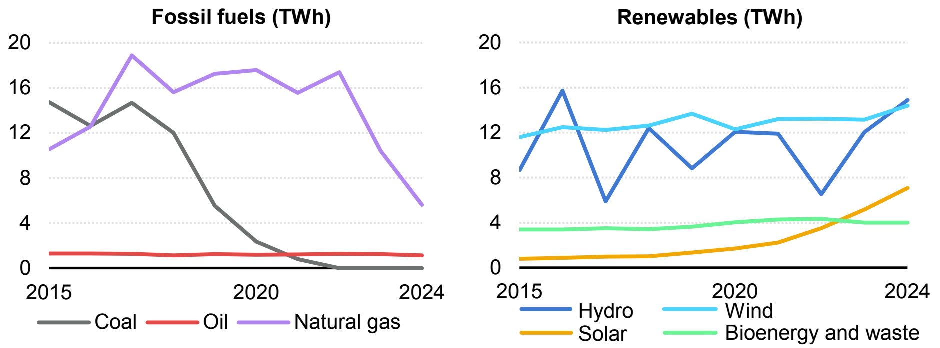
Portugal's electricity system is central to achieving a secure and equitable clean energy transition. Growth in renewable generation has delivered most of the country's GHG emissions reductions, and continued expansion of solar PV and wind, together with electrification of transport, buildings and industry, will be the primary pathway for meeting Portugal's 2030 climate and energy targets and its 2045 climate-neutrality goal. As electrification accelerates, electricity will increasingly become the main driver of energy security.

Portugal's electricity sector is entering a mid-transition in which renewable generation and electrification must scale rapidly while gas-fired generation phases down. As more generation and flexibility emerge behind the meter, consumer decisions and digitalisation will play a growing role alongside large-scale grid and renewable investments. This will require grids, markets and regulation to evolve so that renewable deployment, electrification and system flexibility can expand in a co-ordinated, affordable and secure manner.

Portugal's electricity mix has historically been shaped by the annual variability of its large hydropower fleet, which can fluctuate from around 10% to more than 30% of total generation. Wet years delivered higher renewable shares and lower emissions while dry years required higher gas-fired generation and increased electricity imports from Spain. But this pattern is changing. Strong deployment of onshore wind from 2005 to 2015 lifted Portugal from roughly 30% renewable generation to well over 50%. Growth in wind generation has slowed over the last decade but it remains a key element of electricity supply, rising from 23% of generation in 2015 to around 30% in 2024. Hydropower capacity expanded notably, with about 2.2 GW added between 2015 and 2024. Most of this increase came from pumped hydropower storage, which improves system flexibility and supports the integration of variable renewable generation. Coal-fired generation was phased out in 2021, significantly reducing the carbon intensity of thermal generation, which now relies primarily on natural gas CCGTs.

A new structural shift is now underway. Solar PV has grown rapidly from less than 2% of generation in 2015 to around 15% in 2024, with decentralised PV production accounting for 40% of all PV electricity generation. The combination of strong solar expansion and continued wind output is reducing the impact of hydropower variability on annual emissions. It is also pushing gas-fired generation to historically low levels and moving Portugal towards a system where variable renewable energy (VRE) from solar PV and wind play a central role. In late 2023, Portugal met 100% of its electricity demand with renewable generation over six consecutive days. In 2024, a wet hydro year combined with continued solar growth resulted in a record low 12% share for gas-fired generation and a record high renewable share of 85%.

Electricity generation by source in Portugal, 2015-2024



Note: TWh = terawatt hour.
Source: IEA (2025), Electricity Information.

Electricity sector outlook

Looking ahead, Portugal's NECP sets a target for renewable energy to supply 93% of electricity generation by 2030 and identifies electrification as the central driver of emissions reductions across the transport, buildings and industry sectors. Achieving these objectives will require scaling up renewable electricity and expanding grid capacity and system flexibility in tandem with rising demand.

Annual electricity demand in Portugal has been broadly stable for decades, typically ranging from 47 TWh to 50 TWh. In 2024, demand reached a record 51.3 TWh, with electricity consumption increasing across all sectors of the economy. Looking ahead, the NECP, the TSO's planning scenarios, the Directorate-General for Energy and Geology's security of support report, and the CN50 Energy Scenario, all anticipate rising electricity demand as electrification expands across transport, buildings and industry. These projections vary widely depending on the pace of electrification and the potential development of large new industrial or digital loads, but they all indicate that the electricity system may need to accommodate substantially higher demand by 2030.

The NECP outlines a pathway to meet the 93% of renewable energy in electricity generation target and supply growing demand from electrification primarily through continued deployment of VRE, led by strong solar PV growth (both utility-scale and distributed), the expansion and repowering of onshore wind, and the introduction of floating offshore wind. This trajectory will further reduce the impact of annual variation in hydropower availability so that even in dry years the need for gas-fired generation and imports from Spain will be notably reduced.

This pathway strongly supports Portugal's climate and energy objectives but also raises new challenges for ensuring energy security. As VRE becomes the core of the electricity system, there is a risk that gas-fired generation could exit the market before battery storage, DSR and other flexibility measures are deployed at sufficient scale. The government is, therefore, exploring regulatory and market reforms to accelerate the deployment of flexibility resources, support the continued expansion of renewable generation and grid capacity, and ensure an orderly phase-out of gas-fired generation (see the Focus Area chapter).

End-use electrification will become the main driver of GHG reductions, but progress to date has been slow. From 2015 to 2024, the share of electricity in national final energy consumption only increased by 2 percentage points to 28%, just slightly above the IEA average of 25% (2023). Much stronger policy support will be needed to accelerate electrification across transport, buildings and industry (see End-use sectors section).

Portugal's challenges of rapidly scaling up renewables and electrification while managing an orderly phase-out of gas-fired generation underline the importance of stronger cross-sector planning and co-ordination so that the electricity system evolves in a coherent manner that supports the least cost achievement of Portugal's 2030 targets and its 2045 climate-neutrality goal.

System readiness: Grids and flexibility

Delivering the next stage of Portugal's energy transition will increasingly depend on the electricity system's ability to integrate large volumes of variable renewable generation and support rapid electrification across the transport, buildings and industry sectors. Rapid growth in distributed solar PV, EVs and heat pumps is already increasing pressure on low-voltage (LV) and medium-voltage (MV) networks, and these trends will accelerate as electrification becomes the main driver of emissions reductions. At the same time, large-scale renewable projects will require timely reinforcement of the transmission network to connect new onshore and offshore capacity, manage north-south power flows, and strengthen interconnection with Spain. The blackout in April 2025 highlighted the need to maintain system resilience as operational complexity increases (see the Focus Area chapter for more details about the April 2025 blackout).

Flexibility needs will rise sharply as solar and wind play a greater role in the generation mix. Pumped hydropower storage remains important, but the system will increasingly depend on battery storage, DSR and smart EV charging. These resources are beginning to develop, but are not yet scaling at the pace required to stay ahead of rising VRE shares and falling gas-fired generation. Portugal is therefore preparing a National Energy Storage Strategy for 2026-2050, intended to provide a long-term framework for scaling storage and other flexibility resources in line with the goals of the NECP.

Interconnections with Spain currently help ensure supply adequacy during dry years. As VRE output grows rapidly in Portugal and Spain, higher interconnection capacity within Iberia and stronger interconnection with Europe will become more important for efficient system balancing and opening Iberian renewables to wider markets.

This transformation positions REN, the TSO, and E-REDES, the main DSO, as key enablers of Portugal's energy transition. They must adapt networks originally designed around large, centralised power plants to a future with widespread distributed resources and rapidly growing electrified loads. Stronger co-ordination between TSO and DSO planning and operations will be essential to avoid new bottlenecks and support efficient investment.

Ensuring timely and cost-effective connections for new generation and electrified demand will require efficient permitting of grid investments, strengthening existing infrastructure, better using existing rights-of-way, and a greater focus on non-wire alternatives and grid-enhancing technologies. At the same time, efficient and flexible operation of the electricity system will require empowering a wide range of actors, including households, businesses, energy communities and aggregators. Unlocking this potential requires regulatory and market arrangements that reward flexibility and enable active participation across the system.

Markets and investment

Portugal's major renewable investments were historically driven by government support schemes. Feed-in tariffs underpinned the rapid deployment of onshore wind in the 2000s, while ad hoc competitive auctions offering contracts for difference supported the first wave of utility-scale solar PV in the late 2010s and early 2020s. In 2024, targeted grant funding under the RRP helped initiate large-scale battery storage projects, with an additional EUR 60 million of support allocated in 2026.

Investment conditions are now shifting. Utility-scale solar PV growth is increasingly driven by merchant projects and corporate power purchase agreements (PPAs), while distributed solar PV has expanded strongly through self-consumption schemes. However, revenue certainty for storage and DSR remains limited. Developers report challenges securing long-term contracts, navigating grid-connection queues and obtaining financing, especially for storage and repowering projects.

Looking ahead, Portugal aims for markets to deliver most new investment needed to expand solar PV, onshore wind, hydropower and floating offshore wind as part of a diversified renewable portfolio needed to reach its 2030 renewable electricity target and its 2045 climate-neutrality goal. Achieving this will require a more predictable and co-ordinated enabling environment, with transparent and efficient permitting, timely grid access and clearer market revenue streams that support bankable renewable, storage and flexibility projects.

Portugal is taking a leading role in floating offshore wind, building on experience from the WindFloat Atlantic demonstration project and moving early to establish a commercial-scale programme. The government has completed spatial planning and set out a multi-year auction timetable aiming for deployment of 2 GW by 2030, with longer-term potential of around 10 GW. This provides a clear signal of long-term intent and positions Portugal among the front runners globally in floating offshore deployment. However, given the long lead times and capital intensity of these projects, realising this potential will depend on a stable regulatory and revenue framework, including clarity on auction design, grid connection processes and market integration.

Portugal participates in the Iberian Electricity Market (MIBEL), a joint wholesale market with Spain. The day-ahead and intra-day markets are operated by OMIE, while OMIP and OMIClear provide derivatives trading and clearing services. Prices are set at the Iberian level, supported by strong interconnection between Portugal and Spain, although limited links between Iberia and France constrain integration with the wider European market. MIBEL provides a competitive and transparent price signal, but growing volatility, rising balancing costs and immature flexibility markets increase investment risk for merchant renewable and storage developers.

Portugal's electricity market remains relatively concentrated. EDP continues to hold a large share of generation capacity and retail customers, complemented by Iberdrola, Endesa and a growing number of independent power producers. While competition has increased over the past decade, supplier and generator shares remain more concentrated than in many other IEA Member countries. This has implications for wholesale market liquidity, hedging opportunities and entry conditions for new suppliers and project developers. Strengthening market depth and competition will become increasingly important as Portugal seeks to scale up renewable generation, storage and DSR through market-based investment.

While Portugal's retail electricity market is mostly liberalised, regulated tariffs remain in place and the share of consumers under these tariffs has changed little since 2019, staying at roughly 6% of retail electricity sales. The government originally planned to end regulated tariffs in 2015 but has repeatedly postponed the phase-out, most recently extending it to December 2027. Continued ad hoc extensions create uncertainty for suppliers and weaken incentives for consumers to engage in the competitive market. A firm and irreversible phase-out date is needed to strengthen retail competition, improve market liquidity and support cost-reflective price signals. Protection for vulnerable households can be provided through the social tariff.

As Portugal relies more on market-based investment and less on subsidised support schemes, the role of long-term contracting becomes increasingly important for securing revenue stability and enabling project financing. Corporate PPAs are expanding, mainly among large industrial and commercial consumers, and have supported several recent renewable and hydrogen-related investments. However, the overall PPA market remains shallow, with limited liquidity and only early signs of participation by smaller buyers or aggregated demand. Recent measures, including the creation of an open PPA registration and negotiation platform, aim to increase transparency and reduce transaction barriers. The government is also developing a state-backed warranty mechanism for PPAs to reduce counterparty risk and improve access to long-term contracts for renewable energy projects. Clearer guidance on contractual standards and efforts to strengthen forward-market liquidity will be important for scaling PPAs and improving bankability for new renewable and storage projects.

Investment conditions for renewables and flexibility remain mixed. Long permitting times, uncertainty around grid-connection queues and limited visibility on long-term revenues for storage continue to increase financing costs and delay projects. Recent utility-scale solar PV development has been predominantly merchant, supported by Iberian wholesale prices, but developers report difficulties in securing bankable long-term contracts. Repowering of onshore wind faces similar challenges, and financing for utility-scale storage projects remains constrained by the absence of clear and predictable revenue mechanisms.

A more coherent and predictable investment framework will be needed to sustain the pace of renewables, storage and flexibility deployment. This includes a clearer allocation of grid capacity, faster and more co-ordinated permitting, and greater certainty around future market revenues. If merchant and corporate-contracted investment does not scale quickly enough, Portugal may also need to consider maintaining auctions as a complementary tool, using predictable and transparent schedules to provide revenue stability where needed. Strengthening the overall investment environment will be essential to ensure that renewable generation, electrification and system flexibility can grow in a co-ordinated and least-cost manner.

Increasing renewable generation will also help lower electricity prices. Analysis by Ember shows that increasing solar PV and wind generation in Iberia has reduced the share of hours in which gas-fired generation sets the marginal price in the MIBEL wholesale market from around 75% in 2019 to about 19% in 2025. This shift, driven by more hours in which very low marginal cost renewable generation determines the marginal price, has contributed to lower wholesale electricity prices across Iberia. Because Portugal and Spain share the same wholesale market, further deployment of renewable generation, storage and DSR in Portugal is likely to reinforce these trends and deliver sustained wholesale price reductions.

Price signals and affordability

Clear and efficient electricity price signals are essential for enabling the investments needed for Portugal's energy transition. Households and SMEs will be responsible for taking many of the key decisions that drive electrification, including switching to EVs, heat pumps, induction cooking and efficient appliances. Larger industrial consumers also depend on predictable and cost-reflective electricity prices when evaluating electrification options for process heat, motors and other equipment. Across all sectors, these choices rely heavily on payback periods and ongoing operating costs. However, Portugal's electricity prices include numerous non-energy and non-network charges that raise end-user bills and weaken incentives for electrification. These surcharges also increase the cost of electricity relative to fossil fuels and slow the adoption of low-carbon technologies throughout the economy.

Strengthening price signals requires careful attention to affordability. Portugal has high levels of energy poverty, and many low-income households face inefficient housing and limited access to affordable, low-carbon mobility options. Any tariff or retail pricing reforms must, therefore, protect vulnerable consumers while ensuring that overall price signals are cost-reflective, transparent and supportive of electrification.

A large share of retail electricity prices is made up of non-energy and non-network charges, including cost of legacy subsidies, energy efficiency levies, financing of the social tariff, recovery of the tariff deficit, tariff convergence costs for the Azores and Madeira, funding for the Directorate-General for Energy and Geology, the special CESE levy on energy companies, and the audiovisual fee. These costs artificially increase electricity prices, weakening the incentive to invest in electrification. Essential policy costs should be shifted to the state budget, with clear multiannual commitments, while temporary or distortionary charges, including the CESE levy, should be discontinued. This would help accelerate electrification by providing cost-reflective electricity prices while ensuring continued support for essential programmes. In December 2025, Portugal took a step in this direction by repealing the clawback mechanism, which had created price distortions by imposing ex post charges on electricity producers. The continued availability of the regulated tariff for LV consumers also reduces price transparency and weakens incentives for efficient consumption. An irreversible phase-out of the regulated tariff is needed to support cost-reflective price signals and stronger retail competition.

ERSE (the independent energy regulator) has approved several retail electricity tariffs for LV consumers: a simple tariff that is the same regardless of time of use, and two time-of-use tariffs – bi-hourly (peak and off-peak) and tri-hourly (peak, mid-peak and off-peak).The time-of-use tariffs can support demand shifting and reduce system costs, but uptake in Portugal's retail market remains modest, with the simple tariff still the most common choice among residential consumers. In addition, the time-of-use tariff price differentials are often too limited to strongly influence consumer behaviour or support services such as smart EV charging, heat pump optimisation or automated DSR. Strengthening time-of-use price signals together with greater availability of these tariffs and a framework that enables aggregators to offer flexible-demand products will become increasingly important as electrification grows. More cost-reflective retail pricing would also improve the economics of behind-the-meter batteries, distributed solar PV and DSR.

Portugal's social tariff provides significant discounts on electricity and natural gas bills for eligible low-income households and is automatically applied, reducing administrative burdens and improving coverage. However, the number of beneficiaries has remained broadly unchanged for several years, indicating persistent underlying vulnerabilities. Around 774 000 households received the electricity social tariff in July 2025, compared with roughly 753 000 households in December 2020. This stability over time means that about 14-15% of households continue to qualify, despite improving macroeconomic conditions and some reductions in measured energy poverty indicators.

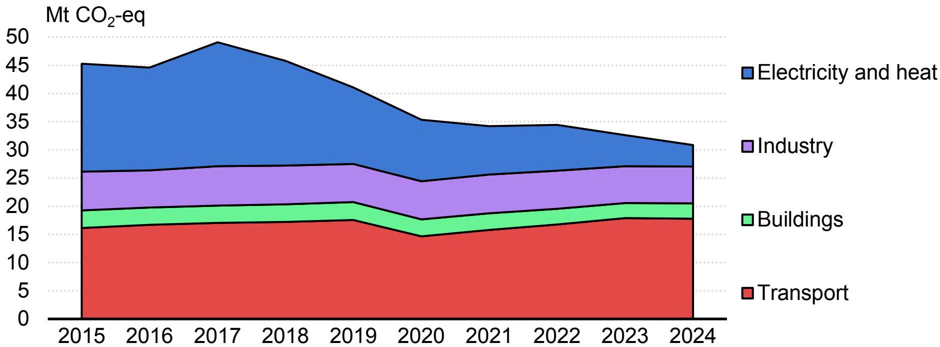
The lack of decline in the number of households receiving the social tariff suggests structural affordability challenges that cannot be addressed through tariff discounts alone and which require complementary measures supporting deep renovations that deliver sustained reductions in energy bills. In addition, eligibility is currently linked to contracted power (6.9 kVA [kilovolt ampere]) rather than to actual electricity consumption, which can reduce incentives for efficiency and electrification. Moving social tariff financing from electricity bills to the state, refining eligibility criteria and shifting to consumption-based support could protect vulnerable consumers while preserving efficient price signals.

Portugal is entering a mid-transition where the rapid progress in electricity sector decarbonisation must be matched by faster action across end-use sectors. Stronger price signals and improved market conditions will only translate into emissions reductions if households, businesses and industry adopt efficient, low-carbon technologies at scale. Achieving this will require co-ordinated policy delivery across transport, buildings and industry, supported by clear sectoral pathways that fit within a coherent national roadmap.

End-use sectors

With clear progress on decarbonising electricity supply, the next phase of Portugal's energy transition must focus on cutting emissions from end-use sectors. Transport, buildings and industry together accounted for 82% of energy sector GHG emissions in 2024, and unlike the electricity sector, end-use sectors are not delivering the structural declines in GHG emissions needed to meet Portugal's 2030 and 2045 climate goals. Greater efforts in end-use sectors are needed to ensure that electrification and energy efficiency drive strong reductions in fossil fuel demand and that demand-side flexibility scales up to support system stability and energy security.

Energy-related greenhouse gas emissions by sector in Portugal, 2015 and 2024



Source: IEA (2026), Greenhouse Gas Emissions from Energy.

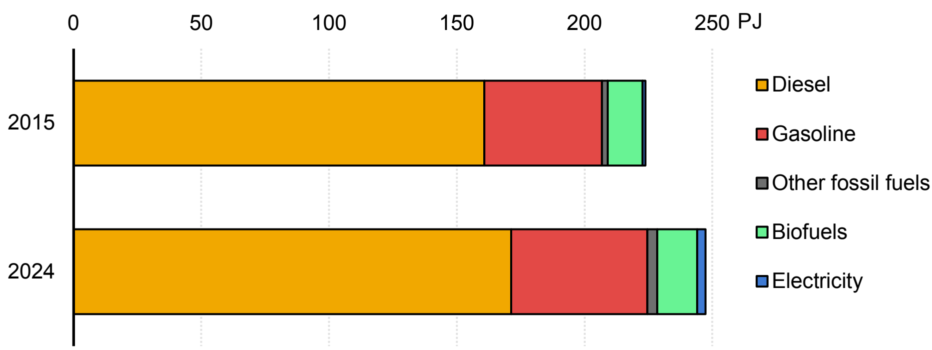
Decarbonising end-use sectors presents a more complex challenge than transforming electricity supply. Policies must influence millions of households, businesses and local authorities, rather than a limited number of utilities and project developers. Cross-cutting barriers include fragmented governance, financing and administrative constraints, particularly for smaller local governments; and shortages of skilled labour for building renovation, heat pump installation and EV charging infrastructure. Social acceptance and behavioural change will also be essential as consumers adapt to new technologies and energy-use patterns. Upfront investment costs and limited access to financing remain important barriers for many households and small businesses, particularly in a context of relatively low incomes and persistent energy poverty.

Electrification is the primary pathway for reducing emissions in end-use sectors: it raises energy efficiency and shifts demand from fossil fuels to Portugal's increasingly low-carbon electricity supply. Yet progress remains slow. From 2015 to 2024, electricity's share of total final consumption rose by only 2 percentage points to 28%, only slightly above the IEA average. Each end-use sector will require a distinct policy approach: in transport, accelerating electrification must be complemented by stronger measures to encourage a modal shift away from private vehicles; in buildings, deep renovations are needed to ensure heat pumps can operate efficiently; and in industry, targeted innovation is required for hard-to-decarbonise processes where cost-effective alternatives are still emerging.

Transport

Transport has made the least progress in Portugal's energy transition. The sector remains almost entirely dependent on imported oil, which covered 92% of transport's TFEC in 2024. The same year transport accounted for 58% of Portugal's net oil imports. Road transport dominates demand, at 94% of transport TFEC in 2024, with passenger vehicles representing around 60% and freight trucks around 40%. Diesel is the primary fuel in both segments. Transport oil demand increased steadily from 2015 to 2020, fell temporarily during the Covid-19 pandemic, and has since returned to a clear upward trajectory. Transport is the largest source of Portugal's energy-related GHG emissions (54% in 2024). Decarbonising transport is, therefore, essential for meeting Portugal's climate and energy security goals.

Energy use in transport by fuel in Portugal, 2015 and 2024



Note: PJ = petajoule.
Source: IEA (2026), World Energy Balances.

Structural factors amplify these challenges. Limited purchasing power drives a strong preference for used vehicles, resulting in a slow vehicle turnover rate and an old and inefficient fleet (with an average age of 14.1 years in 2024, compared with the EU average of 12.7 years). Of roughly 1 million passenger vehicles sold in 2024, 79% were used vehicles and only 21% were new. Despite growing EV sales, rising from nearly zero in 2015 to 38% of new sales in 2025, the EV share in the total fleet is still only around 6%. With population and GDP growth driving rising mobility demand, transport oil demand and GHG emissions continue to increase.

The NECP indicates that meeting the national 55% GHG reduction target will require transport emissions to fall by about 40% by 2030 (compared to 2005 levels). To achieve this reduction, the plan combines measures to shift travel from private cars to public transport, biking and walking; accelerate the electrification of passenger and freight road vehicles; expand the role of electrified rail; and decarbonise aviation and maritime transport.

Modal shift

Shifting trips from private cars to public transport, rail, walking and cycling is Portugal's most durable lever for reducing oil use and emissions. Unlike technological substitution within the car fleet, the modal shift reduces energy demand structurally, reducing both oil consumption and the need for costly grid upgrades by lowering the number (and length) of car trips that must be electrified.

Portugal has taken important steps to support the modal shift. The Incentiva+TP programme is a recent merger of the previous PART and PROTransP programmes, which lowered monthly pass prices, expanded bus and metro services, and reduced household mobility costs. The Incentiva programme gives transport authorities more predictable, long-term financing for service expansion, fare integration and fleet modernisation. Major investments through the EU RRP and Cohesion Policy Funds support electrified public transport, including new rolling stock and metro extensions in Lisbon and Porto, along with large-scale deployment of electric buses and associated charging infrastructure. Measures such as low-emission zones, dedicated bus lanes and digital mobility platforms (MaaS, Co-operative Streets) further support the modal shift.

Sustainable urban mobility plans are now a key planning instrument in Portugal, linking land-use and mobility decisions to promote compact, mixed-use development and reduce car dependence. The Integrated Mobility Pilot in Beira Interior demonstrates how shared, demand-responsive transport can improve accessibility while reducing private car use in low-density regions.

While these initiatives establish a strong foundation, private car use is still increasing and progress on the modal shift remains uneven. Many municipalities face limited administrative capacity to plan and deliver new services, and sustainable urban mobility plans often lack the enforcement tools needed to implement measures such as parking reform, low-traffic zones and street redesign. Integration of ticketing and fare structures across operators – still incomplete in parts of Lisbon and Porto – would also improve convenience and support higher public transport uptake. Improving first-and last-mile access through better cycling infrastructure, safe pedestrian routes, and secure bike parking remains essential to make public transport a viable and attractive alternative to private car use.

Electric vehicles and charging infrastructure

Private vehicle electrification remains the largest single lever for reducing oil demand. Portugal has achieved strong progress: EV uptake has accelerated rapidly, reaching 38% of new passenger car sales in 2025 (one of the highest shares in the European Union); however, the EV share in the total fleet is still only around 6%. This growth has been supported primarily by a favourable fiscal framework. Battery electric vehicles are exempt from the vehicle registration tax and the annual circulation tax; plug-in hybrid electric vehicles receive partial relief based on electric range; and companies benefit from VAT deductibility and exemptions from corporate car taxes that strongly favour battery electric vehicles. Subsidies for new EVs (currently EUR 4 000) have also contributed to uptake, although the annual budget of around EUR 10-12 million supports only about 1% of annual vehicle sales and is typically exhausted within weeks.

Looking ahead, EV policy needs to better reflect consumers' limited purchasing power and the structure of Portugal's vehicle market, where around 80% of purchases are used vehicles. The absence of support for used EVs limits electrification to higher income households. Introducing a used EV subsidy targeted to low-income households, scaled by income and paired with a scrappage requirement, would help lower the average fleet age, reduce emissions and ensure that scarce public resources are directed to those the most in need.

Electrification of high-usage professional vehicles (taxis, ride-hail drivers and delivery vans) offer the highest emissions reduction impact per EUR subsidy and should be priority beneficiaries. Targeted support and dedicated charging facilities at train stations, airports and other high-use corridors would accelerate the electrification of high-usage vehicles. SMEs that rely on light commercial vehicles face similar capital constraints and should also be a focus of support. Expanding Portugal's EV incentive budget would reinforce market confidence and focusing funds on low-income households, SMEs and high-use drivers would maximise impact.

Public sector leadership is equally important. The national government should adopt a binding requirement for all new government vehicles to be electric where technically feasible and set a clear timeline for converting the entire fleet to EVs. Local governments should follow in the same direction, supported by national co-financing and technical assistance to address budget constraints.

Portugal's public charging network has grown rapidly under Mobi.E, which provides a single interoperable platform across operators. As of 2026, the network included roughly 7 650 public stations and 14 450 charging points. The NECP targets more than 21 000 public charging points by 2030. Strategic RRP investments funded multi-charger hubs, ultra-fast stations on major corridors and the Mobility Management Platform, which enables real-time monitoring and system interoperability. Environmental Fund support partially compensates electricity suppliers for public charging operating costs, stabilising charging tariffs and protecting users from wholesale price volatility. National rules have been aligned with the EU Alternative Fuels Infrastructure Regulation, mandating universal access, transparent pricing, multiple payment methods and smart/bidirectional charging capability. In August 2025, Portugal adopted a new legal framework for electric mobility that opens the charging market to greater competition, removes the requirement for charging contracts and simplifies procedures for deploying charging infrastructure.

To ensure charging infrastructure supports increased EV uptake, planning will need continual adjustment to maintain adequate charger-to-vehicle ratios and anticipate higher EV demand scenarios. Co-ordination between grid operators, municipalities and the national Alternative Fuels Infrastructure Regulation Working Group, which identifies investment needs outside the main transport corridors, will be essential to ensure timely grid reinforcement and integration of smart-charging capabilities that let vehicles act as a flexible load. Portugal should also support vehicle-to-grid pilots so that in the longer term EVs can provide full DSR capabilities.

Equity in access will also be critical to maintaining public support. The Electric Streets programme expands street charging in dense urban areas lacking private parking, and Environmental Fund grants cover up to 80% of installation costs for chargers in multi-family buildings. Future charging infrastructure policy should target LV charging in urban areas with a focus on low-income households, ensuring that every driver can benefit from the transition to electric mobility. Strengthening charging infrastructure around park-and-ride hubs would also support combined public transport and EV travel.

Rail and freight decarbonisation

Meeting the NECP's goal of reducing transport emissions by 40% by 2030 also requires strong action to increase the use of electrified rail and boost the efficiency and electrification of road freight. The National Railway Plan, approved in 2025, sets ambitious long-term goals for rail to carry 20% of passenger travel and 40% of freight by 2050. Portugal is making steady progress on rail electrification: 71% of the network was electrified in 2024, well above the EU average of 58%, allowing rail to leverage Portugal's largely decarbonised electricity supply.

The development of a high-speed rail network is central to shifting medium-distance travel away from cars and short-haul aviation. The Lisbon-Porto line, scheduled to be operational by 2030 and designed to carry around 10 million passengers per year, forms the backbone of this strategy, supported by cross-border connections to Spain and proposed extensions toward Vigo. In the longer term, services will need to extend to Algarve and other high-traffic corridors. Successful delivery will depend on strong integration with local transport networks, urban mobility hubs and airports.

Rail freight also offers substantial efficiency and emissions benefits. The NECP prioritises capacity upgrades, interoperability, longer trains and better seaport-rail integration to shift cargo from road to electric rail. Where rail is not viable, electrification of road freight will be essential. Light and medium commercial EVs are already commercially competitive, and heavy-duty electric trucks are entering the market. With appropriately designed depots, managed charging and route optimisation, operators can electrify freight without major distribution grid upgrades. Sustainable biofuels, given their limited availability, should be reserved for the hardest to electrify segments of heavy freight.

Maritime and aviation decarbonisation

Domestic maritime transport and aviation represent a small share of oil demand but remain important for air quality and environmental performance. Portugal has deployed electric ferries in Lisbon and is in the process of upgrading its ports to provide electric onshore power supply to docked ships. Additional efforts are needed to support electrification of ferries and domestic maritime shipping and electrification of port operation vehicles. Aviation presents a longer-term challenge, making this sector a high priority for the limited supply of sustainable biofuels. Emerging electric aircraft offer opportunities for pilot training and regional services. Targeted incentives for electric planes and charging infrastructure would help with the commercialisation of these technologies. In the interim, airports can make progress through full electrification of ground operation vehicles and buses.

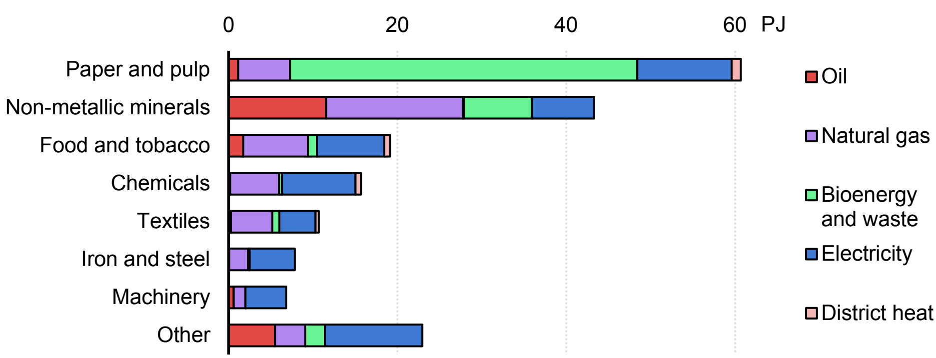
Industry

Industry is at the centre of Portugal's mid-transition challenge. The sector must reduce emissions in line with national climate targets while remaining competitive as markets shift to demand for technologies, materials and industrial products that underpin the energy transition. This dual objective makes industrial decarbonisation uniquely complex, especially in Portugal where a large share of the industrial base is comprised of SMEs with diverse processes and energy needs.

Despite the strategic importance of industrial transformation, progress has been limited. The industry sector has achieved incremental efficiency improvements, but energy demand and GHG emissions have remained broadly stable since 2015, with modest fluctuations driven mainly by market conditions. The industrial fuel mix is mostly unchanged, with little progress on electrification and continued dependence on oil and gas. In 2024, electricity accounted for 31% of industrial energy demand (TFEC), followed by bioenergy at 24%, natural gas at 23%, and oil at 19%.

The structure of Portugal's industry sector has also remained mostly unchanged, with few large-scale investments in new clean energy industrial activities. A small number of legacy subsectors dominate industrial energy use and GHG emissions. Paper and non-metallic minerals together account for slightly more than half of industrial energy demand. Non-metallic minerals generate around a third of industrial GHG emissions. Less energy-intensive industries, including machinery, food and beverages, and textiles, provide most of the sector's value added.

Energy use in industry by fuel and subsector in Portugal, 2024



Source: IEA (2026), World Energy Balances.

To meet its 2030 targets and achieve climate neutrality by 2045 Portugal will need to rapidly accelerate industrial decarbonisation. At the same time, the global energy transition is redrawing the map of industrial competitiveness, with technologies and products that drive decarbonisation becoming the foundation of future growth and trade. Portugal must, therefore, manage two transformations at the same time: cutting emissions from today's industrial base while positioning its firms to compete in emerging markets focused on the energy transition. This will require clear long-term direction, stable policy and innovation frameworks, and an integrated approach that aligns decarbonisation with competitiveness across all subsectors.

Several policy instruments support industrial energy efficiency and decarbonisation efforts. The Management System of Intensive Energy Consumption, in place since 2008, is the main mechanism driving industrial energy efficiency. It requires energy-intensive facilities to undertake regular energy audits and implement identified efficiency measures. The scheme has delivered meaningful improvements in energy performance across multiple subsectors and has helped build technical capacity within firms and service providers. The Environmental Fund provides support for the Management System of Intensive Energy Consumption audits, equipment upgrades and workforce training.

Portugal's RRP provided notable funding for industrial decarbonisation and EU innovation programmes have supported pilot and demonstration projects. Portugal also implements the EU Ecodesign and Energy Labelling framework, which sets minimum energy performance standards for industrial components such as motors, pumps, compressors, power transformers and lighting. The Programa Portugal Indústria 4.0 promotes advanced manufacturing skills and supports SME adoption of automation, data and artificial intelligence technologies.

These measures have resulted in energy transition progress, but they are primarily oriented toward incremental improvements and operate without a unifying strategic framework. The Management System of Intensive Energy Consumption focuses on incremental efficiency gains rather than deeper structural changes. RRP funding has accelerated early projects but will end in 2026, and existing innovation programmes are not structured around industrial decarbonisation priorities.

As a result, companies lack visibility on long-term technology options, future regulatory expectations and the types of support that will be available. This is especially challenging for SMEs, which typically do not have in-house expertise to evaluate technologies, investment needs or sequencing of actions. The absence of subsector emissions reduction pathways makes it harder to co-ordinate infrastructure planning, workforce development and financing and reduces incentives for firms to invest in cleaner technologies at the necessary scale.

A unified Industrial Decarbonisation Strategy can provide the clarity and co-ordination needed to address these gaps. By setting subsector-specific pathways, identifying the technologies and infrastructure required for each industry and outlining targeted measures to unlock investment and strengthen competitiveness, the Strategy can move Portugal from incremental progress to a more comprehensive approach. This includes co-ordinating workforce development, aligning innovation funding with sector-specific needs, and providing stable long-term policy and investment signals.

The forthcoming Green Industrial Strategy offers an opportunity to bring these elements into a single coherent framework. Embedding subsector pathways within this Strategy would ensure that industrial decarbonisation is fully integrated with broader industrial development objectives. With a unified Industrial Decarbonisation Strategy, Portugal would not only gain the clarity needed to reduce emissions across existing subsectors but also strengthen its position to capture emerging clean technology value chain opportunities. Portugal has comparative advantages in abundant renewable electricity, strong maritime infrastructure and established manufacturing capabilities in some markets. Leveraging these opportunities will require stable long-term direction and better alignment between industrial, innovation and energy policies, ensuring that decarbonisation efforts reinforce broader industrial development objectives.

Clean technology value chain opportunities

Portugal's growing residential and commercial heat pump market creates an opportunity to expand domestic manufacturing in a key clean energy technology. Bosch's EUR 100 million investment to expand heat pump manufacturing in Portugal demonstrates the potential to anchor high-value production linked to electrified heating. Building a domestic heat pump industry would advance multiple national priorities. It would lower emissions in buildings and industry; enhance supply chain resilience; and create high-quality jobs in manufacturing, installation and servicing. More broadly, it would embed Portugal within Europe's clean energy technology value chain, ensuring that the country participates not only as a consumer of decarbonisation technologies but also as a producer and exporter.

Portugal could draw lessons from Poland, where strong and stable deployment incentives created a large internal market that, in turn, attracted major manufacturing investment. The combination of sustained demand, targeted incentives and workforce development enabled Poland to build a heat pump manufacturing base and create over 10 000 new jobs. For Portugal, a similar two-track approach expanding domestic demand coupled with clear manufacturing targets, dedicated investment and industrial skills programmes could anchor production capacity at home.

Portugal has demonstrated leadership in floating offshore wind, a technology that will play a key role in accelerating the global energy transition. The country is building on experience gained from the WindFloat Atlantic project, the world's first grid-connected semi-submersible floating wind farm, to launch a large-scale offshore wind development programme aiming for 2 GW by 2030 and longer-term plans for around 10 GW. Efforts should be made to not only deploy floating turbines but also to establish a national offshore wind cluster, including blade, tower and floating-foundation manufacturing, as well as port infrastructure and specialised ship building. Portugal is home to Lisnave, one of Europe's leading ship maintenance and repair yards, and has extensive maritime industrial experience that could be leveraged to capitalise on wider economic benefits of floating offshore wind deployment.

Biomethane can make a modest but meaningful contribution to industrial decarbonisation. Portugal's Action Plan for Biomethane 2024-2040 aims to establish a sustainable market by promoting production, setting clear regulatory frameworks and fostering regional value chains. The NECP estimates technical biomethane production potential at around 4-6 TWh per year, or roughly 15-20% of current industrial gas demand. Production from wastewater, agricultural and food processing residues could strengthen the circular economy. Portugal held its first biomethane contract-for-difference auction in 2024, awarding support for 2 gigawatt hours (GWh) at around 62 EUR/MWh. Scaling up production will be challenging, but successful deployment would reduce emissions and import dependence while creating value in rural regions. France's national biomethane programme, which combined guaranteed feed-in tariffs with regional project support, offers a strong model for scaling production while building regional value chains.

Portugal is updating its National Hydrogen Strategy to account for continued high production costs for electrolytic hydrogen and to align with recent EU legislation, including the requirement that at least 42% of industrial hydrogen consumption be renewable by 2030. The revised Strategy will place an emphasis on using renewable hydrogen for industrial decarbonisation. Hydrogen offers an opportunity for emissions reductions and the future competitiveness of Portugal's economically important refining sector. Galp Energia's 100 megawatt (MW) electrolyser project at the Sines refinery is an example of a well-targeted hydrogen investment. It is designed to produce about 15 000 tonnes of hydrogen per year using electrolysers paired with dedicated renewable energy generation, enough to replace roughly 20% of the site's current hydrogen demand, which is currently met through emission-intensive natural gas reforming. A 100 MW electrolyser, which is expected to produce about 15 000 tonnes of clean hydrogen every year, was installed at Galp Energia's Sines Refinery in January 2026. The Sines project could help open a pathway for Portugal's refining and petrochemical industries to pivot toward renewable-based, higher value chemicals as demand for transport fuels declines. Financial support, such as the recent renewable hydrogen auction, are needed to scale up production and bring down costs.

Portugal's lithium resources could also help the country establish leadership in critical mineral production and battery manufacturing, two of the main pillars of the global energy transition. The government's stated ambition to develop domestic lithium refining and battery manufacturing capacity offers an opportunity to strengthen the industrial base, create skilled jobs and enhance Europe's supply chain security. These opportunities must be realised in a way that safeguards environmental integrity and ensures transparent, inclusive engagement with local communities. Building a competitive value chain from extraction to processing and manufacturing will require careful planning, sustained investment and strong governance.

The NECP notes carbon capture, utilisation and storage as a potential long-term option for hard-to-abate sectors such as cement. Portugal, however, does not have any operational CO_2 storage capacity and only preliminary storage assessments. No commercial infrastructure exists for capture, transport or export of CO_2. Near-term policy should thus focus on direct emissions reductions through electrification and efficiency, while research and development can explore longer-term solutions to process emissions that are better matched to Portugal.

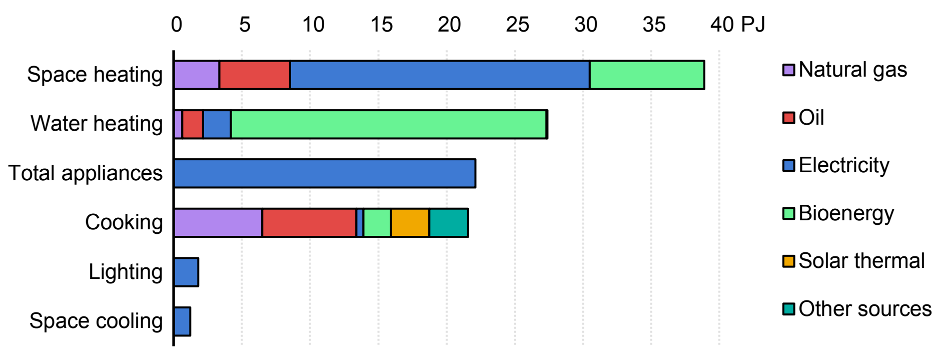
Portugal's industrial transition is about more than decarbonisation; it is about positioning the country for long-term competitiveness in a rapidly electrifying world. The forthcoming Green Industrial Strategy provides a timely opportunity to integrate climate, innovation and economic policy into a coherent mission for industrial energy transition. Building on its low-carbon electricity, Portugal has the ingredients to become a producer and not only a consumer of clean technologies and materials. Delivering this outcome will require consistent direction, co-ordination between ministries and agencies, and targeted investment to scale up promising clusters such as floating offshore wind and heat pump manufacturing. With coherent policy design and sustained commitment, industrial decarbonisation can become the foundation for a new phase of growth, one that aligns Portugal's energy transition with a competitive, future-ready industrial base.

Buildings

Portugal's buildings sector is making a small but notable contribution to the country's energy transition. Electrification has increased gradually and demand for oil heating has declined, supported in part by rising heat pump uptake. From 2015 to 2024, the share of electricity in buildings' TFEC grew from 56% to 59% (IEA average in 2023: 46%), while the share of oil fell from 13% to 10%. These trends have helped to slightly reduce GHG emissions from buildings, which accounted for 29% of Portugal's TFEC in 2024 but only 8% of national emissions.

Energy demand is split roughly 60:40 between residential and service sector buildings, a balance that has remained stable over the past decade. In residential buildings, electricity covers most demand from appliances and cooking, while biomass remains the dominant fuel for space heating, particularly for rural and low-income households. Fuel oil is used mainly for water heating in older homes, and bottled liquified petroleum gas covers a notable share of cooking. Natural gas plays a relatively small role in buildings' energy demand, reflecting the late development of Portugal's gas network and the limited number of buildings with a gas connection. Electricity covers most energy demand in service sector buildings except for space heating, which is mainly supplied by gas and oil.

Energy use in residential buildings by fuel and end use in Portugal, 2023



Source: IEA (2025), Energy End-uses and Efficiency Indicators.

Portugal faces major structural challenges to achieving further progress on an equitable energy transition in the buildings sector. Most of the housing stock is old and inefficient: nearly two-thirds of dwellings were built before thermal performance requirements were introduced in 1990, and around two-thirds lack an energy performance certificate (EPC), limiting the ability to target renovation programmes effectively. Among the buildings that do have an EPC, about three-quarters fall short of modern comfort standards. High levels of energy poverty mean that many households are unable to adequately heat or cool their homes, face high energy bills, and have a limited capacity to invest in upgrades.

Central role of deep renovations and electrification

In light of these challenges, a major acceleration of deep renovations is essential to meet Portugal's energy transition and social policy goals. Deep renovations provide the structural upgrades needed to cut energy poverty, improve comfort, and eliminate oil and gas use in buildings, which are the main source of the sector's GHG emissions.

Electrification provides the primary pathway for reducing building GHG emissions and improving comfort, but it can only deliver these benefits when combined with deep renovation. Heat pumps are expanding rapidly in Portugal and can provide efficient heating and cooling, reduce bills, and improve comfort year-round. But deep renovations are needed to ensure that heat pumps are correctly sized and efficiently operated. Renovation should also include induction cooking and EV-ready wiring. Distributed PV and behind-the-meter batteries can further reduce energy bills and support system flexibility, but due to their cost, they will not be included in every project. Deep renovation programmes should include these technologies when affordable for the owner, or at a minimum ensure that buildings are PV- and battery-ready by incorporating pre-wiring, roof suitability and electrical panel upgrades so that households can add PV and batteries when they are able to.

The buildings sector also faces a parallel public health challenge. Biomass remains the primary fuel for residential space heating, especially for low-income households. Its widespread use is contributing to poor indoor air quality and seasonal spikes in urban particulate pollution. Replacing biomass heating with heat pumps, coupled with deep renovation to reduce overall heat demand, would improve indoor comfort, lower exposure to air pollution and provide important public health benefits. Portugal's renovation challenge, therefore, centres on developing policies that can rapidly accelerate comprehensive renovation packages that improve comfort, reduce emissions and enable efficient electrification across the housing stock.

Policy and institutional landscape

Portugal has established a solid policy foundation for building renovation, anchored in two long-term strategies: 1) the Long-Term Strategy for Building Renovation charts a pathway toward nearly zero energy buildings by 2050; 2) the Long-Term Strategy for Combating Energy Poverty aims to eradicate energy poverty by 2050 through targeted renovation, stronger social protection and improved monitoring. Together these strategies provide a coherent long-term vision for a more efficient and equitable building stock.

The Long-Term Strategy for Building Renovation calls for the renovation of 364 million square metres of floor area by 2030, or roughly 49% of the national stock. However, progress toward this goal remains far below target. By the end of 2023 only 4.1% of residential and 2.7% of non-residential floor area had been renovated. This illustrates the scale of the challenge and highlights the need for measures that accelerate deep, comprehensive renovation rather than incremental upgrades.

Portugal's buildings policy landscape involves a broad set of actors. The Ministry of Environment and Energy Transition provides national strategic direction for renovation and energy poverty policy. The Portuguese Energy Agency (ADENE) plays a central role in policy implementation through administration of the EPC system, building efficiency programmes, consumer information tools and technical support to the government. The Association of Energy and Environment Agencies, representing municipal and regional energy agencies, supports local deployment of renovation programmes and provides on-the-ground engagement with households and SMEs. The Housing and Urban Rehabilitation Institute oversees social housing policy and is responsible for renovation and rehabilitation programmes of the public housing stock. Municipalities manage permitting and local outreach, while commercial banks, financial institutions, ESCOs and installers provide financing and technical delivery. This broad landscape underscores the need for strong co-ordination so that renovation policies can be implemented efficiently and consistently across the country.

Data systems and building information will be critical to scaling deep renovation. ADENE's ongoing modernisation of the Energy Certification of Buildings system is improving the clarity and usability of EPCs, including comfort indicators, prioritised renovation actions and links to available financial support. However, building-related data remain dispersed across multiple institutions, limiting the ability to target programmes effectively, identify priority buildings or monitor renovation depth. Strengthening data integration across EPCs, social housing registries, municipal records and smart meter information would help to more accurately target support to low-income households, improve planning for one-stop shops and prioritise deep renovation interventions. Improved interoperability would also enhance Portugal's contribution to the EU Building Stock Observatory and enable more consistent monitoring of progress toward long-term renovation goals.

Portugal has a wide range of programmes and measures that support building efficiency improvements, including appliance and equipment incentives and support for renewable heating and insulation upgrades. However, these programmes are not clearly co-ordinated, and none provide a comprehensive pathway to deliver deep renovations. In addition, these schemes are administratively complex and often difficult for households to navigate. As a result, support has mostly reached households that are already capable of managing contractors and financing, while those most in need face high barriers. The government has signalled a clear intention of directing policy support to low-income households, but so far these measures have generally focused on single technologies and have included support for heat pumps without requiring upgraded insulation. Existing programmes therefore help deliver incremental improvements but fall short of enabling comprehensive renovation packages. Portugal needs stronger co-ordination, simplified delivery and mechanisms that actively support deep renovation to accelerate progress toward its 2030 and 2050 goals.

Measures to accelerate deep renovation

Portugal has many institutions and programmes supporting building renovation, but these do not provide households or small businesses with a clear, co-ordinated pathway for undertaking deep renovations. Strengthening delivery structures and creating stronger market incentives can help shift Portugal from incremental upgrades to comprehensive renovation packages that reduce emissions, improve comfort and address energy poverty.

One-stop shops need to become the central mechanism for organising and delivering deep renovations. Portugal has established a growing network of local one-stop shops, supported by the Association of Energy and Environment Agencies and operated largely through municipal and regional energy agencies. These centres provide outreach and basic guidance to households and SMEs on building renovations. Their current scope varies across municipalities, with most focusing on awareness raising. To accelerate deep renovations, Portugal should reinforce and expand its network of one-stop shops so that they can deliver comprehensive renovation support. This includes managing the entire process from initial assessment to project delivery, covering permitting, accessing financial support, contractor selection and quality control. This would significantly reduce the burden on households and SMEs and be especially beneficial for low-income households. Ireland’s model shows that well-resourced one-stop shops, supported by strong communication and outreach strategies, can drive deep renovations at scale while creating skilled local employment across regions.

Portugal should also establish a broad white certificate programme to mobilise private investment and significantly expand the range of actors that can participate in building renovations. Under such schemes, an obligated party (typically energy suppliers, but potentially network operators or fuel distributors) must deliver a defined volume of verified energy savings each year. These savings are expressed as tradable “white certificates”, which are issued only after approved measures or renovation packages have been completed and verified. A well-designed scheme enables multiple pathways for compliance. Obligated parties may undertake efficiency measures directly in residential or service sector buildings; support consumers financially or technically to carry out eligible renovation actions; or purchase certificates from third parties such as ESCOs, energy communities, SMEs or installers that have delivered verified savings.

This approach creates an open market for renovation activity, allowing any qualified actor to identify opportunities, implement measures and receive payments through the certificate system. It directly expands the delivery ecosystem beyond public programmes and large utilities, enabling SMEs, local installers and ESCOs to play a much greater role. This is particularly important in Portugal, where the ESCO market remains underdeveloped and concentrated in a small number of public sector and large industrial clients. A white certificate programme would give ESCOs a stable revenue stream and a clear business case to scale their activities in the residential and services sectors.

White certificate schemes can also be structured to prioritise deep renovations. By awarding proportionally more certificates for comprehensive renovation packages than for individual measures, the system naturally steers market activity toward high-impact projects that deliver greater emissions reductions, lower bills and improved comfort. It can also include additional incentives for renovations in low-income households or social housing stock, ensuring that market-driven investment supports social policy objectives.

International experience shows that well-designed white certificate schemes can drive large-scale investment, standardise verification and support the delivery of deep renovations. Italy's scheme, in place for more than two decades, illustrates how certificate mechanisms can evolve over time and continue to stimulate efficiency improvements. Poland's programme offers an example from a country with a similar building stock and income profile, demonstrating that white certificate markets can scale even in contexts where households have limited capacity for upfront investment. Portugal could also explore co-operation with Spain, which introduced a white certificate programme in 2023, to develop an Iberian market that benefits from greater scale, shared verification systems and lower administrative costs. For Portugal, a well-designed scheme with clear rules and transparent monitoring would provide a powerful complement to grant-based programmes and help accelerate renovation at a scale consistent with the country's 2030 and 2050 goals.

Public funding will remain essential to ensure that all households can participate in the energy transition. In the first instance, support should be targeted to low-income households and social housing, where the benefits of renovation for comfort, affordability and health are the greatest. At the same time, renovation programmes should also extend to middle-income households to ensure that renovation rates increase across the broader housing stock and to strengthen social acceptance of the transition. Support should be scaled to household income so that lower-income households receive the highest levels of assistance.

Social housing is also a strategic opportunity: projects can be bundled, and there is a single responsible authority, making deep renovation easier to deliver at scale. Ensuring that the Housing and Urban Rehabilitation Institute has adequate resources, staffing and co-ordination support will be critical for accelerating renovation in the social housing stock, combined with local delivery capacity through municipalities and energy agencies.

Portugal will also need to expand its skilled workforce to deliver deep renovations at scale. Construction and renovation activities are labour-intensive, and current capacity constraints, particularly for insulation installers, qualified heat pump technicians and electricians, already limit the pace of renovation. Recent initiatives under the RRP and national training programmes provide a foundation, but expanding deep renovations will require stronger co-ordination between national authorities, ADENE, the Association of Energy and Environment Agencies, training institutions, and industry. Scaling the workforce for construction trades and renovation services would not only support climate and energy goals but also deliver significant employment and local economic benefits.

Portugal has the strategic foundations to make progress, but achieving deep renovations at scale will require a step change in delivery capacity. Strengthening one-stop shops, creating a white certificate programme and directing public funding to where it generates the greatest benefit would create an integrated renovation system capable of addressing Portugal's energy poverty challenge, reducing emissions and enabling efficient electrification. Together these actions would transform renovation from a fragmented set of individual measures into a coherent national programme that supports households, strengthens local economies and accelerates Portugal's clean energy transition.

Recommendations

1 Adopt a national roadmap based on bottom-up sectoral agreements to support timely and cost-effective emissions reductions.

Portugal has established a clear long-term direction for its energy transition through the Roadmap for Carbon Neutrality 2050, the Basic Climate Law, and the National Energy and Climate Plan (NECP) 2030. The NECP commits to reducing GHG emissions by 55% by 2030 (vs. 2005 levels) and achieving climate neutrality by 2045. Strong progress has been made, with emissions down 43% in 2024, driven mainly by decarbonisation of electricity supply. Portugal is now entering a mid-transition, in which further progress will depend increasingly on end-use sector decarbonisation, where emissions remain high and structural declines have yet to materialise.

To stay on track to meet its goals, Portugal needs to translate its strategic ambitions into a coherent, co-ordinated national roadmap, such as the Roadmap for Carbon Neutrality, which is under review in 2026. While the NECP identifies clear objectives, the pathways for achieving them are dispersed across numerous strategies, regulatory reforms and funding programmes. This fragmentation makes it difficult to align investment planning, infrastructure needs, workforce development and consumer incentives. A national roadmap would integrate these efforts, increase transparency, and provide clarity and direction for authorities, industry and consumers.

The roadmap should be built on bottom-up sectoral agreements, developed in close collaboration with industry, municipalities, and labour and consumer groups, to ensure that each sector's pathway reflects practical implementation barriers, technology readiness and cost-effectiveness. This approach would also help sequence actions in electricity, buildings, transport and industry; support targeted measures where progress is lagging; and build shared ownership of the transition.

A well-defined roadmap would provide the predictability required for investment, help avoid bottlenecks in supply chains and workforce skills, and ensure that Portugal's 2030 and 2045 goals remain achievable. This effort could build on the ongoing revision of the Roadmap for Carbon Neutrality 2050, led by the Portuguese Climate Agency, which offers an opportunity to integrate sectoral pathways under a coherent national framework.

2 Ensure a fair and effective energy transition by empowering the groups most impacted by, and critical to delivering, the transition.

In line with the IEA's people-centred transition recommendations, which emphasise fairness, inclusion and active participation, Portugal's energy transition will depend on empowering the groups most affected by and essential to delivering on it. Actions are being taken under the Just Transition Fund, as well as through the implementation of the Social Plan for Climate Action, which was the subject of public consultation in 2025 at the national level. High energy poverty rates mean many households face financial and structural barriers, yet they are also central to driving change through their decisions concerning renovation, heating, mobility and on-site energy production.

Ensuring that public support empowers low-income households to participate in the transition by improving access to building renovation, clean heating, efficient appliances, distributed PV, behind-the-meter batteries, electric vehicles and charging options, and affordable mobility is essential to avoid widening inequality and to maintain social acceptance.

Structural changes in the energy system will also affect workers and regions linked to fossil fuel supply chains. Portugal's gas sector faces declining demand and the oil sector's long-term trajectory will be similar. Workers in these sectors have valuable technical and customer facing skills that can support electrification, building renovation and emerging clean energy industries, but they will need clear pathways for retraining and redeployment.

Targeted labour market measures, workforce programmes and regional support can help ensure that these workers benefit from the opportunities created by the energy transition. Lessons from Portugal's recent industrial transitions, including the closure of the Matosinhos refinery and the retirement of coal-fired plants, highlight the importance of early planning, co-ordinated regional support and clear pathways for workforce redeployment.

Delivering on Portugal's climate and energy objectives depends heavily on the capacity of the institutions implementing them. Municipalities, regional agencies, regulators and public bodies face rising workloads as they manage grants, permitting, renovation programmes, grid planning and evolving market regulations. Many report resource and skills constraints that slow implementation and limit the pace at which investment can be delivered. Strengthening institutional capacity, improving technical skills and ensuring adequate staffing will be essential so that clean energy programmes reach households and businesses in all regions and the transition proceeds at the scale and speed required.

3 Ensure electricity prices reflect the cost of supply so that consumers can fully benefit from electrification, while protecting vulnerable and low-income households.

Transparent electricity price signals are essential for Portugal's energy transition. Households, small and medium-sized enterprises, and industry will take many of the decisions that drive electrification, including replacing fossil fuel equipment with heat pumps, purchasing electric vehicles and efficient appliances, and investing in industrial electrification. These choices depend heavily on operating costs and payback periods.

Electricity prices in Portugal currently include numerous non-energy and non-network charges, including the cost of legacy subsidies, energy efficiency levies, financing of the social tariff, recovery of the tariff deficit, tariff convergence costs for the Azores and Madeira, funding for the Directorate-General for Energy and Geology, the CESE levy on energy companies, and the audiovisual fee.

Essential policy costs should be shifted to the state budget with clear multiannual commitments while temporary or distortionary charges should be removed. This would accelerate electrification by providing cost-reflective electricity prices while ensuring continued support for essential programmes. Improved time-of-use price signals would strengthen the economics of photovoltaics and batteries, electric vehicle smart charging, heat pumps, distributed energy resources, and demand-side response. This would empower consumers to participate in the transition, supporting higher shares of renewables and increased system flexibility while lowering electricity bills.

Strengthening price signals must go hand-in-hand with maintaining affordability given Portugal's relatively high levels of energy poverty. Portugal's social tariff provides important discounts for eligible low-income households. However, the number of beneficiaries has remained stable, indicating underlying affordability challenges that cannot be addressed through tariff discounts alone. Social tariff support should be linked to consumption (kWh) thresholds and financed through the state budget. An irreversible phase-out of the regulated tariff is also needed to support price transparency and incentivise efficient consumption. Complementary support measures for deep building renovation, appliance efficiency and access to clean mobility will also be essential to ensure that low-income households can fully benefit from the transition as price signals improve.

4 Accelerate electrification of the transport sector with a focus on support for used electric vehicles, expansion of the urban charging network and renewed measures to increase modal shift.

Portugal's uptake of electric vehicles (EVs) is expanding rapidly, supported by a favourable fiscal regime and a well-developed charging network along major corridors. In 2025, EVs accounted for 38% of new car registrations, higher than the average EU share. Public transport policy has also delivered successful fare-reduction programmes and expanded services. However, major challenges remain. Oil covered 92% of transport total final energy consumption in 2024, road transport remains dominant, and the vehicle fleet is relatively old and inefficient. Transport is the largest source of Portugal's energy-related greenhouse gas emissions (54% in 2024) and transport oil demand continues to grow.

Shifting trips from private cars to public transport, rail, walking and cycling is Portugal's most durable lever for reducing oil use and emissions. Unlike technological substitution within the car fleet, modal shift reduces energy demand structurally, lowering oil consumption and the need for costly grid upgrades. At the same time, private vehicle electrification remains essential for decarbonising the large share of travel that will continue to rely on road transport. Achieving this shift will require sustained behavioural change supported by policies that make public transport, walking and cycling convenient, affordable and attractive alternatives to private car use.

EV policy needs to better reflect limited purchasing power and the structure of Portugal's vehicle market, where around 80% of purchases are used vehicles. Introducing a used EV subsidy targeted at low-income households would help lower the average fleet age and reduce emissions. Professional drivers and small and medium-sized enterprises should also be priority beneficiaries, ensuring that scarce public resources reach those with the greatest financial need and those with the highest potential to reduce emissions.

Expansion of charging infrastructure should prioritise low-voltage charging in urban areas, where many households rely on street parking and cannot install private chargers, with specific attention to low-income households. Strengthening charging availability around park-and-ride hubs would enhance integration between public transport and EV use.

Rail freight also offers substantial efficiency and emissions benefits and more efforts are needed to shift freight from Portugal's diesel-dependent truck fleet to its highly electrified rail system. Modal shift must remain a central pillar of transport policy. Urban and regional planning should ensure equitable access to active mobility options, reliable and affordable public transport, and national high-speed rail so that all citizens can benefit from cleaner and more efficient mobility.

5 Establish an industrial decarbonisation strategy with subsector emissions reduction pathways, identifying targeted measures to unlock investment and strengthen competitiveness.

Portugal's industrial emissions have remained broadly flat for more than a decade, even as national climate ambition has increased. The sector now faces two transitions at the same time. Existing industrial facilities must cut emissions rapidly to meet the 2030 targets and industry must position itself to compete within global value chains that are shifting to clean technologies and low-carbon production. These pressures come at a time when electrification and efficiency measures remain uneven across subsectors and when many Portuguese industries, particularly small and medium-sized enterprises (SMEs), face structural constraints related to scale, skills and access to capital.

A clear industrial decarbonisation strategy, building on the forthcoming Green Industrial Strategy, currently under preparation and expected to be finalised during the first half of 2026, can provide the direction needed by establishing subsector emissions reduction pathways that reflect Portugal's diverse industrial base and identify where additional policy, regulatory or financial measures are required.

Industrial processes use fuels, heat and feedstocks in very different ways, so decarbonisation pathways must be tailored to the different subsectors. Electrification and energy efficiency should remain the primary focus for most subsectors, supported by stronger implementation of the Management System of Intensive Energy Consumption energy audit programme and targeted measures for SMEs and innovation.

At the same time, Portugal has opportunities to build new value chains around emerging clean technologies. Bosch's recent investment in domestic heat pump manufacturing illustrates how stable demand signals and workforce programmes can anchor production capacity and create skilled jobs. International experience, including Poland's rapid scale up of heat pump manufacturing, shows how policy stability and strong market signals can accelerate this process. Implementation of the biomethane strategy needs clearer milestones to provide a pathway for hard-to-decarbonise sectors to transition away from natural gas.

A national industrial decarbonisation strategy with bottom-up sectoral pathways and targeted measures would support investment, boost competitiveness and ensure that industry can play a greater role in Portugal's energy transition.

6 Accelerate deep renovations through comprehensive one-stop shops, a white certificate programme and targeting those the most in need.

Portugal's buildings sector has relatively low greenhouse gas emissions, reflecting a high level of electrification. Despite this, buildings remain central to Portugal's energy transition and social policy goals. Most of the housing stock is old and inefficient, and high rates of energy poverty mean many households face low comfort, high bills and limited ability to invest in upgrades. Deep renovations are essential not only to reduce emissions but also to improve comfort, cut energy poverty and deliver efficient electrification.

Progress, however, remains limited. Portugal has numerous building efficiency support schemes, but the programmes are fragmented, administratively complex and often focus on single measures rather than deep renovations. Heat pump uptake is accelerating, but energy savings depend on pairing heat pumps with deep renovations that improve thermal insulation.

To accelerate deep renovations, Portugal should reinforce and expand its network of one-stop shops so that they can deliver comprehensive renovation support. This includes managing the entire process from initial assessment to project delivery, covering permitting, accessing financial support, contractor selection and quality control. Ireland’s model shows that well-resourced one-stop shops, supported by strong communication and outreach strategies, can drive deep renovations at scale while creating skilled local employment across regions.

Portugal should also establish a broad white certificate programme that rewards energy suppliers, energy service companies, energy communities, small and medium-sized enterprises, and consumers for verified energy efficiency improvements. Successful schemes in Italy and Poland show that white certificates can mobilise private capital and drive large-scale renovation. Portugal should also explore co-operation with Spain to develop an Iberian white certificate market, allowing both countries to benefit from greater scale and more efficient programme delivery.

Given Portugal’s persistent energy poverty challenges, public support for deep renovations should be targeted to low- and middle-income households and social housing. Together these actions would turn the renovation challenge into a cornerstone of social, economic and climate progress and ensure that all people benefit fully from Portugal’s energy transition.

Focus area: Energy security in the mid-transition

Portugal's energy system is entering the mid-transition that requires managing two interconnected energy systems moving in opposite directions. Rapid growth in renewable electricity generation, particularly solar PV, is changing the balance of the electricity system and driving structural declines in natural gas demand. Meeting 2030 climate and energy targets and placing the country on a path toward carbon neutrality by 2045 will require rapidly scaling up end-use electrification in tandem with renewable generation from solar PV and wind and managing an orderly decline of natural gas to mitigate price shocks and avoid stranded assets.

Ensuring energy security through the mid-transition will require transforming Portugal's electricity system from one dominated by large, centralised plants to a more flexible, digitalised and distributed system. As gas-fired generation operates fewer hours, its ability to provide short-term flexibility and system stability will diminish, increasing reliance on storage, DSR and stronger TSO-DSO co-ordination. Managing these shifts calls for integrated efforts across policy design, system planning and daily operations, as well as regulatory and market reforms that ensure people and businesses can actively participate in, and benefit from, the evolving energy system.

Portugal has made steady progress on its energy transition over the past two decades, notably through strong wind deployment and the phase-out of coal in 2021. But until recently, the overall structure of the energy system had changed little. Electricity demand remained broadly stable and the generation mix continued to swing between strong hydro years with high renewable shares and dry years that required increased gas-fired generation and electricity imports from Spain. Outside the electricity sector, fossil fuel use in buildings and industry showed limited decline, while transport oil demand increased. These patterns are now shifting as rapid solar PV growth and accelerating end-use electrification begin to reshape both electricity supply and fossil fuel demand.

From 2015 to January 2026, installed PV capacity increased from just 0.5 GW to 6.9 GW. PV generation has moved from being a marginal resource to a core element of the system and is now consistently displacing gas-fired generation, regardless of annual variations in hydropower generation. Even in a dry year, gas-fired generation will not return to the levels observed in the past. As a result, CCGT operating hours have fallen below 3 000 hours per year on average and reached record lows in 2024. The PV surge is also creating a more decentralised electricity system. Of the 6.9 GW of PV capacity installed as of January 2026, 3 GW is connected to the distribution grid and around 2 GW of this distributed capacity has been added since 2021.

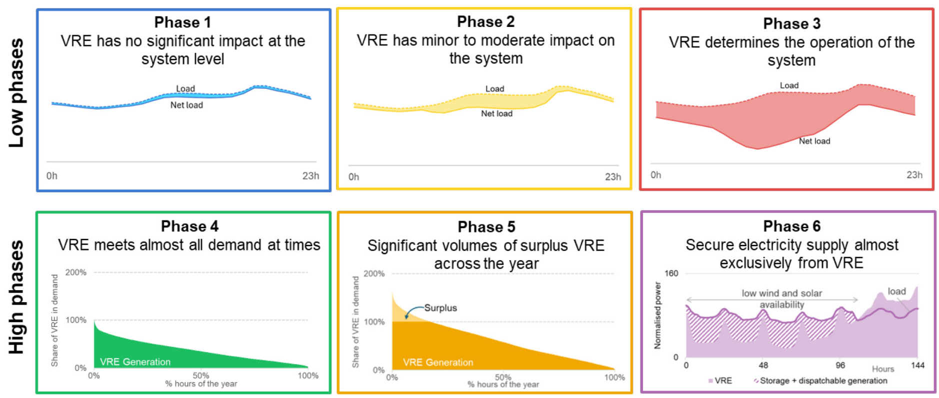
Electricity demand is now expected to grow after decades of relative stability (+1.0% from 2015 to 2024). From 2015 to 2024, heat pump sales increased by around 350% and EV sales rose from a negligible share to 38% of new registrations in 2025. As of December 2025, there were more than 45 gigavolt ampere (GVA) of new grid connection requests from large electricity consumers, with over 10 GVA already allocated or reserved. Electricity demand in 2024 reached a record 51.3 TWh. Official planning documents[1] give a wide range for expected 2030 demand, reflecting uncertainty about the pace of end-use electrification and the connection of new large industrial and data centre loads. What is clear is that strong growth in electrification across transport, industry and buildings, combined with rapid scaling of PV and wind generation, is essential for meeting Portugal's 2030 climate and energy targets and putting the country on a path to carbon neutrality by 2045.

Portugal is now in Phase 4 of the IEA's Phases of Variable Renewable Energy (VRE) Integration Framework, when VRE generation frequently meets most or all demand for extended periods. In 2024, VRE provided about 46% of total electricity generation, and its contribution is expected to increase to around 65% by 2030. As VRE expands, not only does its annual share grow, but the number of hours during which

[1] The NECP, the TSO's planning scenarios, Direção Geral de Energia e Geologia (2024), CN50 Energy Scenarioand Direção Geral de Energia e Geologia (2025), Monitoring Report on the Security of Supply of the National Electricity System.

VRE supplies a dominant portion of electricity demand also increases. In 2024, VRE met around half of demand during roughly one-quarter of the hours of the year. This could rise to around half of all hours by 2030, according to current projections. These conditions introduce additional operational challenges related to system stability, flexibility and balancing, particularly during periods of very high VRE output, while also increasing the need to ensure system adequacy during periods of low VRE availability. As a result, Portugal is expected to move towards Phase 5 of the IEA VRE integration framework.

Six phases of Variable Renewables integration



Source: IEA (2025), Carbon-Free Electricity in G20 Countries.

At these levels, CCGTs will operate very infrequently, reducing available inertia and short-term flexibility and further increasing the risk of an unmanaged exit of gas-fired generation. Maintaining reliability will depend on scaling up battery storage and DSR, complemented by longer duration flexibility from pumped hydro and cross-border interconnections.

Climate variability is also reshaping Portugal's energy security landscape. The IEA Portugal Climate Resilience Policy Indicator shows that climate change will increase Portugal's average annual temperature while annual precipitation will decline and become more variable. This increases the risk that hydropower be constrained by drought and that frequent heatwaves could reduce electricity generation and grid infrastructure capacity while driving up electricity demand from air conditioning. These risks reinforce the need for a flexible, diversified and well-managed electricity system that can maintain security across more varying conditions.

The Iberian Peninsula blackout of April 2025 demonstrated the key role that electricity has in providing energy security. The event caused several hours of outages across Portugal and Spain, affecting 60 million people and disrupting transport, communications and industry. According to the factual report by ENTSO-E and analysis conducted by the Spanish system operator Red Eléctrica, the incident was of multifactorial origin, caused by insufficient voltage control capacity and power oscillations in the Spanish grid that resulted in rapid disconnections leading to a further surge in voltage that spread to the Portuguese grid. In its aftermath, the Portuguese and Spanish TSOs strengthened joint operational planning and contingency co-ordination, accelerated grid-resilience upgrades, and expanded battery and DSR pilots to enhance system stability. These measures mark important first steps, but the event highlights the need for continued vigilance and investment to maintain reliability as the energy transition advances.

The broad shifts driven by Portugal's mid-transition underscore the need for an integrated approach to electricity and gas planning that links infrastructure development, flexibility needs and gas system phase-out pathways into a coherent strategy that supports cost-effective achievement of energy and climate targets.

Integrated energy system planning

Portugal enters the mid-transition with several structural advantages for co-ordinated electricity and gas planning. REN serves as the TSO for electricity and gas, and the distribution landscape is relatively concentrated, with E-REDES operating most of the electricity distribution system and a small number of gas DSOs covering the bulk of gas distribution. System operators, ERSE (the independent energy regulator) and the government also benefit from co-operative working relationships. Together these features give Portugal a strong foundation for developing an integrated energy system planning framework. Elements of electricity/gas co-ordination already exist. Sector coupling is included in adequacy assessments for the electricity and gas systems. Interconnected electricity and gas demand assumptions are used in the development of grid and network investment plans. These efforts provide an important starting point for deeper, more formalised integration.

Portugal's mid-transition dynamics require a step change in how electricity and gas planning is carried out. Rapid growth in solar PV is reshaping the operational profile of the electricity system, reducing the running hours of gas-fired plants and sharply increasing the volume of generation connected at the distribution level. Electrification of transport, buildings and industry is starting to accelerate, and requests for grid connections from new large industrial and data centre loads have grown notably, though there is significant uncertainty about the pace of overall electricity demand growth. At the same time, natural gas demand is declining much faster than expected and will continue to fall as electrification advances. Managing this decline will require careful attention to operational reliability, fair cost recovery, and avoiding stranded assets and price shocks.

These shifts mean that electricity and gas can no longer be planned through separate processes with shared assumptions. Investment decisions in one system increasingly affect the other system, and the risks of misaligned investment and inefficient system development grow as the pace of change accelerates. An integrated planning framework will ensure infrastructure investment, flexibility needs, gas phase-out pathways and remuneration models evolve in a co-ordinated and least-cost manner.

Portugal should establish an integrated energy system planning framework that links electricity and gas development pathways and aligns planning cycles. This framework should use joint scenarios that reflect climate targets, electrification trends and realistic expectations for the decline in gas demand. Planning should include uncertainty ranges rather than fixed forecasts so that decisions can be adapted as system conditions evolve. Integrated planning should clarify how the gas system will operate reliably during a managed decline in gas demand, including how decommissioning responsibilities will be assigned and financed. At the same time planning will need to clarify how electricity system flexibility will be scaled up in parallel with electrification and renewable deployment. To support this approach, REN is developing supplementary simulation models to capture uncertainty in generation and demand projections. These tools allow planners to test system adequacy and flexibility needs under a range of possible scenarios and help identify critical operating conditions for the network.

Several countries offer approaches that are relevant to Portugal's needs. Denmark uses fully integrated electricity and gas scenarios that include explicit gas phase-out trajectories. The Netherlands combines electricity and gas planning with regional energy strategies that align local electrification with grid needs and gas network evolution. Ireland's single TSO planning framework provides system-wide scenarios that integrate renewable build out, gas system adequacy and future flexibility requirements. These examples show that clear scenario design, linked planning cycles and transparent cross-sector methodologies can guide investment toward cost-effective and climate-aligned outcomes.

An integrated planning process needs to be complemented by remuneration mechanisms that support stable financing for electricity system expansion and a managed, cost-effective decline of the gas network.

Appropriate remuneration

Portugal’s current tariff and remuneration models were designed for systems where both electricity and gas demand were expected to grow steadily. Network operators recover their costs through a regulated asset base with an allowed rate of return, supplemented by volumetric tariffs and a limited set of quality-of-service incentives. In a mid-transition context, this approach is increasingly misaligned with the system’s needs. The electricity sector requires targeted investment in grid capacity, flexibility and digitalisation rather than simple expansion of traditional assets, while the gas sector must manage a structural decline.

Some important steps have already been taken. ERSE has begun to modernise remuneration by introducing a methodology based on total expenditure (TOTEX) for electricity networks, which evaluates capital and operating expenditures together rather than separately, reducing the traditional bias toward capital investment. ERSE’s opinions on TSO and DSO plans have also emphasised the need to align investments with decarbonisation targets, demand uncertainty and emerging flexibility needs. For electricity networks, ERSE has encouraged system operators to consider non-wire alternatives and to prioritise projects that enable the integration of renewables and distributed resources. For gas, ERSE has warned that proposed expansion projects are inconsistent with the observed decline in gas demand and carry stranded asset risks.

Despite progress, the current remuneration approach for electricity still favours capital-intensive grid expansion. The existing TOTEX methodology remains primarily a cost-control tool and does not yet provide incentives for electricity system operators to choose operational solutions, digitalisation or flexibility in place of reinforcement. Capital investments remain more visible and easier to justify within the current framework, while flexibility, active network management and digital solutions lack clear remuneration signals. As a result, reinforcement continues to dominate planning and investment decisions even when more cost-effective operational solutions are available. For gas, the framework still lacks a clear approach for managing decline and funding decommissioning, which creates affordability pressures and risks leaving inadequate resources for end-of-life responsibilities as demand falls.

Portugal should, therefore, update its remuneration frameworks so they support the mid-transition pathway. This requires two complementary steps. First, for electricity, Portugal should build on its initial adoption of TOTEX and strengthen it into a fully developed remuneration framework that places operational solutions, digitalisation and flexibility on equal footing with capital reinforcement. Portugal should also introduce a performance-based regulatory framework that rewards operators for delivering measurable system outcomes, such as reduced network constraints, lower curtailment of renewable generation, increased hosting capacity, greater use of demand-side flexibility. International experience, including the United Kingdom's RIIO-ED2 framework and implementation of performance-based regulation, shows that a mature TOTEX approach combined with performance-based incentives can align utility remuneration with decarbonisation, distributed energy resources (DERs) integration and flexibility, and support efficient investment.

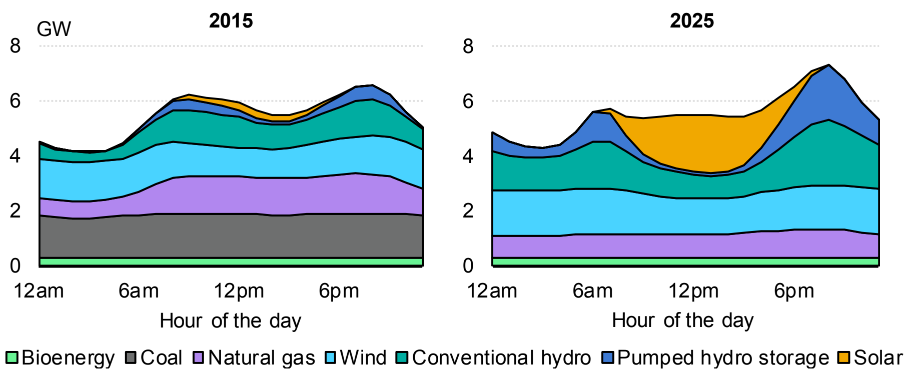
For gas, remuneration should shift from supporting system growth to supporting a managed and socially fair phase-out. The framework should provide stable funding for safe and reliable operation as throughput declines, create explicit provisions for decommissioning and site remediation, and allocate costs in a way that limits price shocks for remaining consumers, particularly vulnerable households. Designing electricity and gas remuneration reforms within a single integrated planning process will help ensure that investment flows are consistent with climate targets, maintain energy security through the mid-transition and minimise the overall cost of Portugal's energy transformation.

International experience, including the Netherlands' approach to managing the phase-out of production from the Groningen gas field, shows that remuneration frameworks can support an orderly phase-out by using tools such as accelerated depreciation, strict tests for new investments and clear criteria for when asset consolidation is preferable to reinforcement.

Proactive grid planning

Increased solar PV generation, combined with sustained wind and hydro output, is driving structural changes in the operation of Portugal's electricity system. Between 2015 and 2025, PV shifted from a negligible resource to providing close to 50% of the power injected into the grid during peak solar hours. This has reshaped intra-day power flows. Solar PV is now the main source of generation mid-day, while wind and hydro generation dominate in the evening and early morning peaks.

Average hourly electricity generation in Portugal, 2015 and 2025



Note: Conventional hydro includes run-of-river hydro and reservoir hydro.
Source: IEA analysis based on ENTSO-E (2026), Transparency platform (accessed March 2026), collected through the IEA Real-time Electricity Tracker.

The rise of solar PV has also fundamentally changed how Portugal's large pumped hydro fleet operates. Pumping activity is concentrated during solar hours when high levels of PV in Portugal and Spain drive down wholesale prices. Pumped hydro discharge increasingly serves the evening ramps that were previously met by CCGT generation. As a result, there has been a structural decline in gas-fired generation, with CCGTs shifting from mid-merit generators to residual, system security assets, with low annual utilisation and dispatch driven by renewable variability rather than demand peaks. In addition, a large share of the PV growth is occurring in the distribution network, especially through self-consumption and small-scale installations, which is beginning to change local power flows and grid operations.

Meeting Portugal's 2030 climate and energy targets implies continued rapid growth of PV capacity, a return of strong growth in onshore wind and the development of new offshore wind resources, along with accelerated end-use electrification. Maintaining the needed pace of renewable growth and electrification now depends on scaling up grid investment and modernising how network capacity is assessed and allocated.

Coupled with rapidly increasing connection requests and emerging local constraints, these dynamics indicate that Portugal's grids have entered a mid-transition phase in which traditional grid planning is no longer sufficient.

Distribution outlook

E-REDES expects investment needs in 2026-2030 to be about 50% higher than in 2021-2025 to upgrade ageing assets, accommodate new distributed generation and support rising demand. Growth in new connections and distributed generation is putting increasing pressure on Portugal's distribution networks. E-REDES reports almost 50 000 new LV and MV customer connections in 2024, including close to 2 000 new EV charging points and a strong uptake of heat pumps, reflecting rapid electrification across the buildings and transport sectors. At the same time, small-scale PV installations have accelerated sharply. Between 2020 and 2023, more than 5 600 PV self-consumption projects under 1 megavolt ampere (MVA) requested connection. Although most of these small systems were connected without restrictions, the DSO warns that local constraints are beginning to emerge, especially in areas with rapid growth in rooftop PV and new commercial loads. This trend prompted the creation of a dedicated investment programme focused on resolving local constraints arising from self-consumption.

Available capacity at substations is tightening. The 2024 distribution network development plan shows that while most high- and medium-voltage substations had more than 2 MW of headroom in 2025, a growing minority already have very little or no remaining capacity to host new generation or large consumers. By 2030, the share of substations with comfortable margins is expected to fall further, even after planned reinforcements. This reflects the combined pressure of rapid distributed PV generation growth, rising electrification and the ageing of existing assets.

E-REDES also expects that, by 2030, the theoretical capacity of its network to host new renewable generation could reach more than 7 GW. However, it emphasises that the effective capacity it can offer users is limited by constraints on the transmission grid. In several regions, especially those with significant solar development, available transmission headroom is already low. As a result, even where the distribution operator reinforces its assets, it cannot make additional firm capacity available unless the transmission system can evacuate the power.

New industrial and data centre loads add a further layer of pressure. E-REDES has identified several zones where large projects, each with tens of megawatts of demand, are planned or under negotiation. These projects have long lead times and uncertain realisation schedules, and E-REDES notes that deviations from expected timing or scale could require adjustments in investment plans.

Together these developments indicate that Portugal's distribution networks have moved beyond isolated or local constraints and are now experiencing the early stages of systemic pressure. Rising volumes of distributed PV, increasing electrification and growing demand for large connections are tightening capacity at substations and feeders. At the same time, limits on the transmission system restrict the DSOs' ability to offer additional firm access.

Transmission outlook

Firm capacity on Portugal's transmission network is already scarce. ERSE notes that the volume of capacity that can be offered to new generation and storage projects is insufficient to meet current levels of demand for grid access. Much of the available technical capacity cannot be allocated because it is tied up in firm commitments to projects that have not yet been built, or because existing rules do not allow capacity to be offered on a conditional or time-differentiated basis.

The next decade will require a major acceleration in transmission investment. REN must deliver around EUR 2.5 billion of reinforcements from 2026 to 2030, roughly three times the volume completed from 2021 to 2025. Only about one-quarter of this amount reflects new investments proposed in the 2024 ten-year development plan. The remainder consists of reinforcements that were approved in earlier cycles but have not yet been delivered. ERSE highlights that lengthy licensing and environmental procedures have delayed many transmission system projects and now pose a material risk to meeting Portugal's 2030 targets.

Several regional bottlenecks have been identified. In the north of the country, reinforcement of the 400 kilovolt (kV) corridors serving hydro and wind clusters is needed to relieve existing constraints and maintain efficient cross-border flows with Spain. In the south, receiving capacity for new solar generation is already limited, and additional 400 kV lines are required to support the scaling up solar deployment. The TSO's development plan also identifies the need to strengthen the network around Sines and other industrial zones where new large loads may locate over the coming decade.

Future demand growth adds further pressure, but there is notable uncertainty on the scale and pace of increasing demand. Projections show that synchronous peak demand could exceed 18 GW from 2029, nearly double the 2024 level, driven in large part by major industrial and data centre projects. ERSE cautions that these projects carry significant uncertainty over timing and final capacity and recommends measures to ensure that network reinforcements proceed in parallel with more robust commitments from project developers.

The TSO also confirms that power flows are becoming more complex as distributed solar expands. During high solar periods, energy increasingly flows from lower voltage networks up to the transmission system, particularly in regions with dense rooftop PV. While this does not currently result in congestion at transmission substations, it reduces the system's ability to offer additional firm capacity and increases the need for co-ordinated planning between the TSO and DSOs.

Taken together, these developments show that Portugal's transmission network is facing tightening capacity, rising regional constraints and substantial challenges in building out the needed capacity and flexibility under the tight timelines needed to meet 2030 climate and energy targets. The volume of reinforcements required is significantly higher than in previous years, and delays in delivering previously approved projects have reduced the margin available to accommodate new renewable generation and electrification. These structural pressures reinforce the need to accelerate investment, modernise planning approaches and strengthen co-ordination across the system.

Operational stresses

The changing shape of electricity supply and demand is placing new stresses on system operation. Higher volumes of variable wind and solar generation are causing steeper and less predictable ramps in both directions, requiring more frequent adjustments by the system operator. Pumped hydro storage now plays a much greater role in managing these variations, shifting between pumping and generation more dynamically as solar output rises and falls throughout the day.

Gas-fired power plants increasingly operate as a source of flexibility rather than as regular mid-merit units. Their annual utilisation has fallen to very low levels, and dispatch now occurs mainly during periods of low renewable availability or when system conditions are tight. This shift has reduced energy market revenues and increased reliance on CCGTs as security-of-supply assets rather than regular generators. The 2024 Electricity Monitoring Report on the Security of Supply shows CCGT utilisation falling to even lower levels by 2030, underscoring the growing difficulty of maintaining their financial viability.

More variable generation and sharper changes in output are also increasing the need for redispatch and other real-time interventions. ERSE's 2024 market report shows that the cost of ancillary services more than doubled between 2023 and 2024, driven largely by technical constraints on the grid and the settlement of imbalances. While curtailment of wind and solar remains low in Portugal, it has increased gradually from around 0.25% of total production in 2019 to about 0.5% in 2023, indicating that constraints are becoming more frequent during high-production periods. REN projects that, without additional flexibility measures, curtailment could reach around 3.4 TWh in 2030 (1.4 TWh wind and 2 TWh solar), potentially affecting up to 65% of installed renewable capacity. The same studies show that installing around 2 GW of storage could reduce this curtailment exposure to roughly 5% of installed renewable capacity. These findings reinforce the importance of scaling flexibility solutions, including batteries, pumped hydro and DSR, so Portugal can integrate rising levels of wind and solar at least cost.

Power flows are becoming more complex as well. The TSO reports that periods of reverse flows from lower voltage networks into the transmission system are now common during sunny hours in regions with dense distributed solar. Maintaining voltage quality and stability under these conditions requires more active management. These signs suggest that parts of the system are beginning to operate closer to their technical limits and indicate that Portugal's electricity system faces increasing operational challenges as renewable generation and electrification expand. Managing greater variability, higher redispatch needs, emerging reverse flows and declining utilisation of CCGTs will require enhanced operational tools, expanded flexibility resources and timely investment in network reinforcements.

The structural challenges across the transmission and distribution system and increasing stresses on grid operations underline the need for Portugal to move from reactive reinforcement toward proactive, scenario-based grid planning that can maintain the needed pace of deployment for renewables, storage, electrification, DSR and DERs. Proactive planning will need to address challenges around grid capacity; connection queue management; TSO-DSO co-operation; and environmental assessment, permitting and licensing.

Grid capacity constraints

Portugal has taken important steps in recent years to expand grid capacity and modernise its approach to network development. REN and E-REDES have also begun to introduce digital tools and monitoring capabilities. E-REDES has deployed the GridWise data platform and is undertaking pilot projects on active

LV management and dynamic line rating. These efforts complement Portugal's progress on hybrid connections, which now allows storage or complementary generation to be added to existing connection points without a full licensing process. In addition, ERSE's adoption in 2025 of general conditions for flexible connection agreements opens the door to non-firm access for generation and storage projects.

Despite this progress, grid capacity is constraining the pace of renewable deployment and electrification. Capacity is not expanding at the needed speed. A significant share of the major transmission upgrades included in REN's 2025-2030 plan was approved in previous cycles but remain undelivered. At the DSO level, a growing number of substations are approaching their limits, and available firm capacity is further constrained by bottlenecks at the transmission interface. In addition, ERSE notes that there is a significant volume of technical hosting capacity on the transmission network, but much of it cannot be allocated because it is tied up in firm commitments to projects still under development. Notable capacity is also committed to CCGTs that are running at much lower levels. As a result, available capacity is often underutilised, even in regions where renewable output, power flows and local demand profiles would allow for greater connection volumes under a more dynamic approach.

Capacity continues to be allocated mainly through firm connections that do not match the operational needs for VRE generation or support flexible grid operations. Hybrid and flexible connections remain limited in scope. Hybrid connections currently function primarily to support the addition of battery storage to existing connections, but they are not yet embedded in the broader planning and capacity allocation framework. Flexible connections have only recently been introduced and are not yet managed dynamically; developers face uncertainty about curtailment volumes and access conditions, limiting the attractiveness of non-firm access. Without broader deployment of real-time monitoring, dynamic line rating, seasonal capacity windows or probabilistic approaches to hosting capacity, the system cannot fully benefit from these new tools.

Taken together, these factors mean that Portugal's approach to grid capacity allocation remains largely static and focused on incremental reinforcement, even as system needs evolve more quickly and become more variable. To maintain the pace of renewable deployment, support emerging storage projects and integrate rising electrification, Portugal will need a more dynamic and flexible approach. This includes managing hosting capacity in real time where possible, integrating hybridisation into future planning, scaling the use of non-firm connections, and building the digital and operational capabilities needed to make better use of existing grid infrastructure.

Connection queue management

Grid constraints are contributing to long connection queues. The problem is further compounded due to weaknesses in Portugal's queue management system. The current first-come, first-served approach does not distinguish between mature projects and speculative placeholders, nor between genuine demand and duplicative or stalled applications. ERSE notes that long connection queues have been a persistent issue for renewable and storage projects but are now emerging on the demand side as well, driven by a strong increase in high-volume connection requests from industrial loads and data centres.

As of December 2025, there were more than 45 GVA of new connection requests from large consumers, with over 10 GVA already allocated or reserved. Portugal has introduced targeted measures for large consumer connections, including exceptional procedures for allocating capacity within designated high demand zones under the High Demand Areas Capacity Allocation Mechanism. The first use of this mechanism in Sines proved effective, leading to refinements for faster procedures and better project incentives. In January 2026, Portugal extended this approach nationwide by designating the mainland electricity system as a high demand zone to manage approximately 41 GW of connection requests from large electricity consumers. Beginning in 2026, the government will also systematically publish anticipated grid connection dates and project-specific information, improving transparency and planning certainty for developers. Together these measures aim to prioritise viable projects and ensure that scarce capacity is used efficiently as connection requests continue to grow.

While these measures represent important progress, shortcomings continue to reduce the ability of the TSO and DSOs to plan and allocate capacity efficiently. Opaque queues make it difficult to identify which projects are likely to materialise, where reinforcement is genuinely needed, and where flexibility or hybridisation could accelerate connections. This increases the risk that investments, flexibility measures or operation improvements are directed to the wrong locations. For project developers (both generation and large loads), these conditions create uncertainty around timelines, available capacity and the likelihood of connection. Long and non-transparent queues raise development risk, hinder financing and make it difficult to evaluate whether a given site remains viable. The absence of public information on demand-side queues complicates siting decisions and increases the risk of costly delays.

International experience shows that more advanced queue management systems, such as the maturity-based prioritisation used in the United Kingdom, the cluster-study approach implemented under FERC Order 2023 in the United States, Spain's milestone-based guarantees and Denmark's locationally driven processes, can significantly reduce speculative applications; direct projects toward areas with real hosting capacity; and accelerate the connection of storage, renewables and new loads. Adapting these principles to Portugal's context would help ensure that scarce capacity is allocated efficiently and that grid planning reflects genuine, system-beneficial project demand.

TSO-DSO co-ordination

Portugal has taken meaningful steps to improve co-ordination between the transmission and distribution systems. The ten-year transmission development plan and the five-year distribution development plan now reference each other's assumptions and identify shared constraints, and ERSE requires E-REDES to disclose cases where transmission-level limitations restrict the firm capacity it can offer locally. E-REDES is rolling out LV monitoring, smart meters are universal, and several pilot projects support improved visibility and operational flexibility.

Despite this progress, grid visibility remains incomplete and the current co-ordination model is still too limited for a system with rapidly rising distributed generation and new large loads. REN lacks granular, real-time information on MV and LV conditions, even though reverse flows from distribution into the transmission network are becoming more common during periods with high PV generation. Conversely, the E-REDES does not have forward-looking insight into transmission constraints or planned system limits, which restricts its ability to offer firm capacity and anticipate where non-firm access might be feasible. Hosting capacity assessments exist at the distribution level but are not mirrored by an equivalent, publicly available assessment of transmission hosting capacity, making it difficult to form a unified view of where the system can most efficiently accommodate new renewable generation or large loads.

Current co-ordination is largely linear: REN defines available capacity, after which the DSOs assess what can be offered locally. As distributed solar, EV charging and new commercial loads grow, this sequential process becomes increasingly misaligned with how power now flows across voltage levels. REN and E-REDES expect more frequent reverse flows, tighter voltage margins and more dynamic local conditions, but joint operational and planning tools are still at an early stage. Without shared data platforms, synchronised hosting capacity mapping and integrated scenario-based planning, bottlenecks at the TSO-DSO frontier will continue to restrict access for users, even where physical capacity exists.

Overall, these developments show that Portugal's grids require more integrated and forward-looking co-ordination between REN and E-REDES. International experience highlights the importance of shared hosting capacity maps, joint scenario-based planning and co-ordinated assessment of non-wire alternatives, supported by timely data exchange on network conditions and distributed resources. Adopting these practices would strengthen proactive planning and help ensure that Portugal can accommodate continued growth in renewable generation, electrification and DERs.

Environmental assessment, permitting and licensing

Portugal is among the EU front runners in modernising environmental impact assessments (EIA), permitting and licensing for renewable energy and storage projects. In 2022, Portugal introduced a fast-track regime to accelerate renewable energy development. This framework simplified and, in some cases exempted, certain renewable and storage projects from full licensing steps. It allowed government authorities to process applications faster, reduced procedural stages and prioritised projects in areas with lower environmental sensitivity. Originally designed as a temporary measure, this regime has since been extended multiple times and remains in force through 2026.

In 2023, Portugal implemented broader structural reforms to EIA and permitting. These measures streamlined EIA procedures for energy and grid infrastructure projects; clarified which categories of projects require a full EIA; and introduced simplified procedures for repowering, grid reinforcements and small renewable installations. The reforms also created clearer timelines for authorities and reduced duplication between environmental and licensing stages.

In 2023, the European Union updated its Renewable Energy Directive (RED III), requiring all member states to undertake broad reforms to simplify and accelerate permitting for renewable energy and related grid projects. RED III introduced tighter standard deadlines for permitting, lighter procedures for repowering, a new framework for renewables acceleration areas (RAAs), designated zones with strong renewable resources, favourable grid access conditions and pre-assessed environmental constraints where projects can be permitted through faster and simplified procedures. These reforms aim to streamline the granting of permits for renewable generation and grid infrastructure projects.

In 2024, Portugal partially transposed RED III, incorporating several reforms into national law. The partial transposition introduced faster permitting deadlines for renewable and storage projects, created the legal basis for RAAs, strengthened rules for digital processing of applications, and clarified when simplified environmental procedures can be used. In 2025, Portugal introduced draft legislation to complete the transposition of RED III. This legislation aims to finalise the designation and operationalisation of RAAs, fully recognise overriding public interest for renewable and grid projects, extend simplified EIA rules where appropriate, and further streamline licensing and grid connection procedures. Once adopted, these measures should materially shorten approval times; reduce administrative uncertainty; and provide clearer pathways for integrating renewables, storage and flexibility resources.

In 2024, the government created the EMER2030 Mission Structure, a permanent body with dedicated staff and funding to co-ordinate licensing for renewable energy projects across ministries and agencies. Its mandate is to establish a full one-stop shop for renewable energy projects, supported by digital tools for application tracking and information sharing. EMER is also responsible for preparing proposals for RAAs and for developing plans to allocate new renewable generation capacity. EMER will need sufficient staffing and authority to ensure consistent and timely decisions across the multiple institutions involved in the licensing chain.

Portugal is also progressing efforts to establish RAAs. In support of the work initiated by the Working Group for the Definition of Renewables Energy Acceleration Areas in 2023, the National Laboratory for Energy and Geology completed mapping identifying around 12% of mainland Portugal as potentially suitable, low-conflict zones for wind and solar development. Work to finalise the RAAs and fully incorporate them into Portugal's planning process is now being accelerated, under the co-ordination of EMER. A Strategic Environmental Assessment is underway. The initial Critical Decision Factors report was delivered in December 2025 and the assessment is expected to be concluded the first semester of 2026.

Experience from systems such as ERCOT's Competitive Renewable Energy Zones shows that coupling site designation with grid development guarantees effectively unlock investment at scale. While completing implementation of the RAAs, governments should be careful to avoid creating a perception that regions outside the RAAs are "no-go areas" for renewables deployment.

Overall, Portugal has made substantial progress streamlining EIA, permitting and licensing to support accelerated deployment of renewables and storage. Measures adopted include the transposition of RED III into domestic law, extensions of

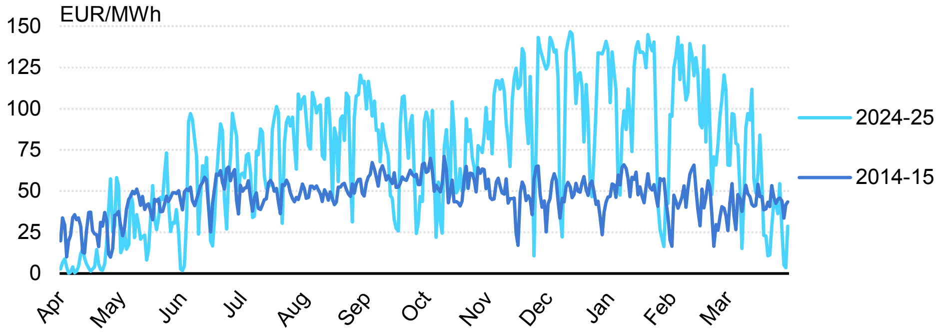
EIA exemptions, and simplified procedures for new energy storage and self-consumption projects. However, many of these initiatives still need to be fully implemented and integrated into the energy system planning process. Slow permitting and licensing of grid infrastructure and renewable energy projects remain one of the greatest barriers to achieving Portugal's ambitious energy and climate targets. Completing RED III implementation, operationalising EMER and formally designating RAAs will help ensure that permitting and licensing processes support, rather than delay, grid development and project deployment. Bringing these reforms over the finish line is essential for shifting from reactive reinforcement to proactive, scenario-based grid planning that can maintain the pace of renewable deployment, electrification and distributed energy resources.

Electricity flexibility and market reform

Portugal's electricity system is entering a phase in which flexibility becomes a central requirement for maintaining security and efficient market operation. Portugal's large hydropower fleet currently provides significant system flexibility through time arbitrage of VRE generation and system support services. CCGTs are the other primary resource supporting electricity system flexibility, however increasing generation from renewables, especially the recent surge in solar PV, is rapidly reducing CCGT operating hours and revenues, creating risks of an unmanaged exit. This transformation requires rapidly scaling up a diverse portfolio of flexibility resources, battery storage, DSR and DERs to provide short-term balancing and frequency support to reduce curtailment and maintain system security.

As solar and wind generation expands, market behaviour already shows more frequent periods of system stress. Price volatility in the MIBEL wholesale market has more than doubled over the past decade, and ancillary service and imbalance costs have risen sharply as redispatch needs grow. At the same time, numerous ancillary services are mandatory, with no remuneration, and others are procured through non-market mechanisms. This limits revenues for CCGTs and batteries, DSR and DERs, increasing the risk that gas-fired generation will exit the market before alternative flexibility resources can scale up. These trends underline that Portugal will need a much larger and more diverse portfolio of flexibility resources, supported by stronger market signals and clear long-term planning, to ensure a secure clean energy transition.

Average daily MIBEL wholesale electricity spot price, 2014-2015 and 2024-2025



MIBEL = Iberian electricity market.
Source: IEA analysis based on data provided by ERSE; OMIE (2026), Day-ahead price (Accessed April 2026).

Portugal has taken notable steps to increase the deployment of flexibility resources. In July 2024, it opened a tender for 500 MW of battery storage with grant support (up to 20% of costs) of EUR 99.8 million in RRP funding. The amount was increased in 2025 by another EUR 60 million in support for new storage investments, prioritising deployment in areas of high renewable penetration or where storage can help manage network constraints. By April 2025, acceptance terms had been signed for 30 projects for a total of around 540 MW, with an operational deadline of 2028/2029.

Following the April 2025 blackout, the government committed to an additional auction for around 750 MW of battery capacity created as part of EUR 400 million investment package, focusing on batteries capable of fast frequency response, voltage control and black-start services in operationally stressed network areas. The NECP targets 2 GW of battery storage capacity by 2030, which appears modest relative to the system's needs and the pace of solar growth. International experience from ERCOT (United States) and Australia shows that once regulatory frameworks and market signals are in place, battery capacity can scale at gigawatt levels per year.

Portugal is also preparing a National Energy Storage Strategy for 2026-2050, which is intended to provide a long-term framework for expanding storage capacity and system flexibility in line with the NECP. The Strategy is expected to define technology-neutral deployment pathways for storage across multiple time horizons and assess future needs for system services and flexibility resources. It will also examine how storage can contribute to congestion management, system reliability and more efficient grid investment. In addition, the Strategy is expected to explore market mechanisms and opportunities for storage to participate across energy, balancing and ancillary service markets.

Portugal is exploring options to expand DSR. E-REDES has launched market-based flexibility pilots, including the FIRME project, which tests competitive procurement of local flexibility services from batteries and other distributed resources to address emerging LV and MV constraints. However, DSR remains far below its potential. Industrial DSR exists but is modest in scale and is focused on emergency services. Commercial and residential DSR are not yet active in energy or balancing markets, despite full smart meter rollout. Aggregators are recognised in law but cannot yet operate because baseline methodologies, settlement rules and market interfaces are still under development. Mandatory or non-market procurement of ancillary services also limit DSR participation. As a result, the demand side does not yet contribute meaningfully to system flexibility, even though it could play a major role as renewable generation expands and gas-fired generation declines.

Portugal is working to enable more flexible system operation. E-REDES is strengthening its capability to manage distributed flexibility, expanding active system management tools and preparing the distribution network to accommodate growing volumes of DERs. REN has expanded real-time operational tools, including enhanced forecasting for wind and solar and upgraded monitoring systems for the transmission network, and ERSE has encouraged both operators to integrate non-wire alternatives and flexibility solutions into their planning processes.

Portugal should prepare a scenario-based electricity flexibility roadmap that provides a whole system view of needs and a clear pathway for scaling solutions. The roadmap should quantify requirements for short-term balancing, fast frequency response, ramping, inertia, voltage support and seasonal storage under multiple scenarios, reflecting renewable deployment, electrification and climate variability. It should identify the most cost-effective mix of solutions, including battery storage, pumped hydro, DSR, DERs and interconnections, and set out the sequence of regulatory and market reforms needed to scale flexibility resources. The roadmap could be developed jointly by the Directorate-General for Energy and Geology, ERSE, REN and E-REDES, in consultation with generators, aggregators, large consumers and consumer groups. This process could also be aligned with the National Flexibility Assessment planned for 2026 to provide an institutional framework.

A flexibility roadmap on its own will not deliver the needed resources unless the market framework can procure and value them. However, Portugal's current ancillary services arrangements are still procured through narrow, non-market frameworks, giving the TSO access to a limited set of balancing resources. This forces greater reliance on redispatch and imbalance settlement, raising costs. It also prevents batteries, DSR and DERs from accessing the revenues they need to scale.

These challenges are already visible in market outcomes. Ancillary services costs increased from 2.92 EUR/MWh in 2023 to 7.66 EUR/MWh in 2024, and reached 18.14 EUR/MWh in May 2025; together with imbalance costs, they accounted for around 43% of the total wholesale electricity price that month. In value terms, system services represented around EUR 500 million in 2023, about 13% of total wholesale market value, and rose to around EUR 830 million in 2024, approximately 25% of the wholesale market. Most of this increase reflects higher redispatch volumes and imbalance settlement, signalling that the system is relying heavily on corrective actions rather than accessing a broader portfolio of market-based flexibility resources. As renewable generation expands and wholesale prices come under downward pressure, system-services markets are becoming increasingly important and need to be accessible to the full suite of flexibility resources, reducing reliance on corrective actions and enabling a broader portfolio of market-based solutions.

These rising costs reflect deeper structural weaknesses in Portugal's ancillary services framework, particularly in the design and procurement of key frequency products. Frequency retainment reserve (FCR) is provided by hydro and gas-fired plants as a mandatory and non-remunerated service, limiting transparency, competition and efficiency. Other resources such as batteries or DSR, are not permitted to provide FCR, limiting overall system efficiency. Automatic Frequency Restoration Reserve (aFRR) is not market-based, with low participation and insufficient market revenues to incentivise investments in battery storage or industrial demand-response programmes.

There are also issues with symmetric procurement requirements: FCR and aFRR are procured symmetrically, meaning energy offers must be identical upward and downward. This limits the range of assets that can participate, as some technologies may not have equal ability to deliver in both directions, constraining the value they can deliver to the system. In addition, there are no markets for fast Frequency Response (FFR), even though those services will be critical to ensure system flexibility in a high VRE future.

Adding markets for system-wide services such as frequency control has proven effective in other countries. In Australia's National Electricity Market, frequency ancillary services costs fell by more than 50% from 2019 to 2024, reflecting intensified competition driven by growing battery capacity. The limited accessibility of Portugal's ancillary services markets to DERs, batteries, DSR and even pumped hydro storage drastically reduces regulation capacity and system efficiency.

Multiple barriers limit the participation of flexibility resources. Beyond market design issues, barriers to participation include unclear rules for value stacking across multiple markets (energy, balancing, ancillary services), aggregator frameworks that remain under discussion and missing long-term contracts creating investment uncertainty. These obstacles particularly affect batteries, DSR, DERs and consumer participation through energy communities and industrial demand response. This framework limits revenues for existing and emerging flexibility providers, reduces the bankability of new projects, and narrows the revenues available to CCGTs that remain necessary during the transition, creating risks that gas capacity exits faster than alternatives scale.

Long-term electricity markets suffer from low liquidity, further constraining investment. Market participants report that liquidity in Iberian forward, derivatives and bilateral markets is insufficient for managing price risks, with limited trading volumes constraining investment in new generation capacity. The causes are likely multiple: insufficient demand-side participation, barriers to market entry, product definitions that may not adequately reflect Iberian power mix characteristics, or market participants hedging through Spanish or other European markets instead. Some contract types, such as forwards and long-term PPAs, lack sufficient transparency to inform all actors on conditions and the long-term state of the system, which can undermine confidence. Without improved long-term price signals and clear adequacy frameworks, Portugal faces investment uncertainty that could delay the renewable deployment needed to meet its 2030 and 2035 renewables targets.

Resource adequacy and potential capacity remuneration mechanisms

Portugal is achieving notable success in decarbonising its electricity system, with rapid growth in solar PV and sustained contributions from wind and hydro. Coal generation was phased out in 2021 and Portugal is advancing toward ambitious targets of 93% renewable electricity by 2030 and 100% by 2035. However, rapid expansion of variable renewable generation risks rendering gas-fired plants uneconomic, potentially leading to retirements before alternative flexibility resources such as storage and DSR have scaled sufficiently to maintain system security.

Conclusions from recent European and national adequacy assessments diverge. ENTSO-E's European Resource Adequacy Assessment (ERAA) 2025 does not identify major adequacy concerns for Portugal through 2035, while Portugal's national Electricity Security of Supply Report (RMSA-E 2024) identifies risks in several scenarios. In particular, the national assessment finds that the loss-of-load expectation exceeds the current security-of-supply standard (five hours per year) under certain trajectories and sensitivities. In its comments on the ERAA 2025, REN highlighted areas where European modelling assumptions may not fully reflect Portuguese system conditions, including hydro and pumping operation, the availability of cross-border capacity with Spain, and the economic viability of CCGTs under energy-only market conditions. These differences underline the importance of complementing European assessments with national analyses that capture country-specific characteristics while remaining consistent with the ERAA methodology.

When adequacy assessments identify risks, one potential response is the introduction of a capacity remuneration mechanism (CRM). A CRM compensates electricity resources for available capacity, rather than for electricity generation. Such mechanisms are intended to ensure that adequate capacity remains available when energy-only markets may not provide enough revenues to support continued operation or new investment.

In the European Union, introducing a CRM requires strong analytical justification and approval under state-aid rules, demonstrating that reforms to energy markets, system operation and flexibility provision have been considered and that residual adequacy risks remain. Previous CRMs have taken three to five years to attain approval from the European Commission and start operational implementation. The European Commission has expressed its intent to streamline the approval process, but these efforts are still ongoing. Portugal is undertaking the required adequacy studies through the RMSA-E 2025, which it aims to complete by May 2026, at which point the European Commission's review process would start. Under this timeline, a full CRM would likely not be operational until at least 2028.

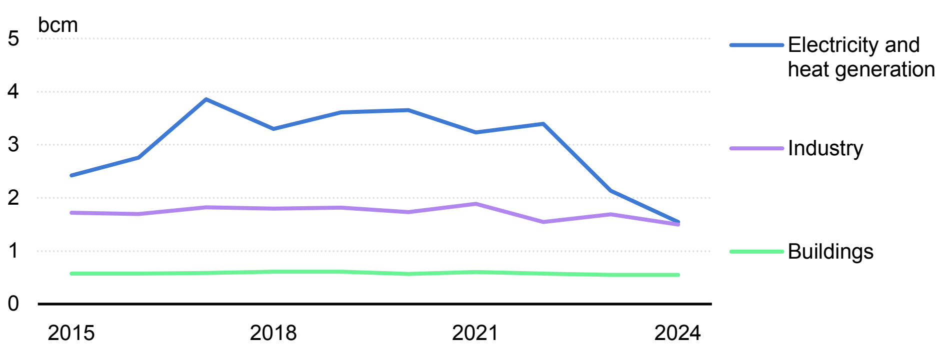
A strategic reserve, focused on retaining or procuring specific capacity under bilateral contracts for a defined period, could be established more quickly and serve as a temporary bridge until a CRM becomes operational (if it receives approval from the European Commission). This creates a critical near-term challenge: CRMs risk either premature operator exits if remuneration is too low or costly lock-in of excess gas generation if remuneration is too high. While a strategic reserve could address transitional adequacy gaps, Portugal also needs to prioritise electricity market reforms that provide clearer revenue options for gas-fired generation, batteries and DSR, such as improving long-term (forward and futures) market liquidity, completing ancillary services markets, and establishing long-term contracts for flexibility resources.

Iberian market integration offers opportunities for co-ordinated adequacy planning despite challenges. Portugal and Spain operate MIBEL as a single energy market with strong interconnection (3 200 MW capacity), and ACER's Security of EU Electricity Supply report (November 2025) shows that enhanced cross-border co-ordination could significantly decrease additional capacity needs. Spain has already moved ahead with implementing a CRM, which could complicate full alignment but also provides an opportunity for Portugal to learn from Spain's experience and explore pragmatic co-ordination approaches. Joint working groups on mechanism design, procurement timelines and resource eligibility could help avoid market distortions, optimise the use of shared interconnection capacity and reduce the risks of inefficient double procurement, even if full harmonisation proves challenging given the different implementation timelines.

Managing declining natural gas demand

The strong success in decarbonising Portugal's electricity sector, especially the recent rapid increase in solar PV, is driving reductions in gas demand at a rate much faster than anticipated. The gas TSO's ten-year plan published in March 2025 projects declining gas demand across all future scenarios, citing continued displacement of gas-fired generation by renewables and estimating that demand would fall to 3.1-3.5 billions of cubic metres (bcm) by 2035. However, this level of reduction has already occurred. From 2022 to 2024, electricity sector gas demand dropped sharply from 3.4 bcm to 1.5 bcm, causing total gas demand to fall from 5.6 bcm to 3.6 bcm, although this trend was reversed somewhat after the blackout in 2025.

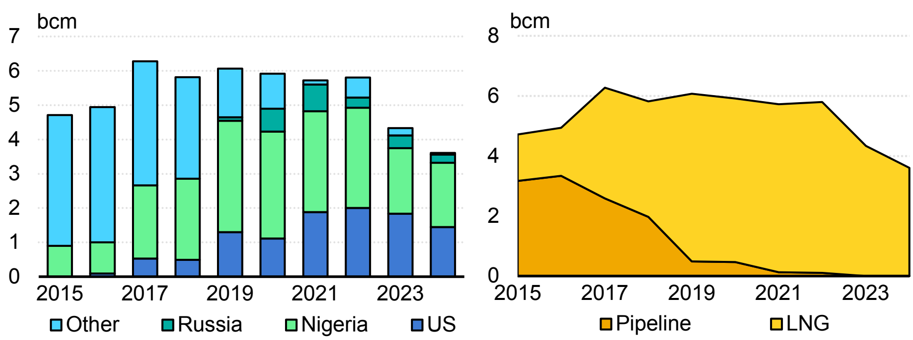
Natural gas demand by sector in Portugal, 2015-2024



Source: IEA (2026), Natural Gas Information.

In addition to the sharp decline in demand, Portugal has also experienced a major shift in how it receives its gas imports. Since the closure of the Maghreb-Europe pipeline in 2021, Portugal has relied primarily on the Sines LNG terminal for gas supply. In early 2026, pipeline imports from Spain rose to over 20% of supply and were sourced from LNG delivered to Spain's regasification terminals. Gas security is supported by underground storage at Carriço, which can hold around 0.3 bcm, equivalent to roughly 10% of 2025 annual demand. While Portugal's LNG-based system has proven physically resilient, maintaining uninterrupted supply during the 2022-2023 European gas crisis, the country remains exposed to global LNG price volatility.

Natural gas supply by country and by type in Portugal, 2015-2024



Note: Portugal still imports a small share of its gas supply from the Russian Federation, which will be ended in line with new EU sanctions banning Russian LNG imports.

Source: IEA (2025), Natural Gas Information.

Portugal's gas demand is expected to continue declining. Meeting climate and energy targets requires very high levels of renewable electricity generation, with the NECP setting a 2030 target of 93% renewable electricity compared with 85% in 2024. Although gas demand from industry and buildings has been relatively stable in recent years, reducing gas demand in both sectors is required to meet GHG reduction targets. The buildings sector is already seeing strong growth in heat pumps, and major industrial investments are underway to reduce reliance on natural gas.

Portugal's gas system was developed around high and relatively stable demand from gas-fired generation, but the sharp decline in demand in recent years means the system is now operating with much lower throughput. While the network continues to operate safely and reliably, the sustained demand declines needed to meet climate targets require operational adjustments across the gas transmission and distribution systems. Lower utilisation will also affect cost recovery and could increase the unit cost of gas delivered to consumers. These issues are particularly relevant for the Sines LNG terminal, which is currently the only active entry point for natural gas. The government and ERSE should review existing commercial and contractual arrangements linked to Sines and ensure they remain compatible with projected gas demand declines so that supply costs and security risks are minimised.

All these system-wide challenges should be incorporated into an integrated electricity and gas planning framework that aligns the evolution of the gas system with climate targets and with the accelerating pace of renewable deployment and electrification. Such a framework should clarify long-term operational, financial and decommissioning responsibilities, so that the gas sector can transition in an orderly and cost-effective manner.

The revised EU Gas Directive provides new legal tools that support the managed decline of gas infrastructure. When demand reduction implies the need to retire parts of the distribution network, the Directive requires EU member states to ensure that DSOs develop formal network decommissioning plans, subject to approval by the national regulator. Article 38(4) then authorises network operators to refuse new access or discontinue existing access where such actions are foreseen in an approved plan and support climate-neutrality objectives. Portugal's gas DSOs should, therefore, prepare and ERSE should assess and approve, network decommissioning plans that reflect the country's structural decline in gas demand, ensuring that reinvestment, consolidation and asset retirement are carried out in an orderly, cost-effective manner.

In addition, the current tariff and remuneration model, which relies on growth, capital recovery and volumetric charges, is no longer sustainable in a context of declining demand. Without reform, unit network charges will increase, affordability will decline, and the sector may lack the resources needed for reliable operations and decommissioning. A new compensation framework is needed to ensure stable funding that supports an orderly decline in gas demand and protects remaining consumers from sudden price increases.

Despite structural declines in gas demand and clear policies favouring electrification, the gas TSO's ten-year development plan (PDIRG 2026-35) and the main gas DSO's five-year plan (PDIRD-G 2025-29) both include significant gas system expansions. The TSO requested approval for more than EUR 225 million in investments beyond essential maintenance, including adaptation of the transmission system and storage for 10% hydrogen blending, the construction of two new storage caverns (to increase gas reserves for energy security purposes), and new high-pressure pipelines. The DSO requested approval for new medium-pressure pipelines, network reinforcements, capacity increases and projects linked to future hydrogen blending that would expand the gas distribution system.

ERSE's opinions on both the TSO's and DSO's plans conclude that these investment proposals are not consistent with the structural decline in gas consumption, carry stranded asset risks and lack clear justification in the context of Portugal's decarbonisation pathway. In a system where gas demand is already falling and must continue to decline to meet climate targets, gas network expansion projects beyond essential maintenance should not be undertaken. If built, these assets risk becoming stranded and their costs would ultimately fall on consumers at a time when investment needs to be directed toward reinforcing and modernising the electricity system to support renewable integration, electrification and energy security.

International experience shows how regulators can manage structural decline in a way that protects consumers and maintains reliability. In the Netherlands, the phase-out of the Groningen gas field prompted the regulator (ACM) and network operators to adopt a structured approach to network decommissioning. This included accelerated depreciation for assets with shortened economic lives, strict scrutiny of reinvestment proposals and clear criteria for when parts of the distribution network should be shut down. Operators were required to demonstrate that any proposed investment was consistent with projected demand, and ACM rejected projects that risked becoming stranded. These measures helped to maintain reliable service while avoiding unnecessary expenditure, offering a useful model for Portugal as its gas demand continues to fall.

Hydrogen blending into the gas grid would impose substantial costs while delivering limited climate benefits. Blending maintains natural gas use and associated emissions for many years, while requiring extensive and costly network upgrades. Gas-burning appliances and boilers would need to be replaced with hydrogen-ready models, which are currently scarce and expensive. Industrial users that rely on natural gas for process heat or feedstocks would face high equipment replacement costs or process redesign.

At the system level, large-scale blending would require major volumes of electrolytic hydrogen produced from new renewable electricity at a time when Portugal already faces challenges in deploying sufficient renewables to support direct electrification of end-use sectors. Blending would also require new regulations, updated safety standards, retraining of TSO and DSO staff, and revised protocols for emergency services. Developing these frameworks would consume significant regulatory and institutional capacity at a time when attention is urgently needed for electricity system and market reforms.

In contrast, targeted investments that replace existing fossil-based hydrogen production and develop clusters of hydrogen demand that do not rely on transmission across the gas network offer a clearer route for cost-effective decarbonisation. The electrolyser investment underway at the Sines refinery is an example of well-targeted efforts that use domestic low-carbon electricity to reduce natural gas imports and industrial GHG emissions while supporting future economic competitiveness. Such projects would also contribute to meeting binding EU targets that require the share of industrial hydrogen demand met by non-fossil sources to reach 42% by 2030 and 60% by 2035.

Biomethane can support the reductions in natural gas use while helping industrial consumers that need more time to electrify processes or that will continue to rely on gas-based feedstocks in the future. Portugal's Action Plan for Biomethane 2024-2040 aims to build a sustainable market by promoting production from wastewater, agricultural and food processing residues. The NECP estimates Portugal's technical biomethane potential at 4-6 TWh per year, equal to 30-45% of 2024 industry gas demand. The Action Plan includes measures to streamline licensing procedures, improve market transparency through a dedicated biomethane portal and resource mapping, and introduce mechanisms to support grid connection and project financing. Early market development remains challenging. The Renewable Gases Auction held in early 2025 resulted in limited uptake for biomethane projects, highlighting the need for targeted support mechanisms as the market develops.

Scaling up biomethane will be challenging but would reduce natural gas imports, lower GHG emissions, and support the circular economy and rural development. International experience shows that biomethane deployment is the most cost-effective when production and end use are geographically clustered. This allows projects to connect through shorter pipelines and avoids large infrastructure investments, supporting commercial viability. This approach is also consistent with recent regulatory decisions in Portugal, where ERSE approved targeted biomethane connection investments but did not support large pipeline expansions without clearly demonstrated demand.

Denmark illustrates what is possible when policy support, stable pricing frameworks and targeted infrastructure investment are aligned. In 2023, biomethane covered around 45% of Denmark's gas demand. Most production is linked to agricultural waste, with injection points located close to feedstock and demand. Experience from France, which has built the European Union's largest biomethane injection market, and from Italy, where production has expanded rapidly under dedicated tenders, also shows that clear tariffs, long-term visibility and a predictable regulatory environment are central to sustained growth. Similar principles can guide Portugal toward cost-effective and well-sequenced development of a biomethane sector.

The transformation of Portugal's gas sector is not only a technical and financial challenge but a social and institutional one as well. Thousands of skilled professionals in network operation, maintenance, customer service and emergency response have ensured that homes stay warm and businesses are supplied safely and reliably. As gas demand declines, protecting this human and technical capital becomes essential to managing a just and orderly transition.

The expertise embedded within gas network companies, planning, system integrity, safety management and customer interface remains highly relevant to the clean energy future. Many of these competencies can be redeployed toward new priorities such as cooling networks, building efficiency retrofits, electrification support services and the development of sustainable biomethane projects. These activities can provide continuity of employment, sustain regional economies and contribute directly to national decarbonisation goals.

A proactive reskilling and redeployment strategy, jointly developed by operators, regulators, social partners and government, will be critical. Such a strategy should identify emerging labour needs across the energy system, ensure that training and certification pathways are available, and include measures to support workers and communities affected by declining gas use. By harnessing the gas sector's institutional experience and technical rigour, Portugal can safeguard social cohesion while accelerating progress toward a clean, secure and affordable energy system. These social and workforce considerations should be incorporated into Portugal's integrated energy system planning so that the evolution of the gas system is aligned with climate targets and a just transition.

Recommendations

7 Establish integrated energy system planning and remuneration mechanisms that support energy security through the mid-transition.

Portugal is entering a mid-transition in which the electricity and gas systems are evolving in opposite directions. To meet climate targets, renewable generation, grid flexibility and capacity, and economy-wide electrification must be rapidly scaled up in tandem. At the same time, natural gas demand is falling much faster than anticipated, reaching a level in 2024 that the gas transmission system operator did not expect until 2035. This rapid decline is concentrated in the electricity sector, where combined-cycle gas turbines are being displaced (reduced operations) by strong growth in solar photovoltaic and sustained hydro and wind output, but buildings and industry are also likely to experience structural reductions in gas demand as heat pump deployment accelerates and competitiveness pressures favour electrification.

These trends are essential for meeting climate targets but create challenges for the gas sector: maintaining reliable operation with decreasing throughput, ensuring fair cost recovery across a shrinking customer base and preparing pathways for decommissioning. Gas-fired generation will continue to play a limited but important role in supporting electricity security until sufficient flexible resources such as storage and demand-side response are scaled up.

Managing this crossover requires an integrated planning approach across the Directorate-General for Energy and Geology, electricity and gas system operators, and ERSE. Electricity and gas network development plans should be clearly linked, aligned with climate targets, and reflect the accelerating pace of change and uncertainty around future demand. This calls for adaptable planning frameworks that ensure that investment decisions can be adjusted as system conditions evolve.

Remuneration frameworks also need to be updated: for electricity, to support needed grid capacity expansions while placing a greater emphasis on efficiency, digitalisation and the integration of flexibility solutions; for gas, to ensure predictable cost recovery during managed decline while minimising the risk of stranded assets. The potential roles of biomethane and electrolytic hydrogen should be assessed based on realistic volumes, geographic clustering and cost-effective delivery options, recognising that their use is likely to be targeted rather than system-wide.

A coherent planning and remuneration framework will help maintain energy security, guide investment toward least-cost pathways, and ensure that both systems evolve in a co-ordinated and financially sustainable manner through Portugal's mid-transition. Integrated planning should also recognise the gas sector's existing technical expertise and incorporate workforce planning and reskilling needs to support a just and orderly shift toward a clean energy economy.

8 Move to proactive grid planning to maintain growth in renewable generation, electrification and distributed energy resources.

Meeting Portugal's climate and energy targets requires continued rapid growth in renewable generation; accelerated electrification across transport, industry and buildings; and the expansion of distributed energy resources. However, grid capacity and system flexibility are not keeping pace, with both the transmission and distribution networks showing emerging constraints that are already affecting connection timelines for generation and demand. Rapid growth in distributed solar PV, from negligible levels in 2015 to 3.1 GW at the start of 2026, is reshaping local network needs while electrification will place additional pressure on the grid. Without a more proactive, forward-looking planning framework, Portugal risks slower renewable deployment, rising curtailment and delays in electrification that could increase the cost and difficulty of achieving its climate and energy targets.

International experience shows how quickly grid constraints can limit both the expansion of renewable generation and end-use electrification, and how decisive policy responses can address them. The Netherlands provides a prominent example: after severe congestion emerged from rapid electrification and renewable growth, grid operators introduced proactive congestion management, transparent data publication, clear locational signals, readiness-based connection queues, and regulatory reforms enabling non-wire alternatives and flexible resources. Similar lessons come from Texas' competitive renewable energy zones and Australia's renewable energy zones, both of which used anticipatory transmission investments and permitting reform to unlock large-scale renewable development.

Portugal now has a strong opportunity to follow this path. Work has begun on identifying renewables acceleration areas (RAAs), but this process needs to move quickly so that RAAs can genuinely support more spatially informed grid planning and streamline permitting. Portugal also needs broader reforms to move toward truly proactive grid planning.

These include strengthening TSO-DSO co-ordination, publishing more granular information on grid constraints and ensuring that planning incorporates flexibility solutions alongside traditional reinforcements. A proactive, transparent and adaptive grid-planning framework will help Portugal integrate renewable generation at the required pace, facilitate electrification and the expansion of distributed energy resources, and reduce the risk of persistent bottlenecks across transmission and distribution networks.

9 Prepare a scenario-based electricity flexibility roadmap and extend market-based and technology-neutral solutions to all ancillary services.

Portugal should prepare a comprehensive flexibility roadmap that quantifies future requirements for storage capacity, ramping capability, frequency response across different time frames, inertia and voltage support through 2030, 2035 and 2050. This roadmap should be based on multiple realistic scenarios that go beyond the National Energy and Climate Plan and test sensitivity to variables including renewable deployment pace (delays or acceleration), demand growth (electrolysers, data centres, electric vehicles, heat pumps), technology cost evolution, and climate variability affecting hydro and renewable output. The roadmap should identify cost-effective resource mixes, set deployment trajectories for different flexibility technologies, and sequence regulatory and market reforms to enable timely scaling. The roadmap should be aligned with the National Flexibility Assessment planned for 2026 and the National Energy Storage Strategy 2026-2050.

Market-based procurement should be extended to all ancillary services. Introducing markets for services has proven efficient in promoting competition and reducing costs in several countries. In Australia's National Electricity Market, frequency ancillary services costs fell by more than 50% from 2019 to 2024, reflecting intensified competition driven by growing battery capacity. Similarly, Germany has seen battery participation drive cost reductions in secondary reserves.

Portugal should establish market-based, technology-neutral procurement for frequency retainment reserve (FCR) (currently mandatory and non-remunerated), aFRR (automatic frequency restoration reserve; currently non-market), fast frequency response, synthetic inertia and voltage control where feasible. For services with limited providers or high technical requirements (such as black-start or certain voltage support applications), bilateral contracting may remain appropriate, but procurement should still be competitive and transparent. Real-time co-optimisation between energy and ancillary services markets would enhance efficiency but requires broader European co-ordination.

Removing participation barriers is essential for scaling flexibility. Portugal should eliminate symmetric bidding requirements for FCR and aFRR, which prevent batteries and other technologies from providing asymmetric response more cost-effectively. Aggregator frameworks must be finalised to enable the participation of distributed energy resources and demand-side response. Clear rules for value stacking across energy, balancing and ancillary services markets will allow resources to optimise revenue across multiple services. Longer-term contracts (three to five years) for flexibility services will provide investment certainty for capital-intensive solutions.

Enhanced transparency on forward contracts and power purchase agreements will support market development. Grid codes should require flexibility provision from new renewable plants above defined thresholds (e.g. >1 MW) with appropriate market-based compensation. These reforms will strengthen investment signals, enable rapid scaling of diverse flexibility resources and support a secure transition away from gas-fired generation while maintaining system reliability.

A scenario-based electricity flexibility roadmap would allow Portugal to quantify its flexibility needs, assess the cost-effective mix of flexibility options, and set out a clear sequence of regulatory and market reforms. This can be closely aligned with the National Flexibility Assessment that Portugal plans to prepare in 2026. Extending market-based, technology-neutral procurement to all ancillary services will be essential to deliver the roadmap; strengthen investment signals; and ensure that flexibility resources scale in time to support the secure, least-cost transition away from gas-fired generation.

10 If adequacy assessments demonstrate need, implement a technology-neutral capacity mechanism to deliver cost-effective electricity security.

Portugal is achieving notable success in decarbonising its electricity system, with rapid growth in solar photovoltaics and sustained contributions from wind and hydro. However, this progress increases the risk that gas-fired generation could become uneconomic and retire before alternative flexibility resources have scaled sufficiently to ensure system security.

As the operating hours of combined-cycle gas turbines (CCGTs) decline, the system will rely increasingly on storage, demand-side response (DSR) and other flexible resources whose development remains at an early stage. Ensuring a secure transition, therefore, requires a clear, evidence-based assessment of whether Portugal can meet future adequacy needs through reforms to existing markets and improved grid planning or whether a capacity remuneration mechanism (CRM) may also be required.

Under EU electricity market rules, a capacity remuneration mechanism may be introduced only if adequacy assessments demonstrate a genuine security-of-supply risk and show that reforms to energy markets, system operation and flexibility provision cannot address it. The mechanism must have clear objectives and a defined purpose, targeting specific adequacy needs while preserving market efficiency. If it is determined that a CRM is necessary and appropriate, an important consideration will be whether a strategic reserve, focused on retaining specific capacity temporarily, could address near-term gaps until storage and DSR scale up, or whether more comprehensive arrangements, such as a capacity market with regular auctions, would be required for persistent concerns, or if a combination of approaches may be appropriate.

Technology neutrality ensures cost-effectiveness while supporting the energy transition. Article 22 of Regulation (EU) 2019/943 mandates that CRMs be open to all resources capable of delivering required technical performance, including energy storage and DSR. Technology-neutral, competitively allocated mechanisms allow markets to reveal the least-cost resource combination, with batteries and DSR often providing adequacy at a lower cost than thermal generation while delivering flexibility co-benefits.

The mechanism must encourage the scaling of new flexible resources rather than preserving gas-fired generation beyond security requirements, ensuring capacity payments complement rather than substitute energy market revenues. International examples include Ireland’s technology-neutral capacity auctions where diverse resources compete equally while maintaining security through instantaneous renewable penetration exceeding 90%, and the United Kingdom’s reformed capacity market demonstrating the value of clear eligibility rules and willingness to adapt.

Volume-based mechanisms promote competition and transparent price discovery while co-ordination through MIBEL offers potential efficiency gains. Remuneration should link to actual availability during system stress, with appropriate penalties for non-performance. Moreover, regular reassessment ensures adaptation as renewable deployment, storage additions and demand patterns evolve.

Finally, given the single Iberian energy market and ACER's finding that cross-border co-ordination could reduce capacity needs, Portugal should consider establishing joint working groups with Spain to explore alignment opportunities on mechanism design and resource eligibility, recognising that Spain's implementation head start may limit full harmonisation.

Annexes

Acknowledgements

The IEA review team visited Lisbon on 27-31 October 2025 and met with government officials and public and private sector stakeholders across the energy sector. This report is based on information from these meetings, the review team's assessment of Portugal's energy policy and detailed research by the IEA. The review team members were Néstor Cortés Suárez (Spain), Mihaela Grigorie (Switzerland), Alice Van Rixel (Netherlands), Carlos Maravall Rodriguez (European Commission), and Peter Journeay-Kaler (Consultant), Jacques Warichet and Kieran McNamara from the IEA Secretariat.

Peter Journeay-Kaler managed the review and is the main author of the report. The report benefited from reviews and insights from IEA staff, including Jacques Warichet, Gergely Molnár, Eren Çam, Jack Gregory, Rita Madeira, Milosz Karpinski, Vasilios Anatolitis-Pelka and Isaac Portugal. Anders Caratozzolo and Fabian Burkard designed and prepared the energy data sections of the report, dedicated analysis, figures and tables, supported by Anita Finco, George Vamos and Emma Mares. Roberta Quadrelli, Agnieszka Koscielniak and Zakia Adam provided support on statistics and data. Isabelle Nonain-Semelin and Astrid Dumond managed the editing and the production process. Poeli Bojorquez managed the design process. Clara Vallois managed the translation process. Jennifer Allain edited the report. Nicolette Groot supported the organisation of the energy review team's visit.

The IEA is especially grateful to Cátia Brito, Ana Clara Costa, Dulce Garcia, Frederico Oliveira, Nádia Pinto, Tomás Alves, João Carlos Silva and Pedro Isidoro Silva from the Directorate-General for Energy and Geology for their tireless efforts co-ordinating the review visit, prompt responses to the team's many requests and unflagging patience demonstrated throughout the weeks leading up to and during the review.

Abbreviations and acronyms

ACER	European Agency for the Cooperation of Energy Regulators
ADENE	Portuguese Energy Agency
aFRR	automatic frequency restoration reserve
CCGT	combined-cycle gas turbine
CESE	special levy on the energy sector
CRM	capacity remuneration mechanism
DER	distributed energy resource
DSO	distribution system operator
DSR	demand-side response
EIA	environmental impact assessment
EMER	Framework for the Licensing of Renewable Energy Projects
EPC	energy performance certificate
ERAA	European Resource Adequacy Assessment
ESCO	energy service company
ETS	Emissions Trading System
EU	European Union
EUR	euro
EV	electric vehicle
FCR	frequency containment reserve
GDP	gross domestic product
GHG	greenhouse gas
IEA	International Energy Agency
ISP	fuel excise duties
LNG	liquefied natural gas
LV	low voltage
MIBEL	Iberian electricity market
MV	medium voltage
NECP	National Energy and Climate Plan
PPA	power purchase agreement
PV	photovoltaics
RAA	renewables acceleration area
RED	Renewable Energy Directive
RMSA-E	Electricity Security of Supply Report
RRP	Recovery and Resilience Plan
SME	small and medium-sized enterprise
TFEC	total final energy consumption
TOTEX	total expenditure
TSO	transmission system operator
VAT	value-added tax
VRE	variable renewable energy

Units of measurement

bcm	billions of cubic metres
g CO_2	gramme of carbon dioxide
GVA	gigavolt ampere
GW	gigawatt
kV	kilovolt
kVA	kilovolt ampere
kWh	kilowatt hour
MJ	megajoule
Mt CO_2-eq	million tonnes carbon dioxide equivalent
MVA	megavolt ampere
MW	megawatt
MWh	megawatt hour
PJ	petajoule
t CO_2	tonne carbon dioxide
TWh	terawatt hour

See the IEA glossary for a further explanation of many of the terms used in this report.

Infographic sources

Natural gas decline: IEA analysis based on IEA (2025), Monthly Gas Statistics.

Solar PV Expansion: IEA analysis based on IEA (2025), World Energy Balances; IEA (2025), Monthly Electricity Statistics.

Emissions: IEA (2026), Greenhouse Gas Emissions from Energy.

Used vehicle imports: IEA analysis based on Eurostat (2025), Statistics; ACEA (2025), Statistics; EAFO (2025), Statistics.

Industry fuel source: IEA analysis based on IEA (2025), World Energy Balances.

Infographic notes

Industry fuel source: District heating is excluded from the chart.

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Typeset in France by IEA - May 2026
Cover design: IEA

Portugal 2026

Energy Policy Review

Government action plays a pivotal role in ensuring secure and sustainable energy transitions. Energy policy is critical not just for the energy sector but also for meeting environmental, economic and social goals. Governments need to respond to their country's specific needs, adapt to regional contexts and help address global challenges. In this context, the International Energy Agency (IEA) conducts Energy Policy Reviews to support governments in developing more impactful energy and climate policies.

This *Energy Policy Review* was prepared in partnership between the Government of Portugal and the IEA. It draws on the IEA's extensive knowledge and the inputs of expert peers from IEA Member countries to assess Portugal's most pressing energy sector challenges and provide recommendations on how to address them, backed by international best practices. The report also highlights areas where Portugal's leadership can serve as an example in promoting secure and clean energy transitions. It also promotes the exchange of best practices among countries to foster learning, build consensus and strengthen political will for a sustainable and affordable energy future.