Energy Policy Review

Spain 2026

INTERNATIONAL ENERGY AGENCY

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Executive summary

Spain has made impressive progress in transforming its energy system. Between 2015 and 2025, it more than doubled renewable electricity capacity to about 119 GW and improved energy intensity by 2.4% per year on average. It also reduced greenhouse gas emissions by around one-fifth between 2015 and 2024. Spain's progress reflects an ambitious strategic and institutional framework that is anchored in the National Energy and Climate Plan, the Climate Change and Energy Transition Law, and well-defined policies to accelerate electrification, decarbonisation and climate adaptation. The social dimension is a defining feature of Spain's energy strategy, including through the Just Transition Institute and measures designed to link investment in clean energy with jobs, regional development and social inclusion.

The energy transition is helping to improve security and competitiveness. While Spain relied on imports for almost 70% of total energy consumption in 2024, the rapid decarbonisation of the power sector is reducing this exposure. Domestically deployed renewable electricity increased from 35% of total generation in 2015 to 56% in 2025, while all low-emission sources collectively accounted for around three-quarters. By expanding the share of domestically available, low-cost, renewables, Spain reduced its vulnerability to fossil fuel price shocks and lowered wholesale electricity prices. The impact on energy security is substantial: without the renewable capacity additions deployed between 2011 and 2024, natural gas imports in 2024 would have been almost 40% higher. Over the same period, the growth of wind and solar power avoided an estimated USD 26 billion in cumulative gas import costs.

Persistent challenges remain as Spain's transition advances. Spain has demonstrated its ability to deploy clean power at scale. The central challenge now is to turn the transition of power supply into a transformation of the economy as a whole. As in many IEA Member countries, the transport sector is a key challenge. Emissions

in this sector increased by nearly 8% between 2015 and 2024. While progress is made through residential renovations, fossil fuel based heating remains widespread in the building sector. In industry, electrification, renewable heat and low-carbon fuels offer significant opportunities, but investment is hampered by high upfront costs and uncertainty over future demand and infrastructure. Across all three end-use sectors, low relative fossil fuel prices compared to those for electricity undermine the commercial case for switching.

Rebalancing energy price signals can unlock demand-side transformation. Accelerating electrification across sectors is a top priority for Spain. At 25% of final energy consumption (in 2024), electricity's share remains well below Spain's 2030 objective of 35%. Spain's high penetration of renewable electricity results in relatively low wholesale spot prices for power compared to those in peer countries, but taxes, levies, and network charges keep final consumer prices high. At the same time, these cost components are much lower for fossil fuels, blunting the incentive for households, businesses and industry to choose electric solutions even when these are cleaner and more efficient. Carefully shifting the balance of taxes and levies while protecting vulnerable consumers would make electrification more attractive, improve competitiveness, and help ensure that low-cost renewable electricity generation delivers its full economic value.

As the power system transforms, stability becomes a key policy challenge. Policy makers must ensure that grid infrastructure, system operation and network planning evolve as quickly as the generation mix. Recent experience, including the April 2025 blackout, underlines the need to strengthen resilience.

Spain launched important electricity system operation reforms, including enhanced supervision, updated operating procedures and additional grid technology investments. Maintaining stable frequency, voltage and inertia in a transformed power system will depend on diligent implementation of these measures. It will also require a sustained focus on system planning and reinforced governance that continuously adapts to changing circumstances.

The growing role of variable renewables places flexibility at the centre of electricity governance. Storage is needed to absorb surplus generation and shift it to periods of higher demand. Reinforced interconnectivity would enable Spain to both improve its own security of supply and allow its surpluses to serve wider European markets. Demand-side flexibility – including smart charging, aggregation and industrial load management – can reduce costs for consumers and the system. Spain

has taken critical steps in this direction through financial support, legal recognition of storage as a system flexibility resource, and modernised grid-operation rules that better reflect the importance of storage and demand-side flexibility. This is leading to growth in flexibility resources. Additional action, including strengthening incentives for the uptake of dynamic pricing, could accelerate this progress.

Further efforts are needed to ensure a more balanced renewable energy supply mix. While stability and flexibility mechanisms are essential for the next phases of the energy transition, action on the generation side can help ease challenges too. Solar PV made up about 50% of total renewable electricity capacity and accounted for over 90% of renewable capacity additions in 2025. The speed of deployment has been impressive, but a system dominated by solar additions risks worsening curtailment, cannibalising prices and weakening investment signals. A higher share of wind power would allow Spain to integrate more renewables in its electricity system, thereby protecting the business case for their future deployment.

Complex permitting and social acceptance challenges could slow the further development of renewables, especially wind power. Addressing these barriers through continued efforts to facilitate permitting processes, ensure benefit-sharing by renewable projects with local communities, and increase stakeholder engagement will be essential for sustaining the growth of renewable electricity capacity at a pace that meets expected increases in demand.

The planned phase-out of nuclear power between 2027 and 2035 has important implications for Spain's security of energy supply and decarbonisation. Nuclear plants provide reliable, low-carbon electricity and support the well-functioning operation of the power system. Managing the phase-out safely and affordably will require monitoring to ensure that renewables, flexibility and stability resources are deployed and integrated quickly enough, while also reflecting broader geopolitical and economic dynamics and related risks. Approving operators' extension requests can provide cost-efficient transitional relief.

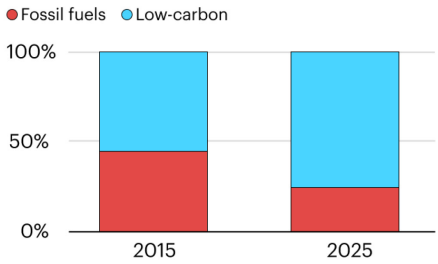
As in many countries, implementation capacity is now just as important as policy ambition. An integrated planning approach with regular progress reviews linked to corrective actions and strengthened co-operation across ministries, regions, local authorities, regulators and operators can help roll-out broad and ambitious energy transition policies. Administrative bottlenecks, especially in permitting and project evaluation, risk slowing delivery. Skills shortages in renewable deployment, grid integration, construction and energy efficiency could also constrain progress.

Reinforced administrative resources and a major effort to scale up training and reskilling would help Spain convert its targets into investment, infrastructure and consumer benefits.

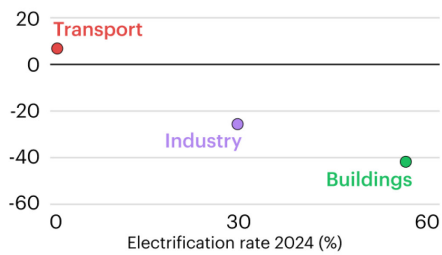
Spain's people-centred approach is a major asset. The country developed advanced frameworks for delivering a just transition and fighting energy poverty, supported by dedicated institutions and targeted policies. However, affordability remains an important concern for many households. The transition will better retain public support if it visibly improves living conditions, lowers exposure to fossil fuel price volatility and provides vulnerable groups with access to clean technologies, efficient homes and affordable mobility. Continued focus on targeted building renovation and energy efficiency support and inclusive clean energy technology programmes can deliver lasting social benefits.

Overall, this review finds that Spain is entering the coming years from a position of strategic strength. It has built one of the largest renewable electricity fleets among IEA Member countries, created a robust policy framework and demonstrated that its decarbonisation efforts support security, competitiveness and social inclusion. The priority should now be to convert this foundation into a fully integrated, flexible and resilient energy system. If Spain can accelerate electrification, modernise grids, unlock flexibility, manage the nuclear phase-out prudently and sustain public and businesses confidence, it can move from being a low-emissions power sector frontrunner to a model for whole-economy energy transition.

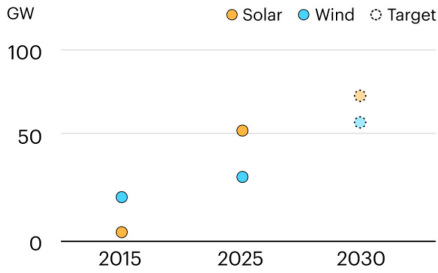
Rapid **power sector decarbonisation** is driving Spain's energy transition and strengthening energy security



Emission reductions and electrification rates **vary across end-use sectors**



Solar capacity grew sharply, resulting in important affordability and decarbonisation gains



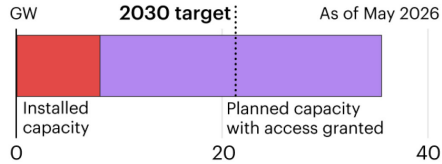
Wind deployment needs to accelerate to help deliver a balanced and efficient renewables supply mix

25 to 35%

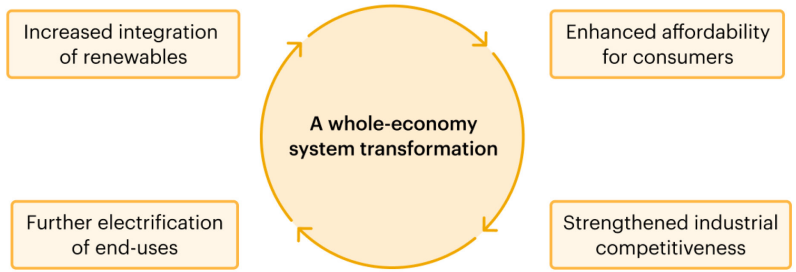
Spain has ambitious goals to increase its **electrification rate** by 10 percentage points between 2024 and 2030

22.5 GW by 2030

Achieving Spain's **storage target** would help enable increasing shares of variable renewables in the power system



The shift from a supply-side to an economy-wide transformation can further **unlock Spain's decarbonised electrification potential**



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Sources for this infographic can be found in the annexes.

Policy recommendations for Spain

Energy policy landscape

1. Strengthen implementation oversight and co-ordination to ensure timely and comprehensive economy-wide execution of energy transition objectives and commitments.
2. Electrify industrial and domestic demand in line with the rapid expansion of supply, by adopting reductions in electricity taxation that enhance competitiveness and affordability.
3. Accelerate transition in the transport sector by addressing cost barriers, enhancing infrastructure deployment and strengthening consumer confidence.
4. Incentivise building renovations to reach energy efficiency and electrification targets, while implementing targeted support for vulnerable consumers.
5. Strengthen workforce planning and skills strategies to support the energy transition across all sectors, while ensuring adequate human administrative capacity for timely permitting and other regulatory requirements.

Energy security and diversification of supply — Focus area

6. Develop integrated infrastructure planning that jointly addresses current and future needs across electricity, natural gas, hydrogen and other renewable gases sectors.
7. Consider approving the extension of existing nuclear reactors, following safety reviews, taking into account their role in security of supply and the costs and benefits of long-term operation.

Resilient electrification of the energy system — Focus area

8. Rebalance the renewables portfolio by deploying more wind, hybrid and storage technologies to increase system value, while addressing permitting and social acceptance challenges.
9. Increase electricity system flexibility through accelerated storage deployment, greater demand side response and interconnections.
10. Reinforce grid security and resilience by strengthening governance across power system actors, implementing enhanced operational procedures and aligning regulatory frameworks with evolving system needs.

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Energy policy landscape

Spain's energy system is centred on a commitment to deliver an affordable, resilient and sustainable transition. The country has taken significant steps in reducing economy-wide greenhouse gas (GHG) emissions, which decreased by 19% between 2015 and 2024 (excluding removals). It sharply increased the capacity of renewable energy to about 119 GW in 2025, more than doubling the 2015 level of 51 GW, and it put innovative policies in place to enhance energy efficiency across all sectors, resulting in average annual energy intensity improvements of 2.4% between 2015 and 2025.

Spain's energy transition is closely tied to its energy security and competitiveness objectives. In 2024, imports made up 69% of total energy consumption, and the government's goal is to reduce that share to 50% by 2030. Increasing the use of domestically deployed low-carbon energy will play an important role in meeting this objective, since almost all of Spain's fossil fuel consumption is supplied through imports. Meanwhile, the dominance of renewable energy sources (RES) in the electricity system (56% of generation in 2025, up from 35% in 2015) already has had a positive impact on affordability. Renewables increasingly are defining - and lowering - the spot wholesale electricity price, leading to more affordable end prices for consumers. As a result, Spain has improved its ranking among EU countries in terms of the competitiveness of its electricity prices for households and non-household customers.

To further leverage the potential of domestic renewables, Spain has decisively committed to electrifying its economy. This requires a shift from a predominantly power supply-driven transformation towards a more integrated, system-wide one. In order to avoid emerging bottlenecks that could constrain progress, it will be important for electricity demand growth, renewable capacity deployment, grid development and flexibility resources to evolve in a co-ordinated manner.

Transitioning to an electrified, low-carbon economy has implications beyond the energy sector, including for jobs, regional development and social equality. Spain is a pioneering country when it comes to people-centred transitions. It has a sophisticated policy framework in place, developed by a dedicated Institute for the Just Transition (JTI), which focuses on ensuring that the transition to a sustainable energy system and economy happens in an orderly and inclusive manner.

Climate and energy strategy

The Ministry for the Ecological Transition and the Demographic Challenge (MITECO) is responsible for Spain's energy and climate policy. It houses the Spanish Climate Change Office, which formulates national climate change policies. The National Climate Council issues recommendations on climate change-related plans, programmes and measures, and the Commission for Climate Change Policy Co-ordination co-ordinates between national and regional authorities.

Energy policy implementation is led within MITECO by the Secretary of State for Energy. This involves several institutions that hold competencies in different areas of energy policy. These include the Directorate General for Energy Policy and Mining Regulation, the Directorate General for Energy Planning and Co-ordination, the Just Transition Institute (JTI), the Institute for Energy Diversification and Savings (IDAE), the Corporation of Strategic Reserves of Oil Products (CORES), the City of Energy Foundation, and the National Radioactive Waste Company (Enresa).

Oversight of the electricity and natural gas sectors is carried out by the National Commission on Markets and Competition (CNMC), Spain's independent multi-sector regulator that also reports directly to the Spanish parliament. The Nuclear Safety Council (CSN) is the sole competent regulatory body for matters of nuclear safety and radiation protection. Operationally independent from the government, it also reports directly to the Spanish parliament.

As demonstrated in the National Energy and Climate Plan (NECP), Spain is committed to delivering its 2050 climate neutrality objective and leveraging the energy transition to increase sustainability, competitiveness, affordability and energy security. The country's strategy is based on a mix of policy instruments, including investments, subsidies and regulatory measures, with the May 2021 Climate Change and Energy Transition Law (Law 7/2021) as a central pillar. This legislative framework underlies measures to support renewable energy deployment, energy efficiency, emissions reductions and electrification.

The National Energy Security Strategy 2015 defines the country's vision, challenges and objectives linked to energy security. In October 2022, Spain published the Plan Más Seguridad Energética (Plan for More Energy Security), which provides an updated vision in the context of the invasion of Ukraine. The government is currently working on a fully revised Strategy that also draws lessons from the April 2025 blackout and the 2022 and 2026 crises.

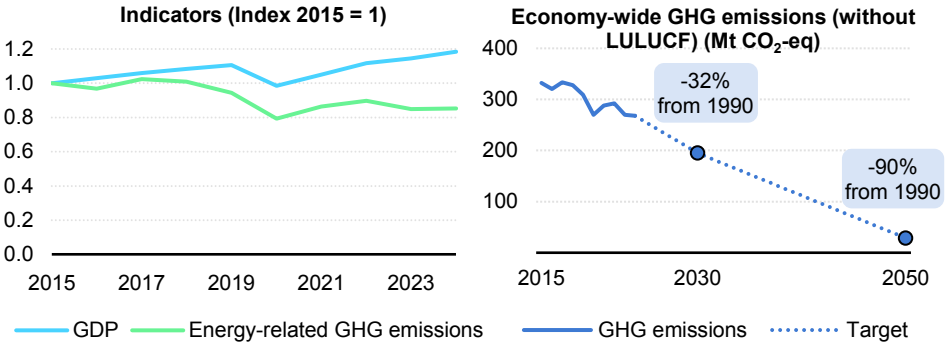
Climate trends and targets

Spain reduced its emissions significantly over the past decade. From 2015 to 2024, it cut GHG emissions by 64 million tonnes of CO_2-equivalent (Mt CO_2-eq), or 19% (excluding removals). However, important variations exist between sectors. The steepest GHG emissions reductions – both in relative and absolute terms – come from electricity and heat production, which declined by 64% or 47 Mt CO_2-eq between 2015 and 2024. Among end-use sectors, industrial energy-related[1] CO_2 emissions decreased by 26%, and buildings emissions by 42%, while emissions from the transport sector increased by 7.7% over the same period. The Land Use, Land-Use Change and Forestry (LULUCF) sector contributed to additional reductions through emission absorptions or removals, which have been stable over the last decade and accounted for 52 Mt CO_2-eq in 2024.

As a member of the European Union, Spain is covered by the binding joint EU target for a 55% net reduction in GHG emissions by 2030 (compared to 1990), as set out in the European Climate Law. The NECP reflects this with an economy-wide gross reduction target of 32% by 2030 (compared to 1990, excluding removals). Spain is also party to a joint EU and member states nationally determined contribution (NDC) under the United Nations Framework Convention on Climate Change (UNFCCC). The updated EU NDC proposes an indicative reduction in emissions in the range of 66.25% to 72.5% by 2035 (compared with 1990), as a milestone on the pathway towards carbon neutrality by 2050.

[1] Energy-related emissions attributed to end-use sectors include direct emissions from fuel combustion as well as indirect emissions from electricity and heat generation. The latter are reallocated to end-use sectors based on their consumption.

Selected indicators growth (2015-2024), and economy-wide GHG emissions, historical (2015-2024) and targets (2030, 2050) in Spain



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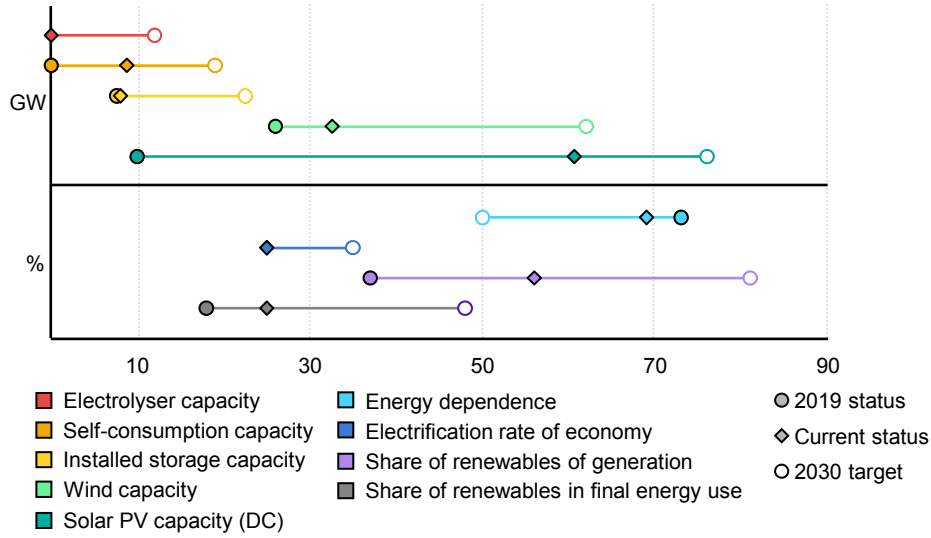
Sources: IEA analysis based on IEA (2026), World Energy Balances; EEA (2026), EEA greenhouse gases - data viewer, (accessed April 2026).

Spain's headline targets are broken down in the NECP, which projects that the country will exceed its EU Effort-Sharing Regulation (ESR) emissions reduction target of 37.7% (by 2030, compared to 2005 levels), and instead reach a reduction of 42%. The ESR applies to sectors outside the current EU Emissions Trading System, notably transport, buildings, agriculture, waste and small industry.

Spain is also subject to the revised Energy Efficiency Directive (EED), which establishes a binding EU-level target to reduce final energy consumption by 11.7% by 2030 compared to a 2020 reference scenario. Within this framework, Spain has set an indicative national objective of 71.7 Mtoe for net final energy consumption and 98.4 Mtoe for net primary energy consumption by 2030, as specified in its NECP. This represents a 43% improvement in energy efficiency (compared to 1990).

The NECP moreover defines ambitious targets for renewable energy deployment. Spain aims to reach a 48% share of renewable sources in final energy consumption by 2030, exceeding the Renewable Energy Directive III (RED III) binding EU target of 42.5% to 45%. This implies an 81% share for renewables in the electricity mix. To deliver these objectives, the government plans to increase solar photovoltaic (PV) capacity to 76 GW and wind power capacity to 62 GW by 2030. Additionally, the Spanish economy is expected to achieve an electrification rate of 35%, with storage and self-consumption capacity targeted to reach 22.5 GW and 19 GW by the same year.

Overview of progress on Spain's 2030 climate and energy targets



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Notes: Current status refers to 2024 for energy dependence, electrification rate of economy, share of renewables in final energy use; 2025 for wind capacity, solar PV capacity (DC), renewables share in electricity generation, self-consumption capacity, and electrolyser capacity; and May 2026 for installed storage capacity. Electrolyser capacity has no 2019 value. Electrification rate in 2019 and current are the same.

Sources: IEA analysis based on IEA (2026), World Energy Balances; EEA (2026), EEA greenhouse gases - data viewer, (accessed June 2026); Eurostat (2026), Share of renewable energy in final consumption, (accessed June 2026); MITECO (2025), Annual statistics on self-consumption and energy storage, (accessed June 2026).); REE (2026), Self-consumption capacity, (accessed June 2026).

Spain is recognised for its robust policy framework, the ambition of its energy transition commitments, and the effective implementation of these commitments during the first half of the 2020s. However, delivery risks remain significant. These include financing challenges exacerbated by high interest rates, and revenue uncertainty linked to price cannibalisation in the renewables sector. They also include slow and complex permitting, social acceptance and behavioural constraints, shortages of skilled workers and administrative human resource capacity, supply chain pressures, and grid bottlenecks. Addressing these barriers will be critical for achieving Spain's ambitious climate and energy targets.

Climate and energy policy framework

Spain's NECP and Climate Change and Energy Transition Law are the foundation of the country's policies to deliver its energy-related targets through 2030. Beyond this, Spain's Long-Term Decarbonisation Strategy (LTS), approved in 2020[2], aims to deliver climate neutrality by 2050. These strategic pillars have been translated into different policy instruments.

An important pillar of Spain's climate and energy policy framework is the "energy efficiency first" principle. The country operates a long-standing energy-efficiency obligation scheme under Law 18/2014, which requires electricity and fuel suppliers ("obligated parties") to deliver annual energy savings. Order TED/133/2026 increased the annual energy-savings target for 2026 to 801 ktoe (≈ 9.3 TWh), up from 375 ktoe in 2024. Obligated parties have traditionally met these obligations through contributions to the National Energy Efficiency Fund (NEEF) at a price set by official orders (EUR 198/MWh in 2026). With these contributions, the NEEF finances energy efficiency programmes and measures across the economy. Since 2023, obligated parties have also been able to meet part of their contributions to the NEEF (up to 92% in 2026) with Energy Saving Certificates (CAEs), which can be purchased from final users that have implemented certified energy efficiency measures.

A second pillar of the policy framework is the objective of enabling a shift to a renewables-based energy system. Royal Decree Law 23/2020 introduced measures to support the deployment of renewable electricity, including rules on grid access and connection, a competitive auction framework and provisions to simplify certain authorisation procedures. It also amended Law 24/2013 on the Electricity Sector to introduce legal definitions and concepts related to electricity storage facilities, hybridisation, independent aggregators and renewable energy communities[3]. These reforms helped create a legal basis for the continued expansion and integration of renewables, while later measures have further developed the framework. In particular, Royal Decree Law 7/2026, adopted as part of Spain's response to the crisis in the Middle East, combines short-term protection for affected households and industry with measures to accelerate electrification, improve the use of grid capacity and increase the deployment of renewable energy and storage, thereby reducing structural dependence on fossil fuels.

[2] An update of the LTS is expected in 2026.
[3] A renewable energy community is a legal entity through which citizens, SMEs and local authorities jointly develop and benefit from renewable energy projects.

Climate adaptation and resilience are additional pillars of Spain's climate and energy policy framework. The country is directly impacted by climate change, suffering significant increases in heat-related mortality and in premature deaths caused by air pollution. Extreme weather, heat and water stress also affect the general state of Spain's economy and energy infrastructure. The cost of climate-related economic losses has increased steadily, rising from EUR 29.2 per capita in 2021 to EUR 65.8 per capita in 2023.

In response to these impacts, Spain has adopted specific governance tools and institutions. The National Plan for Adaptation to Climate Change (PNACC) 2021-2030 is the country's framework for assessing climate risks and strengthening resilience across all sectors, including the energy system.

The PNACC Work Programme 2021-2025 operates across 18 ministries and public bodies and translates the strategic framework into concrete actions. In the energy domain, the PNACC Work Programme strengthens the systematic consideration of climate change adaptation in planning, regulation and investment decisions. Priorities include assessing and managing water scarcity and hydrological variability that affect hydropower generation, enhancing the resilience of electricity transmission and distribution networks to extreme weather events, and identifying climate-related stress on renewable energy assets and thermal power plant cooling systems. The PNACC Work Programme also promotes improved knowledge about climate risks, vulnerability assessments, and co-ordination mechanisms between energy, water and environmental authorities, with the objective of reducing exposure and increasing the adaptive capacity of the energy system over time. Adaptation dimensions are increasingly reflected in other energy and climate policy frameworks as well, including in the NECP, ensuring greater consistency between decarbonisation and resilience objectives.

As Spain tackles the rising impact of extreme weather and moves away from an economy that is heavily reliant on fossil fuels, it is guided by well-developed social considerations, as reflected in its Just Transition Strategy and National Strategy Against Energy Poverty (discussed in the "Skills, jobs and social inclusion" section of this report).

Monitoring of Spain's climate and energy policy is anchored in EU governance that requires regular reporting on NECP progress. At the national level, Royal Decree 91/2025 establishes additional governance arrangements for energy, climate change and air-quality reporting, operationalised through the HERMES

platform to facilitate data collection across competent authorities. Additionally, the 2021 Climate Change and Energy Transition Law introduces climate-related disclosure and planning requirements for large entities and parts of the financial sector. This has been operationalised by subsequent implementing measures such as Royal Decree 214/2025.

Taxation and carbon pricing

In addition to a 21% value-added tax (VAT), Spain applies several sector-specific energy taxes. These notably include a special tax on electricity, excise duties on hydrocarbons (covering petrol, diesel, natural gas and other fuels), and a tax on coal. These taxes are largely harmonised with EU minimum taxation requirements under the Energy Taxation Directive and constitute a significant share of final energy prices. In addition, Spain levies several energy-related environmental taxes, including a tax on the value of electricity production, taxes on the extraction of hydrocarbons, and charges related to nuclear fuel and radioactive waste management.

Spain is subject to the EU Emissions Trading System (ETS), which currently covers power and heat generation, energy-intensive industrial installations, intra-European Economic Area aviation, and, since 2024, maritime transport. Under the revised EU ETS Directive (Fit for 55), the EU-wide emissions reduction target for ETS sectors increased from 43% to 62% by 2030, compared to 2005 levels. In Spain, emissions covered by the EU ETS fell by approximately 58 % between 2005 and 2023, while EU-wide ETS emissions declined by 47% in the same period, indicating that Spain is decarbonising more quickly than the EU average in these sectors. This continues the earlier reduction trend (-45% between 2005 and 2019) that was noted in the 2021 Energy Policy Review. The European Union has also established a separate emissions-trading system for buildings and road transport (ETS2), which is expected to apply from 2028.

Relative to other EU countries, Spain makes comparatively limited use of environmental taxation as a tool to support climate and energy objectives. According to European Commission data, environmental tax revenues in Spain remain below the EU average as a share of both GDP and total tax revenue. This reflects a fiscal mix that places greater weight on labour and relatively limited emphasis on energy, transport and pollution.

The country could consider additional domestic environmental taxation options as part of a broader approach for improving relative price signals and further reducing fossil-fuel use. By expanding the scope and level of environmental taxation, Spain could accelerate fossil fuel reductions at a lower economic and fiscal cost than regulatory or public spending alternatives. Such a consideration is particularly important in light of Spain's limited fiscal space and the temporary nature of Next Generation EU (NGEU) funding, which is scheduled to conclude at the end of 2026. However, any such approach would require careful design to protect vulnerable households and maintain competitiveness.

The Spanish government is considering further carbon pricing initiatives. In March 2026, Spain introduced the legal framework for carbon contracts for difference (CCfDs) as part of its crisis response energy package. Royal Decree Law 7/2026 enables the state to support industrial decarbonisation investments by partially or fully compensating the gap between the cost of low-carbon technologies and prevailing carbon and energy price signals. This policy instrument could play a significant role in accelerating industrial decarbonisation, though its effectiveness will depend on credible and well-structured implementation, including clearly defined strike price methodologies, eligibility criteria, timelines and budget allocations. Spain could draw on established international experience as it defines the details of its own instrument, including the United Kingdom's Industrial CfD programme and Germany's H2Global initiative.

Energy research and technology

Spain's energy innovation framework

Innovation is an important enabler of Spain's transition to a secure, competitive and low-emission energy system. Public spending on energy research, development and demonstration (RD&D) as a share of GDP grew between 2020 and 2024 from 0.007% to 0.113%, positioning Spain as one of the leading energy RD&D spenders among IEA Member countries. A sustained and effective energy innovation effort depends not only on sector-specific funding, however, but also on the strength of the broader science, technology and innovation system. In particular, energy innovation is closely intertwined with materials science, digital technologies, power electronics and industrial processes. Spain's expenditure on overall RD&D in 2024 was 1.54% of GDP, below the average for both the European Union (2.13%) and the OECD (2.72%), and indicates room for improvement.

Spain's energy-innovation landscape is part of the wider EU innovation ecosystem, where strategic priorities and funding instruments increasingly operate at European scale. Horizon Europe, the European Union's flagship research and innovation programme, provides substantial support to Spanish institutions, including across energy-relevant clusters, such as energy systems, industry, mobility and digitalisation. Spain has been among the largest recipients of Horizon Europe funding. It performs particularly strongly in project co-ordination, reflecting the country's solid research capacity and integration into European research networks.

The EU Innovation Fund, which is financed by revenues from the EU Emissions Trading System, plays a central role in supporting first-of-a-kind demonstration and industrial-scale deployment projects in energy and industrial decarbonisation. Also here, Spain is among the leading host countries of projects, including in renewable hydrogen and industrial applications. In 2025, Spain launched the Innvierte Deep-Tech Transfer instrument, managed by Spain's Centre for Technological Development and Innovation (CDTI) in partnership with the European Investment Fund. The European Investment Bank (EIB) Group additionally provides large-scale financing for clean-energy innovation and technology scale-ups in Spain, including projects related to climate and deep tech.

Spain moreover hosts the headquarters of two energy-related flagship facilities under the European Strategy Forum on Research Infrastructures: EU-SOLARIS, operational since 2023, is focused on solar thermal research, while IFMIF-DONES is a fusion materials testing facility that is currently under construction (since 2026) also expected to become operational in 2029.

At the national level, Spain does not have a dedicated energy innovation strategy. Instead, energy is included as a strategic priority in the Spanish Science, Technology and Innovation Strategy 2021–2027, although it does not specifically reference energy security, affordability or competitiveness. This broader strategy is operationalised through the State Plan for Scientific, Technical and Innovation Research 2024-2027, which addresses elements such as talent acquisition, knowledge transfer, public-private co-operation, administrative simplification and open science. While these frameworks cover important cross-cutting issues, they do not fully translate energy innovation ambitions into a clearly prioritised set of technologies, quantified milestones and long-term funding commitments.

Spain's Strategic Projects for Economic Recovery and Transformation (PERTEs) programme, implemented under the Plan de Recuperación, Transformación y Resiliencia (National Recovery and Resilience Plan, NRRP), is the country's main instrument for public-private collaboration across identified strategic areas of the economy. PERTEs use targeted public funding to leverage private investment in certain sectors or value chains. Initiatives supported by one of the PERTEs are required to carry high technological or financial risk, undertake disruptive research and innovation phases, and aim to deliver first-of-a-kind industrial deployment. Of the twelve PERTEs, five are directly or closely linked to energy, representing a clear expression of national strategic prioritisation of energy in innovation.

The government also directly supports business RD&D, combining direct funding and tax incentives. Spain's total public support to business RD&D was estimated at around 0.22% of GDP (2024), well above the EU average, with tax relief accounting for nearly 65% of the total. However, administrative complexity and slow reimbursement procedures reduce the effectiveness of such support, particularly for innovative SMEs and start-ups. As in most countries, Spain does not systematically collect or publish data on tax incentives specifically for energy-related RD&D, limiting the ability to assess whether support aligns with energy system priorities.

Industrial policy shaping clean-technology manufacturing

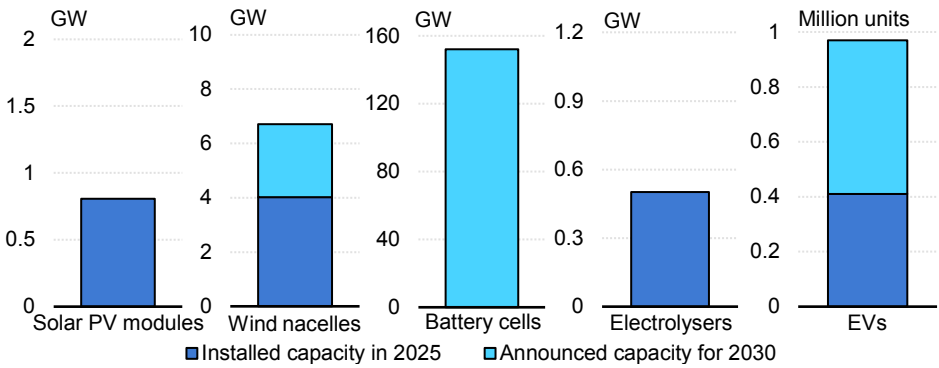
Spain's clean-technology manufacturing landscape is shaped by a combination of EU industrial policy frameworks and national instruments. At EU level, the Net Zero Industry Act and the Clean Industrial Deal provide the overarching framework for scaling the manufacturing of net-zero technologies. They introduce non-price criteria in auctions and procurement and mobilise financing for industrial decarbonisation. Complementing this, the Critical Raw Materials Act and the RESourceEU Action Plan aim to strengthen upstream supply chains for strategic materials. In addition, the Industrial Accelerator Act proposes binding "Made in EU" requirements across procurement, auctions and support schemes for strategic net-zero technologies.

As discussed above, Spain's national industrial policy actions are primarily channelled through the PERTEs programme. The PERTE for Renewables, Renewable Hydrogen and Storage supports manufacturing and deployment across renewable energy, hydrogen and storage value chains, while the PERTE for Electric and Connected Vehicles focuses on battery manufacturing and the wider EV supply chain. The PERTE for Industrial Decarbonisation supports electrification, renewable hydrogen use, carbon-capture solutions and low-carbon thermal technologies in

energy-intensive industries, and the PERTE for Microelectronics and Semiconductors targets selected segments of the semiconductor value chain that are relevant for digital and clean energy applications.

The PERTEs are complemented by regulatory and funding instruments. Royal Decree 962/2024 streamlines offshore wind deployment by combining remuneration, grid access and maritime concessions in a single competitive process. Spain is also leveraging Important Projects of Common European Interest (IPCEI), such as Hy2Use, which supports large-scale renewable hydrogen production and associated industrial clusters. Evolving EU state-aid rules under the Clean Industrial Deal State Aid Framework provide additional flexibility for Spain to support clean-technology manufacturing, industrial decarbonisation and electricity cost compensation for energy-intensive industries. These measures are set to underpin growth in Spain's manufacturing capacity. Wind, batteries and electric vehicles (EVs) are the technologies for which the largest manufacturing capacity increases are projected on the basis of announced projects.

Installed and announced annual manufacturing capacity in Spain, 2025-2030



IEA. CC BY 4.0.

Notes: Capacity figures refer to annual production capacity. Announced capacity to 2030 refers to all project announcements, both committed and preliminary.

Source: IEA (2026), Energy Technology Perspectives 2026.

The building blocks of Spain's industrial policy framework for clean-technology manufacturing feature a broad yet project-based approach. Their overall impact – and therefore the realisation of project pipelines – will depend on effective co-ordination across programmes and alignment of enabling conditions, such as electricity prices, grid access and permitting capacity.

Investment and financing

Energy sector investment in Spain is guided by the NECP, which defines investment needs, priority areas and the respective roles of market actors and public authorities. The plan estimates total investment requirements of around EUR 308 billion between 2021 and 2030, with around 82% of this expected to come from private actors. Investment needs are concentrated in renewable energy deployment, energy efficiency and savings, electricity networks, and the electrification of end-use sectors. Public support is intended to be primarily catalytic, reducing investment risks, supporting innovation and accelerating deployment rather than substituting for private capital.

The NRRP represents a major source of public financing for the energy transition, alongside other national and European funding instruments. Following the October 2023 Addendum and inclusion of a REPowerEU chapter, the NRRP reached approximately EUR 163 billion, including loans and grants, with around 37% allocated to climate-related measures such as renewables, storage, renewable hydrogen, industrial decarbonisation and energy efficiency. Implementation is largely channelled through IDAE, which manages a broad portfolio of grant programmes at national and regional level, combining support for innovative large-scale projects with wide-reach schemes that target households, SMEs and local authorities.

Direct public support is complemented by market-based and regulatory instruments, including competitive renewable energy auctions, as well as the National Energy Efficiency Fund (NEEF). Managed by IDAE, the NEEF is a public financial instrument funded mainly through mandatory contributions from energy companies. It was created to contribute to national energy saving obligations under the EU Energy Efficiency Directive and is frequently cited in European policy exchanges as an example of national implementation. The NEEF is linked to the CAE system, which consists of tradable incentives for investments in energy efficiency.

Spain has also put in place predictable remuneration frameworks for transmission and distribution networks. In September 2025, the government announced a EUR 13.6 billion investment plan for the transmission grid and a 62% increase in investment limits for distribution grids.

European and national financial institutions further enhance access to capital through long-term lending, guarantees and equity. Apart from the RRF loans, key vehicles include the EIB, InvestEU, and national promotional instruments such as ICO green credit lines and COFIDES co-investment funds, which help improve project bankability and leverage private and foreign capital.

Skills, jobs and social inclusion

Employment trends and skills availability

Randstad Research reports that Spain's energy sector employed nearly 109 000 people in Q1 2025,[4] over 90% under permanent contracts. In 2024, Spain ranked 7th globally for employment creation in the wind sector and 2nd in the European Union for employment creation in the solar sector. Research by BBVA confirms the potential for these sectors to generate substantial future employment. The Spanish government expects the energy transition to deliver an employment increase of 560 000 jobs by 2030, compared with a baseline scenario, mainly coming from the renewables and efficiency sectors. While these figures indicate the potential of the energy transition to increase employment at scale, effective translation of opportunities into positive outcomes will depend on the availability of suitably skilled workers and on policies to ensure that employment growth is geographically and socially inclusive.

Ensuring that Spain's workforce has the right skills in the right places at the right time will become increasingly important as the transition accelerates. National assessments have identified skills gaps in energy efficiency, waste management, grid-related occupations and electrical engineering. Although Spain has made progress in aligning skills policies with energy objectives, skills shortages remain a bottleneck. Scaling up renewables' share in the energy mix and increasing electrification and energy efficiency at the pace foreseen by the NECP will require faster deployment of training and reskilling programmes across affected (sub-) sectors, including electricity grids, storage, renewables, hydrogen, as well as construction, renovation and manufacturing.

Just transition governance and skills policies

To manage the socio-economic impacts of its transforming energy system, Spain established the Just Transition Institute (*Instituto para la Transición Justa*, JTI) in 2020 through Royal Decree 500/2020, building on the previous Institute for Coal Mining Restructuring and the Alternative Development of Mining Regions. The JTI's core mandate is to anticipate and address the employment, territorial and demographic effects of the transition by ensuring that workers and regions affected by the decline of carbon-intensive activities receive fair and targeted support.

[4] The data is limited to utilities and does not fully capture the oil and gas sub-sectors.

This approach is being operationalised through Spain's Just Transition Strategy, which seeks to manage the consequences of the transition with principles of equity and solidarity, particularly in regions facing industrial restructuring and depopulation.

Emphasis is on skills development and labour-market alignment, recognising that the shift towards a low-carbon economy requires new professional profiles and qualifications that are not yet widely available in the existing workforce. The Strategy includes a dedicated pillar on Green Vocational Training, which sets out a targeted framework to reduce skills mismatches by expanding training capacity and better aligning vocational education with the needs of the green economy. Key measures include promoting training pathways linked to green productive sectors, revising vocational education curricula and national professional qualification catalogues, and systematically integrating green and digital competences into vocational training programmes.

The Just Transition Strategy is being implemented through Just Transition Agreements, which deploy a broad set of initiatives. This includes support for new investments and services, worker protection and reskilling, measures to facilitate renewable energy deployment and value-chain development in affected areas, as well as assistance for entrepreneurship and projects that strengthen local social and environmental services. Complementing these Agreements, the JTI has developed specific tender mechanisms linked to the closure of coal-fired power plants, notably making access to grid capacity in affected areas conditional on commitments to local job creation and community investment, thereby aligning the expansion of renewables with regional development objectives.

The Strategy also embeds gender equality as a cross-cutting objective. It explicitly aims to reduce employment inequalities affecting women and other disadvantaged groups in the context of the transition. In practice, gender considerations are mainstreamed across just-transition measures, including by prioritising projects that maximise job creation opportunities for women in coal regions and providing additional financial support where relevant. Competitive tender schemes supporting energy transition projects similarly integrate gender equality criteria in their evaluation frameworks.

Spain is currently drafting its new Just Transition Strategy (2026-2030), which is expected to reinforce the social and labour dimension of the NECP. The primary goal of the Spanish government in this context is to maximise the economic and employment opportunities arising from the transition while minimising negative impacts on workers and vulnerable regions.

Broader labour market policies led by the Ministry of Labour and Social Economy reinforce Spain's just transition governance. For example, working through the Public State Employment Service (SEPE), the ministry co-ordinates active labour-market policies and supports nationwide training initiatives focused on emerging skills needs, including those linked to clean energy and building decarbonisation. Training courses on renewable energy technologies and self-consumption have been incorporated into the SEPE Catalogue of Formative Specialities. This enables accredited centres to deliver relevant programmes nationwide and supports the scale-up of skills required to meet the objectives of Spain's energy transition.

The Spanish government also recognises the growing impact of climate change on workers. Rising temperatures and more frequent extreme weather events are increasingly affecting working conditions, worker health and safety, and labour productivity. In response, Spain approved legislation in 2024 granting workers up to four days of paid leave when extreme weather prevents them from accessing their workplace. Since climate impacts are projected to intensify in the coming years, maintaining and further developing such measures will become increasingly important.

Social inclusion and the challenge of energy poverty

Policy and market evolution have positively affected energy affordability, when compared to peer countries. In particular, household energy prices declined from 15% above the EU average in 2018 to 16% below it by 2024. Household income meanwhile increased on average by 28.5% over the same period, with increases for lower-income households even greater (42% and 37% for the lowest two income deciles). Nevertheless, energy poverty remains an important challenge for Spain, with notable geographic and gender disparities. Households in rural and semi-rural areas tend to experience higher levels of energy poverty due to greater heating and transport needs. In addition, female-headed households face a higher risk of energy poverty, largely due to lower average incomes of women.

Recognising the importance of this issue, Spain approved its first National Strategy against Energy Poverty (NSEP) in 2019, which sought to provide a comprehensive response through consumer protection measures, improvements in housing efficiency and awareness-raising on energy efficiency. The current NSEP, which covers the period 2026 to 2030, aims to shift the government's approach from emergency and price-shielding measures towards more structural and preventative impact, including by durably lowering energy needs and exposure to market volatility.

Policy spotlight on NSEP 2026-2030: Spain's plan to tackle persistent energy poverty

Following an extensive participatory process, the National Strategy against Energy Poverty (NSEP) 2026-2030 is structured around four pillars, 13 measures and 33 actions to pursue three strategic objectives:

- Improve knowledge and monitoring to better identify energy poverty, its drivers and affected groups.
- Strengthen protection for vulnerable consumers by ensuring access to essential energy services.
- Reduce energy needs through structural measures, notably energy efficiency and housing renovation.

Pillars and key measures

Pillar I – Characterisation of energy poverty establishes an Energy Poverty Observatory to consolidate data, update indicators, develop methodologies and produce interim and final evaluation reports.

Pillar II – Consumer protection includes the precautionary principle for supply disconnections, reinforced protection for electricity-dependent consumers, safeguards against unexpected rebilling, stronger consumer rights in energy contracting, and targeted action to reduce non-take-up of the social electricity tariff.

Pillar III – Structural improvement of energy conditions prioritises interventions in inhabited dwellings and comprehensive energy renovations for vulnerable households, alongside support for energy communities and collective self-consumption. It introduces a social CAE to incentivise efficiency investments in alignment with Spain's Social Climate Plan.

Pillar IV – Co-ordination, information and awareness focuses on administrative co-ordination, improved information dissemination and roll-out of an advisory offices network that provides tailored support to vulnerable consumers. It also promotes improved detection of energy poverty through primary health care and social services.

Reflecting the broader aim of the government to ensure that vulnerable households are not left behind by the energy transition, Spain's NECP also focuses on combatting energy poverty through a combination of consumer-protection measures and structural interventions. It applies social electricity tariffs, such as the *Bono Social Eléctrico* (Electricity Social Tariff) and *Bono Social Térmico* (Thermal Social Tariff) to protect vulnerable households from high energy prices. It also promotes residential energy efficiency and building renovation measures as a means to deliver lasting reductions in energy consumption and energy bills, with priority given to low-income households. Spain's draft National Building Renovation Plan (NBRP) similarly highlights renovation of the building stock as a key lever for reducing energy poverty. Interventions under the plan – such as improving insulation, replacing inefficient equipment and promoting the use of renewable energy – are supposed to prioritise the most vulnerable households and address territorial inequalities.

This policy approach appears to be having a positive impact. Spain's energy poverty rate[5] decreased from 20.8% in 2023 to 15.9% in 2025, a faster decrease than in most EU countries. However, the rate is still relatively high, indicating the need to maintain efforts. Government analysis also shows that even households in the highest income brackets reported difficulties keeping warm in the winter. Spain's new energy poverty strategy therefore specifically addresses the need to work with academia and civil society to develop more comprehensive indicators for measuring energy poverty.

Continued attention will be needed to sustain the downward trend, particularly in light of the volatility of global energy markets and the forthcoming introduction of ETS2. To mitigate the impacts on vulnerable households of extending EU carbon pricing to the buildings and road transport sectors under ETS2, the European Union established a Social Climate Fund, which begins to operate in 2026. Spain is among the larger beneficiaries and can leverage this instrument to further address energy poverty. The country conducted a public consultation during May and June 2026 on its draft Social Climate Plan, which concentrates investment capacity on vulnerable households, transport users and microenterprises. The plan outlines measures aimed at accelerating the energy renovation of buildings, expanding access to affordable and clean mobility solutions (including public transport, shared and on-demand mobility), and supporting the electrification of end uses for vulnerable

[5] This rate is based on so-called subjective indicators, such as the ability to keep the home warm in winter.

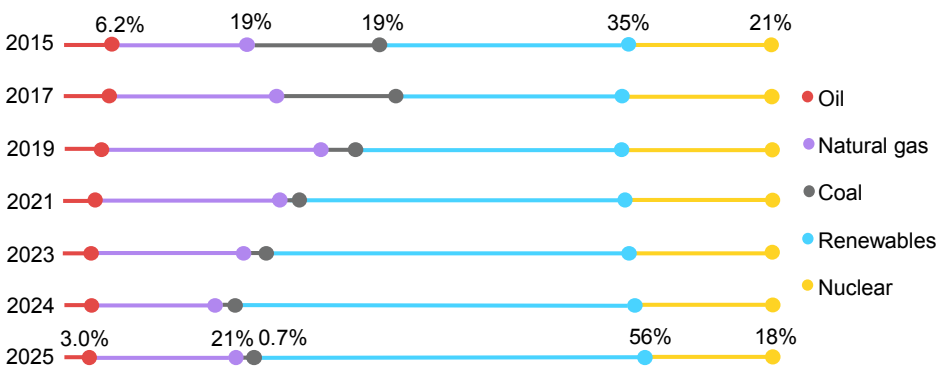
groups. The objective of these measures is to improve living conditions and social equity as the energy transition progresses. Success will depend on ensuring its effective roll-out, ahead of ETS2.

Electricity

Supply, demand and policy outlook

Electricity generation rose from 278 TWh in 2015 to 293 TWh in 2025, with a temporary dip to 260 TWh in 2020 reflecting the impact of the Covid-19 pandemic. In 2025, the share of low-carbon sources in the electricity mix was 75%, up from 56% in 2015. Renewables alone accounted for 56% in 2025, up from 35% a decade earlier. Spain managed to almost completely phase out coal-fired power generation, which represented just 0.7% in 2025, down from almost 20% in 2015. Reliance on oil in the power sector fell sharply over the same period, accounting for only 3% of generation in 2025, down from 6.2% in 2015. Natural gas' share in the electricity mix grew between 2015 and 2019 and decreased from 2020 to 2024, contributing 19% in both 2015 and 2024. Its share increased again in 2025 (to 21%) due to the implementation of special system operating procedures following the blackout that year.

Share of electricity generation by source in Spain, 2015-2025



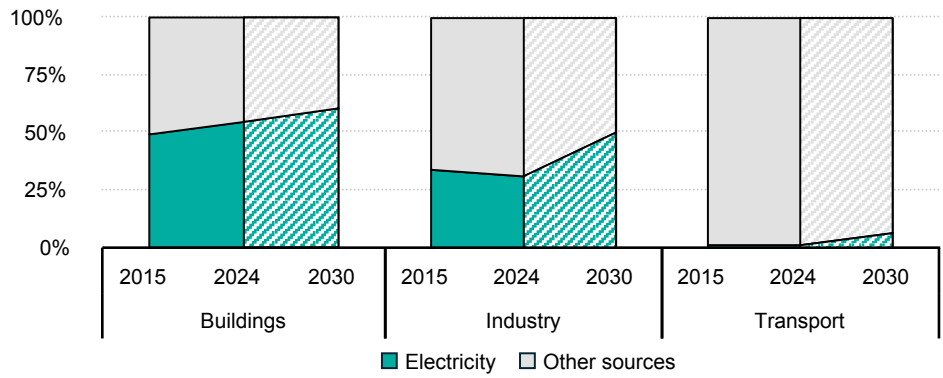
IEA. CC BY 4.0.

Sources: IEA (2026), World Energy Balances; IEA (2026), Electricity 2026.

Since June 2025, all technologies, including renewables, may be used to provide dynamic voltage control services. This marks a shift from past regulation, which limited the provision of such services to conventional generation. This regulatory change, which aims to mitigate the increase of natural gas in the generation mix, appears to be having an impact. Natural gas' share was 18.7% of the electricity mix in the first half of 2026, only slightly higher than in the same period in 2025 (18.2%).

Following robust economic growth, annual electricity demand grew by 2.7% in 2024 and 3.9% in 2025 (y-o-y). This was higher than the IEA average of 1.9% and 1.6%. However, the share of electricity in Spain's total final energy consumption (TFEC) was with 25% in 2024 still far below its NECP projections of 35% by 2030, though different end-use sectors demonstrate widely varying levels of electrification. In 2024, electricity made up 55% of demand in Spain's building sector and 29% in its industry sector. As in many countries, transport is lagging behind, with electricity accounting for only 2% of energy demand in this sector.

Share of electricity in total final energy consumption in Spain (2015-2024) with projections (2030)



IEA. CC BY 4.0.

Sources: IEA (2025), World Energy Balances; European Commission (2024), Spain - Final updated NECP 2021-2030 (submitted in 2024).

In order to pursue accelerated electrification, Spain offers targeted fiscal incentives. These include exemptions from registration taxes for EVs and other vehicles emitting less than 120 CO_2/km, rebates for buildings with solar installations, and tax advantages for using electricity in shipping. Electricity consumed by the operators of

renewable energy, cogeneration and waste-to-energy facilities with installed capacities not exceeding 50 MW also benefit from an electricity excise tax exemption. Additionally, autonomous communities have the possibility to introduce regional energy-related tax deductions, such as incentives for installing renewable energy systems in households or supporting purchases of electric vehicles.

Notwithstanding these efforts, Spain's relatively high final electricity prices compared to those of fossil fuels are a persistent obstacle to accelerated electrification (as discussed below in the "Electricity prices" section).

Transmission and distribution

System operation in Spain is ensured by Red Eléctrica de España (REE), which includes technical management, system security and ancillary services. CNMC, Spain's independent regulator, certified REE as an ownership-unbundled transmission system operator (TSO) in 2012. REE currently operates more than 45 500 km of transmission lines. It also manages grid development and enlargement, maintenance, cross-border flows and non-discriminatory third-party access to the transmission grid.

Transmission planning is conducted by the TSO and approved by the government. It is carried out over six-year periods, with total investment subject to a regulatory cap expressed as a share of GDP. CNMC ensures that planning is economically efficient, cost reflective and compliant with regulation. Spain's grid planning process feeds into ENTSO-E's European Ten-Year Network Development Plan, which provides an EU-wide picture of transmission infrastructure developments.

Distribution companies (DSOs) operate, maintain and develop distribution networks, of which they are also the owners. There are some 300 DSOs in Spain, though the five largest have a combined market share of around 90%. Each of Spain's DSOs prepares its own three-year plan, subject to a spending cap defined by the government.

At the regulatory and technical level, Spain's electricity system is based on the Electricity Act (Law 24/2013), which outlines the regulation of the electricity sector, the responsibilities of system operators, the distinction between regulated and competitive activities, and various authorisations, rights, obligations and sanctions. Royal Decree 1955/2000 regulates transmission and distribution activities, commercialisation of supply and authorisation of electricity infrastructure. Grid access and connection decisions are currently based on Royal Decree 1183/2020, CNMC Circular 1/2024, and Article 33 of Law 24/2013. Decree 647/2020 regulates the implementation of grid connection codes for certain electrical installations, and Order TED/749/2020 establishes the technical requirements for grid connections.

Given the fast evolution of the electricity system, the Spanish government is adapting the regulatory framework to new needs and challenges. To that end, it held a public hearing regarding a Draft Royal Decree aimed at establishing minimum requirements for the design, operation and safety of facilities and related equipment connected to electricity transmission and distribution networks. The new regulatory proposal also provides criteria for making more efficient use of grids, in particular by establishing priority uses, such as the electrification of households, transport and industry. In March 2026, Spain published Royal Decree Law 7/2026, which sets out the Comprehensive Response Plan to the Crisis in the Middle East. This includes steps to accelerate electrification and ensure that electricity networks are used efficiently.

Markets and investment

Spain's wholesale electricity market is organised under Royal Decree 2019/1997. It operates within the integrated European framework through the Iberian power market (MIBEL), which has coupled Spain and Portugal since 2007. The spot market, including day-ahead and intraday markets, is operated by OMIE, Spain's electricity market operator, while the futures market is managed by OMIP, which is based in Portugal. (Both are part of the Iberian market operator group, OMI). Spain and Portugal remain separate bidding zones within MIBEL, and price divergence occurs when interconnections are congested. Endesa, Iberdrola, Naturgy and Acciona are the four key electricity generators in Spain, with a combined market share of well over 50% – although this share is declining with the rapid expansion of renewable capacity and the entry of new producers.

Electricity networks are remunerated under a regulated framework that allows a financial rate of return of 6.58% on eligible transmission and distribution investments for the 2026-2031 regulatory period, as set by the CNMC. This rate is 100 basis points higher than the 5.58% of the previous six-year period and is intended to provide investment certainty while limiting impacts on consumer electricity bills. Spain's regulated return on investment in electricity networks is higher than in most EU peer countries, where allowed returns typically range between 3.5% and 5.5%. This reflects Spain's policy choice to strengthen investment incentives for grid modernisation in support of rapid electrification and renewables integration.

As highlighted in the 2026 Energy Policy Review of Portugal, the Iberian market is characterised by relatively low liquidity in long-term markets, with most long-term contracting taking place under bilateral over-the-counter (OTC) arrangements. Limited trading volumes and transparency in forward markets constrain effective price discovery and hedging opportunities. This can increase revenue uncertainty and financing costs for capital-intensive assets, particularly storage and other flexibility

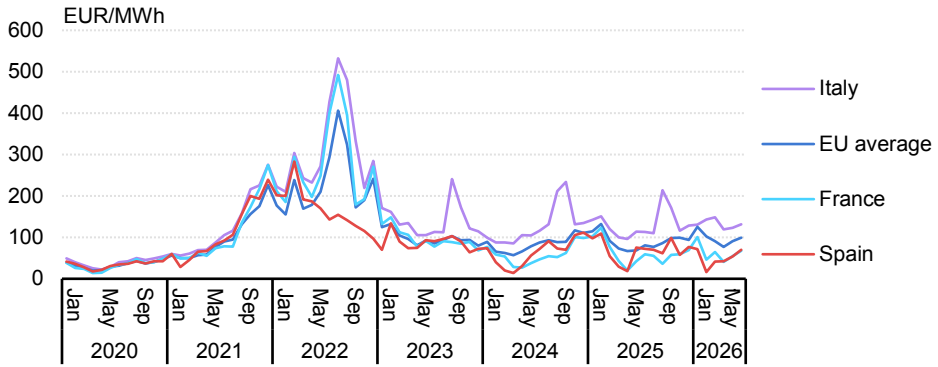
resources. In this context, the continued development of long-term contracting frameworks – including more liquid forward markets and power purchase agreements (PPAs) – will be important for supporting investment, especially in flexible back-up generation and battery storage.

Broader market reforms will remain important for strengthening long-term investment signals and ensuring that emerging flexibility solutions can be scaled up in line with system needs. Key innovations introduced by Royal Decree 88/2026 include granting consumers the right to have their electricity supplier nominate PPAs in the market at no additional cost. This can reduce barriers to demand-side participation in PPA contracting and potentially contribute to the development of forward markets. Royal Decree 88/2026 also establishes the regulatory framework for independent aggregators.

Electricity prices

Spain's wholesale spot electricity prices are highly competitive relative to those of neighbouring countries. Spot prices were about 20% lower than the EU average in 2025 and almost 50% lower in the first half of 2026, driven by comparably high shares of low-marginal-cost renewable technologies and lower exposure to gas markets.

Monthly wholesale electricity prices in selected countries, 2020- May 2026



IEA. CC BY 4.0.

Note: EU average excludes countries where no data was available (Cyprus, Malta, Netherlands, and Czechia for all years, and Bulgaria, Romania, and Poland from January 2020 to May 2021)

Source: IEA analysis based on ENTSO-E (2026), Transparency platform (accessed July 2026), collected through the IEA Real-Time Electricity Tracker.

Spain's wholesale electricity price is based on the marginal price established in the OMIE day-ahead market, where electricity is traded through a uniform price auction. It also includes the tax on the value of electricity generation (IVPEE), introduced in 2012 by Law 15/2012 and set at 7% for Spanish electricity producers. A similar tax in Portugal, the *Mecanismo de Equilíbrio Concorrencial* (MEC), was removed in December 2025.

Wholesale prices are only one segment of retail electricity prices, which consist of three components:

- energy and supply, including the wholesale price
- network costs
- taxes, levies, fees and charges.

The energy and supply component has historically reflected wholesale market prices, but in recent years the share of ancillary services and system adjustments has increased, from 3% in 2019 to 19% in 2025. The energy and supply component accounted for 41% of electricity bills for households and 57% of bills for industry in 2025.

Network costs are mainly composed of transmission and distribution, losses, and other system-related charges, including after-sales services, system services and metering. Its share in the retail price has remained relatively stable in recent years, accounting for 28% of residential bills and 16% of industry bills in 2025.

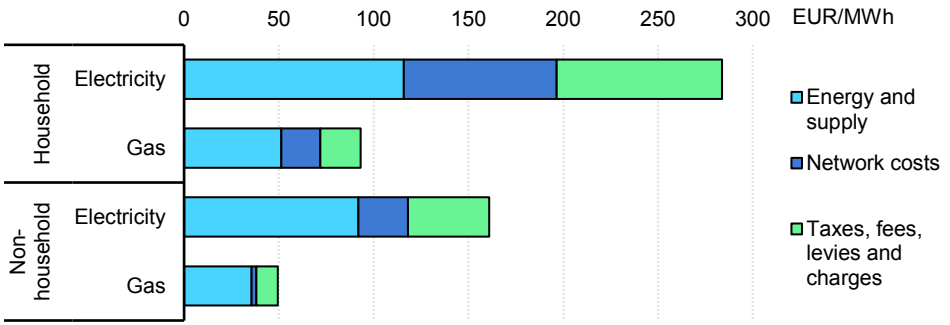
Taxes, levies, fees and charges made up 31% of residential electricity prices in Spain in 2025, while the share of this component for industrial customers was 27%. In addition to 21% VAT, electricity bills in Spain include the special tax on electricity (IEE), which is a 5.113% excise tax applied to electricity consumption and contracted power costs.

Taken together, these retail electricity price components result in high final costs to consumers that do not fully reflect Spain's relatively low wholesale electricity prices. In contrast, and as already highlighted in the previous Energy Policy Review (2021), natural gas prices are much less burdened by additional costs, taxes and levies.

In absolute terms, the non-energy and supply component in electricity prices per MWh was four times that of gas for households, and five times that of gas for industry in 2025. These rates are significantly above the average for the European Union, where charges on electricity were only 2.8 times the amount of such charges on gas supplied to households and 3.6 times the amount of such charges on gas supplied to industry.

This reinforces Spain's high electricity-to-gas price ratio, which reached about 3:1 for both households and industry in 2025 and functions as a disincentive to electrify

Electricity and natural gas price components for households and industry in Spain, 2025



IEA. CC BY 4.0.

Notes: Taxes include VAT. Household and non-household electricity bands reflect consumption of kWh – all bands and gas bands reflect consumption of GJ – all bands.
Source: Eurostat (2026), Energy database, (accessed May 2026).

For Spain's electricity-intensive industries, the competitiveness of final electricity prices relative to that in peer countries is also impacted by several other factors. This notably includes lower ETS compensation compared to some other countries (including Germany and France) and non-exemption of redispatch costs.

In response to the Middle East crisis, Royal Decree Law 7/2026 temporarily reduced taxes on electricity, natural gas and oil products from March 2026. In the electricity sector, it reduced the VAT rate applied to electricity bills for households from 21% to 10%, lowered the rate of the IEE from 5.113% to 0.5%, and temporarily suspended the 7% IVPEE tax. Subsequently, in June 2026 Royal Decree Law 18/2026 approved the permanent phase-out of the IVPEE by 2028 (and partially by 2027).

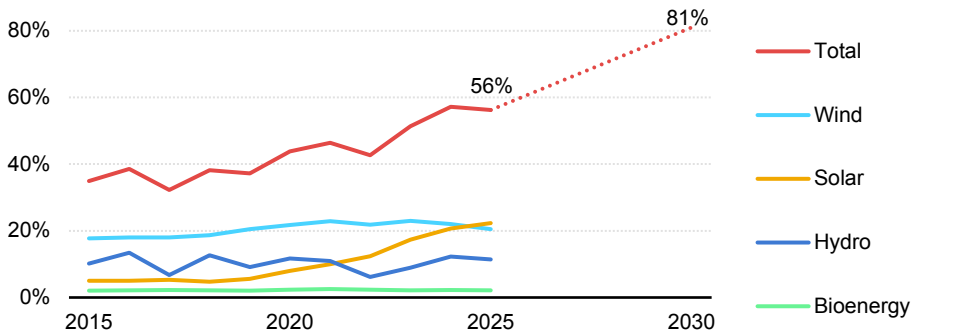
In 2022, Spain published a White Paper for the Reform of the Tax System. This included simulations showing that permanently abolishing the IVPEE would by itself reduce retail electricity prices by around 2-4% while also stimulating electricity consumption and electrification. It noted that the associated revenue loss could be offset through higher taxation of fossil fuels. A combined reform, including abolishing

the IVPEE and reducing the IEE on electricity to EU minimum levels[6] would further lower electricity prices, improve competitiveness for industry and facilitate electrification. These government findings suggest that the current temporary reductions in electricity taxation could have benefits beyond those of short-term crisis response. Making selected elements permanent, with actions such as through Royal Decree-Law 18/2026, could indeed strengthen the chances of delivering Spain's energy objectives.

Renewable energy

Renewables generated 165 TWh and accounted for 56% of Spain's electricity mix in 2025, while they are aimed to deliver 81% in 2030. Wind and solar PV accounted for 125 TWh or 43% in 2025, doubling the 63 TWh they generated in 2015, when VRE made up 23% of the total mix.

Share of renewable electricity generation by source in Spain (2015-2025) and target (2030)



IEA. CC BY 4.0.

Sources: IEA (2026), World Energy Balances; IEA (2026), Electricity 2026.

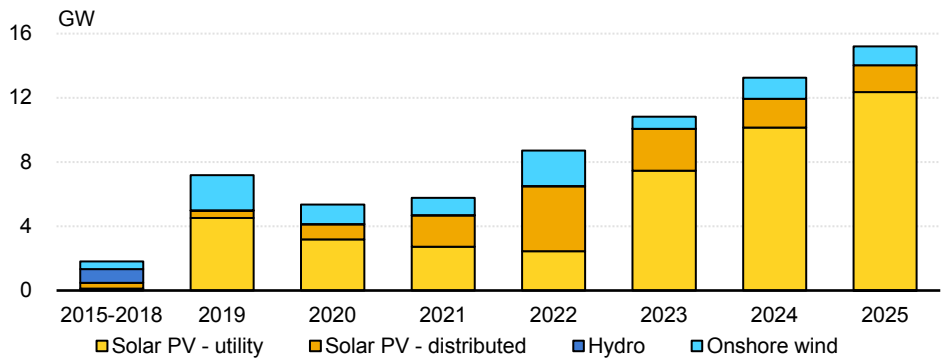
[6] Under the EU Energy Taxation Directive, the minimum excise duty on electricity is EUR 0.5 per MWh (cEUR 0.05/kWh) for non-business use and EUR 1.0 per MWh (cEUR 0.1/kWh) for business use.

By reducing reliance on imported fuels, renewable electricity strengthens resilience against external shocks and international price volatility. The strong role of domestic renewable energy in Spain's power system therefore presents a key opportunity to enhance energy security, affordability and competitiveness.

Spain's renewable capacity has evolved through distinct phases, shaped by changes in policy support and market conditions. After an early period of renewable capacity growth between 2005 and 2011 that was driven by feed-in tariffs and premiums (first introduced in 2000), deployment stagnated until 2019.

Growth rebounded strongly, especially of solar PV, with 66.5 GW of renewable capacity installed between then and 2025, propelled by new policy mechanisms and market dynamics. Competitive auctions were launched in 2016 with a "maximum discount" design. They were refined in 2021 as contracts for difference, leading to six rounds that awarded a total of around 15 GW. The 2018 repeal of charges on self-consumption also led to more generous compensation for surplus generation by grid-connected distributed resources and contributed to the addition of about 10 GW of distributed solar PV capacity. In addition, more than 40 GW added capacity stemmed from corporate power purchase agreements (PPAs) and merchant projects thriving in supportive market conditions without direct subsidies.

Annual net renewable capacity additions by technology in Spain, 2015-2025



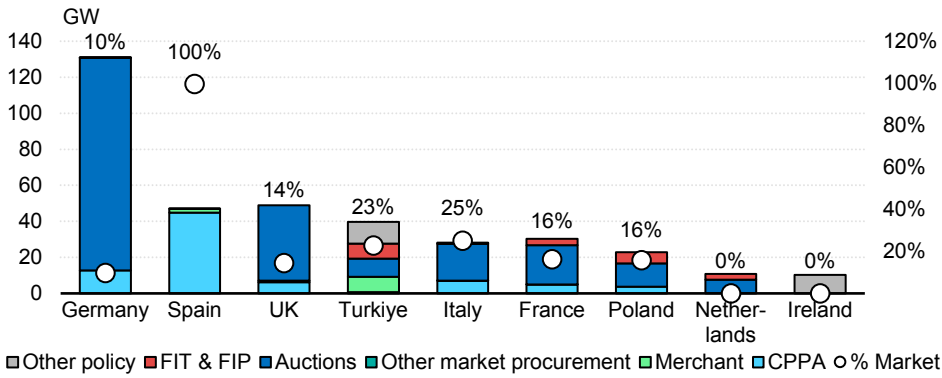
IEA. CC BY 4.0.

Notes: Solar PV values are in direct current (DC). Other renewables is present in 2019 and 2020 and is not visible on the chart's scale.

Source: IEA (2025), Renewables 2025.

Spain is Europe's largest unsubsidised market for utility scale projects, more than four times Germany's when it comes to corporate PPA-backed capacity. Reflecting this dynamic, Spain's last auction, held in 2022, awarded under 100 MW, as developers favoured the more attractive economic offers from corporate buyers and spot markets.

Projected renewable capacity additions by remuneration type and share of unsubsidised projects in selected European countries, 2025-2030



IEA. CC BY 4.0.

Notes: Solar PV values are in direct current (DC). FIT= feed-in tariff, FIP = feed-in premium, CPPA = corporate power purchase agreement.
Source: IEA (2025), Renewables 2025.

Despite the robust growth of market-led projects, the business case for new solar PV and wind in Spain faces growing pressures. Permitting and lack of social acceptance have become bottlenecks, particularly for wind, involving complex procedures with multiple authorities. Spain installed only 1.2 GW of new wind capacity in 2025, well below the annual additions required to reach its 2030 target of 62 GW. At the same time, it had 40 GW of wind projects in pre-construction phase or early development, many of which were stalled by permitting and environmental assessment procedures.

In order to improve permitting procedures and increase the social acceptance of renewable energy deployment, Spain introduced new requirements for developers in Royal Decree Law 7/2026, the Comprehensive Response Plan to the Middle East Crisis. In particular, they must now notify local authorities and affected landowners before formally starting permitting processes. Renewable energy projects are also

legally required to provide positive returns (so-called benefit-sharing) to the communities in which they are installed. Additionally, Spain is developing a new "excellence standard", under which projects that achieve certain levels of local participation, local benefits and environmental criteria will be prioritised in permitting and grid access procedures.

Curtailment and price cannibalisation further challenge the business case for unsubsidised projects. These pressures have increased as rapid renewable deployment has at times outpaced growth in electricity demand, grid capacity and system flexibility, leading to more frequent periods of oversupply and low or negative wholesale electricity prices.

As mismatches between demand and supply intensify, the role of energy storage becomes increasingly central to maintaining the value and integration of renewable generation. By absorbing excess production during periods of low demand and high output and shifting it to periods of higher system need, storage can support more stable revenue streams for renewable projects. In addition, storage contributes to system adequacy and operational stability, particularly in a context of declining synchronous generation. Accelerating the deployment of energy storage, alongside ongoing regulatory and market reforms, is therefore critical for fully capturing the benefits of Spain's expanding renewables capacity while sustaining investment signals and system reliability. Apart from increasing flexibility, ensuring a more balanced renewables supply mix would further facilitate integration of renewables and increase their business case. (Both levers are discussed in later sections of this report.)

Nuclear energy

Spain has seven operating nuclear reactors. Their net generation capacity is 7.1 GW, operating at a capacity factor of approximately 90%. In 2025, nuclear energy accounted for 54 TWh or 18% of electricity generation. Nuclear energy's share of low-carbon generation decreased from 37% in 2015 to 25% in 2025, due primarily to a massive increase in renewables. However, nuclear reactors continue to play an important role in Spain's transforming electricity system.

Apart from providing reliable baseload generation, Spain's nuclear reactors support key grid functions as the system evolves. In particular, electricity grids benefit from large, synchronous generators such as nuclear, hydroelectric and thermal plants, whose rotating masses store kinetic energy and provide inertia, thereby helping to stabilise grid frequency during disturbances.

On the other hand, nuclear generation is less flexible than other sources and is typically unable to adjust output in response to daily or weekly fluctuations in electricity demand and renewable generation. In addition, several of Spain's nuclear plants are located in areas that already are experiencing significant curtailment of renewables. Maintaining inflexible generation in these regions can increase competition for grid capacity and make it more difficult for renewable projects to secure sufficient running hours to recover investment costs.

MITECO oversees nuclear energy policy, including policy related to the management of radioactive waste. It is also responsible for:

- Issuing operating licences for nuclear facilities once they are approved by the Spanish nuclear safety authority.
- Submitting regulatory proposals for the development of legislation.
- Adopting provisions to implement regulations.
- Enforcing nuclear legislation and applying sanctions where necessary.

The Spanish Nuclear Safety Council (*Consejo de Seguridad Nuclear*, CSN) is a legally and financially independent regulatory body responsible for ensuring nuclear safety and radiation protection at all nuclear facilities. Enusa Industrias Avanzadas, S.A., S.M.E. (Enusa) is a state-owned company responsible for the front end of the nuclear fuel cycle, which includes the procurement of enriched uranium from several countries for nuclear fuel fabrication. Empresa Nacional de Residuos Radiactivos, S.A., S.M.E. (Enresa) is a state-owned company responsible for the back end, including nuclear decommissioning and the management and disposal of radioactive waste and spent nuclear fuel. Enresa is currently decommissioning the Vandellòs 1, Jose Cabrera and Santa María de Garoña nuclear power plants, which were shut down in 1990, 2006 and 2013. Ownership of nuclear reactors is shared among Spain's largest utilities (Iberdrola, Endesa and Naturgy), which also operate the facilities through administrative groups, notably ANAV (Asociación Nuclear Ascó-Vandellòs II) and CNAT (Centrales Nucleares Almaraz-Trillo).

In 2019, the Spanish nuclear plant operators reached an agreement with Enresa to establish a progressive phase-out of Spain's nuclear fleet between 2027 and 2035. Under this timeline, Almaraz Unit I is scheduled to close in November 2027 and Almaraz Unit II in October 2028. The phase-out dates in this agreement are reflected in Spain's NECP. However, in 2026 CNAT submitted a request to extend the life of the Almaraz nuclear plant to 2030, which was approved by the government in August 2026.

Cost, taxes and levies on nuclear power in Spain

Apart from its costs for operations, investments and depreciations, the nuclear sector is also subject to taxes. Its tax burden was projected at EUR 17/MWh for the period 2025-2035 by PricewaterhouseCoopers (excluding the Enresa fee, discussed below). However, this does not yet reflect the abolishment of the IVPEE tax (partially, or 50% by 2027, and fully by 2028), mentioned earlier. Deducting this general tax on the value of electricity production, the remaining taxes associated with operating Spain's nuclear power plants (a levy on spent nuclear fuel, regional environmental taxes and the CSN fee) are set to amount to EUR 13/MWh.

In addition to these taxes, nuclear power plants in Spain are required to contribute to the financing of radioactive waste management and future decommissioning activities through the Fund for the Financing of the Activities of the General Radioactive Waste Plan (GRWP), which is managed by Enresa. An updated GRWP, adopted in 2023, introduced additional requirements, including decentralised temporary onsite storage of spent fuel and radioactive waste, as well as the development of a deep geological repository by 2073. This also resulted in a rise of the Enresa fee of approximately 30%, from EUR 8/MWh in 2020 to EUR 10.4/MWh in 2025.

The role of nuclear energy in Spain's power system is further discussed in the first Focus Area of this report "Energy security and diversification of supply".

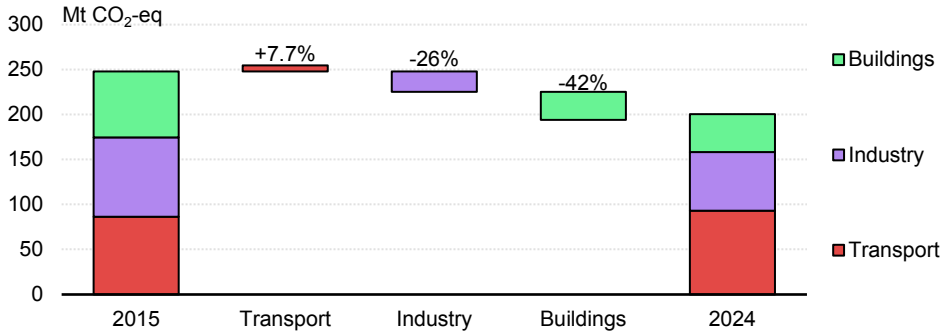
End-use sectors

In 2024, transport was Spain's largest end-use sector, both in terms of TFEC (42%) and energy-related CO_2 emissions (46%). Industry was responsible for 28% of TFEC and 33% of emissions, while buildings accounted for 30% of consumption and the lowest share of energy-related emissions (21%).

Spain's TFEC saw nominal growth between 2015 and 2024 (+2.9%) to reach a total of 3 270 PJ in 2024. This was largely driven by increased energy use in transport (+12%), which offset a slight decline in buildings (-2.7%) and industry (-2.3%). Spain projects that demand will fall to 3 002 PJ by 2030, implying a reduction of 8.2% between 2024 and 2030.

The country's CO_2 emissions declined by 20% from 2015 and 2024, driven by emissions reductions in buildings (-42%) and industry (-26%), while transport recorded an increase (+7.7%).

Energy-related CO_2 emissions and changes by sector in Spain, 2015 and 2024



IEA. CC BY 4.0.

Note: Emissions from electricity and heat generation are reallocated to end-use sectors according to their consumption.

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

Buildings

Fossil fuels meet around a third of the energy demand from buildings, as oil and natural gas continue to dominate space and water heating. Electricity however accounts for the largest share of demand (55% in 2024), driven by its widespread use for appliances in residential buildings and for lighting and space cooling in services and commercial buildings. Distributed renewable energy technologies are meanwhile beginning to reshape the role of buildings within the power system. Beyond their contribution to decarbonisation, supplementary generation and electrification of end uses, such technologies can enhance system resilience as on-site self-consumption, can reduce reliance on the grid at peak times.

Objectives and legislative framework

Spain aims to improve the energy efficiency of its buildings and increase the share of RES in their final consumption to 68% by 2030. The ultimate goal is to have an emissions-free building stock by 2050, a target that is reflected in the draft National Building Renovation Plan (NBRP).

Achieving this objective will require addressing the challenges posed by the age profile of Spain's buildings. Nearly half the building stock (49%) was constructed before 1980, and most (89%) before 2006, the year the Technical Building Code

(*Código Técnico de la Edificación*, TBC, see below) entered into force. As a result, a large share of buildings was constructed under less stringent energy performance requirements, suggesting substantial renovation needs to achieve Spain's energy and climate objectives.

Spain's regulatory framework for buildings is anchored in the TBC, which applies to all permanent public and private buildings. The TBC sets energy performance requirements for new construction and major renovations, including compliance with nearly-zero energy building (nZEB) standards. A revision of the TBC is underway to transpose the EPBD and introduce Zero-Emission Buildings (ZEB) standards, with application expected sometime between 2027 and 2028.

The Regulation on Thermal Installations in Buildings (RITE) complements the TBC by covering heating, cooling and domestic hot water systems. The RITE establishes minimum efficiency levels, insulation requirements and the integration of renewable energy sources. Like the TBC, it is being revised to align with the adapted EPBD.

In parallel, Energy Performance Certificates (EPCs), which are regulated under Royal Decree 390/2021 and mandatory for new buildings, building transactions and public buildings, are also being revised following the completion of a public consultation in early 2026. Adoption of the revised EPCs is expected sometime during the same 2027-2028 timeframe.

Another important pillar of Spain's building policy framework is the draft NBRP, which establishes the pathway for reaching sector objectives through accelerated renovation rates, minimum energy performance standards and concrete consumption- reduction trajectories. The plan targets a 25% reduction in residential primary energy consumption by 2030 and 33% by 2035, compared to 2020 levels. To deliver this, it sets out more than 200 actions categorised across seven policy pillars: energy renovation, energy poverty, urban regeneration, renewable energy, governance and funding, citizen engagement, and innovation, circularity and industrialisation.

Spain's NBRP thereby includes a focus on expanding one-stop shops (OSSs) to help households navigate the often complex renovation process. These centres provide integrated technical, administrative and financial support, guiding citizens from initial assessment to project completion and facilitating access to grants and financing.

Overall, Spain's evolving policy strategy for decarbonising the building sector reflects a shift from technology-specific subsidies towards a long-term renovation market built

on integrated renovation, fiscal incentives and blended financing instruments. As stressed in Spain's urban agenda, the government also explicitly recognises the systemic nature of housing policy and aims to move towards an affordable, sustainable and resilient housing model.

Support mechanisms for electrification and energy efficiency of residential buildings

A successful transition of the buildings sector requires that urban and rural communities, homeowners and tenants across all generations are included in the transition. Spain has therefore introduced significant incentives for households to accelerate building renovation and improve energy performance.

Residential renovation programmes support energy upgrades in individual dwellings, multi-apartment buildings and neighbourhoods, conditional on achieving at least a 30% reduction in non-renewable primary energy consumption. Grants typically range from 40% to 80% of eligible costs, depending on depth of renovation and vulnerability profile of the household, with regions responsible for programme delivery. In parallel, personal income tax deductions for energy efficiency renovations (extended to 2026) offer a stable and widely accessible incentive for households, complemented by local tax reductions in some municipalities.

The NEEF and market-based instruments further support energy efficiency improvements. The CAE system covers both deep renovation and individual measures, such as insulation, window replacement, appliance upgrades and heat-pump deployment. While savings from major retrofits are typically four times greater than those from minor ones, the latter have so far occurred four times more often (24 020 versus 5 924 renovations under the CAE system from November 2023 to June 2026). Some 53% of interventions have targeted the insulation of walls and roofs, while replacement of fossil-fuel-fired boilers with electric heat pumps occurred in only 6.5% of CAE applications.

Adoption rates for heat pumps in Spain generally remain relatively low compared to those in some peer countries. Spain's installed heat pump stock corresponded to an estimated 99 units per 1 000 households in 2025. For comparison, France's heat pump density was 218 units per 1 000 households.

With the crisis response decree of March 2026, Spain introduced a mandate to adjust CAE coefficients to further accelerate the replacement of fossil-fuel-fired

boilers with heat pumps. The coefficients will have a specific duration and be higher for actions carried out by vulnerable households. While electrifying space heating is a critical, and relatively underrepresented, lever for delivering building decarbonisation objectives, these kinds of adjustments can also grant advantages to specific technologies or end-user groups that do not necessarily directly reflect the amount of energy savings. They thus risk undermining the clarity of the CAE system. Their impacts and cost-effectiveness should therefore be systematically assessed, and policy designs adjusted where needed in order to safeguard efficient resource allocation and avoid unintended market distortions over time.

The abovementioned initiatives demonstrate that building electrification is gaining importance, but also that constraints remain. Despite existing support schemes, high upfront costs and relatively elevated electricity prices (compared to those for fossil fuels) continue to limit uptake.

Non-price barriers persist as well, notably skills shortages in installation and renovation activities, and these may become more pronounced as deployment accelerates. Structural characteristics of the housing stock additionally shape policy effectiveness. Relatively high home ownership rates in Spain mitigate split-incentive issues to some extent. However, stakeholders identify the predominance of multi-apartment buildings (particularly in urban areas) and their collective decision-making procedures to decide on energy renovations as an important constraint. This underscores the need for policy approaches tailored to co-ownership structures. For example, Spain could consider legislative reform to reduce the voting threshold for energy renovations to a simple majority for measures that qualify for public support, as France did under the Climate and Resilience Law.

The potential of district heating and cooling

District heating and cooling (DHC) is increasingly recognised in IEA countries, as a strategic decarbonisation option, notably by enabling the integration of renewable energy sources and waste heat at scale. Currently, however, it plays a very limited role in Spain, covering only around 0.2% of total heating and cooling demand in 2023. The low penetration rate reflects the historical absence of a comprehensive regulatory framework for district heating and cooling that has constrained investment and large-scale deployment.

At the same time, Spain presents significant untapped potential for DHC solutions, with substantial winter heating demand in colder regions, growing cooling needs in dense urban areas, and favourable conditions for network deployment in urban regeneration zones. Moreover, the potential for waste heat and cold recovery from industry and services remains largely underexploited.

Policy work on a dedicated national regulatory framework for DHC networks is ongoing and is aimed at increasing legal certainty for municipalities and investors and reducing administrative barriers. A forthcoming regulation is expected to facilitate project authorisation, promote waste heat and cold recovery from industrial and tertiary activities, and ensure alignment with EU legislation, notably the Energy Efficiency Directive (EED) and the Renewable Energy Directive (RED III). The public hearing and consultation process for the draft Royal Decree governing heating and cooling networks and thermal guarantees of origin was completed on 8 September 2025.

International experience illustrates the potential impact of strong DHC governance. For example, Denmark combines a clear national planning framework with municipal responsibility and strong waste-heat integration, enabling district heating to cover the majority of space-heating demand and act as a core pillar of its heat decarbonisation strategy. If effectively implemented, Spain's framework could similarly unlock district heating as a complementary solution for building-sector decarbonisation in suitable urban areas.

Industry

Most of industry's energy supply comes from natural gas (37% in 2024), followed by electricity (29%) and oil (19%). In recent years, biofuels and waste have grown to become the fourth most important source (11%). Meanwhile, the carbon intensity of industry's energy consumption decreased from 69 gCO_2/MJ in 2015 to 50 gCO_2/MJ in 2024.

These improvements are a result of the evolving nature of industrial activities in Spain and decisive steps by the government in the area of energy efficiency. Spain has put in place energy audits and management systems (mandatory for large enterprises), along with other measures specifically aimed at improving energy efficiency in the industry sector. For example, the government provides support for innovation and sustainability plans in the manufacturing industry and has introduced the PERTE for Industrial Decarbonisation.

As in the buildings sector, the NEEF and the CAE system are key policy instruments to promote energy efficiency and emissions reduction in the industrial sector. By relying on validated measurements, the CAE system facilitates the rapid monetisation of Energy Saving Actions and helps attract private investment into energy efficiency projects. In the industrial sector, verified CAE savings reached 2 580 GWh in 2025, underscoring their significant contribution to national energy efficiency targets.

Given its exposure to the price volatility of imported fossil fuels, the decarbonisation of Spanish industry is effectively a matter of industrial competitiveness. Policy instruments, such as the Industrial Decarbonisation PERTE, and support for projects such as those selected under the Innovation Fund's Industrial Heat Auction,[7] help improve the economics of individual decarbonisation projects. However, these measures cover only a subset of eligible investments and do not entail long-term structural support.

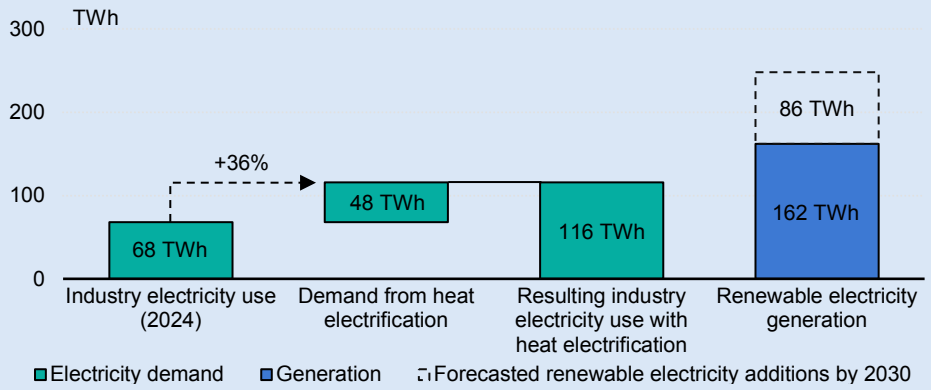
[7] Spain has been particularly successful in the 2025 Industrial Heat Auction, with 24 out of 65 selected EU projects coming from Spain.

Case study: the potential for electrifying low-temperature heat and steam

Fossil fuels continue to dominate Spain's industrial thermal energy use, despite the fact that a large share of low-temperature heat and steam demand could be electrified cost-effectively using mature technologies such as heat pumps and electric boilers, along with thermal energy storage. There is a significant opportunity to improve energy security and reduce emissions in segments such as food, textiles, chemicals and paper.

Spain's industrial sector has a large technical potential (about 245 PJ in total) to electrify low-temperature heat and steam with commercially available technologies. Widespread deployment of these technologies could replace nearly half of direct fossil fuel use, reducing reliance on imports. Fully realising this potential would add around 48 TWh of annual industrial electricity demand to today's 68 TWh; additional demand that could be covered by the projected growth in Spain's RE electricity generation capacity.

Growth in industrial electricity demand from electrifying the supply of low-temperature heat and steam in Spain



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Sources: Analysis based on IEA (2026) World Energy Balances and IEA (2025), Renewable Energy Progress Tracker.

Despite this large potential, structural barriers are constraining electrification in practice. In 2024, industrial electricity prices in the sectors covered here were about EUR 110/MWh on average (excluding VAT), or more than twice the price of natural gas, which was less than EUR 50/MWh.[8] This price differential is disincentivising electrification for many SMEs, including in food, textiles and ceramics. High-efficiency heat pumps that capture ambient and waste heat can compete at current price ratios, but electric boilers need to be near price parity to be viable. An additional barrier can be identified at the grid connection level. Similar to the case for many generation and storage facilities, a large number of industrial demand projects are stalled due to queues for grid connection.

The Spanish government has adopted several policy measures to promote electrification in the industrial sector. For example, Royal Decree-Law 7/2026 includes an update to the tax on economic activities (*Impuesto de Actividades Económicas*) aimed at stimulating electrification, along with tax benefits for businesses investing in heat pumps, while recent regulatory and policy changes have also prioritised the connection of industrial demand

The transition of energy-intensive industries

For heavy industry, which accounted for 82% of industrial emissions and 20% of value creation in 2023, options beyond direct electrification will be required as well. These are likely to include further investment in diverse technologies such as low-emissions hydrogen, biogas and carbon capture and storage. Spain is aiming for 74% of hydrogen used in industry to be renewable by 2030, a share that would substantially exceed the minimum requirement under the EU's revised RED III. In light of these ambitions, the government has integrated the Reserve Fund for Guarantees of Energy-Intensive Entities into the broader Fund for the Promotion of Industrial Decarbonisation (FCPJ).

A key feature of the reformed FCPJ is the aforementioned formalisation of CCfDs. These contracts aim to incentivise investment in low-emissions industrial technologies by guaranteeing a stable, long-term carbon price signal. By reducing exposure to volatility in EU ETS allowance prices, CCfDs can effectively lower the investment risk for first-of-a-kind and capital-intensive decarbonisation projects.

[8] Prices refer to industrial consumer bands with annual consumption 20 000 MWh-69 999 MWh of electricity and 10 000 GJ-99 999 GJ of natural gas.

Transport

Oil dominates the transport sector's energy supply (92% in 2024). The remaining share is met by biofuels (5.3%), electricity (1.2%), and natural gas (1.1%). Among transportation sub-sectors, road transport accounts for 88% of energy consumption, aviation for 8.3%, water for 2.8% and rail for 1.0%.

Spain's transport sector is expected to contribute substantially to the country's emissions reduction efforts over the coming years. To support this, the government is developing a broad set of policy and regulatory measures aimed at decarbonising transport. The proposed framework focuses on promoting low- and zero-emission technologies, supporting infrastructure deployment and establishing regulatory frameworks that balance environmental objectives with economic feasibility. The relevant draft Royal Decree – which also will transpose the revised EU RED III into national legislation – has twice been published for public consultation, most recently in January 2026.

Road transport

The government has identified sustainable urban planning, promotion of public transport and electrification of mobility as key measures to reduce the urban carbon footprint and improve quality of life in urban areas. Spain has taken several policy initiatives to accelerate an effective modal shift and electrification.

Modal shift

Spain's specific context – in which travel between cities and between cities and rural areas or peripheries faces particular challenges – requires special consideration for both rural mobility and inter-city transport use. Spain has taken a holistic approach that aims to facilitate a structural modal shift away from private vehicle use by expanding mobility options that are accessible, affordable and sustainable.

In December 2025, Spain adopted a Sustainable Mobility Law that places public transport and collective mobility at the forefront of transport policy. The law includes the development of a National Sustainable Mobility Strategy, compulsory mobility plans for commuting in larger workplaces, a reorganisation of road passenger transport concessions, and strengthened co-ordination across provincial, regional, and municipal authorities.

By formally recognising public transport as the backbone of mobility and integrating modal shift targets into planning and governance processes beyond financial support, the law aims to drive a transition towards more sustainable and efficient travel patterns across the country.

Royal Decree 1052/2022 regulates low-emission zones (LEZs) and establishes minimum requirements that local authorities must meet to restrict high-emission vehicles and improve urban air quality. The national government supports municipalities in implementing such LEZs, as well as the digital and sustainable transformation of urban transport more broadly.

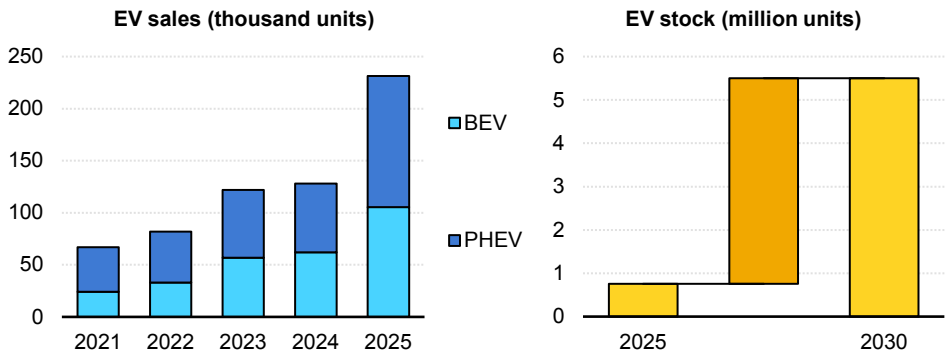
The draft Social Climate Plan, currently under public consultation, additionally proposes a set of transport measures targeted at vulnerable groups. These include the roll-out of on-demand and shared mobility services in rural areas, the introduction of a unified “Social Single Ticket” that enables affordable access to multimodal public transport, and investments in dedicated bus lanes and safe cycling infrastructure.

Reflecting initiatives to incentivise collective mobility, the growth of Spain’s high-speed rail network has been one of the steepest in the European Union, with an increase of 33% between 2015 and 2023. In October 2024, Spain also launched the second phase of its passenger rail liberalisation by expanding competition on high-speed and long-distance routes. Multiple operators now compete on major corridors, such as Madrid–Barcelona. At the same time, conventional, regional and commuter services suffer from persistent reliability problems, including delays and service suspensions. Much of the commuter and regional rolling stock exceeds 20 years of age, and no new trains were added to local networks between 2008 and the early 2020s, while renewals on medium-distance lines were delayed.

Electrification of road transport

Yearly sales of electric vehicles (EVs) almost doubled between 2021 and 2024, and increased sharply in 2025 (+80%), when they reached 231 395 units. By the end of 2025, the total EV stock amounted to 760 300 vehicles, of which 630 000 were cars. 2026 ACEA data further shows that EVs – including battery electric vehicles (BEVs) and plug-in hybrid vehicles (PHEVs) – accounted for 23% of Spanish vehicle sales in May 2026.

EV sales (2021-2025) and EV stock and target (2025 and 2030) in Spain



IEA. CC BY 4.0.

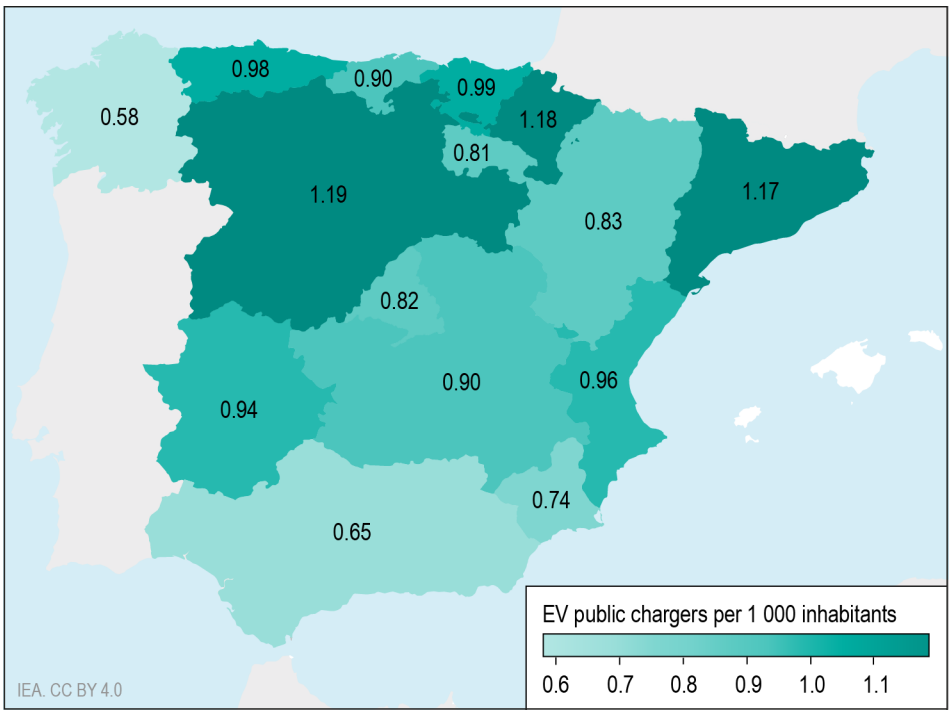
Note: BEV = battery electric vehicle; PHEV = plug-in hybrid vehicle.
Source: IEA (2026), Global EV Data Explorer, (accessed May 2026).

Despite the strong momentum, Spain's EV stock at the end of 2025 was only 14% of its target of 5.5 million EVs by 2030. With just 2% of its car fleet electric in 2025, Spain scored lower than neighbouring countries France and Portugal, which each had 6%. Electrification of corporate fleets is particularly lagging. Research indicates that only around 4% of new corporate cars in Spain were battery-electric in 2024, compared with, for example, around 40% in Belgium. Uptake in the commercial and heavy-duty vehicle segments also remains limited.

Spain's relatively modest adoption rates of EVs are the result of several factors. In particular, the purchase price of electric vehicles remains higher than that for comparable ICE vehicles (not taking into account available subsidies), while the granting of financial support has so far often been subject to delays. While not specific to the Spanish context, EVs also tend to depreciate differently, resulting in less favourable financing conditions and higher capital costs for consumers and fleets. Price signals are further weakened by a relatively low taxation rate for fossil fuels. Spain's road fuel prices are around 10% below the IEA average, reducing incentives to shift away from conventional vehicles. Vehicle taxation leaves additional room for improvement: Spain collects an average of EUR 1 306 per vehicle, covering registration (which differentiates by CO_2 emissions), ownership and use-related vehicle taxes. This results in vehicle tax revenues that are well below those of most of Spain's European peers; only in Portugal (EUR 1 290) and Greece (EUR 1 196) are they lower. In addition, better targeted incentives for corporate fleets could help accelerate electrification.

The availability of public EV charging infrastructure is another key driver for road transport electrification. In 2024, Spain increased the number of EV charging stations by 60% compared to the year before – nearly double the average EU growth rate (Global EV Data Explorer). Spain's public charging network consisted of approximately 53 000 charging points by May 2026. These were concentrated in Catalonia, Community of Madrid, Andalusia and Community of Valencia, which together accounted for about 60% of the total (in January 2026). However, when looking at the concentration per 1000 inhabitants, Castile and León, Navarra and Catalonia scored highest as of June 2026, based on government data (Galicia, Andalusia and the Murcia Region have the lowest number of EV chargers).

EV public chargers per 1 000 inhabitants by autonomous community, 2026



IEA. CC BY 4.0.

Notes: The map excludes Spain's non-mainland communities. Charging-point data are from MITECO and may differ from IEA Global EV Outlook statistics owing to differences in source data and coverage.

Source: IEA (2026) analysis based on MITECO, EV charging points, (accessed June 2026).

While Spain made notable progress expanding its public EV charging infrastructure, leading European peer countries maintain significantly larger networks. For instance, Germany and France have roughly 2.5 public chargers per 1 000 inhabitants while Spain has 1.1. This suggests the need for continued efforts to ensure comprehensive coverage across the country.

Policy momentum has strengthened for both EV uptake and charging infrastructure. In addition to the CAE system – which incentivises the replacement of ICE vehicles with BEVs – a key measure has been the launch of a new centrally managed EV incentive scheme, Auto+, which replaces the previous MOVES III programme. Auto+ is part of the broader Plan Auto 2030, which combines demand-side incentives with industrial policy to accelerate vehicle electrification.

An important change is that subsidies are paid out faster, addressing one of the main weaknesses of MOVES III and strengthening affordability and accessibility for citizens with less financial capacity. It also improves nationwide access in response to past constraints related to regional budget limits. Only passenger cars with a zero-emission label are eligible for support under the new policy framework. Auto+ also explicitly applies to companies and leasing fleets, with the goal of tackling the slow uptake of EVs in corporate fleets.

Recognising the importance of EV charging infrastructure, the government has also built a national governance and transparency framework to track it. A central registry (RIPREE) collects static information on publicly accessible charging points (location and technical characteristics), while a management and visualisation system (SGV) collects dynamic information (availability and prices) for higher-power chargers and makes this accessible via MapaREVE (web and app). This architecture is supported by implementing acts that cover charging service activity, reporting requirements and the operationalisation of dynamic data submission.

Shipping and aviation

Aviation and maritime transport together accounted for around 11% of energy use and emissions in the transport sector in 2023. Both sectors are largely dependent on fossil fuels.

Spain approved the National Action Plan for the Decarbonisation of Maritime Transport (2026–2050) in 2025. This includes EUR 250 million in public support between 2026 and 2030 to facilitate the renewal of existing vessels, the construction

of new low-emission ships, and the development of pilot projects for the use of alternative fuels. This national framework complements EU-level measures, such as the inclusion of maritime transport in the EU ETS and the FuelEU Maritime Regulation, which entered into force in 2025 and sets progressively stricter limits on the greenhouse-gas intensity of energy used on ships. Certain routes and regions, including the Canary Islands, are subject to temporary exemptions under this regulation.

Spain is also covered by the EU ReFuelEU Aviation Regulation, which entered into force in 2025. This mandates a minimum 2% share of sustainable aviation fuels (SAF) in 2025, rising to 6% by 2030 and higher targets thereafter. These measures aim to initiate fuel switching in hard-to-abate transport segments, though their effectiveness will depend on the availability and cost of alternative fuels and the pace of fleet renewal.

Biofuels and renewable fuels of non-biological origin (RFNBOs) remain part of Spain's transport decarbonisation for hard-to-electrify segments, which include very-long-haul heavy road transport, aviation, maritime transport, and non-electrified rail sections. Spain's framework sets a rising renewable content trajectory through 2026 and introduces increasingly higher biofuel sub-targets towards 2030. It also tightens sustainability controls, including explicit limits on and phase-outs of high indirect land use change (ILUC) pathways and strengthened monitoring to reduce fraud and ensure compliance. The country's certification system already tracks aviation fuel streams (such as hydroprocessed esters and fatty acids, or HEFA), supporting operational readiness for EU aviation mandates. The effectiveness of these policies will depend on sustainable feedstock availability, compliance enforcement and cost containment as targets rise.

Fuels

While their share in total energy supply (TES) is below the IEA average of 76%, fossil fuels remain Spain's dominant energy source, accounting for 67% of TES in 2024. This share decreased from 73% in 2015, mainly driven by reduced reliance on coal, the use of which fell from 560 PJ in 2015 to less than 80 PJ in 2025 (-86%). Oil supply meanwhile increased by 1.4% to about 2 060 PJ in 2025, when it accounted for 43% of TES. The share of natural gas increased slightly between 2015 and 2025, from 1 303 PJ (21% of TES) to 1 070 PJ (23%).

Oil

Spain imports nearly all of its crude oil. It then exports about a fifth of this, primarily in the form of refined products. Domestically, oil is consumed mainly in transport, where it covered 92% of the sector's energy use in 2024. It is also used in industry (19% of energy use) and buildings (14%). The Spanish Climate Change and Energy Transition Law prohibits new oil exploration and production on Spanish territory.

Spain has a diversified range of crude oil suppliers: it processed 82 different types of crude oil from 26 countries in 2025. Government data shows that the largest supplier in 2025 was Brazil (14.4%), followed by the United States (14.1%), Mexico (12.6%), Nigeria (8.7%), Libya (7.9%), Algeria (6.3%), Saudi Arabia (5.5%), Canada (4.2%) and Iraq (3.8%), while imports from the Russian Federation (hereafter, "Russia") ceased in 2022.

Spain has nine refineries, which together account for around 12% of the European Union's total refining output (2024). Thanks to investments made by the sector during the last decade, all of Spain's refineries have improved their flexibility to process a wide range of blends. Spain's refinery output reached a peak of 1 400 kb/d in 2018. Output experienced a sharp drop (15% y-o-y), following the beginning of the Covid-19 pandemic in 2020. While refinery output has since rebounded (1 313 kb/d in 2024), it has not yet reached previous levels. Spain mainly refines diesel (39% of total refined product output in 2024), gasoline (17%) and lower shares of fuel oil, naphtha and LPG.

Natural gas

In 2024, industry used 9.7 bcm of natural gas as a fuel, while buildings used 5.8 bcm. Both sectors' gas demand increased between 2015 and 2021, supported by economic activity and relatively favourable gas prices. However, gas consumption dropped in 2022 amid the European supply shock that followed Russia's invasion of Ukraine. The cut in supplies led to record-high prices that sparked both voluntary demand reduction and demand destruction in industry and buildings.

A gradual rebalancing of gas markets and easing of prices since 2023 has supported a modest rebound in consumption. Electricity and heat generation used 9.6 bcm in 2024, similar to the 2015 level, although this was down by almost 40% compared to

2022, when it stood at 15.7 bcm. This largely reflects the rapid expansion of renewable electricity generation and its growing displacement of gas-fired power. Transport accounts for a minimal share of natural gas use (0.4 bcm in 2024).

Almost all of Spain's natural gas is imported, sourced from 16 different countries in 2025. Gas pipelines connect the country with France, Portugal and North Africa, with Algeria the main supplier of gas by pipeline (87%). Spain has seven liquefied natural gas (LNG) terminals. The United States was the largest LNG supplier in 2025 (45% of total imports), overtaking Russia (17%) whose shipments to Spain declined by 41% from a year earlier[9]. Spain has tackled speculative hoarding of LNG capacity in order to minimise idle capacity. For example, it introduced competitive auctions for LNG unloading slots and storage capacity. These involved over 60 shippers in 2024 and resulted in almost full contracting of the available capacity. Nevertheless, actual regasification throughput remained limited relative to Spain's large installed regasification capacity, resulting in one of the lowest utilisation rates among European LNG terminals in 2024.

The role of LNG terminals in Spain, however, cannot be assessed solely by these utilisation rates. Apart from being useful for its neighbours and other European importers, Spain's LNG infrastructure serves a critical function by ensuring security of supply during winter peak demand days, i.e. when the combined capacity of all other supply sources – domestic production, limited withdrawals from underground gas storage, pipeline imports from Algeria, and cross-border flows from Portugal and France – are insufficient to meet national demand.

Renewable gases

Spain has strengthened its regulatory framework for the integration of renewable gases into its gas system. This includes procedures for connecting biomethane and hydrogen production plants and for guarantees of origin. Given the country's high ambitions, having such an enabling framework is important. While current volumes remain small, the NECP foresees nearly 12 GW of electrolysers for the production of renewable hydrogen and 20 TWh of biogas/biomethane by 2030. The near-term policy challenge is around execution. This notably includes streamlining permitting

[9] Reflecting the EU-wide ban, the supply of Russian gas is set to be completely phased-out by the end of 2027.

and connections, ensuring governance of gas quality and sustainability, and mobilising investment at a pace consistent with the country's 2030 objectives while managing public acceptance and infrastructure constraints.

Hydrogen

Spain's new target of 12 GW of electrolyser capacity by 2030 would deliver more than a quarter of the overall amount needed to reach the EU-wide target set by the European Union's hydrogen strategy. It also implies a threefold increase compared to the target of 4 GW established in Spain's 2020 Hydrogen Roadmap. Spain's electrolyser capacity objectives position low-emissions hydrogen as a central decarbonisation vector for refining, chemicals and other energy-intensive industrial activities.

To deliver the hydrogen target, Spain sharply intensified its focus on renewable hydrogen in 2024 and 2025. Spanish projects now account for around 20% of announced renewable hydrogen projects in Europe, although deployment remains at an early stage. Spain has secured strong outcomes across successive European Hydrogen Bank auctions: two Spanish projects were awarded a total of EUR 239 million in the pilot round (around one-third of available funding), eight projects received approximately EUR 292 million in the second auction, and one was awarded EUR 4 million in the third.

In July 2024, the government launched a EUR 1.2 billion RRF-financed support programme for renewable hydrogen clusters. It also allocated EUR 794 million of state aid to support industrial activities in the renewable hydrogen value chain under the Hy2Use Important Project of Common European Interest (IPCEI) programme. These support schemes apparently have helped lead to several final investment decisions, such as the recent announcement for the Andalusian Hydrogen Valley project, along with others in Cartagena and Bilbao. Construction has also started in Castellón on what will be Spain's largest renewable hydrogen plant so far.

Spain also collaborates with neighbouring countries to deliver its low-carbon hydrogen objectives. The Spanish gas transmission operator (TSO), Enagás, formed a joint venture with the French TSO, Natran, and the French storage operator, Teréga, to develop the cross-border Barcelona-to-Marseille (BarMar) underwater hydrogen pipeline. The project is a key component of the H2Med hydrogen pipeline initiative, which aims to connect Portugal, Spain, France and Germany by 2030. The final investment decision on the project is expected in 2028 at the earliest. If

completed, H2Med could transport up to 2 Mt/year of renewable hydrogen, representing approximately 10% of the European Union's projected hydrogen consumption by 2030.

In total, Spain's hydrogen project pipeline includes more than 19 GW of announced electrolysis capacity by 2030, though high volumes are currently at early-development stages (feasibility study or concept stage). The pipeline indicates long-term potential, but it also showcases execution challenges. According to IEA's analysis, only 17% of this announced capacity is almost certain or has strong potential to be operative by 2030, with an additional 17% having moderate potential. Project deployment has yet to accelerate to the necessary scale, and is hampered by uncertain demand and higher cost estimates that have been driven by inflation, elevated interest rates and slower-than-expected progress in large-scale electrolyser deployment.

Despite these challenges, Spain has positioned itself at the forefront of low-emissions hydrogen development. It has already established a relatively advanced policy framework on the supply side, including well-defined support mechanisms focused on priority end-use applications. It has also established specific hydrogen deployment targets for road and short-sea maritime shipping, which, together with ReFuelUE Aviation Regulation, can strengthen industry commitments and enhance the prospects for converting announced projects into operational capacity at scale. While the sector remains at an early stage, low-emissions hydrogen is expected to play an important role in Spain's long-term decarbonisation pathway. Further progress could be supported by strengthening demand-side measures and addressing operational expenditure (OPEX) risks, including through targeted instruments such as CfDs and other long-term revenue stabilisation mechanisms.

Biogas

In 2025, Spain's biogas and biomethane production stood at around 4.3 TWh, an increase of about 15% compared to 2020. Production is expected to reach over 9 TWh by 2030, according to IEA forecasts. though this would fall short of Spain's NECP target of 20 TWh.

According to IEA estimates, Spain holds a biogas and biomethane production potential of around 62 TWh/year, primarily through manure and crop residues from its large agricultural and livestock sectors. This is the fourth largest technical potential in the European Union, following Germany, France and Romania, although Spain's current production level (2025) is low.

Biogas production from wastewater and organic industrial waste for onsite use currently accounts for most renewable gas production in Spain. The production of biomethane, a purified form of biogas that is compatible with natural gas, has so far been limited. As of the end of 2025, Spain had around 15 biomethane plants connected to the grid, compared to hundreds in France and Germany.

Spain aims to leverage its biogas potential through several policies. The 2022 Biogas Roadmap establishes 45 measures to expand domestic production, including RD&I, regulation and economic incentives. Spain's policy development has been driven by broader EU policy. For example, the country introduced mandatory quotas and caps for transport biofuels under Ministerial Order TED/728/2024, which implemented EU RED II and encouraged domestic production of advanced biofuels over imports. Since 2025, this has included the production of biomethane made from waste and residues.

Compared to subsidies for biogas in other European countries, Spanish subsidies are small. Biogas success in Germany and Italy has mainly been driven by feed-in tariffs and feed-in premiums allocated through tenders. In France, long-term demand has been supported by biomethane blending obligations for gas retailers. Additionally, France and Germany provide support to cover injection costs, while France benefits from streamlined permitting and a strong integration of biofuel policy with agricultural policies. Despite relatively less public support, Spain's biogas sector is seeing increasing interest from private investors, with hundreds of projects reportedly under evaluation or development. Moreover, several major Spanish energy companies have announced biomethane portfolios.

Spain launched a public consultation on biomethane in April 2026 as part of the Royal Decree-Law 7/2026, with the aim (among others) of introducing the legal basis for future mandatory uptake targets for non-transport sectors. The decree also transposes RED III, including improvements on renewable acceleration zones and permitting. Although the biomethane aspects of the decree are still at an early stage, if implemented successfully, they could lead to a turning point for the development of the biomethane sector in Spain.

Coal

By 2025, coal made up only 1.6% of Spain's total energy supply, down from 11% in 2015. Spain shut down its coal mines between 2018 and 2020 and is now completely dependent on imports for its remaining coal use, which is mainly in power generation. In 2021, it joined the Powering Past Coal Alliance, which aims to end coal use for electricity generation by 2030.

Recommendations

1 Strengthen implementation oversight and co-ordination to ensure timely and comprehensive economy-wide execution of energy transition objectives and commitments

Spain has established a robust and ambitious strategic framework for its energy transition, anchored in the Climate Change and Energy Transition Law and the National Energy and Climate Plan (NECP) and reinforced by recent legislation, notably Royal Decree-Law 7/2026. These instruments provide clear objectives for decarbonisation, electrification, energy security, affordability and resilience. The central challenge is now consistent, economy-wide implementation. Outcomes will depend on timely execution, effective co-ordination and sustained follow-through across sectors and levels of government. Such co-ordination will be essential in order to maintain investor confidence, particularly given the scale of private capital mobilisation foreseen in the NECP; to sustain public support for the energy transition, notably where infrastructure deployment and behavioural change are required; and to preserve policy credibility at both domestic and international levels.

Key transition drivers, such as electrification, building renovation, adaptation and skills development, require co-ordinated action across ministries, regulators, autonomous communities, local authorities and private actors. This means that results are potentially vulnerable to governance bottlenecks.

To support economy-wide execution, Spain could reinforce implementation oversight of the NECP and other energy transition-related plans. This includes establishing regular, structured progress reviews focused explicitly on delivery and supported by independent assessment and predefined correction triggers. Building on existing EU and national reporting obligations, such reviews would help identify implementation gaps early, distinguish structural problems from temporary delays, and enable timely adjustment when deliveries deviate from agreed trajectories. Spain could gather inspiration for such reviews from the United Kingdom's Climate Change Committee, a statutory, independent monitoring body that tracks delivery against climate and energy targets, regularly reports to Parliament and provides formal government responses ("comply or explain"). It could also derive lessons from the Netherlands, where independent assessments of climate and energy policy implementation by the Netherlands Environmental Assessment Agency systematically

feed into government decision-making, enabling timely policy reinforcement through additional policy packages (climate packages) whenever delivery risks emerge.

Spain should moreover consider further reinforcing structured co-ordination across governance levels and increasing the accountability of regional authorities for the powers and responsibilities that these bodies already have. This is particularly important given the central role of autonomous communities in permitting, infrastructure roll-out, building renovation and skills provision. More formalised co-ordination would reduce implementation bottlenecks, enhance accountability and ensure that national priorities are effectively translated into action across the territory. Spain could draw conceptual inspiration for this from Denmark, whose experience – albeit at a much smaller scale than Spain's – highlights the benefits of clearly allocating delivery responsibilities to sub-national authorities. This clarity has helped translate Denmark's national targets into consistent territorial implementation, particularly in infrastructure-intensive sectors such as heating and buildings.

2 Electrify industrial and domestic demand in line with the rapid expansion of supply, by adopting reductions in electricity taxation that enhance competitiveness and affordability

Faster growth in electricity demand can unlock the potential of Spain's rapid renewable electricity generation expansion, in particular by increasing renewables utilisation and reducing curtailment, increasing grid stability and lowering overall energy system costs. Electrification in the industrial sector offers a particularly large opportunity, since it can function as a flexible source of demand, able to adapt to the needs of the power system. However, accelerating electrification across the whole economy will ultimately depend on the affordability of electricity.

In order to incentivise electrification, Spain should therefore aim to reduce electricity taxation and remove non-energy related levies from electricity bills. In this context, it should consider making selected temporary measures under Royal Decree-Law 7/2026 permanent, including the reduction of the 7% tax on electricity generation (IVPEE) – as is already planned by 2028 (and partially, or 50%, by 2027) by the Spanish government – and the special 5.113% tax on electricity (IEE). Rebalancing the tax burden across energy carriers would also strengthen incentives to switch from fossil fuels to electricity by better reflecting decarbonisation priorities and underlying system costs. Such reforms would need to be accompanied by thorough assessments of their potential impacts on affordability, industrial competitiveness and public finances, and may require gradual phasing-in to ensure

predictability, limit negative distributional impacts, and maintain public and political support. Several peer countries have already introduced similar reforms. For example, Finland gradually reduced the electricity tax for groups of industrial users to the EU minimum rate of EUR 0.5/MWh as part of its energy tax reform, while increasing taxation on fossil fuels.

Spain should also continue to prioritise the permitting of grid reinforcement, which enables the electrification of industry and the connection of emerging loads. However, as capacity availability is often not the issue (35% of transmission grid nodes showed firm access capacity availability in October 2026), it is particularly important to accelerate the implementation of authorised projects and to improve access and connection procedures. This should be complemented by leveraging and continuing to adjust as needed the capacity maps introduced in 2026, ensuring that they are transparent, regularly updated and easily usable for guiding investment decisions. Ongoing reforms to introduce flexible access arrangements represent a promising development and could be scaled up as well. In parallel, Spain could further leverage the use of allocation mechanisms, such as auctions and the prioritisation criteria established in Royal Decree-Law 7/2026, in order to ensure that scarce grid capacity is directed towards projects that deliver the highest social value, where scarcity does exist.

3 Accelerate transition in the transport sector by addressing cost barriers, enhancing infrastructure deployment and strengthening consumer confidence

Transition in the transport sector remains limited and risks of adoption becoming concentrated in larger cities and among higher-income households exist. Accelerating progress will require reinforcing Spain's holistic approach to sustainable mobility, combining demand reduction, stronger price signals, co-ordinated infrastructure deployment and targeted measures for lagging segments.

Further building on improvements by expanding investments in the accessibility of public transport and incentivising its use is both effective and efficient. Spain should reinforce efforts to support a modal shift, in particular from private car use and domestic aviation to rail and other collective transport modes. Continued investment in high-quality rail services - supported by competitive pricing and scheduling, including on short- and medium-distance routes - can reduce oil demand, ease pressure on road infrastructure and enhance connectivity. In parallel with reinforcing rail services, Spain could advance its legislative initiative to restrict short domestic

flights where competitive rail alternatives exist. This could take inspiration from France's ban on domestic air routes with direct rail alternatives of less than 2.5 hours.

According to Spain's draft National Action Framework for electric vehicle charging and alternative fuels, the country has made solid progress in electromobility, rapidly expanding publicly accessible charging stations and EV uptake. Ensuring the effectiveness of EV support schemes remains however important. While Spain has introduced significant financial incentives, their impact will depend on clear communication, accessibility and timely delivery. Strengthening price signals would further reinforce uptake. This could include increasing the tax differential between ICE and EVs, particularly for corporate fleets. In developing its national charging master plan, Spain could learn from existing examples, such as the Dutch National Charging Infrastructure Agenda. The plan should aim to improve alignment across government levels and stakeholders and provide a clear framework for corridor charging, urban and rural deployment, grid connection planning and interoperability, while helping to address remaining coverage and reliability gaps.

Greater focus is needed on segments where electrification is lagging, notably heavy-duty transport and workplace charging. Targeted measures for buses, freight vehicles and commercial fleets, including dedicated infrastructure and tailored support, will be essential for decarbonising road transport beyond passenger cars. Expanding workplace charging can further broaden access – particularly for drivers without home charging options – while supporting charging patterns that are better aligned with periods of high renewable generation.

Additional innovative schemes and initiatives could further broaden transport decarbonisation options for specific types of users. Spain can build on the measures included in its draft Social Climate Plan to support the uptake of electric vehicles among vulnerable groups, including targeted support for the acquisition of light-duty EVs by self-employed workers and microenterprises, as well as the electrification and renewal of commercial and heavy-duty fleets.

4 Incentivise building renovations to reach energy efficiency and electrification targets, while implementing targeted support for vulnerable consumers

As buildings undergo renovations, policy should more strongly favour the deployment of heat pumps or other low-emissions solutions. This would help disincentivise investment in fossil-fuel-based systems that risk long-term lock-in. Some of these

measures have already been included in Royal Decree-Law 7/2026. Clear, forward-looking signals improve investment certainty for households, installers and manufacturers. They also facilitate decarbonisation in multi-household buildings, prevent fossil-fuel lock-in and help align construction decisions with Spain's emissions-free building stock objectives for 2050. Existing funding instruments already provide a basis for such an approach but could be leveraged further to support electrification at scale. Aside from rebalancing taxation, as discussed in Recommendation 2, the government could consider tightening bans on the installation of oil and gas boilers in new and renovated buildings, while balancing affordability concerns and providing targeted support where needed. Ireland's ongoing policy development in this area could serve as a valuable reference.

Meanwhile, ensuring that the benefits of building renovations are socially inclusive should remain a priority. Spain should continue support for vulnerable households, notably through the implementation of the forthcoming Social Climate Plan and access to the EU Social Climate Fund. Targeted renovation programmes for low-income and energy-vulnerable households, combined with simplified administrative procedures and tailored support, can deliver durable reductions in both energy demand and energy bills while improving comfort. These measures would complement existing consumer protection mechanisms and reduce households' exposure to energy price volatility over the long term. Further strengthening the role of one-stop shops would help inform citizens about available options, facilitate access to financial incentives and support them throughout the administrative and practical aspects of the renovation process.

Finally, Spain could strengthen its national energy saving system in order to better support long-term efficiency gains in residential renovation. Although Energy Saving Certificates (CAE) have become an important policy tool, they tend to favour measures with immediate impacts, making them more suited to industry than housing. Households face persistent barriers such as high upfront costs and long payback periods, particularly for major renovations. Apart from the CAE system, targeted support for deep renovations, alongside stronger implementation capacities for the National Energy Efficiency Fund (NEEF), could accelerate comprehensive residential projects, especially in multi-apartment buildings. These measures should be accompanied by robust monitoring and evaluation. Spain should also carefully assess the impact of the crisis-related correction applied to the CAE system under Royal Decree-Law 7/2026 and continue to accelerate the replacement of fossil fuel-fired boilers with heat pumps using well-suited and targeted support instruments.

5 Strengthen workforce planning and skills strategies to support the energy transition across all sectors, while ensuring adequate human administrative capacity for timely permitting and other regulatory requirements

The energy transition is also a transition for workers, employers and institutions. While it is generating employment opportunities, skills shortages and administrative capacity constraints may impede the timely and cost-effective delivery of Spain's energy and climate objectives. Spain has already taken important steps to address these challenges, but the pace, scale and cross-sectoral nature of the energy transition now require a more integrated, forward-looking and data-driven approach to private and public workforce planning.

Spain should consider strengthening the monitoring of relevant skills in order to systematically inform policy design and implementation related to the energy transition. This should be grounded in up-to-date labour-market intelligence, the mapping of current and projected needs across sectors and regions, and the explicit linking of workforce planning to the targets and timelines set out in the NECP, National Building Renovation Plan, Social Climate Plan and electricity system planning frameworks. Even stronger co-ordination between energy, labour, education and regional authorities would help ensure that skills policies respond dynamically to evolving needs and reduce mismatches between training provision and project pipelines.

In parallel, Spain should continue to expand and adapt upskilling and reskilling programmes, with particular focus on sectors where delivery risks are increasing, notably buildings, transport, electrification and energy efficiency. Accelerating renovation and electrification will require a rapid scale-up of skilled installers, electricians, energy auditors, construction workers and site managers, while grid expansion and digitalisation will demand more specialised technical profiles. Spain's experience with the coal phase-out and just transition policies provides a strong foundation for this effort and highlights the importance of proactive workforce planning, territorial targeting and sustained stakeholder engagement. Extending these lessons beyond coal regions to other sectors affected by decarbonisation will help anticipate labour market disruptions, support worker mobility and reskilling, and promote a fair and inclusive transition.

Finally, the government should address human-resource constraints within the public sector as these risk becoming a limiting factor for the energy transition. The government plays a central role in administering and enabling the transition, notably through permitting, environmental assessments, grid-connection approvals and regulatory oversight. This role is set to expand due to legislative changes to permitting and grid connection requests, which require a more detailed project-by-project assessment and tighter follow-up on development trajectories. Ensuring adequate public-sector staffing, alongside targeted training for permitting and regulatory authorities, would help reduce bottlenecks, improve predictability for investors and project developers, and support timely delivery of Spain's energy and climate objectives.

Focus areas

Energy security and diversification of supply

Broadening challenges

Energy security is a policy priority for the Spanish government. Over the past decade, the country has built a robust framework to manage energy-security risks across fuels. This is underpinned by firm governance arrangements, mandatory diversification rules and stockholding obligations for imported fossil fuels on the one hand, and the rapid deployment of renewable energy sources on the other. These policies have delivered tangible results, strengthening Spain's resilience to external supply shocks and reducing exposure to international price volatility.

Despite these achievements, Spain's energy security remains structurally challenged due to its high import dependence, which stood at 69% in 2024. As in other European countries, this dependence was exposed during the 2022 energy crisis following Russia's invasion of Ukraine, and again in 2026 in the wake of the crisis in the Middle East. These crises reflect the continued relevance of policies aimed at reducing reliance on imported fuels. At the same time, the nature and scope of energy-security challenges are continuing to evolve. Technological change, geopolitical tensions, climate impacts and digitalisation are broadening the risk landscape, introducing new vulnerabilities alongside traditional concerns about fuel supply.

Spain therefore faces an increasingly complex policy environment, requiring it to adapt to evolving conditions. Although it can rely on important legacy strengths within its established framework, continued efforts to diversify supply and accelerate the energy transition – in particular through electrification of end uses – will remain critical. Managing emerging system-level risks and ensuring long-term coherence in governance are also becoming increasingly important.

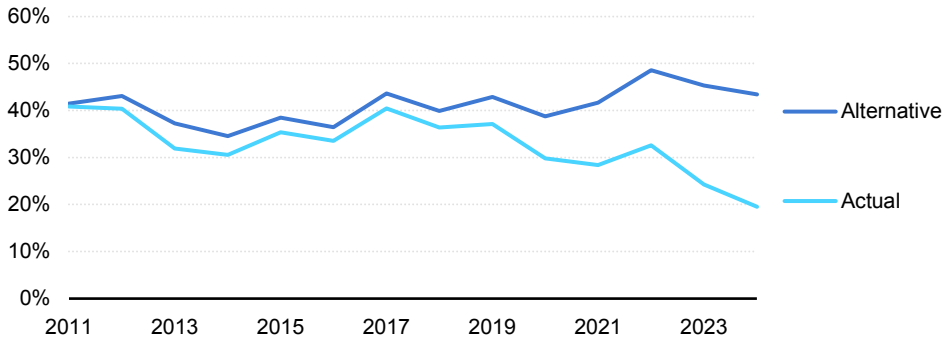
Spain's Energy Security Strategy dates from 2015, a period when both the energy system and associated security challenges differed markedly from those of 2026. In October 2022, Spain published Plan Más Seguridad Energética (Plan for More Energy Security), which provided an updated and modernised vision of energy security in the context of the invasion of Ukraine. The upcoming update of the Energy Security Strategy should further reflect the country's advancing energy transition, including a focus on system planning and operation, day-to-day climate resilience and, increasingly, extreme weather events, cyber and physical security, and supply chains for clean technology.

Renewable deployment as an asset for Spain's energy security

Spain's rapid expansion of renewables has driven the country's emissions reductions. It has also delivered important economic and energy security gains. By replacing imported fossil fuels, renewables have reduced the country's exposure to import risks. They are enabling Spain to meet domestic demand but also to contribute to wider European security of supply. At the same time, the growth of distributed generation, especially rooftop solar PV installations, has opened new opportunities for strengthening resilience at the local level.

The scale of these benefits is significant. Spain's rapid deployment of wind and solar capacity between 2011 and 2024 substantially reduced natural gas imports for electricity generation. Without the additions of renewable capacity over this period, Spain's natural gas imports in 2024 would have been nearly 40% higher, due to reliance on gas-fired power generation. In this counterfactual low-renewables scenario, Spain's electricity import dependence in 2024 would have been more than twice the actual level.

Electricity import dependence and counterfactual low-renewable scenario in Spain, 2011-2024



IEA. CC BY 4.0.

Source: IEA (2025), Renewables 2025.

As renewable penetration has increased, Spain's exposure to gas-driven wholesale electricity price volatility has declined relative to the situation in peer markets. This structural shift has helped moderate Spain's vulnerability to external supply and price shocks. Over the same 2011-2024 period, the cumulative savings from import bills versus this counterfactual scenario reached USD 26 billion. Moreover, in light of the Middle East crisis in 2026, Spain's electricity market remains notably less affected by cost increases stemming from dependence on natural gas compared to its European peers. Enabling further well-planned expansion of renewables deployment and matching this with accelerated electrification of energy demand will be key drivers of future energy security in Spain.

Managing natural gas and oil supply in a transitioning energy system

Security and diversity of supply

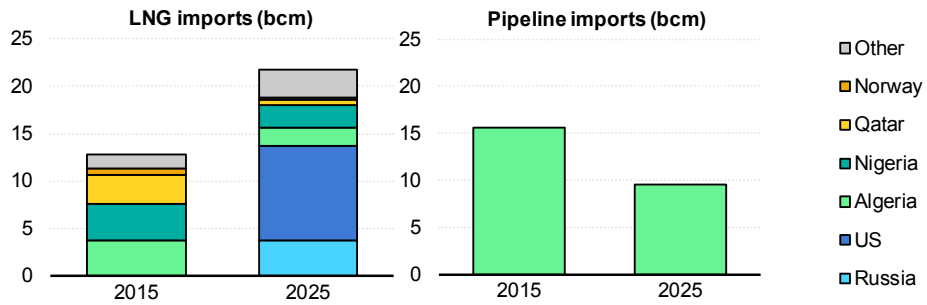
Despite strong growth in renewables, oil and natural gas continue to be important energy sources in Spain. Ensuring the security of supply for these fuels – which are almost entirely imported – has long been a central pillar of Spain's energy policy. The country's diversified gas supply infrastructure, including its seven large LNG terminals and extensive pipeline network, guarantee reliability in almost any situation.

As already highlighted in the previous IEA Energy Policy Review of the country, existing infrastructure and transmission capacity in Spain are sufficient to match supply with demand under a wide range of scenarios. In addition, the government has legally mandated minimum gas stocks equivalent to 20 days of consumption, enhancing resilience to sudden supply disruptions.

In 2004, Spain implemented binding safeguards to underpin diversification of gas supply. When natural gas supplies from a single country of origin exceed 50% of Spain's annual domestic consumption, shippers and self-consumers accounting for more than 7% of all imports must diversify their portfolios, ensuring that less than 50% of their gas supplies originate from that country (Royal Decree 1716/2004).

Spain has further increased security of natural gas supply by increasing the share of LNG, which went from 42% of total gas imports to 67% between 2015 and 2025. In 2015, 60% of natural gas imports were supplied by one country, Algeria. As of 2025, Algeria was still the main supplier, but its share had decreased to 35%, while imports from the United States had increased from 0 to 30% over the same period. Since 2018, imports from Russia have made up large shares too, but these have fallen to 12% in 2025, and they are set to phase out by the end of 2027 in line with the EU wide phase-out in response to Russia's full-scale invasion of Ukraine.

Spain's gas imports by LNG and pipeline, 2015 and 2025



IEA. CC BY 4.0.

Source: IEA (2026), Natural Gas Information.

Overall, Spain imported gas from 16 different countries in 2025. This diversification has significantly reduced concentration risks. Nonetheless, continued vigilance is warranted. Across Europe, the expiration of long-term LNG contracts is increasing exposure to spot markets, thereby heightening supply and price volatility, including for Spain. Replacing remaining Russian LNG volumes by the end of 2027 without creating new dependencies will also necessitate careful portfolio management by companies, complemented by government oversight. In this context, Spain's reliance on LNG markets might reinforce exposure to global market dynamics while pipeline-based diversification options remain structurally constrained in the medium term.

The security of oil supply has also received sustained policy attention. Spain maintains a diversified portfolio of oil import sources and operates a robust, independently verified 90-day oil stockholding system through CORES. This framework provides a high level of preparedness for supply emergencies. However, oil markets remain exposed to geopolitical tensions, sanctions and shipping disruptions, underscoring the need for continued monitoring and risk assessment.

Reducing demand in a well-planned manner

While reinforcing supply-side safeguards for oil and gas, Spain has increasingly focused on reducing demand for these import-dependent fuels as a core pillar of its energy security. Rapid deployment of renewable energy and the electrification of end-use sectors have thereby already reduced exposure to fossil fuel imports while simultaneously advancing decarbonisation objectives.

Oil and natural gas play distinct roles in Spain's energy system and require differentiated transition strategies. Oil remains the single largest energy source. It accounted for 43% of total energy supply in 2025 and is concentrated in the transport sector. Reducing oil demand through rapid electrification, efficiency measures and an accelerated modal shift in the transportation sector is an evident priority for strengthening the country's energy security.

Natural gas, which accounted for around 23% of total energy supply in 2025, plays a more complex role. Gas demand is structurally higher in industry and buildings than in transport. It also plays an important role in the electricity system, where gas-fired generation has increasingly been used for providing flexibility, balancing services and dispatchable capacity during periods of low renewable output or system stress. Managing this complex role requires a carefully calibrated approach to gas contracting, infrastructure use and power-sector planning.

Spain must secure sufficient gas volumes in the short to medium term to ensure security of supply and electricity system flexibility, while avoiding over-contracting or infrastructure lock-in that would delay the structural decline in gas demand that is required to meet climate and energy-security objectives. The appropriate balance will depend on the pace of electrification in industry, buildings and transport, the scale and timing of renewable deployment, and the availability of low-emission alternatives for so-called hard-to-abate uses and for electricity system stability and flexibility, including storage, demand-side flexibility, interconnections and renewable gases.

Reliable data, transparency and proactive planning are essential for ensuring that gas continues to support rather than constrain the energy transition. It is equally important to approach electricity and gas planning in an integrated manner, linking electricity infrastructure development, flexibility needs, natural gas phase-out pathways and remuneration models in a co-ordinated and cost-effective way. At a strategic level, the NECP already provides an integrated analytical view of the energy system, linking rapid electrification, renewable deployment, declining natural gas use and the development of renewable gases through interlinked system modelling. However, infrastructure planning and investment decisions remain largely separated across energy vectors. In the electricity sector, REE acts as the transmission system and electricity system operator, while the CNMC provides regulatory oversight. In parallel, the gas sector is governed through separate planning and regulatory arrangements, with Enagás serving as the transmission system operator and technical manager of the gas system. While recent reforms (such as CNMC Circular 1/2024 and 2/2025) increasingly acknowledge interactions between electrification, flexibility and gas system evolution, there is no joint electricity–gas demand scenario nor a co-ordinated framework linking grid expansion, flexibility requirements, gas phase-down pathways and network remuneration.

The potential of renewable gases

Spain has taken large strides when it comes to renewable gases. As reflected in the NECP, it views renewable gases as a long-term energy-security lever to reduce structural reliance on imported natural gas, while creating domestic supply options for sectors that are difficult or costly to electrify.

Spain's approach to biogas and biomethane is anchored in the 2022 Biogas Roadmap, which established a 2030 production target of 10.4 TWh per year, subsequently scaled up in the NECP to 20 TWh. This strategy prioritises waste and residue-based feedstocks, notably from agriculture, livestock and organic waste

streams, with the dual objective of lowering gas import needs while supporting circular-economy outcomes. This emphasis is justified by Spain's sizeable technical potential and aims to avoid sustainability risks associated with energy crops. More recently, Spain has proposed binding biomethane targets for non-transport sectors.

Spain has also adopted an explicitly strategic and outward-looking security narrative for renewable hydrogen. Building on abundant solar and wind resources, the NECP highlights renewable hydrogen as a means to substitute imported fossil fuels in domestic refining, chemicals and other energy-intensive industries, while also contributing to European supply diversification. Political and administrative backing for the Iberian Hydrogen Corridor (H2Med) and the development of an internal hydrogen backbone reinforces this role, positioning Spain not only as a consumer but also as a potential export hub for renewable hydrogen within the European Union.

These strategies are supported by an increasingly dense policy stack. Spain has advanced enabling regulation for grid connection and injection of renewable gases and is rolling out systems for guarantees of origin, which are important for market transparency, cross-border trade and compliance with EU sustainability requirements.

Despite these advancements, delivery risks remain significant, and a gap between announced project pipelines and commissioned capacity persists for both biomethane and renewable hydrogen. This reflects a combination of challenges, including lengthy permitting processes, constraints in grid connection and injection, cost competitiveness, and uncertainty around long-term offtake, particularly from industrial end-users. Scaling up the production of renewable gases will require more predictable demand signals, faster and more co-ordinated administrative procedures, and continued targeted support during the early deployment phase. Without progress on these fronts, project realisation may continue to lag ambitions, limiting the near-term contribution of renewable gases to Spain's energy-security objectives.

While Spain's emphasis on waste- and residue-based biomethane reduces exposure to land-use and food-system risks, rapid scale-up without robust safeguards could also create new external dependencies, for example through imported feedstocks. Implementation of guarantees of origin, certification schemes and sustainability criteria will therefore be important, not only to protect environmental integrity,[10] but to ensure that renewable gases strengthen Spain's energy-security position.

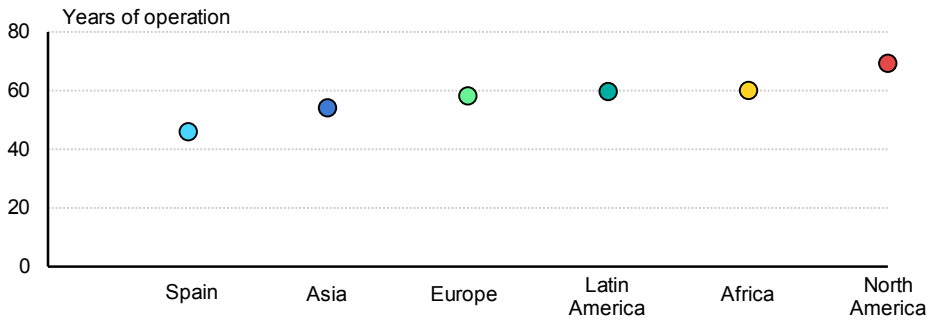
[10] The Spanish government has introduced a "seal of sustainability" for biomethane projects that have high social and environmental standards.

Nuclear energy phase-out

Spain has committed to a progressive phase-out of nuclear power between 2027 and 2035. This covers all seven of its reactors, which accounted for 7.1 GW (4.8%) of installed electricity capacity, 18% of electricity generation and 12% of total energy supply in 2025. This phase-out is a key element of Spain's long-term energy transition strategy, as stated in the NECP. The plan foresees that nuclear capacity will be replaced by renewable generation and new electricity storage by 2030. At the time the NECP was submitted to the Spanish parliament, the analyses conducted by the system operator confirmed that the security of electricity supply associated with the generation mix set out in the NECP could be ensured.

The planned retirement of nuclear capacity however raises important security of supply considerations, especially in light of a rapidly changing international energy context. Nuclear generation currently provides firm, dispatchable, low-carbon electricity. While it is typically less suited for providing certain key functions for the Spanish grid, such as dynamic voltage control and oscillation damping, it also contributes to system stability through synchronous operation. As reactors progressively retire, Spain will need to ensure that sufficient replacement – in terms of both generation and broader system readiness – is deployed in time to maintain reliability. Spain's reactors are scheduled to be phased out with an average operating life of around 46 years, which is below international practice for comparable reactors (status in 2022).

Average planned lifetime operation of nuclear reactors in Spain and global regions, 2025



IEA. CC BY 4.0.

Source: IEA/NEA analysis based on IAEA (2026), Power Reactor Information System (PRIS), (accessed in August 2026).

Moreover, between 2019 and 2024, decisions have been taken in several other countries to extend the operating periods of over 60 reactors. Recent examples include a 10-year licence renewal for the TIHANGE-3 in Belgium, directional decisions towards extending the operating life of Sweden's RINGHALS-3 reactor to 80 years, and the NRC in the United States granting extensions for 90% of its PWR fleet (most comparable to Spain's reactors in technical terms) to 60 years, with some plants already approved to operate for 80 years.

Spain maintains a limited and conditional framework for long-term operation (LTO) of its nuclear plants. The existing policy allows operators to request plant-specific, time-bound extensions that are subject to strict regulatory assessment. In that context, in October 2025, the plant operator CNAT submitted a request to the government to extend the operational life of the two-unit Almaraz nuclear power plant by about three years, until June 2030. This request triggered a formal assessment process, under which the CSN evaluated the safety case for extended operation; and after which the Spanish government approved the extension in August 2026.

The regulatory framework in Spain for LTO is already well defined. The CSN has issued legally binding instructions specifying the requirements for operating reactors beyond the period of their original design licence. These requirements incorporate the European Union Nuclear Safety Directive 2014/87/Euratom and lessons learned from the Fukushima Daiichi Nuclear Power Plant incident, resulting in additional analysis that must be included in periodic safety reviews. In addition, the government defined three conditions that must be met for any extension beyond agreed phase-out dates: 1) nuclear safety is guaranteed with endorsement by the CSN; 2) security of electricity supply is ensured; and 3) no additional costs will be passed on to taxpayers.

These conditions limit extensions to cases where they are both technically justified and system-relevant, while maintaining the integrity of the overall phase-out policy. At the same time, the requirement that operators bear full costs may affect the economic attractiveness – and therefore willingness – of operators to pursue extensions of operating periods. From a system perspective, LTO can however represent a cost-efficient transitional option. Refurbishment costs required to extend nuclear power plant operations are generally an order of magnitude lower than the investment needed for new nuclear capacity, and the resulting levelised costs of electricity are comparable to those for other low-carbon power generation. This makes LTO one of the most economical sources of low-carbon electricity in the near term.

Phase-outs of nuclear facilities will need to be closely aligned with the deployment of alternatives. As reactors are shut down, maintaining adequacy will be a key challenge for Spain's electricity system. Extending the operation of Spain's nuclear fleet beyond currently anticipated dates could help alleviate short-term system pressures if alternative energy sources are not ready in time. However, this approach should not reduce the urgent need to accelerate investments in long-term, low-carbon flexibility solutions.

Increasing new challenges

While Spain's energy transition strengthens several dimensions of energy security, it also introduces new sources of risk. Some of these are linked to the transformation of the electricity system discussed in the Focus Area on a Resilient electrification of the energy system. Others stem from emerging dependencies along the supply chains for clean-energy technologies, from climate and extreme weather challenges, and from cyber security threats.

The upcoming revision of Spain's 2015 Energy Security Strategy presents an opportunity to more closely align policy with the evolving energy system and its associated challenges. Other IEA Member countries are taking similar modernisation initiatives, which could function as useful inspiration. For example, Australia strengthened its security framework for critical infrastructure in 2026 through the adoption of Enhanced Critical Infrastructure Risk Management Program (CIRMP) Rules. These rules require operators of designated critical infrastructure assets, including in the energy sector, to adopt more robust risk-management measures across cyber and information security, physical security, personnel security and supply-chain risks, while also addressing broader threats to national and economic security.

Supply chain risks

As is the case for the supply of fossil fuels, diversification is important for supply chains for clean energy technologies. Without significant domestic production, Spain relies heavily on imports of critical minerals, in large part from the People's Republic of China (hereafter, "China"). For example, production of rare earth elements – used notably in permanent magnets for EVs and wind turbines – is highly concentrated in China, which accounts for 60% of global mined production, 91% of refined output and 94% of permanent magnet manufacturing. Another material with very high supply concentration is graphite, with China accounting for 75% of world supply.

There are no commercially viable alternatives to graphite in battery anodes and in electrodes for electric arc furnace steelmaking – two key technologies for the energy transition in transport, electricity generation and heavy industry. Nevertheless, alternative sources of supply are emerging. For rare earth magnets, production is available and expected to expand in Japan, the United States and Viet Nam. And Japan, Australia and the United States are among the leading suppliers of refined graphite outside the dominant Chinese market.

Demand for these materials is expected to grow as Spain advances electrification, expands renewable energy deployment and develops domestic battery manufacturing capacity, including gigafactories. Ensuring reliable access to these inputs will be important for maintaining the pace and resilience of the energy transition. However, when looking at possible sources of supply, the current project pipeline shows that the average global share of the top country supplying refined critical minerals (China for copper, lithium, cobalt, graphite and rare earths, and Indonesia for nickel) is expected to stay high, decreasing only slightly between 2025 and 2035, from 70% to 67%.

Spain has begun to respond to these risks, including by building on a significant domestic resource base. The country is Europe's second-largest producer of copper and the largest of gypsum, fluorite, strontium and sepiolite. Developing this potential in a structured and sustainable way has become a central policy objective in recent years.

In 2022, the government approved the Roadmap for the Sustainable Management of Mineral Raw Materials, followed by an Action Plan for the Management of Mineral Raw Materials 2026-2030 in March 2026. This action plan is backed by EUR 414 million in public investment and includes 34 interdepartmental measures organised around four strategic axes: strategic autonomy, industrial development, circularity, and sustainable management. On the regulatory side, the plan includes the modernisation of the Mining Law and mining waste management standards, together with traceability mechanisms for imported raw materials. It also places strong emphasis on circularity, targeting the valorisation of secondary materials from more than 1 000 existing mining waste facilities and the recovery of critical minerals from end-of-life electronic equipment. The centrepiece on the supply side is the first National Mining Exploration Programme (PNEM) in more than five decades, with EUR 182 million allocated to map primary resources using advanced geophysical techniques and to identify additional potential for secondary materials.

These efforts are complemented by initiatives at both the European and international levels. Spain hosts seven Strategic Projects designated under the EU Critical Raw Materials Act. Located in Extremadura, Galicia, Andalusia and Castilla-La Mancha, these projects cover the extraction, processing and recycling of critical raw materials. They are expected to strengthen the security of supply of materials essential for the energy transition for both Spain and the European Union. Spain also participates in activities of the IEA Critical Minerals Security Programme and has taken steps to strengthen co-operation with Latin American countries in the area of critical materials, notably Chile.

Beyond expanding supply, Spain is seeking to strengthen resilience against supply-chain disruptions. To this end, it has introduced the concept of a strategic reserve for essential industrial inputs and critical products. The *Reserva Estratégica basada en Capacidades de Producción Industrial* (Strategic Reserve based on Industrial Production Capacity, RECAPI), established under the framework of National Security Law 36/2015 and further developed through the Law on Industry and Strategic Autonomy, does not seek to stockpile materials but to identify critical products and national production capacities that can be rapidly mobilised during crises.

These measures represent important steps towards strengthening the security and resilience of critical raw material supply chains. However, they remain at an early stage relative to the scale and speed of the growth in demand for such materials implied by Spain's electrification trajectory. Ensuring that supply-side constraints do not become a bottleneck to the energy transition will require clearer prioritisation of critical materials, stronger international partnerships, closer alignment between industrial and energy policy, and continued co-operation at EU and international level to reduce exposure to highly concentrated global markets.

Climate and extreme weather-related risks

Spain is directly affected by climate change, and its energy system is already experiencing significant impacts from rising temperatures, droughts and other extreme weather events.

Electricity supply climate risks in Spain

Asset vulnerability	Present and future hazard exposure
Electricity system	
• Thermal peak derating of power plants coincides with demand spikes driven by increased use of air conditioning (AC) during heat waves.	Spain shows increased rates of heatwaves, with temperatures exceeding 45°C. In 2025, heatwaves in Spain caused a demand surge of up to14% driven by increased AC usage.
Electricity networks	
• High temperatures can reduce the grid's carrying capacity by 5-10% . • Transformers risk overheating. • Floods and storms threaten substations and pylons. • Faulty lines can trigger wildfires in dry seasons, posing a direct threat to the networks.	Spain has seen a number of severe storms and flooding events leading to power outages in recent years, especially linked to gota fría (or "cold drop") weather phenomena in the southeast. Wildfires in 2023 led to power cuts in affected areas. The IEA estimates that over 10% of Spain's electricity grid is situated in high-risk areas where wildfires could occur more frequently than every 10 years, and more than 90% are in areas where wildfires could occur roughly every 25 years. Around 80% of grid infrastructure will be exposed to up to 10% increases in the severity of heavy rainfall events by mid-century.
Thermal power	
• Heat derating of turbines and steam cycles above 35-45 °C. • Risk of partial shutdowns during extreme heatwaves. • Water scarcity during droughts limits output due to cooling requirements.	Some of the largest remaining thermal units are located in southern and inland regions, which face thermal and hydrological stress. By mid-century, 40% of natural gas capacity faces at least 20 days per year above 35°C.
Hydropower	
• Extended droughts reduce inflows and usable storage. • Run-of river plants face a strong sensitivity to rainfall variability. • Pumped storage hydropower is less dependent on natural inflows but still exposed to heat and evaporation. • Extreme heat increases evaporation from reservoirs. • Sedimentation decreases reservoir capacity and requires regular control of floodgates.	Hydropower generation oscillated between 11% to 5% over the last 15 years, demonstrating volatility to extreme heat. Spain has undergone periods of extended drought, with hydroelectric generation dropping by over 53% in 2022. The hydrological potential of operating plants could further decline by up 18% by mid-century and 30% by the end of the century compared to the average of 1971-2010.

Asset vulnerability	Present and future hazard exposure
Solar PV	
• There is a 0.5% efficiency loss per degree above 25 °C. • Severe dust events temporarily reduce generation by 13-15%. • Hailstorms with stones larger than 3 cm can damage modules. • Flooding damages electrical equipment, accelerates corrosion and undermines mounting structures. • Mirror soiling, e.g. from dust, reduces reflectivity for concentrated solar power (CSP), which also requires water for cooling and cleaning.	Spain is susceptible to increased hail occurrences, particularly in the northeast, partly due to the influence of Saharan dust. According to an Allianz report, Spain also recorded a high number of hailstorm insurance claims. CSP is concentrated in Andalusia and Extremadura, which both have semi-arid climates. While Andalusia is a prime location for CSP due to its high Direct Normal Irradiance, it is also prone to reduced rainfall and mirror soiling. Around 20% of PV capacity is expected to face over 20 extra days per year above 35°C, rising to 90% by the end of the century.
Wind power	
• Lower operational performance above 40 °C and temporary safety shutdowns above 45 °C. • High wind events lead to wind power curtailment (“feathering” of wind turbine blades). • Lower air density during heatwaves reduces output. • Potential shifts in wind regimes due to climate change.	Wind power in Spain is automatically shut down under wind speeds in excess of 25 m/s. Around 5 GW of wind capacity was disconnected in January 2026 due to excessive wind speeds during Storm Kristin. By mid-century, 16% of wind capacity is expected see at least ten extra days above 40°C per year.

Note: Future exposure to median climate outcomes in the SSP2-4.5 scenario, a medium-severity climate outlook consistent with a global warming of around 3 °C by the end of the century. Mid-century impacts refer to the 2040-2060 period, and end-of-century impacts represent the 2080-2100 period.
Source: IEA analysis based on IEA (2023), National Climate Resilience Assessment.

Spain’s PNACC already reflects some of these increasing risks. It includes measures, assigns responsibilities and defines performance indicators and sources of funding across four priority areas:

- Incorporating climate-impact considerations into energy supply, planning and management.
- Preventing climate impacts on electricity generation.
- Safeguarding energy transport, storage and distribution.
- Managing changes in electricity demand associated with climate change.

These considerations are also embedded in Spain's NECP, which treats climate adaptation as a cross-cutting requirement and increases energy-security targets consistent with recent climate-risk assessments. Spain has further strengthened its analytical foundation through the Climate Change Risks and Impacts Assessment (ERICC-2025), the country's first comprehensive nationwide assessment of climate-related risks. ERICC-2025 provides a basis for identifying, prioritising and sequencing adaptation measures, including in the energy sector, while taking into account social, economic and environmental implications.

Spain has meanwhile not yet published a consolidated progress report tracking PNACC energy-related indicators. Producing such a report could enable current and future governments to assess implementation, identify gaps and ensure policy consistency over time. Explicitly incorporating ERICC-2025 findings into future PNACC updates and energy policies would further strengthen the coherence and resilience of Spain's energy transition under changing climate conditions.

Cyber security

As in other IEA Member countries, Spain's exposure to cyber threats is becoming more prominent. In 2024, Spain experienced more than 100 000 cyberattacks, with an incident defined by the government as very serious taking place every three days on average. Compared to 2015, the frequency of cyberattacks has increased by 300%, with the energy sector accounting for an important share (9%) of all attacks. Stakeholders specifically highlight the material risks of cyberattacks to industrial control systems, refineries, nuclear plant safety systems, and automated grid infrastructure.

Spain is covered by several EU initiatives to tackle cyber risks. These notably include the Directive on the Resilience of Critical Entities (EU 2022/2557) and the 2025 Preparedness Union Strategy, which focuses on resilience planning for cyberattacks on energy systems, integrated risk and threat assessments, and cross-border preparedness exercises involving electricity and gas operators.

The Council of Ministers approved an allocation of EUR 1.157 billion for cybersecurity within the national framework of the Industrial and Technological Plan for Security and Defence, and cyber intrusion is also monitored by Spain's electricity TSO. Following the April 2025 blackout, this issue has become more prominent in discussions related to electricity sector reform.

Recommendations

6 Develop integrated infrastructure planning that jointly addresses current and future needs across electricity, natural gas, hydrogen and other renewable gases sectors

Electrification and the structural shift away from fossil fuels, including natural gas, are two important drivers of Spain's energy transition. Spain's NECP projects electricity demand to increase significantly in the coming years, reaching around 35% of total final energy consumption by 2030. As electrification expands across buildings, transport and industry, and efficiency improvements reduce overall energy use, gas demand is expected to decline. These shifts are not independent developments, but rather two sides of the same transformation. The growing importance of low-emissions gases also plays an important role, with hydrogen and other renewable gases requiring co-ordinated decisions on network infrastructure, connection points, storage and end-use applications.

At present, these interlinked dynamics are not sufficiently reflected in institutional arrangements. While strategic tools such as the NECP provide an integrated vision, this is not systematically translated into joint infrastructure planning, operational decisions or investment frameworks. Electricity and gas planning remain largely separate processes, led by different operators and governed through distinct regulatory frameworks. As a result, system operators and regulators risk making decisions based on only partially aligned assumptions. This can lead to inefficient investment, stranded assets and security of supply risks.

Spain should move towards a more co-ordinated approach to infrastructure planning that actively brings together the regulator, system operators and key stakeholders across electricity, gas, hydrogen and other renewable gases. As the Spanish government is creating the structure to advance integrated planning, it should ensure that this approach is clearly reflected in regulations that can drive effective progress across energy sectors. The government should consider establishing a formalised framework for joint planning and co-ordination between system operators (REE and Enagás), built on shared, long-term scenarios and structured co-ordination to align network development, flexibility needs and investment decisions across electricity,

gas and emerging energy carriers. It will be particularly important to clarify the long-term operational, financial and decommissioning responsibilities of system operators as natural gas demand declines.

Clear guidance will ensure that gas infrastructure adapts to evolving system needs, with transparent cost allocation and early definition of pathways for repurposing or retiring assets. Overall, a more integrated and co-ordinated planning approach would improve predictability, reduce transition risks and support a cost-effective evolution of the energy system, ensuring energy security in both the long and short term.

7 Consider approving the extension of existing nuclear reactors, following safety reviews, taking into account their role in security of supply and the costs and benefits of long-term operation

Nuclear energy is a low-emissions electricity source that provides firm and stable capacity and supports security of supply by reducing reliance on natural gas imports. While not typically suitable for delivery of dynamic voltage control, nuclear energy supports system stability as a source of synchronous generation, contributing to the secure and reliable functioning of the electricity grid.

In 2025, the Spanish Congress approved a motion for the government to reconsider the nuclear phase-out. Around the same time, the operator of the Almaraz nuclear power plant formally requested a three-year operational extension to 2030. In August 2026, the government approved this extension citing international energy-market uncertainty and the need to mitigate consumer exposure to price volatility. Spain should build on this precedent and further develop a transparent assessment framework to provide the basis for case-by-case approval decisions. Such decisions should be grounded in criteria for safety (ensured by the regulatory body), energy-security adequacy, and costs and benefits for both consumers and the power system. Taxes and levies associated with nuclear energy should thereby ensure that the economic framework recognises both the contribution of nuclear power to the energy system and the costs associated with externalities, such as waste management and decommissioning costs.

Finally, the government should establish a long-term workforce planning outlook reflecting its decisions on operation extensions as well as eventual phase-outs of nuclear plants. This would support skills retention and knowledge management across the nuclear supply chain and help ensure that nuclear-related skills can be effectively redeployed to other parts of the energy system and the wider economy.

Resilient electrification of the energy system

Renewables-driven electrification lies at the core of Spain's energy transition strategy and underpins the country's objectives for energy security, competitiveness and affordability. Spain is already conducting a rapid transformation on the electricity supply side. Installed capacity has grown to an all-time high of 153 GW (based on REE data for July 2026), due primarily to the rapid expansion of renewables, which make up over 70%. According to the NECP, by 2030 capacity is expected to grow to 214 GW, of which 160 GW will be renewable. On the demand side, economy-wide electrification is expected to grow from 25% in 2024 to 35% by 2030.

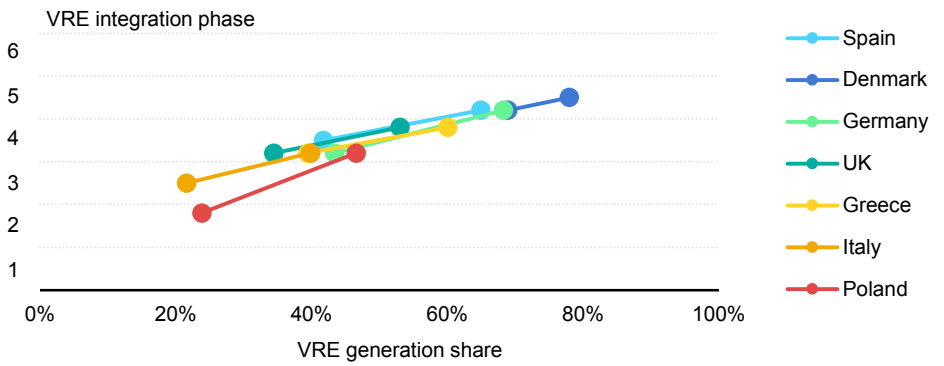
Achieving these electrification and decarbonisation objectives will depend on whether electricity demand, renewables integration, grid modernisation and flexibility progress at the right pace. Ensuring this will require shifting from a supply-driven focus towards an integrated, system-wide approach.

Renewables integration

Managing the transition to higher shares of variable renewables

In 2025, Spain recorded its largest-ever annual addition of renewable capacity: approximately 15 GW, of which over 90% was solar PV. With solar PV and wind accounting for 43% of electricity generation in 2025, the IEA's classification system for VRE integration places Spain in Phase 4. At this stage, variable renewables are capable of meeting a substantial share of electricity demand during certain hours and days. These higher shares of VRE also increase operational complexity and place growing demands on system operation, particularly during periods of low demand, when voltage control, inertia and other stability services become increasingly important.

VRE integration phase assessment for Spain and selected countries, 2024-2030



IEA. CC BY 4.0.

Notes: VRE includes solar PV and wind. The left-hand side dot represents 2024 and the right-hand side dot represents 2030.
Source: IEA (2026), Renewable Energy Progress Tracker.

By 2030, Spain is projected to generate around 65% of its electricity from VRE sources. It will then be moving into Phase 5, where periods of full VRE demand coverage become longer and more frequent. At that stage, conventional synchronous generators are expected to operate less often and at increasingly lower output levels. While this reflects the success of the energy transition, it also changes the technical conditions under which the electricity network operates.

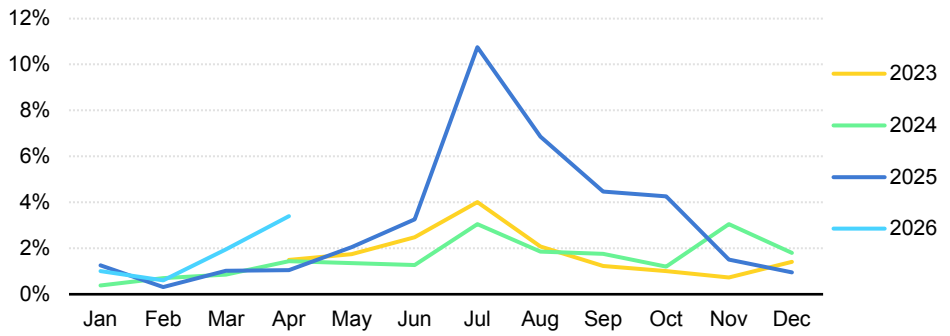
Conventional generators have traditionally provided key stability services, including inertia, fault current, voltage control and reactive power management. Their reduced presence will increase the importance of alternative sources capable of delivering these services. Inverter-based resources, including renewable generation and storage (such as grid-forming batteries), can do this if appropriately designed, configured and authorised. Ensuring their deployment, however, will require a combination of technical solutions, enhanced operational practices and supportive regulatory frameworks rather than a simple one-for-one replacement of conventional generation assets, as discussed below.

Managing the evolution towards Phase 5 will also require limiting connection queues and curtailment – key determinants of system cost efficiency and affordability – and ultimately the pace of electrification in end-use sectors. In Spain, however, network constraints are becoming increasingly pronounced. Technical curtailment of

renewable generation has risen steadily in recent years, from 0.4% in 2021 to around 1.8% during the 2023-2024 period, although the level is still quite low compared to other countries with similar VRE penetration levels. Technical curtailment follows a strong seasonal pattern, broadly aligned with solar PV output, i.e. increasing in spring, peaking during the summer months (particularly in July) and declining again in winter.

Following the 2025 Iberian blackout, this upward trend intensified sharply. Since April 2025, the system has been operating in a "reinforced" mode, relying more heavily on gas-fired generation to ensure stability. This resulted in a 20% growth in gas consumption in the electricity sector from 2024 to 2025, as well as a marked increase in curtailment, which peaked at 11% in July 2025. Although curtailment declined thereafter, it has remained elevated, reaching approximately 3.5% of renewable generation in April 2026, or more than three times the level recorded a year earlier. This elevated curtailment rate not only harms the revenues of renewable suppliers, but significantly increases system costs, due to increased reliance on relatively more expensive gas-fired generation.

Monthly renewable curtailment percentage in Spain by year, 2023-2026



IEA. CC BY 4.0.

Sources: IEA analysis based on ESIOS Red Eléctrica (2026), Markets and Prices, (accessed June 2026).

Adverse price signals are also becoming more frequent. In 2025, electricity prices fell to EUR 0/MWh or below for more than 800 hours (about 9% of the year), while 17% of hours remained below EUR 5/MWh, and over 30% were below EUR 30/MWh. The growing frequency of zero and negative-price hours is directly

compressing solar capture prices (average price received by solar generators), which had already fallen below EUR 35/MWh in 2025, around 47% lower than the average day-ahead market prices that year.

Renewable deployment in line with system needs

In addition to insufficient demand – especially during high VRE output hours – a significant contributing factor to Spain's current challenges is the composition of its renewables expansion. Between 2015 and 2025, growth has been concentrated in solar PV. Between 2021 and 2025, Spain added over 47 GW of new solar PV capacity, with a further 7-10 GW expected in 2026. Meanwhile, wind deployment has been slower, hydropower capacity has remained broadly unchanged, and battery-storage deployment, despite recent progress, has remained limited. As a result, generation profiles have become increasingly concentrated during midday hours, amplifying price cannibalisation and economic curtailment.

Recent developments in the grid-connection queue for VRE capacity suggest that these imbalances could gradually ease. By early 2026, the queue had grown to around 200 GW, driven largely by standalone battery projects and hybrid configurations. While the pipeline for standalone wind projects remained broadly stable (and even increased slightly in 2026), the standalone solar PV pipeline has been declining as developers increasingly shift to hybrid projects that combine solar PV with storage and (in some cases) wind generation. If realised, these investments could contribute to a more diversified and system-friendly generation mix.

Nevertheless, continued efforts to diversify renewable technologies and accelerate storage deployment will remain important for limiting the curtailment of renewables and protecting the business case for further deployment. In this context, policy design will play an increasingly important role. Spain's latest auction for renewable energy capacity, held in 2022, awarded only 45 MW out of the 3.3 GW offered. The low subscription rate was partly attributed to the confidential ceiling price, which many bids reportedly exceeded.

The government is redesigning its utility-scale auction scheme, which is expected to award two-sided contracts for difference (CfDs) with durations of 12 to 15 years and incorporate non-price selection criteria in line with evolving EU guidance. In parallel, the government has announced new tenders for allocating grid-connection access to renewable energy projects. These tenders are expected to award access rights based on non-price criteria, including socio-economic and environmental

considerations, and may be tailored to specific technologies when justified by system needs. Such redesigned tenders could provide policy makers with more effective tools for steering investment towards technologies and project configurations that better support system integration, alleviate network constraints and advance broader policy objectives.

Beyond investment incentives and auction design, Spain is introducing measures to improve project delivery and strengthen public acceptance for renewable energy deployment. Royal Decree-Law 7/2026 aims to enhance public participation, improve legal certainty and streamline procedures related to environmental assessments and project permitting. It also facilitates self-consumption and energy communities by extending the maximum distance for collective self-consumption projects to 5 km, by allowing different models to be combined, and by introducing the role of a self-consumption manager to facilitate collective initiatives. The Decree-Law also makes part of the grid-access capacity reserved at certain competition nodes available for renewable installations associated with self-consumption. Finally, it gives local authorities a stronger role in promoting energy communities and requires electricity producers to share part of the economic benefits of renewable projects with nearby citizens and communities, in line with the European Commission's grid package.

Towards a flexible and reliable transformed power system

Mismatches between supply, demand, transmission and distribution can lead to imbalances in the power system and hamper electrification. In Spain, connection constraints are increasingly becoming a limiting factor for the energy transition. The issue is not simply one of insufficient infrastructure. Access capacity maps confirm that around three-quarters of transmission nodes have no remaining capacity for new generation connections, but these constraints partly stem from the way capacity has been allocated or reserved, rather than solely from physical limits of network infrastructure.

Addressing the dynamics of a transforming electricity system will require a multi-pronged approach. Such an approach should include measures to expand flexibility solutions, align demand growth with periods and locations of renewable surplus, and ensure that grid capacity is allocated to projects that intend to connect to the grid within reasonable timeframes, as opposed to more speculative projects. At the same time, grid security and resilience will continue to be important.

Storage

Spain has a large existing fleet of gas-fired plants whose load factors have been steadily declining, but they still provide most of the country's flexibility and back-up services. However, the role of storage as a flexibility provider is expected to grow sharply as Spain transitions to a decarbonised electricity system. Storage supports effective grid management by providing fast-responding balancing services, delivering voltage and frequency control, utilising renewable generation during periods of peak demand, and contributing to adequacy through capacity provision.

As of May 2026, total installed storage capacity in Spain stood at 8.1 GW, including 6.4 GW of pumped hydro storage (3.3 GW closed loop and 3.1 GW open loop), 0.8 GW of thermal storage, and 0.9 GW of battery storage. Most batteries are behind the meter (BTM). Between the end of 2025 and May 2026, the installed capacity of batteries in front of the meter (FTM) increased however rapidly, from 96 MW to 222 MW, an evolution that is expected to continue.

Recent storage development has so far been largely driven by public support schemes rather than market-based revenues. In particular, grant tenders financed under the FEDER 2021-2027 programme have played a central role. The main call, concluded in December 2025, awarded support to projects totalling approximately 2.2 GW of power capacity and 9.4 GWh of energy storage capacity. Co-located (hybrid) battery projects, primarily paired with solar PV and wind, accounted for more than half of the awarded projects, reflecting a policy focus on integrating storage with renewable generation. Between 2021 and 2025, Spain also conducted dedicated NRRP auctions for storage that supported around 1.5 GW of additional capacity for batteries, including co-located, standalone and thermal.

At the same time, a series of regulatory and market revisions have begun to strengthen the investment case for storage. A key step was Royal Decree 917/2025, which formally incorporated energy storage into Spain's electricity system framework as a flexibility resource and updated dispatch and system-operation rules to better integrate storage and renewable generation. Subsequent regulatory changes (notably under Royal Decree 997/2025 and Royal Decree-Law 7/2026) enabled both stand-alone storage and hybrid generation-plus-storage projects to connect more rapidly and make use of available network capacity, including in constrained areas subject to curtailment. These measures are intended to support faster integration of storage in areas with high renewables penetration. Spain's draft Transmission Network Development Plan for 2025-2030 further reflects this shift, placing stronger

emphasis on accommodating new electricity demand linked to industrial electrification, hydrogen production and other emerging uses, while also focusing on greater integration of renewable generation, storage and other flexibility resources.

Reforms have also expanded the range of system services that storage and renewable assets can provide and create opportunities for additional revenue streams. Revisions to grid-operation rules, notably Operating Procedure 7.4, allow inverter-based (asynchronous) resources to participate in voltage-control services, extending participation beyond conventional synchronous generators. The new real-time voltage-control framework entered into operation in March 2026.

Additional arrangements for procuring reactive power capacity are expected to develop over time. The government is also advancing a centralised, pay-as-bid capacity market for the peninsular system. The mechanism can enable a wider range of firm flexibility resources, including multi-hour battery storage, to compete for long-term contracts. The combined effect of these changes could materially improve the bankability and accelerate the delivery of Spain's battery-storage pipeline.

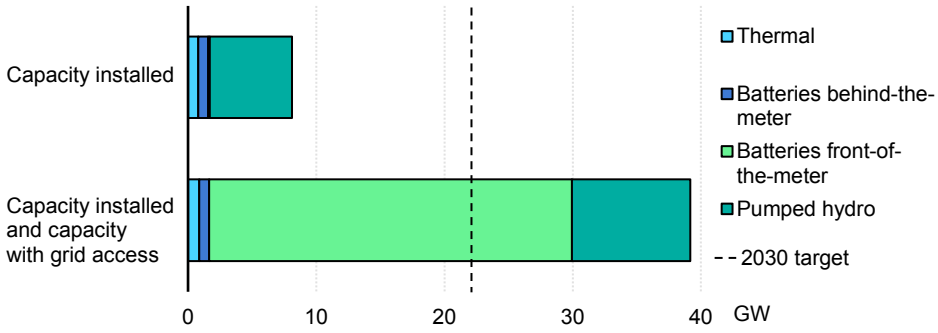
Pumped-hydro meanwhile remains the backbone of Spain's long-duration flexibility and continues to be reinforced. In January 2026, Spain launched a EUR 90 million competitive tender under the BORALMAC2 programme to support nearly 1 GW of new or upgraded pumped-storage capacity, equivalent to around 7 GWh of long-duration storage. The budget was increased by an additional EUR 75 million in April 2026. The scheme, which is funded through the NRRP and administered by IDAE, builds on earlier calls that awarded EUR 100 million to over 2 GW of pumped-storage projects, and aims to modernise existing assets and enable new reversible facilities. Royal Decree Law 7/2026 meanwhile reaffirmed storage (particularly pumped hydro) as a public-utility activity, further consolidating its role within the power system.

These different initiatives appear to be having an impact. As of May 2026, 30.3 GW of additional storage capacity secured access to the grid,[11] driven largely by FTM battery storage (approximately 27.4 GW). This pipeline suggests that Spain could

[11] This only includes projects under the competency of the state administration, notably excluding BTM batteries.

meet its 2030 installed storage target of 22.5 GW, including pumped hydro, thermal and battery storage. It will however be important to ensure that a large share of this capacity is promptly connected to the grid and made operational.

Storage capacity in Spain in May 2026, and target for 2030



IEA. CC BY 4.0.

Note: "Capacity with grid access" only includes projects under the competency of the state administration, notably excluding BTM batteries.
Source: IEA analysis, based on REE (2026) , Network access and connection, (accessed June 2026).

The role of demand

The government projects electricity demand to grow by 34% between 2019 and 2030, based on an expected increase in consumption by data centres, as well as strengthened policy efforts to shift consumption towards electric options for vehicles, heating, cooling and various industrial processes. Creating this demand is an important part of Spain's decarbonisation pathway, but the management of it is equally critical. Better alignment between the location and timing of loads and available supply and network capacity can reduce connection delays, increase utilisation rates of renewable capacity and reduce peak-period stress, thereby increasing stability and affordability.

Management of demand and grid connection queues

Integrating demand-side considerations into grid planning and connection decisions is becoming increasingly important. In particular, the connection of new large loads – such as data centres, EV charging hubs, electrolysers and electrified industrial

processes – should be aligned with available network capacity and system conditions. This can be supported through targeted incentives, for instance by providing accelerated access where capacity is available, or by granting conditional access in constrained areas in exchange for co-located storage or demand flexibility.

Spain has begun to develop a more sophisticated framework for managing the connection of demand loads and making more efficient use of available network capacity. Circular 1/2024 introduced a distinction between firm and flexible access arrangements and established the methodology for granting transmission and distribution network access for new demand loads. Subsequent CNMC decisions in 2025 enhanced transparency and harmonised capacity calculations across network operators, creating a more consistent basis for connection decisions. Since 2 February 2026, REE has been required by CNMC's Circular 1/2024 and its *Especificaciones de Detalle* (Detailed Specifications) to publish monthly demand access-capacity maps. These maps provide granular information about network availability and are an important instrument for guiding the connection of large industrial electricity demand, including datacentres, electrolysers, storage, and self-consumption facilities. The government has also introduced grid tenders to allocate network capacity to strategic projects. These have prioritised decarbonisation, including industrial electrification and renewable-based hydrogen.

At the same time, Spain is strengthening the management of connection queues and access rights. Royal Decree-Law 7/2026 introduces a capacity reservation fee to discourage speculative behaviour, replaces the previous guarantee system with a more targeted, incentive-based approach, and reinforces interim milestones to ensure project maturity and facilitate the earlier release of unused network rights. It also enhances transparency requirements, tightens project identification criteria and addresses practices that may lead to inefficient capacity hoarding.

Spain is also developing a framework for flexible access arrangements to increase the utilisation of existing network infrastructure. Royal Decree-Law 7/2026 enables storage and variable-consumption assets to connect under defined operating conditions, while ongoing regulatory developments aim to further operationalise these arrangements. In early 2026, the CNMC launched a public consultation on additional implementing rules under Circular 1/2024, including more detailed provisions for access permits for flexible demand. The government aims to enable time-bound, power-limited or operating-window-based connections in areas where firm capacity is scarce, allowing new demand to connect while preserving system security.

Unlocking potential through market design and aggregation

Demand response can play a central role in lowering overall system costs by enabling consumers to adapt their consumption patterns in response to supply availability and grid constraints. It simultaneously provides direct economic benefits to both residential and industrial users. In particular, shifting demand towards periods of high renewable output increases the utilisation of wind and solar assets, while reducing peak demand lowers balancing needs, congestion management costs and longer-term investment requirements. In addition, the ability of aggregated demand-side resources to respond rapidly to system imbalances strengthens overall system reliability, particularly during periods of system stress such as extreme weather events or tight supply.

Spain's demand-side flexibility capacity remains limited compared to that of other EU countries, with an enrolled explicit demand response of around 2 GW versus more than 4 GW in both France and Italy. Stakeholders consistently point to a structural mismatch between Spain's increasingly renewables-heavy generation profile and prevailing consumption patterns.

Existing price signals and market arrangements are not yet sufficient to unlock the full potential of demand-side measures. Since 2014, Spain's regulated tariff for small consumers (PVPC) has been directly linked to wholesale market prices, with its energy component reflecting hourly trends in markets. However, the tolls and charges rely on fixed time bands defined by historical demand patterns and not by real-time system conditions. Three levels exist:

- off-peak (*valle*) from 00:00 to 08:00, as well as weekends and national holidays (cheapest)
- flat period (*llano*) from 08:00 to 10:00, from 14:00 to 18:00, and from 22:00 to 00:00 (mid-level prices)
- peak (*punta*) from 10:00 to 14:00 and from 18:00 to 22:00 (most expensive).

Better reflecting real-time costs could provide additional incentives for implicit demand response from household consumers.

Since 2024, the PVPC tariff has moreover progressively incorporated a share of forward market prices alongside the spot market, with the weight of futures increasing to around 55% by 2026. While this reform enhances price stability for small consumers, it reduces exposure to short-term wholesale market signals and weakens the influence of real-time system conditions on retail prices.

A further structural issue impacting demand-side response from households is the fact that a large share of Spanish small electricity consumers outside the PVPC tariff (which covered 28.5% of residential consumers at the end of 2024) is not exposed to dynamic price signals. These fixed-price retail contracts, as well as industrial consumption through hedged supply arrangements and corporate PPAs significantly dampen or eliminate intraday incentives.

As reflected in Spain's NECP, strengthening demand response frameworks will be important for translating price signals into dispatchable flexibility and for broadening participation across households and businesses. More sophisticated and widely applied dynamic tariffs that more closely reflect actual system conditions could function as a key driver.

Enabling aggregation is also important. Many households, SMEs and industrial users lack the scale or capability to participate directly in flexibility or balancing markets. A clear and stable framework for independent aggregators would allow flexible loads, such as EV charging, heat pumps, industrial processes and behind-the-meter storage, to be pooled and offered as reliable, dispatchable resources. Aggregated demand response can provide fast, cost-effective flexibility that complements supply-side solutions and reduces the need for network reinforcements or peaking capacity.

Spain has begun to move in this direction. In November 2025, the CNMC revised the *Servicio de Respuesta Activa de la Demanda* (Active Demand Response Service) to align it more closely with standard balancing products, shorten contract durations and open participation to smaller consumers through aggregation. The Service is now explicitly positioned as a non-fossil flexibility mechanism aimed at addressing shortages in balancing capability. While it remains the main operational demand-side flexibility instrument, its current scale is limited and activation is still largely driven by system security considerations rather than price-based optimisation, which is where significant untapped potential remains.

Interconnections

Despite being physically linked to France, Portugal, Andorra and Morocco, Spain's electricity system remains one of the least interconnected in the European Union relative to generation capacity. Its interconnection level with the rest of continental Europe is only around 2% of installed generation capacity, well below the EU targets of 10% by 2025 and 15% by 2030.

The exchange capacity between Spain and France currently stands at 2.8 GW. This is mainly provided through the Santa Llogaia-Baixas HVDC link, which entered operation in 2015, in addition to several smaller interconnectors across the Pyrenees. Meanwhile, Spain's interconnections with Portugal are increasing. In July 2026, Spain and Portugal commissioned a new 400-kV interconnection between Galicia and northern Portugal, increasing bilateral exchange capacity by around 1 GW to 4.2 GW from Spain to Portugal, and 3.5 GW in the other direction.

Utilisation of Spain-France interconnections is high: REE reports that it was congested during around 68% of hours in the day-ahead market in 2024, indicating persistent scarcity of cross-border capacity and strong price-convergence pressure. In contrast, the Spain-Portugal interconnection, which underpins the Iberian Electricity Market (MIBEL), is less structurally constrained: congestion affected only around 7% of hours in 2024, reflecting a higher degree of internal Iberian integration and more balanced generation profiles.

Spain also maintains Europe's only electricity interconnections with Africa, through two 400-kV submarine cables linking Spain and Morocco with a total technical capacity of 1.4 GW. These links played a tangible security-of-supply role during the April 2025 Iberian blackout, when Morocco temporarily supplied up to 900 MW to support system restoration in Spain.

Spain's cross-border capacity provides important reserve back-up and support at times of system stress. Further strengthening such interconnections would allow it to better balance demand and supply and increase the utilisation of renewable generation during periods of surplus, thereby improving overall system efficiency. Recognising this potential, the country is advancing a set of initiatives to address its interconnection deficit. The most advanced is the Bay of Biscay subsea interconnection with France, which is supported by EUR 1.6 billion from the European Investment Bank and aims to increase transfer capacity between the two countries to around 5 GW. Construction on the Spanish side started in 2025, though delays are contributing to large cost overruns and risk undermining plans to complete the project by the end of the decade. REE has also expanded the allocation and monetisation of existing cross-border capacity through annual long-term transmission rights auctions with France and Portugal.

Looking further ahead, Spain's draft 2025-2030 transmission network development plan proposes almost EUR 2 billion for cross-border interconnections, signalling sustained political and financial commitment to deeper regional integration. At

EU level, Spain and France remain engaged in the High-Level Group on Interconnections for South-West Europe, which monitors progress on priority projects and seeks to overcome persistent bottlenecks to Iberia-EU connectivity. Spain is also exploring potential electricity links with Italy. Several long-distance subsea interconnector projects have been proposed to establish a direct electricity connection between the Iberian Peninsula and northern Italy – most notably the privately-promoted Apollo Link and IberiaLink. These projects, which are currently at the study and early-development stage, are included in European planning frameworks such as ENTSO-E's Ten-Year Network Development Plan. Beyond its immediate neighbours, Spain has entered into discussions with Ireland on a potential long-distance electricity interconnector. In April 2026, the two countries signed a memorandum of understanding to explore the feasibility of a future subsea cable, marking an initial step towards assessing its technical, economic and regulatory viability.

Stability, governance and delivery

Rapid changes in generation technologies, operating patterns and risk exposure require a renewed approach to system governance that matches the pace and complexity of the energy transition. The Iberian blackout of 28 April 2025 demonstrated that Spain's system required closer supervision of the fulfilment of obligations by all stakeholders. It also showed that Spain could benefit from updated grid codes as well as institutional arrangements to increase and improve the resources available to contribute to system stability in a more efficient manner.

Subsequent investigations by the Spanish government, the CNMC and a European Expert Panel comprised of over 40 experts from ENTSO-E members and national regulators converged on a multifactor diagnosis that centred on voltage and stability management during off-peak periods. According to the official reports, the event was triggered by a combination of oscillations, insufficient voltage and reactive power control capabilities in the system at the time of the blackout, as well as cascading generator disconnections that rapidly escalated into a system-wide collapse. This sequence highlighted structural gaps in real-time monitoring, co-ordination across system actors and compliance with operational requirements.

Following the blackout, additional measures to strengthen grid supervision, operational rules and stability services have reinforced the institutional tools available to manage a rapidly transforming electricity system. Spain has also taken targeted technical measures to address voltage and inertia management at system stress points, including in island systems and near interconnectors. The government has

prioritised measures to strengthen system stability, combining synchronous solutions with grid-forming and other power-electronics-based technologies to dampen oscillations, raise fault levels and absorb reactive power during low-demand periods. In this context, the Council of Ministers approved an amendment to the 2021-2026 Transmission Plan that focuses on system resilience and control stability and allocates an additional EUR 750 million to grid operability measures.

One of the actions included in the Plan is the installation of eight synchronous compensators on the mainland and additional units in the island systems. A further amendment proposed to the Transmission Plan in May 2026 was to incorporate 4 e-STATCOMS to contribute to oscillation damping, 8 Magnetically Controlled Shunt Reactors to aid dynamic voltage control, and 20 conventional shunt reactors to contribute to static voltage control. According to the government, the investment for these changes is expected to be EUR 600 million, while they would provide annual savings of around EUR 400 million, due to reduced programming of gas-fired units.

At the regulatory level, reforms have aimed to correct gaps in the provision of stability services. As discussed earlier, recent legislation introduced structural reforms to grid access, storage integration and system flexibility. In parallel, the CNMC revised Operating Procedure 7.4, which had been adopted two decades earlier under a very different demand-supply paradigm. The update established a framework for the provision of voltage control services, enabling inverter-based asynchronous resources to actively contribute to voltage management through power electronics – functions that previously were largely provided by synchronous generation.

Complementary measures have further strengthened the oversight of voltage control obligations through enhanced regulatory supervision by the CNMC, including periodic monitoring of compliance, as well as reinforced verification mechanisms. These include inspections of system restoration capabilities, tighter monitoring of real-time system performance, and clearer allocation of responsibilities between TSOs, DSOs and generators. Effective stability and resilience will depend on consistent implementation of these measures and priorities across institutions, sustained regulatory clarity, and continuous co-ordination between long-term planning and short-term operational decisions.

Recommendations

8 Rebalance the renewables portfolio by deploying more wind, hybrid and storage technologies to increase system value, while addressing permitting and social acceptance challenges

By strengthening the role of low-cost domestic generation, the rapid expansion of solar PV has created important benefits for Spain's electricity security, affordability and decarbonisation. However, it has also resulted in a structurally imbalanced renewables portfolio that is increasingly exposed to the declining capture prices that characterise solar-dominated systems. If not addressed, these trends could weaken project economics, slow capacity additions beyond the near term, and put additional pressure on Spain's target of reaching 81% renewable electricity generation by 2030.

Spain needs a policy shift towards a more diversified and system-oriented framework. Greater priority should be given to wind, hybrid and storage technologies, alongside measures to increase electrification of demand. This should be reflected in upcoming grid capacity tenders, future auction design and broader market arrangements. Well-designed support mechanisms could help steer investment towards projects that deliver the most benefits to the system. In this context, and considering planned increases in demand, Spain could introduce a dedicated competitive auction to award contracts for difference (CfDs) specifically for hybrid projects that combine wind, solar and storage. This would improve both project bankability and system value.

Measures adopted in 2025 and 2026 to accelerate permitting, support repowering, promote flexibility and remove barriers to co-located renewable generation and storage are moves in the right direction. The priority now is to ensure that these reforms translate into faster project delivery, clearer grid-access procedures and stronger co-ordination across permitting authorities. This will be particularly important for wind, storage and hybrid projects, which often face longer development timelines, more complex permitting requirements and greater social acceptance challenges than solar PV.

Spain should continue implementing all of the ambitious measures contained in Royal Decree-Law 7/2026. This includes the designation and active roll-out of renewable

acceleration areas, the digital permitting platform to improve co-ordination across authorities, streamlined judicial and administrative timelines, and the promotion of concrete measures to facilitate wind repowering and hybrid projects, including the hybridisation of projects with battery storage. These efforts should be underpinned by full implementation of the EU Renewable Energy Directive III, including the principle that renewable energy projects can be considered of overriding public interest. At the same time, stronger local value-sharing and community-ownership mechanisms would help reinforce public acceptance of, and secure the social licence needed for, the next phase of investment in renewables and flexibility.

9 Increase electricity system flexibility through accelerated storage deployment, greater demand side response and interconnections

Spain should continue to incentivise system-friendly deployment of storage, including grid-scale batteries and co-located and hybrid projects with renewables, in order to reduce congestion, increase the system value of renewable generation and enhance electricity security. This requires the full and effective implementation of recent policy measures, including the flexibility framework and network access reforms introduced under Royal Decree-Law 7/2026.

Spain could draw on international experience from other countries facing similar system flexibility needs. One example is Australia, where battery energy storage systems – especially those with grid-forming capacities – have expanded rapidly amid targeted government incentives and system-service procurement. Spain should also ensure that storage resources are fully recognised and remunerated through its capacity market, as envisioned under the government's initiative. This would reflect their contribution to adequacy, system reliability and peak capacity, and provide long-term investment signals.

Spain could also build on its strong self-consumption framework by taking inspiration from Australia's Cheaper Home Batteries Programme. Such an approach would be consistent with the country's ongoing efforts to modernise its approach, including recent regulatory proposals aimed at facilitating the integration of distributed battery storage. A clear, nationwide and easily accessible support scheme for residential batteries that offers predictable, upfront incentives would help mobilise household-level flexibility and complement large-scale storage investments. This would

strengthen system resilience and improve peak demand management while increasing consumer participation in the energy transition.

In order to unlock demand-side response across industry, buildings and transport, Spain should improve network tariff design by ensuring that grid charges better reflect system conditions. Further, it should improve dynamic pricing mechanisms, strengthen the role of independent aggregators and adjust regulatory frameworks to enable participation across sectors while lowering administrative barriers. Other countries with high shares of VRE in their electricity mix have taken strides in this direction. For example, Norway allows retail tariffs to reflect hourly market outcomes, unlocking the flexibility potential of demand response.

Interconnectors can also play a significant role in supporting flexible power system operations, in addition to being sources of resilience. Spain should continue efforts to strengthen existing interconnections and develop new projects where there is a business case, deepening regional integration to support balancing, security of supply and cost-effective decarbonisation. The focus should be on the most mature and near-term viable further interconnections beyond those currently under construction. Maturity and deliverability should be the decisive criteria.

10 Reinforce grid security and resilience by strengthening governance across power system actors, implementing enhanced operational procedures and aligning regulatory frameworks with evolving system needs

Spain should continue to strengthen governance, oversight and enforcement across all power system actors, including transmission and distribution network operators, generators and market participants. This should include the consistent implementation and enforcement of network codes, a strengthened role for the system operator in system stability, and enhanced co-ordination mechanisms during normal operations as well as emergency conditions. Regulatory authorities should further increase their in-house technical expertise in order to effectively oversee evolving system needs and technologies and grid use, while enabling cost-effective investments.

Tightening voltage regulation and minimum technical requirements for grid connections will be essential for ensuring that resources contribute appropriately to voltage and frequency control, particularly in the case of converter-based generation

and storage. This includes updating grid codes to reflect system conditions under high renewable penetration rates and in view of the future integration of large loads. It will also be important to ensure compliance across both existing and new assets. Spain's ongoing regulatory reforms aimed at adapting technical requirements to the needs of an increasingly decarbonised and renewables-based power system have already made important steps in this direction.

Finally, the government should continue to monitor network planning implementation and deployment of targeted investment in grid stability technologies, such as synchronous condensers and advanced power electronics, where system studies identify local or regional stability constraints. A good example of this is the modification of current planning that is being carried out to accelerate the introduction of these types of devices. Strategic deployment of these assets can help maintain inertia, fault current and system strength as conventional synchronous generation is retired. At the same time, investments for resilience and stability measures should go hand in hand with rigorous cost benefit analysis to ensure that investments are proportionate, efficient and targeted to identified risks. Transparent evaluation frameworks can help manage impacts on electricity consumers and industry while safeguarding system reliability and public confidence.

Annexes

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Abbreviations and acronyms

BEV	battery electric vehicle
BTM	behind the meter
CAE	Energy Saving Certificate (*Certificado de Ahorro Energético*)
CCfD	carbon contract for difference
CCGT	combined-cycle gas turbine
CDTI	Centre for Technological Development and Innovation
CfD	contract for difference
CNMC	National Commission on Markets and Competition
CSN	Nuclear Safety Council (*Consejo de Seguridad Nuclear*)
CORES	Corporation of Strategic Reserves of Oil Products

DHC	district heating and cooling
DSO	distribution system operator
EEA	European Environment Agency
EED	Energy Efficiency Directive
EIB	European Investment Bank
ENTSO-E	European Network of Transmission System Operators for Electricity
EPBD	Energy Performance of Buildings Directive
EPC	energy performance certificate
ESR	Effort Sharing Regulation
ETS	Emissions Trading System
FCPJ	Fund for the Promotion of Industrial Decarbonisation
FTM	front of the meter
GRWP	General Radioactive Waste Plan
HEFA	hydroprocessed esters and fatty acids
ICO	Instituto de Crédito Oficial
IDAE	Institute for Energy Diversification and Saving
IEE	special tax on electricity (*Impuesto Especial sobre la Electricidad*)
ILUC	indirect land use change
IPCEI	Important Projects of Common European Interest
IVPEE	tax on the value of electricity production
JTI	Just Transition Institute (*Instituto para la Transición Justa*)
LEZ	low-emission zone
LNG	liquefied natural gas
LTO	long-term operation
LTS	Long-Term Decarbonisation Strategy
LULUCF	Land Use, Land-Use Change and Forestry
MIBEL	Iberian electricity market
MITECO	Ministry for the Ecological Transition and the Demographic Challenge
NBRP	National Building Renovation Plan
NDC	nationally determined contribution
NECP	National Energy and Climate Plan
NEEF	National Energy Efficiency Fund
NGEU	Next Generation EU
NRRP	National Recovery and Resilience Plan
NSEP	National Strategy against Energy Poverty
OMIE	Spanish electricity market operator
OMIP	Iberian derivatives market operator
OSS	one-stop shop

PERTE	Strategic Projects for Economic Recovery and Transformation
PNACC	National Plan for Adaptation to Climate Change
PPA	power purchase agreement
PVPC	voluntary price for the small consumer
RD&D	research, development and demonstration
RED	Renewable Energy Directive
REE	Red Eléctrica de España
RES	renewable energy sources
RFNBO	renewable fuels of non-biological origin
RIPREE	registry of publicly accessible recharging points
RITE	Regulation on Thermal Installations in Buildings
RRF	Recovery and Resilience Facility
SAF	sustainable aviation fuel
SEPE	Public State Employment Service
SGV	management and visualisation system
SME	small and medium-sized enterprise
TBC	Technical Building Code (*Código Técnico de la Edificación*)
UNFCCC	United Nations Framework Convention on Climate Change
VAT	value-added tax

Units of measurement

g CO_2	gramme of carbon dioxide
GJ	gigajoule
GW	gigawatt
GWh	gigawatt hour
km	kilometre
ktoe	thousand tonnes of oil equivalent
kV	kilovolt
kW	kilowatt
kWh	kilowatt hour
MJ	megajoule
Mt CO_2-eq	million tonnes of carbon dioxide equivalent
Mtoe	million tonnes of oil equivalent
MW	megawatt
MWh	megawatt hour
PJ	petajoule
TWh	terawatt hour

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

Infographic note

Emission reduction: Emissions from electricity and heat generation are reallocated to end-use sectors according to their consumption.

Infographic sources

Power sector decarbonisation: IEA (2026), World Energy Balances.

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

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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 Spain and the IEA. It draws on the IEA's extensive knowledge and the inputs of expert peers from IEA Member countries to assess Spain'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 Spain'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.