International Energy Agency
Secure Sustainable Together

Energy Policies of IEA Countries

Portugal

2016 Review

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INTERNATIONAL ENERGY AGENCY

The International Energy Agency (IEA), an autonomous agency, was established in November 1974. Its primary mandate was – and is – two-fold: to promote energy security amongst its member countries through collective response to physical disruptions in oil supply, and provide authoritative research and analysis on ways to ensure reliable, affordable and clean energy for its 29 member countries and beyond. The IEA carries out a comprehensive programme of energy co-operation among its member countries, each of which is obliged to hold oil stocks equivalent to 90 days of its net imports. The Agency's aims include the following objectives:

- Secure member countries' access to reliable and ample supplies of all forms of energy; in particular, through maintaining effective emergency response capabilities in case of oil supply disruptions.
- Promote sustainable energy policies that spur economic growth and environmental protection in a global context – particularly in terms of reducing greenhouse-gas emissions that contribute to climate change.
- Improve transparency of international markets through collection and analysis of energy data.
- Support global collaboration on energy technology to secure future energy supplies and mitigate their environmental impact, including through improved energy efficiency and development and deployment of low-carbon technologies.
- Find solutions to global energy challenges through engagement and dialogue with non-member countries, industry, international organisations and other stakeholders.

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Netherlands
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The European Commission also participates in the work of the IEA.

International Energy Agency
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International Energy Agency
9 rue de la Fédération
75739 Paris Cedex 15, France

www.iea.org

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1. EXECUTIVE SUMMARY AND KEY RECOMMENDATIONS

EXECUTIVE SUMMARY

Despite the difficult economic climate, Portugal has continued to develop and reform its energy policy with undoubted benefits over the period since the previous in-depth review in 2008. These benefits include greater economic activity in the energy sector, rapid increases in renewable energy deployment, further market liberalisation in the electricity and natural gas sectors, and greater emphasis on energy efficiency in policy making. Significant changes in the Portuguese and European macroeconomic environment, such as declining energy consumption and funding constraints, resulted in a proposal to integrate the National Energy Efficiency Action Plan (NEEAP) and the National Renewable Energy Action Plan (NREAP). The outcome of this process was a new energy strategy, based on Cabinet Resolution 20/2013, of 10 April. This strategy allowed a concerted action for the accomplishment of national and European energy objectives, lower investment costs and greater national competitiveness. The new strategy also included proposals to reinforce interconnections with the European electricity and natural gas networks, and measures to promote economic and environmental sustainability.

The new NEEAP raised energy efficiency to a policy priority while ensuring continuity of the majority of measures contained in the 2008 Action Plan. The revised plan established new energy savings targets of a 25% reduction of primary energy consumption nationally and a 30% reduction of energy consumption in the state-owned sector to be reached by 2020. The renewable energy sources (RES) target remained 31% of RES in total gross final energy consumption. This will come from a 59.6% contribution of renewables to electricity demand, a 35.9% contribution to heating and cooling and an 11.3% contribution from the transport sector.

Furthermore, in order to help achieve policy coherence, the government also brought together energy, environment and spatial planning under the responsibility of a single minister. The concentration of these responsibilities within one ministry − the Ministry for Environment, Spatial Planning and Energy − supports the development and implementation of energy policy. Within this ministry, the Directorate-General for Energy and Geology (DGEG) is responsible for co-ordinating energy policies, including the implementation of the new NEEAP and NREAP. It monitors energy savings as well as target-setting and planning new actions. Various state organisations and regional delegations/agencies for energy implement policy actions on a practical level.

Regular monitoring and verification of the resources used to achieve energy savings are needed to ensure transparent and cost-effective implementation of the action plans. Task-sharing and co-ordination between government bodies should be clear to ensure full and effective monitoring of energy efficiency results and to obtain the necessary data. Monitoring the implementation of the energy strategy will present a challenge for government and consideration should be given to the establishment of a mechanism to review, evaluate and monitor the implementation of all phases of the strategy and ensure the cost-effective delivery of outcomes. This evaluation process should be independent and include publication of regular performance reports.

Over the period since the previous in-depth review, Portugal has continued to experience growth in the RES sector and its contribution to total gross final energy consumption in 2013 was 25.7%. In the electricity sector, RES accounted for 63% of installed generating capacity in 2014, providing a 61.3% contribution to final electricity supply. The increase in renewable energy penetration has produced multiple benefits such as less dependence on imported fossil fuels and declining carbon dioxide emissions in the electricity sector. Renewable electricity generation with priority despatch has reduced wholesale electricity market prices by displacing the most expensive fossil fuel-fired generation. A progressive arrangement for renewable electricity micro- and mini-generation has been introduced with simplified online licensing arrangements. Conversely, the costs of supporting RES have been costly and made a significant contribution to the tariff deficit. In recent years, rising subsidies to renewable energy have contributed to higher electricity costs and, as a result, growth in the tariff debt. Negotiated reforms of the electricity feed-in tariff regime to address these high costs included reduced feed-in tariff rates and an extension to the period over which renewable generators receive a subsidy.

Portugal should be commended for its achievements and its ambitions in the large-scale deployment of renewable energy. Nonetheless, its focus on growth in renewable electricity brings with it some risks. While negotiated reform of the feed-in tariff arrangements and the introduction of competitive tendering to support future renewable electricity generation have reduced the risk of further increases in the electricity tariff deficit, Portugal remains exposed to a further reduction in electricity demand. Any reduction could both depress market prices, thus increasing the incremental cost of feed in-tariffs and reduce the electricity supply volume on which the deficit must be levied leading to significant upward pressure on electricity prices. The future additional contribution of renewable energy to the tariff deficit may be most effectively controlled by careful management of the schedule for small-scale hydropower and wind power capacity additions and, if necessary, rescheduling project execution.

Portugal has also shown significant commitment to addressing the challenge of climate change and has adopted an ambitious 20% greenhouse gas (GHG) reduction target compared to a 1% increase permitted under the EU-Effort Sharing Decision. The National Low Carbon Roadmap (RNBC) includes a set of road maps for achieving long-term cost-effective GHG emissions reductions. The Green Growth Commitment and the Strategic Framework for Climate Policy (including a new National Climate Change programme and a new National Climate Change Adaptation Strategy) provide a solid basis to build on previous efforts. Portugal has also introduced a carbon tax in the non-traded sector in the context of a broader-scope green fiscal reform in place from 2015. A general carbon tax is an effective measure that provides incentives to find the least-cost ways to reduce emissions among sectors.

The country, which is projected to experience temperature increases and less precipitation, is vulnerable to climate change impacts. In response, it has adopted a National Climate Change Adaptation Strategy (ENAAC) which aims to improve the level of awareness and knowledge on climate change, supports the implementation of adaptation measures and promotes the mainstreaming of climate adaptation in sector-specific policies. It is important that major vulnerabilities in the energy system to climate change be identified and that studies to evaluate the possible expansion of the system in terms of its resilience be conducted and acted upon.

NATURAL GAS AND ELECTRICITY MARKETS

In many aspects the natural gas market in Portugal has made good progress since the publication of the previous in-depth review in 2009. The network operator, REN Gasodutos, has been fully unbundled, privatised and certified as transmission system operator (TSO) by ERSE, the energy regulator. Competition has started to emerge in the retail sector and there have been many infrastructural improvements, which have strengthened the network and delivered greater security of supply. Transmission infrastructure has undergone a number of significant investments since 2008: storage capacity at the Sines liquefied natural gas (LNG) terminal has increased with the addition of a third tank; three new underground storage facilities entered in operation and the project for the third interconnection between Portugal and Spain was identified as a project of common interest (PCI) by the European Commission and was recently awarded funds from the European Commission's Connecting Europe Facility (CEF) to support technical and environmental studies. Further infrastructure additions are planned including a new compressor station and new pipelines for the national network. While there is merit in expanding export capacity to Spain, the opportunity to take commercial advantage of the interconnection will be limited until such time as further connections are built to link the Iberian Peninsula with the European market as well as the creation of an Iberian natural gas market. Accordingly, additions to the transmission network, including storage facilities, should not proceed unless they are necessary to safeguard security of natural gas supply.

The successful implementation of the Iberian Electricity Market (MIBEL) and its success indicates the need for an Iberian Natural Gas Market (MIBGAS). Despite this, progress on its development has been very slow since 2008. A regional natural gas market will offer greater energy security, a more liquid wholesale market and allow market participants access to a greater number of supply options. The Portuguese government and the sector regulator, ERSE, alongside their counterparts in Madrid must build on the consultation process that started in 2014 and develop a credible timetable for implementation of the new gas market.

In the electricity sector, the market operator (the Iberian Energy Derivatives Exchange or OMIP) now offers a mature range of services including forward prices up to three years ahead and financial transmission rights for cross-border power flows. Spain and Portugal have been making good progress towards the 2020 target of 3.0 gigawatts (GW) of interconnection capacity with a price convergence 85% of the time. In 2014, progress was made on the provision of balancing services with France. This is an encouraging move towards a wider European approach to the provision of market services.

The TSO has successfully undertaken an extensive investment programme to support the growth in renewables; at the same time as it improved its service quality. This has been mirrored at distribution level. Portugal has strengthened many of the building blocks which have allowed it to undertake the impressive increase in renewable electricity generation.

Market liberalisation has continued since the last review. To date, competition for customers has seen large numbers of them move onto commercial offerings and a range of players now offer competitive services. Transitional end-user tariffs set by the regulator for both electricity and gas were scheduled to end on 31 December 2015 but this date has been postponed to 31 December 2017. The proposed expansion of vulnerable customers receiving a 34% discount to 20% of the household market needs to be carefully considered. It is not clear that there are stringent criteria to target assistance to those in genuine need. The socialisation of this cost onto energy companies (and eventually onto customers) is inefficient. The government should fund such assistance directly so as to ensure that support is effectively targeted.

REDUCING THE TARIFF DEFICIT

An electricity tariff deficit emerges when there is a shortfall of revenues in the electricity system because retail tariffs are set below their costs, including subsidies to renewables. Following the economic crisis, Portugal was left with a substantial tariff deficit: the total accumulated tariff debt was estimated by the regulator at EUR 4.69 billion (3.1% of GDP) at the end of 2014. EDP Serviço Universal, as the last-resort supplier of energy, is responsible for paying the electricity producers under special regime (renewable and co-generation) and it is entitled to recover the corresponding amount.

Portugal's plan to address the tariff deficit was the outcome of a negotiation process with industry stakeholders. It includes revising special tariffs on new renewable contracts, and phasing out end-user regulated tariffs (recently extended to 2017). The objective is to eliminate the tariff debt by 2020. A first package of measures, introduced in 2012, focused on feed-in tariffs in wind-power generation and small hydro, on feed-in tariffs and conditions for co-generation and on revision of investment incentives for hydropower (power guarantee) and renegotiation of specific elements of the guaranteed compensation mechanism (CMEC scheme/methodology). A second package of measures was introduced in 2013 and a third package in 2014. These were aimed at tackling remaining excess rents in the energy sector, improving competitiveness of the sector and achieving a more balanced distribution of the economic surplus between different stakeholders.

The European Commission has indicated that eliminating the tariff debt by 2020 presents Portugal with a significant challenge. This has been further complicated by the decision to extend the phasing-out of regulated tariffs until the end of 2017. It is therefore essential that the Portuguese authorities ensure swift implementation of all reform proposals and continue their efforts to identify further potential cost-saving measures in the energy sector.

INTERNATIONAL INTERCONNECTIONS

The Iberian electricity system remains an island with interconnection with France being only 1.5% of total capacity. This is very low by European standards and, if not addressed, could have important implications. Efficiency gains in the electricity sector could help to reduce prices, and could be achieved by improving international interconnection capacity. While the electricity markets of Portugal and Spain are increasingly well connected in a common Iberian electricity market (MIBEL), better connections from Spain to France, and onward to other European countries, could allow more competition and facilitate grid management. Increasing interconnection is also central to support Portugal's renewables aspirations. Interconnection with Europe offers potentially more cost-effective options to manage system constraints and also a wider market for Portugal's renewable potential. The recent European Union decision to target a minimum of 10% interconnection capacity as a share of total generating capacity by 2020 and 15% by 2030 is an important one. In the current circumstances, there are concerns that Iberian electricity consumers could be unable to benefit from the advantages of a fully-integrated European electricity market (OECD, 2014).

After many years of limited results, it is highly encouraging to see recent positive developments and the strong political support for further developing interconnections between the Iberian Peninsula and France. The planning and construction of new interconnections should be vigorously pursued and EU funding sources used to the full. Portugal should continue its close engagement with neighbouring states and the European Commission to expedite delivery of interconnection, facilitating an Iberian contribution to least-cost delivery of the 2030 aggregate EU renewable energy target.

In the natural gas sector, the Iberian Peninsula is also considered isolated, but Portugal and Spain are striving to improve interconnection between the two countries, and between the region and France, in order to envisage Iberia becoming an important entry point into Europe (for both pipeline gas and LNG). The third interconnection between Portugal and Spain and the MIDCAT project (the natural gas interconnection between Spain and France) have already been identified as projects of common interest by the European Commission. This identification reveals the recognition of the importance of this project for the construction of a true European internal energy market. Furthermore, to promote electricity and natural gas interconnections, the Madrid Declaration at the Madrid Summit in March 2015 signed by the heads of state of Portugal, Spain and France, and by the President of the European Commission, with the support of the European Investment Bank, represents an important progress. A High-Level Group for South-West Europe was also established to focus on interconnections and the technical and political issues associated to the interconnection projects.

KEY RECOMMENDATIONS

The government of Portugal should:

- ☐ *Continue to implement measures to ensure that there is sufficient flexibility in energy policy to deal with uncertainty in demand growth and wider policy development at the EU level. This policy process should accommodate regular independent reviews and the development of a monitoring tool to examine implementation of energy policy and ensures that it continues to remain relevant and cost-effective.*
- ☐ *Ensure implementation of all measures to reduce the tariff deficit and continue its efforts to identify further potential cost-saving measures in the energy sector. In this regard, careful consideration needs to be given to the decision to extend regulated tariffs to 2017.*
- ☐ *Alongside its regional partner Spain and the European Commission, pursue the development of key transmission infrastructure, including interconnections with neighbouring countries, notably France, in order to foster market integration, facilitate renewable energy integration and enhance security of supply (electricity and natural gas).*

Reference

OECD (2014), OECD *Economic Survey: Portugal*, OECD Publishing, Paris.

PART I
POLICY ANALYSIS

Figure 2.1 Map of Portugal

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

2. GENERAL ENERGY POLICY

Key data (2014 estimated)

Energy production: 5.6 Mtoe (biofuels and waste 52.2%, hydro 23.9%, wind 18.5%, geothermal 3.1%, solar 2.3%), +44.4% since 2004

TPES: 21.1 Mtoe (oil 45.1%, natural gas 16.4%, coal 12.7%, biofuels and waste 12.6%, hydro 6.4%, wind 4.9%, geothermal 0.8%, solar 0.6%, net electricity imports 0.4%), -18.3% since 2004

TPES per capita: 2.0 toe (IEA average: 4.4 toe)

TPES per GDP: 0.09 toe/USD 1 000 PPP (IEA average: 0.13 toe/USD 1 000 PPP)

Electricity generation: 52 TWh (hydro 30%, wind 23.3%, coal 23%, natural gas 12.5%, biofuels and waste 6.4%, oil 3.2%, and solar 1.2%, geothermal 0.4%), +16.1% since 2004

Electricity and heat generation per capita: 5.6 MWh (IEA average: 9.9 MWh)

COUNTRY OVERVIEW

Portugal is geographically situated on the west coast of continental Europe, in the Iberian Peninsula. It borders Spain to the north and east, and the Atlantic Ocean to the west and south. Major population centres include Lisbon, the capital city, Porto, Braga and Coimbra. In addition to the continental territory, Portugal includes the two autonomous regions located in the Atlantic Ocean, the islands of the Azores located to the west and Madeira to the southwest. On the continental territory, the river Tagus divides the more mountainous north from the plains of the south.

Portugal is a parliamentary republic, based on the constitution of 1976, most recently amended in 2005. The national legislature is the unicameral National Assembly (parliament) of 230 members, who are elected by universal suffrage for a term of four years. The Assembly of the Republic has responsibilities at political, legislative and fiscal levels. The most recent parliamentary election was held in October 2015. The prime minister, who presides over Cabinet meetings, is nominated by the president, the supreme representative of the Portuguese Republic.

Portugal covers a total area of 92 212 square kilometres and is home to 10.39 million people. In the past, Portugal benefited from a fortuitous location, being situated in a geo-strategic position between Europe, America and Africa. The climate is marked by mild winters and balmy warm summers. The wettest months are November and December, and the driest periods typically occur between April and September.

THE ECONOMY

Portugal has made significant reform progress in the context of a deep economic crisis, which paved the way towards exiting the European Union (EU)/International Monetary

Fund (IMF) Economic and Financial Assistance Programme in June 2014. Following many years of a credit-fuelled expansion of the non-tradable sector and declining export performance, the global financial crisis triggered a severe recession, leading to high unemployment and public debt. The government has been implementing a wide-ranging structural reform agenda, which is helping to rebalance the economy towards the export sector. This work is still in progress, however (OECD, 2014).

Public and private debt is high, translating into high external debt. Unemployment is falling, but it is still too high, and is a factor creating inequality and poverty. The recovery strengthened somewhat in 2015 on the back of strong external demand, a weaker euro and lower oil prices. After having contracted for three years, domestic demand has started to rise, and business investment is projected to pick up further in 2016. However, considerable economic slack will remain, as the unemployment rate will continue to fall only moderately (OECD, 2015).

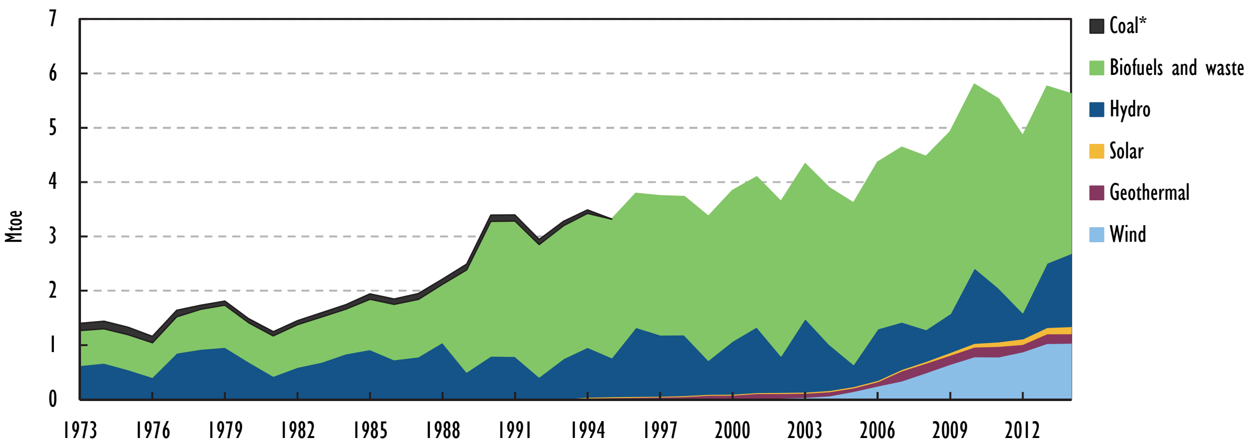
SUPPLY AND DEMAND

SUPPLY

Portugal produced 5.6 million tonnes of oil-equivalent (Mtoe) of energy in 2014. Energy is produced from renewables, which makes total production volatile year on year (Figure 2.2). Production averaged 5.0 Mtoe over the ten years to 2014.

In 2014, energy was produced from biofuels and waste (52.2%), hydro (23.9%), wind (18.5%), geothermal (3.1%) and solar (2.3%). Portugal has no fossil fuel production (including coal, oil and natural gas). Wind, solar, geothermal, and biofuels and waste increased at an annualised rate of 31%, 20%, 8.4% and 0.2%, respectively during 2013-14. Hydro production is volatile year on year, and was 4.7% higher in 2014 than in 2004. The boom of wind and solar power has been the main driver in growing energy production in Portugal. In 2014, total production was 44.4% higher than in 2004.

Figure 2.2 Energy production by source, 1973-2014



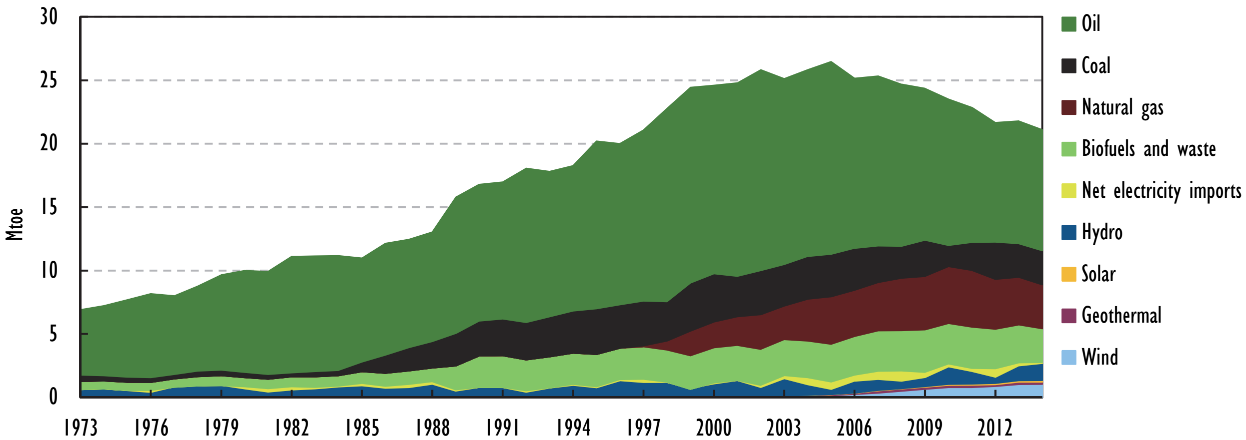
Note: estimated for 2014.

* Coal production ceased in 1994.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Portugal's total primary energy supply (TPES) was 21.1 Mtoe in 2014.[1] It was 18.3% lower, to 25.1 Mtoe, in 2003 with a peak of 26.5 Mtoe in 2005 (Figure 2.3). The Portuguese government projects that demand will return in the coming years and TPES will be 13.5% higher in 2020 than in 2014.

Figure 2.3 TPES, 1973-2014



Note: estimated for 2014.

* Negligible.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

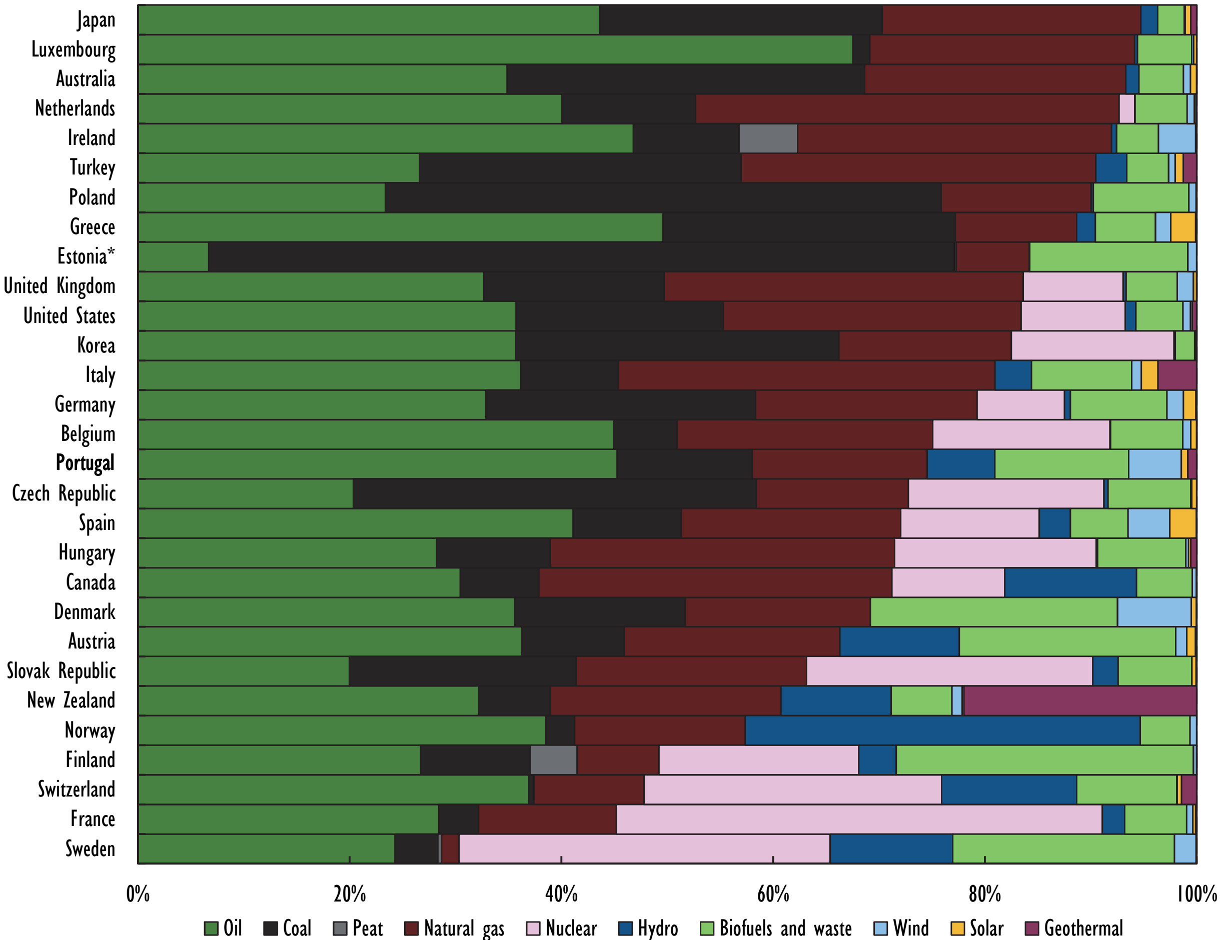
Fossil fuels accounted for 74.3% of TPES in 2014, including oil (45.1%), natural gas (16.4%) and coal (12.7%). Renewables accounted for 25.4%, including biofuels and waste 12.6%, hydro 6.4%, wind 4.9%, geothermal 0.8% and solar 0.6%.The remaining 0.4% was accounted for by net electricity imports. In the ten years to 2014, the use of oil and coal has contracted by 35.3% and 20.4%, while natural gas supply grew by 5%. Gas supply boomed in the ten years to 2010 when it peaked at 4.5 Mtoe (120% higher than in 2000). The boom in wind power has led to an increase in its share in TPES, up from less than 0.1% in 2004 to 4.9% in 2014.

Portugal relies on imports of fossil fuels for most of its energy needs as domestic energy production accounts for around 27% of TPES. During 2014, Portugal imported 15.2 Mtoe of crude oil and oil products and exported 4.6 Mtoe. Net imports of oil and oil products have declined by 32.7% compared to 2004. Natural gas imports amounted to 3.5 Mtoe in 2014 which is 5.1% higher than in 2004. Coal imports were 2.6 Mtoe, down from 3.2 Mtoe ten years earlier.

Portugal's fossil fuel share in TPES is at a median level among IEA member countries, between Belgium and the Czech Republic (Figure 2.4). Wind power share in TPES is the second-highest, behind Denmark. Geothermal power share in TPES is the fifth-highest, behind New Zealand, Italy, Turkey and Switzerland. The oil share is the fourth-highest behind Luxembourg, Greece and Ireland.

1. TPES is the sum of production plus imports, less exports, less international marine bunkers, less international aviation bunkers, plus/minus stock changes. This equals the total supply of energy that is consumed domestically, either in transformation (for example refining) or in final use.

Figure 2.4 Breakdown of TPES in IEA member countries, 2014



* Estonia's coal represents oil shale.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

DEMAND

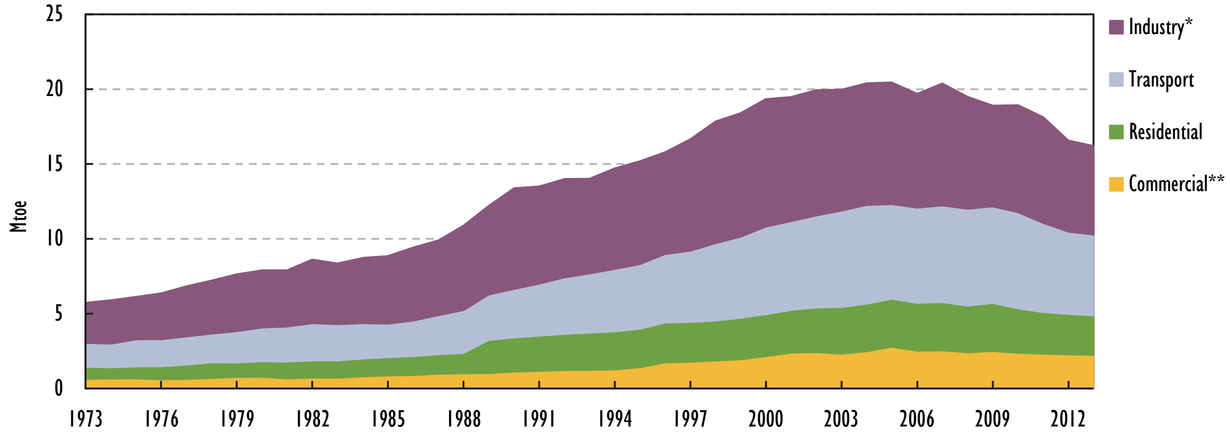
Portugal's total final consumption (TFC) amounted to 16.2 Mtoe in 2013 (the latest data available for sector-specific demand). TFC represents around 75% of TPES, with the remainder used in power generation and other energy industries.[2] TFC has declined by 18.9% from 2003 to 2013, peaking at 20.5 Mtoe in 2005 (Figure 2.5).

Industry and transport are the largest consuming sectors with 36.7% and 33.3% of TFC in 2013, respectively. The residential sector represented 16.3% while the commercial and other services sector (including agriculture and fisheries) had the smallest share of 13.7%.

Over the decade to 2013, the industry sector cut consumption by 26.7%, with its share in TFC falling from 40.6% in 2003. Transport demand declined by 16.2% over the same period, albeit its share in TFC increased from 32.3% in 2003. The residential and commercial sectors decreased consumption by 15.3% and 3.5%, respectively.

2. TFC is the final consumption by end-users, i.e. in the form of electricity, heat, gas, oil products, etc. TFC excludes fuels used in electricity and heat generation and other energy industries (transformations) such as refining.

Figure 2.5 TFC by sector, 1973-2013



* *Industry* includes non-energy use.

** *Commercial* includes commercial and public services, agriculture, fishing and forestry.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

INSTITUTIONS

The **Directorate-General for Energy and Geology** (DGEG) rests within the **Ministry for Environment, Spatial Planning and Energy** (MAOTE). It is responsible for the development and implementation of policies related to energy and geological resources within a framework of sustainability and security of energy supply. DGEG also provides support to government decision making during an energy crisis and/or emergency situations; and it supports the participation of MAOTE at European and international level.

The **National Laboratory for Energy and Geology** (LNEG) is the state laboratory overseen by MAOTE. It supports research and development (R&D) investments in sustainable research and its mission is to promote economic development, contributing to an increase in competitiveness and sustainable progress of the Portuguese economy.

The **Energy Services Regulatory Authority** (ERSE) is the national regulatory authority (NRA) for natural gas and electricity. It is a financially autonomous public corporate body whose purpose is to oversee the natural gas and electricity sectors. ERSE is independent in the exercise of its functions, within the framework of the law, and its mission includes, *inter alia*, protecting the rights and interests of consumers in relation to prices, quality of service, information access and security of supply.

The mission of the **Portuguese Competition Authority** (AdC), which was established in 2003, is to ensure compliance with competition rules. It also has regulatory powers on competition over all sectors of the economy, including the regulated energy sectors, the latter in co-ordination with the relevant sector regulators.

The **Portuguese Environmental Agency** (APA) is a public institute under the authority of MAOTE. Its mission is to propose, develop and monitor, in an integrated and participative manner, public policies for the environment and sustainable development, in close co-operation with other sectors' policies, and public and private entities. APA also manages the **Portuguese Carbon Fund** (FPC), a state-owned financial instrument that participates in carbon markets to ensure compliance with national targets on climate change.

The **National Authority for Fuel Market** (*Entidade Nacional para o Mercado de Combustíveis* or ENMC) is a public corporation under the supervision of both the Ministry of Finance and the ministry responsible for energy.[3] The latter minister has three main responsibilities: co-ordinating the allocation and sale of stocks during an energy supply crisis; authorising the sale of surplus reserves held by ENMC (should such an occasion arise); and approving the amounts market participants pay to support ENMC.

The **Agency for Energy** (ADENE), established in 1984 and previously designated as "Centre for Energy Conservation", is entrusted with a large number of public tasks regarding the energy efficiency sector and related areas, and is also a relevant interface with other sectors. ADENE co-ordinates the training of qualified experts related to the EU Directive on the Energy Performance of Buildings.

The **Portuguese Energy Association** (APE) is a non-profit, non-governmental public service institution, active in the energy and environment sectors. Its mission is to promote public debate on the development of the energy sector.

EnergyIN, the Competitiveness and Technology Cluster for Energy, is a non-profit association, founded by market participants and the MIT-Portugal Programme. Its role is to co-operate with the business and scientific communities to boost the competitiveness of the energy sector. The **Portuguese Association of Oil Companies** (APETRO) was founded in September 1992 and brings together the major oil companies operating in Portugal: BP, Cepsa, Repsol and Petrogal. Its mission is to foster the establishment and development of the right conditions to facilitate a responsible and profitable operation of the oil sector.

MAJOR POLICIES

Portugal has been developing, since 2008, an energy policy that places a strong emphasis on energy efficiency and on the promotion of renewable energies. These policies are the government's principal tools to tackle climate change and reduce energy import dependence, while maintaining appropriate levels of security of supply. More recently, Portugal adopted a series of measures focused on eliminating the "tariff deficit" and restoring the economic sustainability of the energy system. This was necessary in order to avoid unmanageable growth in costs while at the same time promoting greater competition and more efficient investment decisions.

The National Energy Strategy for 2020 (ENE 2020), which was approved by Cabinet Resolution 29/2010, of 15 April, was a continuation of the previous 2005 strategy (Cabinet Resolution 169/2005, of 24 October). Given the difficult economic circumstances Portugal was enduring, ENE 2020 was repealed by **Cabinet Resolution 20/2013**, which also approved the National Energy Efficiency Action Plan (NEEAP) for the period 2013-16 and the National Renewable Energy Action Plan (NREAP) for the period 2013-20.

NATIONAL RENEWABLE ENERGY ACTION PLAN AND NATIONAL ENERGY EFFICIENCY ACTION PLAN

Portugal submitted its first National Renewable Energy Action Plan (NREAP) to the European Commission in 2007. Following the approval of this plan, NREAP 2010, Portugal introduced a number of measures to promote renewable energies, in particular a pilot zone for wave technologies, solar energy technology demonstration projects, and

3. Previously known as *Entidade Gestora de Reservas Estratégicas de Produtos Petrolíferos*, the managing authority of petroleum products strategic reserves (EGREP) until 2013.

several photovoltaics (PV) power stations in the south of the country. It also developed two industrial wind energy clusters in the north. Furthermore, in June 2011, Portugal submitted its second National Energy Efficiency Action Plan (NEEAP) for European Commission approval.[4] Significant changes in the Portuguese and European macroeconomic environment (in particular declining energy consumption and funding constraints) and the need to review the NEEAP, imposed by the EU Energy Efficiency Directive, resulted in a review of energy efficiency and renewable energy programmes. The outcome of this review was the publication of an updated NEEAP and NREAP, which were introduced by **Cabinet Resolution 20/2013** of 10 April. This Cabinet Resolution approved the NEEAP for the period 2013-16 and the NREAP for the period 2013-20 and repealed the National Energy Strategy for 2020.

The integration of these two Action Plans, NEEAP and NREAP, allowed a concerted action for the accomplishment of the national and European energy objectives, minimising the investment costs and increasing national competitiveness. The revised objectives of both Action Plans are to:

- meet all the commitments assumed by Portugal with regard to its EU obligations
- reduce greenhouse gas (GHG) emissions
- reinforce the diversification of primary energy sources, contributing to increased security of energy supply
- increase the energy efficiency in the economy, in particular in public administration, contributing to a reduction in public expenditure
- contribute to national economic competitiveness by reducing energy consumption and import costs.

The NEEAP raised energy efficiency as a policy priority, taking into account that saving energy promoted environmental protection and energy security at reasonable cost. Also, it gave continuity to the majority of measures established in NEEAP 2007.

ELECTRICITY AND NATURAL GAS MARKETS

In October 2012, the general principles regarding the organisation and the functioning of the national electricity system (SEN) were amended (Decree-Law 215-A/2012 of 8 October) and the transposition of Directive 2009/72/EC of 13 July (establishing the common rules for the internal market in electricity) was concluded (Decree-Law 215-B/2012 of 8 October).

The general principles regarding the organisation and the functioning of the national natural gas system (SNGN) were amended in October 2012 and the transposition of Directive 2009/73/EC of 13 July (that establishes the common rules for the internal market in natural gas) was concluded (Decree-Law 230/2012 and Decree-Law 231/2012 of 26 October).

THE TARIFF DEFICIT

An electricity tariff deficit emerges when there is a shortfall of revenues in the electricity system. This happens when tariffs for the regulated components of the retail electricity price are set below the corresponding costs borne by the energy companies. Generally, regulated tariffs should be set at a level that sufficiently covers the relevant costs borne

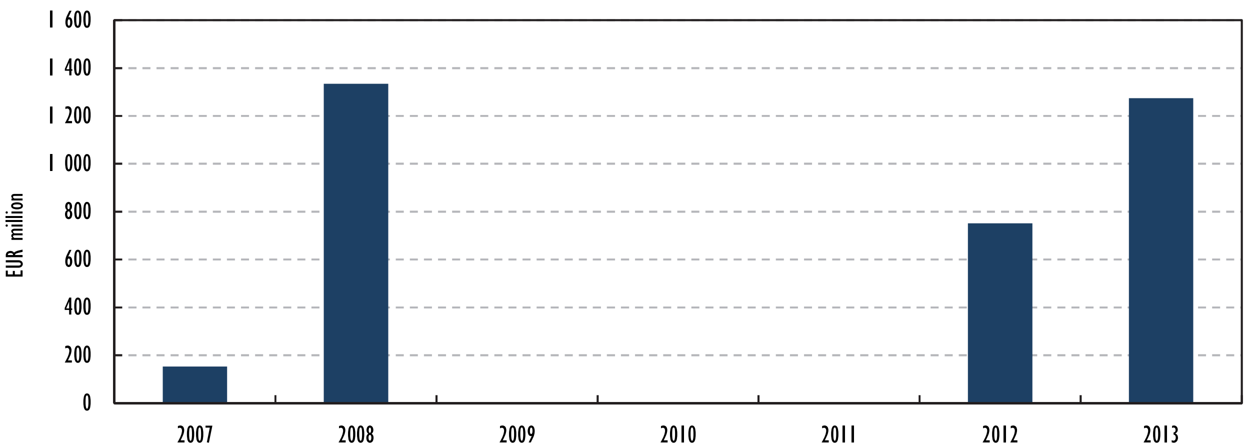
4. The first NEEAP was submitted to the EU in June 2007.

by electricity utilities. In some countries, however, the authorities consider it imprudent (usually for social reasons) to increase the regulated tariffs to a level that fully corresponds to quickly rising electricity costs. Within the European Union, Spain and Portugal have the highest tariff deficits. While the scope of the deficits differs in the two countries, both governments have formally recognised the right of the affected utilities to recover the appropriate amounts.

In the case of Portugal, the tariff debt is substantial: the total accumulated tariff debt was estimated by the regulator ERSE at EUR 4.69 billion (3.1% of GDP) at the end of 2014. The bulk of the Portuguese tariff deficit emerged in 2008, 2012 and 2013 (EU, 2014a). The tariff deficit was driven by several factors: in 2007 and 2008, the mismatch between the wholesale energy price and the price implied in the tariff was the major factor contributing to the deficit. Since 2009, wholesale electricity prices have returned to lower levels.

In recent years, falling demand, rising subsidies to renewable energy and legacy support to thermal electricity generation led to increasing electricity costs and, as a result, growth in the tariff debt. These subsidies include support under the special regime (to renewables and co-generation) and under the ordinary regime (such as power guarantee incentives and compensation for the early termination of former long-term power purchase agreements). Between 2009 and 2011, there was a large increase in renewable energy output leading to a corresponding increase in support costs. Surging renewable subsidies were a major factor in rising electricity costs, reflecting an increase in installed capacity. Between 2009 and 2011, support to renewable electricity increased from EUR 528 million to EUR 752 million, i.e. by 42% (CEER, 2013).

Figure 2.6 Evolution of the electricity tariff deficit in Portugal, 2007-13



Source: EU (2014a), *European Economy, Economic Papers 534, Electricity Tariff Deficit: Temporary or Permanent Problem in the EU?* European Commission, Directorate-General for Economic and Financial Affairs, Brussels.

The regulated tariffs will be eliminated by the end of 2017 and the regulator will continue to approve tariffs in the interim. Ordinance 97/2015 of 30 March, following Decree-Law 15/2015 of 30 January, postponed until 2017 the end of regulated electricity tariffs for low-voltage customers and the end of natural gas supply to customers with annual consumption less than or equal to 10 000 m^3. At the same time, vulnerable consumers (who represent a large portion of domestic consumers) will continue to pay a social tariff. Accordingly, there is a risk that the tariff debt may continue to grow should falling demand result in tariff revenues that do not match the corresponding costs.

The financial burden of the tariff deficit is carried by EDP the last resort supplier of energy. By law, it is entitled to recover the corresponding amount. Some of this debt was secured by EDP (Energias de Portugal) and is backed by payment rights repaid as a surcharge on electricity costs. In 2009, for example, EDP placed on the market EUR 1.7 billion bonds for tariff deficits from 2007 to 2009, and made subsequent placements in the following years including 2011 and 2014. These bond issues were priced at 100 to 150 basis points over the Portuguese government bonds. It is worth noting, however, that these bonds do not have an explicit guarantee of the state budget as can be the case in neighbouring Spain.

In recognition of the scale of the problems the tariff deficit was imposing on the sustainably of the Portuguese electricity sector and the economy, the government and regulator entered into negotiations with industry stakeholders. The outcome of this process was the introduction of a number of measures to reduce the liability over the next ten years. Accordingly, the regulator was required to establish regulations to ensure that the payment of the deficit was made to EDP on time and in full. Portugal's plan to address the tariff deficit includes revising special tariffs on new renewable contracts, and phasing out end-user regulated electricity tariffs by end-2017. These measures, among others, are expected to eventually lead to the elimination of the imbalances that led to the creation of the tariff deficit. These measures to address the electricity tariff deficit were included in the economic programme for Portugal (EU, 2014b). The objective is to eliminate the tariff debt by 2020. A first package of measures, introduced in 2012, focused on feed-in tariffs in wind-power generation and small hydro, on feed-in tariffs and conditions for co-generation, on revision of investment incentives for hydropower (power guarantee) and renegotiation of specific elements of the stranded cost compensation mechanism (CMEC) scheme. The savings associated with this first package of measures were projected to amount to EUR 2.1 billion.

A second package of measures was proposed in 2013, which, taken together with the first package, was projected to reduce the outstanding debt by 2020 to between EUR 0.6 billion to EUR 0.7 billion. This second package, amounting to an expected EUR 1.4 billion in savings, includes:

- a contribution on energy generators to address windfall profits resulting from regulatory changes in Spain
- technical changes to the *revisibilidade* calculation under the CMEC mechanism to correct certain distortions in the system services market
- regarding Sines and Pego coal power plants, a new contribution applicable for seven years upon the expiry of their current framework
- a modification of the remuneration regime for public domain hydro terrains
- revision of the tariff harmonisation mechanism applicable to Madeira and Azores autonomous regions.

Furthermore, a special levy on energy operators was established for 2014. However, this levy was motivated by state budget needs rather than cost inefficiencies in the system, and only one-third of the revenue (about EUR 50 million out of EUR 150 million) will be used to reduce the electricity tariff debt. The results of these measures have been mixed so far. In 2014, the European Commission argued that rent-reducing measures implemented to eliminate the tariff debt by 2020 and to ensure the sustainability of the system appear to be insufficient (EU, 2014c). The European Commission claimed that elimination of the tariff debt by 2020, however, would require real electricity price increases of close to 2.0% per year, half a percentage point above initial projections, which raised further concerns about the impact of the electricity tariff on competitiveness. Conversely, the IMF noted that having taken the measures highlighted above, the focus of the Portuguese government should now be on limiting energy price increases. In response, the government committed to presenting additional concrete measures to tackle remaining excess rents and to deliver cost reductions to be reflected in energy prices (IMF, 2014).

Subsequently, a third package of measures was introduced to tackle remaining excess rents in the energy sector, to improve competitiveness of the sector and to achieve a more balanced distribution of the economic surplus between different stakeholders. The package includes:

- extension of the 2014 special levy on energy operators to 2015 (although again with only a third of the proceeds allocated to the electricity system)
- amendments to widen the eligibility requirements and to increase the amount of the social tariff discount, which is applicable to electricity consumers below a certain income threshold and certain social security benefits
- amendment to the special levy on energy operators in order to include the long-term natural gas sale and purchase agreements (take-or-pay) of the national natural gas system
- initiatives to increase the transparency of fuel station and bottled liquefied petroleum gas (LPG) prices
- the establishment of an Iberian natural gas market (MIBGAS)
- reclassification of forest-clearing costs (for fire prevention purposes) in power line corridors, from a policy cost, which can be passed onto the system, to a regular activity cost, to be borne by the electricity transmission network concessionaire itself.

The first measure in the above list, the special levy extension, is expected to contribute another EUR 50 million to the tariff debt reduction effort for 2015 as well. The second and third measures are expected to have most impact in terms of cost-reduction potential (EU, 2014b). Once more, the European Commission found that, even with these additional proposed measures, eliminating the tariff debt by 2020 will remain a significant challenge. Nonetheless, in the case of take-or-pay, the measure has generated EUR 50 million in savings in 2015. It is therefore crucial that the Portuguese authorities ensure swift implementation of all outstanding reform proposals and continue their efforts to identify further potential cost-saving measures in the energy sector.

CROSS-BORDER INTERCONNECTIONS

In the Iberian Peninsula as a whole, the installed electricity capacity is 120 gigawatts (GW) of which interconnection with France represented only 1.2% in 2013, 2.4% in 2015 and will reach 4.1% in 2020, assuming that a new western undersea interconnection cable is built by 2020. Portugal is relatively well interconnected with Spain. Since 2014, the commercial interconnection capacity is 2 000 megawatts (MW), after the recent interconnection in the south between Algarve and Andalusia, equalling 11% of installed capacity in Portugal. Another 200 MW will be added before 2017 (in the north from Minho to Galicia), increasing the commercial capacity to 3 000 MW.

Interconnection with France, however, has long been a bottleneck for electricity exchanges between the Iberian Peninsula and the countries north of the Pyrenees. The NTC of 1.4 GW doubled in summer 2015 when the Santa to Llogaia-Baixas interconnection entered into commercial operation. The interconnection was inaugurated on 20 February 2015 by the Prime Ministers of Spain and France. The project, however, took 25 years to finish and cost more than initially expected, mainly because building the line over the Pyrenees raised strong local opposition on the French side. The project needed facilitation by the European Commission and had to be built completely underground.

On 4 March 2015, the Energy Interconnection Links Summit took place, where the Madrid Declaration was signed by Spain, Portugal, France and the European Commission (EC). The Madrid Declaration attaches critical importance to the attainment of a fully functioning and interconnected internal energy market, a fundamental dimension in building the European Energy Union. For the EU member states below the minimum level of physical market integration, such as Portugal and Spain, it is essential to build the necessary energy infrastructure to achieve an efficient internal energy market, in particular cross-border interconnections of the electricity and gas networks.

Financial support for fulfilling this obligation is available at European level, notably through the Connection Europe Facility, the Structural Funds, and the European Fund for Strategic Investment which has been recently presented by the EC and the European Investment Bank (EIB).

At the Madrid Summit, several new interconnections between Spain and France were considered. The Western Interconnection project, currently at the feasibility stage, would connect the two countries through an undersea cable in the Bay of Biscay. The main technical challenge for the 370 km of high-voltage direct current (HVDC) cable is the crossing of the Capbreton submarine canyon. The Western Interconnection would increase interconnection capacity from 2.8 GW to 5 GW for a cost of almost EUR 2.0 billion. It is included in the list of European energy infrastructure projects of common interest (PCIs).

The TSOs of France, Portugal and Spain have also prepared a “Common strategy paper for the development of interconnections of the Iberian Peninsula with the internal electricity market and beyond”, including two more projects to help increase the interconnection capacity between Spain and France: one between País Vasco or Navarra (Spain) and Cantegrit (France) and another one between Aragón (Spain) and Marsillón (France).

On this basis, and following the “Common strategy paper”, the TSOs have further assessed three projects that will be addressed in parallel in order to raise the cross-border capacity between Spain and France to 8 GW in 2020. All three projects were endorsed by France, Portugal, Spain and the European Commission on 4 March 2015 and are set to benefit from EU funding and EIB loans. The three countries and the EC also agreed to create a high-level group for South-West Europe on interconnections. The group will be set up by the European Commission to facilitate an agreement on the detailed routes of the interconnectors before the end of 2015 to expedite the construction of the lines by 2020. On this basis and in line with the studies carried out by the TSOs, the group will report to the President of France, the Prime Ministers of Spain and Portugal and the President of the European Commission. The aim is to ensure the most rapid early launch, possibly in 2016, of the administrative process for the permit granting, according to the trans-European energy infrastructure regulation (TEN-E, 347/2013).

The new cross-border lines would require network reinforcement both in Spain and in France for accommodating stronger power flows. This is especially true for south-west France where the transmission network is relatively weak. As previously agreed by the European Council, the European Commission will report regularly to the European Council with the objective of reaching a 10% interconnection target by 2030 as proposed by the Commission.

In the natural gas market, the project for a third interconnection between Portugal and Spain was identified as a project of common interest (PCI) by the European Commission. While there is merit in expanding export capacity to Spain, the opportunity to take commercial advantage of the interconnection will be limited until such time as further connections are built to link the Iberian Peninsula with the European market. In June 2015, this project was awarded funds for technical and environmental studies from the Connecting Europe Facility (CEF).[5]

The MIDCAT project, a natural gas connection between France and Spain east of the Pyrenees, was included in the European Commission's list of PCIs. It is also considered a key element of regional security of supply in the 2014 European Energy Security Strategy Communication. It will therefore be eligible for EU funding, including from the sizable structural funds. The development of MIDCAT and the third interconnection between Portugal and Spain were agreed upon by the Prime Ministers of France, Portugal and Spain and the President of the European Commission at the Madrid Summit on 4 March 2015.

ENERGY SECURITY

OIL

With very limited indigenous oil production, Portugal is almost fully dependent on imports. In 2014, the country had well-diversified crude oil supply sources: Angola was the largest source of oil imports (24.2% of total crude oil import), followed by Russia (11.5%), Saudi Arabia (11.4%), Algeria (8.6%), Nigeria (8.4%), Azerbaijan (7.4%) and others.

Portugal meets its stockholding obligation to the IEA and the European Union by holding stocks and placing a minimum stockholding obligation on industry. Oil industry operators hold two-thirds of the EU obligation (i.e. 60 days of consumption), while the stockholding agency ENMC (*Entidade Nacional para o Mercado de Combustiveis*), the National Authority for Fuel Markets is obliged to hold the remaining one-third of the EU obligation and to meet the difference between total EU and IEA stock obligations. Operators and ENMC are also required to hold reserves of 20 and 10 days of liquefied petroleum gas (LPG), respectively. Small operators may delegate their obligation to ENMC under certain conditions.

Portugal held 20.1 million barrels (mb) of oil stocks (7.1 mb of agency stocks and 13 mb of industry stocks) at the end of March 2015. Most stocks were in the form of middle distillates (35% of total) and crude oil (30%). In terms of number of days, Portugal held 94 days of net imports according to IEA methodology. The use of stocks held by ENMC and by industry is central to Portugal's emergency response policy. The country has a

5. The Connecting Europe Facility is a European Commission measure to support trans-European networks and infrastructures in the sectors of transport, telecommunications and energy.

well-defined stock release procedure for public stocks stored in the country. DGEG is the core body of the Portuguese National Emergency Strategy Organisation (NESO).

NATURAL GAS

Mandatory gas reserves must be provided by market suppliers, i.e. market participants who import gas. The minimum quantity of stocks of natural gas needs to be more than 30 days of exceptionally high gas demand (one day in 20) to ensure the consumption by protected consumers and to meet the consumption of non-interruptible power plants.

Release of compulsory gas stocks is decided by the minister responsible for energy. No automatic triggers exist under the current relevant laws. The drawdown capacity of the underground storage facilities in Carriço is 7.14 million cubic metres per day (mcm/d), while the nominal drawdown capacity of LNG storage plants in Sines terminal is 32.4 mcm/d compared to a maximum daily peak of 14.72 mcm/d.

ELECTRICITY

Portugal's electricity portfolio is well diversified with an emphasis on renewables. Similar to other systems with high penetration of renewable energy sources, there is more installed capacity than is needed and there is ample available reserve provided that the resource is available. Thermal flexibility and water reserves are also a fundamental tool for a secure system. The Iberian Electricity Market (MIBEL) makes it easier to share the available power and decreases the probability of energy shortages. The Spanish and Portuguese TSOs have bilateral agreements for mutual support in emergencies.

There is an adequate interconnection capacity with Spain and network bottlenecks are not expected in emergency situations. The system possesses enough resources to meet N-1 events at all times.[6] The TSO can make use of "interruptible contracts" in emergency situations; Portugal has never activated them in the last 15 years.

ENERGY TAXATION

Retail sale prices of unleaded gasoline and diesel fuels were liberalised in January 2004 and the maximum price regime was abolished. Excise duties, however, continue to be determined on an annual basis by government.

DGEG monitors the price of all energy products and makes them available on its website. In 2008, it created a website specifically for the purpose of providing consumers with accurate retail fuel prices.[7] Electricity and natural gas prices are determined annually by ERSE and once a year, disaggregated price data (energy and supply, network cost, taxes and levies) are gathered.

6. A criterion for network planning is the (n-1) criterion, related to the loss of single line, transformer or generator. With one branch or generator out of operation, thermal over-loadings of branches, voltage declination below permitted range, loss of stability, loss of load and interruption of power transits must not appear.

7. www.precoscombustiveis.dgeg.pt.

ASSESSMENT

Portugal has formulated a range of progressive policies in the period since the last review was conducted in 2008, notwithstanding the severity of the economic crisis that has affected the country during the period.

In particular, it set out a National Energy Strategy for 2020 (ENE 2020) in 2010, which was based on a focused set of five priorities: setting an agenda for competitiveness, growth, energy and financial independence; support for renewable energy; promotion of energy efficiency; guaranteeing security of energy supply; and sustaining the strategy by promoting economic and environmental sustainability.

More recently, taking into account the macroeconomic environment, Cabinet Resolution 20/2013 approved a revised NEEAP for the period 2013-16 and a new NREAP for 2013-20, and repealed ENE 2020. These integrated plans aim to: meet all Portugal's EU commitments; reduce GHG emissions; reinforce energy diversification to increase energy security; increase energy efficiency, in particular in public administration; and contribute to economic competitiveness, in particular by reducing energy costs. In order to help achieve policy coherence, the government also brought together energy, climate change and spatial planning under the responsibility of a single minister. The concentration of the three roles within one ministry represents good progress and supports the implementation of energy policy. Notably, it may deliver potentially positive impacts by strengthening spatial planning policy for both renewable energy and energy efficiency.

There have been undoubted benefits from the energy reforms undertaken since the last in-depth review was published. These include greater economic activity in the energy sector; rapid increases in renewables deployment; market liberalisation for electricity and natural gas at retail level; new entry into the markets; and greater emphasis on energy efficiency in policy making.

Portugal has demonstrated significant commitment to addressing the challenge of climate change and has adopted ambitious targets for: the reduction by 25% of primary energy consumption of 25% by 2020, including a 30% reduction by public administration compared to projected demand. In the recently concluded negotiations on 2030 EU targets in the European Energy Council in October 2014, Portugal proposed more ambitious targets than those eventually adopted, including for renewables, energy efficiency and interconnections.

Renewable energies in Portugal have advanced at an impressive pace since 1990. Wind energy, which has been the key technology driver behind this growth, has increased by 52% per year compared to 28% in OECD Europe. Portugal's policy direction has been strongly oriented towards its ambition to become a major player in the application of renewable energies, especially in sectors such as wind power. Establishing a green industrial base, however, requires careful management to ensure that it does not impose unnecessary costs on consumers and undermine the economy's competitiveness. Portugal has successfully created a wind turbine industry that has now become an exporting sector.

Conversely, the costs of supporting RES have contributed to the tariff deficit and negotiated reforms of the electricity feed-in tariff regime to address this deficit involved reduced feed-in tariff rates and extension to tariff periods. The extended tariff periods are appropriate in terms of plants' operational life but an increasing maintenance cost for a wind generation plant towards the end of its life.

Portugal should be commended for its achievements and its ambitions in large-scale deployment of renewable energy. Nonetheless, its focus on growth in renewable electricity brings with it some risks. While negotiated reform of the feed-in tariff arrangements and the introduction of competitive tendering to support future renewable electricity generation have reduced the risk of increases in the electricity tariff deficit, Portugal remains exposed to further reductions in electricity demand. Any reduction could both depress market prices, thus increasing the incremental cost of feed-in tariffs, and reduce the electricity supply volume on which the deficit must be levied, leading to significant upward pressure on electricity prices. The future additional contribution of renewable energy to the tariff deficit may be most effectively controlled by careful management of the schedule for small-scale hydropower and wind power capacity additions and, if necessary, rescheduling project execution.

Creating single markets in electricity and natural gas has long been a priority for the European Union. At the present time, however, the Iberian Peninsula remains an energy island and increasing international interconnection across the Pyrenees to accommodate renewables efficiently has become a regional energy policy priority. The region has ample wind and solar resources, but it is located far from the large consumption centres in Europe. Wind and solar generation profiles can be complementary as different regions have different wind patterns, and statistical aggregation of wind and solar over large geographical areas can reduce forecasting errors. Market integration over large geographical areas and expansions in transmission capacity will enable variable renewable energy to help reduce CO_2 emissions at least cost.

For obvious reasons, physical cross-border capacity in electricity and natural gas is essential not only for market integration but also for renewable energy integration and strengthening security of supply. New momentum for additional interconnections is evident: the October 2014 European Council agreed on a target of a 10% share of electricity interconnection capacity in total installed generating capacity in every member country by 2020. Furthermore, this target is to be raised to 15% by 2030. European Union funds are available for priority projects, and the political leaders of France, Portugal and Spain are committed to this objective. After many years of limited results, it is highly encouraging to see the recent positive developments and the strong political support for further developing interconnections between the Iberian Peninsula and France. In the natural gas market, greater interconnection capacity between the region and France can lead to a closer a price convergence that can benefit both Spain and Portugal under current price trends. Accordingly, the IEA welcomes the recent decision to expand interconnection capacity between the region and France, notably the MIDCAT project. The planning and construction of new electricity and natural gas interconnections should be vigorously pursued and EU funding sources used to the full.

Beyond physical interconnections, cross-border market integration with the rest of Europe has significantly improved over the past few years. Since May 2014, the Iberian market area is coupled with other European market areas, allowing for an optimal utilisation of interconnections. Integrating the intraday and balancing markets closely with the rest of Europe would ensure a more efficient use of existing interconnections.

An economic policy priority for Portugal has been the need to address the substantial tariff debt it has accumulated in recent years. In 2014, this deficit, which arose from a significant mismatch between the end-user prices and costs, was estimated to be as high as EUR 4.69 billion, as tariffs charged to consumers were kept below market costs including renewable energy subsidies for a number of years.

The government has developed, and started to implement, a series of measures that it believes will lead to the elimination of the tariff debt by 2020. These include the reduction of remuneration of large power plants under power purchase agreements (PPAs) and a power guarantee mechanism; the adjustment of the combined heat and power (CHP) remuneration scheme; measures to improve the wholesale market and correct distortions in the ancillary services market. Other measures not yet implemented have also been agreed. While this suite of actions is welcome, and will lead to greater sustainability for the energy system, it will be important to closely monitor their effectiveness to ensure the objective is fully met. For example, one measure involves the allocation of 80% of the revenues from the sale of CO_2 emission allowances to the tariff system, which is subject to carbon price market outcomes. Management of the deficit requires careful planning, monitoring and adjustment to ensure that the deficit does not increase further and to manage the impact of factors such as new capacity additions and lower than anticipated demand.

End-user electricity prices in Portugal are high, partly as a result of the high tariffs still being paid to producers under legacy agreements. Over each of the next eight years, electricity prices are set to rise by an additional 1.5% to 2% in real terms. In addition to the impact on consumers, this will also have significant costs in terms of competitiveness, particularly for electricity-intensive industrial consumers, and represents a further policy challenge for the government. While many of the energy package measures undertaken are aimed at reducing prices for consumers and other users, it should also be noted that recent price rises have taken place against a background of falling electricity demand, partly as a result of lower economic activity and improved energy efficiency.

In present economic circumstances and taking into account uncertainty about future energy demand, a cautious policy approach that provides sufficient flexibility to adjust to changing circumstances is required. Further investments in energy and transmission infrastructure over and above those required to meet EU targets and energy security needs may well be less effective in boosting sustainable national competitiveness than measures aimed at further liberalisation of the energy market and increasing competition at the wholesale and retail levels alongside greater measures to promote energy efficiency.

Portugal was expected to complete the liberalisation process in the retail markets for natural gas and electricity by the end of 2015. Instead, with the introduction of Decree-Law No. 15/2015 of 30 January, and Ordinance No. 97/2015 of 30 March, the process has been further pushed to 31 December 2017. At present, large numbers of customers in both markets are supplied on regulated tariffs. The market is further complicated by the presence of special tariffs for vulnerable customers. The government, with the support of the regulator, needs to prepare a clear vision for the operation of the market during this period, including measures to move customers away from regulated tariffs. Measures also need to be taken to reduce the market share of incumbents and to support market entry.

RECOMMENDATIONS

The government of Portugal should:

- ☐ *Continue to build on its existing energy policy to ensure that there is sufficient flexibility in its overall approach to deal with uncertainty in demand growth and wider policy development at the EU level. This process should include:*

- *The preparation of an annual energy policy statement, a monitoring tool which examines implementation of energy policy and ensures that it continues to remain relevant and cost-effective.*
- *The development of energy plans and scenarios to 2030 and beyond to ensure long-term visibility. This should be done in close consultation with stakeholders, to further improve public awareness and understanding of energy realities, including liberalisation and market reform, energy security and costs.*

☐ *Ensure that sufficient resources are available to implement a complex energy policy agenda. This should include capability to monitor and evaluate policies and programmes, an investment in regulatory capacity to make sure the energy sector is cost-effective, and improve the country's long-term economic competitiveness.*

☐ *Complete the process of liberalisation in the natural gas and electricity markets, and in particular take steps to promote new entry, reduce market concentration, support the development of new interconnections between the Iberian Peninsula and Europe, for the benefit of final consumers.*

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3. CLIMATE CHANGE

Key data (2013)

GHG emissions without LULUCF* (2012): 68.9 $MtCO_2$-eq, +13.1% since 1990

GHG emissions with LULUFC* (2012): 58.2 $MtCO_2$-eq, +-4.5% since 1990

Target 2008-12: +27% from 1990 (actual: +19% from 1990)

CO_2 emissions from fuel combustion: 44.9 $MtCO_2$, +18.6% since 1990

CO_2 emissions by fuel: oil 55.5%, coal 23.4%, natural gas 19.3%, other 1.8%

CO_2 emissions by sector: power generation 35.2%, transport 34.7%, industry 12%, other energy industries 9.3%, commercial and other services 4.5%, residential 4.4%

* Source: United Nations Framework Convention on Climate Change, 2015

TARGETS AND OBJECTIVES

According to the United Nations Framework Convention on Climate Change (UNFCCC, 2015), the average of 2008-12 GHG emission without land use, land-use change and forestry (LULUCF) was 72.4 million tonnes of carbon dioxide-equivalent ($MtCO_2$-eq), which is 19% higher than 60.9 $MtCO_2$-eq in 1990.

The average of 2008-12 GHG emissions with LULUCF was 58.2 $MtCO_2$-eq which is 2.7% lower than 60.9 $MtCO_2$-eq in 1990.

ENERGY-RELATED CO_2 EMISSIONS

EMISSION TYPES

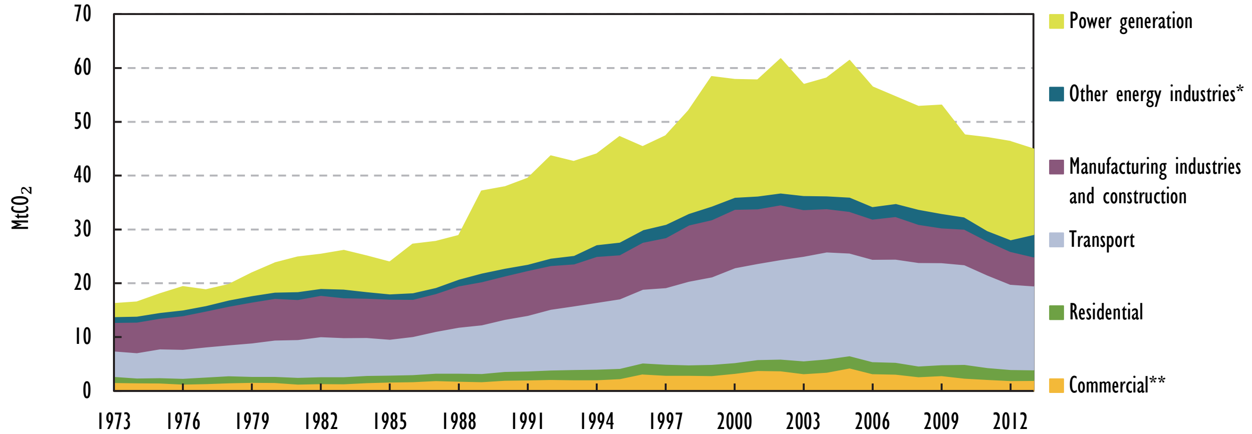
According to the UNFCCC (2015), the main greenhouse gas (GHG) in Portugal in 2012 was carbon dioxide (CO_2), accounting for 73.2% of total GHG emissions, followed by methane (CH_4) at 17.8% and by nitrous oxide (N_2O) at 6.5%. Hydrofluorocarbons (HFCs) and sulphur hexafluoride (SF6) collectively accounted for 2.5% of the overall GHG emissions in the country.

UNFCCC data show that Portugal's energy sector accounted for 69.6% of total GHG emissions, followed by the waste sector (11.9%), agriculture (10.5%), industrial processes (7.7%) and solvents (0.3%).

SOURCES OF CO_2 EMISSIONS

CO_2 emissions from fuel combustion were 44.9 Mt in 2013, which is 18.6% higher than in 1990 yet 26.8% lower than in 2005. Emissions peaked at 61.4 million tonnes (Mt) in 2005. The decline in emissions since 2005 is to the result of a surge in wind power generation as well as a reduction in economic activity. The sharpest decline in emissions was 10.4% in 2009 during the economic recession (Figure 3.1).

Figure 3.1 CO_2 emissions by sector, 1973-2013



* *Other energy industries* includes other transformations and energy own-use.

** *Commercial* includes commercial and public services, agriculture/forestry and fishing.

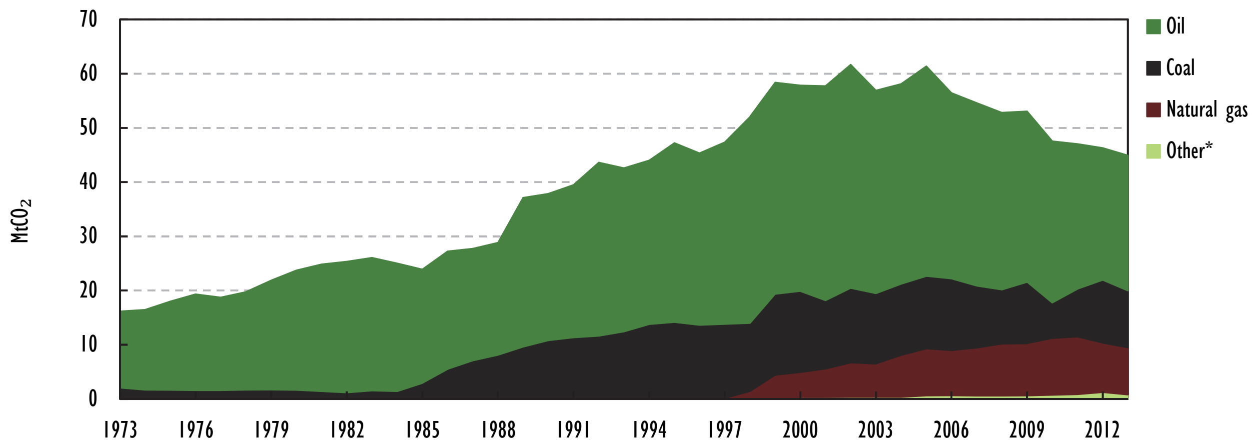
Source: IEA (2015a), *CO_2 Emissions from Fuel Combustion 2015*, www.iea.org/statistics/.

The power generation sector is the largest CO_2 emitter in Portugal with 15.8 $MtCO_2$ in 2013 or 35.2% of the total. Transport and industry (manufacturing and construction) accounted for a further 34.7% and 12%, respectively. Commercial and public services and the residential sector accounted for around 4.4% each. Emissions from other energy industries (the refining sector) nearly doubled in 2013, owing to higher refinery output, increasing its share in total emissions from 4.7% in 2012 to 9.3% in 2013.

Since 1990, emissions have increased in all sectors aside from industry and commercial and public services. Over the 23 years, refining, transport and households have increased emissions by 191%, 60.9% and 8.5%, respectively. Emissions from the power generation sector were 5.1% higher than in 1990. Industry and the commercial sector emitted 33.2% and 1.1% less, respectively.

Commercial services, the power generation sector and industry have reduced their emissions significantly since the peak in 2005. The three sectors emitted 53.6%, 37.5% and 30.4% less in 2013 than in 2005, respectively. Transport and households reduced emissions by 18.2% and 13.6% over the same period, however in the refining sector emissions, while volatile year on year, were 56.3% higher in 2013 than in 2005.

Figure 3.2 CO_2 emissions by fuel, 1973-2013



* *Other* includes industrial waste and non-renewable municipal waste.

Source: IEA (2015a), *CO_2 Emissions from Fuel Combustion 2015*, www.iea.org/statistics/.

Oil and oil products accounted for 55.5% of energy-related CO_2 emissions in Portugal in 2013, followed by coal at 23.4%, natural gas at 19.3% and industrial and non-renewable municipal waste at 1.7% (Figure 3.2).

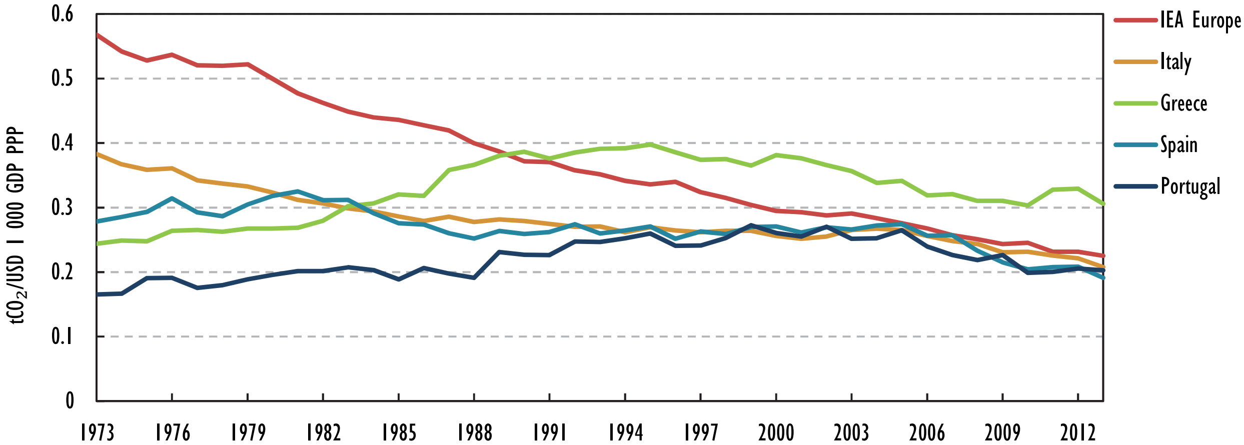
Over the period 1990-2013, emissions from oil and coal use have declined by 7.9% and 2.7%, respectively, while Portugal began consuming natural gas and waste in the late 1990s. Compared to the peak in 2005, the sharpest decline in emissions has been from oil (35.6%) and coal (21.5%), while emissions from natural gas contracted by a marginal 0.2%. Emissions from waste were 31.5% higher. These trends are in line with the decline in the use of oil and coal in industry and power generation.

CARBON INTENSITY

Carbon intensity, measured as CO_2 emissions by real gross domestic product adjusted for purchasing power parity (GDP PPP), amounted to 0.2 tonnes of CO_2 per USD 1 000 PPP (tCO_2/USD 1 000 PPP) in Portugal in 2013.

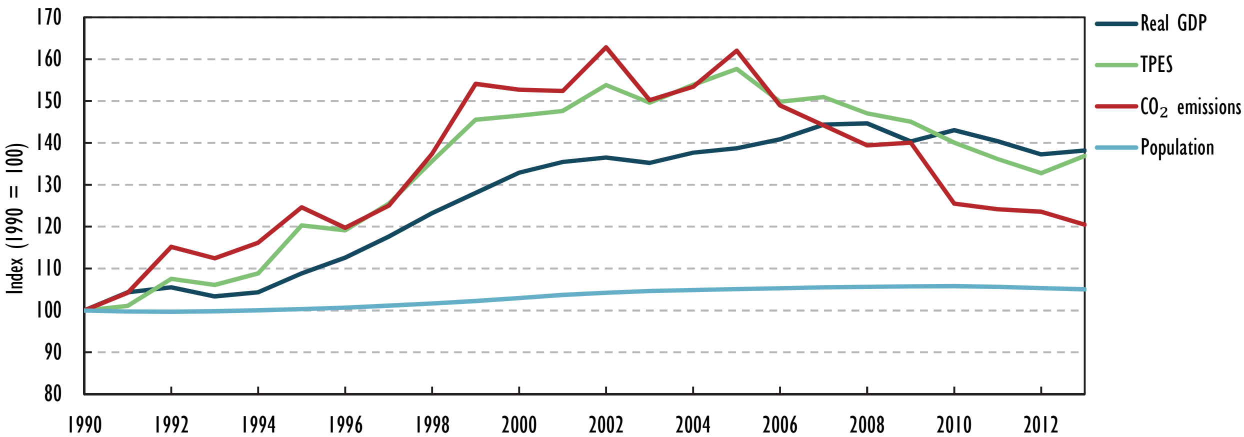
This is less than the IEA average of 0.3 tCO_2/USD 1 000 PPP and lower than the IEA Europe average of 0.23 tCO_2/USD 1 000 PPP.

Figure 3.3 Energy-related CO_2 emissions per unit of GDP in Portugal and in other selected IEA member countries, 1973-2013



Source: IEA (2015a), *CO_2 Emissions from Fuel Combustion 2015*, www.iea.org/statistics/.

Figure 3.4 CO_2 emissions and main drivers in Portugal, 1990-2013



Sources: IEA (2015a), *CO_2 Emissions from Fuel Combustion 2015*, www.iea.org/statistics/; IEA (2015b), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Portugal's carbon intensity was 10.6% lower in 2013 than in 1990, although it was the same in 2007 as in 1990. Carbon intensity was at 0.26 tCO_2/USD 1 000 PPP in 2005 and has declined since. The fall in intensity since 2005 has been driven mainly by uncoupling energy supply and emissions, through a surge in renewable energy sources (mainly wind) and a reduction in the use of oil and coal in industry and power generation (Figure 3.4).

INSTITUTIONS

The government of Portugal designated the **Ministry for Environment, Spatial Planning and Energy** (MAOTE) as the ministry responsible for climate policy and for achieving a competitive, resilient and low-carbon economy. The **Climate Change Committee** (CAC), an inter-ministerial body, was created in 1998 in order to integrate environmental issues with government policy. The CAC prepared the first National Strategy on Climate Change and its implementation document, the National Climate Change Programme (PNAC), in 2001. Under the programme of rationalisation and structural reform carried out under the Reduction Plan and Improving Central Administration (PREMAC), which aimed to promote the increase of efficiency and reduce costs in response to the economic crisis, the CAC and the **Executive Committee of the Climate Change Commission** (CECAC) were abolished and their activities and competences integrated into the new **Portuguese Environmental Agency** (APA). With the recently adopted Strategic Framework for Climate Change Policy (QEPiC), a new inter-ministerial body − the Inter-ministerial Commission for Air and Climate Change (CIAAC) − was established.

The **Portuguese Environmental Agency** (APA), which falls within the scope of MAOTE, was established to propose, develop and monitor, on an integrated and participative manner, public policies for the environment and sustainable development, in close co-operation with other sector policies and public and private entities. The APA also manages the **Portuguese Carbon Fund** (FPC), which aims to support the transition to a resilient, competitive and low-carbon economy by financing or co-financing measures that contribute to the fulfilment of the commitments by the Portuguese State under the Kyoto Protocol and other international and EU commitments on climate change. The financing of the Fund was in the past ensured by a combination of funds from the central budget and its own revenues. At present, the FPC only has its own income, including revenues earned from the collection of taxes on heating oil, diesel oil and low-efficiency light bulbs. It also earns revenues from auctioning allowances under the EU-ETS (industrial installations and aviation operators) which currently constitutes its main revenue source.

POLICIES AND MEASURES

Portugal's GHG targets (including for the second Kyoto commitment period) are derived from the European Union's 2020 targets. As a result of the effort sharing of the Union's GHG target of -20% from 2005 to 2020, Portugal will have to limit the growth of emissions from the sectors outside the European Union Emissions Trading Scheme (EU-ETS) to 1.0% above its 2005 levels by 2020. For this, it can use international flexibility mechanisms to cover an amount equalling 4% of the non-ETS sector emissions in 2005 (with 1% deriving from projects in least developed countries and small-island developing states). The ETS sector in the European Union as a whole will have to cut emissions by 21% from 2005 to 2020. For the first Kyoto commitment period (2008-12), Portugal's target was +27% from the base year (1995 for F-gases, 1990 for the other gases).

In preparation for COP21 in Paris in December 2015, participating countries agreed to publicly outline what post-2020 climate actions they intend to take under the international agreement, known as their Intended Nationally Determined Contributions (INDCs). The EU and its Member States, including Portugal, are committed to a binding target of at least a 40% domestic reduction in greenhouse gas emissions by 2030 compared to 1990, to be fulfilled jointly. Emissions reductions below 2005 levels would be 43% in the EU-ETS sector and 30% in the non-ETS sector. The level of effort to be made by each member state to achieve this EU target has not yet been decided. Importantly, however, the plan is to meet the target with EU measures alone, without any contribution from international credits. This would arguably increase compliance costs above today's levels. By 2050, the European Union is aiming to reduce GHG emissions by 80% to 95% below their level in 1990.

EUROPEAN UNION EMISSIONS TRADING SCHEME (EU-ETS)

The EU-ETS is a mandatory cap-and-trade system covering CO_2 emissions from energy-intensive industry. It was launched in 2005 and its first commitment period ran until the end of 2007. The second phase covered the period 2008-12. Installations under the EU-ETS can meet their obligations either by reducing emissions on their own, or by purchasing allowances from other installations covered by the scheme, or by purchasing credits under the Kyoto Protocol's flexible mechanisms (joint implementation or the clean development mechanism) up to an established limit.

From 2005 to 2012, emission allowances were allocated to the facilities on the basis of a national allocation plan (NAP). The NAP was prepared by the central government following criteria set out in the ETS Directive (2003/87/EC, later amended by 2009/29/EC) and approved by the European Commission. More than 95% of the allowances in the Union were allocated to the companies free of charge. Over-allocation of allowances as well as a decline in economic activity led to a large surplus of allowances, a steep decline in their prices and a need to reform the ETS scheme.

The third phase of the EU-ETS will run from 2013 to 2020. It is significantly different from previous phases. National allocation plans are no longer required and a single EU-wide ETS cap is introduced. The cap is reduced by 1.74% per year from 2010 onwards, resulting in a total reduction of 21% by 2020 below 2005 levels. More than 40% of allowances will be auctioned and electricity generation will no longer receive free allowances. For the sectors where allowances will still be given away for free, such as manufacturing industry and heat sectors, harmonised allocation rules apply, based on EU-wide benchmarks of emissions performance. A separate cap applies to the aviation sector. From 2021 to 2030, the number of allowances will be reduced by 2.2% per year, and a market stability reserve of allowances is expected to be introduced from 2019.

In Portugal, the ETS sector comprises around 214 installations and accounts for approximately 37% of national GHG emissions. The emissions reduction to be achieved from the sectors covered by the EU-ETS will be 21% below 2005 emission levels. In the 2005-07 commitment period, the ETS sector was allocated an annual average of 37.9 Mt of allowances, while the actual emissions were 100.7 Mt or an average of 33.6 Mt. In the 2008-12 commitment period, the average allocation was 31.8 Mt per year, while the actual emissions were only 132.6 Mt or an average of 26.5 Mt per year. EU-ETS emissions in 2012 were 31% below 2005 levels.

In the 2013-20 phase, Portugal will receive revenue from auctioning allowances. Decree-Law 38/ 2013 which transposed Directive 2009/29/EC into national law, established that 100% of auction revenues shall be used to support the Portuguese Carbon Fund. This money will be used to support climate policy, further stating an indicative allocation (mitigation, adaptation, R&D and co-operation with developing countries) of the revenues that are not directly allocated to the compensation for the additional costs of renewable energy, including that 30% of those revenues should be used in financing adaptation policy.[1] This includes the implementation of the National Climate Change Adaptation Strategy (ENAAC), including adaptation and co-financing programmes under the Multiannual Financial Framework 2014-20.[2]

DOMESTIC MEASURES OUTSIDE THE EU-ETS

COMMITMENT FOR GREEN GROWTH

Portugal has recently launched an ambitious long-term commitment – the Commitment for Green Growth – establishing goals and initiatives on green jobs, resource productivity, energy efficiency, electric mobility, spatial planning, forest management, water resource efficiency, air and water quality, and biodiversity. It also sets the target of reducing GHG emissions by 30% to 40% until 2030 below 2005 levels and to increase renewable energy share to 40% by 2030.

The Commitment for Green Growth seeks to lay the foundations for a commitment to policies, goals and targets that foster a development model that will reconcile essential economic growth with lower consumption of natural resources, social justice and quality of life for the population.

GREEN TAXATION REFORM

The purpose of the Green Taxation Reform is to stimulate innovation and sustainable growth, help to reconcile protection of the environment with economic growth, while remaining consistent with the general principles and goals of environmental policy, especially those set out in national and EU guidelines and standards. The reform must also encourage the efficient use of resources, thereby preserving and harnessing natural capital and fostering fair and sustainable use of the soil, territory and urban areas while introducing signs which facilitate the transition to a low-carbon economy.

Under the principle of fiscal neutrality, the net income from the green taxation reform will be allocated to the reduction of personal income taxes. Importantly, it includes a carbon tax, indexed to the price of carbon permits in the EU-ETS which aim to achieve more effective consumption decisions and to promote a low-carbon economy that is inclusive, competitive and innovative, and which will be more efficient in the use of resources, particularly energy. It also includes incentives to electric vehicles, biodiversity and sustainable mobility.

1. Directive 2009/29/EC of the European Parliament and of the Council of 23 April 2009 amending Directive 2003/87/EC so as to improve and extend the GHG emission allowance trading scheme of the Community.

2. The Multiannual Financial Framework (MFF) lays down the maximum annual amounts (ceilings) which the EU may spend in different political fields over a period of no less than five years. This MFF covers seven years: from 2014 to 2020.

NATIONAL CLIMATE CHANGE ADAPTATION STRATEGY

The National Climate Change Adaptation Strategy (ENAAC) was adopted in 2010. It is the main policy instrument to addresses global resilience, promoting and increasing awareness on the adaptation needs induced by climate change. Under this strategic framework, in 2012, a progress report was prepared for the energy sector, identifying actions on adaptation, mitigation and prevention for the sector-specific vulnerabilities and drawing recommendations accordingly. The report focused mainly on the minimisation and prevention of identified vulnerabilities for energy infrastructure, featuring areas of risk and vulnerability of key infrastructure, the identification of adaptation measures, barriers to adaptation, interdependences with other sectors, identified key knowledge gaps in terms of the energy sector and provided recommendations.

A new ENAAC 2020 was recently (2015) adopted alongside the Strategic Framework for Climate Change Policy (QEPiC). ENAAC aims at improving the level of awareness and knowledge on climate change, implementing adaptation measures and promoting mainstreaming of climate adaptation policy in sectoral policies.

THE PORTUGUESE CARBON FUND

The Portuguese Carbon Fund (FPC), established by law in 2006 under the Ministry for Environment, Spatial Planning and Energy, is a financial instrument for acting on the carbon market to ensure compliance with national targets on climate change, making use of the flexibility mechanisms of the Kyoto Protocol and supporting national projects to reduce emissions.[3] The FPC has also created a Support Projects Programme to support projects or groups of projects on the national territory that could lead to reductions/ removals of GHG emissions under the Kyoto Protocol.

The APA also manages the Fund. Previously, the financing of the Fund was ensured by a combination of funds from the central government budget and its own revenues. At present, the Fund raises its own income, including revenues earned from the collection of taxes on heating oil, diesel oil and low-efficiency light bulbs (paid by manufacturers and retailers). It also receives income from auctioning allowances under the EU-ETS (industrial installations and aviation operators), which at present constitutes its main revenue source.

The FPC obtains emission credits generated under the flexible mechanisms under the Kyoto Protocol: clean development mechanism; joint implementation of projects; and international emissions trading.

Additionally the carbon fund has been supporting other initiatives such as:

- projects in Portugal leading to a reduction of GHG emissions
- projects that improve emissions accounting methodologies
- the participation of public and private entities in the flexibility mechanisms of the Kyoto Protocol
- projects under the Portuguese Initiative Immediate Implementation (fast start) in Portuguese-speaking African countries (Mozambique, Cabo Verde, Angola, São Tomé e Príncipe and Guinea-Bissau) and Timor-Leste

3. The Portuguese Carbon Fund was established by Decree-Law 71/2006 of 24 March 2006.

- innovative renewables projects under the NER300 EU programme. The aim of NER 300 is to establish a demonstration programme comprising the best possible CCS and RES projects and involving all EU member states.

The Fund also supports the Mobi.E Project, which is associated with the construction of a charging network for electric vehicles. The Mobi.E programme encourages the acquisition of electric vehicles by promoting demand for, and introducing to, electric vehicles (EV) in the market for mixed and passenger light vehicles and electric scooters. It plans to make the most of investments, which have already been made, in terms of developing an intelligent and integrated management platform. Proposals related to the programme include upgrading existing charging infrastructure, adapting it to public and private covered parking sites, and developing solutions for charging vehicles at home. The potential for reducing CO_2 emissions associated with the Program for Electric Mobility in Portugal is estimated at 920 334 tCO_2 by 2020.[4]

NATIONAL LOW CARBON ROADMAP

The National Low Carbon Roadmap (RNBC) aims to determine a set of paths for cost-effective emissions reductions (for long-term targets concerning the national GHG emissions reduction) and its subsequent policy options, taking into account the national contribution to the EU target for 2050 (work completed in 2012).

STRATEGIC FRAMEWORK AND NATIONAL PROGRAMME FOR CLIMATE CHANGE FOR 2013-30

The National Programme for Climate Change for the period 2013-30 (PNAC 2020/2030): identifies policy options, measures and instruments for a trajectory established by the Green Growth Commitment adopted by the government in early 2015, compatible with the 2020 and 2030 EU emissions reduction targets. It identified sectoral responsibilities, funding and monitoring, and control mechanisms.

The Strategic Framework:

- aims to ensure a stable investment environment to allow for the development of sustainable low-carbon technologies
- acknowledges the role of carbon markets and the EU Emissions Trading Scheme (EU-ETS) as essential tools for achieving efficient and cost-effective emissions reductions
- aims to ensure that the potential of land use, land-use change and forestry (LULUCF) is recognised and promoted at national and international levels
- aims to promote mainstreaming of climate policy goals, in terms of both adaptation and mitigation, in the relevant sectoral policies.

INTERNATIONAL MEASURES

By the end of 2012, the FPC has budgeted around EUR 124.8 million (payments were around EUR 96.9 million), corresponding to about 11.8 $MtCO_2$-eq. Following a risk analysis of the portfolio funds performed by the Climate Change Commission Executive Committee (CECAC), it was estimated that the investments made correspond to about 8.1 $MtCO_2$-eq, of which 7.3 $MtCO_2$-eq. concerns credits prior to 2012. By the end of 2013, the Carbon Fund had received in its account about 6.8 $MtCO_2$-eq.

4. Portugal's Sixth National Communication to the UNFCCC, p. 142.

ASSESSMENT

In 2012, GHG emissions were about 22% below 2005 levels. Under the EU Burden-Sharing Agreement, Portugal was allowed to increase its GHG emissions by 27% above 1990 levels during the Kyoto period 2008-12. The country complied with this target. CO_2 emissions from the energy sector during the Kyoto period have decreased by 14%.

The trend shows that the evolution of emissions was driven by strong economic growth associated with an increased energy demand in the 1990s, stabilised emissions in the early 2000s and a reduction since 2005. The stabilisation of emissions was largely the result of a shift to natural gas from more carbon-intensive fuels and a growth in the implementation of renewable energies. The reduction of emissions in recent years is also a consequence of the European economic crisis, which has had a severe impact in Portugal.

To date, Portugal´s strategy for meeting its legally binding target under the Kyoto Protocol relied heavily on supply-side measures, e.g. changing the electricity generation mix. It is possible that there are other more cost-effective measures available. The IEA understands that in the post-2012 policy and support architecture, the country is examining a set of cost-effective measures for all sectors. The National Low-Carbon Roadmap includes a set of paths for long-term cost-effective reductions and is a basis for including this perspective in the future. The recently adopted Green Growth Commitment and the Strategic Framework for Climate Policy (including a new National Climate Change Programme and a new National Climate Change Adaptation Strategy) provide a solid basis to build on previous efforts. The IEA welcomes the introduction of a CO_2 tax in the non-traded sector in the context of a broader scope green fiscal reform in place from 2015. A general CO_2 tax is an effective measure in that it provides incentives to find the least-cost ways to reduce emissions among sectors.

Almost two-thirds of GHG emissions are in the non-traded sector. This share is above the EU average, where almost half the emissions are included in the EU-ETS. A large share of the non-trading sector emissions is from transportation and the heating of buildings. The transport sector, largely dominated by road traffic, increased its emissions by 65% during the period 1990-2012. There has, however, been a reduction of emissions in this sector since 2006. There is a potential for reduced fossil fuel use in the heating of buildings. This dependence could be reduced by using efficient heating technologies and by insulating buildings.

Before the economic crisis, several policy measures aimed to decarbonise the transport sector. Given the economic and financial weaknesses that have emerged in recent years, policy measures in the transport sector focused mainly on the economic and financial restructuring of the multiple operators and public bodies operating in the public transport sector. Notable programmes already introduced, and which form part of the updated National Energy Efficiency Action Plan (NEEAP), include the Mobi.E electric mobility programme and a review of the taxation system for private vehicles (green taxes). Changes to the vehicles taxation system aim to promote the introduction of vehicles with low CO_2 emissions to encourage their expansion in the road transport sector.

The government needs to develop a strategy that recovers the market share of public transport and has a real impact on reducing CO_2 emissions. Special attention should be given to measures such as steps to redress the decline in the use of public transport, simplified ticketing, tax rebates for public transport users, congestion charges for urban traffic, and others. Some measures are set out in the NEAAP but these require greater elaboration if they are to meet their targets. Furthermore, transport policy and infrastructure planning should be subject to critical review in relation to its energy and CO_2 impacts. The integration of spatial planning responsibilities into the environment and energy ministry facilitates this activity.

Portugal, which is projected to experience temperature increases and less precipitation, is vulnerable to climate change impacts. It has adopted a National Climate Change Adaptation Strategy which aims to improve the level of awareness and knowledge on climate change by implementing adaptation measures and promoting mainstreaming of climate adaptation policy in sectoral policies. It is important that major climate change vulnerabilities in the energy system are identified and studies to assess ways to strengthen its resilience are undertaken and acted upon.

RECOMMENDATIONS

The government of Portugal should:

- ☐ *Develop an action plan, based on a periodic evaluation of climate and energy policies, and on how to cost-effectively reduce GHG emissions from the non-traded sector until 2030, notably in the transport sector.*
- ☐ *Use the mechanisms of the National Climate Change Adaptation Strategy to identify the major weaknesses across the energy system caused by the impact of climate change and to develop measures to improve the resilience of the energy system.*

References

IEA (International Energy Agency) (2015a), *CO_2 Emissions from Fuel Combustion 2015*, www.iea.org/statistics/, OECD/IEA, Paris.

IEA (2015b), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/, OECD/IEA, Paris.

UNFCCC (United Nations Framework Convention on Climate Change) (2015), GHG Emission Profiles data series, http://unfccc.int/ghg_data/ghg_data_unfccc/ghg_profiles/items/4625.php, accessed on 9 September.

4. ENERGY EFFICIENCY

Key data (2014 estimated)

Energy supply per capita: 2.0 toe (IEA average: 4.4 toe), -17.6% since 2004

Energy intensity: 0.09 toe/USD 1 000 PPP (IEA average: 0.13 toe/USD 1 000 PPP), -15.9% since 2004

TFC (2013): 16.2 Mtoe (oil 50%, electricity 24%, biofuels and waste 13.6%, natural gas 9.7%, heat 2.2%, solar 0.4%, coal 0.1%), -18.9% since 2003

Consumption by sector (2013): industry 36.7%, transport 33.3%, residential 16.3%, commercial and public services (including agriculture and fisheries) 13.7%

FINAL ENERGY USE

FINAL CONSUMPTION BY SECTOR

Portugal's total final consumption (TFC) was 16.2 million tonnes of oil-equivalent (Mtoe) in 2013. Energy demand was 18.9% lower in 2013 than in 2003. Demand peaked at 20.5 Mtoe in 2005 and has been contracting steadily since, notably since the economic crisis in 2008. The Portuguese government expects that energy demand will recover to 20.3 Mtoe by 2030.

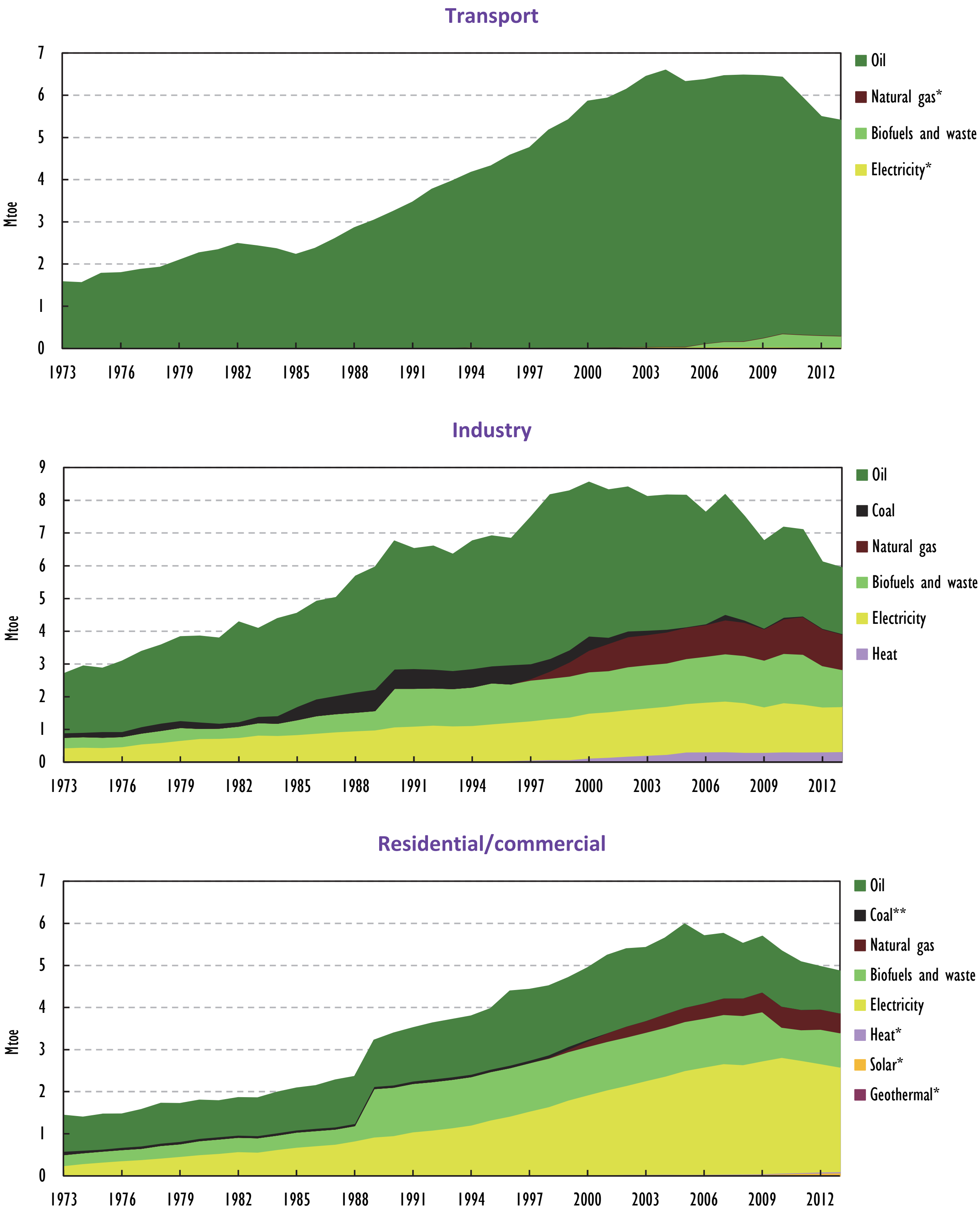
Industry is the largest consuming sector in Portugal, with final consumption of 5.9 Mtoe in 2013 or 36.7% of TFC. It is also the sector with the fastest decline in energy demand, down by 26.7% compared to 2003. Most of the decline, namely 21%, has come since 2008. Portugal has a median level of industry share in TFC among IEA member countries.

Transport accounted for 33.3% of TFC in 2013 or 5.4 Mtoe. Transport was also affected by the economic crisis with demand declining by 16.5% since 2008. Compared to 2013, demand was 16.2% lower as consumption stagnated during 2004-08. However, the decline is slower than the overall TFC and transport's share has increased slightly from 32.3% in 2003. Portugal ranks eighth-highest among IEA member countries with respect to the share of transport in TFC.

Residential consumption was 2.6 Mtoe in 2013 or 16.3% of TFC, down by 15.3% compared to 2003. Residential consumption also stagnated during 2004-08 and has declined by 15.5% since the crisis years. Household share in TFC has increased from 15.6% in 2003 to 16.3% in 2013, ranking Portugal as seventh-lowest in the IEA membership.

The commercial sector, including public services and agriculture and fisheries, is the smallest consuming sector with 2.2 Mtoe in 2013 or 13.7% of the total compared to 11.6% in 2003. Demand from this sector grew slightly from 2004 to 2008 but has contracted by 7.1% since 2008. Portugal has the fourth-lowest share among IEA members.

Figure 4.1 TFC by sector and by source, 1973-2013



* Negligible.

** Coal consumption in the residential/commercial sector ceased in 2001.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Oil is the main fuel in the transport sector although the use of biofuels and waste has surged over the past decade. Biofuels and waste accounted for 4.9% of energy consumed by transport in 2013, first introduced in transport in 2006. Oil represented 94.3% in 2013 while electricity and natural gas together accounted for 0.8%.

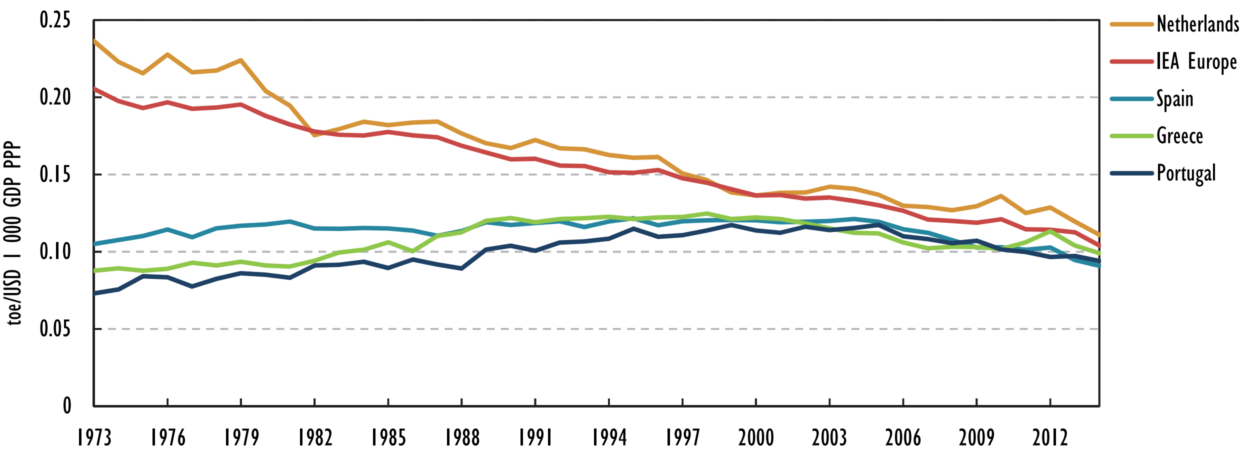
Industry relies on oil, electricity, biofuels and waste, and natural gas for most of its energy needs. Oil accounted for 33.9% of industry demand in 2013, electricity for 23.1%, biofuels and waste for 19% and natural gas for 18.2%, rounding up to 94% of demand. The remainder was sourced from heat (5.5%) and coal (0.3%). The use of oil in industry has halved since 2003 while natural gas use has increased by 18%. Biofuels and electricity consumption declined by 14.4% and 4.9%, respectively, while heat use was up by 52.5%.

Electricity accounts for 51% of energy demand from residential and commercial sectors together. The remainder comes from oil (20.5%), biofuels and waste (16.7%), natural gas (9.7%), and small amounts of heat, solar and geothermal. Over the past decade, demand has shifted away from the use of oil and biofuels and waste towards more electricity, heat and natural gas.

ENERGY INTENSITY

Energy intensity, measured as the ratio of total primary energy supply (TPES) by real gross domestic product adjusted for purchasing power parity (GDP PPP) was 0.09 tonnes of oil-equivalent per USD 1 000 PPP (toe/USD 1 000) in 2014. The ratio is lower than 0.13 toe/USD 1 000 PPP, the IEA average, and slightly lower than the IEA Europe average of 0.10 toe/USD 1 000 PPP. Portugal's energy intensity is ranked seventh-lowest among IEA member countries. Energy intensity in Portugal was 15.9% lower in 2014 than ten years earlier, while the average IEA intensity declined by 17.8% over the same period.

Figure 4.2 Energy intensity in Portugal and in other selected IEA member countries, 1973-2014

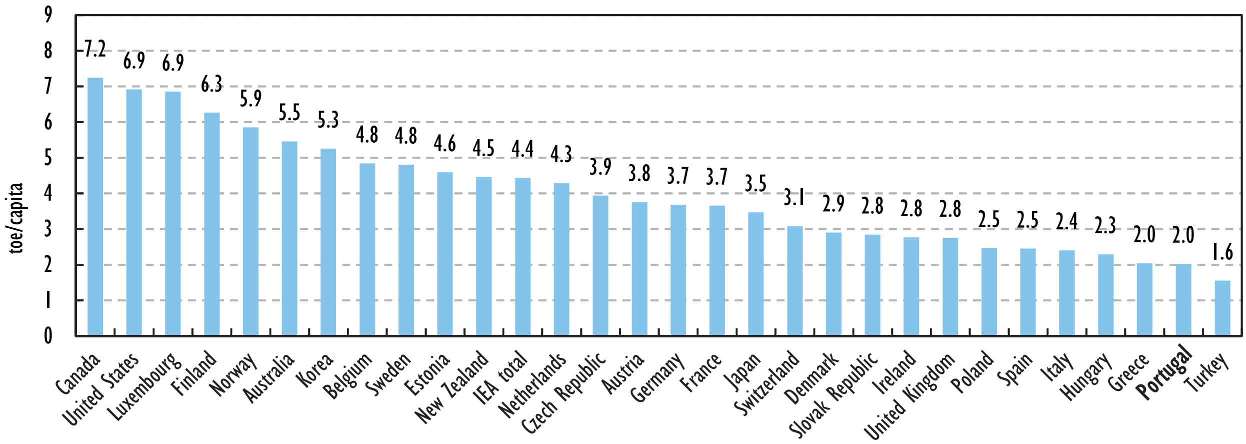


Note: data are estimated for 2014.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Another common indicator for international comparisons is energy consumption per capita (see Figure 4.3). Portugal's rate of 2.0 toe per capita per year, the second-lowest among IEA member countries, only higher than Turkey.

Figure 4.3 TPES per capita in IEA member countries, 2014



Note: data are estimated.

Source: IEA (2015), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

INSTITUTIONS

The **Directorate-General for Energy and Geology** (DGEG) is the lead ministry with responsibility for development and implementation of energy efficiency polices and measures. The competences relating to energy efficiency at local or regional level rest with **municipal authorities**. Some of these are supported by **regional energy agencies**, whose main role is to identify local needs and to find solutions to reduce energy consumption.

The **Portuguese Agency for Energy** (ADENE) was established in 2000 under the authority of the Ministry of Environment, Spatial Planning and Energy. ADENE, which was established in 1984 and previously designated as "Centre for Energy Conservation", is entrusted with a large number of public tasks regarding the energy efficiency sector and related areas, and is also a relevant interface with other sectors. ADENE co-ordinates the training of qualified experts related to the EU Directive on the Energy Performance of Buildings.

POLICIES AND MEASURES

In Portugal, policies and measures to improve energy efficiency and conserve energy originate from both the European Union and domestic governments. European Union regulations are directly applicable in all member states, while EU directives leave member states room to decide how to implement them. The National Energy Strategy for 2020 (ENE 2020) established a goal of reducing final energy consumption by 20% by 2020. Subsequently, the government defined a more ambitious goal, corresponding to a 25% reduction in primary energy consumption (30% in the public sector) by 2020.

EU DIRECTIVES AND REGULATIONS

Portugal's energy efficiency policies are aligned with the relevant EU regulations and directives. Since 2006, European policies have been designed to help reach indicative (non-binding) EU targets for energy efficiency for 2016 and for 2020. The 2016 target is to reduce final energy use in the sectors outside the EU-ETS by 9% from the early 2000s. The 2020 target, agreed upon in 2007, is to reduce primary energy use in the Union by 20% from baseline projections.

The 2016 target was embedded in the Directive on Energy End-Use Efficiency and Energy Services (2006/32/EC). The directive encourages energy efficiency through the development of a market for energy services and the delivery of energy efficiency programmes and measures to end-users. It requires member states to create national energy efficiency action plans for meeting the target. The directive also sets the framework for measures such as financing, metering, billing, promotion of energy services, and obligations for the public sector. In addition, it requires member states to oblige energy distributors or retailers to offer either competitively priced energy services, audits or other measures to improve energy efficiency.

The Energy Efficiency Directive 2012/27/EU (EED) was developed and adopted out of concern that the European Union was unlikely to reach the 20% energy efficiency target for 2020. The EED replaces the previous directive 2006/32/EC and strengthens many of its elements. The EED comprises a series of binding measures and requires each member state to:

- Set an indicative national energy savings target for the period 1 January 2014 to 31 December 2020 in line with the EU-wide 20% target by 2020.
- Oblige energy providers to achieve cumulative end-use energy savings by 2020 equivalent to 1.5% of annual energy sales over the seven years from 2014 to 2020. Member states may pursue alternative ways to achieve equivalent energy savings.
- Carry out a comprehensive assessment of national heating and cooling systems to identify and implement the cost-effective potential for deploying highly efficient co-generation, efficient district heating and cooling, and other efficient heating and cooling solutions by the end of 2015.
- Assess the energy efficiency potential of its gas and electricity infrastructure, in particular regarding transmission, distribution, load management and interoperability, and identify measures and investments for the introduction of cost-effective energy-efficient improvements in the network infrastructure by 30 June 2015.
- Ensure that the metering and billing of actual energy consumption in all sectors occur at a frequency that enables end-users to take informed decisions about their energy consumption; and that meters are installed for all energy sources at end-users' premises, if technically possible and economically feasible.
- Develop public procurement rules ensuring that central governments purchase only highly efficient products.
- Facilitate the development of national financing facilities for energy efficiency measures.

In addition to the horizontal EED, several EU regulations and directives to increase energy efficiency are in force. The Directive on the Energy Performance of Buildings (EPBD, 2002/91/EC, recast as 2010/31/EU) sets requirements for energy efficiency in building codes, including minimum energy performance requirements and energy certificates. The 2010 recast requires all new public buildings to be at least "near-zero energy" by the end of 2018, and all new buildings to reach this target by the end of 2020.

The recast Directive Establishing a Framework for Setting Ecodesign Requirements for Energy-related Products (Ecodesign, 2009/125/EC) aims to improve energy efficiency throughout a product's life cycle. It applies to products that use energy and to products that have an impact on energy use, such as building components. Product-specific standards are set by EU regulations based on the directive.

Requirements for energy labelling of household appliances are based on several directives adopted since 1992. The recast of the Energy Labelling Directive (2010/30/EU) expands the mandatory labelling requirement to cover commercial and industrial appliances and also energy-related appliances. Product-specific labelling standards are set up under this directive.

Current EU transport policies aim to reduce CO_2 emissions from new passenger cars, which in practice will lead to efficiency improvements in the car fleet. Under Regulation 443/2009, car manufacturers and importers are obliged to limit CO_2 emissions from new passenger cars to a weight-based fleet-wide average of 130 grammes of CO_2 per kilometre (gCO_2/km) by 2015 and to 95 gCO_2/km by 2020. In terms of fuel consumption, the 2015 target roughly corresponds to 5.6 litres per 100 km (L/100 km) of petrol or 4.9 L/100 km of diesel. The 2020 target equates to around 4.1 L/100 km of petrol or 3.6 L/100 km of diesel. A similar regulation for new vans was introduced in 2011 (Regulation 510/2011), with a limit of 175 gCO_2/km by 2017 and 147 gCO_2/km by 2020.

NATIONAL POLICIES AND MEASURES

The first National Energy Efficiency Action Plan (NEEAP) was enacted in 2008 by means of Cabinet Resolution 80/2008. It comprised a set of measures aimed at an increase in energy efficiency, equivalent to 9.8% of TFC by 2015. The plan was made up of a broad range of programmes and measures considered crucial for Portugal to achieve, and surpass, the 9% target set under Directive 2006/32/EC on End-Use Efficiency and Energy Services.

Subsequently, Portugal experienced significant turmoil in its macroeconomic environment, which indirectly resulted in declining energy consumption and funding constraints. This changing economic landscape coupled with the need to review the NEEAP in light of the introduction of Directive 2012/27/EU resulted in a review of energy efficiency and renewable energy programmes.[1]

Accordingly, the NEEAP and the National Renewable Energy Action Plan (NREAP) were revised concurrently and integration of the two plans was proposed by Portugal as a means to more effectively ensure compliance with national and EU targets. The basic aim of the revision was to align the respective targets regarding primary energy consumption and secure the energy sector's contribution to reducing greenhouse gas emissions. Accordingly, in June 2011, Portugal submitted its second NEEAP to the European Commission.

Cabinet Resolution 20/2013, of 10 April adopted and published the 2013-16 NEEAP (Energy Efficiency Strategy – PNAEE 2016) and the 2013-20 National Renewable Energy Action Plan (Renewable Energy Strategy – PNAER 2020). This Cabinet Resolution also repealed the previous National Energy Strategy for 2020.

1. Directive 2012/27/EU of the European Parliament and of the Council of 25 October 2012 on energy efficiency.

The revised objectives of the both Action Plans aimed to:

- meet all the commitments assumed by Portugal with regard to its EU obligations
- reduce GHG emissions
- reinforce the diversification of primary energy sources, contributing to increased security of energy supply
- increase the energy efficiency in the economy, in particular in public administration, contributing to a reduction in public expenditure
- contribute to national economic competitiveness by reducing energy consumption and import costs.

The new NEEAP raised energy efficiency as a policy priority, taking into account that saving energy promotes environmental protection and energy security at reasonable cost. Also, it gave continuity to the majority of measures established in NEEAP 2008. It covers six specific sectors: transport, residential and services, industry, state, behaviour, and agriculture. These sectors aggregate ten programmes and integrate several energy efficiency improvement measures and management of energy demand.

In terms of energy savings, the NEEAP 2016 establishes the following objectives:

- By 2016: final energy savings of 1 501 thousand tonnes of oil-equivalent (ktoe), corresponding to a reduction in energy consumption of approximately 8.2%, of average consumption for the period 2001 to 2005 (18 368 ktoe).
- By 2020: a reduction of 25% in primary energy consumption below the 2007 baseline consumption projections from the PRIMES model (corresponding to a maximum limit of 22.5 Mtoe in primary energy consumption).[2] Portugal expects to achieve a 26% reduction by 2020, thereby surpassing the EU objective of 20%.

Furthermore, Portugal also established a specific objective for the public sector of reducing energy consumption by 30%.

Portugal's 2020 target

The NEEAP 2008 established a goal of reducing final energy consumption by 9.8% by 2015. Fifty measures were defined to achieve this goal, organised into 12 programmes, with a view to reducing energy consumption in the areas of transport, residential & services, industry, state and behaviour. The ENE 2020, approved by Cabinet Resolution No. 29/2010 of 15 April, later defined a goal of reducing final energy consumption by 20% by 2020.

In NEEAP 2016, Portugal established a general target to reduce primary energy consumption by 25% by 2020 along with a specific target reduction of 30% for public administration. The NEEAP 2016 envisages inducing savings of 8.2%, below the indicative goal defined by the European Union of 9% of energy savings by 2016, with a reduction in energy consumption being distributed over various sectors of activity, as can be seen in Table. 4.1.

2. The European Commission uses the PRIMES energy model to simulate the European energy system and markets on a country-by-country basis and across Europe for the entire energy system.

Funding mechanisms

The **Energy Efficiency Fund** (FEE) is a financial instrument created by Decree-Law 50/2010 of 20 May with the following objectives: funding programmes and measures identified in the NEEAP, encouraging energy efficiency on the part of citizens and businesses, supporting energy efficiency projects and promoting behavioural change. The EEF, by means of specific calls, supports energy efficiency projects in sectors such as transport, buildings, services, industry and public services. The EEF also supports projects not covered by the NEEAP but which demonstrably contribute to energy efficiency.

Other funding mechanisms include the **Innovation Support Fund** (FAI), which offers financial incentives to pilot projects related to energy performance contracts in privately owned buildings. The **Consumption Efficiency Promotion Plan** (PPEC) is a tender mechanism to promote measures that improve efficiency in electricity consumption and the adoption of more efficient equipment, by which eligible promoters submit candidate measures to that effect.

Table 4.1 Summary of NEEAP 2016 impacts by programme

Programme	Potential savings (toe)	Percentage of target	2016 target (toe)
Transport	344 038	23%	1 501 305
Residential and services	634 265	42%	
Industry	365 309	24%	
State sector	106 380	7%	
Behaviour	20 313	1%	
Agriculture	30 000	2%	

Source: DGEG, IDR country submission.

Table 4.2 Proposed annual energy savings to 2020

Sector	Energy savings (toe)						
	2014	2015	2016	2017	2018	2019	2020
Transport	19 944	12 395	13 914	13 939	15 101	16 156	17 643
Residential and services	52 445	53 135	53 834	54 590	55 545	55 340	55 009
Industry	34 500	34 500	34 500	34 500	34 500	34 500	34 500
State	13 463	17 581	18 680	19 774	20 865	21 958	23 050
Total annual energy savings	120 372	117 611	120 928	122 803	126 011	127 954	130 202
Total accumulated energy savings	120 372	358 315	717 206	1 198 900	1 806 606	2 542 266	3 408 128

Source: DGEG (2013), *Directive 2012/27/EU: Article 7 Alternative Policy Measures for Energy Efficiency Obligation Schemes*, Direcção-Geral de Energia e Geologia, Lisbon.

Alternatives to the Energy Efficiency Obligation Scheme

Under the Energy Efficiency Directive, EU countries are required to establish an energy efficiency obligation scheme. This purpose of the scheme is to ensure that energy distributors and/or retail energy sales companies achieve a cumulative end-use energy savings target by 31 December 2020. As an alternative to establishing such schemes, EU member states may opt to take other policy measures to achieve the same energy savings, provided that the annual quantity of end-use energy savings achieved by such policy measures is equivalent to that stipulated in the directive. In December 2013, Portugal notified the European Commission of its decision to use the alternative approach instead and provided information on end-use energy savings targets, measures to be adopted and methodologies used to calculate savings.

Portugal identified an energy savings target of 3.408 Mtoe by 2020in accordance with the methodology set out in the directive and identified a series of programmes and measures so as to achieve the end-use energy savings overall target across the transport, residential and services, industry and state sectors. Portugal has also proposed a comprehensive monitoring programme to verify compliance with the goals defined for each measure. These proposals were supported by a mechanism to provide continuous and comparative assessment of the cost-benefit ratio of the different measures.

ESCOs

An ESCO (an energy services company) is commonly understood to mean a company that offers energy services, including implementing energy efficiency projects and other sustainable energy projects (EU, 2014a).

At the time of the last in-depth review, the Portuguese ESCO market was relatively small with less than ten companies active in the market. The number of ESCOs increased during the 2010-13 period, in spite of the economic downturn.

In order to boost the implementation of energy consumption reduction measures in buildings and public facilities, Decree-Law 29/2011 of 28 February was published It established the legal regime for the formation and execution of energy performance contracts in the nature of energy efficiency management contracts to be concluded between the departments and agencies of the direct public administration; indirect, autonomous and energy service companies, with a view to implementing measures that will improve energy efficiency in public buildings and equipment of the provision of public services.

The Legislative Order 15/2012 of 3 July approved the Regulation of Energy Services Companies Qualification System (SQESE) to facilitate participation in the pre-contractual procedures for those interested. The applications are submitted electronically in the Directorate-General for Energy and Geology (DGEG) site through log-in provided to those already registered and approved companies.

By the end of 2013, the number of ESCOs operating was estimated to be between 15 and 20, but the potential pool of contractors is much larger, with more than 100 companies registered in the official DGEG database. This database established in 2011, is used by companies that want to develop energy performance contracts (EPCs) with the central government and to apply for the qualification system in which the ESCOs must be registered. In 2015, there were 49 ESCOs qualified and fulfilling all the requirements. While most ESCO activity has been in the industry sector, recent programmes, notably Eco.AP, have raised the attractiveness of the public sector for ESCOs.

In 2015, Decree-Law 68-A/2015 of 30 April was published. It established that all rules applicable central government are also applicable for regional and local public bodies that decide to use energy performance contracts. The first EPC in the public sector is being implemented under this mechanism. It was developed by the Lisbon municipality, and will deliver the replacement of 20 000 incandescent lamps from the traffic lighting system by LEDs, resulting in energy savings of approximately 94%.

The ESCO market evolved as a result of public programmes and legislative changes but the lack of appropriate financial resources and access to capital is probably the most significant barrier to its expansion. Financing ESCO projects remains a problem and commercial banks are reluctant to support energy efficiency projects (EU, 2014a).

EU-funded projects

The European Union's structural and investment funds offer financing for projects that help meet the EU 2020 goals for smart, sustainable and inclusive growth. This includes a broad range of low-carbon projects. The funds include the Regional Development Fund, the European Social Fund, the European Agricultural Fund for Rural Development and the European Maritime & Fisheries Fund. The European Commission and the national authorities must, however, agree on programmes setting out the priorities for each country, region or policy area concerned, before any financing can be considered. This work is yet to be completed in Portugal.

SECTORS

BUILDINGS

The buildings sector is responsible for approximately 30% of final energy consumption in Portugal. DGEG estimates that 50% of this consumption can be reduced by 50% through energy efficiency measures.

Energy efficiency requirements for residential buildings were first introduced in Portugal in 1990 and for non-residential buildings in 1998. In 2006, building codes were revised for all buildings as a result of the transposition of the Energy Performance of Building Directive (EPBD) 2002/91/EC. Decree-Law 118/2013 and Law 58/2013 of 20 August transposed Directive 2010/31/EU on the energy performance of buildings and a new legal framework entered in force on 1 December 2013. This new legal framework replaced the previous 2006 provisions.

The Energy Certification Programme aims to improve the average energy efficiency of buildings by implementing guidelines which regulate the Energy Certification System for Buildings (SCE), as a result of the transposition into domestic law of Directive 2010/31/EU by means of Decree-Law 118/2013 and Law 58/2013 both of 20 August 2013.

Efforts to reduce energy consumption in the residential and services sectors include the following initiatives:

- **Home and office renewal** initiative, which integrates a set of measures to increase the energy efficiency in lighting, appliances and space rehabilitation. In cumulative terms, the impact of the implemented measures reached 244 874 toe, which represents 61% of the reference target for 2016.
- **Energy efficiency system in buildings** requires energy certification of buildings regarding lighting, heating, ventilation and air conditioning. In cumulative terms, the impact of the implemented measures reached 102 841 toe, which represents 64% of the reference target for 2016.
- Developments in the **national building energy certification** (SCE) scheme reflect the continuity in energy certificates and a reassessment of energy savings per building. About 640 000 certificates had been issued by the end of 2013. The residential

sector was more dynamic in certification, with about 90% of all certificates registered; while small services buildings (PES) held 9% and large service buildings (GES) held the remaining 1%.

- Integration of **thermal RES/solar thermal energy** such as measures promoting the integration of RES in residential and services buildings and equipment. In cumulative terms, the impact of the implemented measures reached 41 160 toe, which represents 56% of the reference target for 2016.
- The solar thermal measure is the outcome of the **Solar Thermal Programme 2009** initiative, which created a framework of incentives associated with the acquisition of equipment for water heating in the residential segment, and subsequently extended to other sectors.

In total, the buildings sector recorded savings of 388 875 toe in the six years since the implementation of the first NEEAP, resulting from the aggregate effect of three programmes, Home and office renewal, Energy efficiency system in buildings, and Solar thermal energy. This represents 61% of the reference target for 2016.

Table 4.3 Buildings programmes and measures

Programmes	Measures
Home and office renewal	Promotion of more efficient equipment
	Efficient lighting
	Efficient windows
	Efficient insulation
	Green heat
Energy efficiency system in buildings	Energy certification system for residential buildings
	Energy certification system for non-residential buildings
Thermal solar energy	Residential thermal solar energy
	Non-residential thermal solar energy

Source: DGEG, IDR country submission.

Targets for new buildings

The target for new buildings is to certify 268 000 residential units by 2020 with an energy class B or higher for new buildings or large-scale renovations. This goal was defined within the context of certification systems (SCE) in terms of the number of buildings certified up to 2012, the current scenario for the evolution of the economy and the dynamics of the domestic real estate market. From 2007 to 2014 the annual average from records for such buildings is 17 000 residential units, 7.9% of which involved large-scale renovations.

TRANSPORT

The transport sector is responsible for 33.1% of energy consumption with the road transport sector accounting for 95% of this. The transport sector also accounts for 34.2%

of CO_2 emissions. A period of economic growth before the economic crisis saw an increase of 7% in the stock of passenger cars and a 17% increase in the length of motorways. This growth was not matched by an increase in the performance of public transport. As a result, the modal split in Portugal remains strongly in favour of passenger car use: 88.3% of passenger-kilometres compared to the EU average of 72.2% in 2012 (EU, 2014b).

The government has introduced a number of energy efficiency improvement measures in the transport sector. The **Eco-car programme** sets out a number of measures aimed at improving the energy efficiency of motor vehicles, the most notable of which are:

- Green taxes introduced to promote the introduction of low-CO_2 emission vehicles by means of tools and mechanisms encouraging their sales growth. Some of the tools to achieve this measure relate to vehicle tax reforms, as well as making consumption guides available and publicising energy information on new vehicles.
- The Mobi.E programme promotes the acquisition of electric vehicles and makes the most of existing investments in terms of developing an intelligent and integrated management platform. Solutions in this sector include upgrading existing charging infrastructure and adapting it to public and private covered parking sites.

The **Urban mobility programme** consists of the three measures that aim to encourage the use of collective instead of individual transport, with a particular emphasis on urban areas:

- The first measure focuses on improving energy efficiency by introducing more efficient vehicles in the public road transport sector.
- The programme on the development of fleet management centres and the automatic attribution of taxi services.
- The programme on the use of bicycles and soft modes of transport was created to develop a strategy and a set of measures to promote the everyday use of bicycles and adopt sustainable mobility solutions.

The **Energy efficiency system for the transport sector programme** consists of four measures to encourage actions which provide additional passenger railway networks as well as improved energy management in public transport fleets. These measures are:

- Streamlining the services offered by CP-Comboios de Portugal (the state-owned railway service) by reducing the travel time on the Lisbon-Porto, Lisbon-Castelo Branco and Lisbon-Algarve routes.
- The introduction of a regulation to manage energy consumption in the transport sector, which is targeted on operators of transport fleets and company transport fleets with an annual consumption above a reference value (an annual consumption of more than 500 toe). Operators are obliged to prepare action plans, by means of specific audits, with a view to improving energy intensity or reducing specific consumption.
- Support for the installation of equipment to inflate tyres with nitrogen by promoting the installation of nitrogen-generating systems in the workshops of passenger and goods transport operators and in the workshops of private fleets (private and municipal companies), with an emphasis on heavy vehicle fleets.[3]
- Support for the adoption of fleet management systems and eco-driving to promote the adoption of systems to monitor the performance of professional drivers.

3. Inflating tyres with nitrogen can increase the fuel economy of a vehicle.

Table 4.4 Energy efficiency measures in the transport sector

Programmes	Measures
Eco-car	Green taxation: Revision of the taxation regime for private vehicles
	Mobi.E: Promotion of the acquisition of electric vehicles
Urban mobility	Promotion of sustainable mobility and adoption of good practices
	Use of transports and mobility solutions more energy efficient
Energy efficiency system in transport	Passenger railway transport services
	Regulations for Managing Energy Consumption in the Transport Sector
	Support for installing equipment to fill nitrogen tyres
	System to manage fleets and promote eco-driving

Source: DGEG, Cabinet Resolution 20/2013, 10 April.

Energy consumption reductions have been in the order of 284 542 toe between 2008 and 2013, resulting from the combined effect of the three programmes above. They represent 83% of the reference target for 2016.

APPLIANCES AND EQUIPMENT

Requirements for minimum energy efficiency standards and energy labelling of appliances are based on EU law, in particular Directive 2009/125/EC and related product-specific regulations, and Directive 2010/30/EU on energy labelling.

The first Energy Labelling Directive was transposed into Portuguese law in 1994. It rated the energy efficiency of a range of household appliances on a scale from A to G, with A being the most efficient. The most recent Energy Labelling Directive (2010/30/EC) defines ratings of A+, A++ and A+++ for a range of appliances, such as household refrigerators and washing machines, as their energy efficiency has improved significantly since the early 1990s.

The first minimum efficiency performance standards (MEPS) were applied to household refrigerators under Directive 96/57/EC of September 1996. The successor to that directive is the Ecodesign Directive (2009/125/EC), first adopted in 2005 and recast in 2009 to make provision for MEPS for both energy-using and energy-related products (such as windows). Under this directive, the European Union introduced product-specific regulations that apply directly in all EU member states. To date, MEPS have been developed for around 20 product groups. In addition to household appliances, the Ecodesign Directive is also applied to industrial equipment.

The Energy Labelling and Ecodesign Directives were implemented in Portuguese National Law, by means of Decree-Law 12/2011 of 24 January (Ecodesign) and Decree-Law 63/2011 of 9 May (energy labelling). Energy efficiency measures concerning appliances, equipment and lighting relate to a considerable extent to the measures stemming from this legal framework and the existing EU regulations respectively for eco-design and energy labelling.

There are also some domestic measures in the lighting sector. For example, Portugal has applied a tax on low-efficiency lamps as a measure to promote the more efficient use of energy and aims to motivate citizens to purchase the more efficient and more economical option. This measure was implemented through Decree-Law 108/2007 of 12 April and Ordinance 54/2008 of 18 January, which define the kind of lamps subject to the tax. The import of low-efficiency lamps is also taxed: incandescent light bulbs are taxed at EUR 0.41 per unit while high-pressure mercury vapour lamps are subject to a tax of EUR 6.77 per unit.

Revenues generated by the tax on inefficient incandescent light bulbs are used to support other NEEAP measures, including the Portuguese Carbon Fund and the Energy Efficiency Fund.

INDUSTRY

A number of measures have been implemented to reduce consumption of energy in industry and services. Among the most significant of these is the Intensive Energy Management Consumption System (SGCIE). The SGCIE, created by Decree-Law 71/2008, is one of the measures integrated in the NEEAP that aims to promote energy efficiency and the monitoring of energy consumption in energy-intensive installations consuming more than 500 toe per year. The SGCIE requires these energy-intensive installations to periodically conduct energy audits in order to determine energy consumption and promote greater energy efficiency, including the use of renewable energy sources.

The operators of the relevant installations are obliged to develop an Energy Consumption Rationalisation Plan (PREN) in order to establish targets for energy and carbon intensity and specific energy consumption. Upon DGEG approval, the PREN becomes an Agreement for Rationalisation of Energy Consumption (ARCE).

The SGCIE divides energy-intensive installations into two categories:

- Energy-intensive installations with annual consumption over 500 toe and less than 1000 toe, are required to carry out energy audits every eight years and meet a target of a 4% reduction in energy intensity while maintaining carbon intensity.
- Installations with annual consumption equal or over 1 000 toe are required to carry out energy audits every eight years and must meet a target of a 6% reduction in energy intensity while maintaining carbon intensity.

Facilities participating in the EU-ETS or facilities with annual energy consumption lower than 500 toe are not covered by the SGCIE but both may participate on a voluntary basis.

The ARCE provides facility operators excise duties exemptions (ISP) on oil and energy products and the possibility to apply for incentives on energy audit costs and on investments in energy management and monitoring equipment. Energy audits, energy consumption rationalisation plans and biennial execution and progress reports have to be prepared by competent auditors recognised by DGEG according to their professional qualifications. This is governed by specific legislation (Law 7/2013 of 17 January and Order 11/2015).

By July 2015, there were 371 qualified auditors recognised and DGEG had approved 923 audits (including second audits) and PRENs, which became ARCEs. The implementation of these ARCEs is projected to lead to a reduction of 104 956 toe/year in total energy consumption and 283 tCO_2 reductions. It is expected that a new scheme will be approved in the near future, which will extend the scope of the SGCIE.

Combined heat and power

Industrial combined heat and power (CHP) production plays a significant role in achieving greater energy efficiency in a number of industrial sectors in Portugal, and particularly, within small and medium-sized enterprises (SMEs) and energy-intensive industries. Since 2009, there has been a change in the legal framework applicable to CHP for the purpose of transposing EU Directive 2004/8/EC and to promote the development of high efficiency co-generation.[4] The modification of the CHP legal framework has been defined by Decree-Law 23/2010 and Ordinance 140/2012 established the new regime applicable to new CHP projects; a transition regime for plants is already in operation but its success to date has been limited.

Consumer behaviour

Behavioural activities include measures aiming to promote energy-efficient consumer habits and attitudes, such as recommending more efficient consumer goods, by means of communication and awareness campaigns.

Smart grids

Smart grids include electricity networks (transmission and distribution systems) and interfaces with generation, storage and end-users. In Portugal, the transition to a smarter distribution grid is led by EDP Distribuição by means of the InovGrid project for the development and implementation of smart grid concepts and technology. An important element of InovGrid has been the roll-out of smart grid infrastructure in the Portuguese municipality of Évora in 2011. The infrastructure spans the entire municipality, reaching around 32 000 electricity customers. The deployment in Évora has demonstrated many of the benefits of smart grids.

The outcome of this project has strengthened EDP's business case for smart grids. Accordingly, EDP Distribuição is currently deploying second-generation smart meters to 100 000 customers throughout the country, with the objective of developing the supply chain and improving the integration with existing business processes, in preparation for a future roll-out (currently pending government/regulator decision).

ASSESSMENT

The government has set national targets for the reduction of primary energy consumption by 25% by 2020 and a target for the reduction by 30% in energy consumption of public administration. The main instrument to implement these targets is the NEEAP, which is to be delivered every third year to the EU Commission. Energy intensity of primary energy use in Portugal is in line with the EU average, but this conceals a less positive result when the final energy intensity is measured. In reality, the country's substantial investments in renewable energy and the lower energy consumption of the residential sector, as compared to the rest of Europe, have masked an energy intensity of the productive economy which is 27% higher than the EU average. This result has reinforced the need to strengthen direct actions regarding final energy consumption.

4. Directive 2004/8/EC of the European Parliament and of the Council of 11 February 2004 on the promotion of co-generation based on a useful heat demand in the internal energy market and amending Directive 92/42/EEC.

Portugal is among those EU member states which have not fully implemented all the requirements of the Energy Efficiency Directive. These requirements include an energy efficiency saving scheme or alternative measures to achieve 1.5% yearly savings from 2014 to 2020. It also requires EU member states to prepare a comprehensive analysis of district heating and cooling (DHC) demand as well as establishing DHC/CHP and waste heat supply potential to cover heat demand. Projections done by DGEG estimate that total final energy consumption in 2020 will be 17 794 ktoe. Although the gap between the target and estimated final consumption during this period is small, the government should quickly identify actions needed after 2016 in order to achieve the 2020 target.

DGEG co-ordinates the implementation of the NEEAP and monitoring energy savings but also sets targets and plans new actions. Different central state organisations and regional energy agencies for energy implement policy actions on a practical level. Regular monitoring and verification of the resources used to achieve energy savings is needed to ensure transparent and cost-effective implementation of the Action Plan. Task-sharing and co-ordination between government bodies should be clear to ensure full and effective monitoring of energy efficiency results and to obtain the necessary data.

The transport sector is responsible for about one-third of final energy consumption and a similar share of CO_2 emissions. In spite of many energy efficiency measures in force, energy consumption in the transport sector increased between 1991 and 2010 but decreased in 2011. Redrafting of the fiscal incentive in 2008 was a success and available data on average CO_2 emissions show positive progress in CO_2 emissions of newly registered cars since 2008 (a reduction of nearly 18%). The mobility/transport sector is not well integrated in the economic development. Public transport is underdeveloped and has led to increasing traffic volumes and congestion in some cities. It is difficult to access data relating to energy consumption from the main stakeholders (EEW, 2013). There is a greater need to encourage modal shift in both passenger transport and freight movement: thus far, programmes in the sector have had limited success. Furthermore, implementation of the measures planned in the NEEAP needs to be better monitored.

Households and SMEs need proper data on their energy use in order to motivate behavioural change or to promote investments in energy efficiency. The Energy Efficiency Directive requires energy companies to give feedback to customers regarding their energy use. The roll-out of smart meters will allow collection of detailed data on the energy use of small consumers. Portugal has undertaken a number of studies in these fields and has conducted a comprehensive field trial of the technology. This information obtained from this work should be utilised to support the roll-out of advanced metering technologies to SMEs and commercial enterprises with a view to supporting their efforts to manage energy demand.

Energy audits of SMEs and the service sector can be used to identify economically feasible investments to improve energy efficiency. This sector of the economy tends to lack expertise/know-how and access to affordable financing sources. ESCOs could be helpful for planning and implementing these measures if lower-cost financial instruments are available. The success of the Eco.AP programme and the future of the ESCO market may depend on the ability of the ESCOs and large energy consumers to raise funds. A guarantee fund that could provide for a commercial bank loan is seen as a crucial next step in the development. National programmes have been typically short-lived in Portugal, which causes instability and contributes to the lack of motivation and reluctance to engage in long-term contracts. In this regard, the government should seek partners, such as the European Investment Bank, to support investments in energy efficiency projects.

RECOMMENDATIONS

The government of Portugal should:

- *Implement in full, without delay, the Energy Efficiency Directive and develop an action plan for the period 2017 to 2020 to ensure the achievement of an overall national 25% energy efficiency target and a 30% target for public administration.*
- *Prepare a coherent monitoring and verification plan of the resources used and energy savings with clear responsibilities and task-sharing for data collection as well as co-ordination to finalise NEEAP reporting.*
- *Continue to implement various measures to improve the energy efficiency of passenger cars and public transport and use taxation to support the purchase of cars with low fuel consumption.*
- *Commence the phased and cost-effective introduction of smart meters across the SME and commercial sectors.*
- *Establish, at reasonable cost, a financing framework for energy efficiency investments in SMEs and boost diverse markets for energy efficiency services.*
- *Develop additional requirements towards near-zero-energy buildings.*
- *Channel EU structural funds or other suitable financing sources to fund initiatives supporting energy-use improvements and innovation for buildings.*

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PART II
SECTOR ANALYSIS

5. RENEWABLE ENERGY

Key data (2014 estimated)

Share of renewable energy: 25.4% of TPES and 61.3% of electricity generation (IEA average: 9.4% of TPES and 22.4% of electricity generation)

Biofuels and waste: 12.6% of TPES and 6.4% of electricity generation

Hydro: 6.4% of TPES and 30% of electricity generation

Wind: 4.9% of TPES and 23.3% of electricity generation

Geothermal: 0.8% of TPES and 0.4% of electricity generation

Solar: 0.6% of TPES and 1.2% of electricity generation

OVERVIEW

Renewable energy has made strong progress in Portugal over the past decade and the country has become one of Europe's leaders in terms of use of renewable energy sources (RES) such as wind and micro-generation. Portugal has ambitions to become a leader in the application of renewable energies and export its knowledge and technology.

SUPPLY AND DEMAND

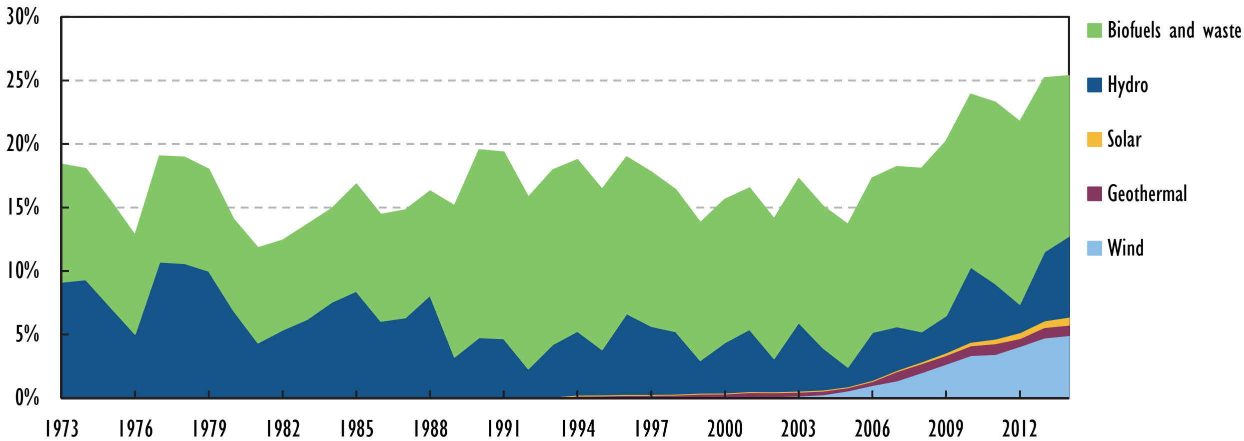
Renewable energy accounted for 25.4% of Portugal's total primary energy supply (TPES) in 2014. This share is made up of biofuels and waste (12.6%), hydro (6.4%), wind (4.9%), geothermal (0.8%) and solar (0.6%).

Renewable energy as a share of TPES has increased from 15.1% in 2004, which is the result of a surge in wind power generation (Figure 5.1). Wind power has increased by a factor of 14 over the past ten years: most of the growth since 2004 is the result of generous government incentives. Electricity from wind slowed down in 2010 and declined for the first time in 2011 (by 0.2%), recovering by 9.7% per year to 2014. In 2004 wind power represented 0.3% of TPES, increasing to 4.9% by 2014.

Solar power has also boomed since 2004 albeit at a slower rate compared to wind – increasing fivefold from 0.1% of TPES to 0.6% in 2014. Geothermal was 125% higher over the same period while hydro was up by 58%, albeit variable year-on-year. Biofuels and waste declined by 7.5% in total during 2004-14, mainly because of a contraction since 2011.

Portugal has the seventh-highest share of renewables in TPES among IEA members, with a second-highest share of wind behind Denmark while the share of geothermal is the fifth-highest. Hydro and solar shares rank as the seventh-highest among IEA members as does the total share of renewables (Figure 5.2).

Figure 5.1 Renewable energy as a percentage of TPES, 1973-2014



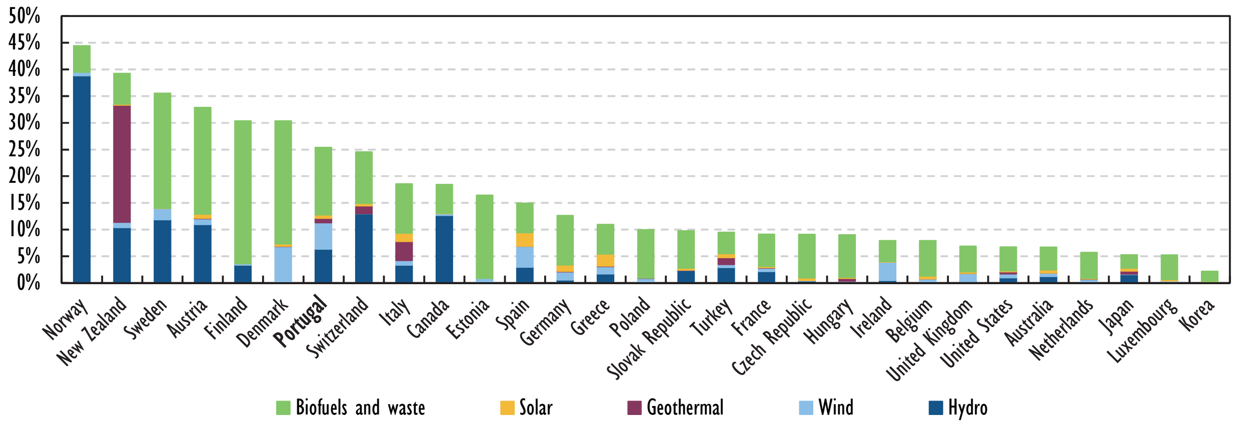
Note: Data are estimated for 2014.

Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Wind, hydro and geothermal energy are used in electricity generation alone. Solar power is consumed in power generation as well as in households and businesses. Almost 27% of biofuels and waste go into electricity and heat production with the remainder used in industry (36.7%), households and businesses (15%) and transport (10.9%).

Electricity from renewable sources amounted to 31.9 terawatt-hours (TWh) in 2014, or 61.3% of total generation. Renewables in electricity generation include hydro (30%), wind (23.3%), biofuels and waste (6.4%), solar (1.2%) and geothermal (0.4%). The share of renewables in generation has increased from 28.1% in 2004.

Figure 5.2 Renewable energy as a percentage of TPES in Portugal and IEA member countries, 2014

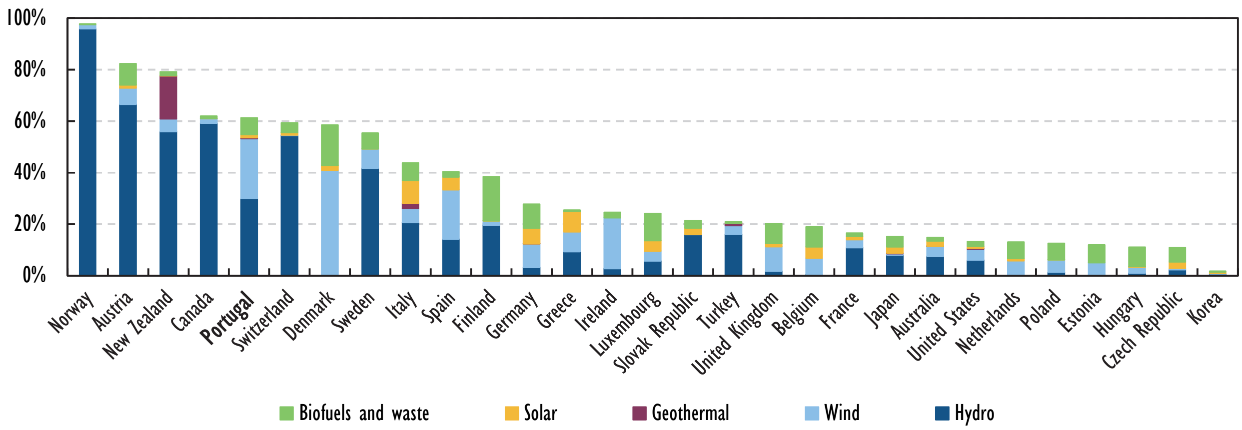


Note: Data are estimated.

Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Portugal is ranked fifth-highest among IEA member countries with regard to the renewables share in electricity generation (Figure 5.3). Portugal's share of wind in electricity generation is ranked the same as the wind share in TPES, second behind Denmark. The share of geothermal is fifth-highest and the share of hydro is seventh-highest, while solar power in electricity generation is fourteenth-highest among IEA members.

Figure 5.3 Electricity generation from renewable sources as a percentage of all generation in Portugal and IEA member countries, 2014



Note: Data are estimated.

Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

INSTITUTIONS

Responsibility for the development of renewable energy policy rests with the **Directorate-General for Energy and Geology (DGEG)**. Some competences are shared between DGEG and the Energy Services Regulatory Authority (ERSE). For example, the additional costs resulting from the application of feed-in tariffs (FITs) under special regime production (SRP) are regulated by ERSE. The regulator, therefore, monitors the SRP and publishes monthly information relating to the SRP. Redes Energéticas Nacionais (REN), the operator of the electricity transmission network, provides access to the network to electricity from renewable sources.

POLICIES AND MEASURES

OVERVIEW

Similar to other EU members, Portugal's renewable energy policy is aligned with its EU 2020 targets. In this regard, Portugal has a binding national target for renewable energy to equal 31% of gross final consumption of energy by 2020. In addition to this overall target, Portugal and other EU member states have a separate binding national target for renewable energy to meet 10% of transport fuel demand in 2020. Beyond 2020, the EU member states have agreed on a target for a 27% share of renewable energy in energy consumption in 2030. The target is binding for the European Union as a whole only. The level of effort to be made by each EU member state to achieve this EU target has not yet been decided.

In general, support mechanisms for renewable energy sources are based on feed-in tariff systems, tax benefits and small levels of investment subsidies. The principal instrument for promoting renewable electricity is the special production regime, whereby electricity produced from renewable energy benefits from a feed-in tariff. Large hydropower plants are excluded from this support mechanism. A simplified licensing procedure and favourable tariffs apply to micro-generating capacity from renewables at household level and mini-generation at a commercial level, now made into small generation and self-consumption.

NATIONAL PLANS

The **National Energy Strategy for 2020** (ENE 2020) was approved by Cabinet Resolution 29/2010 of 15 April, and is a continuation of the previous 2005 strategy (Cabinet Resolution 169/2005 of 24 October). ENE 2020, which was repealed by Cabinet Resolution 20/2013, was based on five main pillars, each containing a focused set of priorities and an outline of enabling measures, including measures relating to investments in renewable energy and new major developments in the renewables portfolio and greater economic and environmental sustainability.

Portugal's targets on renewable energy for 2020 and the policies and measures to meet them were initially laid out in its **National Renewable Energy Action Plan** (NREAP). Portugal submitted its first National NREAP to the European Commission in 2010. Following this, it introduced a number of measures to promote renewable energies, in particular a pilot zone for wave technologies, solar energy technology demonstration projects, and several photovoltaics (PV) power stations in the south of the country. It also developed two industrial wind energy clusters in the north of the country.

The first NREAP established a national 2020 target of 31% of renewable energy in gross final energy consumption. In sectoral terms, Portugal aims to achieve a share of 10% of renewable energy in the transport sector, 30.6% in the heating and cooling sector and 60% in the electricity sector. For the purposes of the NREAP, however, the share in the electricity sector will correspond to 55.3%, taking into account pumped production in gross final energy consumption as per the methodology defined by the directive (NREAP 2010).

The first NREAP, however, was prepared under a different economic context and the plans contained therein were placed under review. This review concluded that the outgoing plans for both renewable energy (NREAP 2010) and energy efficiency (NEEAP 2008-15) needed to be adjusted in order to intensify efforts to promote energy efficiency programmes, as opposed to a higher-level investment in generation, without compromising the objectives originally established for renewable energy.

Accordingly, updated NEEAP and NREAP were approved by Cabinet Resolution 20/2013, of 10 April 2013. This Cabinet Resolution approved the NEEAP for the period 2013-16 and the NREAP for the period 2013-20 and repealed the ENE 2020. The integration of the NEEAP and NREAP allowed greater alignment of national and European energy objectives, reduced investment costs while increasing national competitiveness.

The new NREAP was prepared taking into account a perceived oversupply of electricity production resulting from a reduction in demand. Furthermore, more selective criteria were established for the selection of technologies, with a focus on those offering greater maturity and economic rationality, or the more self-sustaining as the ones based on hydro, wind and solar sources. Thus, the Cabinet Resolution 20/2013 approved NREAP 2020, aiming to adjust the energy supply to the demand and to review the objective of each RES in the national energy mix, taking into account, namely, the technology's maturity and its competitiveness.

The NREAP 2020 foresees an 18% reduction in the total installed capacity target for renewable energy by 2020, without prejudice to the accomplishment of the targets, since the share of electricity produced from renewable sources in NREAP 2020 is higher than in NREAP 2010 (59.6% vs. 55%), as well as the global target (34.5% against the target of 31%).

Following approval of NREAP 2020, Portugal set out its strategy for the promotion of renewable energy, in which concerns relating to overcapacity in electricity supply were addressed. Under this new scenario, the share of these energy sources in the electricity sector in 2020 is now projected to be about 60%. Accordingly, 15 800 megawatts (MW) of installed renewable energy capacity is expected by 2020 (18% lower than NREAP 2010 projections).

By the end of 2013, installed hydropower capacity was 5 536 MW (of which 4 975 MW was in plants with a capacity of over 10 MW). By 2020, hydropower capacity is expected to increase to 8 940 MW, including more reversible capacity. New reversible capacity is important as it facilitates the creation of synergies between hydro and wind, in order to optimise local resources and ensure more effective management of the electricity generation system.

ELECTRICITY

In Portugal, RES generation output is legally acquired by the last resort supplier from the generators, applying a FIT appropriate to the generation technology. The energy price paid by the last-resort supplier may be one of either:

- the price resulting from the application of the FIT published by government
- the price resulting from the bids submitted during the tender process for the allocation of interconnection points for wind and forest biomass energy facilities.

In this tender process, the discount on the tariff published by the government is one of the weighted factors. The prices published by the government at present are based on an avoided costs methodology (i.e. the cost of new generating facilities, fuel and environmental impacts economic evaluation). The remuneration the generator receives therefore depends on factors such as the time it takes to build the capacity and the load profile of the energy. The last-resort supplier is obliged to offer energy bought to RES generators in the market mechanisms, i.e. the Iberian Electricity Market (MIBEL) daily spot market (since 2011), and regulated auctions for forward contracts (since 2012). Therefore, the last resort supplier operates as an aggregating agent.

Access to the network is guaranteed and the connection procedure is non-discriminatory (there are, however, limitations to the nominal power of each renewable energy generator which can be connected at each point of the network, depending on the grid capacity to accommodate these connections).

The costs of promoting RES (the difference between costs of acquiring energy from the generators and the revenues from the market are imbedded in the regulated allowed costs of the last-resort supplier and presented to the regulator ERSE. It is also worth noting that there are other financial mechanisms available to support projects under research, development and demonstration (RD&D) programmes related to renewable energy, such as the Energy Efficiency and the Renewable Energy Fund (FAI), the Portuguese Carbon Fund (FPC) and the QREN (under the Regional Operational Programmes and COMPETE – Factors of Competitiveness).

Wind energy, as a result of its technological maturity, is one of the main components of electricity supply. Over the past decade, there has been strong development in wind power in Portugal, with installed capacity increasing from 1 063 MW in 2005 to 4 726 MW in 2013. Growth of installed capacity by 2020 is likely to slow down, given lower forecast energy demand. In this scenario, it is expected that total installed capacity of wind power will be 5 300 MW by 2020, of which 5 273 MW will be onshore.

Solar energy will play a role in increasing decentralised electricity production. To this end, in addition to continuing the micro-generation programme, a new mini-generation programme was created in 2011, with a view to installing approximately 250 MW of new capacity by 2020. This mechanism aims the service sector (schools, public buildings and markets) and the industrial sector, for a new range of capacities of up to 250 kilowatts (kW), according to the technologies involved. Recently, the possibility for self-consumption was introduced, which will expand the penetration of renewables, mainly solar, from very small to large capacities, with the possibility of exporting the surplus to the grid.

The construction of solar plants of greater capacity will depend on the cost evolution of each technology. Under a PV tender procedure launched in 2010, total capacity of 140 MW was awarded (70 lots of 2 MW each, out of 75 available). On the other hand, it is expected that, by the end of 2015, pre-commercial concentrated solar PV units will be installed, aiming to demonstrate the economic viability of this technology. Regarding the concentrated solar thermoelectric (CSP), it is expected to be more 50 MW by 2020.

Biomass can make an important contribution to electricity production in Portugal. By the end of 2013, total installed biomass capacity for the production of electricity was 656 MW. This figure includes municipal solid wastes (MSW), of which 447 MW is produced in combined heat and power (CHP) production plants. By 2020, it is expected that the installed capacity in this technology should meet 769 MW.

Portugal also promotes the use of biogas. By the end of 2013, there was 67 MW of biogas capacity, more than the 220 target of 60 MW of biogas capacity. The injection of biogas into the natural gas network, in the form of bio-methane is also being considered by policy makers. This possibility has been provided in Decree-Law 231/2012 of 26 October, which amended Decree-Law 140/2006 of 26 July.

There is significant ocean and wave energy potential available along the Portuguese coast and the government is promoting investment in these technologies. To that end, a pilot zone has been created for the installation of the first prototypes. The development of this project has been supported by the decision to award a concession for the zone alongside a definition of the cost-sharing arrangement for electricity network infrastructure investments, as well as the development of associated technologies. Outside this pilot zone, there is a near-shore plant, on the island of Pico in the Azores. This plant, which became fully operational in 2005, uses an oscillating water column system. There is also a pilot project in Peniche area based on WaveRoller technology.

Portugal's potential conventional geothermal energy is limited to the Region of Azores, where a capacity of 29 MW has been installed on the island of São Miguel. Enhanced geothermal systems (EGS) technology, which makes it possible to use the thermal energy of high-temperature rocks (dry rocks) that exist at great depths to produce electricity, may in the future be tested in Portugal. This technology is believed to be the most suitable for the purpose of exploring the geothermal potential in mainland Portugal.

SUPPORT COSTS FOR RENEWABLE ELECTRICITY

In January 2015, the Council of European Energy Regulators (CEER) published its latest update to the regular *CEER Status Review of Renewable and Energy Efficiency Support Schemes in Europe*. The aim of the review was to assess the impact of the expenditure to promote renewable energy through national support schemes at aggregate level for each country, on a comparable basis.

In 2012, according to the report, Portugal generated 14 TWh of renewable electricity that received support. This represented 30% of gross electricity generation, the second-highest share in a comparison of 22 European countries, after Denmark (56%) and ahead of Spain (22.9%). The average for the countries studied was 12.6% (CEER, 2015). In 2013, this number increased to 16.59 TWh.

Table 5.1 Support for renewable electricity by technology, 2012

Technology	Electricity generated receiving support (TWh)	Renewables incentive costs (EUR million)	Cost (EUR/MWh)
Other biogas	0.20	13.27	65.57
Hydropower	0.62	29.71	47.97
Renewable CHP	1.79	96.19	53.77
Solar – PV	0.22	66.41	300.37
Biodegradable waste	0.74	52.05	70.17
Other solid biomass	0.39	15.73	39.87
Offshore wind	0.003	0.36	123.74
Onshore wind	10.01	507.43	50.67
Total (average cost)	**13.97**	**781.15**	

Source: CEER (2015), *Status Review of Renewable and Energy Efficiency Support Schemes in Europe in 2012 and 2013*, Council of European Energy Regulators, Brussels.

In 2013, the weighted average support level for renewable electricity in Portugal ranged from EUR 53.49 per MWh for onshore wind power to EUR 293.67 per MWh for solar power (photovoltaics and concentrated solar power combined). For hydropower, the weighted average support was EUR 54.89 per MWh and for bioenergy it was EUR 65.48 per MWh. The weighted average level of support was EUR 58.94 per MWh of renewable energy generated compared to EUR 55.85 per MWh in 2012 and an average among the countries surveyed of EUR 110.65 per MWh.

Table 5.2 Support for renewable electricity by technology, 2013

Technology	Electricity generated receiving support (TWh)	Renewables incentive costs (EUR million)	Cost (EUR/MWh)
Other biogas	0.24	17.13	71.89
Hydropower	1.32	72.88	54.89
Renewable CHP	1.86	109.25	58.69
Solar PV	0.26	75.74	293.67
Biodegradable waste	0.68	52.00	76.59
Other solid biomass	0.47	21.69	46.09
Offshore wind	0.004	0.51	131.40
Onshore wind	11.75	628.51	53.49
Total (average cost)	**16.58**	**977.71**	

Source: CEER (2015), *Status Review of Renewable and Energy Efficiency Support Schemes in Europe in 2012 and 2013*, Council of European Energy Regulators, Brussels.

Support costs for renewable electricity amounted to EUR 781.15 million, or EUR 16.76 per MWh of all electricity generated (from renewables or other) in 2012. This was the sixth-highest in the CEER cross-country reviews and to an average of EUR 13.68 per MWh. In 2013, the total support costs in Portugal increased to EUR 977.71 million, largely the result of more hydro and onshore wind power generation.

THE TARIFF DEFICIT AND REFORM OF THE SUPPORT MECHANISMS

The Portuguese electricity tariff deficit is substantial: the total accumulated tariff debt was estimated by the regulator at EUR 3.7 billion (2.2% of GDP) at the end of 2013; according to other government estimates, it could be as high as 2.6% of GDP (EUR 4.4 billion).[1] One of the more recent drivers of the deficit has been higher subsidies to renewable electricity.

In recognition of the scale of the problems that tariff deficit was imposing on the sustainability of the Portuguese electricity sector and the economy, the government and the regulator introduced a number of measures to reduce the liability over the next ten years. The government’s objective is to eliminate the tariff debt by 2020.

A first package of measures, introduced in 2012, focused on feed-in tariffs in wind-power generation and small hydro, on feed-in tariffs and conditions for co-generation, on revision of investment incentives for hydropower (power guarantee) and on renegotiation of specific elements of the CMEC scheme. The savings associated with this first package of measures were projected to amount to EUR 2.0 billion by 2020.

A second package of measures was proposed in 2013, which, taken together with the first package, was projected to reduce the outstanding debt by 2020 to between EUR 0.6 billion and EUR 0.7 billion. A number of measures in this package have an impact on renewable energy supply, including a modification of the remuneration regime for public domain hydro terrains.

The Law 83-C/2013 of 31 December, which approved the state budget for the year 2014, set in Article 228 the extraordinary contribution on the energy sector, with the purpose of financing mechanisms to promote systemic sustainability of the energy sector and to contribute to the reduction of the tariff debt of the national electricity system. By Article 237 of Law 82-B/ 2014 of 31 December, the extraordinary contribution of the energy sector was extended to the year 2015.

The results of these measures have been mixed so far. In 2014, the European Commission argued that rent-reducing measures implemented to eliminate the tariff debt by 2020 and ensure the sustainability of the system appear to be insufficient (EU, 2014). In response, a third package of measures was introduced to tackle remaining excess rents in the energy sector, improving competitiveness of the sector and achieving a more balanced distribution of the economic surplus among the different stakeholders.

The reforms

Feed-in tariffs (FITs) for electricity produced from renewable sources was until recently treated under the Special Production Regime, established by Decree-Law 312/2001

1. Ministry for Environment, Spatial Planning and Energy website, www.portugal.gov.pt/pt/os-ministerios/ministerio-do-ambienteordenamento-do-territorio-e-energia/mantenha-se-atualizado/20140129-maote-ar-energia.aspx, last accessed on 1 July 2015.

of 10 December. Until 2012, producers were remunerated on the basis of a formula established by means of separate legislation (Decree-Law 189/88 of 27 May, and updated by Decree-Law 225/2007 of 31 May). The FIT were updated at suitable intervals, for the purpose of reflecting the latest investment and operational costs of each technology, as well as inflation and energy prices.

Access to this support mechanism was subject to a limit, which was determined by the technical ability of the electricity transmission and distribution networks to absorb new capacity. Nonetheless, once granted access to the networks, the total amount of production that could benefit from the FITs was limited to an overall energy value or a specific number of years (generally 15 years), whichever was reached first. After this, the plants sold their output on the open market. The FITs could also be combined with other benefits and incentives have been introduced to support innovation and trials of new technology.

More recently, as a result of Portugal's changing economic circumstances and the accompanying decline in electricity demand, the government conducted a series of comprehensive structural reforms in a number of sectors, including the electricity sector. One of the outcomes of this process was a new regulatory framework (Decree-Law 215-A/2012 and Decree-Law 215-B/2012, of 8 October), which allowed anyone producing electricity from renewable sources to sell it in the open market.

For wind energy producers, a revised feed-in tariff scheme was negotiated in March 2013. The main consideration was to balance the need for cost reductions with investor certainty. Producers could voluntarily opt into the new scheme and the majority of producers have chosen to do so. As a result, they benefit from guaranteed prices for an additional five or seven years beyond the 15-year validity of their original remuneration scheme, after which they would otherwise be remunerated at market prices. In return for this extension, producers that opted into the new scheme have to pay a contribution to the maintenance of the national electricity system until 2020, and accept lower feed-in-tariffs, which are based on the daily average wholesale market price subject to a floor and cap. The definition of the floor, however, significantly reduces the link to market prices unless the latter rise significantly in the future, because the floor is above the average market price prevalent in 2013. Cost reductions have been more successful for the scheme supporting micro- and mini-production of renewable electricity, which saw a reduction of 30% in feed-in tariffs in 2013 (OECD, 2014).

In the solar energy sector, the FIT for concentrated PV power plants of up to 1.0 MW capacity up to a market total of 11 MW will receive an average of EUR 380 per MWh for 12 years (Ordinance 1075/2010 of 15 October, revised by the Ordinance 250/2011 of 24 June). Also, for existing and still valid tender procedures (forest biomass, wind, hydro and PV) the previous FIT remains valid until the completion and fulfillment of the established preconditions:

- Wind power "Phase C": 13 lots available for public auction within the range of 6 megavolt-amperes (MVA) to 50 MVA, up to a total of 200 MVA, discounted in the order of 5% to 23% on a tariff of an indicative average FIT of EUR 75 per MWh.
- Hydroelectric plants of up to 10 MW each to a total of 150 MVA: indicative average FIT of EUR 91-95 per MWh for a period of 25 years (Decree-Law 126/2010 of 23 November).
- Solar photovoltaics (PV or CPV) of 2.0 MVA each, to a total of 150 MVA: an indicative average of EUR 257 per MWh for a period of 20 years and for the first 34 GWh per installed megawatt (Decree-Law 132-A/2010, of 21 December).

- Forest biomass: an indicative average of EUR 119 per MWh for a period of 25 years (Decree-Law 5/2011, of 10 January revised by the Decree-Law 179/2012 of 3 August, and by Decree-Law 166/2015 of 21 August).

Ordinance 243/2013, revised by ordinance 133/2015 of 15 May, also established a procedure to allow the modification of renewable energy power plants in the licensing process or already in operation, namely, installed and injection power increase, change of technology (the same renewable source is maintained) and location. The acceptance of the changes depends on the offer of a discount to the applicable FIT. These procedures allowed producers using technologies such as solar thermoelectric (parabolic dishes, concentrated tower, etc.) that request change to PV or CPV to be awarded a FIT of EUR 151 per MWh in 2013, EUR 106 per MWh in 2014, and under EUR 95 per MWh in 2015.

Regulation Decree-Law 35/2013 has established an alternative voluntary compensation regime applicable to wind farms and amended the existing small hydro power plants (SHP) support regime in order to reduce the electricity tariff deficit. The voluntary financial contribution, applied to wind farms receiving the older FIT in return for a feed-in premium, was the outcome of negotiations between the government and wind promoters, and was interpreted as a compromise solution that avoided retrospective changes. The compensation regime for SHP, which has reduced by ten years the eligible period for SHP to benefit from FIT, did not receive the agreement of producers.

REGIONAL INTERCONNECTIONS AND ENERGY POLICY

The Iberian Peninsula has ample wind and solar resources, but it is located far from the large consumption centres in Central West Europe (CWE). The conclusions of the European Council of October 2014 include the commitment to reach a 10% share of electricity interconnection capacity in installed generating capacity by 2020. The European Council also decided to increase to 15% the interconnection target by 2030.

More interconnections between France and Spain are needed in order to integrate renewables from the Iberian Peninsula into CWE in an efficient manner. Completing planned interconnection projects between the region and France will enable greater electricity trade between the two. Portugal and Spain will be able to export excess renewable energy, in particular wind, solar and hydropower. In contrast, on occasions when wind power generation is low or hydro resources are tight, less expensive power imports from France could flow in the opposite direction.

The region remains in several ways isolated. This is true for cross-border transmission capacity and, less so, for market rules that differ from the rules in the CWE region. More cross-border capacity is needed for accommodating renewables efficiently. Overhead lines would be a relatively inexpensive solution, but overcoming local opposition calls for using more expensive underground or undersea lines. From a European energy policy perspective, developing interconnections between the Iberian Peninsula and France needs to be supported if the policy targets for 2020 and 2030 are to be met.

Cross-border interconnections are a priority of EU energy policy. In June 2015, the European Commission, France, Portugal and Spain signed a memorandum of understanding creating a High-Level Group for South-western Europe on interconnections. This High-Level Group will prepare a plan to implement the so-called Madrid Declaration, signed on 4 March by the European Commission President and the heads of state of France, Portugal and Spain. The High-Level Group considers both gas and electricity infrastructure and will ensure regular monitoring and provide technical assistance to the countries. To support the work of this Group, the Commission has launched two studies on the benefits, costs and the technical possibilities for further electricity and gas interconnections between the region and the rest of Europe.

MICRO-GENERATION AND MINI-GENERATION

Micro-generation Law (Decree-Law 363/2007, of 2 November, revised by the Decree-Law 118-A/2010 of 8 October and by the Decree-Law 25/2013 of 8 March) regulates small-scale production of renewable electricity (up to 5.75 kW). It provides for simplified licensing procedures for local grid-connected, low-voltage, small and/or residential energy producers. The licensing of solar, wind, hydro, biomass and non-renewable CHP is conducted online via Internet, using the System of Registration of Micro-generators (SRM). The **micro-generation** law defines two regimes:

- The **general regime** is applicable to any type of micro-generation up to a limit of 5.75 kW (25 amperes single-phase).
- The **special regime** is applicable to renewable electricity production up to a limit of 3.68 kW (16 amperes single-phase) where a reference FIT is established and applied to each technology according to a different percentage: 100% for solar, 80% for wind, 40% for hydro, 70% for biomass CHP and 40% for non-renewable CHP. The reference FIT for new producers reduces each year and, once defined, is valid for 15 years divided into two periods , one of eight years and another for the remaining seven years with different values for each. In 2010, the value for the first period was EUR 400 per MWh and EUR 240 per MWh for the second. The mechanism includes an annual reduction rate of EUR 20 per MWh. In 2014, the reference FIT was EUR 66/145 per MWh for PV and EUR 218/115 per MWh for other technologies. By mid-2014, there were 25 000 installations in the special regime and 900 in the general regime delivering a total capacity of 93 MW and 4.0 MW, respectively.

Mini-generation Law (Decree-Law 34/2011 of 8 March, revised by the Decree-Law 25/2013 of 19 February) regulates the small-scale renewable energy generation (from 5.75 kW to 250 kW). It also provides for the same simplified licensing procedures for local grid-connected, low- or medium-voltage, small/commercial/industrial energy producers. The licensing of solar, wind, hydro, biogas and biomass is conducted online via internet, using the System of Registration of mini-generators (SRMini).

The **mini-generation** law defines two regimes:

- The **general regime** is applicable to any type of renewable energy generation technology up to 250 kW.
- The **special regime** is applicable to any type of renewable energy generation technology up to 3.68 kW (16 A single-phase). A reference FIT which is established and applied to each RES according to a different percentage: 100% for solar, 80% for wind, 50% for hydro, 60% for biomass and 60% for biogas. The reference FIT for new producers are reduced each year and, once defined, is valid for 15 years. In 2011, the value was EUR 250 per MWh, with an annual reduction rate of 14%. In 2014, the reference FIT was EUR 105.7 per MWh for PV and EU 158.6 per MWh for other technologies. By mid-2014 there were 1 200 installations in the special regime delivering a total capacity of 52 MW.

Grid access is available to all producers under both regimes. The distribution system operator (DSO) or transmission system operator (TSO) is obliged to provide grid connection information so that producers are able to include this information within their licensing request. In September 2014, the government approved a decree law that aims to merge the micro-generation and mini-generation framework, and to develop generation for self-consumption, using simplified licensing procedures and reducing the regulatory burden.

The new regulatory framework (Decree-Law 153/2014 of 20 October) is applicable to small-scale RES generation with grid injection and with a FIT (up to 250 kW) and to generation based on any kind of source for own consumption (no capacity limit). It provides for the same simplified licensing procedures as the previous programmes of micro- and mini-generation for local grid-connected energy producers or off-grid using self-consumption. Licensing is conducted online via Internet, using the Electronic System of Registration of Generation Units (SERUP), allowing the two regimes:

- The **small generation** is applicable to any type up to a limit of 250 kW, where a reference FIT is established and applied to each RES according to a different percentage: 100% for solar, 90% for biomass and biogas, 70% for wind and 60% for hydro. The reference FIT for new producers in 2015 is valid for 15 years, and has a value of EUR 95 per MWh, to which EUR 5.0 per MWh are added if there is 2 m2 of solar thermal panels in the consumer's installation or of EUR 10 per MWh if there is an electric vehicle charging power outlet connected to the mobility grid in the consumer facility.
- **Self-consumption** is applicable to any kind of source since it does not benefit from a FIT, and has the possibility of injecting the surplus into the grid, which if paid by the last-resort supplier at 90% of the average monthly market price. Optionally, renewable energy generators in self-consumption (either grid connected or off-grid) can also trade the electricity surplus or the generated electricity by green certificates.

The self-consumption also has a sustainability mechanism to compensate the national electric system thru the general and economic interest costs (CIEG). This monthly fee is paid by the generator and depends on some factors such as the installed capacity, the value that allows the compensation of the CIEG for the self-consumption unit (established and published by ERSE), and the total installed capacity of self-consumption in the national electricity system (with 0%, 30% or 50% for an installed capacity less than 1%, from 1% to 3% and above 3%, respectively).

HEATING AND COOLING

In terms of incentives for use of solar systems for domestic water-heating, the Portuguese government launched a programme (**Solar Thermal 2009**) to support the installation of solar thermal collectors in 2009. The incentive programme applies to the purchase of a solar thermal "kit", comprising panels and ancillary equipment, installation, yearly maintenance for six years, and a six-year guarantee. In its initial phase, the programme was only aimed at households and state support consisted of a subsidy of EUR 1 641 for each installation. Three banks (Caixa Geral de Depósitos, Millenium and BPI) offered special preferential-rate financing programmes for those wishing to take a loan to cover the remaining cost of the solar thermal system. In addition, the incentive scheme can be combined with existing tax credit provisions for the installation of such systems. Individuals could apply for the scheme until 31 December 2009 or until the exhaustion of the state funds provided for the scheme (EUR 100 million).

In a second phase, the programme was expanded to private social charitable institutions (Programme for Social Change and Innovation, PSCI) and to sports associations, where a subsidy up to 65% of the value of the investment was available. In 2010, two new regulations were created within the context of the National Strategic Reference Framework (QREN) to support the installation of solar thermal systems:

- The **System of Incentives to Qualify and Internationalise Small and Medium-sized Enterprises (SMEs) – Diversification and Energy Efficiency** was dedicated to SMEs and sought to support projects that include investments in installing solar thermal systems for domestic water-heating or climate control.
- The **Regional Operational Programmes (POR) for Mainland Portugal** was aimed at promoting decentralised energy conversion systems and systems using energy supported by a process of energy audits, more specifically the use of solar thermal energy to produce hot water for domestic use.

This type of equipment also benefited from tax incentives, both in terms of value-added tax (VAT) where this equipment is subject to an intermediate rate of 13% (versus the general rate of 21%), as well as in terms of income tax, where it was possible to deduct up to EUR 803 of the value of acquiring such equipment from taxes.

Moreover, the **Energy Efficiency Fund** launched several co-financing calls in 2012 for households, industry and the public sector. The call at household level – Efficient Building 2012, provided subsidies to investments in solar thermal installations, while the call for the public sector only included funding for energy audits.

This sector is also supported, albeit indirectly, by means of the **Micro-production Regime** as electricity producers have to install a minimum of 2 m2 of solar thermal panels or a biomass boiler (with equivalent thermal energy production) as a counterpart to be entitled to the FIT.

New regulations on the energy certification of buildings should play an important part in the advancement of space- and water-heating and environment technologies, based on the use of renewable energy, in particular by using solar thermal collectors, boilers and heat exchangers, biomass and heat pumps.

The **National Building Energy Certification and Internal Air Quality System** (SCE) programme provides benefits, in terms of classification, for buildings that use renewable energy for climate control or for domestic water-heating, thereby encouraging the use of renewable energy for thermal purposes in buildings. Within the scope of these regulations, the use of renewable energy is voluntary, with the exception of domestic water-heating. It is possible to install, in place of solar thermal collectors, alternative systems using renewable energies that aim to ensure, on an annual basis, that the energy equivalent to the solar thermal system is obtained, such as boilers or heat exchangers that use biomass or heat pumps with a minimum coefficient of performance (COP) of 2.3.

TRANSPORT FUELS

The use of biofuels in transport is based on an obligation under the EU Renewable Energy Directive (2009/28/EC) to supply 10% of road transport energy needs from renewable sources by 2020. The previous, but non-binding, EU target was for a 5.75% share for 2010. Cabinet Resolution 20/2008 of 4 January established an ambitious 10% target for 2020.

The profile of transport fuel consumption in Portugal favours diesel and local refineries produce an excess of petrol and a deficit of diesel. Portugal, therefore, based its efforts on promoting biofuels and on the production of diesel substitutes. Hence, in order to help achieve this target, Decree-Law 49/2009 of 26 February established a compulsory biofuels target for the road diesel: 6% by volume for 2009 and 10% for 2010.

This obligation, however, was limited by the maximum content of fatty acid methyl esters (FAME) specified in standard EN 590 (this value being set at 7% by volume in 2010). The market for rich blends of biodiesel (B10, B15 and B20) did not develop and, as a result, Portugal was unable to achieve its ambitious 10% target set by the government.

With the end of the support mechanism for biofuels set by means of Decree-Law 62/2006, 66/2006 and 49/2009 on 31 December 2010, a new mechanism was drawn up to be applied until 2020, under EU Directive 2009/28/EC on the Promotion of the Consumption of Energy from Renewable Sources.

Decree-Law 117/2010 of 25 October amended by Decree-Law 6/2012 of 17 January, and Decree-Law 224/2012 of 16 October, define the current mechanisms to support biofuels in force up to 2020. A new model of support based on mandatory limits for biofuels incorporation for the years 2011 to 2020 was outlined in this new Decree-Law, which established sustainability criteria for the production and use of biofuels and bio-liquids. The statute establishes, for the entities that introduce biofuels in fuels used in the transport sector, mandatory targets, by energy content, for the incorporation of biofuels in fuels in this sector (petrol and diesel):

- 2011 and 2012 – 5.0%
- 2013 and 2014 - 5.5%
- 2015 and 2016 – 7.5%
- 2017 and 2018 – 9.0%
- 2019 and 2020 – 10%.

Compliance with these targets is satisfied by biofuels titles (TdB), which are issued by the Coordinating Entity for the Compliance with Sustainability Criteria (ECS) on biofuels. Each tonne of oil equivalent (toe) of sustainable biofuels is equivalent to one TdB. This new decree law also sets a requirement for the incorporation of 2.5% in energy content of biofuel replacements in gasoline, for the quantities of petrol placed in consumption for the years 2015 to 2020 and, until 2014, a specific annual goal of a minimum of 6.75% (by volume) of biodiesel incorporated in diesel.

Table 5.3 National mandatory targets for biofuels, 2010-13

Targets	Unit	2010	2011	2012	2013
FAME in diesel	% (by volume)	6.75%			
Biofuels in petrol	% (by energy content)	-	-	-	-
Biofuels in road transport fuels (petrol and diesel)	% (by energy content)	-	5.0%	5.0%	5.5%

Source: Decree-Law 117/2010 of 25 October.

This current scheme also lays out also a specific mechanism to support the production of biofuels from wastes, residues, non-food cellulosic material and ligno-cellulosic material, once those biofuels benefit from a double-counting provision (2.0 TdB instead of 1.0 TdB per toe of biofuel).

Table 5.4 Estimate of the annual amount of tax exemptions granted to biofuels (corresponding to ISP tax exemption), 2009-13

Estimate of cost with tax exemptions	2009	2010	2011	2012	2013*
Small dedicated producers (EUR 000)	2 061	1 644	1 758	1 808	2 071
Larger producers (EUR 000)	77 140	100 518	0	0	0
Total	79 201	102 162	1 758	1 808	2 071

* Provisional data.

Source: DGEG, IDR country submission.

This statute also provides that small dedicated producers can continue to benefit from excise tax (ISP) exemption under the Code of Excise. The TdBs corresponding to the biofuels introduced into consumption by small producers revert to DGEG and can be auctioned. The resulting revenues are added to the Energy Efficiency Fund (FEE). The TdB auctions conducted by DGEG in 2014 and 2015 resulted in a significant income for the FEE of around EUR 2.78 million and EUR 3.02 million, respectively. The auction conducted in 2014 was for biofuels (with TdB) introduced into the market in 2011 and 2012, and the 2015 auction was for biofuels (with TdB) consumed in 2013.

Also, in order to increase the use of renewable electricity in the road transport sector, the government recently approved (Commitment to Green Growth) several fiscal incentives for electric vehicles, including a subsidy for the purchase of an electrical vehicle when scrapping an old conventional one.

ASSESSMENT

Since the last review, Portugal has continued to experience growth in the renewable energy sector and its contribution to TPES in 2014 was 25%. The largest percentage contribution of renewable energy to supply is in the electricity sector where it provided a 61% contribution to final electricity supply. Hydro and wind power made the leading contribution with 30% and 23% respectively, the latter being the second-highest wind energy contribution to national annual electricity demand among IEA member countries worldwide.

Instantaneous and daily renewable electricity output regularly exceeds national demand and this is managed through a combination of electricity exports and pumped storage. Maximum instantaneous wind energy penetration reached a record level, − 90% of demand − in 2013 and it is evidence of a coherent approach to planning by the government and the electricity sector that such high levels of variable renewable generation are accommodated without curtailment of output.

The increase in renewable energy penetration has produced multiple benefits. Dependence on imported fossil fuels decreased from 83.3% of TPES in 2008 to 71.5% in 2013. The CO_2 intensity of the electricity sector declined from over 600 gCO_2/kWh in 1999 to around 230 gCO_2/kWh in 2013. Renewable energy has therefore contributed to two of the three fundamental energy policy goals of energy security, sustainability and competitiveness. On competitiveness, renewable electricity generation with priority despatch reduces wholesale electricity market prices by displacing the most expensive fossil fuel-fired generation. Any incremental cost of renewable electricity feed-in tariffs above wholesale market prices is, however, recovered through a levy on final consumers. This cost made a significant contribution to the accumulated (unrecovered) electricity tariff deficit and negotiated reforms of the electricity feed-in tariff regime to address this involved reduced feed-in tariff rates and extension to tariff periods. The extended tariff periods are appropriate in terms of plant operational life and an increasing maintenance cost for a wind generation plant towards the end of its life.

It is within this context that Portugal will deliver its obligations relating to its binding EU 2020 renewable energy target of 31% renewables in gross final energy consumption, including the mandatory EU-wide target of 10% renewables in transport. In 2013, the country revised its 2010 NREAP, to take account of previous reduction in national energy demand and future NEEAP impacts upon energy consumption. The revised plan indicates that the target will now be met from a 59.6% renewables contribution to electricity demand, a 35.9% contribution to heating and cooling and an 11.3% contribution to the transport sector. The NREAP provides a trajectory, which indicates that the EU target may largely be met by 2017-18 and states that, according to demand growth, a "margin of safety" of between 0.7% and 3.5% over the targeted 31% is included in the plan to avoid extra compliance costs for "the economy, companies and families".

The key additional investments to deliver upon these targets are the construction of approximately 800 MW of additional wind power, 3 337 MW of hydropower, including reversible hydropower, and 1.2 million m2 of solar heating panels. The latter is expected to be achieved through mandating solar heating panels for new buildings. The shares presented to the European Commission in Portugal's NREAP progress reports were calculated taking into account only sustainable biofuels. Compliance with the sustainability criteria only entered into force in July 2014 in Portugal; the calculated shares do not correspond to the physical incorporation of biofuels in the conventional fuels consumed in the transport sector. The quota of renewables in the transport sector, taking into account all biofuels, is estimated to be around 5.61% in 2013. A 0.45% renewable energy contribution from renewable electricity use in electric vehicles is anticipated. Given the high contribution of renewables to, and low CO_2 emissions intensity of electricity supply, high-efficiency electric heating may be a viable alternative or a complementary measure to deliver the renewable heat target.

Portugal should be commended for its achievements and its ambitions in large-scale deployment of renewable energy. Nonetheless, its focus on growth in renewable electricity brings with it some risks. While negotiated reform of the feed-in tariff arrangements and the introduction of competitive tendering to support future renewable electricity generation have reduced the risk of increases in the electricity tariff deficit, Portugal remains exposed to any further reduction to electricity demand. Any reduction could both depress market prices, thus increasing the incremental cost of feed -in tariffs, and reduce the electricity supply volume on which the deficit must be levied, leading to significant upward pressure on electricity prices. Large-scale hydropower is not supported by the special regime production (SPR) and new small-scale hydropower, while requiring the highest level of support per unit of energy generated, will make a small additional energy contribution. The future additional contribution of renewable energy to the tariff deficit may be most effectively controlled by careful management of the schedule for small-scale hydropower and wind-power capacity additions and, if necessary, rescheduling project execution.

Over the next eight years, electricity prices are set to rise by an additional 1.5% to 2% as the tariff deficit is reduced and eliminated by 2020. Electricity prices are already comparatively high, particularly for electricity-intensive industrial consumers; therefore, additional price rises will have an impact in terms of competitiveness. Efficiency gains in the electricity sector could help to reduce prices, and could be achieved by improving international interconnection capacity. While the electricity markets of Portugal and Spain are increasingly well connected in a common Iberian electricity market (MIBEL), better connections from Spain to France, and onward to other European countries, could allow more competition and facilitate grid management. In the current circumstances, there are concerns that Iberian electricity consumers could be unable to benefit from the advantages of a fully integrated European electricity market (OECD, 2014). In this regard, the establishment of a high-level group between France, Portugal and Spain, and with the European Commission to drive forward key energy infrastructure projects in South-West Europe is a welcome step.

The stated "margin of safety" capacity excess included in the NREAP may also add to the tariff deficit and it could be considered whether there are more cost-efficient ways to provide such a safety margin including enhanced energy efficiency measures. This margin of safety may also potentially represent a public asset in the form of excess renewable energy credits that may be traded to assist other EU member states meet their targets via the statistical transfer mechanism. It should be investigated whether the value of any renewable energy production in excess of targets could be monetised to offset any associated increase to the tariff deficit.

It is also stated in the NREAP that at least an additional 1.0 GW of wind power capacity can be promoted without significant losses of renewable energy, guaranteed by the pumping systems envisaged in the National Programme for Dams with High Hydroelelectric Potential (PNBPH). While the MIBEL market has facilitated the development of competition and the growth in the contribution of renewable electricity on the Iberian Peninsula, further market development will be required to allow production cost-reflective market price formation in a system dominated by near-zero marginal cost, variable renewable input. Some increasingly critical system services, such as reactive power provision, are currently mandated rather than procured in the market. Consumer demand response can provide regulation services, such as balancing, and may come at low cost. An enhanced demand response scheme is needed alongside a transition from capacity payments to services-based payments.

There is an adequate level of interconnection between Portugal and Spain, as evidenced by the convergence of market prices. As both jurisdictions are pursuing policies of high penetrations of variable renewables in their electricity systems, further interconnection with the Union for the Co-ordination of the Transmission of Electricity (UCTE) network may be the least-cost mechanism to deal with production excesses or deficits. While such interconnection is unlikely to be delivered in time to facilitate 2020 targets, Portugal should continue close engagement with neighbour states and the European Commission to expedite delivery of interconnection facilitating an Iberian contribution to least-cost delivery of the 2030 aggregate EU renewable energy target.

A progressive arrangement for renewable electricity micro- and mini-generation has been introduced with simplified online licensing arrangements. The measure is targeted on facilitating the onsite generation of renewable electricity primarily for own-use. The measure is proportionate and promotes public acceptance of renewable energy. It allows those who wish to invest in small renewable electricity generation for own-use to export normal levels of excess energy to the grid without encouraging overproduction.

The Portuguese public appears to have maintained a strong commitment and positive attitude to renewable energy despite a testing economic climate. Factors including strong renewable sector employment (APREN estimate that 40 727 persons are employed in the renewable electricity sector), forest fire management and payments of 2.5% of revenue to host municipalities by wind farms and other benefits including irrigation, water supply and recreation from hydropower projects may have contributed to this. The inclusion of spatial planning in the ministry's portfolio provides an opportunity to reinforce public commitment through enhancing spatial planning practices for renewable energy. Transparency of renewable electricity's contribution to electricity prices may also serve to maintain a positive public disposition.

RECOMMENDATIONS

The government of Portugal should:

- ☐ *Incorporate the additional cost of renewable energy in end-user electricity prices in a transparent manner and monitor the electricity tariff deficit closely. Any tendency for renewable electricity generation deployment, demand shrinkage, energy efficiency programmes to increase the tariff deficit should be identified, reported upon and addressed in good time.*
- ☐ *Quantify the potential value range for EU statistical transfers of any renewable energy excess and compare this to the potential cost to consumers of the excess and to the cost of alternative measures to guarantee that the target is met.*
- ☐ *Alongside Spain, vigorously pursue the development of key transmission infrastructure, including interconnections with neighbouring countries, especially with France, in order to foster market integration, facilitate renewable energy integration and enhance security of supply.*
- ☐ *Introduce new measures, with Spain, to include an enhanced services market and demand response in MIBEL.*

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6. ELECTRICITY

Key data (2014 estimated)

Total electricity generation: 52 TWh, +16.1% since 2004

Electricity generation mix: hydro 30%, wind 23.3%, coal 23%, natural gas 12.5%, biofuel and waste 6.4%, oil 3.2%, solar 1.2%, geothermal power 0.4%

Installed capacity*: 17.83 GW

Peak demand: 8.3 GW

Electricity consumption (2013): 46.3 TWh (commercial and public services, including agriculture and fisheries 35.8%, industry 34.6%, residential 26.6%, energy sector 2.2%, transport 0.8%)

* Source: REN (2015).

OVERVIEW

The electricity and gas sectors have undergone reforms as part of the European Union's Financial Assistance Program. Regulated tariffs are being phased out gradually between 2015 and 2017 while some state-owned companies will be privatised. At present, both the wholesale and retail markets remain concentrated but the number of customers switching supplier in the retail market is increasing.

SUPPLY AND DEMAND

ELECTRICITY GENERATION

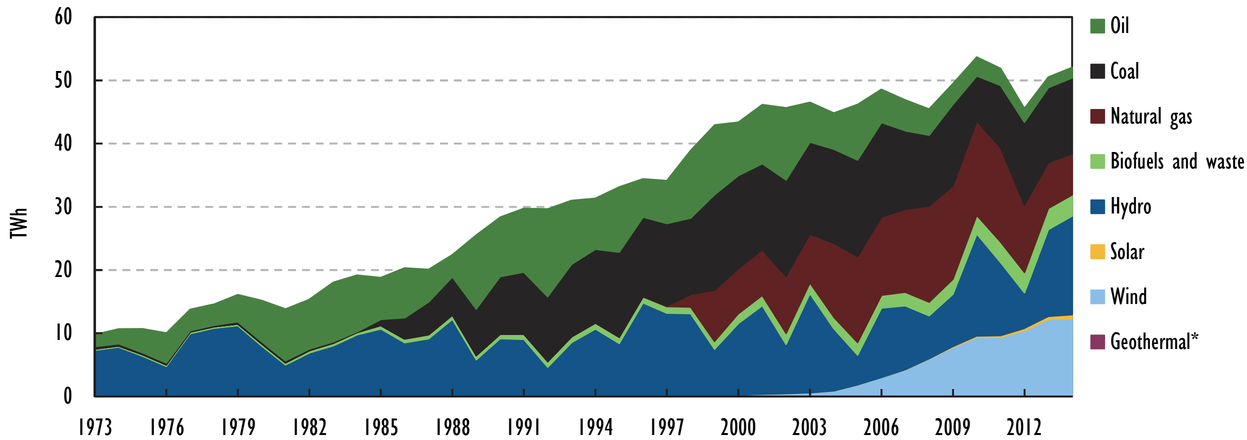
Electricity net generation in Portugal was 52 terawatt-hours (TWh) in 2014. This is 3% higher than in 2013 and 16.1% higher than in 2004. Electricity generation is volatile year-on-year owing to variable hydropower generation. Peak generation in 2010 was at 53.7 TWh (Figure 6.1).

The electricity fuel mix in Portugal is diverse: hydropower accounts for 30%, followed by wind for 23.3% and coal at 23%. The remainder is made up of natural gas (12.5%), biofuel and waste (6.4%), oil (3.2%), solar (1.2%) and geothermal power (0.4%).

Over the past decade, wind power generation soared while coal, oil and gas-fired generation contracted significantly. Wind power grew from 1.8% of total generation in 2004 to 23.3% in 2014. The share of coal declined from 33.1% to 23%; the gas share was down from 26.1% to 12.5%; and the oil share dropped from 12.7% to 3.2%. Hydropower generation fluctuates year-on-year depending on climate conditions. Its share in generation has ranged from 10.2% in 2005 to around 30% to 31% in 2010 and 2014.

Portugal's share of fossil fuels in electricity generation was near a median level among IEA member countries (Figure 6.2). The share of wind power in generation is the second-highest, behind Denmark.

Figure 6.1 Electricity generation by source, 1973-2014

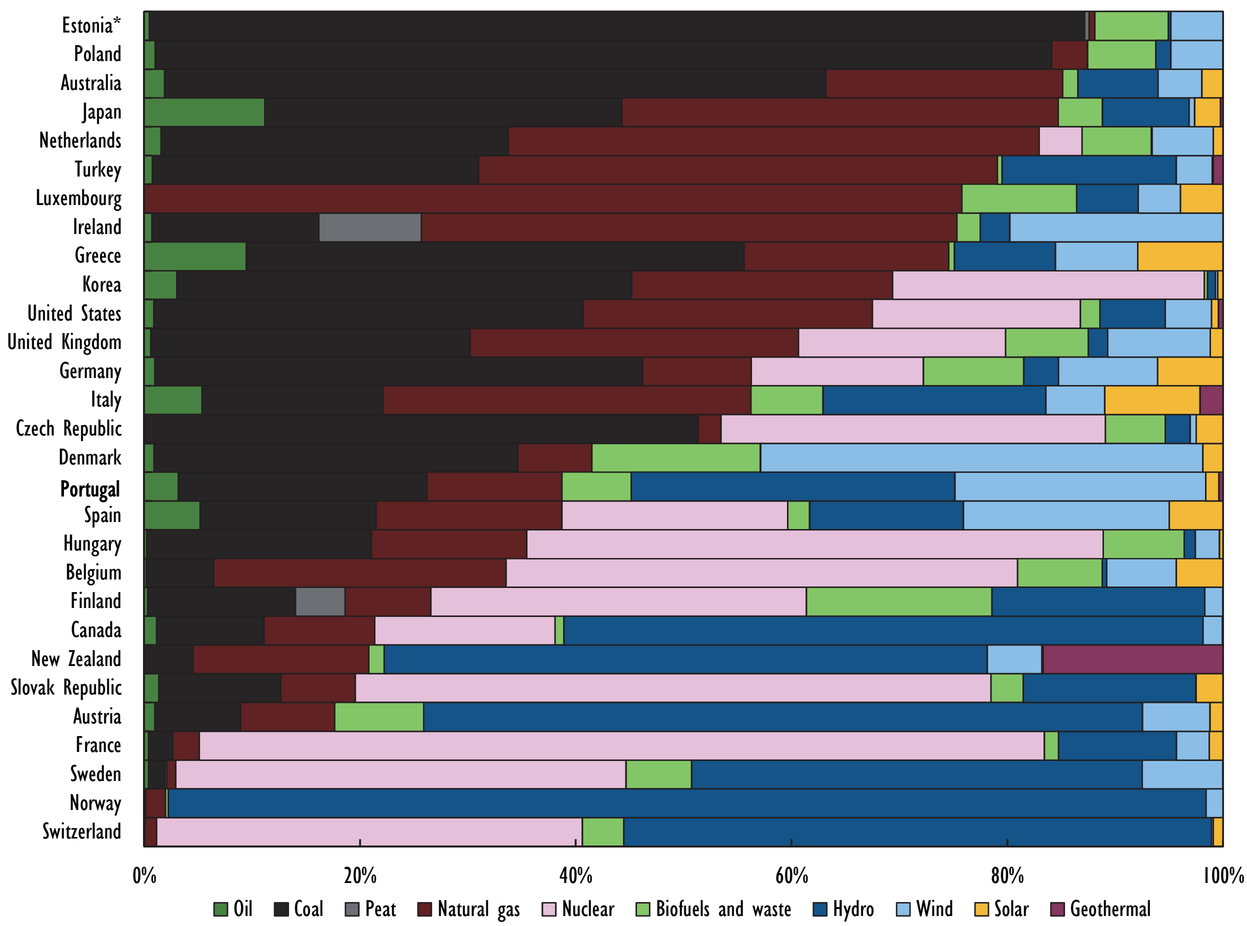


Note: Data are estimated for 2014.

* Negligible.

Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Figure 6.2 Electricity generation by source in IEA member countries, 2014



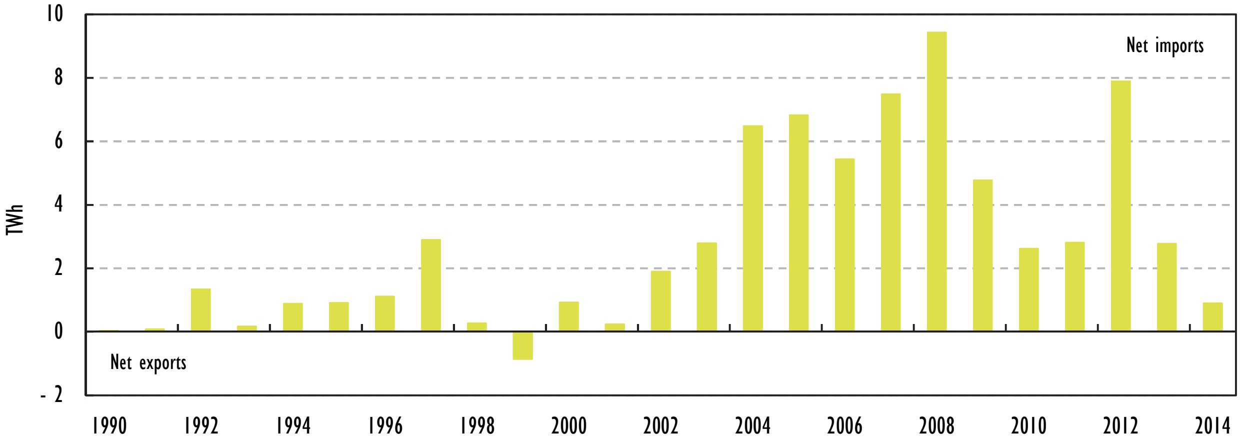
* Estonia's coal represents oil shale.

Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

IMPORT AND EXPORT

Portugal is a net importer of electricity from Spain with net imports of 0.9 TWh in 2014. This accounts for approximately 2% of domestic demand. Net imports were significantly lower in 2014 than the 2.8 terawatt-hours (TWh) recorded in 2013 (6% of domestic demand). The country has been a net importer since 1991, with the exception of 1999 when net exports amounted to 0.9 TWh. Portugal's electricity imports from Spain are highly volatile over the past decade, mainly because of the nature of hydro generation, with a high of 9.4 TWh in 2008 and a low of 0.9 TWh in 2014 (Figure 6.3).

Figure 6.3 Net electricity imports from Spain, 1990-2014



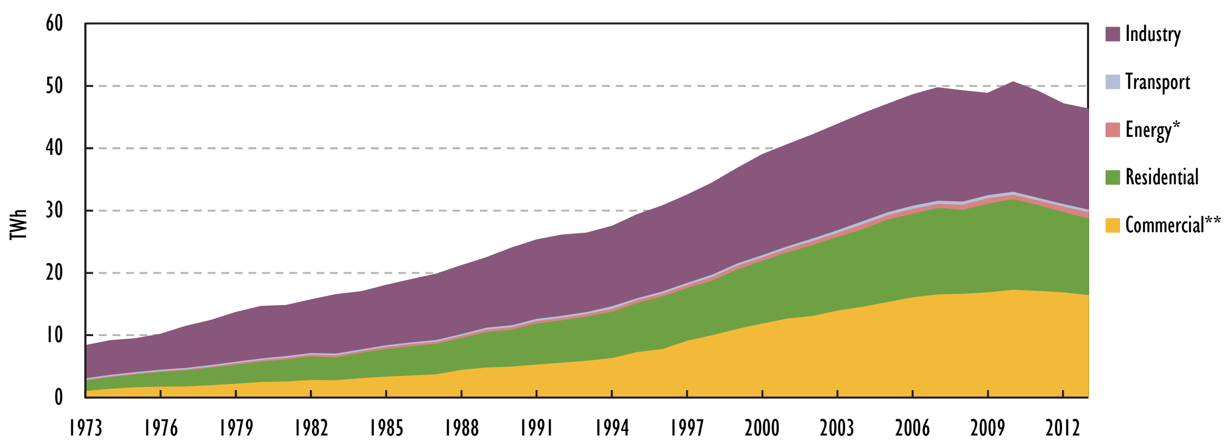
Note: Data for 2014 are estimated.

Source: IEA (2015b), *Electricity Information 2015*, www.iea.org/statistics/.

ELECTRICITY CONSUMPTION

Portugal's electricity consumption amounted to 46.3 TWh in 2013 (the latest sector-specific data available). It peaked at 50.5 TWh in 2010 before declining in the following three years (Figure 6.4). Consumption was 5.6% higher in 2013 than ten years earlier, albeit 8.6% lower than the peak.

Figure 6.4 Electricity consumption by sector, 1973-2013



* *Energy* includes all the transformations sector and own-use.

** *Commercial* includes commercial and public services, agriculture, fishing and forestry.

Source: IEA (2015b), *Electricity Information 2015*, www.iea.org/statistics/.

The commercial and public services sector (including agriculture and fisheries) and the industrial sector are the largest electricity-consuming sectors in Portugal, accounting for 35.8% and 34.6% of electricity consumption, respectively. Demand from commercial services (including agriculture and fisheries) has increased by 6.5% compared to 2003 while industrial demand has contracted by a marginal 0.8%, when compared to 2003.

Residential consumption accounted for 26.6% of total demand in 2013, which is 4.1% higher than in 2003. Consumption in the residential sector has been on steady decline since a peak in 2010, recording a 15.2% decline in the three years.

The transport sector consumes only 0.8% of electricity and demand from this sector was less volatile than others.

MARKET STRUCTURE

In a generation market, the share of the Energias de Portugal (EDP) Group in terms of installed capacity has fallen, largely the result of the growth in renewable energy, a market in which EDP holds a small share. Between 2009 and 2013, the EDP share of total installed capacity fell by approximately 8% (ERSE, 2014). The four large generators participating in the wholesale market in 2013 represented around 61% of installed capacity. In addition to these large players, the last resort supplier acts as an aggregating market participant for several hundred individual renewable energy generators.

The market shares and sales volume (physical) for the wholesale market was 51% (24.3 TWh) for EDP, 7.6% (3.6 TWh) for REN Trading, 1.1% (0.5 TWh) for Iberdrola and 0.3% (0.13 TWh) for Endesa. Renewable energy generators represent 40% of volume in wholesale physical trades (19.3 TWh). Several other market participants were active in the wholesale market, including 11 suppliers and 47 registered trading participants in MIBEL (the Iberian Electricity Market) futures market.

TSO CERTIFICATION

The EU Third Package provides for three basic models for unbundling ownership (OU) of the transmission system operator (TSO), the independent system operator (ISO) and the independent transmission operator (ITO), leaving the choice between different models to member states. OU is mandatory for new TSOs. National regulatory authorities have to carry out a certification of the TSOs, taking into account the views of the European Commission. In 2013, the process of certifying REN as a National Electricity Transmission System Operator under an OU mechanism continued.[1] The Energy Services Regulatory Authority (ERSE) proposed a decision on the certification to the European Commission in 2014 and final approval followed in September of that year. In July 2014, the Portuguese State sold its last remaining share in the company.

On 30 July 2015, ERSE notified REN (Rede Eléctrica Nacional and REN Gasodutos) of its decision, that the conditions of certification set by ERSE on 9 September 2014 were fully satisfied. Accordingly, it certified REN (Rede Eléctrica Nacional) as the TSO of the electricity transmission network, and REN Gasodutos as the TSO of the natural gas transmission network, in the full OU regime.

1. Under the combined provisions of Articles 9 and 10 of Directive 2009/72/EC of the European Parliament and Council of 13 July, and Article 3 of Regulation (EC) No. 714/2009 of the European Parliament and Council of the 13 July.

INSTITUTIONS AND REGULATORY FRAMEWORK

The evolution of the electricity sector in Portugal has been in part driven by reforms as part of the EU Financial Assistance Program. These reforms aim to reduce the energy tariff deficit in the first instance. The privatisation of Redes Energéticas Nacionais (REN) and Energias de Portugal (EDP) were also accelerated alongside the phasing-out of regulated gas and electricity retail tariffs.

The electricity sector is overseen by the national regulatory authority **Entidade Reguladora dos Serviços Energéticos** (ERSE). Regulation focuses both on infrastructures (transmission and distribution) and on last-resort supplier activities. The behaviour of suppliers in the market is also subject to ERSE's oversight. ERSE derives its income from third-party access (TPA) tariffs charged to electricity and natural gas consumers, through network operators but not from the general state budget. ERSE also co-operates with the **Portuguese Competition Authority**, (Autoridade da Concorrência or AdC) notably with regard to wholesale and retail market supervision. The board of ERSE is appointed by the government and its members cannot be removed from office.

The mission of AdC, which was established in 2003, is to ensure compliance with competition rules. It also has regulatory powers on competition over all sectors of the economy, including the electricity sector, the latter in co-ordination with ERSE.

The **Directorate-General for Energy and Geology** (DGEG) rests within the **Ministry for Environment, Spatial Planning and Energy** (MAOTE). It is responsible for the development and implementation of policies related to energy and geological resources within a framework of sustainability and security of energy supply. DGEG also provides support to government decision making during an energy crisis and/or emergency situations; and supports the participation of MAOTE at European and international levels.

The regional governments of Azores and Madeira have oversight for the electricity sector in their territories.

MARKET REFORM

REN (Rede Elétrica Nacional) and REN Gasodutos are the electricity and gas TSOs. Both are part of REN SGPS (Redes Energéticas Nacionais SGPS). After the re-privatisation of a 40% share capital of REN SGPS in 2012, the process continued and currently the Portuguese government does not hold shares in the capital of REN SGPS. These TSOs have both been certified in 2014 under the OU model, after the opinion of the Commission issued in May 2014 and subject to the fulfilment of a number of conditions.

CMEC

In January 2005, following the implementation of Decree-Law 240/2004, the EDP Group signed agreements for the early termination of the power purchase agreements (PPAs) of EDP's binding electricity power plants. The Decree-Law established that in order to maintain the contractual equilibrium of the PPAs, the owners of such agreements, which include a significant portion of EDP's generating capacity in Portugal, have the right to receive a compensation for the early cessation of those agreements (CMEC). The effects of the cessation of these agreements depended on the verification of a set of conditions, which included the launch of the spot electricity market. Changes in the mentioned legislation envisaged the creation of an Iberian Electricity Market (MIBEL), which came into effect on 1 July 2007.

In 2007, the government confirmed its decision to implement the CMEC's mechanism, defining the rules to calculate the compensations due to power generators for such early cessation, and an adjustment to the reference market price of electricity used to calculate the initial amount of the compensation was considered. EDP and REN agreed on the early cessation of the PPAs, with effect as of 1 July 2007. The CMEC regulation preserved the value of the PPAs and set the amount of the compensation at EUR 833 million. It was also established that EDP would pay EUR 759 million for the use of water resources, securing the right to operate 26 hydroelectric plants with a capacity of 4 094 MW, under free market conditions for an average period of 26 years.

TACKLING THE TARIFF DEFICIT

Tariff deficits are shortfalls of revenues in the electricity system, which arise when the tariffs for the regulated components of the retail electricity price are set below the corresponding costs borne by the energy companies (EU, 2014). The tariff debt in Portugal is substantial: the total accumulated tariff debt was estimated by the regulator at EUR 3.7 billion (2.2% of GDP) at the end of 2013 and EUR 4.69 billion (3.1% of GDP) in 2014. This means a substantial increase in comparison to EUR 2.85 billion (1.7% of GDP) of tariff debt at the end of 2012 (ERSE, 2013). The majority of the Portuguese tariff deficit emerged in 2008, 2012 and 2013.

Two different factors were responsible for the emergence of the tariff deficit in Portugal. In 2007 and 2008, there was a mismatch between the actual wholesale price and the price implied in the tariff. First, in 2008, the implied wholesale price was EUR 50 per megawatt-hour and the actual average purchase price of electricity on the wholesale market was EUR 73/MWh (Manso Neto, 2012) in the same year. High wholesale market prices were caused by increased oil and other fuel prices and volatile hydropower production, which are difficult to predict when setting tariffs for the year ahead. Wholesale electricity prices returned to lower levels as from 2009.

In the recent years, rising subsidies to renewable and conventional electricity led to increased electricity costs and, as a result, to a growing tariff deficit. These subsidies included both support under the special regime (to renewables and co-generation) and under the ordinary regime (such as power guarantee incentives and compensation for the early termination of former long-term power purchase agreements).

Despite the work on developing an internal EU electricity market, the government’s main focus in the electricity sector since 2011 has been to solve the massive tariff deficit accumulated since 2001. Following a request by Portugal on 7 April 2011, the European Commission, the European Central Bank (ECB) and the International Monetary Fund (IMF) negotiated an economic-financial assistance programme (henceforth "the Programme"), aimed at restoring access to market-based funding, enabling the return of the economy to sustainable growth, and safeguarding financial stability in Portugal, the euro area and the European Union. The Programme covered the period May 2011 to June 2014 and entailed a financial package of some EUR 78 billion for possible fiscal financing needs and support to the banking system. The Programme foresaw comprehensive action on three fronts, one of which included greater control over state-owned enterprises and the elimination of the tariff deficit.

WHOLESALE MARKET STRUCTURE AND DESIGN

Electricity generation in Portugal has an unconventional structure. While EDP, the former state-owned company, remains the largest generation entity (43% of electricity sold in 2013), a 42% share is supplied through regulated agents which are not exposed to market risks. REN Trading, which accounts for 7.6% of the domestic power generation mix, acts as a regulated market agent for the two historical PPAs. The renewables and combined heat and power (CHP) generators, which earn a feed-in tariff, are represented in the market by a regulated single buyer. Spain's Iberdrola and Endesa are also present in the generation market albeit with very small market shares. Imports account for 6% of energy supply and there is a high level of market integration and price convergence with Spain.

Changes to one of the most contentious issues − the regulated contracts for difference known as CMECs that aim to compensate for stranded costs arising from the liberalisation process − are still under way. Portugal has already reduced the discount rate applied in the CMECs, but it is studying a retrospective reduction in previous years payments after the energy regulator and the antitrust authority advised of flaws in ancillary service-related payments.

Portugal and Spain have been integrating their electricity markets into a single Iberian Electricity Market, MIBEL. They share a common spot market operator, OMIE, which has been operating in both countries since July 2007, and a forward market operator, OMIP, launched in July 2006. In 2013, day-ahead prices were the same in both countries. In February 2014, OMIE was coupled with the Central and Northern European markets.

In 2013, 54.5 TWh were traded in the Portuguese part of OMIE's day-ahead market. The average price in the day-ahead market in Portugal was EUR 43.65/MWh in 2013. Since March 2014, OMIP has auctioned Financial Transmission Rights (FTR) for the Spain-Portugal interconnection and allowed continuous trading of that product in its trading platform. In 2012, Portugal started auctioning forward contracts on energy produced from renewable sources and CHP plants under feed-in tariffs. All forward contracts are settled financially, since no bilateral energy was delivered in the daily schedule in 2013.

Since 2013, there have been some changes in the Portuguese wholesale market. In 2012, CHP feed-in tariffs were reviewed and capacity mechanisms were reduced and limited to hydropower plants during the Financial Assistance Programme. Moreover, in order to promote the sustainability of the system, 80% of the incomes from the CO_2 allowance auctions is used to compensate for the over-costs due to the renewable feed-in tariffs. In April 2012, ERSE approved a new system operation regulation and, in June 2013, the government approved a new measure aimed at cancelling out the effects of external events, specifically the increase in prices from new generation taxes in Spain. At the end of 2013, the Portuguese government announced an extraordinary tax on energy production, transmission, storage and distribution activities in order to decrease the tariff deficit and promote energy efficiency measures.

TRANSMISSION AND DISTRIBUTION

TRANSMISSION

Electricity transmission activities are carried out through the national transmission grid (RNT) under an exclusive concession granted by the Portuguese government. The exclusive concession for electricity transmission was awarded to REN, Rede Eléctrica Nacional, by article 69 of Decree-Law No. 29/2006 of 15 February. Under the terms of this concession, REN is responsible for the planning, implementation and operation of the national transmission grid, the related infrastructure, as well as all of the relevant interconnections and other facilities necessary to operate the national transmission grid. The concession also provides that REN must co-ordinate the national electricity system's (SEN) infrastructures to ensure the integrated and efficient operation of the system, as well as the continuity and security of electricity supply. REN also undertakes research and development relating to electricity transmission in Portugal.

By the end of 2014, the RNT comprised 8 630 km of lines, of which 2 467 km were at 400 kilovolts (kV), 3 601 km at 220 kV and 2 561 km at 150 kV. This represents a fall in network capacity when compared to 2013 (RNT comprised 8 733 km of lines). In 2014, the network had an installed transformer capacity of 35 754 megavolt-amperes (MVA), which represents an increase compared with 2013 capacity (34 984 MVA). The backbone of the RNT is based on 400 kV lines running in a north-south direction along the coast, from generation at Sines in the south to the Alto Lindoso generation plant in the north, close by the interconnection to Spain. This is supplemented by 220 kV lines, principally between Lisbon and Porto, and diagonally from Coimbra to Miranda do Douro, along Douro River, and in the centre of the country. In addition, 400 kV lines run east-west from Sines to the interconnection with Spain near Brovales (Alqueva – Brovales) and from Rio Maior to the interconnection with Spain near Cedillo (Pego – Cedillo). A series of 150 kV lines provide further support to the network.

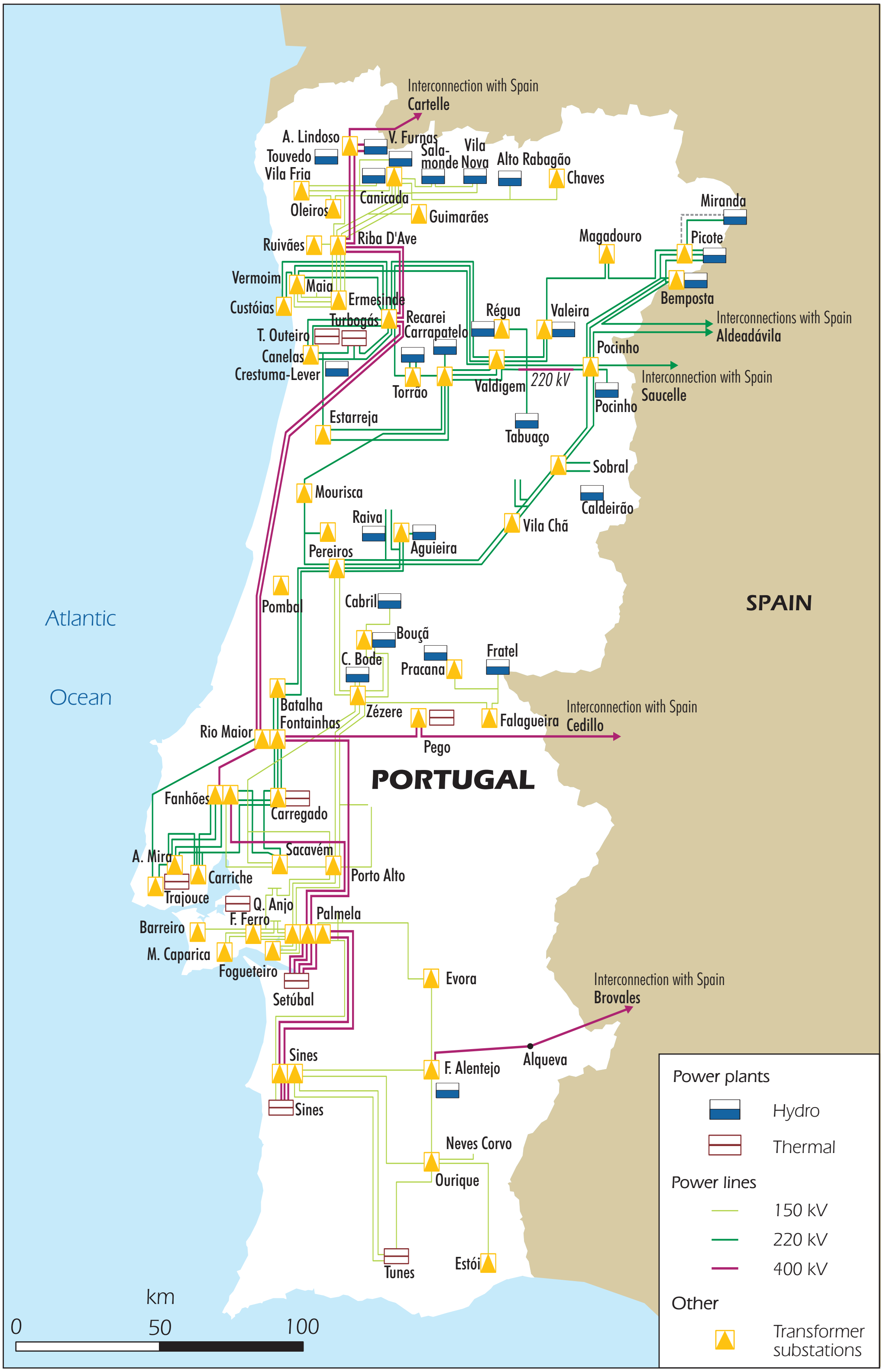
In recent years, as a result of the integration of high levels of new renewables generation (wind power), mostly in inland areas, the RNT has been reinforced in these areas so that it can transmit more renewable energy to consumption centres. Under agreements between Portugal and Spain on the development of the Iberian electricity market, there has been a substantial increase in interconnection capacity between the two countries, which was only possible after the completion of transmission grid reinforcements on both sides of the border.Pursuant to current legislation, REN must conduct planning studies of the transmission grid in order to co-ordinate grid development plans with national generation and demand forecasts. These studies must be sent to the competent authorities for prior approval, without which it is not possible to go on to the investment phase. It is also REN's legal obligation to collaborate in official studies of medium- and long-term security of the country's electricity supply.

DISTRIBUTION

The national distribution grid is operated through an exclusive concession granted by the Portuguese State. This exclusive concession for the activity of electricity distribution in mainland Portugal is held by EDP's subsidiary EDP Distribuição pursuant to article 70 of Decree-Law 29/2006 of 5 February, as a result of converting the licence held by EDP Distribuição under the old electricity framework into a concession agreement. The terms of the concession are set forth in Decree-Law 172/2006 of 23 August. In the autonomous region of Madeira (RAM), the concession for the activity of electricity distribution is held by Electricidade da Madeira (EDM) while in the autonomous region of the Azores (RAA) the concession for the activity of electricity distribution is held by Electricidade dos Açores (EDA).

The low-voltage distribution grids continue to be operated under concession agreements to be entered into after a public tender administered by the relevant municipalities. The existing concession agreements will be maintained but amended to comply with the new regime as provided for in Decree-Law No. 172/2006.

Figure 6.5 The electricity transmission system in Portugal



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

EDP Distribuição owns approximately 99% of the electricity distribution network in mainland Portugal – the exceptions being the autoproducers and small co-operatives network. Besides the high-voltage (60 kV), medium-voltage (specifically the 30 kV, 15 kV and 10 kV) and low-voltage overhead and underground power lines, the distribution network also consists of sub-stations, transformation posts and other equipment necessary for its exploitation. The facilities used for public lighting also form part of the distribution network.

By the end of 2013, the number of customers connected to the EDP Distribuição network was over 6.1 million. The Quality of Service Regulation includes the competences, responsibilities and obligations in terms of Quality of Service for the different agents and entities operating in the electricity sector. With the publication of the Decree-Law No. 215-B/2015 of 8 October, ERSE has the responsibility to assure the fulfilment of the Quality of Service Regulation (ERSE Regulation No. 455/2013, published 29 November 2013) by the different agents, namely through the annual publication of the Service Quality Report.

NETWORK ACCESS TARIFFS AND REMUNERATION

The Networks and Interconnections Access Code (the Code) establishes the provisions related to technical and commercial conditions according to which the access to the networks and interconnections is managed. The Code also establishes the conditions in which access is granted or restricted, as well as the reimbursement to which entities are entitled for offering access to their networks. The principal matters covered by the Code, are the following:

- access to networks and interconnections
- network use contract
- information to be provided by network operators
- reimbursement for the use of installations and services
- information on investments in networks and interconnections
- adjustments for losses
- capacity and management of interconnections
- publication of information on networks and interconnections.

A new Code was approved by ERSE in 2014 by Regulation No. 560/2014 and published on 22 December 2014.

The Global Use of the System tariff includes costs related to the operation of the system, costs arising from energy or environmental policy measures, and costs of general economic interest, such as the maintenance of the contractual balance (CMEC). The allocation of most of these costs to consumer groups is bound by government decision.

The Use of Transmission Network tariff is paid for use of the transmission network and a separate Use of HV and MV Distribution Network tariff is charged for use of the distribution network.

SMART GRIDS

A smart grid is an electricity network that uses digital and other advanced technologies to monitor and manage the transmission of electricity from all generation sources to meet the varying electricity demands of end-users. Smart grids include electricity networks (transmission and distribution systems) and interfaces with generation, storage and end-users (IEA, 2011). In Portugal, the transition to a smarter distribution grid is led by EDP Distribuição by means of the InovGrid project for the development and implementation of smart grid concepts and technology.

This InovGrid project seeks to transform the distribution grid and position it as the means to several challenges in line with regulatory and governmental policies. These include: the need for increased energy efficiency; cost reduction and increased operational efficiency; the integration of a large share of variable generation; the integration of electric vehicles (EV), and the desire to empower customers and support the development of competitive retail markets and new energy services.

An important element of InovGrid has been the roll-out of smart grid infrastructure in the Portuguese municipality of Évora in 2011. The infrastructure spans the entire municipality, reaching around 32 000 electricity customers. Its main components are:

- EDP boxes (EB), installed at all low-voltage customers, offering advanced smart meter functionalities, such as real-time readings on demand, load diagrams, voltage monitoring and remote services (connect/disconnect, contracted power and tariff set-up, tampering alarms, etc.)
- distribution transformer controllers (DTC) installed in every secondary substation, acting as data concentrators and local metering, monitoring and automation devices (power quality monitoring, medium-voltage switching, local sensors, etc.)
- a communication network based on power-line communication (PLC) and general packet radio service (GPRS) technologies, linking EDP boxes and DTCs to head end systems
- charge stations for EVs
- efficient public lighting systems, based on LED luminaries with advanced control.

Beyond the implementation of the physical infrastructure, a dynamic InovCity environment was created by communicating with customers about the new possibilities at their disposal, by bringing independent companies to develop and offer new in-home tools and services (displays, smartphone apps, etc.) and by involving local authorities and institutions in a shared effort to improve energy efficiency and sustainability. The deployment in Évora demonstrated many of the benefits of smart grids, including:

- improved energy efficiency (e.g. reduction of 3.9% in electricity consumption vs. control group; 2.1% error margin for a 95% confidence interval)
- increased operational efficiency of the DSO (e.g. remote readings and work orders)
- increased technical efficiency of the DSO (e.g. reduced operations and maintenance costs and improved asset management)
- improved quality of service (e.g. outage detection and handling, power-quality monitoring)
- reduced energy losses, resulting from lower demand and better network management (e.g. improved three-phase load balance)
- reduced fraud, a result of tampering alarms and consumption monitoring
- improved distributed energy resources integration capabilities, including micro-generation and electric vehicles.

The outcome of the project supported EDP's business case for smart grids. EDP Distribuição is currently deploying second-generation smart meters to 100 000 customers throughout the country, with the objective of developing the supply chain and improving the integration with existing business processes, in preparation for a future roll-out (currently pending government/regulator decision).

CROSS-BORDER INTERCONNECTIONS

CAPACITY

At the end of 2014, nine lines connected Portugal and Spain: six of 400-kV and three 220 V lines, which allow a maximum exchange capacity of 2 800 MW in the Portugal-Spain direction and 2 200 MW in the Spain-Portugal direction. Despite the level of interconnection, significant congestion still exists between the two countries at times. To overcome this congestion, several investment projects, including two new 400-kV interconnections, are in progress. One new line between the two countries is being developed and, once in service in 2016, it will allow to reach about 3 000 MW of exchange capacity. The existing 400-kV interconnection lines are:

- Alto Lindoso – Cartelle 1
- Alto Lindoso – Cartelle 2
- Lagoaça – Aldeadavila 1
- Falagueira – Cedillo
- Alqueva – Brovales
- Tavira – Puebla de Guzman

Existing 220kV interconnection lines:

- Pocinho – Aldeadavila 1
- Pocinho – Aldeadavila 2
- Pocinho – Saucelle
- Planned 400 kV interconnection line:
- Viana do Castelo ("Vila Fria B") (PT) – Fontefría (ES)

During the 2014 winter most of the 400-kV lines had a rating of 2 000 A, except line Lagoaça – Aldeadavila-1 which was higher, and the 220-kV lines of 1 140 A. These ratings decrease as the air temperature rises.

There are no explicit auctions between Portugal and Spain for physical interconnection capacity allocation. The two countries operate under MIBEL (the Iberian Electricity Market) and interconnection congestion is resolved by market splitting between Portuguese and Spanish areas (implicit auctions). Nevertheless, a mechanism was implemented in 2013 based on financial transmission rights, with the first auction of those rights issued by the Portuguese TSO held in December 2013. A second auction was held in March 2014 and each quarter thereafter.

The methodology for interconnection management is consistent with the European Network of Transmission System Operators for Electricity (ENTSO-E) rules and is agreed between Portuguese and Spanish TSOs. The methodology is in turn approved by the national regulators (NRAs) and published on their websites. TSOs exchange expected generation and demand profiles and the planned outages within their areas, and from this starting point they continue to increase generation at their area until such time as they are no longer compliant with the N-1 security rule, thus finding the maximum export capacity. Then they decrease generation in their area until N-1 security is breached, thus creating the maximum import capacity. The allowed interconnection flows are the minimum values found by each TSO in each direction. These values are sent to the MIBEL spot market operator that uses them for a possible market split.

In real time, congestions are solved by topology change and then by internal generation re-dispatch. If no internal possibility is available, TSO's instead resort to curative counter-trading.

CAPACITY ALLOCATION AND CONGESTION MANAGEMENT

In May 2014, MIBEL was coupled with the North-West Europe (NWE) market area, proceeding to the Capacity Allocation and Congestion Management (CACM) guideline which came into force with the publication of Commission Regulation (EU) 2015/1222. Therefore, interconnection capacity between Spain and France is now allocated by implicit auctions, i.e. automatically as part of electricity trade through the power exchanges. The wholesale systems in Spain and Portugal had been coupled already ten years earlier when MIBEL was formed. The objective of price-coupling is to ensure efficient use of existing cross-border capacity one day ahead of physical delivery. This market integration will also increase wholesale price convergence. MIBEL has been coupled with the NWE region since 13 May 2014. Market coupling was designed to ensure full use of net transfer capacity after the day-ahead market.

REGIONAL INTERCONNECTIONS AND ENERGY POLICY

The Iberian Peninsula has ample wind and solar resources, but it is located far from the large consumption centres in Central Western Europe (CWE). The conclusions of the European Council of October 2014 include the commitment to an increase by 10% the share of electricity interconnection capacity over and above the installed generating capacity by 2020 and by15% by 2030. For this, special efforts are needed to connect the Baltic States, Portugal and Spain, Malta, Cyprus and Greece with other countries.[2]

More interconnections between France and Spain are needed in order to integrate variable renewables from the Iberian Peninsula into CWE in an efficient manner. Completing planned interconnection projects between the region and France will enable greater electricity trade between the two. Portugal and Spain will be able to export excess renewable energy, in particular wind power and hydropower. In contrast, on occasions when wind power generation is low or hydro resources are tight, less expensive power imports from France could flow into the region.

2. *a. Footnote by Turkey*: The information in this document with reference to "Cyprus" relates to the southern part of the Island. There is no single authority representing both Turkish and Greek Cypriot people on the Island. Turkey recognises the Turkish Republic of Northern Cyprus (TRNC). Until a lasting and equitable solution is found within the context of the United Nations, Turkey shall preserve its position concerning the "Cyprus issue"; *b. Footnote by all the European Union member states of the OECD and the European Union*: The Republic of Cyprus is recognised by all members of the United Nations with the exception of Turkey. The information in this document relates to the area under the effective control of the government of the Republic of Cyprus.

The region remains in several ways isolated. This is true for cross-border transmission capacity and, less so, for market rules that differ from the rules in the CWE region. More cross-border capacity is needed for accommodating renewables efficiently. Overhead lines would be a relatively inexpensive solution, but overcoming local opposition calls for using more expensive underground or undersea lines. From a European energy policy perspective, developing interconnections with Spain needs to be supported if the policy targets for 2030 are to be met.

Cross-border interconnections are a priority of EU energy policy. In June 2015, the European Commission, France, Portugal and Spain signed a memorandum of understanding creating a High-Level Group for South-West Europe on interconnections. This High-Level Group will prepare a plan to implement the so-called Madrid Declaration, signed on 4 March 2015 by the President of the European Commission and the heads of state of France, Portugal and Spain. The High-Level Group considers both gas and electricity infrastructure and will ensure regular monitoring and provide technical assistance to the countries. To support the work of this Group, the Commission has launched two studies on the benefits, costs and the technical possibilities for further electricity and gas interconnections between the peninsula and the rest of Europe. The results of the study on electricity will be presented in the third quarter of 2015.

ELECTRICITY SECURITY

Portugal's dependence on imported energy has been historically high. In recent years, an increasing amount of renewable energy has led to a decline in energy dependence. In accordance with Portuguese law, the powers relating to security of supply in the electricity and natural gas sectors are the responsibility of the government, which has delegated responsibility for monitoring to the Directorate-General for Energy and Geology (DGEG). In addition, the regulator ERSE monitors the evolution of installed capacity and demand.

In 2013, the capacity margin, which Portugal defines as the difference between installed generating capacity and the maximum peak consumption during the year, reached 49.4% compared to 48.5% in 2012 and 51.2% in 2011. Although there was a reduction of 795 MW (-3.9%) in total installed capacity compared to 2012, the capacity margin was maintained because of the simultaneous reduction in peak consumption by comparison with the previous year.

The Portuguese electricity transport network is relatively robust. In 2013, there were 249 network incidents recorded, four of which (3.2% of the total) had an impact in power supply to final customers, having caused three short interruptions (between one second and three minutes). The combined availability rate, a metric introduced in 2009 by ERSE, was 98.89% in 2013, higher than in 2012 (98.49%).

A long-term Security of Supply Monitoring Report (RMSA) is prepared every year by DGEG with the support of REN. Prospective assessments of the Portuguese electricity generation system, taking into account various elements of security of supply, are performed. In this regard, a probabilistic approach to operational reserve requirements is used, from which no critical situations resulting from increased integration of renewable sources are foreseen over the medium term. These studies also assess the expected reserve margin and the generation adequacy.

The last exercise for monitoring security of supply was in 2013. It concluded that the electricity generation system has the capacity to meet the demand expected for the coming years, taking into account the projected evolution of the power generation system.

RETAIL MARKET AND PRICES

RETAIL MARKETS

In 2012, the government announced the complete elimination of regulated tariffs. A transitory tariff (that includes an aggravation factor with a view to promoting supplier switching) will be in place for three years. ERSE will review this tariff on a quarterly basis.

The elimination of regulated end-user tariffs for residential customers in 2013 led to a high supplier switching rate, especially from last-resort suppliers to the liberalised market suppliers. This movement consolidated the liberalised market, by increasing the diversity of suppliers and commercial offers, and also through the integration of offers between the electricity and natural gas sectors. As a result of these changes, the liberalised electricity market had a 73% share of total consumption and a 37% share of customers at the end of 2013.

The government had planned to phase out regulated tariffs by the end of 2015. The introduction of Decree-Law No. 15/2015 of 30 January, and Ordinance No. 97/2015 of 30 March, however, introduced a new timetable for the gradual phasing-out of such tariffs for normal low-voltage electricity consumers. The new law pushed back the expiration date for the end of all regulated tariffs to 31 December 2017. During this period, transitory tariffs with a gradually increasing premium component will apply and also be updated quarterly by ERSE (LBR, 2015).

Nonetheless, despite the movement towards liberalised markets, the retail market remains concentrated: in December 2013, the HHI for domestic and industrial consumers amounted to 6 778 and 2 239 respectively.[3] The market share of the three biggest suppliers in the liberalised market was 85% in 2013 (EC, 2014).

In order to manage the supplier-switching process, implying meter reading and measurement equipment, a Logistics Operator for Switching Suppliers (OLMC) was to be created. Transmission, distribution and last-resort supply, as well as the logistics and terms applicable to switching operations and to managing organise markets are subject to ERSE regulation.

Legislation applicable to this process has yet to be developed. Nevertheless, until the creation of the OLMC, ERSE has determined that management of the logistics for switching suppliers should be conducted by the operator of the medium-- and high-voltage distribution grid, which currently is EDP Distribuição.

RETAIL PRICES

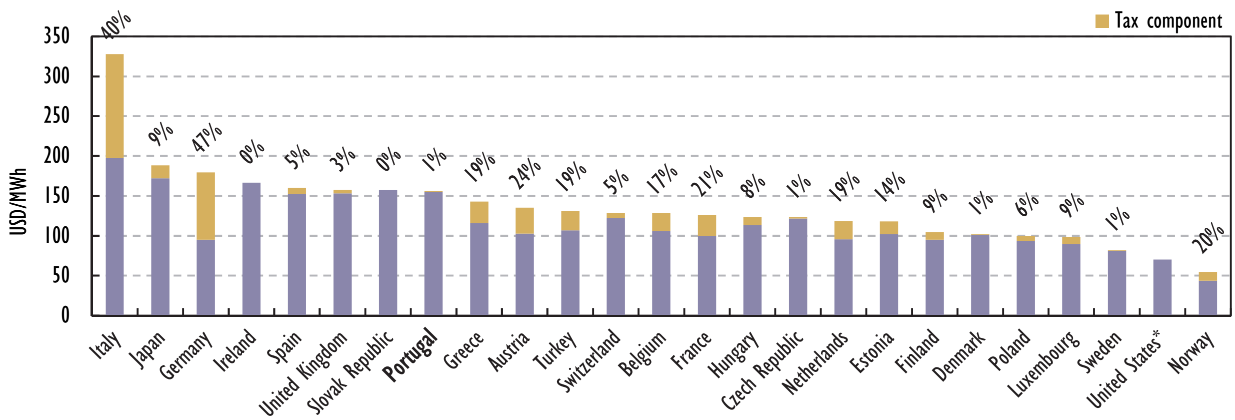
Electricity prices in Portugal are relatively high by IEA standards. They have also increased significantly over the past decade. According to Eurostat, Portuguese

3. The Herfindahl–Hirschman Index (HHI) is a commonly accepted measure of market concentration. The HHI is calculated by squaring the market share of each firm competing in the market and then summing the resulting numbers. Markets in which the HHI is between 1 500 and 2 500 points are generally considered to be moderately concentrated, while markets in which the HHI is in excess of 2 500 points may be deemed to be highly concentrated (United States Department of Justice).

electricity retail prices for household consumers (EUR 0.2131/kWh including taxes and levies) are above the average for the EU-28.[4] Prices for industrial users (EUR 0.1010/kWh excluding taxes and levies) are among the highest in the European Union.[5] This is partly the result of the high share of network costs in the final price.

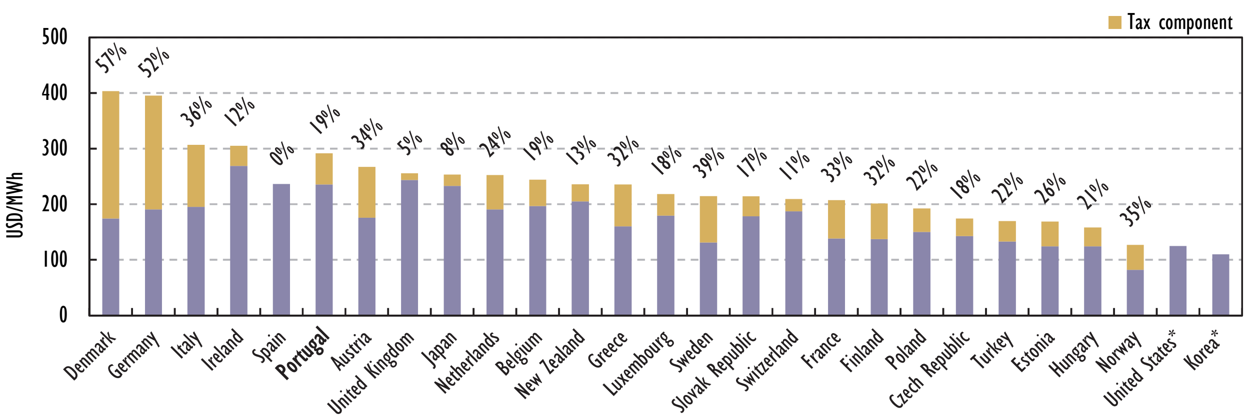
Figure 6.6 Electricity prices in IEA member countries, 2014

Industry



Note: Data not available for Australia, Canada, Korea and New Zealand.

Households



Note: Data not available for Australia and Canada.

* Tax information not available.

Source: IEA (2015c), *Energy Prices and Taxes 2015*, Q3, www.iea.org/statistics/.

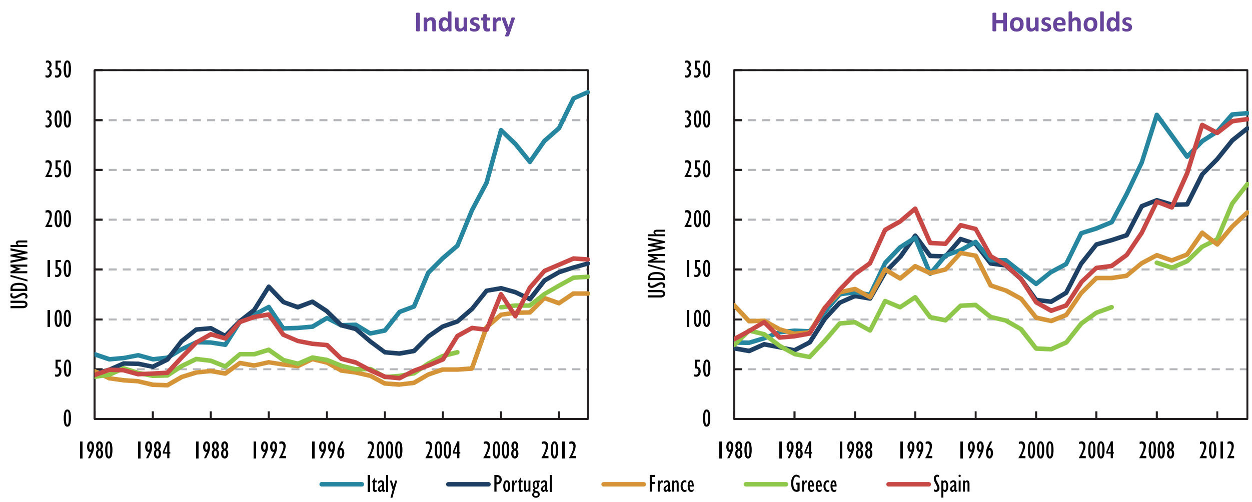
From 2008 to 2013, final electricity prices increased annually on average by 8.8% for household customers (Band DC: 2 500 kWh < Consumption < 5 000 kWh) and 10.5% for industrial customers (Band IC: 500 MWh < Consumption < 2 000 MWh). Much of the price increase for both domestic and industrial customers was the result of an increase

4. Eurostat, Electricity prices for domestic consumers - bi-annual data (from 2007 onwards) - Band DC: 2 500 kWh < Consumption < 5 000 kWh (2nd semester 2013).

5. Eurostat, Electricity prices for industrial consumers - bi-annual data (from 2007 onwards) - Band IC: 500 MWh < Consumption < 2 000 MWh (2nd semester 2013).

in taxes and levies, in particular with the increase of VAT from 6% to 23% as from October 2011, but also the result of a set of subsidies to ordinary producers, namely compensation for stranded costs due to the liberalisation process and payment of feed-in tariffs for renewables and CHP.

Figure 6.7 Electricity prices in Portugal and in other selected IEA member countries, 1980-2014



Note: Data for Greece are not available for 2006 and 2007.

Source: IEA (2015c), *Energy Prices and Taxes 2015*, Q3, www.iea.org/statistics/.

ASSESSMENT

Portugal has made significant progress since the last in-depth review, in particular htrough the creation of a highly integrated Iberian wholesale market (MIBEL). The spot market operator OMIP now offers a mature range of services, including forward prices up to three years ahead and financial transmission rights for cross-border power flows. Spain and Portugal have been making good progress towards the 2017 target of 3.0 GW of interconnection capacity between them and there is price convergence 85% of the time. In 2014, progress was made on the provision of balancing services with France. This is an encouraging move towards a wider European approach to the provision of market services.

The TSO has also successfully undertaken an extensive investment programme to support the growth in renewables. This has happened at the same time as the TSO has improved its service quality. This has been mirrored at distribution level. Portugal has strengthened many of the building blocks which have supported the impressive increase in renewable generation, and the country is now among the leaders in Europe.

The market liberalisation has continued since the last review. Transitional end-user tariffs set by the regulator for both electricity and gas were scheduled to end on 31 December 2015 but, following the introduction of Decree-Law No. 15/2015 of 30 January, and Ordinance No. 97/2015 of 30 March, the expiration date for the end of all regulated tariffs has been postponed to 31 December 2017. To date, competition for customers has seen large numbers of them move onto commercial offerings. There is every prospect that relatively few customers will remain on the regulated tariffs by the end of the transition period. It is evident that levels of retail competition have improved with a range of players now offering competitive services. Supplier switching rates have increased and smaller players have been growing.

There remain, however, some significant challenges for the electricity sector. The Iberian system remains an island, interconnection with France being only 1.5% of total capacity. This is very low by European standards and, if not addressed, has important implications. Accessing a broader market will lower costs as typically wholesale prices are lower across the border and will provide more flexibility for services such as balancing. Increasing interconnection is crucial to support Portugal's renewables aspirations. Significant investments have been made in pumped storage to provide system flexibility in low-demand, high-wind scenarios. Interconnection with Europe offers potentially more cost-effective options to manage system constraints and opens a wider market for Portugal’s renewable potential. The recent EU decision to target a minimum of 10% interconnection capacity as share of total generating capacity by 2020 and 15% by 2030 is an important one. The establishment of a high-level group between France, Portugal and Spain and with the European Commission to drive forward key energy infrastructure projects in South West Europe is a welcome step.

The implications of changes in Portugal's generation mix for system management will likely only become apparent over time. It would be timely to review the opportunities for further development of the wholesale market to ensure that arrangements are optimised for a market with a high degree of weather-dependent renewables. Ensuring that efficient price signals are sent for flexible capacity is crucial. This could include rewarding customers for bidding in demand reduction and paying generators for the provision of system services.

The country's increase in renewables has strengthened energy security but has also come at a cost to consumers. The average premium paid to renewable producers over the pool price is around EUR 60/MWh, above a wholesale price of around EUR 50/MWh. The majority of this cost is passed on to consumers. This has been one contributor to ongoing retail price increases which have averaged around 7% to 8% over the last few years. Of a VAT-exclusive average price of EUR 0.20, around EUR 0.045 goes to support renewables and other regulatory costs. There has been a reluctance to pass on all this cost and other legacy costs, and this has led to the emergence of the tariff deficit. This is foregone revenue that EDP can recoup in the future. The tariff deficit has accumulated to around EUR 5.0 billion. This policy approach amounts to a deferred debt and is unsustainable. This is recognised and a concerted effort has been made to negotiate a variety of changes to historical agreements so as to reduce the costs borne by customers. Studies on this problem have been detailed and substantive. These changes have been achieved by negotiation and amount to around a EUR 3.0 billion reduction. The target is to have eliminated the tariff deficit by 2020 through a combination of these negotiated changes and real price increases of 1.5% to 2%. The exact breakdown of the deficit is opaque to the market and there appears to be scepticism that the 2020 date will be met.

During 2013/14, over 700 000 customers moved off the reference tariff. There is likely to be a small number of customers left at the end of the transition period and it will be important to have clear plans on how to manage the remaining customer base. While competition levels appear reasonably strong, market concentration remains high with incumbent market share being well above 50%. The mechanism to move those customers remaining on the transition tariff to the market should be clearly communicated. This should be accompanied by thorough review of options to strengthen retail competition. The focus of this review should be broader than simply price competition and should look to ensure that the market has strong incentives to innovate in the services that it offers customers.

The proposed expansion of vulnerable customers to 500 000 receiving a 34% discount needs to be carefully considered. All governments have an interest in ensuring that genuinely vulnerable citizens are protected. It is not clear whether there are stringent criteria to target assistance to those in genuine need. The socialisation of this cost onto energy companies (and eventually onto customers) is inefficient. Government should fund such assistance directly. This will encourage the government to ensure that assistance is effectively targeted.

RECOMMENDATIONS

The government of Portugal should:

- ☐ *Carry out an evaluation of wholesale market arrangements to ensure they are optimal for a high share of renewable energy supply in the generation mix; prepare a range of future demand scenarios, including scenarios where demand falls. Market mechanisms to permit demand participation in the market are needed.*
- ☐ *Carefully schedule and adjust new wind power capacity additions: renewables investments that increase costs for consumers in a market that already has surplus capacity should be minimised unless needed to meet Portugal's renewables target or security of supply.*
- ☐ *Strongly pursue, with its regional partner Spain, the development of key transmission infrastructure, including interconnections with neighbouring countries, especially with France, in order to foster market integration, facilitate renewable energy integration and enhance security of supply.*
- ☐ *Ensure that the revised schedule for the phase-out of regulated tariffs is maintained and prepare a mechanism to ensure that all customers have access to the liberalised market.*

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7. NATURAL GAS

Key data (2014 estimated)

Natural gas production: nil

Net imports: 4.1 bcm, +8.2% since 2004

Share of natural gas: 16.4% of TPES and 12.5% of electricity generation

Consumption by sector (2013): 4.3 bcm (power generation 46.7%, industry 29.3%, other energy and energy own-use 11.5%, residential 6.6%, commercial and other services 6.1%, transport 0.3%)

OVERVIEW

Portuguese natural gas consumption dropped by 7.7% in 2014, mainly the result of a fall in consumption in the electricity generation sector. Between 2010 and 2014, consumption fell by 22.8% largely because of a collapse in demand from the power generation sector and increased production from renewables. Portugal has no natural gas resources of its own and meets demand by means of liquefied natural gas (LNG) imports and through two pipelines that connect Portugal with Spain. Imports come mainly from a few long-term contracts held by the GALP Group with Algeria (through Spain) and Nigeria (imported as LNG).

SUPPLY AND DEMAND

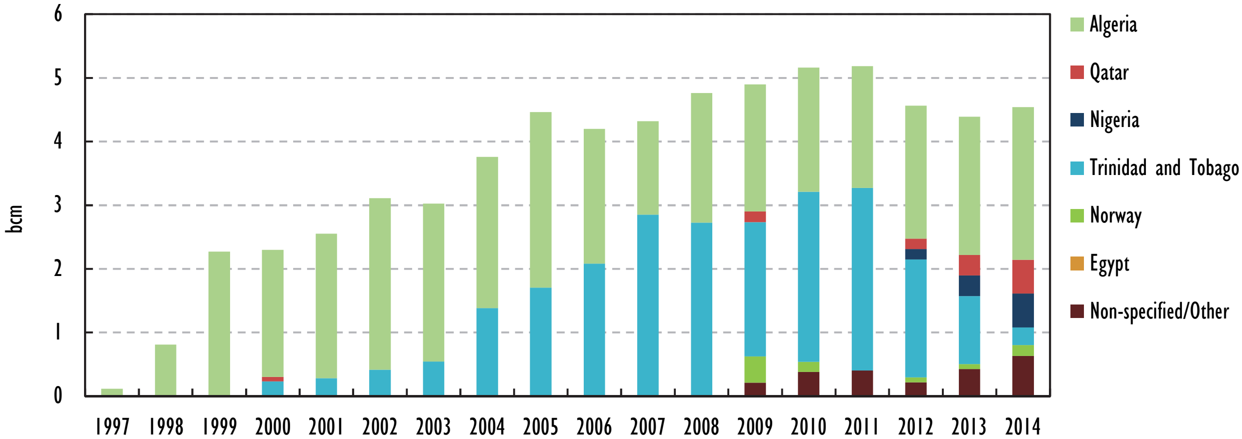
SUPPLY

Natural gas accounted for 16.4% of total primary energy supply (TPES) and 12.5% of electricity generation in 2014. It is imported and total supply was 3.5 million tonnes of oil-equivalent (Mtoe) or around 4.1 billion cubic metres (bcm) in 2014. Gas supply began in 1997 and has been growing steadily up to a peak of 4.5 Mtoe in 2010. Supply contracted by 22.8% in the following four years but the Portuguese government expects that it will increase to 4.3 Mtoe by 2020.

IMPORTS AND EXPORTS

Portugal relies on imports for its natural gas needs. It imports pipeline gas and LNG, with pipeline gas accounting for 71% of total imports in 2014. Since 2004, pipeline gas imports have increased from 2.4 bcm to 2.9 bcm in 2014, by 17.8%, while LNG imports have declined by 17.6%, from 1.4 bcm to 1.2 bcm (pipeline imports accounted for 63% of the total in 2004). Imports totalled 4.1 bcm in 2014, originating mostly from Algeria (58.9% of the total), Qatar (13.1%), Nigeria (6.7%), Egypt (7.3%), Trinidad and Tobago (4.3%), Norway (1.5%), with unspecified sources accounting for the remaining 15.5%. Before 2009, Portugal imported gas solely from Algeria and Nigeria. Figure 7.1 shows natural gas imports by country.

Figure 7.1 Natural gas imports by country, 1997-2014



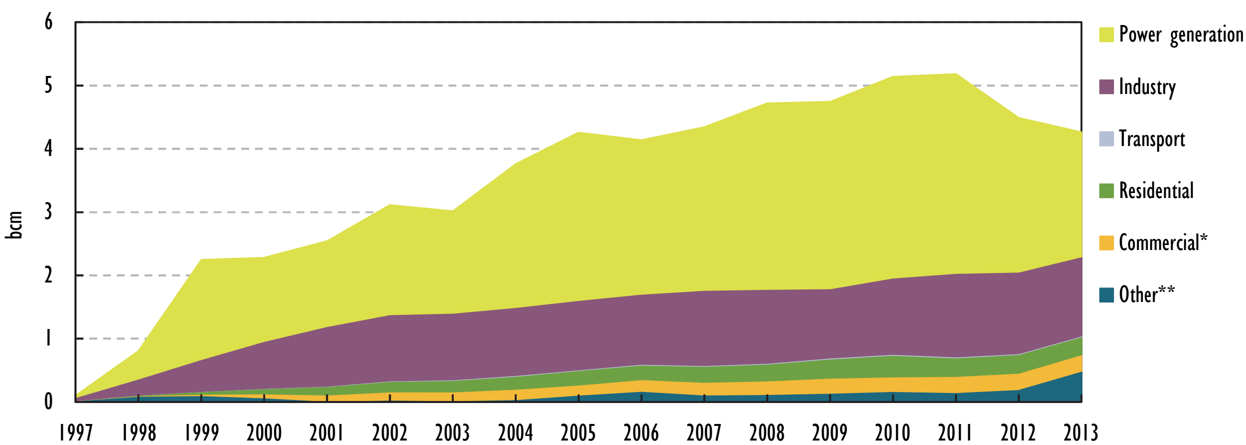
Note: Data are estimated for 2014.

Source: IEA (2015a), *Natural Gas Information 2015*, www.iea.org/statistics/.

DEMAND

Approximately 46% of natural gas in Portugal was used in power generation in 2013 (the latest data available for sector-specific demand). Demand from this sector has fallen by 38.1% from a peak in 2010, as a result of higher renewable energy generation. As such, the share of power generation in total gas consumption has declined from 61.8% in 2010. This sector was also the driver of growing demand for gas before 2010 (Figure 7.2), with its level of consumption increasing by 97.2% during 2003-10.

Figure 7.2 Natural gas supply by sector, 1997-2013



Note: TPES by consuming sector.

* *Other transformations* includes LNG plants, other refining and energy own-use.

** *Commercial* includes commercial and public services, agriculture/fishing and forestry.

Source: IEA (2015a), *Natural Gas Information 2015*, www.iea.org/statistics/.

Industry accounted for 29.3% of demand in 2013, followed by other energy industry, mainly petroleum refining and energy own-use (11.5%), the residential sector (6.6%), the commercial sector including services and agriculture (6.1%), and transport (0.3%).

Natural gas consumption in sectors other than power generation has increased over time. Demand in households and the commercial sector was 55.8% and 87.8% higher in 2013 than in 2003, respectively, with demand from transport and industry up by 40% and 18.9%, respectively. Consumption by petroleum refining (and energy own-use) was 20 times greater over the same period as a result of surges in demand during 2004-06 and 2012-13.

NATURAL GAS TRADE AND TRANSIT

Natural gas transported through the Portuguese transmission network is for domestic consumption. Any transit volumes relate to the capacity shared between the Portuguese and the Spanish gas network operators, REN Gasodutos and Enagás, for interconnecting the Spanish and the Portuguese systems between Campo Maior (PT)/Badajoz (SP) in the Estremadura region and Valença do Minho (PT)/Tuy (SP) in the north of Spain. The transmission network was, however, designed to provide transit to the north-west of Spain (Galicia), with capacity of 0.36 bcm per year (bcm/y) reserved for this specific purpose.

Table 7.1 Natural gas interconnections with Spain

Direction	Capacity		Direction	Capacity	
	bcm/y	GWh/d		bcm/y	GWh/d
Campo Maior (PT) – Badajoz (SP)	0.9	35	Badajoz)SP) – Campo Maior (PT)	3.5	134
Valença do Minho (PT) – Tuy (SP)	0.7	25	Tuy (SP) – Valença do Minho (PT)	0.8	30

Note: The values indicated in bcm are based on values in GWh/d taking into consideration: 365 days/year; SCP of 11,9 kWh/m^3(n) and a load factor of 0,85.

Source: DGEG, IDR country submission.

INFRASTRUCTURE

LIQUEFIED NATURAL GAS

The LNG terminal in Sines, located on the Atlantic coast and about 150 km south of Lisbon, is operated by REN Atlântico, through which REN operates an LNG reception, storage and regasification concession, subject to a public-service regime.

REN Atlântico, under the terms of the concession, performs the activities of LNG trucking and also the construction, operation, maintenance and expansion of the infrastructure. The LNG terminal consists of a jetty to unload LNG vessels up to the Q-Flex class size with an average discharge time of 20 hours, three storage tanks with a capacity of 390 000 m^3, roughly 242 million cubic metres (mcm) of natural gas, and seven open rack vaporisers for regasification. It can load up to 4 500 tanker trucks a year.

The configuration of the terminal allows receipt of LNG cargoes not only from the Atlantic basin (Nigeria, Norway, and Trinidad and Tobago) but also from sources, such as Qatar and Egypt, thereby diversifying supply and increasing security of supply, while providing flexibility for the smaller market players also to access the terminal.

Tariffs for the use of the facility are paid only by its users. The tariff calculation methodology allows for detailed knowledge of the various tariff components by activity or service. There are three tariff components for the use of the LNG reception, storage and regasification terminal: LNG reception, LNG storage and LNG regasification:

- The LNG reception tariff has one energy price.
- The LNG storage tariff has four possible contracted storage capacity prices: annual, quarterly, monthly and daily.
- The LNG regasification tariff has four contracted regasification capacity prices: annual, quarterly, monthly, daily and a price for delivered energy. There is also a fixed term tariff per truck for the LNG trucks loading.

TRANSMISSION

The National Natural Gas Transmission Network (RNTGN) consists of main and branch pipelines totalling 1 375 kilometres and 202 pipeline stations (46 block valve stations, 70 junction stations, 84 gas regulating and metering systems and two custody transfer stations). The entire network operates as a single balancing zone and is managed by REN Gasodutos.

The backbone of the system is the main pipeline running through the west of the country between Sines and Valença do Minho, where the main natural gas consumption points are located, a transit pipeline interconnecting the central zone of the system in the Leiria - Pombal area with the eastern border with Spain, two lines that supply the interior of the country in Beira Interior, and several branches, including the one that supplies the Lisbon area and a connection to the Carriço underground storage facility.

The principal entry points in the network include the connection of the Sines LNG terminal, two fully reversible interconnections with the Spanish high-pressure natural gas network in Campo Maior and Valença do Minho, and also the connection point to the Carriço underground storage facility.

A project to develop a third interconnection pipeline between the Portuguese and the Spanish transmission systems aims to fulfil compliance with the N-1 standard provided in European Regulation 994/2010 from 2018 onwards. This project also includes a potential new compressor station in Carregado, which will allow Portugal to make better use of the LNG terminal capacity of exports into the Spanish gas network, and possibly further on to Europe. This would, however, depend on sufficient interconnection capacities between Portugal and Spain and between Spain and France. The maximum technical capacity at the entry point of Campo Maior is 3.5 bcm per year (bcm/y), the entry point of Valença do Minho is 0.8 bcm/y, while Sines LNG terminal offers 5.3 bcm/y. The extension of the existing pipeline in Celorico da Beira to Braganza (PT)/Zamora (SP) was identified by the European Commission as a project of common interest (PCI).

STORAGE

Portugal has two natural gas storage facilities. The Carriço underground storage has six salt caverns in operation, since the end of 2014, and a maximum working volume of 300 mcm of natural gas. It has a nominal withdrawal capacity of 7.14 mcm/d and an injection capacity up to 2.0 mcm/d. The Sines LNG terminal has three tanks with a combined storage capacity of 390 000 m³ (roughly a storage capacity of 240 mcm of natural gas). The plant's send-out capacity is up to 32.4 mcm/d of natural gas. Further expansion plans are currently under review.

DISTRIBUTION

The distribution network is composed of medium- and low-pressure pipelines and serves the residential, commercial and small and medium-sized industrial sectors. Natural gas distribution is carried out on the basis of public service concessions.

Natural gas distribution is provided by six regional distribution operators and five local distribution operators. The six concession holders are Beiragás, Lisboagás, Lusitaniagás, Portgás/EDP Gas, Setgás and Tagusgás, and five local operators: Dianagás, Duriensegás, Medigás, Paxgás and Sonorgás. GALP Energia has stakes in nine natural gas distributors in Portugal (Lisboagás, Setgás, Lusitaniagás, Beiragás, Tagusgás, Duriensegás, Dianagás, Medigás and Paxgás), five of which operate under concession contracts lasting 40 years. The others operate under licences with an operational period of 20 years.

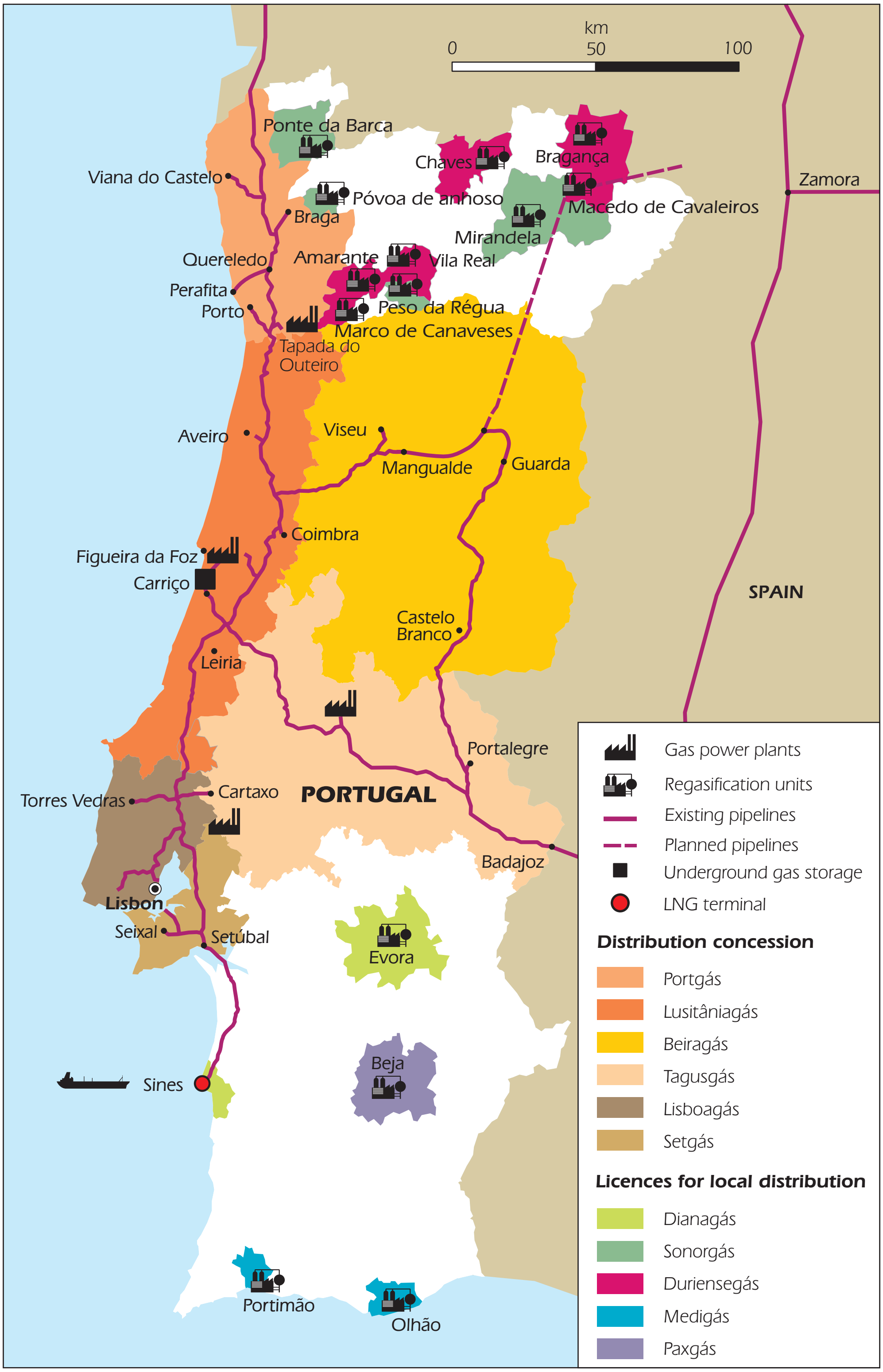
Table 7.2 Number of customers and length of the distribution networks by distribution system operator on 31 December

Network operator	Market share (%)	No. of customers	Length of network (km)
Paxgás	0.43	5 775	62
Dianagás	0.65	8 703	177
Sonorgás	1.05	14 038	318
Medigás	1.36	18 260	247
Duriensegás	2.11	28 316	443
Tagusgás	2.41	32 342	822
Beiragás	3.69	49 466	786
Setgás	11.76	157 581	2 018
Lusitaniagás	15.53	208 060	3 342
Portgás/EDP Gas	22.43	300 645	4 484
Lisboagás	38.57	516 952	4 352
Total	**100%**	**1 340 138**	**17 051**

Source: DGEG, IDR country submission.

By March 2014, Galp Energia, the largest player in the sector, had a distribution network of almost 12 00 km-long and approximately one million customers. The companies the GALP Energia owns, or part-owns, distributed 1.6 bcm of natural gas during 2014. Energias de Portugal (EDP) is also active in the sector through its 72% ownership of EDP Gás Distribuição, which supplies approximately 25% of the population. EDP Gás Serviço Universal is a company 100% owned by EDP Gás Distribuição and is the last-resort supplier for the concession area, being responsible for the supply of natural gas in the regulated market. Several foreign operators are also active in the sector through shareholdings in regional gas companies. GDF Suez and Spain's Enagas also hold shares of Portuguese utilities.

Figure 7.3 Map of Portugal's natural gas infrastructure



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

MARKET STRUCTURE AND OVERSIGHT

MARKET STRUCTURE

In Portugal, the natural gas sector comprises a set of regulated and unregulated activities. These activities range from unregulated procurement operating exclusively regulated infrastructure, to mixed marketing (regulated and unregulated). ERSE, the energy market regulator, is responsible for establishing the regulations for the returns from the regulated activities.

Redes Energéticas Nacionais (REN) is active in both the natural gas and electricity sectors. In the natural gas market, it is responsible for the transport of high-pressure natural gas and overall technical management of the national natural gas system, guaranteeing the reception, storage and regasification of LNG and underground storage of natural gas.

The distribution of natural gas is provided by six distributors (five of which belong to GALP) that work under concession contracts, and five autonomous natural gas distribution units. The downstream natural gas market is dominated by two utilities: GALP Energia and EDP.

MARKET OVERSIGHT

The natural gas sector is overseen by the national regulatory authority, Entidade Reguladora dos Serviços Energéticos (ERSE). Regulation focuses both on infrastructures (transmission, distribution, underground storage and LNG terminal) and on last-resort supplier activities. The behaviour of suppliers in the market is also subject to ERSE's oversight. ERSE derives its income from third-party access (TPA) tariffs charged to electricity and natural gas consumers, through network operators and not from the general state budget. ERSE also co-operates with the Competition Authority (AdC) notably with regard to wholesale and retail market supervision. The board of ERSE is appointed by government and its members cannot be removed from office. Security of supply matters are supervised by the Directorate-General for Energy and Geology (DGEG).

On 30 July 2015, the regulator ERSE notified REN (Rede Eléctrica Nacional and REN Gasodutos) that the conditions of certification set by ERSE on 9 September 2014 were fully satisfied. It thus granted effectiveness to its decision of certification of REN (Rede Eléctrica Nacional) as the transmission system operator of the national electricity transmission network, and of REN Gasodutos as the transmission system operator of the national natural gas transmission network, in the full ownership unbundling regime.

REGULATION OF INFRASTRUCTURE

The following natural gas activities are subject to regulation by ERSE:

- High-pressure transmission of natural gas (REN Gasodutos);
- General technical management of the National Natural Gas System (REN Gasodutos);
- Reception, storage and regasification of LNG (REN Atlântico);
- Underground storage of natural gas (REN Armazenagem);
- Management of the supplier switching process (REN Gasodutos).

A new three-year regulatory period started in July 2013. The main changes introduced by ERSE were:

- Indexation of the remuneration rate to be consistent with earnings on Portuguese Treasury Bonds, with a maturity of ten years and the introduction of limits to the remuneration rate for the 2013-16 period of between 7.33% and 10.50%;
- The introduction of a mechanism to lessen tariff adjustments at the LNG terminal with the aim of reducing the impact of these adjustments on the annual tariffs;
- The extension of incentive-based regulation to underground storage in a similar manner to that for the high-pressure transmission of natural gas and LNG reception, storage and regasification.

Currently, the level of eligible operating costs (cap) to calculate income in activities regulated by incentives has a maximum permitted value and includes a fixed part, subject to a regulatory revenue cap approach and one or more variable parts, subject to a price cap approach, indexed to the cost variables for the size of the infrastructure and the extent to which it is used.

The amount of operating expenses approved in the first year of the current regulation period evolves in the following years in line with the efficiency targets set and published by ERSE for these years. The variable associated with the consumption of electricity at the LNG terminal (energy component) evolves in line with the average annual variation in the price of electricity on the futures market, published by the Iberian Energy Market Operator (OMIP), and with the efficiency target set by ERSE.

The efficiency targets for the current regulatory period vary between 1.5% and 3% per year. General use of the system and management of the supplier switching process are not subject to efficiency targets. This is also the case with some expenditure considered outside company control.

WHOLESALE GAS MARKET

To date, Portugal´s gas market development has been constrained by its limited size and the slow progress of integration with the Spanish market, partially as a result of cross-border entry-exit charges between both national gas transmission systems. Increased integration could lead to the creation of an Iberian Gas Market (MIBGAS).

In recent years, Portugal has taken a number of steps towards market opening and integration with Spain. It abolished transmission exit fees in the interconnection with Spain in June 2012 and Spain reduced the exit price (towards Portugal) in cross-border tariffs. Interconnection capacity between both countries was auctioned for the first time in 2013 and once more in March 2014. As part of the review of gas regulation finalised in 2013, the regulator allows the allocation of binding capacity rights in transmission, underground storage and LNG terminal infrastructures, for periods of up to one year (EU, 2014). The regional integration of wholesale markets was enhanced in 2013, through another harmonised auction of interconnection capacity of natural gas between Portugal and Spain. This rule closely followed the European Network Code on Capacity Allocation Mechanisms.

In the context of the Agency for the Co-operation of Energy Regulators (ACER) Gas Regional Initiative for the South of Europe, which aims to implement a regional natural gas market, the harmonisation of the capacity allocation mechanisms (CAM) in the three countries of the south region (Portugal, Spain and France) has been determined as priority. As such, according to the European guidelines and in the context of the development of an Iberian natural gas market, the Portuguese and Spanish TSOs allocate capacity in the interconnections through a joint capacity allocation mechanism in the Portugal/Spain Interconnections (namely at Valença do Minho and Campo Maior) (ERSE, 2014).

In June 2014, the Spanish regulator and ERSE published a joint consultation paper, which examined possible models for the integration of the gas wholesale markets of Spain and Portugal, including the feasibility for the development of a common Iberian gas hub.[1] The paper examined three different models of market integration: the Market Area Model, the Trading Region Model and the Market with Implicit Capacity Allocation model. It set out the possible application of each model to the Iberian gas market and compared the advantages and disadvantages of each. The regulatory agencies are analysing the responses received. A roadmap for the implementation of the chosen solution will be prepared accordingly.

EMERGENCY PREPAREDNESS

EMERGENCY RESPONSE POLICY

The minister in charge of energy can define priority rules in case of an emergency, taking into consideration the need to provide a stable gas supply for household consumers, health services, safety services and other consumers that are highly dependent on gas.

In 2012, DGEG, in co-operation with the natural gas TSO, developed an emergency plan and a Preventive Action Plan based on EU Regulation 994/2010 on Security of Gas Supply. These plans clearly define the decision-making procedures for all stakeholders in times of gas network emergencies and for all major problems detected in gas networks.

ERSE has established competitive bidding mechanisms to allocate capacity in line with new European network codes. This is expected to eventually lead to demand-side management for client portfolio management from shippers, if and when congestion arises in the gas system.

Suppliers of natural gas are required to maintain mandatory gas reserves. They are subject to an obligation to hold gas reserves corresponding to the consumption level of protected customers (such as residential, tertiary and small industrial users) of up to 20% of the country’s total gas demand over 30 days of exceptionally high gas demand, occurring with a statistical probability of once in 20 years. Suppliers are also obliged to maintain gas reserves corresponding to the consumption of non-dual-fired combined-cycle gas turbines (CCGTs) for 30 days of unusual high gas demand for electricity generation.

1. CNMC/ACER/ERSE, *Study about models for integration of the Spanish and Portuguese gas markets in a common Iberian Natural Gas Market*, July 2014.

The gas inventories that may be counted for the purpose of mandatory security reserves are the combined stocks of each obligated stakeholder kept in underground storage, in LNG storage and on LNG carriers with fixed port destinations in Portugal, with an estimated time of arrival of within three days.

Mandatory gas reserves are commingled with commercial stocks. The average stock level of mandatory gas reserves in 2012 was estimated to be around 175 mcm, which is equivalent to a volume of 15 days of imports in the same year. Some of this volume includes LNG in tankers moving from Nigeria to Portugal. The volume of commercial stocks kept in underground storage and the LNG terminal depends on the commercial decisions of market stakeholders and can vary between nearly zero (immediately before unloading an LNG tanker) and about 225 mcm when stocks are at their maximum and there is no LNG tanker with an estimated time of arrival within three days.

Release of compulsory gas stocks is decided by the minister responsible for energy under conditions established by legislation: no automatic triggers exist. In 2014, the withdrawal capacity of the underground storage facilities in Carriço was 7.14 mcm/d, while the send-out capacity of LNG storage plants in Sines terminal is up to 32.4 mcm/d of natural gas.

There is no demand restraint programme in place for rapid and short-term reduction of gas consumption during a gas supply disruption. There are no interruptible contracts in the Portuguese gas market. In case of a supply disruption, Portugal would maximise the amount of renewable electricity production while balancing the variability of wind power using other sources such as hydropower or imports from Spain. The government holds regular exercises based on various scenarios, including cybersecurity related issues.

Supply disruptions

In early 2013, a *force majeure* incident shut down an LNG liquefaction facility in Nigeria, Portugal's primary LNG supplier, which was responsible for 83% of all LNG imported into the country. Two contracted cargoes were lost. The situation was exacerbated when LNG facilities in another source, Trinidad and Tobago, was undergoing maintenance. While GALP Energia was able to eventually secure replacement cargoes, one of the vessels carrying them was not able to unload because of compatibility issues.

Fuel switching

Short-term fuel-switching capacity is limited to two CCGT plants (990 MW and 830 MW) that have dual fuel-fire capabilities using natural gas and petroleum distillates. These dual-fuel power plants, however, are not required to hold any diesel stocks as no legal requirement exists for increasing fuel-switching capability.

RETAIL MARKET AND PRICES

The process of phasing-out of end-user regulated natural gas tariffs was previously understood to be ending in December 2015. Decree-Law No. 74/2012 of 26 March approved a timetable for the gradual phasing-out of such tariffs for natural gas for either 31 December 2014 or December 2015, depending on the annual gas consumption. After several extensions, Decree-Law No. 15/2015 of 30 January, and Ordinance No. 97/2015 of 30 March, further pushed back the expiration date for the end of all regulated tariffs to 31 December 2017. During this period, transitory tariffs with a gradually increasing premium component will apply and also be updated quarterly by ERSE (LBR, 2015). In April 2013, ERSE approved a new regulatory framework to support the changes in commercial relationships following the removal of regulated tariffs. These modifications, which were aimed at strengthening consumer protection and enhancing competition, included extending the quality of service to all retailers, reinforcing unbundling provisions, adjustments to the supplier-switching procedure and modifications in capacity allocation and pricing provisions (EU, 2014). According to ERSE, the extinction of regulated end-user tariffs for domestic customers led to a high supplier-switching rate, especially from last-resort suppliers to liberalised market regime suppliers (ERSE, 2014).

Nonetheless, the gas retail market in Portugal remains highly concentrated as liberalisation is recent and there remain some barriers to wholesale imports. By the end of 2013, GALP still supplied 71% of total consumption, followed by Gas Natural Fenosa with a share of 13%, EDP with 11%, Endesa with 2.7% and Goldenergy with 2.3% (ERSE, 2014). There are, however, a number of positive signs for the liberalisation process, such as the entry of new retailers and the ability for consumers to switch supplier, with over 600 000 customers switching supplier by the end of 2013, in a market of approximately 1.3 million customers (ERSE, 2014).

Economically vulnerable customers will, however, continue to have access to regulated social tariffs, subject to the ceiling on tariff variation established annually by government. These vulnerable customers include consumers who are part of a restricted group of consumers benefiting from government social support mechanisms.

Natural gas tariffs in Portugal are among the highest in the OECD. Industry tariffs are second only to Switzerland while only Greece and Sweden offer domestic consumers more expensive natural gas.

According to Eurostat, Portuguese gas retail prices for household consumers (EUR 0.1039/kWh including taxes and levies, or 0.0802/kWh excluding taxes and levies) are among the highest in the European Union, second only to Sweden.[2] Prices for industrial users (EUR 0.0546/kWh including taxes and levies, or 0.0437/kWh excluding taxes and levies) are also among the highest in the European Union.[3] This is partly the result of the high share of network costs in the final price.

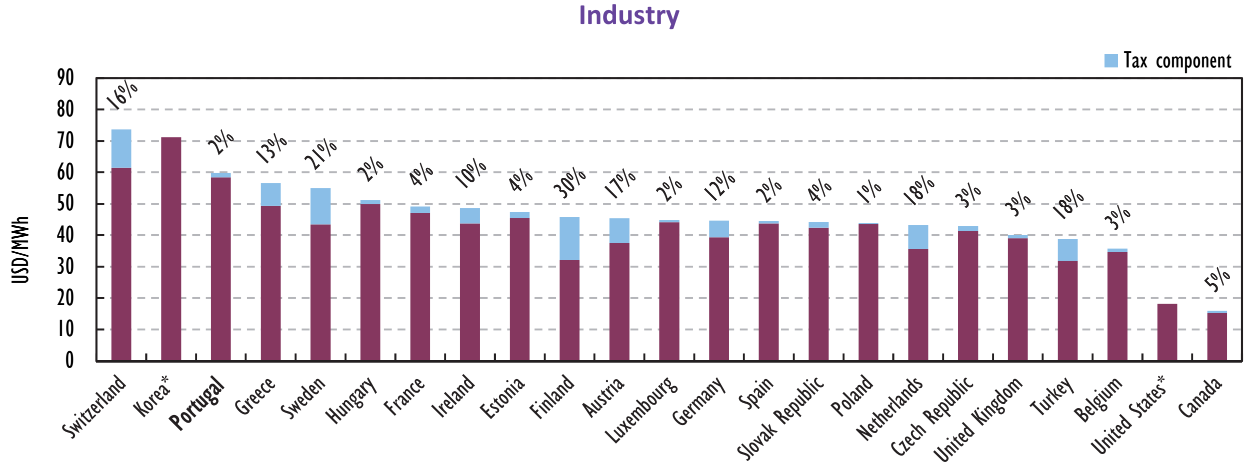
Portugal maintains public service obligations through the concept of vulnerable customers, defined as those who are beneficiaries of government social support plans. They will keep the right to a regulated tariff with a limited increase decided by the government for each year. In 2012, 665 695 electricity and 17 000 natural gas consumers were eligible for this social tariff. During 2012, Portugal approved new provisions for customer protection in accordance with the Third Energy Package (EU, 2014).

2. Eurostat, Gas prices for domestic consumers - bi-annual data (from 2007 onwards) - Band D2: 20 GJ < Consumption < 200 GJ (second semester 2014).

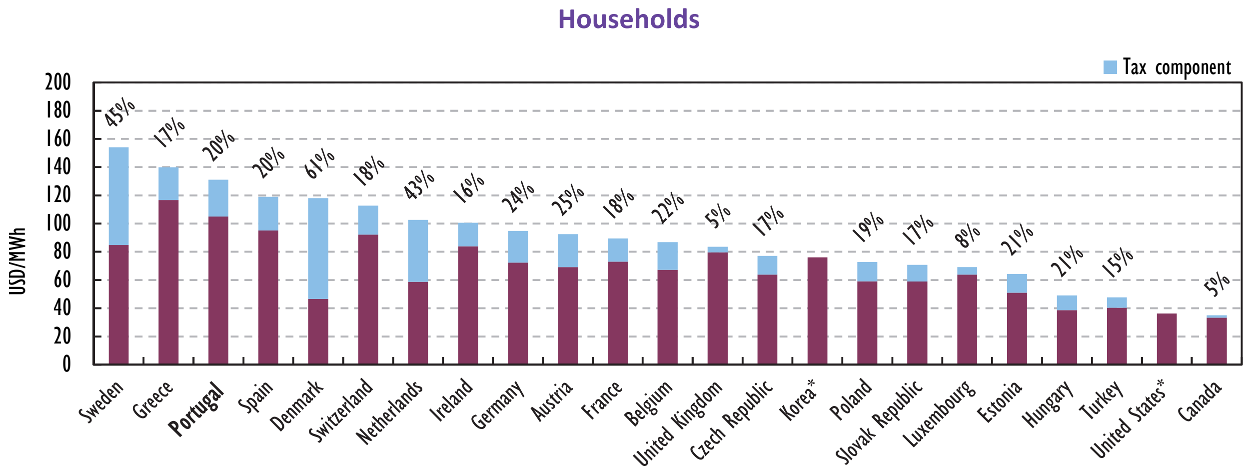
3. Eurostat, Gas prices for industrial consumers - bi-annual data (from 2007 onwards) - Band I3: 10 000 GJ < Consumption < 100 000 GJ (second semester 2014).

PRICES AND TAXES

Figure 7.4 Gas prices in IEA member countries, 2014



Note: Data not available for Australia, Denmark, Italy, Japan, New Zealand and Norway.

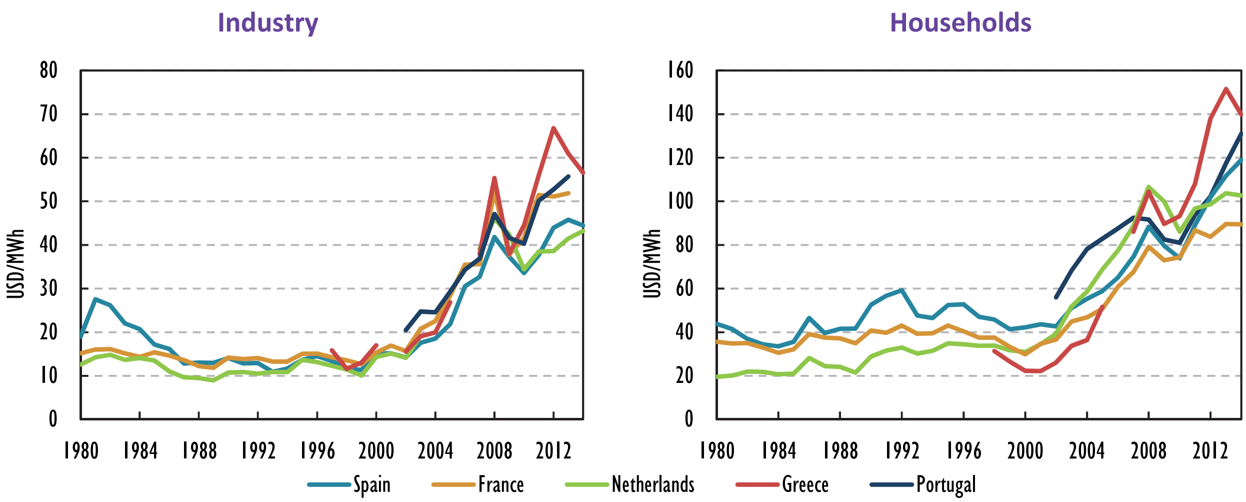


Note: Data not available for Australia, Finland, Italy, Japan, New Zealand and Norway.

* Tax information not available.

Source: IEA (2015b), *Energy Prices and Taxes 2015*, Q3, www.iea.org/statistics/.

Figure 7.5 Gas prices in Portugal and in other selected IEA member countries, 1980-2013



Notes: Data are not available for Greece before 1996 and for Portugal before 2002.

Source: IEA (2015b), *Energy Prices and Taxes 2015*, Q3, www.iea.org/statistics/.

ASSESSMENT

In many respects the natural gas market in Portugal has made good progress since the previous review visit in 2008: the network operator, REN, has been fully unbundled and privatised; competition has started to emerge in the retail sector; and there have been many infrastructural improvements, which have strengthened the network and delivered greater security of supply. Nonetheless, decline in consumption following the economic crisis, alongside low coal prices, low prices under the European Union Emissions Trading Scheme (EU-ETS) and the high penetration of variable renewable electricity are all having a severe impact on the sector. Natural gas demand in the electricity market has collapsed, leading to a greater risk of stranded assets in both electricity generation and natural gas transmission.

Transmission infrastructure has undergone a number of significant investments since 2008: storage capacity at the Sines LNG terminal has increased with the addition of a third tank, three new storage facilities have entered in operation and the project for the third interconnection between Portugal and Spain was identified as a project of common interest (PCI) by the European Commission. Conversely, each of these additions to the network will have to be paid for by a consumption base that is much lower than forecast when the infrastructure was first mooted. For example, the number of LNG cargoes unloaded at Sines fell from 32 in 2013 to 20 in 2014, the number of cargoes loaded was the same in 2013 and 2014 (six each year) and cooling actions fell from three in 2013 to one in 2014, while new entrants prefer to import via Spain by pipeline.

Further infrastructure additions are planned. These will include a third interconnector with Spain and an additional compressor station. While there is merit in expanding export capacity to Spain, the opportunity to take commercial advantage of the interconnection will be limited until such time as further connections are built to link the Iberian Peninsula with the European market and the absence of a regional natural gas market. Accordingly, additions to the transmission network, including storage facilities, should not proceed unless necessary to safeguard security of natural gas supply. This includes ensuring that the gas network is robust enough to withstand the disruption of the largest infrastructure (N-1 standard) at national or regional levels.

The distribution market remains fragmented with thirteen distribution systems and a smaller number of owners. While the number of consumers has increased since 2008, it could be argued that the system has reached its economic limits and further expansion should only take place where economically justified.

The implementation of the Iberian Electricity Market (MIBEL) and its success can suggest an implementation of an Iberian Market for Natural Gas (MIBGAS). Despite this, progress on its development has been very slow since 2008. A regional natural gas market will offer greater energy security, a more liquid wholesale market and allow market participants access to a greater number of supply options. The Portuguese government and the sector regulator, ERSE, alongside their counterparts in Madrid must build on the consultation process that started in 2014 and develop a credible timetable for implementation of the new market.

Despite the success of the government and regulator in introducing competition in retail markets, there remains some concern regarding the completion of the process, which is likely to end in 2017. There needs to be a clear understanding among customers of how the market works and how customers will transit from regulated tariffs to the market. Likewise, a mechanism to protect the needs of vulnerable customers should be developed. There is also a need to review the operation of the system to facilitate supplier switching; the outcome of this review should be the standardisation of all processes and messaging systems. It should examine the feasibility of merging the natural gas and electricity switching mechanisms and vesting responsibility for the management of the process in an organisation independent of the DSOs.

RECOMMENDATIONS

The government of Portugal should:

- ☐ *Present a clear vision for the natural gas market after 2015 and provide a credible mechanism for all customers to transit away from regulated tariffs alongside a means to protect vulnerable customers.*
- ☐ *Ensure that any further expansion of the transmission and distribution networks is subject to rigorous examination with a view to ensuring that only investments needed to meet reasonable demand or to safeguard natural gas security proceed.*
- ☐ *Develop, in co-operation with ERSE and its Spanish counterparts, a credible timetable for the implementation of MIBGAS. This schedule should include clear obligations on all parties as well as intermediate milestones such as a regional wholesale markets and standardised network operation codes.*
- ☐ *Support the development of an independent switching mechanism for the retail market before the conclusion of the liberalisation process.*

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8. OIL

Key data (2014 estimated)

Crude oil production: nil

Crude oil import: 10.5 Mt, -17.4% since 2004

Oil products net exports: -1.8 Mt

Share of oil: 45.1% of TPES and 3.2% of electricity generation

Consumption by sector (2013): 9.6 Mt (transport 52.6%, industry 20.8%, other energy and energy own-use 13.1%, residential 5.3%, commercial and other services 5%, power generation 3.3%)

SUPPLY AND DEMAND

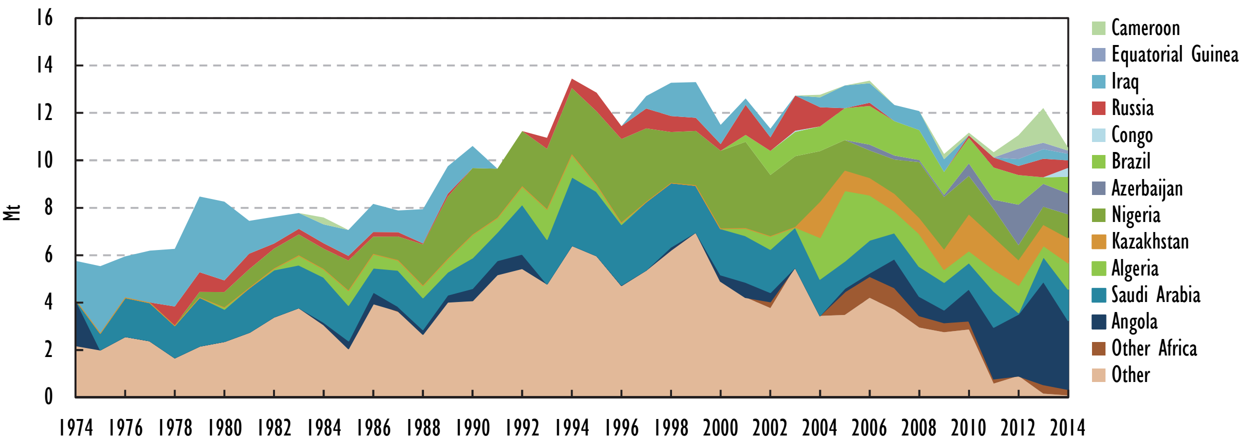
SUPPLY

Oil is the largest energy source in Portugal, accounting for 45.1% of total primary energy supply (TPES) in 2014 or 9.5 million tonnes of oil-equivalent (Mtoe). Oil supply reached a peak of 15.8 Mtoe in 2002 and has been declining since with moderate volatility, falling by 39.8% in the 12 years to 2014. Before 2002, supply was growing with some volatility since the late 1980s.

Crude oil

Portugal relies on imported crude oil as it has no indigenous production. It imported 10.5 million tonnes (Mt) of crude oil during 2014, sourced from Angola (27.6%), Saudi Arabia (12.5%), Algeria (10.5%), Kazakhstan (9.8%), Nigeria (9.6%) and others (Figure 8.1).

Figure 8.1 Crude oil imports by source, 1974-2014



Note: Data are estimated for 2014.

Source: IEA (2015a), *Oil Information 2015*, www.iea.org/statistics/.

Crude oil imports reached a peak of 13.4 Mt in 2006 and have been declining since, down by 21.1% in the nine years to 2014 (with a slight resurgence during 2013). Imports from Angola and Kazakhstan have increased considerably over the same period while imports from Algeria and Nigeria have fallen. Imports from Saudi Arabia have remained relatively unchanged. Portugal also imports refinery feedstocks, totalling 1.4 Mt in 2014, twice more than ten years earlier.

Oil products

Imported crude oil and feedstocks are refined domestically and Portugal is a net exporter of oil products. During 2014, Portugal produced 12.6 Mt of oil products which is around 11.7% lower than the previous year. Refinery output followed the same pattern as crude oil imports, with a peak of 14.4 Mt in 2006 followed by a period of decline, interrupted by resurgence in 2013.

Gas and diesel oil account for 40.7% of domestically produced oil products, followed by fuel oil (18.2%) and gasoline (14.7%).

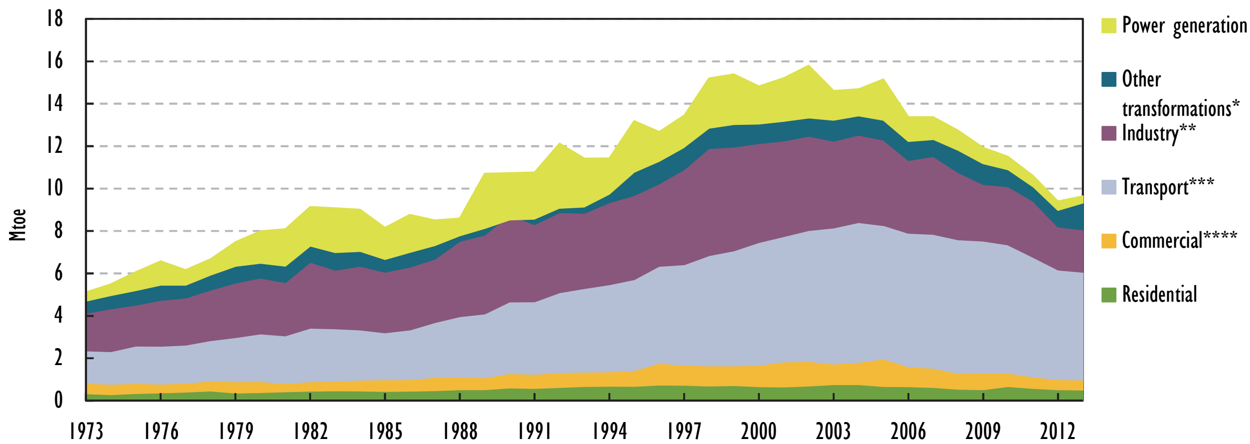
Approximately 36% of domestically produced oil was exported in 2014 (4.6 Mt). Exports have surged over the past decade, increasing by 131% from 2004 to 2014. They are mainly destined for Spain (21.4%), the United States (13.8%), France (9.4%), the Netherlands (8.1%) and all across Europe and North Africa.

Portugal imported 2.8 Mt of oil products during 2014, which represents a 39% decline compared to 2004. The top five sources of imported oil are Spain (53.6%), the United States (17.4%), the Netherlands (8.6%), the United Kingdom (5.9%) and Equatorial Guinea (3.2%).

DEMAND

Transport consumes 59.8% of oil in Portugal. Industry accounts for 19.0% of consumption while 6.9% is refined and/or used for the energy sector's own-use. Households, the commercial and services sector and power generation consume 5.1%, 5.0% and 4.3% (data refer to the year 2013).

Figure 8.2 Oil supply by sector, 1973-2013



Note: TPES by consuming sector.

* *Other transformations* includes refineries and energy own-use.

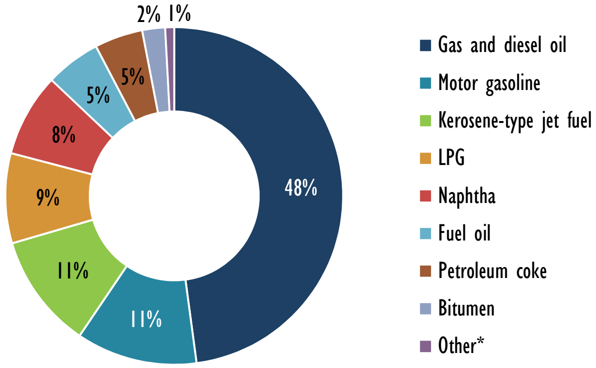
** *Industry* includes non-energy use.

*** *Commercial* includes commercial and public services, agriculture/fishing and forestry.

Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Oil demand has fallen in all sectors besides refining. The strongest decline has been in power generation, with demand down by 77.1% from 2003 to 2013 (the latest sector-specific consumption data available). Industry and the commercial sector have reduced consumption by half over the same period, while demand in households and transport fell by 33.6% and 21%, respectively. Conversely, oil products refining and exports have increased, with oil consumption in refining up by 20% over the ten years. The breakdown of oil consumption by product is represented in Figure 8.3.

Figure 8.3 Oil consumption by product, 2013



* *Other* includes lubricants, paraffin waxes, white spirit, aviation gasoline, gasoline-type jet fuel and other non-defined products.

Source: IEA (2015a), *Oil Information 2015*, www.iea.org/statistics/.

INFRASTRUCTURE

PORTS

All imports of crude oil pass through the two major ports on the Atlantic Ocean, Sines and Leixões. The oil terminal at Sines port is operational year-round and supports very large crude carriers (VLCCs). Leixões port, where difficult winter conditions prevent receiving tankers for some 50 to 80 days each year, can also operate year-round thanks to a single-point mooring buoy, connected to the Petrogal refinery on shore by a 3.0 km pipeline.

Both ports were recently improved in terms of capacity, reliability and accessibility and projects are still ongoing in Sines. In addition to the two major ports, smaller ones and terminals such as at Aveiro, Lisbon and Setubal, as well as in the Madeira and Azores autonomous regions, can be used for import and export of refined products, which enhances flexibility of response during emergencies.

REFINING

There are two refineries in Portugal: Sines with a capacity of atmospheric distillation of 220 thousand barrels per day (kb/d), and the smaller Matosinhos with a capacity of 110 kb/d. The Sines refinery is one of the largest refineries on the Iberian Peninsula. The Matosinhos refinery is a hydro-skimming refinery with vacuum distillation. Both refineries are owned by Petrogal (GALP Energia).

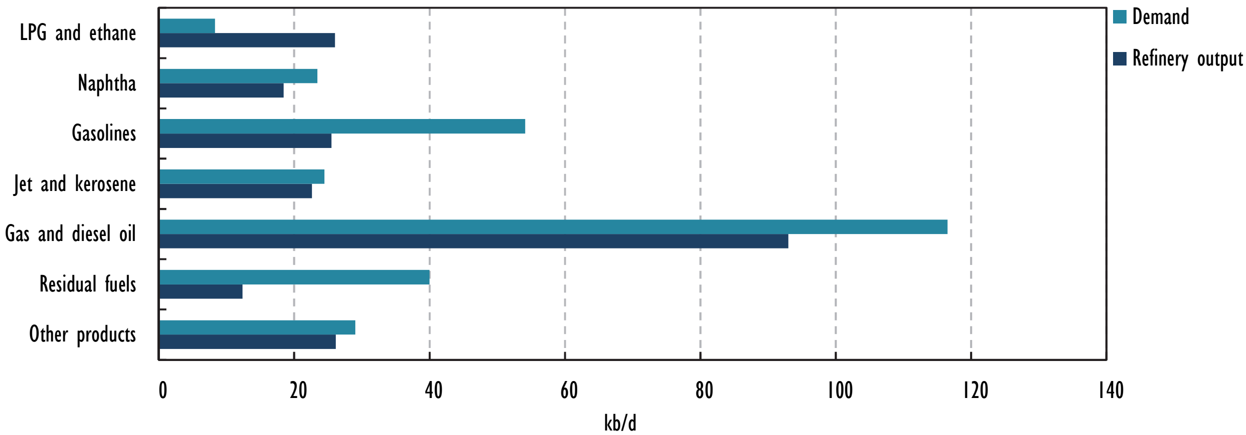
Both refineries recently underwent upgrade projects with investments totalling EUR 1.4 billion in order to adapt them to the changing demand patterns and an increasing dieselisation of the European market. Integrated operations of the refining upgrade commenced following the entry into operation of the new units at the Matosinhos refinery in June 2011 and the start-up of the hydro-cracking complex at the Sines refinery in January 2013.

GALP Energia has upgraded Sines and Matosinhos refineries so as to adjust their production profile to the needs of the Iberian market, where diesel is in short supply, by maximising the annual production of diesel and by reducing the share of fuel oil production which exceeds domestic demand.

The refineries are to an extent interdependent and exchange semi-finished products for the purpose of optimising capacity utilisation; they are however able to operate independently in a contingency situation.

In 2013, the country's refined product output averaged 296 kb/d and the average capacity utilisation rate was 73%. The composition of production in 2013 was 116 kb/d (39%) of gas/diesel oil, 23 kb/d (8%) of other middle distillates, almost entirely jet kerosene, 54 kb/d (18%) of motor gasoline, 40 kb/d (14%) of residual fuel oil, 23 kb/d (8%) of naphtha and 29 kb/d (10%) of other products. The refineries are able to meet domestic demand for all product categories except liquefied petroleum gas (LPG) and ethane.

Figure 8.4 Refinery output vs. demand, 2014



Note: Includes refinery fuels; excludes refinery losses.

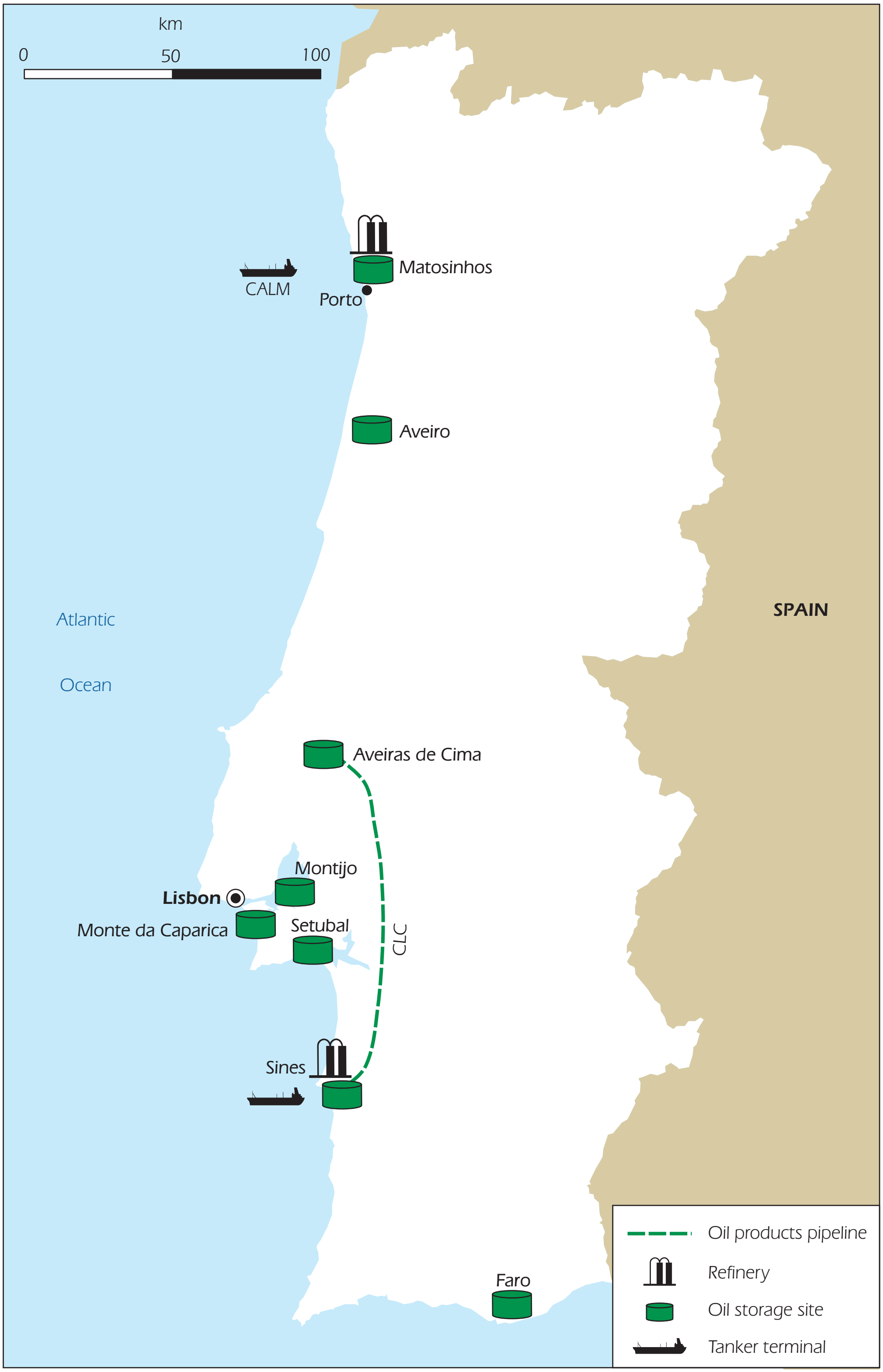
Source: IEA (2015), *Monthly Oil Statistics ((December 2015)*, www.iea.org/statistics/.

PIPELINES

Portugal does not have any cross-border pipelines for transportation of crude oil and oil products. Oil products are distributed to inland areas through the Companhia Logistica de Combustiveis (CLC) pipeline, a 147-km multi-product pipeline between the Sines refinery and the tank farm at Aveiras (45 km north of Lisbon). The CLC pipeline has the capacity to carry 80 kb/d of seven different products, in sequence and by cycles. From the tank farm, oil products are transported to the market by truck.

There is also a 4.0 km jet fuel pipeline running from the Matosinhos refinery to the international Porto Airport (serving the north of Portugal). This jet fuel pipeline, with a capacity of 13 kb/d, is operated by Petrogal.

Figure 8.5 Oil infrastructure in Portugal



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

STORAGE

Total storage capacity in Portugal amounts to 7.0 million cubic meters (mcm) at end-2014 in a total of 50 facilities. The bulk of this capacity, 73%, rests in the two refineries, Sines (3.4 mcm) and Matosinhos (1.9 mcm) each of whose storage capacities have been recently increased in relation to the upgrade project. GALP Energia owns 84% of storage capacity and 100% of the storage capacity in the country for crude oil. The logistical and tanking joint venture company CLC owns 0.295 mcm, representing around 4% of the total storage capacity. Apart from renting commercial storage, the new stockholding entity, ENMC (former EGREP), operates its own depot with around 142 621 tonnes of diesel. ENMC is also analysing the possibility of storing products in salt and other mining caverns.

MARKET STRUCTURE

The most significant player in the Portuguese oil market is GALP Energia. It operates both refineries and maintains a strong position in the downstream oil market. Through its oil retail and wholesale divisions, GALP Energia is directly involved in all sectors of the market. The retail gasoline market in mainland Portugal is highly concentrated, with the four main operators, GALP, Repsol, Cepsa and BP, accounting for over 67% of outlets in 2014. A number of small independent players are also involved in the retail market, including the major supermarket chains (37% in 2014).

TRANSPORT FUELS

The relative shares of diesel and petrol in the transport sector are in the range of 60% and 40% respectively. Approximately 70% of new cars are now diesel-fuelled. Increasing dieselisation of the car fleet in Portugal is expected to drive robust growth in road diesel demand through the next years. The increase in the proportion of diesel vehicles results from the fiscal policy that imposes a significant difference between taxes on petrol and diesel.

The Portuguese car fleet of light vehicles peaked in 2011 with about 6.1 million vehicles but it has been decreasing since then. The current car park is of the order of 5.5 million cars, of which 3.3 million are diesel vehicles.

The number of new diesel car sales has been decreasing in recent years, and in 2013 was around 76 000 new vehicles compared to around 127 000 in 2008, or 40% less. Also the efficiency of the new technology in gasoline-engine vehicles is improving considerably as a result of greater use of gasoline direct injection (GDI), thereby reducing the fuel efficiency advantage of diesel, and hence CO_2 emissions.

EMERGENCY PREPAREDNESS

EMERGENCY RESPONSE POLICY

Portugal's oil emergency response policy is aligned with the European Union's Directive 119/2009/EC on Oil Stocks. There are no distinct provisions for domestic/international oil disruptions. The competence to authorise or to determine the use of security stocks in case of severe supply disruption and to impose general or specific restrictions on consumption, particularly for priority allocation of petroleum products to certain categories of consumers, is committed to the minister responsible for energy. Any decision by the minister must take into account the national interest and any obligations assumed under international agreements and must be defined in an intervention plan. In a crisis, all measures proposed by the minister responsible for energy must be submitted to the Council of Ministers for final approval.

During a supply crisis, the minister responsible for energy has the authority, following consultation with the Council of Ministers on proposals drawn up by the Directorate-General for Energy and Geology (DGEG) and the stockholding agency ENMC, to order the release of compulsory oil stocks in order to safeguard the national economy or to meet supply obligations to other IEA member countries. It is expected that the decision-making process would take about 48 hours. In theory, actual release of stocks could follow immediately. In the case of compulsory stocks commingled with commercial stocks, supplies would be made available through the normal logistical chain. For stocks held abroad under bilateral agreements or tickets, ENMC estimates that delivery to Portugal would require a lead time of five to ten days.

The government is developing a contingency plan for a major oil supply disruption. This plan will cover critical infrastructure procedures and identification. It will also include a manual setting out emergency measures and defining roles for market participants. Once this plan has been developed, the government proposes to conduct a series of emergency exercises.

For local supply disruptions, the government maintains a list of strategic petrol stations that can be used to supply emergency services and priority users. No specific set of rules exists for the operation of this system and no exercises have been conducted. It is worth noting, however, that the list was deployed in 2008 during a nationwide road haulier's strike.

EMERGENCY ORGANISATION (NESO)

The DGEG, part of the Ministry for Environment, Spatial Planning and Energy is the core body of the National Emergency Strategy Organisation (NESO) structure. The DGEG is responsible for ensuring planning of supply, production and use of energy resources, supporting the minister responsible for energy in taking decisions, particularly in crisis or emergency situations, within the National System of Civil Emergency Planning and in close collaboration with industry representatives and the National Authority for Civil Protection.

The minister responsible for energy has the authority to decide whether the country will accept an IEA initial assessment or not, and which response measures to take in order to participate in an IEA collective action. If the country's stocks stay above 90 days, even after a collective action, the minister can also decide if further release is necessary. Otherwise a Cabinet decision would have to be taken.

EMERGENCY OIL RESERVES

Stockholding regime

Portugal meets its minimum stockholding obligation to the IEA and the European Union by holding IEA stocks and placing a minimum stockholding obligation on industry. Oil industry operators are required to hold a maximum two-thirds of the EU obligation (60 days), while the ENMC is obliged to hold, at a minimum, the remaining one-third of the EU obligation and to meet the difference between total EU and IEA stock obligations.

ENMC (previously known as EGREP) is a public corporation under the supervision of both the Ministry of Finance and the ministry responsible for energy. The latter has three main responsibilities: co-ordinating the allocation and sale of stocks during an energy supply crisis; authorising the sale of surplus reserves held by ENMC (should such an occasion arise); and approving the amounts of money companies will pay to ENMC. The minister can authorise a given entity to delegate the entity's total stock obligation to ENMC. The applicant's inability to maintain the required stocks should be justified by reasons beyond its control. Fulfilling all the obligation through ENMC has been used by small operators entering the market so that the need for storage capacity does not create a barrier to entry or competition. All ENMC costs are covered by industry operators.

Location, quality of crude, product types

On 1 August 2014, Portugal held 22.3 million barrels (mb) of stocks. Emergency reserves were composed of 38% crude oil and 62% refined products. Of the total, 52% were held by industry on domestic territory, 39% were public stocks on domestic territory, 6% were public stocks held abroad and 3% industry stocks held abroad. A total of 2.1 mb of stocks were being held abroad at end August 2014 in Belgium (522 thousand barrels of middle distillates), Germany (516 kb of crude oil), the Netherlands (369 kb of crude oil) and Spain (560 kb of middle distillates and 169 kb of motor gasoline). Portugal holds a total of 1.4 mb of stocks for Spain.

REFORM OF THE RETAIL MARKET

In January 2015, the government introduced a new regulation in the retail market, the so-called low-cost legislation (Law 6/2015 of January 16), largely for the purpose of standardising the quality of transport fuels and limiting the use of additives. This law establishes the following obligations for the retailers:

- to sell regular fuel, gasoline IO 95 and diesel, in addition to fuel enriched with additives
- to provide information to consumers on the composition of the fuel.

The reference price is calculated by ENMC for Portugal.

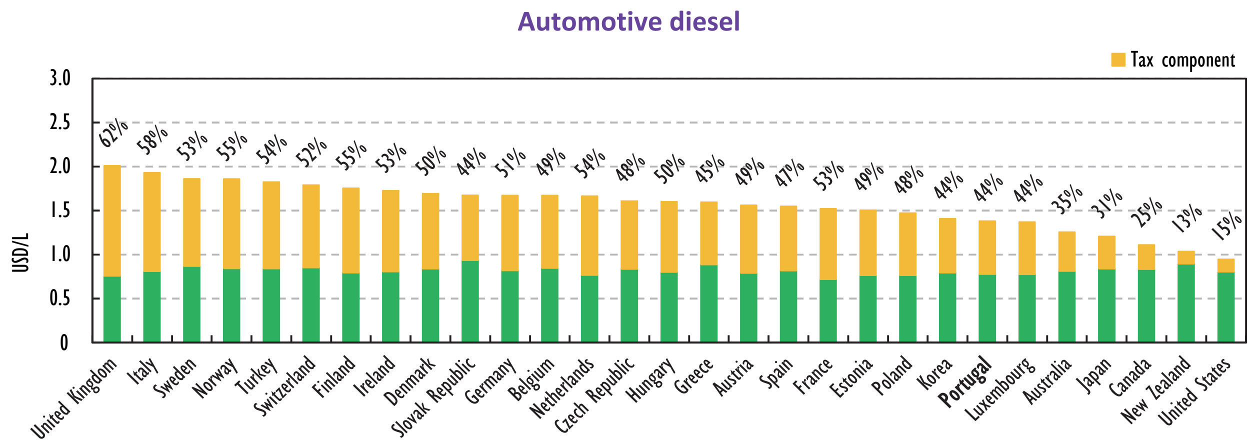
All fuel retailers (i.e. service stations) shall provide information to consumers on the composition of fuel and retailers are obliged to provide information on the composition of the fuel. ENMC, on the basis of information reported by the retailers, will supervise these measures and disclose once a year relevant information regarding their impact on the market.

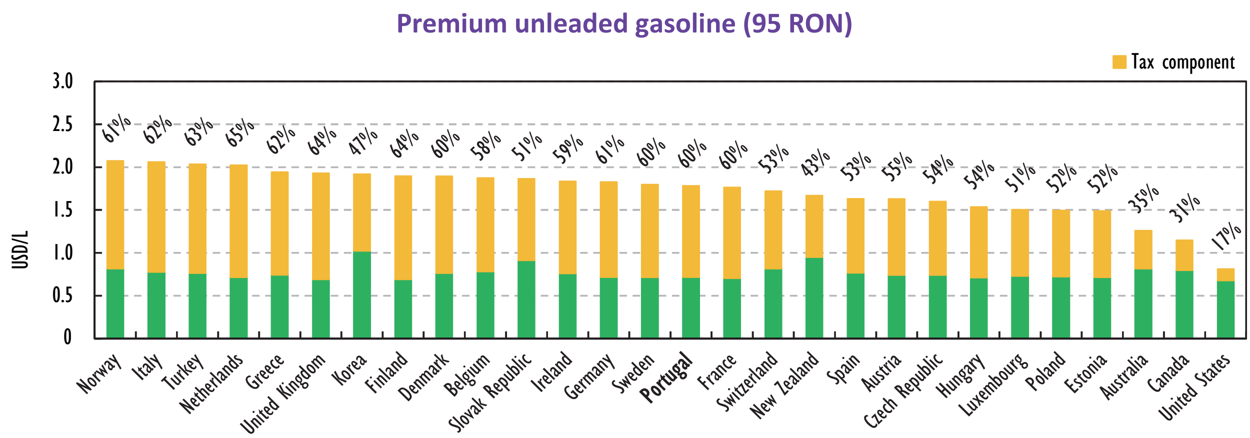
On the bottled liquefied petroleum gas market (propane and butane) some measures will also be introduced. Prices on the selling points and a reference price for the bottled LPG (not an administrative price, but an indicative price calculated by economic rationality criteria) will be periodically published. New technical specifications for bottled LPG will also be adopted in order to bring the technical specifications of bottled LPG closer to the European standards. The aim of regulators is to reduce technical barriers to the trade of these products when imported or exported within the European Union and to increase competition.

PRICES AND TAXES

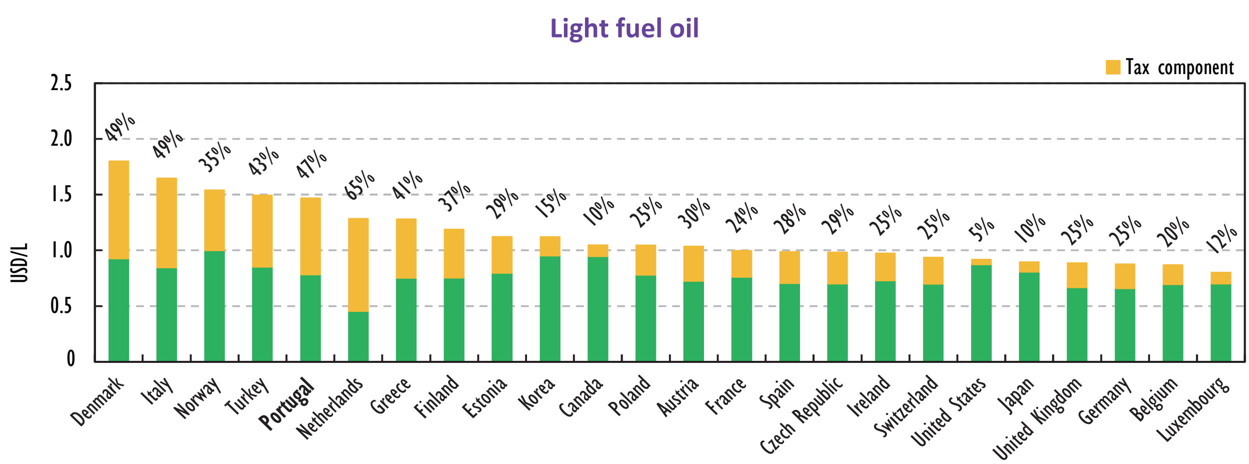
In Portugal, fuel prices are determined by the ex-refinery price, i.e., the price in the international market, two components associated with logistics and retail, and a final tax component. The reference prices used in Portugal by refiners and in gross sales are indexed to the prices in North West Europe (Platts NWE CIF). In addition, a special consumption tax (IEC) is imposed on oil products following their importation or production within Portugal.

Figure 8.6 Fuel prices in IEA member countries, fourth quarter 2014





Note: data not available for Japan.



Note: data not available for Australia, Hungary, New Zealand, the Slovak Republic and Sweden.

Source: IEA (2015d), *Energy Prices and Taxes 2015*, Q3, www.iea.org/statistics/.

The level of the fuel price and the variations that exist depend on the international price and on the amount of tax levied. The tax is made up of two components: tax on petroleum products (ISP) and value-added tax (VAT, of 23% the maximum rate) are applied to transactions along the value chain.

In 2004, the retail sale of liquid fuels was liberalised. Following this event, DGEG put in place monitoring procedures and mandatory reporting mechanisms.

In 2008, an information website was launched with the dual objective of providing consumers with up-to-date information about fuel prices and to encourage competition between retailers.[1] Decree-Law 243/2008 of 18 December, which created the website also made it mandatory to report fuel prices by brand alongside business hours, site location and services provided.

ASSESSMENT

Oil remains the largest source of energy although its share in TPES is declining: from 58% in 2003, 53% in 2008 and 45% in 2014. Portugal has no indigenous sources of oil, imports 100% of the crude oil processed in its refineries, which raises concern about security of supply. Recently, major Portuguese oil companies have started to engage in petroleum exploration activities onshore and offshore of Portugal following a licence-granting procedure from the government. It is commendable that Portugal successfully maintained well-diversified supply sources for crude oil.

The European Union is undergoing a reconstruction of its refining industry. The EU refinery sector is challenged by falling oil demand and chemical production, declining local crude production and shrinking export markets for gasoline alongside strict climate obligations. Over the period 2007 to 2013, 15 refineries closed and further restructuring is expected. The impacts of restructuring are felt differently across the European Union, with countries, such as Germany and Portugal, successfully emerging thanks to process innovation, access to cheap feedstock and global commodity markets. Since the previous in-depth review, GALP Energia invested EUR 1.4 billion to upgrade its refineries in Sines (220 kb/d) and Matosinhos (110 kb/d). The purpose of this investment is to adjust their production profile to the needs of the Iberian market, where diesel is in short supply, by maximising annual production of diesel and reducing the share of fuel oil production, which exceeds domestic demand. This upgrade project has also enabled greater flexibility of the facilities, allowing for adjustments to the production profiles, and for a faster response to changes in demand for refined products. The procedural reconfiguration has secured the operational complementarities of both refineries and created a fully integrated refining system with product and feedstock exchange.

The first year of integrated operations of the refining upgrade was 2013, following the entry into operation of the new units at Matosinhos in June 2011, and the start-up of the hydro-cracking complex at Sines in January 2013. Considering the current European refining industry situation of decreasing oil demand, declining local crude production, and disappearing export markets for gasoline, GALP Energia's upgrade investment was timely and crucial to satisfy market needs.

In transposing the EU Directive 2009/119/EC, which imposes an obligation on EU member states to maintain minimum stocks of crude oil and/or petroleum products,

1. www.precoscombustiveis.dgeg.pt last accessed on 1 July 2015.

Portugal created a national stock agency (EGREP), which was renamed the National Entity for Fuel Market (ENMC), with the enlargement of the competences of this entity regarding crude oil, petroleum products, piped LPG and biofuels. ENMC, a public entity with autonomous administrative, financial and property powers under a national legal framework, operates under the supervision of the Portuguese government.

Total storage capacity in Portugal was 7.0 mcm (at end-2014) maintained in 50 facilities. The bulk of this capacity, 73%, lies in the two refineries, Sines (3.3 mcm) and Matosinhos (1.9 mcm) whose storage capacities have been further increased following recent upgrade projects. Most of the storage capacity (84%) is owned by GALP Energia, which holds 100% of the storage capacity in the country for crude oil. The logistical and tanking joint venture company CLC owns 0.295 mcm, representing around 4% of the total storage capacity.

Apart from renting commercial storage, the new stockholding entity, ENMC, operates its own depot for 140 thousand tonnes of diesel. ENMC is also analysing the possibility of storing products in salt and other mining caverns.

Considering that the economic down-cycle is causing a negative growth in the fuels market, Portugal's storage capacity provides better security of supply with the same volume of oil storage.

Six major oil companies operate in Portugal (GALP, BP, Repsol, CEPSA, AGIP, and ESSO) and these control more than 90% of total wholesale activity (distribution), and four of them (GALP, Repsol, CEPSA, and BP) account for more than 80% of total wholesale activity in Portugal. Through its oil retail and wholesale divisions, GALP Energia is directly involved in all sectors of the market. The retail market (pumping stations) in mainland Portugal is highly concentrated, with the four main operators (GALP, Repsol, CEPSA and BP) accounting around 67% of 2 890 pumping stations in 2014. A number of small independent players are also involved in the retail market (20%) alongside the major supermarket chains (13%).

In order to ensure consumer choice and promote vehicle fuel price competition, DGEG set up a smart mobility web portal (Preços dos Combustíveis Online) that allows users to search for service stations from its address and obtain information associated with brand, types of fuel supplied, fuel prices, and hours of operation. This online service may contribute to the promotion of consumers' benefits in retail market with the information related to the location of service stations, and transparent fuel prices. ENMC, having regular assessment of the retail market performance, can enhance the level of consumer protection.

RECOMMENDATIONS

The government of Portugal should:

- ☐ *Evaluate options to secure the future of its refineries within the context of the persistent challenges facing the European refining industry.*
- ☐ *Closely work with the ENMC to ensure security of oil supply, and finalise the "Contingency Plan" for implementing measures on the use of emergency reserves.*
- ☐ *Protect consumers' interest through ENMC by regularly assessing whether the retail market is functioning properly, and fully implement legislation regarding the sale of low-cost fuels.*

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IEA (2015), *Monthly oil statistics* (December 2015), www.iea.org/statistics/, OECD/IEA, Paris.

IEA (2015d), *Energy Prices and Taxes 2015*, Q3, www.iea.org/statistics/, OECD/IEA, Paris.

9. COAL

Key data (2014 estimated)

Production: nil

Hard coal imports: 4.4 Mt, -17% since 2004

Share of coal: 12.7% of TPES and 23% of electricity generation

Inland consumption (2013): 2.7 Mtoe (power generation 99.3%, industry 0.7%)

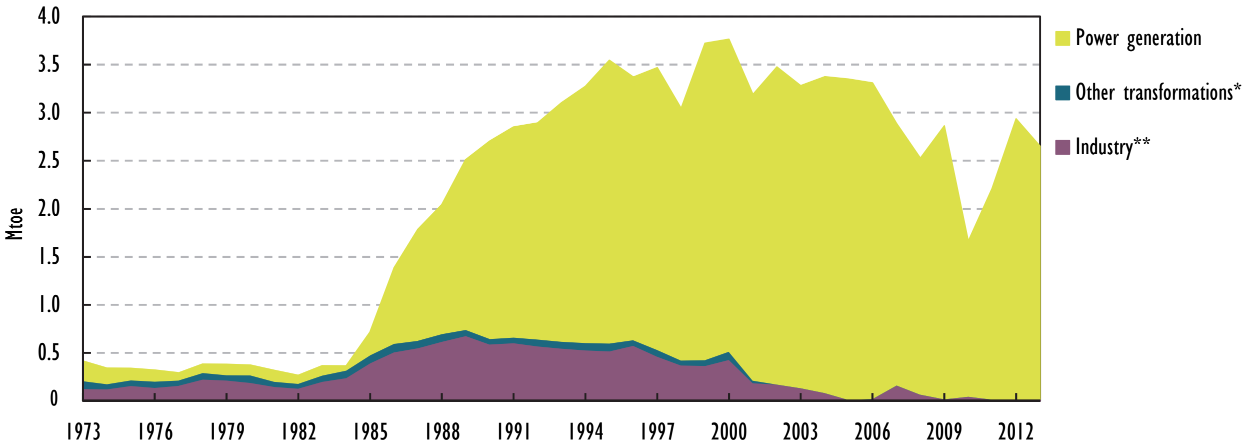
OVERVIEW

The use of coal in Portugal is highly dependent on hydrological conditions, i.e. availability of hydropower, and its market price. Total primary energy supply (TPES) is forecast to halve by 2020, compared with 2013 if the decommissioning of the Sines power plant proceeds in 2017. However, this coal power plant is expected to continue operating after 2017 if the market conditions remain positive. Coal-fired power plants in Portugal have, on average, 38% to 39% thermal efficiency and produce around 850 tonnes of carbon dioxide per gigawatt-hour (tCO_2/GWh). There are no programmes in place to promote CCS or other policies on other clean coal technology.

SUPPLY AND DEMAND

Total supply of coal was 2.7 million tonne s of oil-equivalent (Mtoe) in 2014, or 12.7% of total primary energy supply (TPES). This was 1.3% higher than in 2013 but 20.4% lower than a decade earlier, in 2004. Coal supply ranged from 1.7 Mtoe in 2010 to 3.4 Mtoe in 2004 over the same period and its use depends on the profile of electricity production and hydrological conditions.

Figure 9.1 Coal supply by sector, 1973-2013



Notes: TPES by consuming sector. Sector-specific data are available up to 2013.

* *Other transformations* includes coke ovens, other refining and energy own-use.

** *Industry* includes non-energy use.

Source: IEA (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/.

Portugal relies on imported hard coal for its energy needs. Hard coal imports amounted to 4.4 million tonnes (Mt) in 2014. Imports originated from Colombia (88.1%), the United States (6.6%), South Africa (3.5%) and Ukraine (1.8%).

In 2013 most coal was consumed in power generation with only 0.7% used in industry (Figure 9.1). Coal is also consumed in other transformations, including coke ovens and blast furnaces, as well as for the energy sector own-use. The main sources of greenhouse gas (GHG) emissions in Portugal are the two coal power plants.

TARIFF DEFICIT

Measures relating to power purchase agreements (PPAs) with Energias de Portugal (EDP) for one of the two coal-fired plants (Sines) and the electricity tariff deficit formed part of the economic programme for Portugal. The objective was to eliminate the tariff debt by 2020. One of the main measures included an agreement with EDP on reduced compensation for the early termination of former long-term PPAs (known as CMEC). The agreement with EDP to operate one of the two plants will now end in December 2017, but EDP demonstrates its intention to operate it after that date if the market conditions maintain. Another coal-fired plant (Pego) works under a PPA and it is expected to end in December 2021.

CARBON CAPTURE AND STORAGE

Carbon capture and storage (CCS), is a family of technologies and techniques that enable the capture of CO_2 from fuel combustion or industrial processes, the transport of CO_2 via ships or pipelines, and its storage underground, in depleted oil and gas fields, and deep saline formations. CCS can have a unique and vital role to play in the global transition to a sustainable low-carbon economy, in both power generation and industry. The IEA considers CCS a crucial part of efforts to limit global warming by reducing GHG emissions.

The European Union introduced a directive on the geological storage of CO_2 (the CCS Directive) which established a legal framework for the environmentally safe geological storage of CO_2 to contribute to the fight against climate change.[1] The CCS Directive is in place since 2009 and had to be transposed into national law in member countries by June 2011.

The CCS Directive was translated into Portuguese law by Decree-Law No. 60/2012 of 14 March and entered into force the day after its publication. It established the legal framework for the geological storage of CO_2 in Portugal. Storage of CO_2 can take place within the entire Portuguese territory, the exclusive economic zone and the continental shelf, as defined in the United Nations Convention on the Law of the Sea of 10 December 1982. The DGEG is the competent authority for the granting of exploration permits and awarding CO_2 storage concessions (IEA, 2015b).

In 2010, the National Laboratory of Energy and Geology (LNEG) established a group (COMET) to study the techno-economic feasibility of integrating CCS infrastructures in the west Mediterranean area (Portugal, Spain and Morocco). The feasibility study took into account several scenarios of energy system development for the period 2010-50,

1. Directive 2009/31/EC of the European Parliament and of the Council of 23 April 2009 on the geological storage of carbon dioxide.

the location and development of the major CO_2 point sources and the available potential for geological storage in each of those countries. It is expected that the results will generate insights that can contribute significantly to the deployment of CCS in the region. In December 2012, the COMET Group presented its results, in particular the barriers for the development of CO_2 transport and storage in the region, and addressed legal and regulatory issues.

Portugal has also carried out some technical work to explore in greater detail matters relating to geological storage, including:

- Further assessment of storage potential in the country.
- Development of a CCS roadmap for Portugal to 2050.
- A possible CO_2 injection pilot project, aimed at demonstrating that safe and reliable CO_2 storage is possible in Portugal by providing critical answers about injectivity, capacity, monitoring and modelling of storage reservoirs and cap-rocks.

References

IEA (International Energy Agency) (2015a), *Energy Balances of OECD Countries 2015*, www.iea.org/statistics/, OECD/IEA, Paris.

IEA (2015b), *Insights Series 2014, Carbon Capture and Storage: Legal and Regulatory Review, Fourth Edition*, OECD/IEA, Paris.

10. ENERGY TECHNOLOGY RESEARCH, DEVELOPMENT AND DEMONSTRATION

Key data (2014 estimated)

Government energy RD&D spending: EUR 8.3 million

RD&D per capita: EUR 90 cents

Share of GDP (2013): 0.07 units of GDP per USD 1 000 (IEA median*: 0.37)

* Median of 22 IEA member countries for which data are available.

OVERVIEW

Government energy research, development and demonstration (RD&D) spending as a ratio of GDP in Portugal is the lowest among IEA member countries. The National Energy Strategy for 2020 (ENE 2020) contains a commitment to invest in developing a formal energy research and (R&D) strategy, consistent with energy policy and broader economic goals. Leadership and responsibility for delivery of the strategy will be provided by the appropriate ministry in collaboration with other ministries, third-level institutions, the private sector and state agencies.

INSTITUTIONS

The **Ministry of Education and Science** is the lead ministry for directing investment in research and the training of scientists. It promotes the evaluation of the quality of projects, grants and institutions.

The **Foundation for Science and Technology** (FCT) is the Portuguese national funding agency for science, research and technology. Under the remit of the Ministry of Education and Science, the Foundation commenced operations in August 1997, succeeding the National Board of Scientific and Technological Research (JNICT). On 1 October 2013, the Foundation absorbed the Foundation for National Scientific Computing (FCCN).

The **National Council of Science and Technology** (CNCT) is an advisory body, established in 2012 and chaired by the Prime minister, whose mission is to advise the government on cross-cutting issues of science and technology and to support the major strategic developments. The **National Council for Entrepreneurship and Innovation** (CNEI) is an advisory body to the government on matters relating to national policy for entrepreneurship and innovation.

The **National Innovation Agency** (ANI) is the government platform that promotes the alignment of R&D policies, innovation and technology-based entrepreneurship in the areas of science and economics. Its main function is to promote the value of knowledge, in particular through increased and better collaboration and co-ordination between companies and the research sector.

The **National Laboratory for Energy and Geology** (LNEG) is a research organisation which develops knowledge and creates conditions for innovation in systems and policies, supporting industries and society working towards a green economy. Its multidisciplinary feature puts LNEG at the forefront of a wide range of skills, in science, in energy and geology, with a view to their application in advanced solutions that leverage the economy.

KEY POLICIES

Portugal's energy RD&D policies as defined in ENE 2020 are aligned with the European policies for energy and climate change. The Ministry for Environment, Spatial Planning and Energy (MAOTE) has created a National Coalition on Green Growth proposed to all the stakeholders.

The FCT Foundation for Science and Technology and the Directorate-General for Energy and Geology (DGEG) are engaged in the national policy priorities, in a co-operative and fruitful dialogue in order to achieve an adequate collaboration with the European Union, namely in International Calls for Trans-European Projects (ERA-NETs). Projects funded by FCT at the national level are fully bottom-up and no thematic priorities are set.

The Innovation Support Fund (FAI) supports innovation, technological development and investment in renewable energy and energy efficiency areas, in order to achieve the energy targets as set up in the National Renewable Energy Action Plan (NREAP) and the National Energy Efficiency Action Plan (NEEAP). This Fund has supported the implementation of projects in offshore wind, solar thermal, photovoltaics, biofuels, electric mobility, smart grids, efficiency in buildings and transport.

A strategy for research, development and innovation (RD&I) is under preparation and the final step (decision making) should follow soon.

ENERGY RESEARCH PRIORITIES AND FUNDING

The FCT supports the scientific community in Portugal through the diffusion of different funding instruments aimed at scientists, research teams and R&D centres. These are instruments that allow the FCT to support advanced training, R&D, the creation of research infrastructure and access to them, promote international networks and collaborations, conferences, science communication, and interact with the private sector. The support that FCT offers is open to researchers of any nationality, in all areas of knowledge.

Its budget is sourced from both the national budget and the EU Structural (Cohesion) Funds dedicated to research. FCT offers several mechanisms for funding research. The main instruments are: individual scholarships (PhD, post-graduate, doctoral programmes); scientific employment (FCT researcher); research projects; research units and institutions; and targeted programmes. The first four instruments have been so far open to all scientific sectors, including energy. Proposals compete for funding and are selected by an international panel of experts on the basis of their relative merit (excellence). Typical success rates average 10% to 12% in recent years. As the number and quality of research teams working in the energy sector is large, a relatively large number of scholarships and research projects have been funded over the years on the various topics under the Energy heading. The energy sector benefitted from funding of EUR 6.8 million in 2013 and EUR 8.1 million in 2014.

In addition, participation in international programmes is an important priority for RD&D: notably funding sources such as the EU Seventh Framework Programme (FP7) for the period 2007 to 2013 and Horizon 2020 Projects (H2020) for the period 2014 to 2020.

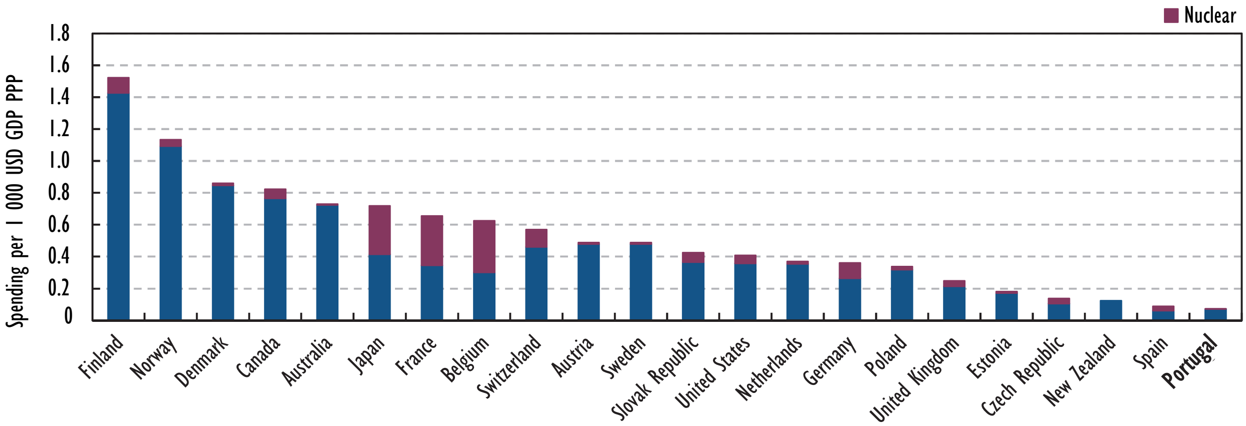
The FCT has a clear goal of taking forward and completing the measures applied to narrow the gap between quantitative output and the qualitative outputs of greater impact of publications and more competitive European and international research funding. This is necessary in order to boost the international competitiveness of Portuguese R&D and more importantly its scientific, economic and social impact.

Targeted programmes are designed to address strategic national needs. Since 2008, FCT has been funding several partnerships between Portuguese universities and their peers in the United States. One of them, a partnership between the Massachusetts Institute of Technology (MIT) and the universities of Lisbon, Porto and Coimbra, includes energy as a priority. The first phase of this partnership covered the period 2008 to 2012, and energy-related projects received approximately EUR 1.4 million per year in funding. Since 2013, the programme entered a second phase, where the universities, having strengthened their capacities during the first five years of the programme, are now being encouraged to obtain competitive funding for their projects, including applied research funded from industry. The role of FCT is to provide a small amount of seed money only. The dedicated budget that FCT has awarded the MIT partnership has been only EUR 100 000 in 2013, and EUR 150 000 in 2014. A similar order of magnitude is expected for 2015. In addition to this amount, the MIT Portugal doctoral programme has been successful in the competition for funding doctoral programmes in 2013. Thus, MIT Portugal has secured an additional EUR 161 000 each year for a package of ten scholarships each year during the period 2013 to 2016. When the entire four-year scholarship cycle is complete in 2017, this will represent a funding of EUR 644 000 during that year.

Through the Renewable Energy Fund (FAI), within MAOTE, Portugal has been supporting projects in the energy sector. Initially focused on R&D projects (2010-12), both on renewable energy and on energy efficiency technologies, FAI is now also supporting energy efficiency demonstration projects, through fully reimbursable grants. Windfloat (floating offshore wind platforms) and Mobi.E (national electric mobility network) are some of the key R&D projects that FAI has supported in the past, alongside projects in solar generation (concentrated solar power or CSP), biofuels, energy management technologies and energy efficiency technologies in transport. To date, FAI has invested approximately EUR 12 million. A number of the projects were successful, and were able to develop, produce and operate functioning prototypes or pre-industrial solutions, some of which have reached commercialisation. Further objectives include open calls for renewable energy technologies in transportation.

Regarding energy efficiency demonstration projects, FAI is focusing its investment support on a small number of projects with strong demonstration value, both for the market and for public policies, namely the application of the Portugal 2020 Programme. The sectors supported − buildings, industry and transportation − are aligned with the priorities identified in the National Energy Efficiency Action Plan (NEEAP). This work includes testing the model developed for public-sector buildings − the Energy Efficiency Programme in Public Administration (Eco.AP) based on energy services companies − in a private environment. To date, FAI has committed approximately EUR 2.0 million to ongoing calls (buildings), and will soon open calls in the transport sector (fuel-switching and biofuels). FAI also supports studies and analyses deemed relevant for public policy objectives.

Figure 10.1 Government energy RD&D spending as a ratio of GDP in IEA member countries, 2013

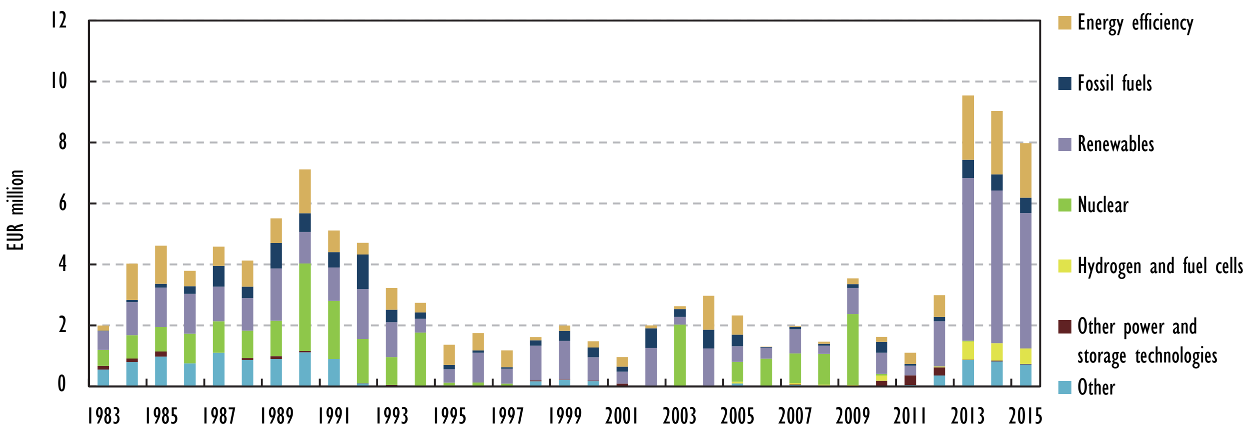


Notes: Data are not available for the Greece, Hungary, Ireland, Italy, Korea, Luxembourg and Turkey.

Source: IEA analysis based on IEA data, 2015.

FCT and FAI also cooperate in funding energy-related projects under the ERA-NET Cofund initiative. FAI has committed EUR 3 million to that effect, to be channelled through FCT participation in joint transnational calls. Priorities in this regard are defined by DGEG, FCT and FAI.

Figure 10.2 Government energy RD&D spending, 1983-2015



Note: Data for 2014 and 2015 are estimated.

Source: IEA analysis based on IEA data, 2015.

ROADMAP FOR RESEARCH INFRASTRUCTURES

Energy-related RD&D investment is consistent with Portugal's commitments to Europe: the priority research areas are renewable energy, energy efficiency, smart grids, sustainable mobility, electricity, natural gas and energy infrastructure interconnections. Portugal is committed to the Strategic Energy Technology (SET) Plan, adopted by the European Union in 2008, the first step to establish an energy technology policy for Europe. It is the principal decision-making support tool for European energy policy.

The development of a national Roadmap for Research Infrastructures (RIs) was concluded in June 2014. Forty RIs were identified as national priorities and, among them, five relate to the energy sector:

- Research Infrastructure on Integration of Solar Energy Systems in Buildings at LNEG
- Biomass and Bioenergy Research Infrastructure, also at LNEG
- National Research Infrastructure for Solar Energy Concentration at the University of Évora and LNEG (the national element of EU-SOLARIS)
- Portuguese WindScanner Facility at the University of Oporto
- Smart Grid and Electric Vehicle Laboratory at the Institute for Systems and Computer Engineering, Technology and Science Porto/Engineering Faculty at the University of Oporto.

These roadmap infrastructures were expected to receive a total funding of EUR 6 million in 2014 and, although the funding has not yet been divided among the 40 RIs in the national roadmap, the aggregate funding for the four energy RIs is expected to be EUR 1.28 million. In 2015, aggregate funding for these four RIs is expected to increase to EUR 2 million.

OTHER PROGRAMMES

The *NET ZERO* – Net Zero Energy School: Reaching the Community (2009-13) project – which was based in the Vergílio Ferreira High School, had the objective of identifying measures that could contribute to an increase in energy efficiency by integrating multidimensional aspects.

SmartGalp (2010-12) was a technical study in the smart metering sector with the objective of demonstrating and quantifying the potential that the real-time consumption monitoring and new interactions with residential consumers could have on energy efficiency, consumption reduction, GHG emissions, and in cost reductions for the end-consumer.

The *Green Campus* - Energy Efficiency Challenge in the Higher Education Sector (2011-13) project focused on the development of competition in the higher education sector with the objective of promoting energy efficiency throughout the academic community. University buildings on the campus were analysed by teams composed of professors, staff and students, who presented a report containing a diagnosis of the energy consumption at a given building and a set of quantifiable measures to increase the energy efficiency therein.

The *Grow with Efficiency* (PPEC) project (2014-15) aims to improve the energy efficiency of 40 children's institutions in Portugal through an increased awareness of the youngsters, and the development of mechanisms for social innovation and knowledge sharing.

Your home, Your Energy (PPEC) (2014-15) was a nationwide initiative focused on the promotion of energy efficiency in the residential sector, aiming to contribute towards an effective reduction of energy consumption, through access to information regarding energy efficiency measures tailored for each participant. The tailored energy efficiency measures are selected through the use of multiple variables like smart metering data, energy certificates from the households and other exogenous variables (like weather data) and socio-economic data.

The Smart Campus: Building-User Learning interaction for energy efficiency (2012-15) project involves the development of intelligent energy management systems (IEMS) for university campuses, which incorporate interaction mechanisms (web applications and mobile applications) between end-users and the energy management system, with the objective of reducing energy consumption.

MONITORING AND EVALUATION

The priorities defined by the European Union and the Portuguese government are aligned along the SET-Plan as well as on other energy policy documents (e.g. Directives on Energy Efficiency, Renewables and Energy Performance of Buildings). Funding for applied research (e.g. from FAI) is bounded by these priorities.

FCT funding is, as explained earlier, distributed on a bottom-up approach based solely on excellence. To participate in EU programmes, however, special funds for instruments such as ERA-NETs (trans-national calls), organised in co-operation with DGEG, are also fully aligned with EU priorities.

When the EU structural funds for 2014-20 (Portugal 2020) are implemented, from 2015 onwards, there will be substantial funding for research fully aligned with energy-related Smart Specialisation priorities, where energy is a major priority. There is yet no decision on the precise modalities and amounts for energy research at this date.

PRIVATE-SECTOR PARTICIPATION

EERA (see following section) acts as a bridge between individual research organisations and the clean energy industry, largely through the European Industrial Initiatives (EIIs), which are also part of the SET-Plan. This collaboration aims to foster world-class technology and innovation in Europe's energy sector, while helping to reduce the time before this technology reaches the market.

INTERNATIONAL COLLABORATION

LNEG is, among others, partner in a number of international associations, e.g. EERA, EuroGeoSurvey (EGS) and the European Sustainable Energy Innovation Alliance (ESEIA). The European Energy Research Alliance (EERA), an independent alliance of public research centres and universities from all across Europe, is helping to co-ordinate a large public research effort to push renewable energy technologies forward – for example, developing more efficient and cheaper wind turbines and solar panels, building a "smart" electricity grid, harnessing energy from the oceans and underground heat sources, as well as finding new ways to store and use energy instead of wasting it.

EERA is the public research pillar of the SET-Plan, launched by the European Union, which is the region's technology response to the pressing challenges of meeting its targets on greenhouse gas (GHG) emissions, renewable energy and energy efficiency over the coming decades. Founded in 2008 by ten leading European public research institutes, EERA now brings together over 250 research centres and universities, actively working together on 15 long-term and sustainable joint research programmes. In this way, EERA promotes a synergy which could not otherwise be achieved, by providing a platform for pooling streamlined national research efforts and sharing knowledge.

LNEG, one of the founder members and member of the Executive Committee is now assuming the vice-presidency of EERA, as well as other EERA partners involved. Within the EERA framework, LNEG is active in several joint programmes: Bioenergy; CCS; Concentrated Solar Power; Economical Environmental Social Impacts; Energy Storage; Fuel Cells and Hydrogen; Geothermal; Photovoltaics; Shale Gas; Smart Cities.

FCT has started to participate in the International Energy Agency's (IEA) Committee on Energy Research and Technology (CERT) during 2014. This shall allow a better co-operation and co-ordination of R&D activities between FCT, DGEG, LNEG and IEA.

ASSESSMENT

Although government energy RD&D spending in Portugal is growing, it remains low in comparison to other IEA member countries. Despite this, there have been a number of successes in the sector since the previous in-depth review was conducted in 2008. Its universities and research institutions continue to maintain high levels of output despite the economic crisis and have been relatively successful in securing external funding. Nonetheless, much more focus is needed if the sector is to thrive as foreseen in ENE 2020 and the in Portugal 2020: the National Reform Programme.

The Foundation for Science and Technology and DGEG are engaged in the development of national RD&D policy priorities, as well as in collaboration with the European Union, for example in bidding for funding for International Calls for Transnational Projects (ERA-NETs) and Horizon 2020. The National Laboratory for Energy and Geology supports the production of knowledge from R&D and aims to establish conditions for innovation. The Innovation Support Fund supports innovation, technological development and investment in renewable energy and energy efficiency areas, in order to achieve the energy targets as set up in the National Renewable Energy Action Plan (NREAP) and the National Energy Efficiency Action Plan (NEEAP). This Fund has supported the implementation of projects in offshore wind, solar thermal, photovoltaics, biofuels, electric mobility, smart grids, efficiency in buildings and transport.

The primary role of the government in this sector must be to encourage energy technology innovation in two ways: through technology-push and market-pull. They can bring the costs and risks of innovation in line with the available benefits by implementing measures that reduce the cost to firms of producing innovation and encouraging investment in energy technologies and innovation on the supply side (technology-push measures). A second, and often complementary, approach is that governments can create a value for the public benefit by implementing measures that increase the private pay-off to successful innovation, thereby increasing demand for low-carbon energy technologies (market-pull measures). Literature on the effectiveness of energy technology policy and on the economics of innovation reaches the consensus that both types of approaches are necessary.

The IEA understands that a strategy for energy-related research, development and innovation is being developed and welcomes this step. All proposals for a new strategy should be developed with the co-operation of the institutions active in the sector as well as industry stakeholders, other ministries and government agencies as well as European funding agencies as appropriate. The strategy should look to best practice elsewhere within the IEA and seek to support the key goals of national energy policy. Without a comprehensive strategy that considers the entire innovation chain, different parts of government have a tendency to support different energy technologies at different times, often with the result that there is inadequate co-ordination or follow-up.

This new strategy must be a coherent set of policies, which support national energy policy and sets out clear measures and quantifiable objectives for the short, medium and long term. Priorities should be established, targets should be set and stakeholders should be kept informed. To maximise the efficiency of the strategy, the government should maintain the already strong links between the energy RD&D strategy and other relevant policy areas such as science and technology, education, economic development and industry. The strategy should also focus on measure to commercialise domestic research activities with a view to meeting wider economic targets such as broadening the domestic industrial base and expanding exports.

Deciding on which areas are to receive funding – and how much – should be determined through structured analytical processes and mechanisms such as technology road-mapping, foresight exercises, and technology assessment and evaluation.

RECOMMENDATIONS

The government of Portugal should:

- ☐ *Work with the National Laboratory for Energy and Geology, the Foundation for Science and Technology, research institutions and universities to ensure that Portugal has a coherent national approach to securing external funding, notably from the European Union for its RD&D activities.*
- ☐ *Complete, in consultation with all stakeholders, the process leading to the development of a national research, development and innovation strategy. This strategy should look to best practice elsewhere for guidance and ensure consistency with other national policies.*
- ☐ *Appoint a co-ordinating group or person within the Directorate-General for Energy and Technology to act as the interlocutor with stakeholders so as to ensure there is a co-ordinated approach to research and innovation. A chief scientific advisor employed in the Directorate-General, similar to what other IEA governments have, may be a good way to start.*

PART III
ANNEXES

ANNEX A: ORGANISATION OF THE REVIEW

REVIEW CRITERIA

The Shared Goals, which were adopted by the IEA Ministers at their 4 June 1993 meeting in Paris, provide the evaluation criteria for the in-depth reviews conducted by the IEA. The Shared Goals are presented in Annex C.

REVIEW TEAM

The IDR team visited Lisbon from 9 to 15 November 2014. During the visit, the review team met with government officials, representatives from ministries and government agencies, market participants, non-governmental organisations, consumers groups and other organisations and stakeholders. This report was drafted on the basis of the information obtained in these meetings, the Portuguese government response to the IEA energy policy questionnaire and information from many other sources. The team is grateful for the co-operation and hospitality of the many people it met during the visit. Thanks to their openness and willingness to share information the review visit was highly productive.

The team wishes to express its gratitude to Mr. Pedro Cabral, Director-General, -Directorate-General for Energy and Geology (DGEG), Ministry for Environment, Spatial Planning and Energy, and his management team and support staff, notably Ms Maria José Espirito Santo, Mr. Carlos Olivera, Ms Luisa Basílio, Mr. Joao Bernardo and also Mr. Pedro Liberato from the Permanent Delegation of Portugal to the OECD, for their input and support throughout the visit.

The team is also grateful to Ms Maria Ceu Faria, Ms Catia Brito, Ms Fedra Oliveira and Ms Teresa Menezes for supporting the team throughout the visit. The team is also grateful to Energias de Portugal for hosting the field trip and providing a detailed overview of the hydropower plant in Alqueva.

The author is particularly thankful to Ms Isabel Soares for organising the team visit and facilitating its many requests throughout the week. Ms Isabel Soares was also the key point of contact throughout the review process and greatly assisted in the preparation of the in-depth report.

The members of the review team were:

- Team leader Mr. Duarte Figueira, Head of Division, Europe, Middle-East, Africa and Latin America, IEA and formerly Head, Office of Unconventional Gas and Oil, Department of Energy and Climate Change, United Kingdom
- Mr. Bruce Parkes, General Manager – Resources, Energy and Communications, Ministry of Business, Innovation and Employment, New Zealand
- Mr. Pentti Puhakka, Chief Counsellor at the Energy Efficiency and Growth Division, Ministry of Employment and the Economy, Finland

- Mr. John McCann, Programme Manager, Wind Energy and Renewable Electricity, Sustainable Energy Authority of Ireland, Ireland
- Mr. Tobias Persson, Head of Unit, Swedish Energy Agency, Sweden
- Mr. Kijune Kim, Head of Country Studies, Office of Global Energy Policy, International Energy Agency
- Mr. Kieran McNamara, Desk Officer, Country Studies, Office of Global Energy Policy, International Energy Agency

The review was prepared under the guidance of Mr. Kim, former Head of Country Studies Division, IEA. Mr. McNamara managed the review and is the author of the report. Ms. Sonja Lekovic prepared and drafted the sections relating to energy data contained in each chapter. Ms. Helen Beilby-Orrin, Mr. Carlos Fernandez-Alvarez, Ms. Rebecca Gaghen, Mr. David Morgado, Mr. Kijune Kim and Mr. Aad van Bohemen each contributed helpful comments throughout.

Ms. Sonja Lekovic, Ms. Catherine Smith and Mr. Bertrand Sadin prepared the figures. Ms. Roberta Quadrelli and Ms. Zakia Adam provided support on statistics. Ms. Muriel Custodio and Ms. Astrid Dumond managed the production process. Ms. Viviane Consoli and Ms. Therese Walsh provided editorial assistance while Ms. Catherine Smith and Ms. Sonja Lekovic helped in the final stages of preparation.

ORGANISATIONS VISITED

General Directorate for Energy and Geology, Ministry for Environment, Spatial Planning and Energy (DGEG)

Associação das Agências de Energia e Ambiente (RNAE)

Associação Portuguesa das Empresas do Sector Eléctrico (ELECPOR)

Associação Portuguesa de Empresas de Gás Natural (AGN)

Associação Portuguesa de Indústria Solar (APISolar)

COGEN Portugal

Confederação Empresarial de Portugal (CIP)

EDP Gás Distribuição (EDP GD)

EDP Gás Serviço Universal (EDP GSU)

EDP Serviço Universal (EDP SU)

Endesa

Energias de Portugal (EDP)

Entidade Gestora de Reservas Estratégicas de Produtos Petrolíferos (Managing Authority of Petroleum Products Strategic Reserves) (ENMC)

Entidade Reguladora dos Serviços Energéticos (ERSE)

Faculdade de Engenharia da Universidade do Porto (CEner-FEUP)

Foundation for Science and Technology (FCT)

GALP Energia

GALP Power

Goldenergy

Grupo de Estudos de Ordenamento do Território e Ambiente (GEOTA)

Iberdrola

Instituto da Mobilidade e dos Transportes (IMT)

Instituto de Engenharia de Sistemas e Computadores, Tecnologia e Ciência (INESC TEC)

Instituto Superior Técnico (IST)

Laboratório Nacional de Engenharia Civil (LNEC)

Ministry of Economy

Ministry of Education and Science

Ministry of Transport

OMIClear

OMIP

Portuguese Association of Large Industrial Electricity Consumers (APIGCEE)

Portuguese Competition Authority (PCA)

Portuguese Environmental Agency (APA)

Portuguese Oil Industry Association (APETRO)

Portuguese Renewable Energy Association (APREN)

Portuguese Association for Consumer Protection (DECO)

Quercus

Redes Energéticas Nacionais (REN)

Sonorgas

Transgás Armazenagem

University of Algarve

University of Évora

ANNEX B:
ENERGY BALANCES AND KEY STATISTICAL DATA

Unit: Mtoe

SUPPLY		1973	1990	2000	2013	2014P	2020	2030
TOTAL PRODUCTION		**1.40**	**3.39**	**3.85**	**5.77**	**5.62**	**7.08**	**8.78**
Coal		0.13	0.12	-	-	-	-	-
Peat		-	-	-	-	-	-	-
Oil		-	-	-	-	-	-	-
Natural gas		-	-	-	-	-	-	-
Biofuels and waste[1]		0.64	2.48	2.77	3.26	2.93	4.20	4.50
Nuclear		-	-	-	-	-	-	-
Hydro		0.63	0.79	0.97	1.18	1.34	0.97	1.02
Wind		-	0.00	0.01	1.03	1.04	1.18	1.84
Geothermal		-	0.00	0.07	0.18	0.17	0.21	0.20
Solar/other[2]		-	0.01	0.02	0.12	0.13	0.52	1.22
TOTAL NET IMPORTS[3]		**5.36**	**13.85**	**20.75**	**15.62**	**15.01**	**16.87**	**14.11**
Coal	Exports	0.01	0.01	0.05	-	-	-	-
	Imports	0.28	3.00	3.97	2.53	2.60	1.16	0.07
	Net imports	0.27	2.99	3.91	2.53	2.60	1.16	0.07
Oil	Exports	0.23	2.47	1.42	5.56	4.59	4.56	4.32
	Imports	6.41	14.38	17.45	16.47	15.15	15.51	14.86
	Int'l marine and aviation bunkers	-1.10	-1.06	-1.31	-1.58	-1.41	-	-
	Net imports	5.09	10.85	14.72	9.34	9.16	10.95	10.55
Natural Gas	Exports	-	-	-	-	-	-	-
	Imports	-	-	2.04	3.81	3.47	4.31	2.81
	Net imports	-	-	2.04	3.81	3.47	4.31	2.81
Electricity	Exports	0.01	0.15	0.32	0.46	0.55	-	-
	Imports	0.01	0.15	0.40	0.70	0.62	-	-
	Net imports	-0.00	0.00	0.08	0.24	0.08	-	-
TOTAL STOCK CHANGES		**0.14**	**-0.46**	**-0.00**	**0.39**	**0.46**	**-**	**-**
TOTAL SUPPLY (TPES)[4]		**6.90**	**16.78**	**24.59**	**21.78**	**21.09**	**23.95**	**22.90**
Coal		0.51	2.76	3.81	2.65	2.69	1.16	0.07
Peat		-	-	-	-	-	-	-
Oil		5.12	10.74	14.83	9.65	9.51	10.95	10.55
Natural gas		-	-	2.03	3.75	3.47	4.31	2.81
Biofuels and waste[1]		0.64	2.48	2.77	2.98	2.66	4.66	5.19
Nuclear		-	-	-	-	-	-	-
Hydro		0.63	0.79	0.97	1.18	1.34	0.97	1.02
Wind		-	0.00	0.01	1.03	1.04	1.18	1.84
Geothermal		-	0.00	0.07	0.18	0.17	0.21	0.20
Solar/other[2]		-	0.01	0.02	0.12	0.13	0.52	1.22
Electricity trade[5]		-0.00	0.00	0.08	0.24	0.08	-	-
Shares in TPES (%)								
Coal		*7.4*	*16.4*	*15.5*	*12.2*	*12.7*	*4.8*	*0.3*
Peat		-	-	-	-	-	-	-
Oil		*74.3*	*64.0*	*60.3*	*44.3*	*45.1*	*45.7*	*46.1*
Natural gas		-	-	*8.3*	*17.2*	*16.4*	*18.0*	*12.3*
Biofuels and waste[1]		*9.3*	*14.8*	*11.3*	*13.7*	*12.6*	*19.4*	*22.7*
Nuclear		-	-	-	-	-	-	-
Hydro		*9.1*	*4.7*	*4.0*	*5.4*	*6.4*	*4.0*	*4.5*
Wind		-	-	*0.1*	*4.7*	*4.9*	*4.9*	*8.0*
Geothermal		-	*0.0*	*0.3*	*0.8*	*0.8*	*0.9*	*0.9*
Solar/other[2]		-	*0.1*	*0.1*	*0.5*	*0.6*	*2.2*	*5.3*
Electricity trade[5]		-	-	*0.3*	*1.1*	*0.4*	-	-

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elements.

Forecasts are based on the 2014/15 submission.

Unit: Mtoe

DEMAND							
FINAL CONSUMPTION	**1973**	**1990**	**2000**	**2013**	**2014P**	**2020**	**2030**
TFC	**5.74**	**13.39**	**19.36**	**16.22**	**..**	**20.22**	**20.30**
Coal	0.24	0.65	0.48	0.02	..	0.03	0.03
Peat	-	-	-	-	..	-	-
Oil	4.21	8.36	12.22	8.11	..	10.58	10.24
Natural gas	-	-	0.79	1.57	..	1.36	1.24
Biofuels and waste[1]	0.58	2.33	2.41	2.21	..	3.12	3.25
Geothermal	-	-	0.00	0.00	..	0.01	0.00
Solar/other[2]	-	0.01	0.02	0.07	..	0.14	0.21
Electricity	0.70	2.02	3.30	3.89	..	4.47	4.80
Heat	-	0.03	0.13	0.35	..	0.52	0.54
Shares in TFC (%)							
Coal	*4.2*	*4.8*	*2.5*	*0.1*	..	*0.1*	*0.1*
Peat	-	-	-	-	..	-	-
Oil	*73.4*	*62.4*	*63.2*	*50.0*	..	*52.3*	*50.5*
Natural gas	-	-	*4.1*	*9.7*	..	*6.7*	*6.1*
Biofuels and waste[1]	*10.1*	*17.4*	*12.5*	*13.6*	..	*15.4*	*16.0*
Geothermal	-	-	-	*0.0*	..	*0.0*	-
Solar/other[2]	-	*0.0*	*0.0*	*0.0*	..	*0.0*	*1.0*
Electricity	*12.3*	*15.1*	*17.0*	*24.0*	..	*22.1*	*23.6*
Heat	-	*0.2*	*0.7*	*2.2*	..	*2.6*	*2.6*
TOTAL INDUSTRY[6]	**2.70**	**6.76**	**8.55**	**5.94**	**..**	**7.26**	**7.07**
Coal	0.14	0.59	0.43	0.02	..	0.03	0.03
Peat	-	-	-	-	..	-	-
Oil	1.80	3.91	4.70	2.01	..	2.53	2.28
Natural gas	-	-	0.66	1.08	..	0.86	0.85
Biofuels and waste[1]	0.32	1.18	1.26	1.13	..	1.80	1.90
Geothermal	-	-	-	-	..	-	-
Solar/other[2]	-	-	-	-	..	-	-
Electricity	0.44	1.05	1.37	1.38	..	1.54	1.49
Heat	-	0.03	0.13	0.32	..	0.51	0.52
Shares in total industry (%)							
Coal	*5.2*	*8.8*	*5.1*	*0.3*	..	*0.4*	*0.4*
Peat	-	-	-	-	..	-	-
Oil	*66.7*	*57.8*	*54.9*	*33.9*	..	*34.8*	*32.3*
Natural gas	-	-	*7.7*	*18.2*	..	*11.8*	*12.0*
Biofuels and waste[1]	*11.8*	*17.4*	*14.8*	*19.0*	..	*24.8*	*26.9*
Geothermal	-	-	-	-	..	-	-
Solar/other[2]	-	-	-	-	..	-	-
Electricity	*16.3*	*15.6*	*16.0*	*23.1*	..	*21.2*	*21.1*
Heat	-	*0.4*	*1.5*	*5.5*	..	*7.0*	*7.3*
TRANSPORT[4]	**1.60**	**3.25**	**5.86**	**5.41**	**..**	**7.66**	**7.73**
OTHER[7]	**1.44**	**3.39**	**4.94**	**4.87**	**..**	**5.30**	**5.50**
Coal	0.08	0.05	0.04	-	..	-	-
Peat	-	-	-	-	..	-	-
Oil	0.85	1.23	1.70	1.00	..	1.01	0.89
Natural gas	-	-	0.13	0.47	..	0.49	0.37
Biofuels and waste[1]	0.26	1.15	1.15	0.82	..	0.76	0.78
Geothermal	-	-	0.00	0.00	..	0.01	0.00
Solar/other[2]	-	0.01	0.02	0.07	..	0.14	0.21
Electricity	0.25	0.95	1.90	2.48	..	2.88	3.23
Heat	-	-	0.01	0.03	..	0.01	0.02
Shares in other (%)							
Coal	*5.6*	*1.6*	*0.8*	-	..	-	-
Peat	-	-	-	-	..	-	-
Oil	*59.2*	*36.3*	*34.4*	*20.5*	..	*19.0*	*16.3*
Natural gas	-	-	*2.6*	*9.7*	..	*9.2*	*6.7*
Biofuels and waste[1]	*18.1*	*33.9*	*23.3*	*16.7*	..	*14.4*	*14.2*
Geothermal	-	-	-	*0.0*	..	*0.0*	*0.1*
Solar/other[2]	-	*0.3*	*0.4*	*1.5*	..	*2.6*	*3.7*
Electricity	*17.0*	*27.9*	*38.4*	*51.0*	..	*54.4*	*58.7*
Heat	-	-	*0.1*	*0.6*	..	*0.3*	*0.3*

Unit: Mtoe

DEMAND							
ENERGY TRANSFORMATION AND LOSSES	**1973**	**1990**	**2000**	**2013**	**2014P**	**2020**	**2030**
ELECTRICITY GENERATION[8]							
Input (Mtoe)	1.33	5.09	7.61	7.83	..	7.85	6.94
Output (Mtoe)	0.84	2.44	3.73	4.35	4.48	4.96	5.15
Output (TWh)	9.79	28.36	43.37	50.53	52.04	57.64	59.85
Output Shares (%)							
Coal	*3.9*	*32.1*	*33.9*	*23.4*	*23.0*	*8.9*	*0.3*
Peat	-	-	-	-	-	-	-
Oil	*19.2*	*33.1*	*19.4*	*3.4*	*3.2*	*1.9*	*0.4*
Natural gas	-	-	*16.5*	*14.3*	*12.5*	*30.4*	*11.0*
Biofuels and waste [1]	*2.0*	*2.4*	*3.6*	*6.6*	*6.4*	*7.3*	*12.7*
Nuclear	-	-	-	-	-	-	-
Hydro	*74.8*	*32.3*	*26.1*	*27.2*	*30.0*	*19.5*	*19.9*
Wind	-	-	*0.4*	*23.8*	*23.3*	*23.8*	*35.7*
Geothermal	-	-	*0.2*	*0.4*	*0.4*	*0.4*	*0.4*
Solar/other [2]	-	-	-	*0.9*	*1.2*	*7.7*	*19.6*
TOTAL LOSSES	**1.31**	**2.87**	**5.33**	**5.54**	**-0.01**	**3.73**	**2.25**
of which:							
Electricity and heat generation[9]	0.49	2.62	3.74	2.88	..	2.38	1.26
Other transformation	0.32	-0.73	0.34	0.26	-0.01	0.70	0.74
Own use and transmission/distribution losses[10]	0.51	0.97	1.25	2.40	..	0.66	0.25
Statistical Differences	**-0.15**	**0.52**	**-0.09**	**0.02**	**..**	**-**	**0.35**
INDICATORS	**1973**	**1990**	**2000**	**2013**	**2014P**	**2020**	**2030**
GDP (billion 2005 USD)	83.24	142.21	188.98	188.59	190.27	209.94	253.42
Population (millions)	8.72	10.00	10.29	10.46	10.39	10.73	10.78
TPES/GDP (toe/1000 USD)[11]	0.08	0.12	0.13	0.12	0.11	0.11	0.09
Energy production/TPES	0.20	0.20	0.16	0.26	0.27	0.30	0.38
Per capita TPES (toe/capita)	0.79	1.68	2.39	2.08	2.03	2.23	2.12
Oil supply/GDP (toe/1000 USD)[11]	0.06	0.08	0.08	0.05	0.05	0.05	0.04
TFC/GDP (toe/1000 USD)[11]	0.07	0.09	0.10	0.09	..	0.10	0.08
Per capita TFC (toe/capita)	0.66	1.34	1.88	1.55	..	1.88	1.88
CO_2 emissions from fuel combustion ($MtCO_2$)[12]	16.2	37.9	57.8	44.9	-	43.7	34.9
CO_2 emissions from bunkers ($MtCO_2$)[12]	3.5	3.3	4.0	4.9	-	5.5	5.3
GROWTH RATES (% per year)	**73-13**	**80-90**	**90-00**	**00-13**	**13-14**	**14-20**	**20-30**
TPES	2.9	5.3	3.9	-0.9	-3.2	2.1	-0.4
Coal	4.2	20.6	3.3	-2.7	1.3	-13.1	-24.4
Peat	-	-	-	-	-	-	-
Oil	1.6	3.0	3.3	-3.3	-1.4	2.4	-0.4
Natural gas	-	-	-	4.8	-7.7	3.7	-4.2
Biofuels and waste[1]	3.9	13.2	1.1	0.6	-10.7	9.8	1.1
Nuclear	-	-	-	-	-	-	-
Hydro	1.6	1.3	2.1	1.5	13.7	-5.3	0.6
Wind	-	-	64.4	38.9	0.7	2.1	4.5
Geothermal	-	13.5	36.1	7.6	-3.5	2.9	-0.2
Solar/other[2]	-	-	5.3	15.1	15.0	25.6	8.9
TFC	2.6	5.4	3.8	-1.4	..	..	0.0
Electricity consumption	4.4	5.1	5.0	1.3	..	..	0.7
Energy production	3.6	8.6	1.3	3.2	-2.4	3.9	2.2
Net oil imports	1.5	2.2	3.1	-3.4	-1.9	3.0	-0.4
GDP	2.1	3.3	2.9	-0.0	0.9	1.7	1.9
TPES/GDP	0.8	2.0	1.0	-0.9	-4.0	0.5	-2.3
TFC/GDP	0.6	2.1	0.8	-1.3	..	..	-1.8

0 is negligible, - is nil, .. is not available, x is not applicable. Please note: rounding may cause totals to differ from the sum of the elements.

Footnotes to energy balances and key statistical data

1. Biofuels and waste comprises solid biofuels, liquid biofuels, biogases, industrial waste and municipal waste. Data are often based on partial surveys and may not be comparable between countries.
2. Other includes ambient heat used in heat pumps.
3. In addition to coal, oil, natural gas and electricity, total net imports also include biofuels and waste.
4. Excludes international marine bunkers and international aviation bunkers.
5. Total supply of electricity represents net trade. A negative number in the share of TPES indicates that exports are greater than imports.
6. Industry includes non-energy use.
7. Other includes residential, commercial and public services, agriculture/forestry, fishing and other non-specified.
8. Inputs to electricity generation include inputs to electricity, CHP and heat plants. Output refers only to electricity generation.
9. Losses arising in the production of electricity and heat at main activity producer utilities and autoproducers. For non-fossil-fuel electricity generation, theoretical losses are shown based on plant efficiencies of approximately 10% for geothermal and 100% for hydro, wind and solar photovoltaic.
10. Data on "losses" for forecast years often include large statistical differences covering differences between expected supply and demand and mostly do not reflect real expectations on transformation gains and losses.
11. Toe per thousand US dollars at 2005 prices and exchange rates.
12. "CO_2 emissions from fuel combustion" have been estimated using the IPCC Tier I Sectoral Approach from the 2006 IPCC Guidelines. In accordance with the IPCC methodology, emissions from international marine and aviation bunkers are not included in national totals. Projected emissions for oil and gas are derived by calculating the ratio of emissions to energy use for 2013 and applying this factor to forecast energy supply. Projected emissions for coal are based on product-specific supply projections and are calculated using the IPCC/OECD emission factors and methodology.

ANNEX C: INTERNATIONAL ENERGY AGENCY "SHARED GOALS"

The member countries* of the International Energy Agency (IEA) seek to create conditions in which the energy sectors of their economies can make the fullest possible contribution to sustainable economic development and to the well-being of their people and of the environment. In formulating energy policies, the establishment of free and open markets is a fundamental point of departure, though energy security and environmental protection need to be given particular emphasis by governments. IEA countries recognise the significance of increasing global interdependence in energy. They therefore seek to promote the effective operation of international energy markets and encourage dialogue with all participants. In order to secure their objectives, member countries therefore aim to create a policy framework consistent with the following goals:

1. Diversity, efficiency and flexibility within the energy sector are basic conditions for longer-term energy security: the fuels used within and across sectors and the sources of those fuels should be as diverse as practicable. Non-fossil fuels, particularly nuclear and hydro power, make a substantial contribution to the energy supply diversity of IEA countries as a group.

2. Energy systems should have **the ability to respond promptly and flexibly to energy** emergencies. In some cases this requires collective mechanisms and action: IEA countries co-operate through the Agency in responding jointly to oil supply emergencies.

3. The environmentally sustainable provision and use of energy are central to the achievement of these shared goals. Decision-makers should seek to minimise the adverse environmental impacts of energy activities, just as environmental decisions should take account of the energy consequences. Government interventions should respect the Polluter Pays Principle where practicable.

4. More environmentally acceptable energy sources need to be encouraged and developed. Clean and efficient use of fossil fuels is essential. The development of economic non-fossil sources is also a priority. A number of IEA member countries wish to retain and improve the nuclear option for the future, at the highest available safety standards, because nuclear energy does not emit carbon dioxide. Renewable sources will also have an increasingly important contribution to make.

5. Improved energy efficiency can promote both environmental protection and energy security in a cost-effective manner. There are significant opportunities for greater energy efficiency at all stages of the energy cycle from production to consumption. Strong efforts by governments and all energy users are needed to realise these opportunities.

6. Continued **research, development and market deployment of new and improved energy technologies** make a critical contribution to achieving the objectives outlined above. Energy technology policies should complement broader energy policies. International co-operation in the development and dissemination of energy technologies, including industry participation and co-operation with partner countries, should be encouraged.

7. Undistorted energy prices enable markets to work efficiently. Energy prices should not be held artificially below the costs of supply to promote social or industrial goals. To the extent necessary and practicable, the environmental costs of energy production and use should be reflected in prices.

8. Free and open trade and a secure framework for investment contribute to efficient energy markets and energy security. Distortions to energy trade and investment should be avoided.

9. Co-operation among all energy market participants helps to improve information and understanding, and encourages the development of efficient, environmentally acceptable and flexible energy systems and markets worldwide. These are needed to help promote the investment, trade and confidence necessary to achieve global energy security and environmental objectives.

(The Shared Goals were adopted by IEA Ministers at the meeting of 4 June 1993 Paris, France.)

* Australia, Austria, Belgium, Canada, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Japan, Korea, Luxembourg, the Netherlands, New Zealand, Norway, Poland, Portugal, the Slovak Republic, Spain, Sweden, Switzerland, Turkey, the United Kingdom, the United States.

ANNEX D: GLOSSARY AND LIST OF ABBREVIATIONS

In this report, abbreviations and acronyms are substituted for a number of terms used within the International Energy Agency. While these terms generally have been written out on first mention, this glossary provides a quick and central reference for the abbreviations used.

AdC	Portuguese Competition Authority
ADENE	Agency for Energy
APA	Portuguese Environmental Agency
APE	Portuguese Energy Association
APETRO	Portuguese Association of Oil Companies
CAC	Climate Change Committee
CCGT	combined cycle gas turbine
CCS	carbon capture and storage
CEER	Council of European Energy Regulators
CEF	Connecting Europe Facility (EU)
CHP	combined heat and power production
CMEC	stranded cost compensation mechanism
CWE	Central West Europe
DGEG	Directorate-General for Energy and Geology
DHC	district heating and cooling
DSO	distribution system operator
EDP	Energias de Portugal
EIB	European Investment Bank
EIIs	European industrial initiatives
ENAAC	National Climate Change Adaptation Strategy
ENE-2020	National Energy Strategy for 2020
ENMC	National Authority for Fuel Markets
ENTSO	European Network of Transmission System Operators
ERSE	Energy Services Regulatory Authority (electricity and gas)
ESCO	energy services company

EU-ETS	European Union Emissions Trading Scheme
FAI	Renewable Energy Fund
FCT	Foundation for Science and Technology
FEE	Energy Efficiency Fund
FPC	Portuguese Carbon Fund
GHG	greenhouse gas
IMF	International Monetary Fund
ISO	independent system operator
LNEG	National Laboratory for Energy and Geology
LNG	liquefied natural gas
LPG	liquefied petroleum gas
LULUCF	land use, land-use change and forestry
MAOTE	Ministry for Environment, Spatial Planning and Energy
MEPS	minimum efficiency performance standards
MIBEL	Iberian Electricity Market
MIBGAS	Iberian Natural Gas Market
MIDCAT	natural gas interconnection between Spain and France
NAP	National Allocation Plan
NEEAP	National Energy Efficiency Action Plan
NES	National Energy Strategy
NRA	National Regulatory Authority
NREAP	National Renewable Energy Action Plan
PCA	Portuguese Competition Authority
PCI	project of common interest
PPA	power purchase agreement
PV	photovoltaics
R&D	research and development
REN	gas and electricity network operator
RES	renewable energy sources
SEN	national electricity system
SME	small and medium-sized enterprise(s)
SNGN	national natural gas system
SET (Plan)	Strategic Energy Technology Plan
TEN	Trans-European Network

TFC	total final consumption of energy
TPA	third-party access
TPES	total primary energy supply
TSO	transmission system operator
UNFCCC	United Nations Framework Convention on Climate Change

Units of measure

bcm	billion cubic metres
b/d	barrels per day
GGWh	gigawatt-hour
kb/d	thousand barrels per day
kWh	kilowatt-hour
mb	million barrels
mcm	million cubic metres
Mt	million tones
$MtCO_2$-eq	million tonnes of carbon dioxide-equivalent
Mtoe	million tonnes of oil-equivalent
MW	megawatt
toe	tonne of oil-equivalent
TWh	terawatt-hour

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Energy Policies of IEA Countries

Portugal

Despite the difficult economic climate, Portugal has continued to develop and reform its energy policies since the previous International Energy Agency (IEA) in-depth review in 2009. These changes have resulted in greater economic activity in the energy sector, increased renewable energy deployment, further market liberalisation and greater emphasis on energy efficiency in policy making.

A new strategy emphasising renewable energy and energy efficiency has focused efforts on meeting national and European energy policy objectives, as Portugal seeks also to lower investment costs and greater national competitiveness. The new strategy includes proposals to reinforce interconnections with transnational European electricity and natural gas networks, and measures to promote economic and environmental sustainability. The strategy should accommodate regular independent reviews and monitoring tools to examine implementation of energy policy to ensure that it remains relevant and cost-effective.

Following the economic crisis, Portugal was left with a substantial tariff deficit as retail electricity tariffs were set below costs, including subsidies to renewables. Portugal's plan to address the tariff deficit was the outcome of a negotiation process with industry stakeholders. Eliminating the tariff debt by 2020 is a significant challenge. The government must ensure swift implementation of all reform proposals and continue its efforts to identify further potential cost-saving measures in the energy sector.

This review analyses the energy policy challenges facing Portugal and provides recommendations for further policy improvements. It is intended to help guide the country towards a more secure and sustainable energy future.