PORTUGAL

INTEGRATED NATIONAL ENERGY AND CLIMATE PLAN 2021-2030

December 2018

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1. OVERVIEW AND PROCESS FOR ESTABLISHING THE PLAN

1.1. Executive Summary

1.1.1. Political, economic, environmental, and social context of the plan

After the Paris Agreement (PA) of 2015, a change in the model of society came about, with the explicit recognition that it would only be possible to overcome the challenge of climate change and slow down the global warming of the planet to just 2°C above pre-industrial levels if everyone contributed.

The European Commission has introduced a series of strategic packages which seek to address the different aspects of this global challenge. These include the Energy and Climate Package, the Clean Mobility Package and the package for Clean Energy for all Europeans.

In such a global context, the inevitability of energy transition is recognised given the urgent need with respect to climate change and the need to change the economic model, particularly with regard to fossil fuels. Portugal is clearly committed to energy transition and reducing the greenhouse gases it emits.

It is Portugal's aim to become carbon neutral by 2050, and the Roadmap for Carbon Neutrality 2050 (RCN 2050) is now underway.

In line with this vision and developed in conjunction with RCN 2050, Portugal's Integrated National Energy and Climate Plan (NECP) is framed within the obligations arising from Regulation (EU) No 2018/1999 of the European Parliament and of the Council of 11 December 2018 on the Governance of the Energy Union and Climate Action. This plan is a draft version as provided for in Article 9(1) of this Regulation.

NECP, as the main instrument for energy and climate policy for 2021-2030, is organised in accordance with the structure set out in part 1 of Annex I of the aforementioned Regulation. It addresses, in a preliminary manner at this stage, the aspects set out in this structure. NECP includes a description of the current situation in Portugal with respect to energy and climate and covers the five dimensions of the Regulation: decarbonisation, energy efficiency, supply security, the internal energy market and research, innovation and competitiveness. It also defines the national contributions and policies and measures planned to comply with the different general commitments made by the Union, including the reduction of greenhouse gas (GHG) emissions, renewable energies, energy efficiency and interconnections.

1.1.2. The five dimensions of the Energy Union strategy

In Portugal, public policies on climate change are today an integral part of a series of sector policies which are fully aligned with the medium and long-term vision and objectives of European climate policy and the Paris Agreement.

The goal is the development of a competitive and low-carbon economy so as to achieve carbon neutrality by 2050.

The response to this challenge will truly transform some of society's more determining aspects, particularly with regard to production patterns and consumption; the production and use of energy; how housing and cities are designed, work and leisure; how we travel and how we deal with mobility requirements.

With a view to carbon neutrality by 2050, goals include:

- energy transition based on the complete decarbonisation of electricity production, with production coming entirely from indigenous sources of renewable energy, which in turn will require a significant rethink of transport and distribution networks, storage capabilities, decentralised production and I.T. Controlled interconnections;
- considerable focus on energy efficiency in all sectors of activity but particularly in relation to industry, housing, services and mobility;

- full decarbonisation of the road and rail transport sectors, including the replacement of technology (with clear focus on electric, smooth and shared mobility), but also with regard to the spatial organisation models of cities and economic and leisure activities and requirements in terms of mobility, including collective mobility instead of individual mobility;
- industrial sectors, including the agri-food industry, will play an extremely important role as they are one of the key areas where innovation and the creation of new business models is required. Reinforcement of the potential of the circular economy and 'industry 4.0' will be critical on the road to identifying and creating innovative, efficient and green solutions with close to zero emissions, in the coming 30 years;
- in agriculture, it will be important to rethink the entire food chain, from the choices we make with regard to what to eat, eliminating wasted food, how plants and animals are produced for food, pressure on soils and water, but also on sea and fish resources;
- the potential of carbon sinks, particularly forests, will have to be reinforced and carefully managed during spatial planning. Investment will be required in management practices and models which promote the carbon sink role of forests and increase their resilience to climate change and help minimise the risk of fires and soil degradation.

For the short-term 2030 horizon, it is particularly important to define a strategy and objectives to help consolidate a path as well as a competitive national economy, which is resilient and increasingly low-carbon.

A carbon neutral society, based on a circular economy which conserves resources at their highest economic value is also one which creates employment (but better qualified), wealth (but more sustainable) and well-being (but more shared).

The path to carbon neutrality is also the path to innovation and knowledge, qualification and training and demographic sustainability.

With regard to energy, a particularly relevant area in the transition to a carbon free society, Portugal's strategy for the 2030 horizon is based on a combination of different policy options and measures as well as technological options, seeking to find synergies between the different alternatives. The path to a carbon neutral economy requires joint action in several strategic areas, with priority being placed on energy efficiency; a greater diversification of energy sources; an increase in electrification; reinforcement and modernisation of infrastructures; development of interconnections; market stability and investment; reconfiguration and computerisation of the market; incentives for investment and innovation; promotion of low-carbon processes, products and services; and improved energy services and informed choice for consumers.

Energy efficiency is vital for complying with climate commitments and in response to the need for a competitive economy and a resilient, safer and self-sufficient energy system. Portugal is committed to the principle of 'Energy Efficiency First' in decisions on investment projects in the energy sector, with a view to sustainability and cost effectiveness. Experience shows that the challenge of energy efficiency is the same as, or greater than that of renewable energies. Both the objectives for energy efficiency as well as those for renewable energies will have to be achieved on a cost-effective basis and jointly with other strategic priorities, such as interconnections, aiming for the real integration of the country into the Energy Union and the need to become carbon neutral. However, the country's supply security must always be ensured.

Energy transition in Portugal will undoubtedly involve the electricity sector, based on the extensive electrification of the economy. Portugal has enormous potential to develop a highly decarbonised electricity production sector, both through the availability of renewable endogenous resources such as water, wind, sun, biomass and geothermal power, as well as through the fact that it has a reliable and secure electricity system which is capable of dealing with variability. Our focus is now on solar energy. Highly competitive technology prices when compared to conventional solutions, together with the abundance of this resource, make solar energy a solution capable of providing continuity to energy transition, without burdening consumers. With an electricity production system which has a strong renewable base, the aim is to promote and reinforce the use of electricity in the different sectors of activity and the economy, with particular emphasis on transport, but also on industry and the residential and services sectors. In parallel, there will be reinforced use of other renewable energy sources, such as biomass and biofuels.

Energy transition is not limited to only technological evolution through the replacement or adoption of new technologies or the use of new forms of energy. Participation by consumers will also play a significant role where they will be more active as consumers/producers of energy and as agents for changes in behaviour which will have considerable impact. A more informed consumer represents better, more efficient and sustainable choices and a consumer at the centre of decision making is a more active consumer in energy transition, and one which is available to participate in the structural changes required to meet the challenge leading to carbon neutrality by 2050. With the consumer as an informed and active agent in the market, and with instruments to protect the more vulnerable consumers, a further strategic priority for 2030 will be addressed; that of fighting energy poverty and consumer vulnerability.

The vision of an electricity production system which is highly decarbonised, decentralised and computerised, with focus on the consumer/energy producer as an active participant in the system which ensures suitable levels of quality of service and supply security, will not be possible to achieve without new design and strategic guidance which takes all these new variables into account. Smart networks, management support systems, smart meters, storage systems, local production of energy, active consumers, flexibility in supply/demand, electric vehicles, among other factors, are the variables which need to be considered when building the model for the network of the future. To guarantee real integration of all the variables, regardless of the configuration to be adopted, it is important to form a strategic vision of the national electricity network which will allow national targets and objectives for the 2030 horizon to be met.

Also with regard to infrastructures, energy interconnections are essential to the development of the internal energy market, ensuring the supply of power, improving the functioning of energy systems, increasing the competition and stability of energy markets, promoting the integration of markets and contributing to compliance with EU energy and climate targets.

Research and innovation with respect to new production technologies and storage will play a crucial role in providing an answer to the challenges of energy transition. The development of new technologies and the improvement of existing low-carbon technologies requires significant effort in innovation and research which will be achieved by adopting an ambitious and wide-ranging agenda which addresses all parts of the technological development cycle up to and including the sale of such technologies. In order to achieve this, a significant contribution will be provided by national support programmes which will be oriented to research and technological development to meet the country’s priorities, as is the case with hydrogen, storage, smart networks and advanced biofuels.

This new energy model for carbon neutrality represents a unique opportunity for Portugal. As such, it will be developed involving significant participation from society and particularly from energy consumers and other participants in the energy system whose contribution will be vital to forming a strategic vision for the coming decade. In relation to the economic recovery which the country has achieved in recent years, the challenge of energy transition is seen as an opportunity which will allow the economy to be leveraged. The aim is to achieve sustainable development based on a democratic and fair model which promotes the advance of civilization and technology, territorial cohesion and creates jobs, prosperity and wealth while also preserving natural resources. The path to the decarbonisation of the economy is an opportunity for economic growth.

1.1.3. Overview of the plan’s main objectives, policies and measures

In line with the strategic vision defined for the five dimensions of the Energy Union and Climate Action, the following figure shows national targets and contributions defined for the 2030 horizon under the Integrated National Energy and Climate Plan (NECP).

Table 1 - Portuguese targets for the 2030 horizon

Targets 2030	National contribution to Union targets
Reduction of CO_{2e} emissions (without LULUCF) (Mt CO_{2e}), with respect to 2005	-17%[1]
Reinforce the weighting of Renewable energies (% in the gross final energy consumption)	47%
Increase Energy Efficiency (% reduction in primary energy consumption[2])	35%
Electricity interconnections	15%

[1] Other national objectives: -45% to -55%.
[2] Based on projections of the PRIMES model for the European Commission carried out in 2007.

Compliance with Portugal's targets and objectives based on a strategic vision for the 2030 horizon:

PROMOTING THE DECARBONISATION OF THE ECONOMY TO ACHIEVE CARBON NEUTRALITY BY 2050, AS AN OPPORTUNITY FOR THE COUNTRY, BASED ON A DEMOCRATIC AND FAIR MODEL OF TERRITORIAL COHESION WHICH EMPHASISES THE CREATION OF WEALTH AND THE EFFICIENT USE OF RESOURCES

To meet the strategic vision defined as well as the associated targets, eight objectives were established for the 2030 horizon:

1. REDUCE GREENHOUSE GAS EMISSIONS
2. PUT ENERGY EFFICIENCY FIRST
3. REINFORCE THE FOCUS ON RENEWABLE ENERGIES AND REDUCE THE COUNTRY'S ENERGY DEPENDENCE
4. ENSURE SUPPLY SECURITY
5. PROMOTE SUSTAINABLE MOBILITY
6. REDUCE CARBON INTENSITY IN AGRICULTURE AND PROMOTE CARBON CAPTURE
7. DEVELOP INNOVATIVE AND COMPETITIVE INDUSTRY
8. ENSURE FAIR, DEMOCRATIC AND COHESIVE TRANSITION

1.2. Overview of the current policy situation

1.2.1. National and EU energy system and the policy context of the national plan

In 2016, the European Commission presented the legislative package 'Clean Energy for All Europeans' with the aim of promoting energy transition in the decade of 2021-2030 and complying with the PA while also promoting economic growth and the creation of jobs. This package requires all MS to draw up and present an Integrated National Energy and Climate Plan (NECP) to the European Commission for the 2030 horizon. MS are also required to set out targets and objectives in this plan for GHG emissions, renewable energies, energy efficiency, energy supply security, the internal market and research, innovation and competitiveness, as well as a clear approach as to how to achieve these goals. The NECP will be the main instrument for energy and climate policy for 2021-2030.

With this in mind, the European Union approved ambitious targets which seek to achieve by 2030, (i) 32% of energy use from renewable sources in final gross consumption, (ii) 32.5% reduction in energy consumption, (iii) 40% reduction in GHG emissions over 1990 levels, and (iv) 15% electricity interconnections.

NECP, as a decisive instrument of national policy in the definition of strategic lines for the coming decade will be in alignment with the visions and goals set out in the Roadmap for Carbon Neutrality 2050.

As it will be a decisive instrument in the definition of strategic investment in the coming decade in the area of energy, NECP will also be in alignment with the National Investment Plan 2030 (NIP).

While Portugal is preparing to comply with its challenge for 2020 with the goal to incorporate 31.0% of renewable sources into energy consumption (the 5th most ambitious target in the EU-28), it is also important to define new ambitions for the 2021-2030 decade. Portugal has strong arguments to continue to build a strategy for carbon neutrality and a carbon-neutral economy based on sources of renewable energy with focus on energy efficiency and the energy consumer. Evidence of this is the ambition which has been defended both nationally and in Europe, for the targets of the 2030 horizon.

1.2.2. Current energy and climate policies and measures across the five dimensions of the Energy Union

The main instruments of current sector policy contributing to the dimensions of the Energy Union are identified below:

- National Investment Programme (PNI 2030), being developed;
- Roadmap to Carbon Neutrality (RNC2050), being developed;

- National Programme on Climate Change (PNAC 2020/203), National Strategy for Adaptation to Climate Change (ENAAC 2020), approved through Council of Ministers Resolution No 56/2015 of 30 July 2015 which also created the National Policies and Measures System later governed by Council of Ministers Resolution No 45/2016 of 26 August 2016;
- National Strategy for the Air (ENAR 2020), approved through Council of Ministers Resolution No 46/2016 on 26 August 2016.
- Circular Economy Action Plan (PAEC), approved through Council of Ministers Resolution No 190-A/2017;
- National Programme for Spatial Planning Policy (PNPOT), revised version awaiting publication;
- National Strategy for Sustainable Cities 2020, approved through Council of Ministers Resolution No 61/2015 on 11 August 2015.
- Strategic Plan for Solid Urban Waste (PERSU 2020+), being revised under public hearing;
- National Waste Management Plan 2014-2020 (PNGR), approved through Council of Ministers Resolution No 11-C/2015 of 16 March 2015.
- Strategic Plan for Water Supply and Waste Water Sanitation (PENSAAR 2020), approved through Official Order No 4385/2015 of 30 April 2015;
- Rural Development Programme for 2014-2020 (RDP 2020), approved through Commission Implementing Decision C(2014) 9896 of 12 December 2014;
- Strategy for Agricultural and Agro-Industrial Effluents 2018-2025, being revised;
- Good Agricultural Practices Code (CBPA), approved through Official Order No 1230/2018 of 5 February 2018;
- National Forestry Strategy (ENF), review approved through Council of Ministers Resolution No 6-B/2015 of 4 February 2015;
- Strategic Transport and Infrastructures Plan (PETi3+) for 2014-2020, approved through Council of Ministers Resolution No 61-A/2015 of 20 August 2015;
- Sustainable Mobility Programme for Public Administration - ECO.mob 2015-2020, approved through Council of Ministers Resolution No 54/2015 of 28 July 2015.
- National Strategy for Ecological Public Procurement (ENCPE 2020), approved through Council of Ministers Resolution No 38/2016 of 29 July 2016.
- National Strategy for Environmental Education (ENEA 2020), for 2017-2020, approved through Council of Ministers Resolution No 100/2017 of 11 July 2017.
- National Action Plan for Renewable Energies 2013-2020 (PNAER), approved through Council of Ministers Resolution No 20/2013 of 10 April 2013.
- National Programme for High Hydroelectric Potential Dams (PNBEPH);
- National Plan for the Promotion of Bio-refineries, approved through Council of Ministers Resolution No 163/2017 of 31 October 2017.
- National Strategy for the Sea (ENM 2013 -2020), approved through Council of Ministers Resolution No 12/2014 of 12 February 2014.
- Industrial Strategy and Action Plan for Renewable Ocean Energy, approved through Council of Ministers Resolution No 174/2017 of 24 November 2017.
- National Action Plan for Energy Efficiency 2013-2016 (PNAEE), approved through Council of Ministers Resolution No 20/2013 of 10 April 2013.
- Energy Efficiency Programme for Public Administration - ECO.AP, created through Council of Ministers Resolution No 2/2011 of 12 January 2011.
- Monitoring Report on the Supply Security of the National Electricity Production System (RMSA-e) (being assessed) and Monitoring Report on the Supply Security of the Natural Gas System (RMSA-GN) (being assessed)[3];
- National Electricity Transmission Network Development and Investment Plan for the period 2018-2027, being assessed;
- National Natural Gas Transmission System Development and Investment Plan for the period 2018-2027 being assessed;

[3] RMSA-e and RMSA-GN are not policy instruments but rather instruments to support decisions, analysing the expected evolution of the National Electricity System (NES) and the NG system, with respect to policy guidelines on supply security set out in different policy instruments.

- Strategy for Research and Innovation for a Smart Specialisation EI&I, 2014-2020, approved on 23 December 2014;
- Relevant agendas for R&D&I of the Foundation for Science and Technology (FCT), being developed.

1.2.3. Key issues of cross-border relevance

Of note is the agreement in 2006 between Portugal and Spain to create **the Iberian Electricity Market (MIBEL)** with the aim of establishing interconnections with commercial capacity of 3 000 MW so as to promote and reinforce price convergence between both markets, as well as strengthen supply security.

With regard to regional cooperation in relation to **trans-border interconnections**, the signing of the Madrid Declaration in 2015 and more recently the signing of the Lisbon Declaration in July 2018 (at the Energy Interconnection Summit) led to a commitment by Portugal, Spain, France and the European Commission to build the necessary infrastructures for implementing an efficient and decarbonised internal energy market. This is particularly important with respect to the trans-border interconnections for gas and electricity networks in Member States which have not yet reached a minimum level of integration into the internal energy market, as is the case with Spain and Portugal.

In November 2018, the Valladolid Declaration was signed by Portugal and Spain, in which both governments underlined the importance of energy supply security in Europe and the need to promote trans-border and inter-regional interconnections to achieve greater integration of the Iberian market /Iberian Peninsula with the rest of Europe, thus contributing to the Energy Union and using existing European financing mechanisms. With the aim of meeting the challenge to incorporate renewable energies and the development of MIBEL, both governments reaffirmed the importance of the internal and external MIBEL interconnection.

1.2.4. Administrative structure for implementing national energy and climate policies

The 4th amendment to the Organic Law of the XXI Constitutional Government of Portugal (laid down in Decree-Law No 90/2018 of 9 November 2018) reorganised departments and other bodies with responsibilities for climate and energy. Matters relating to energy are now the responsibility of the Ministry of the Environment, which was renamed and is now called the Ministry of the Environment and Energy Transition. With this new configuration, the mission of the area of government for the environment and energy transition is to formulate, manage, execute and assess policies for the environment, spatial planning, cities, housing, urban, sub-urban and road passenger transport, climate, nature conservation and energy from a perspective of sustainable development and social and territorial cohesion.

These recent changes have brought energy and climate closer together while aligning energy transition with the aim to decarbonise the Portuguese economy is crucial.

Given the role transport will play in the future with respect to decarbonising the Portuguese economy and its importance in relation to social and territorial cohesion, the integration of competences in transport is also an innovation as this area is now included within a comprehensive vision for sustainability. Responsibility for transport is still shared with the Ministry of the Interior, the Ministry of Planning and Infrastructures and the Ministry for the Sea, due to matters relating to the respective areas. The shared vision also extends to the conservation of nature and forests, more specifically with the Ministry of Agriculture, Forests and Rural Development.

Housing must also be considered within a logic of integrated policies given its importance to the environment and GHG emissions. Other equally important topics include building restoration, the energy efficiency of buildings and the relationship of housing with other urban uses and needs (mobility, tourism, commerce, etc.).

The Directorate General for Energy and Geology (DGEG) is responsible for drawing up, promoting and assessing policies on energy and geological resources with a view to sustainable development and ensuring supply security. DGEG's mission naturally includes the need to raise awareness of the importance of such policies within the framework of economic and social development desired for the country, informing citizens of the instruments available to implement policy decisions and disseminating the results of the respective monitoring and execution.

The Portuguese Environment Agency, I.P. (APA), a public institute under the tutelage of the Ministry of the Environment, continues to be responsible for proposing, developing and monitoring the implementation of environmental policies, more specifically with regard to climate change, an area which is overseen directly by the Minister for the Environment and Energy Transition. This agency is therefore responsible for developing and ensuring the implementation of strategic options, policies and measures leading to a low-carbon economy, particularly with regard to mitigating GHG emissions and adapting to the impacts of climate change.

In this regard, it is also important to highlight the National Policies and Measures System (SPeM), created through Council of Ministers Resolution No 56/2015 of 30 July 2015, later governed by Council of Ministers Resolution No 45/2016 of 26 August 2016, which seeks to assess progress in the implementation of sector mitigation policies and measures, promoting involvement and reinforcing the accountability of different sectors with regard to the integration of climate into policies. SPeM includes the institutional, legal and procedural provisions applicable to the assessment of policies and the calculation of GHG emission projections in response to that set out in Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 (MMR). This system ensures:

a) Management of the process to identify and define policies and measures or groups of policies and measures to limit or reduce emissions of GHG and other air pollutants by sources or increased removal by carbon sinks in order to comply with national obligations;

b) The monitoring and reporting of implementation of measures and their effects, as well as the reporting of projections in compliance with European and international requirements and directives, ensuring the respective liaison with the National Inventory of Atmospheric Emissions (INERPA);

c) The drawing up of national GHG emission projections and other air pollutants by sources and their removal by sinks, as well as the expected effects of the policies and measures being implemented and for future implementation in compliance with European and international requirements and directives and in liaison with INERPA;

d) Assessment of compliance with national obligations, including sector targets under the European Union Climate and Energy Package and air policies for the 2020, 2025 and 2030 horizons, as established in strategic national documents on climate change and air policies.

Council of Ministers Resolution No 56/2015 of 30 July 2015 created the Interministerial Climate Change and Air Commission (CIAAC), a structure to monitor climate policy and sector policies impacting on national targets for the air and climate change, taking into account the synergies between these two areas. This Commission has since been renamed as the Interministerial Air, Climate Change and Circular Economy Commission (CA2), and is now also responsible for promoting and supervising the Action Plan for the Circular Economy (PAEC). In accordance with Official Order No 2873/2017 of 6 April 2017, which approves the Commission's Operating Regulations, the Commission also provides policy guidelines for climate change and the air; promoting coordination and integration with climate change policies for the different sectors while also monitoring the implementation of the relevant sector measures, programmes and actions which were adopted.

The specific competences of CA2 are set out in the abovementioned Official Order. These competences include the monitoring of compliance with commitments assumed by Portugal on a national and Community level and with regard to the United Nations, the promoting and monitoring of relevant national plans on climate change, the validation of proposed policy options and measures with respect to mitigation, monitoring and support for establishing national positioning in international negotiations.

CA2 is presided over by the member of the government responsible for the environment and energy transition and includes representation by the sectors of energy, spatial planning, treasury, agriculture, the sea, the economy and innovation, transport, health, tourism, civil protection, regional development, local government, foreign affairs and cooperation, education and science and by representatives of the regional governments of the Azores and Madeira.

The Ministry of the Environment and Energy Transition is responsible for NECP and involves the following institutions:

- The Directorate General for Energy and Geology (described above);
- The Portuguese Environment Agency (described above);

The following entities are also equally relevant to the NECP development process, particularly with respect to energy:

- ERSE - Energy Services Regulatory Authority, responsible for regulating the natural gas, electricity, LNG, oil derived fuels and biofuel sectors and monitoring the management of operations in the electric mobility network. Its mission is to protect consumer interests, particularly economically vulnerable consumers with regard to prices, quality of service, access to information and supply security and to promote competition between market agents in the internal energy market;

- LNEG - National Energy and Geology Laboratory – a technological research, demonstration and development body whose mission is to promote technological innovation geared towards science and technology to develop the economy, contributing to the increased competitiveness of economic agents in a framework of sustainable progress for the Portuguese economy. Under its duties arising from the Portuguese government's economic and social development strategy and policy, LNEG acts as an interface to integrate technology and R&TD results into businesses;
- ADENE – the National Energy Agency, a private, non-profit public utility association, whose mission is the development of activities of public interest in the areas of energy, the efficient use of water and energy efficiency in mobility.
- IMT - Institute for Mobility and Transport, whose mission includes technical regulations, licensing, coordination, inspection and planning in land and water transport and the respective infrastructures and the economic aspect of the commercial ports and sea transport sectors.
- GPP - Planning, Policy and General Administration Office, whose mission is to support the definition of the strategic lines, priorities and objectives of the policies of the Ministry of Agriculture, Forests and Rural Development (MAFDR) and the Ministry of the Sea (MMar) and coordinate, monitor and assess their application, as well as provide Community and international representation. It also provides technical and administrative support to the offices of members of the government and to other bodies and departments in MAFDR/MMar

1.3. Consultations and involvement of national and EU entities and their outcome

1.3.1. Involvement of the national Parliament

At this stage of preparation of the draft NECP, Parliament has not been involved. During 2019, several actions will be undertaken to involve institutions and stakeholders.

1.3.2. Involvement of local and regional powers

During the preparation of the draft version of the NECP, the Autonomous Regions of the Azores and Madeira were consulted. During 2019, several actions will be undertaken to involve local and regional government, including the National Association of Portuguese Municipalities (ANMP) and the National Association of Wards (ANAFRE).

1.3.3. Consultations with stakeholders, including social partners, and engagement of civil society

Under RNC2050, several hearings were held with more relevant sector stakeholders (private undertakings and government) and civil society, essentially with the following objectives:

- To support the preparation of socio-economic narratives and scenarios;
- To define assumptions and demand;
- To discuss preliminary results.

Socio-economic narratives and scenarios, described in detail in Section 4, have been validated and redefined through a two-stage participatory and iterative process. The first stage was to build narratives (working discussion with specialists from different institutions and areas, held on 24 November 2017 in Lisbon, followed by sharing of comments/written contributions) and a second stage to create socio-economic scenarios and validate them with specialists from institutions, predominantly from the public sphere, with responsibilities in economic forecasting and prospecting (validation took place from 2 March to 6 April 2018. Consultations were held with the Portuguese Environmental Agency, the Department of Economic Studies at the Bank of Portugal; the Office for Strategy and Studies at the Ministry of the Economy (GEE-MECON), the Office of Planning, Strategy, Assessment and International Relations at the Ministry of Finance (GPEARI), INE – National Statistics Institute, the General-Secretary of the Ministry of the Environment, as well as with several individual figures).

To help define the assumptions and demand in the different sectors, seven technical workshops were held in a process to co-create a shared vision. These workshops took place from 27 March to 17 May 2018 and addressed:

- Mobility (Supply Passengers; Demand Passengers; Supply Goods; Demand Goods);
- Forestry (Forestry; Industrial sectors; Demand);
- Agrifood (Supply; Mkt/Distribution; Demand);
- Construction (Materials; Supply; Demand);
- Waste and Wastewater (Production; Destination/Treatment; Technology);
- Cities (Buildings; Mobility; Services; Lifestyles);
- Energy (Resources and Supply; Networks and Storage; Demand)

These workshops sought to envisage the configuration of the value chain in the sectors, in a Carbon Neutral Portugal under the 2050 horizon.

A central aim was to analyse the role of the circular economy in the future of these sectors. Two basic criteria were included in the discussion of the circular economy: (i) the level of criticality to the net balance of GHG emissions and (ii) the 'degree of exposure' to the circular economy with materiality in GHG emissions and to the objective of carbon neutrality.

The results obtained reflect the general view and perception of the discussion. These results are summarised in seven Workbooks providing information on GHG emission modelling work in RNC2050. The abovementioned Workbooks are available on the RNC2050[4] website. They provide a systematised overview of each sector in 2050, along with the drivers to achieve the goals set out (e.g. with regard to public policy and regulations, markets and R&D).

An integrated analysis of the workshop results showed convergence in the overwhelming majority of the topics discussed allowing a socio-economic portrait of a carbon neutral Portugal in 2050 to be drawn up. These results were considered in sector GHG emission modelling for the 2050 horizon. More specifically, when modelling each sector [Energy and Industry; Transport and Mobility; Agriculture and Forestry and Water and Wastewater] it was possible to (i) define, corroborate or fine tune assumptions on basic activity variables; (ii) build variations and/or (iii) lay the foundations for sensitivity analyses.

In addition to these workshops, public discussion sessions were also held on several topics relevant to the decarbonisation of Portuguese society by 2050. These sessions were held in different parts of the country:

- 'Decarbonise Mobility', 26 February in Porto;
- 'The role of the forest in the decarbonisation of Portugal', 18 May in Pombal;
- 'Energy transition in Portugal and the contribution to carbon neutrality', 19 June in Lisbon.

To discuss the preliminary results of GHG emission trajectories, four *workshops* were also held from October to November 2018 for stakeholders in the Agriculture and Forestry, Energy and Transport sectors and public entities involved in the National Policies and Measures System. These workshops were in addition to bilateral meetings with relevant stakeholders.

This first stage of consultations culminated in the public presentation of the first results of the Roadmap, on 4 December 2018. Also presented were the targets defined for 2030 with respect to reducing emissions, renewable energies and energy efficiency and the public consultation for the Roadmap which is to take place before 28 February 2019 was also launched.

4 https://descarbonizar2050.pt/uploads/RNC_Cadernos2050.pdf.

As part of work for NECP, in addition to the approximately 70 technical meetings involving a wide range of experts from the energy and climate sectors, numerous sessions were also held with stakeholders (Figure 1), including:

- Conference 'Clean Energy for all Europeans', held on 14 September 2017, which involved four thematic sessions - Renewable Portugal; Energy Efficiency; the European Electricity Market and the Consumer and Energy. The main aim of the conference was to promote a constructive debate involving experts, academics and stakeholders from the energy sector.
- Workshops with energy sector associations (14 entities per session);
- Meetings with representatives of the Autonomous Regions;
- Meetings with the concession holders of transmission and distribution networks.

Figure 1 - NECP Stakeholder involvement activities held in 2018

KEY

INTERACTION WITH ADENE	INVOLVEMENT MEETINGS WITH INSTITUTIONAL STAKEHOLDERS	2 WORKSHOPS WITH SECTOR AND OTHER RELEVANT ASSOCIATIONS	2 WORKSHOPS WITH REGIONAL STAKEHOLDERS	MEETINGS WITH SECTOR AGENTS
Energy Efficiency dimension	Presentation and discussion of levels of ambition for 20121-2030 based on results of the energy model Discussion on P&M in the renewable energy sector, energy efficiency, market and supply security and R&I and competitiveness	Presentation of status of work Presentation and discussion of levels of ambition for 20121-2030 based on results of the energy model Presentation and discussion of main lines of action 2021-2030	Presentation and discussion of levels of ambition for 20121-2030 based on results of the energy model Coordination of assumptions and lines of energy policy in the autonomous regions	Presentation and discussion of levels of ambition for 20121-2030 based on results of the energy model Coordination of assumptions and lines of energy policy in the autonomous regions

This broad involvement and consultation process will continue in 2019 and culminate in a public consultation process.

1.3.4. Consultations with other Member States

At this stage of preparation of the draft NECP, no other Member States were involved.

However, it should be noted that some of the topics with greater trans-border relevance covered by this plan have been discussed with Member States, particularly Spain and France, in forums such as the High-Level Group (HLG) in relation to interconnections in Southwest Europe. The Luso-Spanish Summit in Valladolid was also important for strategic commitments in matters which are relevant to NECP, more specifically with respect to interconnections, MIBEL and strategies to comply with the Paris Agreement. The 2nd Interconnection Summit between Portugal, Spain and France, is equally of note in this regard.

1.3.5. Iterative process with the European Commission

Since 2015, Portugal has actively participated in the European Commission Technical Working Group on Integrated National Energy-Climate Plans (TWG NECP), maintaining open communication with the European Commission and other Member States.

Through the status updates at the meetings of this Working Group and the quarterly questionnaires, Portugal kept the European Commission informed of work underway to develop the National Plan.

Portugal has also participated on a technical level in the Special Groups, JRC-IDEES (Joint Research Centre Integrated Database on the European Energy System) and POTEnCIA model (Policy-Oriented Tool for Energy and Climate Change Impact Assessment), thus contributing to the ongoing improvement of the database and to the improvement of assumptions and fine tuning of the projection models developing country by these groups.

1.4. Regional cooperation in preparing the plan

1.4.1. Aspects subject to joint planning or coordination with other States

At this stage of preparation of the draft NECP, there has been no joint planning or coordination with other States.

1.4.2. Explanation of how regional cooperation is considered in the plan

As part of foreign policy, Portugal has promoted numerous interactions with neighbouring Member States, particularly with Spain, at this initial stage of the NECP development process so as to ensure a suitable level of involvement and agreement in areas of cooperation.

Therefore, some of the topics with greater trans-border relevance covered by this plan have been discussed with Member States, particularly Spain and France, in forums such as the High-Level Group (HLG) in relation to interconnections in Southwest Europe.

The Luso-Spanish Summit in Valladolid was also important for strategic commitments in matters which are relevant to NECP, more specifically with respect to interconnections, MIBEL and strategies to comply with the Paris Agreement. At this summit, and with particular relevance for regional cooperation, the importance of the Iberian Working Group on Renewable Energies was reiterated, as a contribution to promoting joint work by both countries in relation to energy transition.

Also of note in this regard was the 2nd Interconnections Summit, which resulted in the signing of the Lisbon Declaration by Portugal, France, Spain and the European Commission, with a view to reinforcing regional cooperation for the Energy Union and better integrating the Iberian Peninsula into the internal energy market. At this summit, the three countries agreed on a series of common guidelines with respect to energy and climate policy.

2. NATIONAL OBJECTIVES AND TARGETS

2.1. Dimension Decarbonisation

2.1.1. Objectives relating to GHG emissions and removals

i. The Member State's binding national target for GHG emissions and binding national annual limits under Regulation (EU) No 2018/842

Under the Effort Sharing Regulation, a Union target was established stipulating a reduction of 30% in GHG emissions by 2030, in comparison to 2005 levels, in sectors not covered by the European Emissions Trading Scheme (EETS) so as to contribute to achieving the commitments undertaken in the PA. National contributions were stipulated for the abovementioned Union target. Portugal is required to limit its GHG emissions by at least 17% by 2030 in comparison to its GHG emissions in 2005.

ii. The Member State’s commitments under Regulation (EU) No 2018/841

Under Regulation (EU) No 2018/841 of the European Parliament and of the Council approved on 30 May 2018 (LULUCF Regulation) on the inclusion of greenhouse gas emissions and removals from land use, land use change and forestry in the 2030 climate and energy framework, MS commitments were established to help meet PA objectives and comply with the Union target to reduce GHG emissions for the 2021 to 2030 period.

For the 2021 to 2030 period, and notwithstanding the flexibility provided for in the LULUCF Regulation, MS are required to ensure that their emissions do not exceed removals, calculated as the sum of total emissions and the total of removals in their territory. Each MS may only offset:

a. Sinks calculated as emissions in relation to their level of forestry reference; and

b. The maximum volume of offsetting provided for this Member State for 2021 to 2030, which in the case of Portugal, will be 6.2 million tonnes equivalent of CO_2.

It is important to note that Portugal will propose its level of forestry reference for 2021 to 2025 to the European Commission by 31 December 2018.

iii. If applicable, other national objectives and targets consistent with the Paris Agreement and existing long-term strategies If applicable, other objectives and targets, including sector targets and adaptation goals, if available, to contribute to the overall commitment by the Union to reduce GHG emissions

In the National Climate Change Programme 2020/2030 (NCCP 2020/2030), approved in 2015, targets were set to reduce GHG by 2020 (-18% to -23% with respect to 2005) and by 2030 (-30% to - 40% with respect to 2005). Sector targets were also established for both timelines.

Under its commitment to reach carbon neutrality by 2050, Portugal set national targets for its GHG emissions for the 2030 horizon:

Table 2 - National targets for GHG emissions in Portugal for the 2030 horizon

	2030
GHG Emissions (without LULUCF; with respect to 2005)	**-45% to -55%**

The PA states that parties are required to submit, by 2020, long-term strategies for low-carbon development. The RNC2050 provides the basis for the long-term national strategy which Portugal will be submitting to the United Nations Framework Convention on Climate Change (UNFCCC) by 2020. Under work for RNC2050, also established were objectives to reduce emissions by -65% to -75% by 2040 and by -85% to -90% by 2050 with respect to 2005 levels, compatible with carbon neutrality in 2050.

It is important to note that Portugal has had a National Strategy for Adapting to Climate Change since 2010, which was revised in 2015 (ENAAC 2020) and integrated into the National Climate Policy package adopted by

Council of Ministers Resolution No 56/2015. The goal of ENAAC 2020 is ‘A country adapted to the effects of climate change through the ongoing implementation of solutions based on technical and scientific knowledge and good practices’ and sets out an organisational model promoting liaison between the different sectors and stakeholders. It also sets out priorities for cross-cutting thematic areas and achieving the three objectives of the strategy:

- To improve the level of knowledge on climate change;
- To implement adaptation measures;
- To promote the integration of adaptation in sector policies.

Work is carried out with regard to the different priority sectors (Agriculture; Biodiversity; Economy; Energy and Energy Security; Forestry; Human Health; Security of People and Property; Transport and Communications; Coastal Areas and the Sea) and their contributions to each of the thematic areas (Research and Innovation; Financing and Implementation; International Cooperation; Communication and Dissemination; Spatial Planning; Water Resources), with a view to achieving the strategy’s objectives.

So as to mobilise financing and define priorities to implement adaptation measures, an Action Programme for Adaptation to Climate Change was developed (P-3AC) for 2020-2030. This Programme was open to public consultation up to 28 November 2018 and it is expected to be adopted in early 2019.

The Programme identifies the main national impacts and vulnerabilities to climate change based on the scenarios available on a suitable territorial scale and proposes lines of action to address each of the impacts and vulnerabilities. Indicators are also defined for implementation and results and a robust framework is provided for monitoring and assessment to confirm the effectiveness of the measures.

2.1.2. Objectives relating to renewable energy sources.

i. Contribution to the binding target of the Union of a minimum of 32% in renewable energy by 2030, as the share of energy from renewable sources in final gross energy consumption in 2030.

Portugal’s contribution to the binding target of the Union of a minimum of 32% in renewable energy by 2030, as the share of energy from renewable sources in final gross energy consumption in 2030 can be seen in Table 3.

Table 3 - Indicative trajectory and contribution to the binding target of the Union of a minimum of 32% in renewable energy by 2030

	2020	2022	2025	2027	2030
% Renewables[5]	31%	33-34%	37-38%	40-41%	47%

ii. Estimated trajectories for the sector share of renewable energy in final energy consumption between 2021 and 2030 in the electricity, heating and cooling and transport sectors

The estimated trajectories established for energy from renewable sources in Portugal for the 2030 horizon are shown in Table 4.

Table 4 - Estimated trajectories for renewables in Portugal for the 2030 horizon

		2020	2025	2030
Electricity	Gross final energy consumption (Mtoe)	4.6	5.3	6.1
	% Renewables	68%	76%	80%
Heating and Cooling[6]	Gross final energy consumption (Mtoe)	5.2	4.9	4.6
	% Renewables	34%	36%	38%
Transport	Gross final energy consumption (Mtoe)	5.4	5.0	4.6

5 Multipliers not considered in this case.
6 Includes energy consumed in processes.

	% Renewables - real	8%	13%	20%
Total	Gross final energy consumption (Mtoe)[7]	17.1	17.0	16.8
	% Renewables[8]	31%	37 - 38%	47%

iii. Estimated trajectories per renewable energy technology that the Member State expects to use to comply with general and sector trajectories for renewable energy between 2021 and 2030[99]

A breakdown of the Electricity sector is presented in Table 5.

Table 5 - Total effective contribution (installed capacity) of each renewable energy technology in Portugal in the Electricity sector (GW) for the 2030 horizon [Source: DGEG]

	2015	2020	2025		2030	
Hydro	6.0	7.0	8.2		9.0	9.0
Wind	5.0	5.4	6.6	7.8	8.8	9.2
Solar	0.4	1.9	5.5	6.6	8.1	9.9
Other Renewables [1]	0.3	0.5	0.5	0.5	0.7	0.6
TOTAL [2]	**11.7**	**14.7**	**20.8**	**23.2**	**26.6**	**28.6**

[1] Includes Biomass, Biogas, Waste (50% of production via waste is not renewable), Geothermal and Wave
[2] Does not include cogeneration

A breakdown of the Heating and Cooling sector is presented in Table 6.

Table 6 - Total effective contribution (Final Energy Consumption) of each renewable energy technology in Portugal in the Heating and Cooling sector (ktoe) for the 2030 horizon [Source: DGEG]

	2020	2025	2030
Solar thermal	88	86	83
Biomass:	952	956	937
Biomethane	0	20	80
Heat pumps	175	200	215
Heat from cogeneration[10]	715	670	626
Hydrogen[11]	0	4	11
TOTAL	**1 930**	**1 936**	**1 952**

A breakdown of the Transport sector is presented in Table 7.

Table 7 - Total effective contribution (Final Energy Consumption) of each renewable energy technology in Portugal in the Transport sector (ktoe) for the 2030 horizon [Source: DGEG]

	2020	2025	2030
Biofuels	377	334	277
Hydrogen	0	9	65
RES electricity	45	198	530
TOTAL	**422**	**523**	**872**

iv. Estimated trajectories on bioenergy demand, broken down into heat, electricity and transport, and on biomass supply by feedstocks and origin (distinguishing between

7 The maximum threshold of 6.18% is considered in final national consumption for international aviation.
8 Multipliers not considered in this case.
9 Including expected final gross energy consumption, by technology and sector in Mtoe, and the total planned installed capacity (divided by new capacity and re-powering) by technology and sector, in MW.
10 Of renewable origin.
11 Of renewable origin.

domestic production and imports). For forest biomass, an assessment of its source and impact on the LULUCF sink

A breakdown of bioenergy is presented in Table 8.

Table 8 - Estimated trajectories for the production of bioenergy, broken down into heat, electricity and transport (ktoe) for the 2030 horizon [Source: DGEG]

	2020	2025	2030
Electricity	980	1 280	1 990
Heating and Cooling	1 780	1 760	1 730
Transport	380	330	280
TOTAL	**3 140**	**3 370**	**4 000**

Assessment of the source and the impact of forest biomass on the LULUCF sink will be included after the NECP has been developed.

v. If applicable, other national trajectories and objectives, including long-term or sector trajectories[12]

Not applicable

2.2. Dimension Energy efficiency

i.1 The indicative national energy efficiency contribution to achieving the Union's binding energy efficiency target of 32.5 % by 2030[13]

The contribution in terms of absolute level of primary energy consumption and final energy consumption in 2020 and 2030 is shown in Table 9.

Table 9 - The indicative national energy efficiency contribution to achieving the Union's binding energy efficiency target of 32.5% by 2030 (Mtoe)

	Unit	2020	2030
Primary Energy Consumption[14]	Mtoe	21.8	20.2
Final Energy Consumption	Mtoe	17.5	17.7

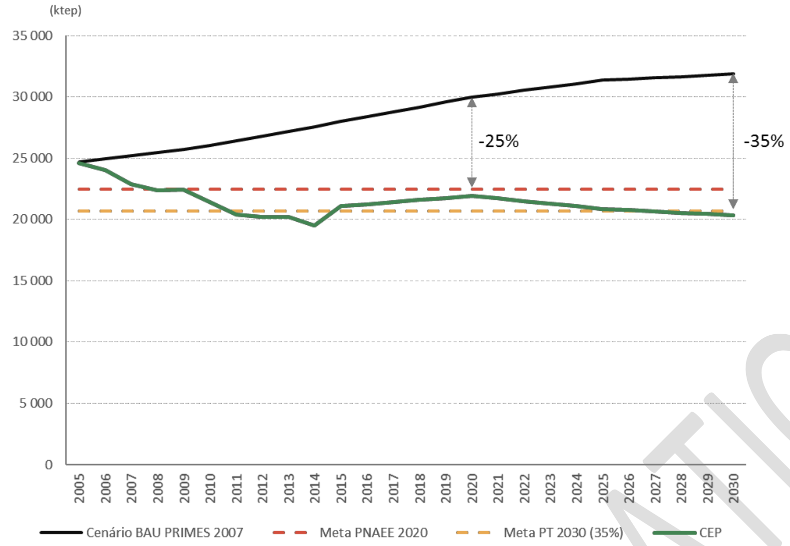
Estimated Primary Energy Consumption in the 2030 horizon allows for a target of 35% lower energy consumption (compared to the PRIMES 2007 model projections), as can be seen in Figure 2.

[12] For example, the renewable energy share in urban heating networks, renewable energy use in buildings, renewable energy produced by cities, communities and self-consumers, the energy recovered from sludge obtained in waste water treatment.

[13] Target referred to in Article 1(1) and Article 3(4) of Directive 2012/27/EU [version amended in accordance with the provisions of proposal COM(2016) 761], based on primary or final energy consumption, in the primary or final energy economies or on energy intensity.

[14] Excludes non-energy uses.

Figure 2 - Indicative trajectory for the indicative national energy efficiency contribution to achieve the Union's binding energy efficiency target of 32.5% from 2021 to 2030 (Primary Energy Consumption, in Mtoe)



The methodology and conversion factors used between primary and final energy will be explained later.

i.2. Accumulated energy savings to be achieved from 2021-2030[15]

Table 10 shows accumulated energy savings to be achieved from 2021 to 2030 as a result of Article 7 of the Energy Efficiency Directive.

Table 10 - The cumulative amount of energy savings to be achieved over the period 2021-2030 under Article 7 on energy saving obligations of Directive 2012/27/EU [version as amended in accordance with proposal COM(2016)761]

Year	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	Accumulated
2021	122 540										122 540
2022	122 540	122 540									245 079
2023	122 540	122 540	122 540								367 619
2024	122 540	122 540	122 540	122 540							490 159
2025	122 540	122 540	122 540	122 540	122 540						612 698
2026	122 540	122 540	122 540	122 540	122 540	122 540					735 238
2027	122 540	122 540	122 540	122 540	122 540	122 540	122 540				857 778
2028	122 540	122 540	122 540	122 540	122 540	122 540	122 540	122 540			980 317
2029	122 540	122 540	122 540	122 540	122 540	122 540	122 540	122 540	122 540		1 102 857
2030	122 540	122 540	122 540	122 540	122 540	122 540	122 540	122 540	122 540	122 540	1 225 397
										TOTAL	6 739 682

The sector breakdown in savings in order to comply with the objective set out in Article 7 of the Energy Efficiency Directive is still being prepared and will be provided at a later date.

15 Due to Article 7 on energy saving obligations of Directive 2012/27/EU [version as amended in accordance with proposal COM(2016)761].

i. 3 The indicative milestones of the long-term strategy for the renovation of the national stock of residential and non-residential buildings, both public and private[16]

The long-term strategy is currently being developed for the renovation of the national stock of residential and non-residential buildings, both public and private, in accordance with Directive 2018/844 of the European Parliament and of the Council of 30 May 2018, amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency. As such, the indicative milestones of the strategy, more specifically with regard to renovated area and energy savings, have not yet been defined.

i. 4 Total area of construction to be renovated or equivalent annual energy savings to be achieved from 2020 to 2030 to promote the exemplary role of public buildings[17]

The long-term strategy is currently being developed for the renovation of the national stock of residential and non-residential buildings, both public and private, in accordance with Directive 2018/844 of the European Parliament and of the Council of 30 May 2018, amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency.

As such, the total area of construction to be renovated or equivalent annual energy savings to be achieved are not yet available.

ii. The indicative milestones for 2030, 2040 and 2050, the domestically established measurable progress indicators, an evidence-based estimate of expected energy savings and wider benefits, and their contribution to the Union's energy efficiency targets as included in the roadmaps set out in the long-term renovation strategies for the national stock of residential and non-residential buildings, (public and private)[18]

As mentioned, the long-term strategy is currently being developed for the renovation of the national stock of residential and non-residential buildings, both public and private, in accordance with Directive 2018/844 of the European Parliament and of the Council of 30 May 2018, amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency. The indicators to be created for 2030, 2040 and 2050 will reflect the contribution of the measures identified in the strategy to achieve the energy efficiency objectives.

iii. Where applicable, other national objectives, including long-term targets or strategies and sectoral targets, and national objectives in areas such as energy efficiency in the transport sector and with regard to heating and cooling

Nothing to note.

2.3. Dimension Energy security

i. National objectives for the diversification of energy sources and supply from third countries, for the purpose of increasing the resilience of regional and national energy system

Diversification of energy sources must be fostered from a perspective of supply security and is a national objective. As Portugal does not have natural gas or oil, it focuses on and will continue to focus on the development of endogenous renewable energy resources (section 0 in this document), which in practice, has in fact been the case. This policy can be seen in the gradual reduction in energy dependency over the last 10-15 years.

Although specific objectives have not been defined for supply by third countries, with regard to the gas and oil sectors, Portugal has a diversified portfolio of suppliers and origins of these products (Chapter 4), which is to be maintained or developed, given that the most recent studies/assessments show a good level of supply security, brought about by such diversification. The increase in recent years of underground storage capacity at Carriço

16 In accordance with Article 2-A of the Directive revising Directive 2010/31/EU on the energy performance of buildings.

17 Due to Article 5 of Directive 2012/27/EU.

18 In accordance with Article 2-A of Directive 2010/31/EU.

and the tanks at the Sines LNG Terminal have also contributed to the diversification of sources supplying natural gas to Portugal.

In the case of electrical power, the diversification of external origins is more limited for geographical reasons, and as such, the focus is mainly on the diversification of internal production (focus on renewable production, exploiting the potential that exists in Portugal). However, high importance is also given to external origins with emphasis on reinforcing interconnections with Spain and also through the interconnection with Morocco, which will allow improved balancing in the NES and consequently, better supply security.

ii. Where applicable, national objectives with regard to reducing energy import dependency from third countries, for the purpose of increasing the resilience of regional and national energy systems

The aim is for national energy dependency to continue on a downward trend, to a minimum of 65% by 2030.

For the country's dependency on imported energy to be reduced even further, the use of endogenous hydro-power resources is considered to be extremely important. In Portugal's case, this will include the development of energy from renewable sources in the sectors of electricity production, transport and heating/cooling and also by diversifying this production (as can be seen in sub-topic 2.1.2).

Portugal's only endogenous energy resources are renewable energies and as such, the general aim is to promote and develop renewable energy production and diversify that production (as can be seen in sub-topic 2.1.2).

In addition to more mature renewable energy technologies, Portugal is also developing other technologies, including off-shore wind, ocean wave and geothermal power, and thus diversify its technological mix of renewable energies. The development of renewable energy storage solutions will also play an important role in the electricity sector (as can be seen in sub-topic iii).

iii. National objectives with regard to increasing the flexibility of the national energy system, in particular by means of deploying domestic energy sources, demand response and energy storage

- **National objectives to increase storage**

In the case of electrical power, storage is seen as a tool for the flexibility and stability of the NES. No rules currently exist for establishing strategic energy security reserves.

By 2030, an increase in storage capacity is planned towards the end of the decade, based essentially on reversible pumped hydroelectric energy. Initially, hydrogen and battery technology will be employed, more specifically through, fuel cells and power- to-gas technology, supported by R&D&I.

With regard to objectives for energy storage in the natural gas and oil and oil derivatives sectors, only national rules exist arising from Community legislation to create security reserves with a view to being able to respond to crisis situations or in the event of supply emergency/disruption in such products. Current underground capacity at Carriço allows all natural gas security reserves for the coming years to be stored.

- **National objectives to increase demand response**

With regard to demand response in the electricity sector, also considered in the evolution of demand are energy savings resulting from existing and planned efficiency measures and consumption requirements, taking into account forecasts for increased electrical vehicle use.

The development of electricity production and the objectives and targets specifically for renewable energy sources, as well as the objectives and targets for energy efficiency can be consulted in sub-chapters 2.1 and 2.2.

Using the annual supply security monitoring reports for the electricity and natural gas sectors as a basis, the aim is to achieve a balance between existing and expected supply and demand up to 2030. Taken into consideration in expected supply are new installation licensing processes and guidelines on energy policy (new installations and decommissioning of existing installations).

2.4. Dimension Internal Energy Market

2.4.1. Electricity interconnectivity

Portugal's target for the development of interconnections in the electricity sector is 15% interconnection by 2030. This target serves as the basis for establishing policies and measures to undertake projects in this area.

In addition to the objectives related to European commitments, and from a regional perspective through the setting up of MIBEL, at the Iberian Summit in Badajoz in 2006, the governments of Portugal and Spain agreed on the objective to achieve commercial capacity interconnection of 3 000 MW.

Following the signing of the Madrid Declaration on 4 March 2015 by ministers from Portugal, Spain, France and by the European Commission, setting up a High-Level Group for interconnections in Southwest Europe (HLG), the Implementation Plan for the Madrid Declaration sets a target of 10% electrical interconnection by 2020. This was agreed at the European Council meeting in October 2014, to be achieved through Projects of Common Interest (PCIs), particularly those promoting the connection of the Iberian Peninsula to the internal electricity market. In this regard, the following projects are identified as priority:

- Portugal-Spain interconnection between Beariz–Fontefría (ES), Fontefría (ES)–Ponte de Lima (PT) (formerly 'Vila Fria / Viana do Castelo') and Ponte de Lima–Vila Nova de Famalicão (PT) (formerly 'Vila do Conde');
- Underground Spain-France interconnection (Sta. Logaia-Baixas) (already in operation);
- Gulf of Biscay Project (connection between the Gulf of Biscay in Spain and the Aquitaine region);
- Two new interconnections through the Pyrenees (Basque Country-Cantegrit and Aragón-Marsillon).

Table 11 - Forecast indicative minimum values[19] of the commercial capacity of the interconnection [Source: REN]

	Portugal > Spain (MW)	Spain > Portugal (MW)	NOTE
2018	2 600	2 000	-
2022	3 000	3 000	After completion of the future 400 kV interconnection line Ponte de Lima (PT) – Fontefría (ES)
2027	3 200	3 600	Estimate based on analyses conducted considering long-term expected evolution with regard to demand, supply, trans-border flows and the physical structure of the networks in the Portuguese and Spanish systems.
2030	3 200 - 3 500	3 600 – 4 200	Estimated interval based on analyses conducted under TYNDP 2016 and reconfirmed in TYNDP 2018.
2040	3 500 – 4 000	4 200 – 4 700	Estimated value based on analyses carried out in the 'Sustainable Transition' and 'Distributed Generation' scenarios of TYNDP 2018. Possible necessary network reinforcement not yet identified to achieve these interconnection capacity figures

The following projects and actions will contribute to this evolution in commercial interconnection capacity:

- In 2021-2022, with the entry into service of the 400-kV interconnection line between Minho (PT) and Galicia (ES) (as previously mentioned, identified under the Madrid Declaration, and also a European Commission Project of Common Interest), it will be possible to overcome existing network restrictions and achieve, in both directions, minimum commercial interconnection capacity of 3 000 MW;
- By 2025, a slight increase is estimated in interconnection capacity, particularly in the Spain - Portugal direction. This estimate is based on forecast evolution for demand, supply, trans-border flows and the

19 Estimated most likely minimum values through representative network simulation scenarios. In practice, in situations of generation deficit for the internal supply of each system, or relevant unavailability of network elements or high renewable production in periods of lower consumption, these figures may be lower.

internal developments of the networks in both systems. In the Portuguese case, the entry into service of the new 400 kV Pedralva-Sobrado line is planned, which, in addition to avoiding a reduction in interconnection capacity, will also allow the flow of renewable origin electricity, essentially hydro, from new plants in the region and provide for an increase in capacity, especially in the Spain - Portugal direction;

- For the 2030 horizon, very long-term analyses have already been conducted by the PT and ES transmission system operators (REN and REE) under the 'Ten Year Development Plan 2016' (TYNDP). These analyses led to an estimate of interconnection capacity figures which were slightly higher than those forecast for 2023-2025. This is explained by the expectable future evolution in demand and particularly with regard to supply, and also by internal developments in both systems.

By 2040, commercial capacities could range from 3 500 MW to 4 000 MW (PT-ES direction) and 4 200 MW to 4 700 MW (ES-PT direction), based on analyses conducted (with the scenarios 'Sustainable Transition' and 'Distributed Generation') under the TYNDP 2018 by REN and REE. Possible reinforcement of the network or new interconnections required to achieve these interconnection capacity figures have not yet been identified.

2.4.2. Energy transmission infrastructure

i. Key national objectives for electricity and gas transmission infrastructure, and if required, modernisation projects that are necessary for the achievement of objectives and targets under any of the five dimensions of the Energy Union Strategy

To meet European commitments, based on national energy policy with respect to internal market integration and supply security, and with the aim of achieving more robust, efficient and interconnected national electricity and gas systems, Portugal is planning to develop the respective transmission and distribution networks. Currently underway are projects which contribute to this goal which are recognised by the European Commission as having a relevant role in internal market integration, supply security and also with respect to economic sustainability.

- **Key gas transmission infrastructure projects (to be implemented by 2030)**

In the priority corridor 'North-South Natural Gas Interconnections in Western Europe (NSI West Gas)' the following projects are planned:

- 5.4.1 Interconnection PT-ES (3rd interconnection) - 1st stage
- 5.4.2 Interconnection PT-ES (3rd interconnection) - 2nd stage

The PCI for the gas sector, PCI 5.4.1 for the Celorico – Vale de Frades gas pipeline, first stage of the future 3rd interconnection between Portugal and Spain, is directly dependent on the completion of PCI 5.5, particularly PCI 5.5.2 - South Transit East Pyrenees ('STEP', corresponding to the 1st stage of the future interconnection between Spain and France). It should be noted that the abovementioned interconnection projects (Portugal – Spain and Spain - France) are also defined in the Madrid Declaration Implementation Plan.

- **Key electricity transmission infrastructure projects (to be implemented by 2030)**

In accordance with the 3rd list of Projects of Common Interest (PCIs) identified for Portugal for 2021-2030, the following projects are planned in the priority corridor 'North-South Electricity Interconnections in Western Europe (NSI West Electricity)':

- 2.16 Total internal lines
  - 2.16.1 Internal line between Pedralva and Sobrado (PT), former 'Pedralva and Alfena (PT)'
  - 2.16.3 Internal line between Vieira do Minho, Ribeira de Pena and Feira (PT), former 'Frades B, Ribeira de Pena and Feira (PT)'
- 2.17 Portugal-Spain Interconnection:
  - Portugal — Spain interconnection between Beariz — Fontefría (ES), Fontefria (ES) — Ponte de Lima (PT) (formerly Vila Fria/Viana do Castelo) and Ponte de Lima — Vila Nova de Famalicão (PT) (formerly Vila do Conde) (PT), including substations in Beariz (ES), Fontefría (ES) and Ponte de Lima (PT)

A new interconnection between the electricity transmission networks of Portugal and Spain in the Minho region will allow a minimum commercial interconnection capacity of 3 000 MW to be achieved, in both directions (ES > PT and PT > ES).

Furthermore, the current proposed National Electrical Power Transmission Network Development Plan for 2018-2027, presented by the TSO in March 2017 sets out a series of network reinforcements (including the 400 kV Falagueira-Fundão axis, the 400 kV Falagueira-Estremoz-Divor-Pegões axis and the 400 kV Ferreira do Alentejo-Ourique-Tavira axis) which will allow network capacity to be created for new renewable energy power plants.

In order to facilitate the connection of the future Tâmega Waterfall dams (Gouvães, Daivões and Alto Tâmega - with 1 158 MW total power and 880 MW pumping capacity) the 400-kV line will be finalised linking the current Vieira do Minho step-down station with the future Ribeira da Pena substation, and its extension to the current Feira substation.

ii. If applicable, main infrastructure projects (trans-European) envisaged other than Projects of Common Interest (PCIs)[20]

In order to achieve the objective set out in this point of the plan, for the 2021-2030 time frame, other infrastructure projects may be considered in the electricity and gas sectors deemed to be equally relevant:

- Of note in the electricity sector are the projects to reinforce internal networks (transmission and distribution) to connect and accept renewable power production (to achieve national potential in this type of electrical power production). Also of note is the interconnection project between Portugal and Morocco which is currently being studied, with forecast installed capacity of 1 000 MW.
- Depending on the evolution seen in the Portuguese and Spanish electricity systems, more specifically with regard to renewable power generation, as well as in relation to the decision on the possible interconnection between Portugal and Morocco, it will be necessary to assess, in addition to possible network reinforcement, the need for new interconnections;
- Planned for the gas sector are projects which could increase the use of LNG and improve LNG reception capacity at the Sines Terminal, to strengthen Portugal's role as an 'entry point' for natural gas into the internal market/European gas system.

The Strategy to Increase the Competitiveness of the Mainland Commercial Port Network - Horizon 2026, approved by Council of Ministers Resolution No 175/2017 sets out a strategic vision based on fundamental pillars, more specifically consolidating Portugal's position as a hub for LNG in the Atlantic. There is a clear focus on innovation in green shipping so as to transform the Portuguese port system into a 'service area' for the supply of LNG vessels and into an LNG re-exporting hub.

This aim can be achieved through conventional onshore terminal solutions (as with the terminal in Sines), onshore small-scale (as is the case in the port of Rotterdam) or bunkering floating off-shore (ship-to-ship, LNG transfer between vessels). This series of capacities will reinforce Portugal's role as an LNG re-exportation hub, actively contributing to establishing a European energy corridor, promoting economic activity related to LNG, ship building and engineering services.

2.4.3. Market integration

i. National objectives related to other aspects of the internal energy market such as market integration and coupling[21], including a timeframe for when the objectives shall be met

Nothing to note at this stage of development in the NECP.

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20 In accordance with Regulation (EU) No 347/2013 of the European Parliament and of the Council of 17 April 2013 on guidelines for trans-European energy infrastructure and repealing Decision No 1364/2006/EC and amending Regulations (EC) No 713/2009, (EC) No 714/2009 and (EC) No 715/2009 (OJ L 115, 25.4.2013, p. 39).

21 Such as an increase in system flexibility, particularly in relation to the competitive setting of prices in line with applicable sector law, market integration and association to increase the commercial capacity of existing interconnections, smart networks, aggregation, demand response, storage, distributed production, dispatch mechanisms, re-dispatch and load shedding and real time price signalling.

ii. Where applicable, national objectives related to the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets, including a timeframe for when the objectives are to be met

Nothing to note at this stage of development in the NECP.

iii. Where applicable, national objectives with regard to ensuring that consumers participate in the energy system and benefit from self-generation and new technologies, including smart meters;

In February 2018, ERSE approved the rules for implementing, as of 1 June 2018, two pilot-projects, including the introduction of dynamic tariffs for access network access in mainland Portugal.

Participation in the pilot-projects, intended only for industrial consumers, is voluntary and will cover 100 consumers per pilot-project, over 12 months. Based on the results of the pilot-projects, ERSE will conduct a cost-benefit analysis to assess the merits for the electricity system and the possible setting of specific targets for installing smart meters.

iv. National objectives with regard to ensuring electricity system adequacy as well as flexibility of the energy system with regard to renewable energy production, including a timeframe for when the objectives should be met

- **National objectives with regard to ensuring the adequacy of the electricity system**

With regard to ensuring the adequacy of the electricity system, the NES Supply Security Monitoring Report (RMSA-E) sets out supply security indicators. Supply security in relation to the production of electricity is linked to the performance of the electricity production system in two ways: *adequacy* (static assessment of the installed capacity to meet electricity demand), and *security* (operational analysis with assessment of system response capacity to disruptions in the supply - demand balance).

Supply security conditions on the RMSA-E timeline are assessed through probabilistic indicators resulting from the simulation of configurations of the electricity production system with the RESERVAS model, which reflect its performance in the two aspects mentioned above. This model is applied by the TSO in collaboration with DGEG when drawing up the RMSA-E:

i) Adequacy

Assessing the adequacy of the available power to meet the hourly demand is carried out using the 'Peak Probabilistic Coverage Index' (ICP), which corresponds to the smallest of the twelve monthly ICPs of each year. Since 2015, a contribution of capacity corresponding to 10% of the Net Transfer Capacity *(NTC)* is planned. To verify the adequacy of the system's capacity to cover peak consumption, the ICP with probability of surplus between 95% and 99% must not be less than 1.0.

ii) *Security*[22]

The operational reserve requirements are assessed on the basis of the deviations in supply and demand balance occurring between all incremental periods. Those requirements are addressed with the existing production resources each year that are capable of supplying the operational reserve. The operational reserve is made up of the secondary and tertiary reserves up to an hour.

To assess overall security of supply levels for configurations of the national electricity generating system under analysis the LOLE indicator is used (Loss of Load Expectation), which is calculated by the RESERVAS model incorporating the loss of load expectation associated with the *Adequacy* component (static LOLE) and the loss of load expectation due to inadequate operational reserve – *Security* component. In the analysis of security of supply, in accordance with studies carried out by the TSO, this indicator should be not more than 5 (h/year).

[22] Of note with regard to the Security aspect is that only the disruptions in the stationary regime of the system are analysed (sufficiency of secondary and tertiary reserves). The dynamic analysis of the system is therefore not contemplated (in the transitory regime).

- **National objectives with regard to ensuring energy system flexibility**

With the growing integration of renewable power production installations into the NES, it is now vital to create mechanisms providing the System Manager with greater real time monitoring of such production and that flexibility mechanisms are built into this production.

In light of the above, by 2022 all production installations with more than 1 MW of installed power and which are connected to transmission and distribution networks are required to implement means of communication to receive real time interruption or reduction instructions from the System Manager relating to the injection of energy produced by them. For this purpose, the production facility is required to have at its disposal all of the communication, metering and control mechanisms necessary so that it may receive System Manager interruption or reduction instructions directly or via a dispatch centre linked to the producer facility.

This requirement must be implemented as quickly as possible for production facilities of more than 1 MW which are not connected to transmission and distribution networks.

Interconnection capacity among the different European systems leads to an increase in system flexibility, which is normally associated possible exchange of reserves to satisfy imbalances between the supply and demand of electricity.

Part of the production of new hydro power plants with storage capacity and reversibility (pumping) which are expected to enter production before 2026 (Gouvães with reversibility, Daivões and Alto Tâmega) ensures an important contribution to increased system flexibility with respect to the integration of intermittent renewable production as this technology provides rapidly mobilisation of operating reserves (rising and falling reserve).

The adequacy of the Portuguese electricity system (medium/long-term assessment) with regard to flexibility corresponds to the supply security assessment referred to in previous point.

v. Where applicable, national objectives to protect energy consumers and improve the competitiveness of the retail energy sector

- **National objectives to protect energy consumers**

At this stage of development in the plan, no specific objectives or targets exist in this regard, however, of note is the strategic objective in the NECP (sub-chapter 1.1.3) to **ensure fair, democratic and cohesive transition**, reinforcing the role of the citizen as an active agent in decarbonisation and in energy transition. **This will create equitable conditions for all**, fighting energy poverty and providing instruments to protect vulnerable citizens while promoting their active involvement and territorial enhancement.

2.4.4. Energy poverty

i. If applicable, national objectives with regard to energy poverty, including a timeline for compliance with objectives

At this stage of development in the plan, no specific objectives or targets exist in this regard, however, of note is the strategic objective in the NECP (sub-chapter **1.1.3**) to **ensure fair, democratic and cohesive transition**, reinforcing the role of the citizen as an active agent in decarbonisation and in energy transition. **This will create equitable conditions for all**, fighting energy poverty and providing instruments to protect vulnerable citizens while promoting their active involvement and territorial enhancement.

Also of note is that the quantification of goals to reduce energy poverty depend on achieving the following short-term measures (to be completed by 2021):

- Definition of the concept of ‘energy poverty’;
- Compiling of information to monitor the number of families suffering from energy poverty. This exercise will allow families affected by energy poverty to be identified so as to be able to provide support;
- Publication of the parameters and criteria used to identify, measure and monitor energy poverty;
- Assessment of the level of energy poverty in Portugal.

After these short-term measures have been completed, the measures to fight energy poverty can be defined thus providing benefits which ensure the supply of electricity to vulnerable customers or support to improve the energy efficiency of homes.

2.5. Dimension Research, innovation and competitiveness

i. National objectives and funding targets for public and private research and innovation in the public and private sectors

At this stage of development in the plan, no specific objectives or targets exist in this regard.

ii. National objectives, including long-term targets, for the deployment of low carbon technologies

The targets proposed by Portugal for 2030 with regard to energy and climate for carbon neutrality by 2050 require continued growth in investment in low-carbon technologies.

The European Strategic Energy Technology Plan (SET-Plan) includes the sector actions and objectives, broken down into different technological trajectories:

i. Solar Photovoltaic Power,

ii. Concentrated Solar Power (CSP),

iii. Offshore Wind Energy,

iv. Deep Geothermal Energy,

v. Ocean Energy,

vi. Consumers/Cities and Smart Communities,

vii. Energy Systems,

viii. Energy efficiency of buildings,

ix. Energy efficiency in Industry,

x. Batteries,

xi. Renewable Fuels for Sustainable Transport/Bioenergy and the Capture and Holding/Use of CO_2 (CC(U)S).

Portugal accompanied the setting of sector measures and development of the respective implementation plans, and it is expected that the measures planned for 2021-2030 will gradually contribute to reaching these targets on a national level.

iii. Where applicable, national objectives with regard to competitiveness

The National R&I Strategy for Energy also includes programmes for competitiveness in the area of energy with a view to increasing the quality and competitiveness of national R&D&I and accelerating the implementation of research results and the replication of such results.

The aims of competitiveness programmes are to: support participation in high quality international R&D; support the creation of technological pilot programmes in Portugal; support qualification, training and mobility; identify value chains; support start-ups in areas of energy; accelerate and replicate the implementation of results.

Competitiveness programmes will cover the following stages: development of the technology; registering of patents; placing on the market; promoting the adoption of the technology and monitoring and evaluation. Innovation programmes will also be developed to support the dissemination of technologies, demonstration installations or pilot installations applicable to technologies with greater technological readiness (TRL 8 or 9).

3. POLICIES AND MEASURES PLANNED

3.1. Dimension Decarbonisation

3.1.1. GHG emissions and removals (to be developed in liaison with APA)

i. Policies and measures to achieve the target set under Regulation [ESR] as referred in the sub-chapter and policies and measures to comply with Regulation [LULUCF], covering all key emitting sectors

As mentioned in sub-chapter 1.1.3, the strategic objectives of NECP include the reduction of GHG and the mainstreaming of mitigation objectives into sector policies.

The scenarios analysed under RNC2050 confirmed the potential to reduce GHG emissions in all sectors of the national economy. Also identified are the viability and good cost effectiveness of energy efficiency options and penetration of renewable energies, thus contributing to compliance with climate policy objectives. Modelling demonstrated cost-effective trajectories and guidelines for sector policies contributing to objectives for GHG emission reduction, renewable energies and energy efficiency.

As mentioned earlier, under the 2015 NACP, emissions reduction objectives were established on a national and sector level for 2020 and 2030. SPeM was also created which is a privileged forum to debate and design cost-effective measures to be implemented by sectors, and provides representation for all relevant sectors. SPeM also seeks to assess progress in the implementation of policies and measures to mitigate sector emissions, promoting involvement and reinforcing the accountability of sectors to integrate climate change into their policies.

SPeM thus sets out the institutional, legal and procedural provisions applicable to the identification, design and assessment of policies as well as to the drawing up of GHG emissions projections in response to that laid down in Regulation (EU) No 525/2013 of the European Parliament and of the Council of 21 May 2013 (MMR), on a mechanism for monitoring and reporting greenhouse gas emissions and for reporting other information at national and Union level relevant to climate change. This Regulation was also adopted by the Regulation for the Governance of the Energy Union and Climate Action. In light of the synergies with policies and measures for the air, SPeM also provides for the monitoring of air as well as projections in this regard.

The sectors covered by ETS are regulated on a European level, and as such, the policies and measures identified focus mainly on sectors not covered by ETS, subject to the limits set for different MS under the decision to share responsibilities, without prejudice to interaction and *trade-offs* between sectors. It is the responsibility of MS to identify and implement policies and measures to comply with such limits.

With regard to SPeM and NECP, policies and measures may be organised in line with sector and cross-cutting axes. Initiatives are planned in the following sectors:

a) Electricity production sector;
b) Transport and Mobility;
c) Services and residential buildings;
d) industry;
e) Waste and Wastewater;
f) Agriculture;
g) Land use, land-use change and forestry.

In the cross-cutting axes, measures are considered which fall within the following areas:

i. Research, development and innovation (RD&I);
ii. Knowledge, Information and Awareness.

The measures to be addressed under SPeM will include operational targets, potential barriers to the implementation of such targets, the relevant agents driving the measures, main recipients, instruments to be activated and financing instruments where applicable.

SPeM thus provides the response to EU obligations and the requirements of the United Nations Framework Convention on Climate Change.

The current list of sector policies and measures under SPeM will allow emissions reduction objectives for the 2020 and 2030 horizons to be satisfied as provided for in NACP. It will be necessary to review this list in light of the new target for 2030 established further to the carbon neutral commitment for 2050 and the new, more ambitious objectives for 2030 defined in accordance with the results of work on the Roadmap for Carbon Neutrality 2050.

The main vectors for decarbonisation in each of the sectors are set out below:

a) Electricity production sector

See sub-chapters 3.1.2, 3.2, 3.3 and 3.4

b) Transport and Mobility

The Transport sector will undergo far-reaching changes in the next two decades and will see substantial decarbonisation.

Even a large increase in demand in all modes of mobility will not stop the rapid and considerable decarbonisation of the sector.

Traditional fossil fuels are being gradually replaced by electricity, biofuels and H2 and electrification will take place in most means of transport.

The increase in demand for mobility will be met both by more public transport as well as by generalised individual shared electric and/or autonomous transport.

Good potential for electric mobility and biofuels is seen in heavy passenger vehicles.

With regard to heavy goods vehicles, the introduction of new fuels (H_2) or other technologies depends on the implementation of basic infrastructure and may start to take place as soon as 2021-2030, although at reduced levels.

With the exception of navigation, gaseous fuels have little or no expression. An increase in the use of soft modes in short distance mobility.

Significant improvements in efficiency in all sectors of mobility will lead to reductions in energy intensity.

c) Services and residential buildings

An increase in the thermal comfort of houses is expected, both with regard to heating as well as cooling.

Continued trend towards the electrification of the sector, where electricity is already the main energy used. Natural gas and biomass will continue as an option in housing at least until 2020-2040.

Extensive electrification of services accompanied by solar thermal for heating water and predominance of heat pumps for heating spaces.

d) Industry

Electrification and use of biomass will contribute to the decarbonisation of the sector.

Reduction in emissions will be at a lower rate than in other sectors. The sector does not depend only on technological solutions (greater efficiency in the use of resources, including energy) but also on changes to current business models and capacity for innovation in low-carbon processes, products and services.

The digitalisation of processes, products and resource management in industry (Industry 4.0) will contribute to greater efficiency and the decarbonisation of the sector.

e) Waste and Wastewater

There has been a significant reduction in urban waste per capita.

A landfill deposit of only 10% of urban waste produced by 2035 as a result of Community obligations, will lead to a reduction of 82% over current figures.

Collection of biowaste and priority in biological treatment with the production of compost.

The waste water sector will not change significantly as the current situation is already favourable.

f) Agriculture

Evolution in CAP in a similar manner to the current situation.

In intensive livestock production, particularly with respect to pig farming, exports will allow for effective increases. However, changes are being seen in effluent treatment systems.

The expansion of biological agriculture, conservation and precision agriculture will allow emissions to be reduced from animal effluents and fertilizers. Carbon will also be captured as a result of increases in organic matter content in soils.

More efficient agricultural practices in the regenerative use of resources will impact directly on the retention of carbon and consumption of energy (e.g. with regard to irrigation).

Reduction in the use of synthetic nitrogen fertilisers.

g) Soil use, changes in soil and forestry usage

Significant reduction in areas affected by forest fires.

Improved forestry management and less loss as a result of fires will provide increases in forestry productivity. Conversion of poor pasture into biodiverse pasture.

An increase in forestation, promotion of more efficient forestry practices and improvement of ecosystem services will lead to a growing role for the bioeconomy impacting on carbon retention and the net balance of emissions.

ii. If applicable, regional cooperation measures in this area

Nothing to note at this stage of development of the NECP.

iii. Without prejudice to the applicability of state aid rules, financing measures in this area at national level, if applicable

It should also be noted that the National Investment Programme (PNI) 2030 is also under discussion. This is an integral part of Portugal 2030 (PT 2030) and addresses the strategy for structural investment.

PNI 2030 will be an instrument to define medium and long-term strategic infrastructure investment priorities in the Mobility and Transport, Environment and Energy sectors.

It covers mainland infrastructures and is broken down into projects and programmes involving investment of over EUR 75 M with a 10-year time frame.

Furthermore, with regard to Community funds, it is important to note the relevance of the Environment Fund (EF) which is a key instrument in the financing of climate policy and support for the transition to a low-carbon economy. Whenever deemed appropriate, it may constitute the national contribution in projects to be submitted to Community funding.

The aim of the EF is to support environmental policies to achieve sustainable development objectives, thus contributing to compliance with national and international objectives and commitments in relation to climate change. A significant part of the budget for this fund comes from income earned from ELT auctions, and as such, this income is used to promote development based on a competitive and low-carbon economy and to fund national climate policy to comply with national, European and international commitments in climate change.

Following this logic, a part of the EF budget is allocated to the financing of national mitigation policies, including energy efficiency measures and the promotion of renewable energies, national policies for adapting to climate change, actions in third countries, in compliance by Portugal with commitments taken on under the United

Nations Framework Convention on Climate Change, the Kyoto Protocol and the Paris Agreement, research, development, innovation and demonstration projects to reduce GHG emissions.

3.1.2. Renewable energy

i. Policies and measures to achieve the national contribution to the binding EU-level 2030 target for renewable energy sources

As part of plans to reinforce renewable energies and reduce the country's energy dependency, the following lines of action are planned to promote the production of electricity and heat and/or cold from renewable energies:

- Promote the decarbonisation of the electricity production system, including the closure of coal-fired power plants by 2030
- Accelerate the production of energy from renewable energy sources, with greater focus on solar
- Promote the use of renewable systems in heating and cooling
- Stimulate investment in the national production of advanced biofuels through the use of waste and endogenous resources
- Promote electrification in all sectors of the economy
- Stimulate the acquisition and use of district heating from renewable energy sources
- Implement mechanisms promoting and simplifying investment, and review of the tariff model
- Create a favourable regulatory environment for participation by new market players, including local energy communities
- Optimise, simplify and revise the legal and regulatory framework for licensing
- Implement instruments for the sharing of costs associated with capacity reinforcement mechanisms
- Foster investment in energy transition and introduce innovative mechanisms
- Stimulate R&D&I, more specifically with regard to storage, low-carbon technologies, hydrogen and other 100% renewable fuels

In relation to the promotion of renewable energy sources in transport, the following lines of action are planned for sustainable mobility:

- Promote energy transition in the transport sector on a cost-effective basis, focussing on electrification, advanced biofuels and hydrogen;
- Promote and support electric mobility;
- Reinforce the capacity of the electric vehicle charging infrastructure on all levels (buildings, services, public roads, service stations, etc.);
- Reinforce the alternative fuel supply infrastructure at national ports and on the main road networks;
- Promote goods transport by rail and sea;
- Stimulate R&D&I in transport systems.

As part of the strategic objective to promote an innovative and competitive industry, the decarbonisation of industry is planned and the use of renewable resources, energy storage and electrification will be promoted.

As part of the strategic objective to reduce carbon intensity in the agricultural sector, a line of action is planned to promote the production and use of renewable energy sources.

ii. If applicable (optional) estimated excess production of energy from renewable sources which could be transferred to other Member States

Nothing to note.

iii. Specific measures relating to financial support

EU support instruments are expected to be used under the Multiannual Financial Framework 2021-2027 for projects falling within the different spheres applicable to the energy sector. EU funds will also be used under the *Connecting Europe Facility* (CEF) as well as Structural Funds and the European Fund for Strategic Investment (EFSI).

It should also be noted that the National Investment Programme (PNI) 2030, which is an integral part of Portugal 2030 (PT 2030), addresses the strategy for structural investment. PNI 2030 will be an instrument to define medium and long-term strategic infrastructure investment priorities in the Mobility and Transport, Environment and Energy sectors. It covers mainland infrastructures and is broken down into projects and programmes involving investment of over EUR 75 M with a 10-year time frame.

With respect to regional cooperation for renewable energy financing instruments, of note are the following lines of action resulting from the II Energy Interconnection Summit attended by Portugal, France, Spain, the European Commission and the EIB:

- to work jointly, with the technical support of the European Commission, to accelerate energy transition, contemplating trans-border auctions for the production of energy from renewable sources and the development of green obligations for green investment financing;
- to provide joint support for the implementation of a minimum carbon price;
- to launch a tri-lateral consultation process to establish common criteria for the concession of green certificates, promoting regional exchanges, thus benefiting fully from European financing instruments available under the new Multiannual Financial Framework and helping reinforce the ambitions of the EU's Nationally determined contributions (NDC) to be submitted in 2020.

iv. Specific measures to introduce one or more one-stop-shops, streamline administrative procedures, provide information and training, and facilitate the adoption of power purchase agreements

Planned actions include optimising licensing times and introducing a one-stop-shop for the licensing of installations contributing to decarbonisation, including renewable energy production units and respective storage.

v. Assessment of the need to build new *district heating* infrastructures from renewable energy sources

Nothing to note at this stage of development of the NECP.

3.1.3. Other items

i. Where applicable, national policies and measures affecting EETS

Nothing to note at this stage of development of the NECP.

ii. Where applicable, policies and measures to achieve other national targets

Nothing to note at this stage of development of the NECP.

iii. Policies and measures to achieve low emission mobility (including electrification of transport)

Nothing to note at this stage of development of the NECP.

iv. Where applicable, national policies, timelines and measures envisaged to gradually eliminate energy subsidies, particularly for fossil fuels

Since 1 January 2018, coal used to produce electricity in Portugal is taxed at a rate corresponding to 10% of the tax on petroleum and energy products (ISP) and with a tax corresponding to 10% of the additional levy on CO_2 emissions (commonly known as the carbon tax).

The above mentioned rates will rise gradually until 2022. Therefore, as of January 2019, this additional levy will rise to 25%, and in 2020 to 50%, 75% in 2021 and in 2022 will reach 100%.

Income obtained from these levies will be used in measures to support the decarbonisation of society.

3.2. Dimension Energy efficiency

Under the strategic objective for putting energy efficiency first (sub-chapter 1.1.3), the following lines of action are planned:

- Review of legal framework on the management and efficiency of energy consumption and reinforcement of monitoring systems;

- Ensure improvement in the efficiency of energy consumption in the different sectors of the national economy;
- Promote the energy renewal of building stock and NZEB buildings;
- Promote the increased use of more efficient equipment and products by renewing existing equipment and products;
- Promote the rational use of energy among end consumers;
- Promote the energy renewal of public administration buildings and infrastructure;
- Promote the energy requalification of public lighting;
- Provide qualified energy efficiency technicians for the energy sector;
- Simplify procedures and redirect and reinforce financing programmes and funds;
- Stimulate R&D&I in the area of energy efficiency.
- Also planned are the following lines of action (some have already been mentioned in sub-chapter 3.1.2) under the strategic objective to promote sustainable mobility and energy efficiency in transport:
- Promote and support electric mobility;
- Reinforce the capacity of the electric vehicle charging infrastructure on all levels (buildings, services, public roads, service stations, etc.);
- Promote vehicle sharing services with focus on electric mobility;
- Promote modal transfers by improving public transport;
- Promote goods transport by rail and sea;
- Promote soft mobility and more efficient behaviour;
- Stimulate R&D&I in transport systems.

Also planned are the following lines of action under the strategic objective to promote innovative and competitive industry:

- Decarbonise industry, promoting the use of renewable resources, energy storage and electrification;
- Foster the eco-innovation of processes and products and promote efficiency in the use of resources;
- Implement cleaner production processes, promoting efficiency in the use of energy and materials and identifying new uses for by-products.
- Also planned are the following lines of action under the strategic objective to reduce carbon intensity in agriculture, promoting carbon capture:
- Promote more efficient agricultural practices in the use of resources and regenerative energies impacting on carbon retention, in the efficient consumption of water and energy;
- Promote the efficient management of livestock effluents.

i. Compulsory energy efficiency schemes and alternative policy measures in accordance with Articles 7-A and 7-B of Directive 2012/27/EU (revised)

In order to comply with energy efficiency obligations and alternative policy measures in accordance with

Articles 7-A and 7-B of Directive 2012/27/EU (revised), specific measures will be implemented under the lines of action already mentioned:

- Review of legal framework on the management and efficiency of energy consumption and reinforcement of monitoring systems;
- Ensure improvement in the efficiency of energy consumption in the different sectors of the national economy;
- Promote the rational use of energy among end consumers.

ii. Long-term strategy for the renewal of the national residential and non-residential building stock, both public and private[23]

The long-term strategy is currently being developed for the renovation of the national stock of residential and non-residential buildings, both public and private, in accordance with Directive 2018/844 of the European Parliament and of the Council of 30 May 2018, amending Directive 2010/31/EU on the energy performance of buildings and Directive 2012/27/EU on energy efficiency. This long-term strategy will particularly take into account the line of action (referred to previously):

- Promote the energy renewal of building stock and NZEB buildings.

iii. Description of policy and measures to promote energy services in the public sector and measures to remove regulatory and non-regulatory barriers that impede the uptake of energy performance contracting and other energy efficiency service models

Specific measures will be implemented to promote energy services in the public sector and eliminate regulatory and non-regulatory barriers to energy performance contracts, take into account the line of action (referred to previously):

- Promote the energy renewal of public administration buildings and infrastructure;
- Promote the energy requalification of public lighting.

iv. Other planned policies, measures and programmes to achieve the indicative national energy efficiency target for 2030, as well as other objectives presented in 2.2.

The following lines of action are planned:

- Promote the increased use of more efficient equipment and products by renewing existing equipment and products;
- Promote the rational use of energy among end consumers;
- Provide qualified energy efficiency technicians for the energy sector.

v. Description of measures to utilise energy efficiency potentials of gas and electricity infrastructure

The following line of action is planned:

- Regulate activities with respect to public lighting infrastructures, upgrading energy performance.

vi. If applicable, regional cooperation in the field of energy efficiency

Nothing to note at this stage of development of the NECP.

vii. Financing measures, including Union support and the use of Union funds, in the area of energy efficiency at national level

EU support instruments are expected to be used under the Multiannual Financial Framework 2021-2027 for projects falling within the different spheres applicable to the energy sector. EU funds will also be used.

It should also be noted that the National Investment Programme (PNI) 2030, which is an integral part of Portugal 2030 (PT 2030), addresses the strategy for structural investment. PNI 2030 will be an instrument to define medium and long-term strategic infrastructure investment priorities in the Mobility and Transport, Environment and Energy sectors. It covers mainland infrastructures and is broken down into projects and programmes involving investment of over EUR 75 M with a 10-year time frame.

Furthermore, with regard to Community funds in the national context, the following currently available instruments are of note:

[23] Including policies, measures and actions to stimulate significant cost-effectiveness and policies and actions to reach the most poorly performing segments of the national building stock, in accordance with Article 2-A of Directive 2010/31/EU on the energy performance of buildings, amended by Directive 2018/844.

- The Energy Efficiency Fund (EEF) supports programmes and measures under PNAEE or other plans which are proved to contribute to energy efficiency.
- The aims of the Innovation Support fund (ISF) are to support innovation, technological development and investment in renewable energies and energy efficiency in order to achieve the targets set out in PNAER, PNAEE and the National Energy Strategy.
- Support under the Plan to Promote Efficiency in Electrical Power Consumption (PPEC), and instrument managed by ERSE/DGEG.
- It is important to note the relevance of the Environment Fund (EF) which is a key instrument in the financing of climate policy and support for the transition to a low-carbon economy. Whenever deemed appropriate, it may constitute the national contribution in projects to be submitted to Community funding. The aim of the EF is to support environmental policies to achieve sustainable development objectives, thus contributing to compliance with national and international objectives and commitments in relation to climate change. A significant part of the budget for this fund comes from income earned from ELT auctions, and as such, this income should be used to promote development based on a competitive and low-carbon economy and to fund national climate policy to comply with national, European and international commitments in climate change. Following this logic, a part of the EF budget is allocated to the financing of national mitigation policies, including energy efficiency measures and the promotion of renewable energies, national policies for adapting to climate change, actions in third countries, in compliance by Portugal with commitments taken on under the United Nations Framework Convention on Climate Change, the Kyoto Protocol and the Paris Agreement and research, development, innovation and demonstration projects to reduce GHG emissions.
- There are also two sources of funding provided by financial entities available for energy efficiency projects. This financial support can be used in initiatives which promote efficiency and the reduction of electricity consumption by different types of consumers.

3.3. Dimension Energy security

i. Policies and measures relating to energy security

Contributing directly to ensuring the supply security and reducing the energy dependency of the country are the following lines of action:[24]:

- Reinforce the diversification of endogenous energy sources;
- Reinforce and optimise the operation of transmission and distribution networks, taking into account the objectives and expected locations of new renewable production capacity;
- Promote the suitable planning of low voltage networks;
- Promote systems for flexibility and dynamic management in consumption to support the management of the electricity system;
- Promote storage systems by creating a legal framework;
- Promote the integration of energy systems and intersector energy interconnection: Electricity/H_2 and Gas; Electricity/Heat and Electricity;
- Promote the digitalisation of the energy system by promoting and expanding smart networks, smart meters and other instruments;
- Promote the integration of the internal energy market with a view to harmonisation and balance/fairness in prices, regionally and on an EU level;
- Promote the diversification of sources and supply routes for energy resources;
- Plan and foster the integrated and joint management of the network from a regional and trans-border perspective;

[24] The lines of action contribute to the Strategic Objective: ‘Ensure the supply security and the reduction of energy dependency of the country.’

- Promote the development of interconnections and reinforce regional cooperation.
- Accelerate participation by small-scale renewable production in market mechanisms, promoting the respective bundling of such production;
- Stimulate R&D&I in smart energy management systems and new infrastructures.

A second series of relevant lines of action for energy security includes those which contribute directly to strategic objectives connected to the diversification of energy sources, the reinforcement of production capacity from endogenous sources and efficiency in the use of energy resources:

- Reinforce the focus of renewable energies in the production of electricity and heat-cold
- Promote sustainable mobility
- Putting energy efficiency first

These lines of action are set out in sub-chapters 3.1.2 and 3.2.

ii. Regional cooperation in this area

Of note in this regard are the following lines of action under the strategic objective to ensure supply security:

- Promote the integration of the internal energy market with a view to harmonisation and balance/fairness in prices, regionally and on an EU level;
- Promote the diversification of sources and supply routes for energy resources;
- Plan and foster the integrated and joint management of the network from a regional and trans-border perspective;
- Promote the development of interconnections and reinforce regional cooperation.

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

In accordance with the results of the II Energy Interconnection Summit, the need should be noted to prioritise the financing of the interconnections under the *Connecting Europe Facility* (CEF), Structural Funds and the European Fund for Strategic Investment. This approach will be maintained in the coming Multiannual Financing Framework through the Connecting Europe Facility and the future InvestEU Programme, also including due participation by the EIB.

It is also important to reinforce the central role of the EIB in mobilising the resources required for carrying out current, and alternative and new project investment, ensuring compliance with interconnection targets without any further delays.

3.4. Dimension Internal energy market

The following lines of action are planned to ensure fair, democratic and cohesive transition:

- Promote the provision of information to domestic and corporate consumers contributing to improved energy literacy;
- Simplify interaction with the market through technology, creating mechanisms which facilitate consumer choice;
- Fight energy poverty and improve instruments to protect vulnerable customers;
- Promote platforms for structured dialogue with local populations;
- Promote sustainable urban development and leverage local intervention capacity;
- Contribute to more sustainable production and consumption patterns;
- Foster training to improve competences and qualified employment in low-carbon sectors;
- Promote the requalification of workers in carbon intensive sectors;

- Improve knowledge with regard to mitigating climate change, disseminate good practices and promote low carbon behaviours in society;
- Promote the sustainable and rational use of land from a perspective of greater territorial cohesion and improvement;
- Promote the innovation and development of low-carbon technologies, practices, products and services in all sectors of activity;
- Reinforce national capacity to participate in European instruments to promote R&D&I.

3.4.1. Electricity infrastructure

i. Policies and measures to achieve the targeted level of interconnectivity

Contributing to the reinforcement of interconnection capacity, in accordance with the objectives set out in sub-chapter 3.3, are the lines of action already mentioned:

- Promote the development of interconnections and reinforce regional cooperation.
- Plan and foster the integrated and joint management of the network from a regional and trans-border perspective;

These lines of action will help achieve the strategic objective to ensure supply security (discussed in sub-chapter 3.3 ii.).

ii. Regional cooperation in this area

With regard to regional cooperation in electricity interconnections, the II Energy Interconnection Summit led to a commitment by Portugal, Spain and France to:

- pursue close coordination with a view to monitoring interconnection projects, assessing the corresponding financing requirements and supervising progress so as to define a new roadmap for their implementation;
- build the necessary infrastructures for implementing an efficient and decarbonised internal energy market. This is particularly important with respect to the trans-border interconnections for electricity networks in Member States which have not yet reached a minimum level of integration into the internal energy market, as is the case with Spain and Portugal.
- develop Euro-Mediterranean cooperation in energy and work with regional partners in the development of interconnections, more specifically exploring the potential to produce energy from renewable sources and increase energy efficiency, for the mutual benefit of the economies and peoples of the EU and neighbouring States to the south and east of the Mediterranean.
- Also resulting from the II Energy Interconnection Summit were the following planned measures:
- Finalise interconnection projects, including the electricity interconnection through the Bay of Biscay, Cantegrit-Navarra and Aragón-Marsillon, Portugal and Spain interconnection between Vila Fria-Vila do Conde-Recarei (Portugal) and Beariz-Fontefría (Spain);
- Accelerate work to prepare and identify sources of funding under the European framework to assess and implement new electricity interconnection projects between France and Spain;
- Identify and introduce additional reinforcements into existing networks so as to fully use electricity interconnection capacity.

More recently, in November 2018, the Valladolid Declaration was signed by Portugal and Spain in which both Governments actively support the Lisbon Declaration signed on 27 July 2018 and reiterated their objectives to work to achieve interconnections allowing a fully operational internal energy market to be achieved which is safe, competitive and clean.

With the aim of meeting the challenge to incorporate renewable energies and the development of MIBEL, both governments reaffirmed the importance of the internal and external MIBEL interconnection.

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

In accordance with the results of the II Energy Interconnection Summit, the need should be noted to prioritise the financing of the interconnections under the Connecting Europe Facility (CEF), Structural Funds and the European Fund for Strategic Investment. This approach will be maintained in the coming Multiannual Financing Framework through the Connecting Europe Facility and the future InvestEU Programme, also including due participation by the EIB.

It is also important to reinforce the central role of the EIB in mobilising the resources required for carrying out current, and alternative and new project investment, ensuring compliance with interconnection targets without any further delays.

3.4.2. Energy transmission infrastructure

i. Policies and measures to achieve the key infrastructure objectives, including, if applicable, specific measures to enable the delivery of Projects of Common Interest (PCIs) and other key infrastructure projects

The II Energy Interconnection Summit led to a commitment by Portugal, Spain and France to revise the Implementation Plan to execute the current PCIs and to identify, as quickly as possible, new or alternative projects required to overcome the interconnection shortage between the Iberian Peninsula and France, without delaying compliance with interconnection targets.

ii. Regional cooperation in this area

With regard to regional cooperation in electricity interconnections, the II Energy Interconnection Summit led to a commitment by Portugal, Spain and France to build the necessary infrastructures for implementing an efficient and decarbonised internal energy market. This is particularly important with respect to the trans-border interconnections for gas and electricity networks in Member States which have not yet reached a minimum level of integration into the internal energy market, as is the case with Spain and Portugal.

In accordance with the results of this summit, Portugal, Spain and France agreed to define common guidelines to promote the efficient use of networks.

3.4.3. Market integration

i. Policies and measures to achieve market integration objectives (sub-chapter, the origin of the reference was not found.**)**

The lines of action relating to policies and measures for market integration objectives are set out in sub-chapters 3.4 and 3.4.

At the Valladolid Summit and in the respective Declaration, Portugal and Spain reaffirmed the importance of the MIBEL internal and external interconnection required to meet the challenge to incorporate renewable energies and develop the Iberian Electricity Market (MIBEL).

ii. Where applicable, measures to increase the flexibility of the energy system with regard to renewable energy production, including the roll-out of intraday market coupling and cross-border balancing markets

Nothing to note at this stage of development of the NECP.

iii. Where applicable, measures to ensure the non-discriminatory participation of renewable energy, demand response and storage, including via aggregation, in all energy markets

The operating model for the European Intraday Market, based on continuous intraday trading, will allow energy trading between agents located in the different countries/price zones with implicit capacity allocation.

To achieve this objective, several market operators and European system operators are implementing the Cross-Border Intraday Market Project (XBID), which provides the basic contract infrastructure for systems and procedures on which the pan-European continuous intraday market will be implemented. This market will permit electrical power to be traded up to 60 minutes before delivery, thus allowing renewable energies to be integrated.

Portugal has been part of this new mechanism since it entered into operation (2018).

With the publication of Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing, system services markets managed by European system operators need to be coordinated. To ensure the implementation of the abovementioned regulation, European system operators are currently cooperating.

- Imbalance Netting – a process for the real-time mutual exchange of imbalances of interconnected European electricity systems. It is expected that Portugal will join this process in 2019;
- Replacement Reserves – Based on the TSO-TSO model, the main aim is to establish and operate a centralised platform capable of compiling all Replacement Reserve (RR) offers from the different national markets operated by each TSO and conduct an optimised allocation of interconnection offers and capacity to satisfy, up to 30 minutes before real time, any differences between scheduled operations in daily and intraday markets and generation and consumption forecasts. This mechanism is expected to start operation at the end of 2019 and Portugal will participate immediately;
- Manual frequency restoration reserves – Based on the TSO-TSO model, the main aim is to establish and operate a centralised platform capable of compiling all manual Frequency Replacement Reserve (mFRR) offers from the different national markets operated by each TSO and conduct optimised allocation to satisfy needs, both before and in real time. It is expected that Portugal will comply with the deadlines set out in Regulation (EU) 2017/2195 of 23 November 2017, i.e. Portugal will be integrated into this new mechanism in 2021;
- Automatic Frequency Restoration Reserves – Based on the TSO-TSO model, the main aim is to establish and operate a centralised platform capable of mobilising in a coordinated an economically efficient manner, energy balancing offers relating to Automatic Frequency Restoration Reserves (aFRR) from the different national markets operated by each TSO and conduct optimised allocation of interconnection capacity to satisfy the needs of each TSO in real time It is expected that Portugal will comply with the deadlines set out in Regulation (EU) 2017/2195 of 23 November 2017, i.e. Portugal will be integrated into this new mechanism in 2021;
- The expected benefits of the abovementioned processes are:
- An increase in efficiency and competition in system services markets in the different systems;
- Greater coordination of the different system services markets and improved possibility for exchanging systems services, thus optimising the operating security of the systems involved;
- Facilitate electricity integration from renewable energy sources.

iv. Policies and measures to protect consumers, especially vulnerable consumers and, where applicable, energy poor consumers, and to improve the competitiveness and contestability of the retail energy market

The lines of actions under the priority to put energy efficiency first (mentioned in sub-chapter 3.2) and for a fair, democratic and cohesive transition (mentioned in sub-chapter 3.4) contribute directly or indirectly to consumer protection, especially consumers which are vulnerable and suffering energy poverty, and to the improved competitiveness of the retail energy market.

v. Description of measures to enable and develop demand response including those addressing tariffs to support dynamic pricing

Of note in this regard is the following line of action under the strategic objective to ensure supply security (mentioned in sub-chapter 3.3):

- Promote the digitalisation of the energy system by promoting and expanding smart networks, smart meters and other instruments.

3.4.4. Energy poverty

Of note in this regard are the lines of action under the strategic objectives to ensure fair, democratic and cohesive transition and put energy efficiency first:

- Combat energy poverty and improve instruments to protect vulnerable customers in an integrated approach involving social policies and/or energy efficiency in housing;
- Promote platforms for structured and differentiated dialogue with local populations on the installation of renewable energies in their regions;
- Create an environment which is favourable for the far-reaching restoration of building stock to improve energy performance.

3.5. Dimension Research, innovation and competitiveness

i. Policies and measures related to the elements set out in point 2.5

Policies and measures relating to national objectives and funding targets for research and innovation in the public and private sectors

Not available at this stage.

Where available, national 2050 objectives related to the promotion of clean energy technologies and, where appropriate, national objectives, including long-term targets (2050) for deployment of low-carbon technologies, including for decarbonising energy and carbon-intensive industrial sectors and, where applicable, for related carbon transport and storage infrastructure

The promotion of Research & Development and Innovation is a line of action cutting across the different strategic objectives of NECP and the different dimensions considered.

The European strategy with regard to Research and Development and Innovation for energy, including the European Strategic Energy Technology Plan (SET-Plan)[25], the Horizon Europe[26] (current draft programme which will replace Horizon 2020) and the Investment Plan for Europe: Junker Plan[27], include R&D&I objectives in energy for the 2020-2030 horizon. Participation and cooperation in the SET Plan has proven to be beneficial with respect to joint efforts to achieve common goals to increase the use of new technologies while also creating joint challenges in relation to disruptive actions. Portugal has participated in several implementation groups and activities and considers collaboration in specialist groups for carrying out coordinated action and other forms of collaboration to develop guided projects to be important. The aim is to comply with ambitious targets for the 2030 horizon.

The NECP is based on a strategy for decarbonisation and reflects a change in the model for the production, transmission, storage and end use of energy, which requires additional effort in Research, Innovation and Competitiveness.

With respect to research, innovation and competitiveness, NECP addresses the topics of prioritising financing and simplifying procedures, the framework for incentives for research and innovation projects, professional qualifications, specialisation of teaching and research structures, entrepreneurship in the field of low-carbon economy, costs, dissemination and monitoring and integration of information on research and innovation in the areas of energy and climate.

Based on the objectives and targets set out for the remaining aspects in NECP, national programmes are planned to promote RD&I, which initially, will include as a minimum, the following topics:

- Smart energy management systems and new infrastructures with a view to enabling power transmission and distribution networks to handle scenarios of high renewable energy penetration in the energy mix by integrating smart network management and dedicated storage systems into networks and points of

[25] https://ec.europa.eu/energy/en/topics/technology-and-innovation/strategic-energy-technology-plan#.

[26] https://ec.europa.eu/info/designing-next-research-and-innovation-framework-programme/what-shapes-next- framework-programme_en.

[27] https://ec.europa.eu/commission/priorities/jobs-growth-and-investment/investment-plan-europe-juncker-plan_pt.

production/consumption. The goal is to create a new energy production model, which will tend to be decentralised and intermittent, but also dispatch enabled;

- Energy storage, with a view to enabling the national energy system to handle scenarios of high renewable and intermittent energy penetration in the energy mix by integrating centralised or decentralised storage systems, in front of or behind-the-meter, to achieve flexibility and security in the energy system;
- Low-carbon technologies, seeking to promote technologies with low-carbon emissions which have the greatest innovation potential in accordance with that set out in the European Union SET Plan; considered in this regard are five high-potential technologies: offshore wind power, the next generation of solar photovoltaic power (PV), ocean energy, concentrated solar power (CSP) and deep geothermal energy;
- Energy efficiency, with a view to the development and market dissemination of technologies which contribute to increased energy efficiency, particularly in industry and in buildings;
- Hydrogen as an energy vector, seeking to promote hydrogen as a stabilising element, considering its capacity for storage and energy transfer and its use in the co-generation of electricity and heat, in the introduction of natural gas into the network – directly or after conversion into methane – transformation into synthetic liquid fuel or use in mobility in fuel cells.

Policies and measures related to achieving national objectives for competitiveness

It is also important to provide programmes for competitiveness in the area of energy with a view to increasing the quality and competitiveness of national RD&I and accelerating the implementation of research results and the replication of such results.

Competitiveness programmes will cover the following stages: development of the technology; registering of patents; placing on the market; promoting the adoption of the technology and monitoring and evaluation. Innovation programmes will also be developed to support the dissemination of technologies, demonstration installations or pilot installations applicable to technologies with greater technological readiness (TRL 8 or 9).

Competitiveness programmes will also include, as a minimum, the following topics:

- *Support for participation in high quality, international research and development*, Portugal 2020 provides for four Thematic Operational Programmes. One of these programmes is Competitiveness and Internationalisation – COMPETE 2020, which aims to improve the competitiveness and internationalisation of the Portuguese economy and will support the internationalisation of national R&D by promoting national participation in international R&D partnerships and consortia, in complement to European R&D funds.
- *Support for setting up pilot technologies in Portugal* in the production, storage, consumption, transmission, distribution and management of energy which contribute to achieving national targets for integrating energy from renewable sources and decarbonising the economy through the integration of low-carbon technologies. Applicable to technologies ready for dissemination (TRL 8 or 9) requiring support to demonstrate applicability and respective benefits, as well as to promote the degree of implementation. Preferably, the technologies to be supported will have close ties to the national programmes presented above;
- *Support for qualification, training and mobility*, the Start-up Portugal+ Programme includes a measure 'Training for Entrepreneurs' which promotes courses for entrepreneurs and their teams, 90% financed through COMPETE funds. This measure allows the range of training for incubators to be increased and meet the needs identified by entrepreneurs, providing them with the skills to develop business in a start-up;
- *Support for creating industrial clusters* in new areas of technological development, including storage, digitalisation and new sustainable and innovative materials in construction, a support programme for creating and consolidating national value chains for the technologies supported by national research and innovation programmes;
- *Support for promoting business models based on low-carbon products and services*, implemented through the realignment of pre-existing funding programmes or by creating new programmes;

The 15 entrepreneurship support measures in Start-up Portugal[28] were reinforced with the presentation of the *Start-up* Portugal+ Programme in July 2018. Of note among the measures included in the *Start-up* Portugal+ Programme is the '*Energy Challenge*' measure which focuses on the initial development of innovative technological solutions in the areas of renewable energies and energy efficiency (metering, management, consumption reduction technologies, materials) and power generation from renewable sources. Support is provided in the areas of business plan preparation, risk analysis, protecting intellectual property rights, development of laboratory prototypes or certification and marking activities. Designed with a four-year timeframe, after 2020, the strategy used in *StartUP* Portugal is expected to be replace with a strategy ensuring continuity of support for national start-ups in the NECP implementation period of 2020-2030;

- *Support for the implementation of results,* with a target public of organisations in the National Scientific and Technological System (SCTN), technological base companies and companies supplying energy services, this national R&I programme will include measures in the following areas: Fundamental and Applied Research; Demonstration; Marketing; Market Development.

On a sector level, and with a view to addressing the strategic objective in the NECP (sub-chapter 1.1.3) to develop innovative and competitive industry, it is important to promote relevant lines of action:

- Decarbonise industry, promoting the use of renewable resources, energy storage and electrification;
- Foster the eco-innovation of processes and products and promote efficiency in the use of resources;
- Promote the digitalisation of industry (Industry 4.0) in processes, products and resource management;
- Involve the scientific and technological system, in liaison with industry, to promote energy transition and carbon neutrality;
- Support the development of industrial *clusters* in new areas of technological development, including storage, digitalisation and new sustainable and innovative materials in construction;
- Promote the design of products and services projected for different life cycles;
- Implement cleaner production processes, promoting efficiency in the use of energy and materials and identifying new uses for by-products;
- Promote industrial symbioses (urban, local, regional);
- Adopt business models based on low-carbon products and services;
- Stimulate R&D&I in the area of the circular economy;
- Reinforce national capacity to participate in European instruments to promote R&D&I.

ii. Where applicable; cooperation with other Member States in this area, including information on how the SET Plan objectives and policies are being translated to a national context

[28] Support for startups is a priority for the Government. In 2016, Startup Portugal was launched, a National Strategy for Entrepreneurship (http://startupportugal.com/home-pt/), with the aims of: Creating an ecosystem of entrepreneurship on a national level; attracting national and international investors to invest in startups; co-financing startups, especially at the idea stage; promoting and accelerating the growth of startups in foreign markets; implementing Government measures to support entrepreneurship. The measures to support entrepreneurship provided for in the National Strategy for Entrepreneurship - StartUp Portugal, are implemented by different entities in the entrepreneur ecosystem, more specifically the Portuguese Agency for Competitiveness and Innovation (IAPMEI), Portugal Ventures, IFD - Financial Institution for Development, PME Investimentos, the Foreign Investment Agency (AICEP), the Portuguese Tourism Board, Universities, the Ministries of the Economy, Foreign Affairs, Presidency and Administrative Modernisation and Finance and, with respect to the Portuguese participation in the Web Summit, The Lisbon Municipal Authority and the Lisbon Tourism Board. In 2018, the National Incubator Network had 135 certified bodies directly supporting more than 3 000 startups.

Nothing to note at this stage of development of the NECP.

iii. Where applicable, financing measures in this area at national level, including Union support and the use of Union funds

In the European context, funding by the *Horizon Europe 2021-2027* programme will be relevant, as will instruments for the support of innovation:

- European Innovation Council (one-stop-shop for innovative projects with high potential);
- European Innovation Fund (connected to the Emissions Trading System to support industry, promotion of renewables).
- Furthermore, with regard to Community funds in the national context, the following instruments are of note:
- Innovation Support Fund (FAI), which aims to support innovation, technological development and investment in renewable energies and energy efficiency, to achieve the targets set out in energy sector planning instruments.

4. CURRENT SITUATION AND PROJECTIONS WITH EXISTING POLICIES AND MEASURES

For purposes of projection work on the different parameters reported in this plan, i.e. GHG emissions and removals, renewable energy in gross final energy consumption, primary and final energy consumption in the economy and evolution of the energy *mix* and main associated technologies, two distinct national energy system simulation models were used. The *input* parameters used in the abovementioned models were coordinated and standardised.

The options made when using this type of model are based on the cost of technologies and energy resources. For this reason, the solutions encountered reflect the best options in terms of cost-effectiveness and therefore, of competitiveness. Attached in greater detail on the TIMES_PT model.

With regard to the modelling of emissions in waste, agriculture (non-energy component), land use, land-use change and forestry (LULUCF), specific models were used developed for the purpose, which were external to TIMES_PT.

For the modelling of the energy system, the Janus model was used with Long Range Energy Alternatives Planning System (LEAP) software developed and supplied by the Stockholm Environment Institute).

LEAP is based on software developed by the Stockholm Environment Institute and is an integrated modelling tool to analyse energy policies and climate change. This programme can:

- create different energy systems and model the production and consumption of energy in different sectors;
- assess the impact of an individual policy as well as interactions among several policies and measures;
- assess the impact on GHG emissions as well as social costs and benefits;
- include more specific modelling methodologies, such as modelling vehicle *stock* in the transport sector, optimising the electricity production system, etc. In this regard, a specific sub-model was developed for the transport sector allowing activity and energy consumption projections to be made in each transport mode while also assessing the impact of modal transfers in passenger or goods transport and the impact of policies promoting soft modes or reducing activity (e.g. teleworking).

4.1. Projected evolution of main exogenous factors influencing energy system and GHG emission developments

i. Macroeconomic forecasts (GDP and population growth)

With regard to NECP modelling, the macroeconomic scenarios considered in evolution projections for the national energy system were based on the most recent macroeconomic projections for Portugal nationally and on a European level (European Commission).

As a starting point for the development of emissions trajectories, consistent socio-economic scenarios were developed under RNC2050 modelling work, based on common evolution narratives in Portugal until 2050 and on the evolution in macroeconomic and demographic parameters for this timeframe.

The following table shows the evolution considered in the abovementioned modelling exercises for the GDP variation rate and the population in Portugal in the 2020-2030 period.

Table 12 - Evolution in the macroeconomic assumptions relating to the GDP variation rate and population (Millions of inhabitants) in Portugal in the 2020-2030 period

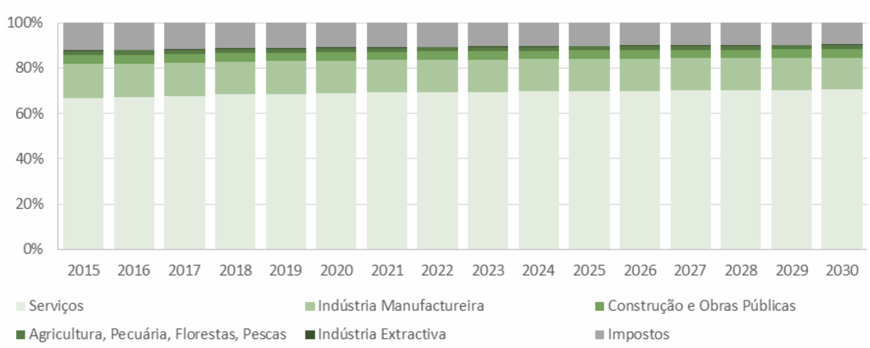
National energy model (JANUS)	2020	2025	2030
GDP variation rare	1.7%	1.3%	1.0%
Population[29]	10.18	10.00	9.84

29 Source: National Statistics Institute, Resident population projections 2012-2060.

ii. Sectoral changes expected to impact on the energy system and GHG emissions

With respect to the scenario considered under the JANUS model, in sector terms, the variation rate in Gross Value Added (GVA) was 2.2% in 2017. For the 2030 horizon, it is considered that the GVA structure will remain largely unchanged, with a slight increase in the area of Services. However, there will be a slight reduction in the areas of Construction and Agriculture. The following figure shows the evolution of the GVA structure for the 2030 horizon

Figure 3 - Evolution of the GVA structure by branch of activity



KEY

Services	**Manufacturing Industry**	**Construction and Public Works**
Agriculture, Livestock, Forestry, Fisheries	**Extraction Industry**	**Taxes**

iii. Global energy trends, international fossil fuel prices, ETS carbon price

For the purposes of modelling the national energy system up to 2030, both in the TIMES_PT and JANUS models, pricing forecasts for the main energy products were used. In the JANUS model, also considered was the cost of CO_2 emissions licences which are set out in the EU Reference Scenario 2016, the figures for which can be seen in the following table.

Table 13 - Forecasts for the evolution in the prices of main energy products and CO2

	Source	Unit	2020	2025	2030
Oil (Crude)	European Commission, *EU Reference Scenario 2016*	€/GJ	11.61	13.18	14.52
Natural gas	European Commission, *EU Reference Scenario 2016*	€/GJ	7.47	8.08	8.79
Coal	European Commission, *EU Reference Scenario 2016*	€/GJ	2.21	2.65	3.18
CO_2 Licences	European Commission, *EU Reference Scenario 2016*	€/ton CO_2eq	15.0	22.5	33.5

With respect to the cost of CO2 emissions licences, a different approach was considered under work for RNC2050 for the TIMES_PT model:

- existing policies scenario, a constant carbon price equal to EUR 20/tonne was considered;
- planned policies scenario (or neutrality scenario), an initial carbon price was not imposed. This results in a 'shadow price' for the model as an emissions restriction in 2050 is imposed with a view to complying with the carbon neutral objective.

iv. Technology cost developments

Modelling based on the JANUS simulation model and the TIMES_PT optimisation model took into account a series of technologies and the respective costs (investment, fixed and variable), in accordance with the best information available nationally and on a European and international level. As the degree of breakdown in the different technologies differs between the two models, and is not directly comparable, an attachment is sent setting out the costs considered in each model for the main technologies as well as the respective information sources.

4.2. Decarbonisation dimension

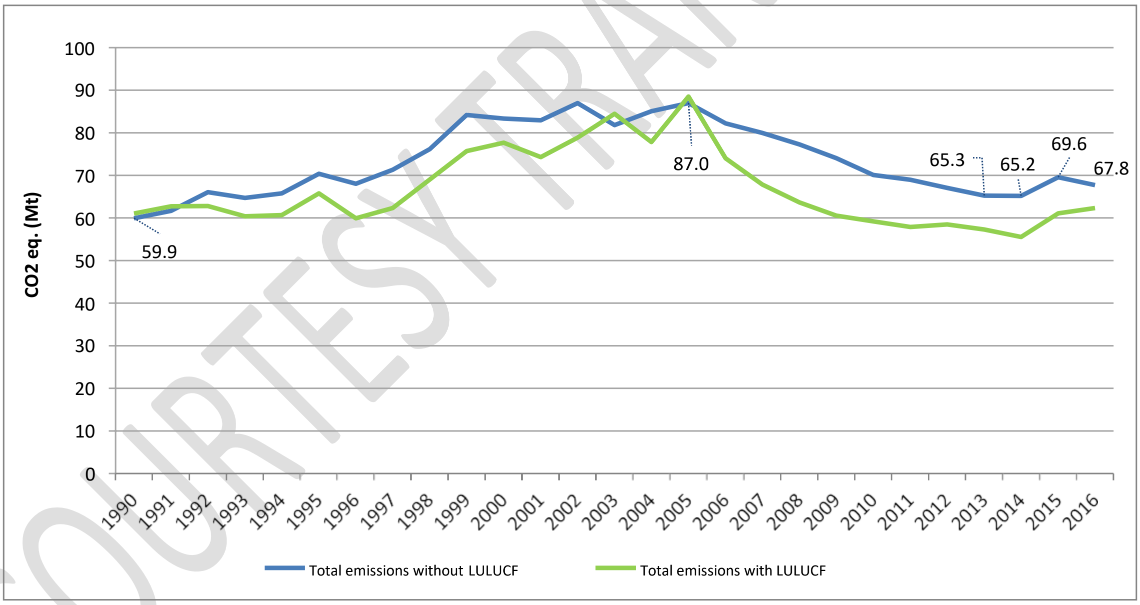
4.2.1. GHG emissions and removals

4.2.1.1. Total greenhouse gas emissions in Portugal

After the rapid growth seen in GHG emissions in the 90s, Portugal reached its peak emission point in 2005, after which there was a significant and sustained fall. Since then, a trajectory of decarbonisation of the national economy has been consolidated. In fact, in 2005 an increase in emissions of around 44% was seen when compared to 1990 levels.

According to the most recent updating of the National Emissions Inventory 2018 (for 2016), GHG emissions, excluding emissions from land use change and forestry, are estimated at approximately 67.8 Mt CO2e, representing an increase of 13.1% over figures for 1990 and a reduction of 22% over 2005, reflecting the abovementioned decarbonisation process.

Figure 4 - Evolution in national GHG emissions (Mt CO2e) [Source: APA]



With regard to the first Kyoto commitment period and as a result of sharing responsibilities on a Community level, it was established that from 2008 to 2012 Portugal could increase its emissions by 27% in relation to 1990. Portugal complied with this objective mainly by limiting GHG emissions in all sectors of the economy by capturing carbon in land use, land-use change and forestry (LULUCF).

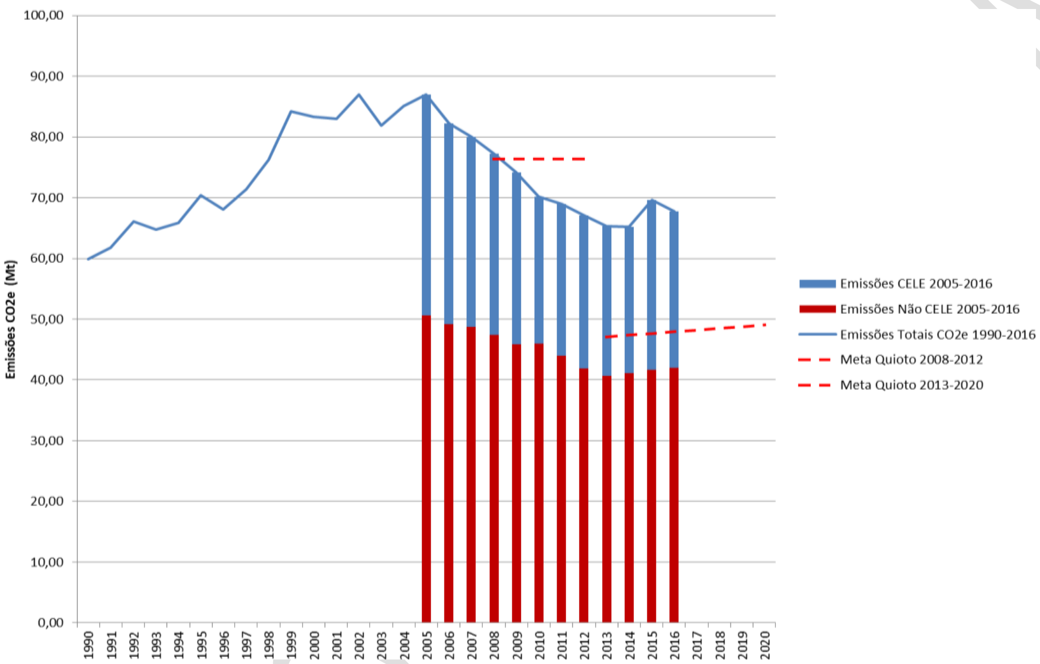
The trajectory since 2005 has thus allowed compliance with the Kyoto Protocol.

For the 2013-2020 period, the EU set a Community goal of a reduction of a minimum of 20% in GHG emissions in relation to 1990. In this regard, the sectors covered by ELT were expected to reduce emissions by 21% in relation to 2005 and remaining sectors by 10% in relation to 2005. Targets were also set to achieve 20% of energy from renewable sources in final consumption and an increase in energy efficiency (EE) of 20%.

With regard to effort sharing, Portugal committed to limiting growth in GHG emissions to +1% up to 2020 (in relation to 2005) for sectors not covered by ELT. Annual limits were also set for non-ELT emissions in this period. Under the 2020 energy-climate package, Portugal also committed to a target of 31% of energy from renewable sources in gross final energy consumption (RES), 10% of which was in transport, an EE general objective of 25% and a specific EE objective for Public Administration of 30%. Ii is important to note that these emission reduction targets are integrated into joint compliance by the EU, its Member States and Iceland in the second Kyoto Protocol commitment period.

The following figure shows the evolution of national emissions, from 1990 to 2016 and identifies, as of 2005, the contribution from ELT and non-ELT sectors, also showing the Kyoto targets in each of the periods.

Figure 5 - Evolution in national GHG emissions (Mt CO2e) by ELT and non-ELT sector



Key
ELT emissions 2005-2016
NON-ELT emissions 2005-2016
Total CO2e emissions 1990-2016
Kyoto target 2008-2012
Kyoto target 2013-2020

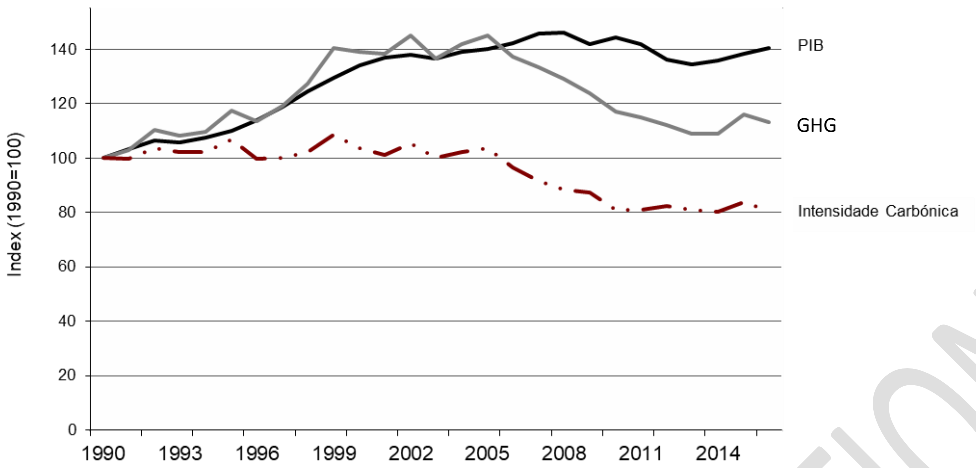
An analysis of GHG emissions per GDP unit shows that a process was started in 2005 to decouple GDP from emissions, as a result of the decarbonisation of the economy, in other words, an economy with less carbon emitted per unit of wealth produced. This trend started before the current economic crisis.

Several factors are driving this trend including the growth in the use of less polluting energy sources such as natural gas, the construction of combined cycle power plants and more efficient co-generation units.

Other reasons include the significant growth in renewable energy (mainly wind and hydro), and the implementation of EE measures. The improvement in efficiency in transport (through fleet renewal) and in housing (through building certification) may also explain such trends.

Despite the significant reduction in the carbon intensity of GDP, when compared to the rest of Europe it can be seen that Portugal has figures which are higher than the European average.

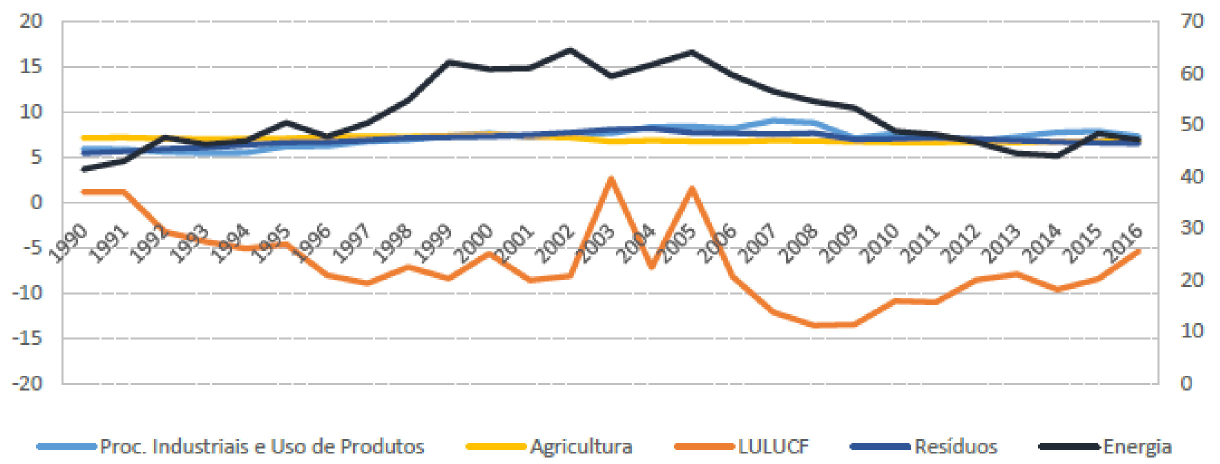
Figure 6 - Evolution in national emissions, GDP and carbon intensity (1990=100%) from 1990 to 2016



Key
Carbon intensity

Public policies on climate change are today an integral part of a series of sector policies in Portugal. In areas such as energy and industry covered by ELT, the 'carbon dimension' today forms part of the strategic and economic considerations of companies. In agriculture and forestry, there is also growth in awareness of the important contribution the sector can make with regard to mitigating GHG emissions. In areas with specific challenges such as the transport sector, important steps have been taken to decarbonise vehicle fleets. Moreover, an electric mobility network has been created and support schemes have been introduced for electric vehicles with the aim of reinforcing incentives for the use of such vehicles.

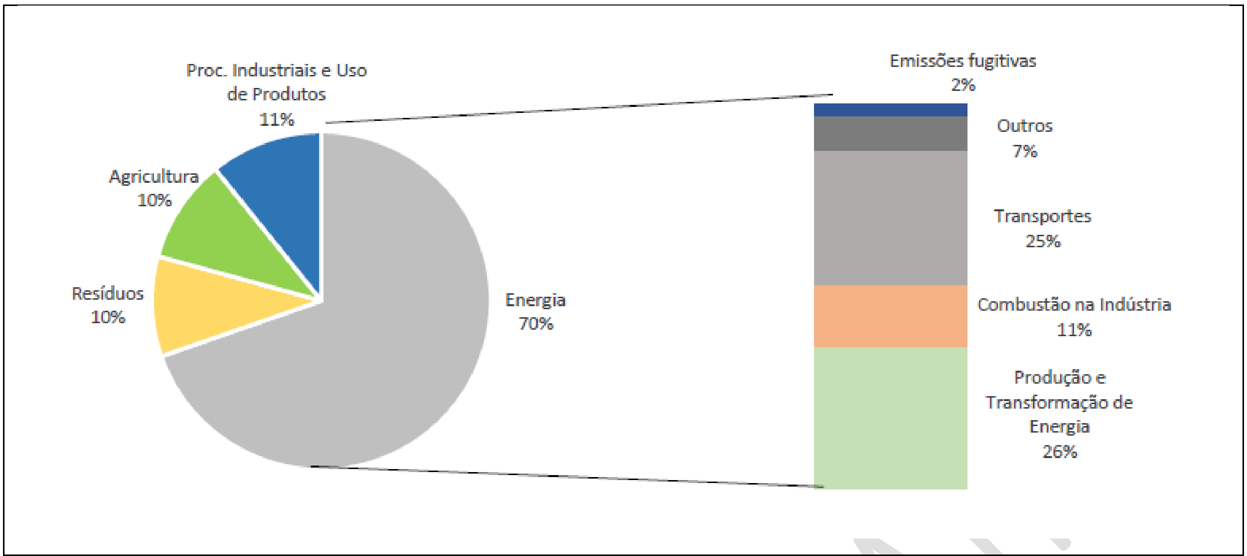
Figure 7 - Evolution in sector emissions 1990-2016 [Source: APA]



Key: Ind. Processes and Use of Products Agriculture LULUCF Waste Energy

In 2016, the energy sector, including transport, continued to be the largest source of GHG emissions, representing 70% of national emissions. In this sector, energy production and transport are the most important sources, representing around 27% and 24%, respectively, of all national emissions.

Figure 8 - Sector emissions in CO2e in 2016 [Source: APA]



Key

Ind. Proc. and Use of Products	11%	Fugitive emissions	2%
Agriculture	10%	Other	7%
Waste	10%	Transport	25%
Energy	70%	Combustion in Industry	11%
		Energy production and processing	26%

Combustion in industry accounts for approximately 11% of national emissions. Fugitive emissions represent 2% of total emissions.

The sectors of industrial processes and product use (IPPU), agriculture and waste have an approximate weighting, representing 10.8%, 10.0% and 9.6%, respectively.

With regard to agriculture, growth in emissions is mostly explained by the increase in the bovine and porcine population as well as by the cultivated area of rice, which is also related to greater water resource availability.

The decrease in emissions from industrial processes essentially relates to the reduction in clinker and nitric acid production in 2016. The use of steel scrap (less pollutant) at steel foundries, instead of pig iron, also contributed to the reduction of emissions in this sector in 2016. The increase in emissions from industrial processes with respect to 1990 (24%) is due to the growth in emissions of fluorinated gases, particularly in the sub-sectors of stationary air conditioning and commercial refrigeration.

The reduction in emissions in the waste sector in recent years is due to the use of biogas in wastewater treatment systems, as well as the focus on Mechanical and Biological Treatments which seek to reduce urban waste (RUB) in landfills and the increase in recovered recyclable waste.

Estimates for the LULUCF sector show that, with the exception of 1990, 1991, 2003 and 2005, this sector is a net sink of CO_2, representing the capture of 5.4 Mt CO_{2e} in 2016.

4.2.1.2. Projections of sectorial developments with existing national and EU policies and measures at least until 2040 (including for the year 2030)

As part of work under RNC2050, projections were made for the activity trajectories and the respective GHG emissions of the energy system (including the production, transmission and consumption of energy), agriculture, waste and wastewater and fluorinated gases. Three possible evolution scenarios for society were considered also characterised by distinct socio-economic scenarios.

Under NECP, the socio-economic parameters of RNC2050 were selected for purposes of reporting GHG emissions projections, which are reflected in a slightly more optimistic evolution in GDP and the population for 2020-2030, which is more consistent with the macroeconomic scenario used in the national energy model (JANUS) presented in Section 4.1.

Preliminary results from these projections have allowed potential national emission reduction to be reanalysed, confirming the technical and economic viability of pursuing a low-carbon trajectory for 2020/2030, as set out in NACP.

A sector analysis of emissions trajectories confirms that all sectors have significant potential to reduce GHG emissions in the different scenarios analysed.

Analysis of the behaviour of the different sectors in the conditions established for the existing policies scenario (as well as for the planned policies or neutrality scenarios) helps identify key factors, trends and behaviours for the timeframe up to 2050, broken down into 10-year blocks from the present time.

The methodologies used to estimate GHG emissions from activity variables are those set out in the National Inventory Report (NIR). A specific projection methodology for the respective activity variables was adopted for each of the sectors of activity. However, it was based on the same socio-economic framework to ensure consistency in the projections obtained.

Shown below is a results summary of modelling carried out on GHG emissions per sector for the 2030 and 2040 horizons, in a scenario of existing policies.

Table 14 - Projection of GHG Emissions (kt CO2 eq.) - Scenario Existing Policies

	GHG Emissions (kt CO2 eq.)			
Sectors	**2005**	**2020**	**2030**	**2040**
Hydraulic	26 167	16 239	7 061	2 996
Energy production and processing	23 039	12 942	4 046	516
Refining	2 466	2 220	2 027	1 665
Fugitive emissions	662	1 077	989	815
Industry	18 335	12 448	10 003	10 090
Combustion in Industry	10 758	7 631	5 680	6 054
Industrial processes	7 577	4 817	4 323	4 035
Transport	19 594	16 386	10 241	5 484
Services	3 166	1 178	1 139	568
Residential	2 724	2 427	2 000	1 929
F-gases	212	2 226	877	606
Agriculture	8 213	7 891	6 693	6 684
Agriculture	6 760	6 728	5 535	5 594
Combustion in Agriculture/Forestry/Fisheries	1 453	1 163	1 158	1 090
Waste and Wastewater	7 701	4 405	3 320	2 362
LULUCF	1 520	-4 642	-6 926	-7 795
Total without LULUCF	86 112	63 200	41 333	30 719
Total with LULUCF	87 632	58 558	34 407	22 924

As can be seen, even in a scenario of existing policies, a sharp reduction in GHG emissions is expected in coming decades, and cost-effective potential exists for Portugal to reduce total emissions by 2030 of around -52% in relation to 2005. This figure will rise to -64% by 2040 (without LULUCF).

In 2030, this reduction will be largely the result of the closure of coal fired power plants and focus on the role of renewable energies in the national energy mix, particularly solar. By 2030, the energy sector has the potential to reduce GHG emissions by around -73% with respect to 2005.

The transport and mobility sector is also expected to see far-reaching changes with much increased use of electric vehicles and potential emissions reduction of around 48% by 2030 with respect to 2005 and around 72% by 2040.

The services and wastes sectors also have solid potential to reduce GHG emissions, contributing with -64% and -57%, respectively by 2030. This will be due to increased energy efficiency and compliance with the Landfill Directive restricting deposits to just 10% by 2035.

The industry and agriculture sectors have lower decarbonisation potential, contributing however with reductions of 45% and 19%, respectively.

Table 15 - Potential GHG emissions reduction with respect to 2005 (%) - Existing Policies Scenario

	Projected reduction of GHG emissions with respect to 2005 (%)	
Sectors	**2030**	**2040**
Hydraulic	73	89
Industry	45	45
Transport	48	72
Services	64	82
Residential	27	29
Agriculture	19	19
Waste and Wastewater	57	69
Total without LULUCF	52	64

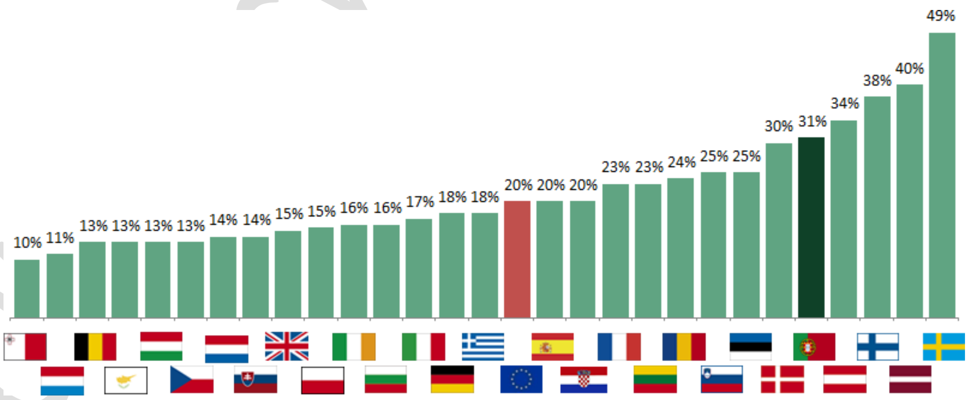
However, additional policy measures need to be considered (to be drafted for the purpose), so as to achieve a more ambitious low-carbon trajectory allowing carbon neutrality to be reached by 2050.

4.2.2. Energy from renewable sources

ii. Current share of renewable energy in gross final energy consumption and in different sectors (heating and cooling, electricity and transport) as well as per technology in each of these sectors

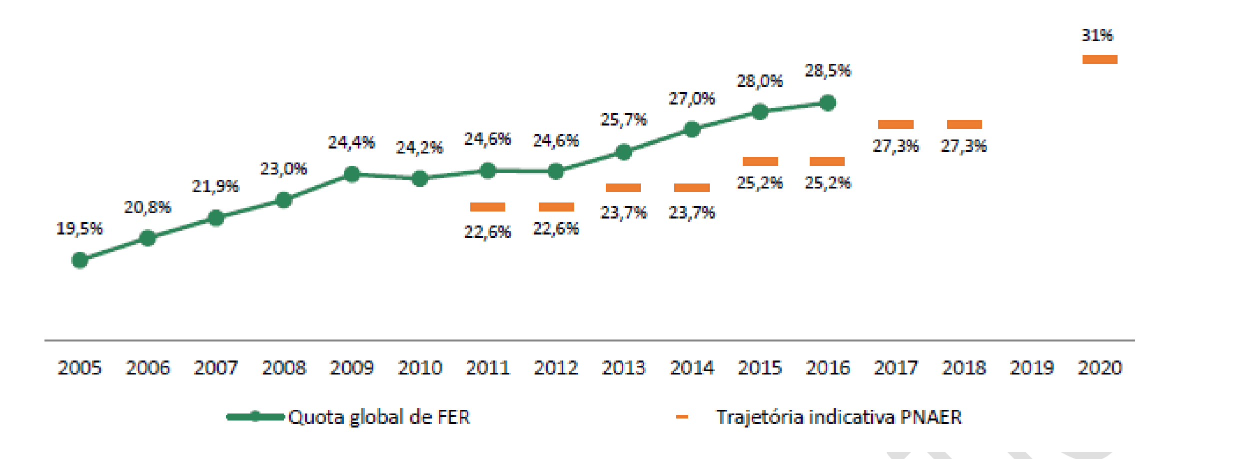
Further to Directive 28/2009/EC of the European Parliament and of the Council of 23 April introducing the requirement for EU members to submit a plan to promote the use of energy from renewable sources, Portugal prepared and submitted its first National Action Plan for Renewable Energy (PNAER) in 2010. The commitment in this plan was to achieve the objectives set in the Directive and to reach the overall target of 31.0% of renewable energy in gross final energy consumption, the fifth most ambitious target in the EU-28, and 10.0% of renewable energy sources in final energy consumption in transport. Later, in 2013, Portugal revised PNAER and maintained the same ambitious targets it has always followed to comply with EU targets.

Figure 9 - Targets for incorporating renewable energy sources into gross final energy consumption by 2020 in the EU-28 [Source: European Commission]



Portugal has seen good progress in compliance with objectives for 2020. In 2016, the incorporation of renewable energy sources into gross final energy consumption stood at 28.5%, +0.5 p.p. above figures for 2015 and 3.3 p.p. Above the indicative trajectory, meaning that Portugal has already achieved around 90% of its target for 2020. The following figure shows the evolution in the share of renewable energy sources in gross final energy consumption in 2005 and 2016.

Figure 10 - Evolution in the share of renewable sources in gross final energy consumption in Portugal [Source: DGEG/Eurostat]



Key:
Overall RES share FER Indicative trajectory of PNAER

On a sector level, in 2016 the share of renewables in the electricity sector (FER-E) was 54.1% (+1.4 p.p. over 2015), in the Heating and Cooling sector (FER-A&A) it was 35.1% (+1.8 p.p. over 2015) and in the Transport sector (FER-T) it was 7.5% (+0.1 p.p. over 2015). The following table shows the evolution in the share of renewable energy sources in gross final energy consumption by sector and overall, in 2005 and 2016.

Table 16 - Evolution in the share of renewable sources in gross final energy consumption in Portugal [Source: DGEG/Eurostat]

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
RES-A&A	32.1 %	34.2 %	35.0 %	37.5 %	38.0 %	33.9 %	35.2 %	33.2 %	34.6 %	34.0 %	33.4 %	35.1 %
RES-E	27.7 %	29.3 %	32.3 %	34.1 %	37.6 %	40.7 %	45.9 %	47.6 %	49.1 %	52.1 %	52.6 %	54.1 %
RES-T	0.5 %	1.6 %	2.5 %	2.6 %	3.9 %	5.6 %	0.7 %	0.8 %	0.9 %	3.7 %	7.4 %	7.5 %
Overall RES share	19.5 %	20.8 %	21.9 %	23.0 %	24.4 %	24.2 %	24.6 %	24.6 %	25.7 %	27.0 %	28.0 %	28.5 %

Table 17 - Evolution of renewable energy contribution by each sector to final energy consumption (ktoe) [Source: DGEG/Eurostat]

	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Gross final consumption of RES for heating and cooling	2 529	2 546	2 602	2 599	2 595	2 218	2 223	1 870	1 942	1 858	1 839	1892
Gross final consumption of electricity from RES	1 251	1 349	1 499	1 598	1 741	1 955	2 144	2 173	2 240	2 355	2 410	2 511
Gross final consumption of energy from RES in transport	28	102	152	157	242	344	40	43	48	192	396	410
Gross total RES consumption	3 791	3 979	4 235	4 336	4 558	4 496	4 384	4 061	4 204	4 377	4 590	4 663
Transfer of RES to other Member States	0	0	0	0	0	0	0	0	0	0	0	0
Transfer of RES from other Member States and 3rd countries	0	0	0	0	0	0	0	0	0	0	0	0
Consumption of RERS adjusted to objective	3 791	3 979	4 235	4 336	4 558	4 496	4 384	4 061	4 204	4 377	4 590	4 663

Analysing the electricity sector in greater detail, the following tables provide a breakdown of the contribution of each technology to the level of installed capacity and gross electricity production.

Table 18 - Total effective contribution (installed capacity) of each renewable energy technology in Portugal in the Electricity sector (MW) [Source: DGEG/Eurostat]

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Hydro	5 017	5 053	5 061	5 058	5 091	5 106	5 535	5 712	5 661	5 715	6 168	6 960
Conventional (without pumping)	3 923	3 959	3 967	3 964	3 997	4 012	4 446	4 369	4 294	4 299	4 379	4 389
<1 MW	28	30	30	30	34	34	34	32	32	32	31	31
1 MW – 10 MW	280	304	312	309	328	343	343	348	341	356	363	373
>10 MW	3 615	3 625	3 625	3 625	3 635	3 635	4 069	3 989	3 921	3 911	3 985	3 985
Only pumping	0	0	0	0	0	0	0	0	0	0	0	0
Mixed	1 094	1 094	1 094	1 094	1 094	1 094	1 089	1 343	1 367	1 416	1 789	2 571
Geothermal	14	25	25	25	25	25	25	25	25	25	25	25
Solar	2	3	24	59	115	134	172	238	296	415	447	462
Photo Voltaic	2	3	24	59	115	134	172	238	296	415	447	462
Concentrated solar power	0	0	0	0	0	0	0	0	0	0	0	0
Tide, wave, ocean	0	0	0	0	0	0	0	0	0	1	0	0
Wind	1 064	1 681	2 201	2 857	3 326	3 796	4 256	4 412	4 610	4 856	4 937	5 124
Biomass	281	287	303	306	362	507	522	530	513	522	537	545
Solid biomass	273	279	290	293	342	482	478	479	458	456	471	477
Biogas	8	8	13	13	20	25	44	51	55	66	66	68
Bioliquids	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	6 378	7 049	7 614	8 305	8 919	9 568	10 510	10 917	11 105	11 534	12 114	13 116

Table 19 - Total effective contribution (gross electricity production) of each renewable energy technology in Portugal in the Electricity sector (GWh) [Source: DGEG/Eurostat]

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Hydro	11 172	11 101	11 384	11 165	10 974	11 475	12 184	11 584	11 331	11 860	12 074	12 627
Conventional (without pumping)	9 735	9 693	9 928	9 725	9 596	10 064	10 946	9 930	9 652	10 054	9 704	9 115
<1 MW	71	78	80	81	91	92	91	84	84	85	82	83
1 MW – 10 MW	864	942	928	873	912	982	971	955	947	1 017	1 002	1 014
>10 MW	9 897	9 769	10 044	9 882	9 673	10 138	10 994	10 194	9 960	10 401	10 353	10 361
Only pumping	0	0	0	0	0	0	0	0	0	0	0	0
Mixed	1 098	1 096	1 123	1 110	1 081	1 148	1 110	1 302	1 339	1 448	1 733	2 342
Geothermal	71	85	201	192	184	197	210	146	197	205	204	172
Solar	3	5	24	41	160	211	280	393	479	627	796	822
Photo Voltaic	3	5	24	41	160	211	280	393	479	627	796	822
Concentrated solar power	0	0	0	0	0	0	0	0	0	0	0	0
Tide, wave, ocean	0	0	0	0	0	0	0	0	0	0	0	0
Wind	1 751	2 937	4 096	5 482	7 003	8 401	9 492	10 361	11 135	11 791	12 002	12 513
Biomass	1 385	1 412	1 588	1 572	1 796	2 325	2 628	2 706	2 765	2 807	2 812	2 766
Solid biomass	1 350	1 380	1 530	1 500	1 713	2 226	2 467	2 496	2 516	2 530	2 518	2 481
Biogas	35	33	58	71	83	100	161	209	250	277	294	285
Bioliquids	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	14 382	15 540	17 293	18 452	20 117	22 610	24 794	25 190	25 907	27 291	27 888	28 900
of which in CHP[30]	1 294	1 309	1 373	1 346	1 375	1 570	1 734	1 721	1 790	1 778	1 738	1 738

[30] Combined heat and power production.

A breakdown of the Heating and Cooling sector is presented in the following tables.

Table 20 - Total effective contribution (Final Energy Consumption) of each renewable energy technology in Portugal in the Heating and Cooling sector (ktoe) [Source: DGEG/Eurostat]

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Geothermal	1	1	1	1	1	1	2	2	1	1	2	1
Solar	22	24	26	30	35	48	59	67	73	77	80	84
Biomass:	2 505	2 522	2 576	2 568	2 559	2 169	2 162	1 801	1 868	1 780	1 757	1 807
Solid biomass	2 505	2 522	2 562	2 556	2 542	2 151	2 162	1 801	1 868	1 771	1 749	1 798
Biogas	0	0	0	0	0	0	0	1	1	8	8	9
Bioliquids	0	0	13	12	18	18	0	0	0	0	0	0
Heat pumps	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	2 529	2 546	2 602	2 599	2 595	2 218	2 223	1 870	1 942	1 858	1 839	1 892
of which is biomass in housing	1 164	1 161	1 161	1 161	1 161	712	712	754	771	767	763	764

With regard to the Transport sector the breakdown is as follows.

Table 21 - Total effective contribution (Final energy consumption) of each renewable energy technology in Portugal in the Transport sector (ktoe) [Source: DGEG/Eurostat]

	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Biofuels[31]	0	72	123	156	208	309	4	4	9	152	328	260
of which in accordance with Annex IX[3232]	0	0	2	5	4	4	4	4	9	10	36	107
Article 3(1)[3333]	-	-	-	-	-	-	0	0	0	0	249	138
Article 3(3)(i) and (ii)[3434]	-	-	-	-	-	-	0	0	0	0	0	0
other biofuels	-	-	-	-	-	-	0	0	0	141	43	15
Hydrogen from RES	0	0	0	0	0	0	0	0	0	0	0	0
RES electricity	11	12	12	13	13	14	13	14	12	12	13	17
of which road transport	0	0	0	0	0	0.0001	0.001	0.001	0.003	0.01	0.04	0.04
of which rail transport	11	12	12	13	13	14	13	14	12	12	13	17
Other	0	0	0	0	0	0	0	0	0	0	0	0
Total	**28**	**101**	**154**	**162**	**246**	**348**	**40**	**43**	**48**	**192**	**396**	**410**

ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

Shown in Table 22 are projections based on current policies and measures, until 2040, in final gross energy consumption in Portugal.

Table 22 - Projections based on current policies and measures, until 2040, in final gross energy consumption in Portugal [Source: DGEG]

	2020	2025	2030	2035	2040
RES-A&A	34%	35%	35%	35%	36%
RES-E	70%	72%	70%	65%	60%
RES-T[35]	9%	11%	17%	22%	30%
Overall RES share	31%	33%	33%	32%	32%

31 In accordance with Articles 17 and 18 of Directive 2009/28/EC.
32 Directive 2009/28/EC.
33 Directive 2009/28/EC amended by Directive (EU) 2015/1513 of 9 September 2015.
34 Directive 2009/28/EC amended by Directive (EU) 2015/1513 of 9 September 2015.
35 Indicator of the RES II Directive.

Shown in Table 23 are projections based on current policies and measures, until 2040, of the contribution of renewable energies in each sector for final energy consumption.

Table 23 - Projections based on current policies and measures, until 2040, of the contribution of renewable energies in each sector for final energy consumption. DGEG]

	2020	2025	2030	2035	2040
Gross final consumption of RES for heating and cooling	1 800	1 900	1 950	2 010	2 070
Gross final consumption of electricity from RES	3 170	3 530	3 640	3 600	3 550
Gross final consumption of energy from RES in transport	420	460	550	650	740
Gross total RES consumption	5 390	5 890	6 140	6 260	6 360
Transfer of RES to other Member States	0	0	0	0	0
Transfer of RES from other Member States and 3rd countries	0	0	0	0	0
Consumption of RERS adjusted to objective	5 390	5 890	6 140	6 260	6 360

Shown in Table 24 are projections based on current policies and measures, until 2040, of the total effective contribution of (installed capacity) of each renewable energy technology in Portugal in the Electricity sector.

Table 24 - Projections based on current policies and measures, until 2040, of the total effective contribution of (installed capacity) of each renewable energy technology in Portugal in the Electricity sector. DGEG]

	2015	2020	2025	2030	2035	2040
Hydro	6.0	7.0	8.2	9.0	9.0	9.0
Wind	0.4	1.8	2.8	2.9	3.0	3.0
Solar	5.0	5.4	5.6	5.6	5.6	5.6
Other Renewables [1]	0.3	0.5	0.5	0.5	0.5	0.5
TOTAL [2]	11.7	14.7	17.1	18.0	18.0	18.1

[1] Includes Biomass, Biogas, Waste (50% of production via waste is not renewable), Geothermal and Wave

[2] Does not include cogeneration

A breakdown of the Heating and Cooling sector is presented in Table 25.

Table 25 - Projections based on current policies and measures, until 2040, of the total effective contribution of (final energy consumption) of each renewable energy technology in Portugal in the Heating and Cooling sector (ktoe) [Source: DGEG]

	2020	2025	2030	2035	2040
Solar thermal	88	94	97	100	104
Biomass	962	1020	1059	1098	1140
Heat from cogeneration (renewable)	726	739	748	755	787
Heat pumps	69	77	76	72	69
TOTAL	1 845	1 930	1 980	2 025	2 100

A breakdown of the Transport sector is presented in Table 26.

Table 26 - Projections based on current policies and measures, until 2040, of the total effective contribution (final energy consumption) of each renewable energy technology in the Transport sector (ktoe) [Source: DGEG/Eurostat]

	2020	2025	2030	2035	2040
Biofuels	382	378	370	360	309
Hydrogen (renewable)	0	0	7	24	51
RES electricity	35	85	170	270	380
TOTAL	417	463	547	654	740

4.3. Dimension Energy efficiency

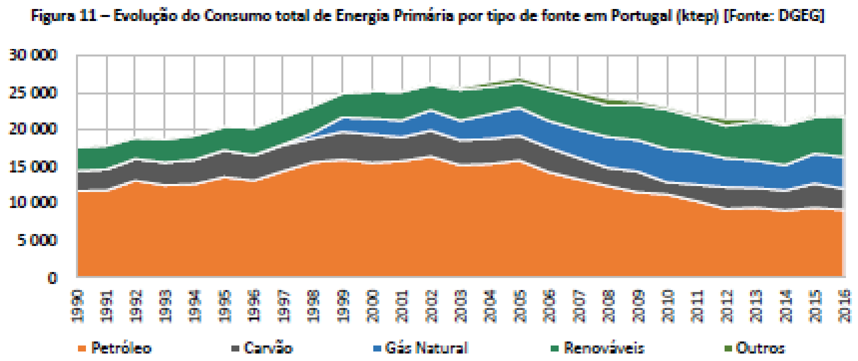
i. Current primary and final energy consumption in the economy and per sector (including industry, residential, service and transport)

During the last decade, 2007-2016, Primary Energy Consumption (PEC) recorded an average annual growth rate of (AAGR) -2,0%. Contributing to this decrease were the following factors:

- The increase and diversification of renewable energy sources in electricity production leading to a significant reduction in the consumption of fossil fuels;
- A reinforcement of energy efficiency measures;
- Contraction of the economy with generalised impact on consumption which was felt with greater effect after 2011.

The following figure shows the evolution in total PEC by type of source: from 1990 to 2016.

Figure 11 - Evolution in Final Primary Energy Consumption per sector of source in Portugal (ktoe) [Source: DGEG]



Key: Oil Coal Natural Gas Renewable Other

The following table summarises total consumption of primary energy in Portugal, per type of source.

Table 27 - Total Primary Energy Consumption in Portugal (ktoe) [Source: DGEG]

	2014	2015	2016	*% 2014/2015*	*% 2015/2016*
Total primary energy consumption	20 921	22 060	21 684	*+5.4%*	*-1.7%*
Oil	9 089	9 447	9 157	*+3.9%*	*-3.1%*
Renewables	5 409	5 895	5 568	*-9.5%*	*+13.7%*
Natural gas	3 486	3 097	4 340	*+17.5%*	*+5.9%*
Coal	2 682	2 259	2 848	*+21.5%*	*-12.6%*
Other[36]	255	361	-229	*+30.1%*	*-163.4%*

With regard to the consumption of primary sources of energy, oil is predominant in the energy mix in Portugal. In 2016, it represented 42% of PEC, followed by renewable energy with 26%, natural gas with 20% and coal with 13%. With the introduction of natural gas in 1997 and the increased diversification of renewable energy sources, the weighting of oil in PEC has fallen in recent years, and since 2009 it has represented less than 50% of consumption. The use of coal in Portugal varies, mainly as a result of demand in the electricity production sector, which is influenced by the greater or lesser availability of renewable resources, particularly hydro and wind, given the high weighting that these components currently have.

[36] Includes Import Balance of Electricity and Industrial Waste.

The Energy Intensity of the economy in primary energy in 2016 recorded a value of 124 toe/M€, where a reduction of 20% was seen with respect to 2005, the year in which energy intensity reached the highest value of recent years (156 toe/M€). As of 2008, a decoupling of PEC from GDP can be clearly seen.

Figure 12 - Evolution in the energy intensity of the economy in Portugal (toe/M€ 2011) [Source: DGEG/INE] primary energy

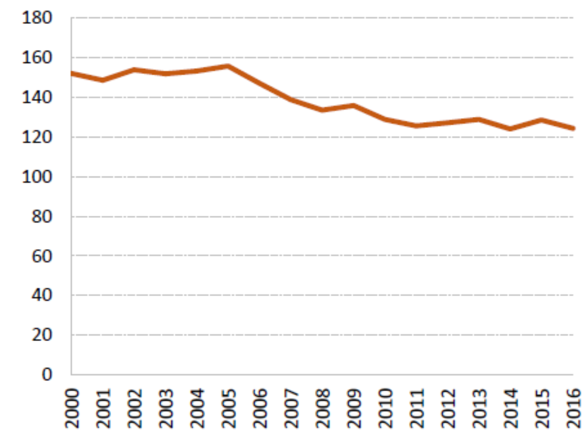
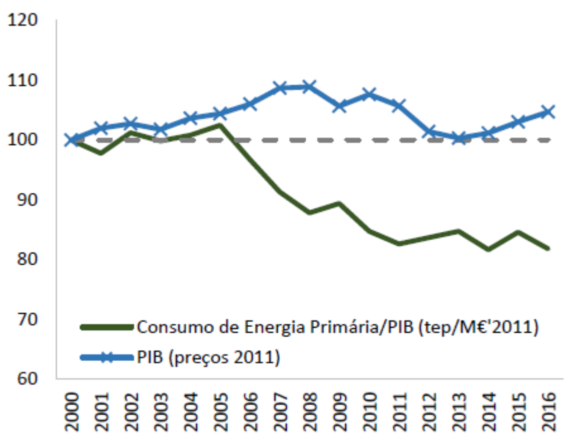


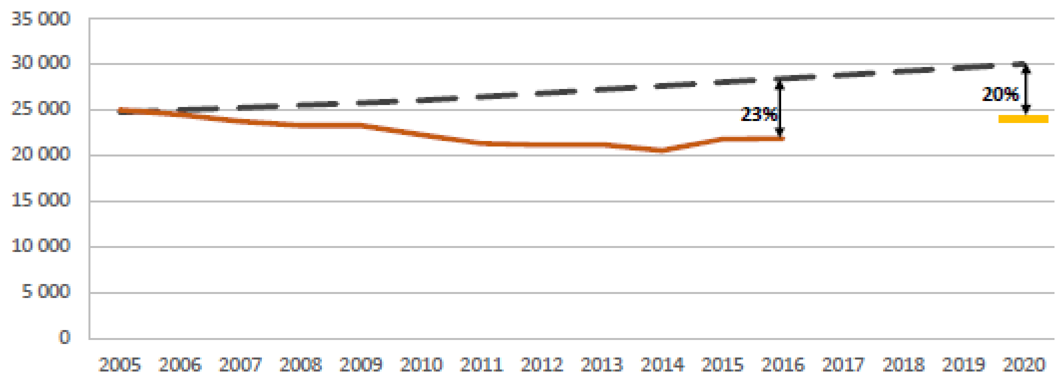
Figure 13 -Evolution of PEC and GDP in Portugal (2000 = 100) [Source: DGEG/INE]



Key:
Primary Energy Consumption/GDP (toe/M€'2011)
GDP (prices 2011)

For the 2020 horizon, and with respect to Directive 2012/27/EU of the European Parliament and of the Council of 25 October on Energy Efficiency, the objective was redefined for a maximum limit on primary energy consumption by 2020 (based on projections of the PRIMES model for the European Commission carried out in 2007) equivalent to a reduction of 20% (24.0 Mtoe, excluding non-energy uses). Portugal later adopted a more ambitious target of 25% reduction (22.5 Mtoe, excluding non-energy uses). Evolution in primary energy consumption excluding non-energy uses, including international aviation uses (reference to calculate compliance with the Energy Efficiency target in 2020) shows that in 2016, the value continues to be below Portugal's reference value (22.5 Mtoe to ensure compliance with the reduction target of 25%) and as such, the country is well on the way to complying with the 2020 target.

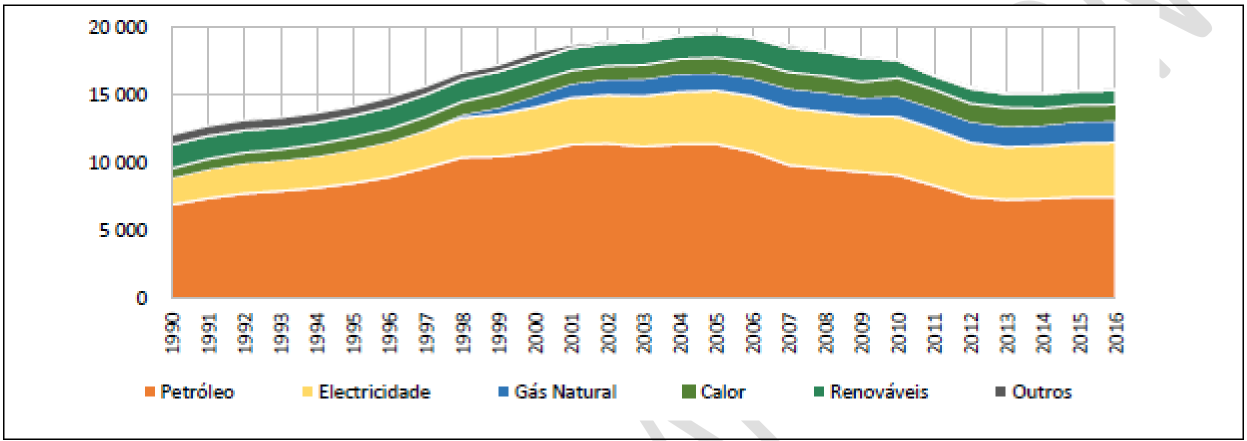
Figure 14 - Evolution in the Portuguese target for Energy Efficiency for 2020 (Mtoe)



In 2016, Portugal recorded total Final Energy Consumption (FEC) of 15 433 ktoe. With respect to 2005, the year in which PEC reached its highest ever value in Portugal, a decrease of 21% was seen. During the last decade, 2007-2016, PEC recorded an average annual growth rate (AAGR) of -2.1%. Of note among the factors contributing to the reduction in PEC in recent years is the promotion of energy efficiency with particular focus on the industrial and domestic sectors and the slowdown in the economy which affected consumption generally across all sectors.

With respect to final energy consumption by type of source, and as already mentioned, oil play a key role in Portugal's energy mix. In 2016, oil represented 48% of final energy consumption, followed by electricity with 26%, natural gas with 10%, heat with 8%, renewables with 7%, which included the use of firewood and plant waste, Solar Thermal, Biogas and other renewables, and other source of energy which represented 1%. In recent years, a reduction has been seen in the weighting of oil in final energy consumption, while natural gas and electricity have recorded an increase. The following figure shows the evolution in FEC by type of source: from 1990 to 2016.

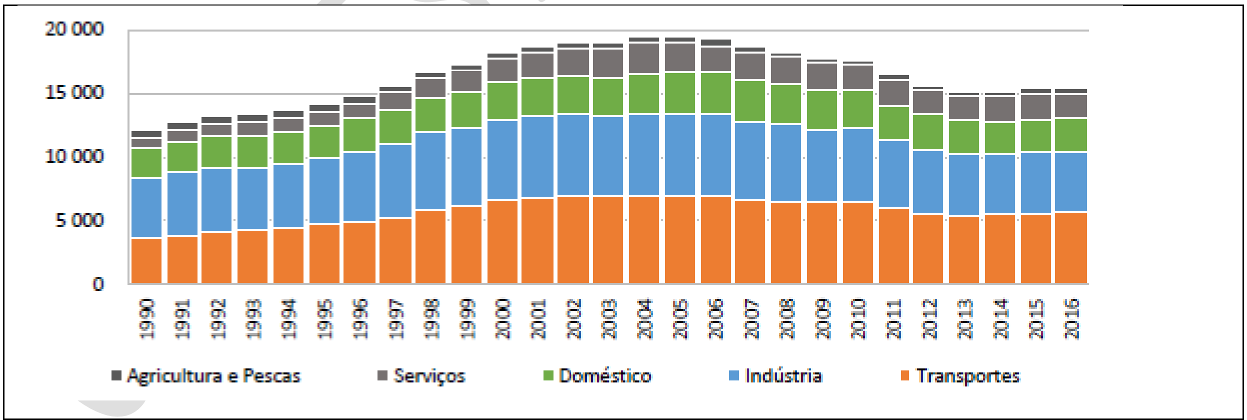
Figure 15 - Evolution in Final Primary Energy Consumption per type of source in Portugal (ktoe) [Source: DGEG]



Key: Oil Electricity Natural Gas Heat Renewables Other

In terms of the different sectors, it can be seen that Transport uses most energy in Portugal, representing 37% of FEC in 2016. This was followed by Industry (31%), Domestic (17%), Services (13%) and finally Agriculture and Fisheries (3%). The structure of consumption per sector of activity has remained largely unchanged over the last decade, with only slight oscillations being seen from year to year, as the following figure shows.

Figure 16 - Evolution in Final Energy Consumption per sector of activity in Portugal (ktoe) [Source: DGEG]



Key: Agriculture and Fisheries Services Domestic Industry Transport

- As mentioned earlier, the transport sector is responsible for most energy consumption in Portugal, but has seen a significant change in the evolution of this consumption in recent years. While in the decade from 1997 to 2006, consumption recorded AAGR of 3.5%, the following decade (2007-2016) saw AAGR of -1.5%. Several factors contributed to this reduction including improved efficiency of the fleet, an increase in fuel prices, an increase in availability of public transport in metropolitan areas, and in recent years, the contraction of the economy. However, as of 2013 a slight increase in consumption was seen as a result of the improvement in the national economy, with an increase of 5.0% in 2016 over figures for 2013. Breaking down energy consumption in the transport sector by type of product, it can be seen that diesel accounted for 71% of total energy consumption in the sector in 2016, followed by petrol (20%) and biofuels (5%). With respect to consumption by mode of transport, around 95% refers to road transport. Consumption of electricity has remained stable in recent years at around 0.5% of total consumption by the transport sector.

- Industry, which also represents an important share of energy consumption in Portugal standing at 31% in 2016, has also seen significant change in recent years. While in the decade from 1997 to 2006, consumption recorded an AAGR of 1.8%, the following decade (2007-2016) saw AAGR of -3.0%. Several factors contributed to this reduction including improved efficiency in production processes, investment in energy efficiency, and in recent years, the contraction of the economy caused a slowdown in industrial production. In the last four years, 2013-2016, consumption has stabilised and there was a reduction of 1.2% with respect to a 2015, while from 2014 to 2015 there was an increase of 1.5%. Breaking down energy consumption in Industry by type of product, it can be seen that electricity accounted for 28% of total energy consumption in the sector in 2015, followed by heat (25%) and natural gas (23%). In recent years, the consumption of oil products has fallen while there has been greater consumption of natural gas and heat. With regard to consumption by type of industry, of note is the Paper Industry which accounted for 29% of total consumption by the sector in 2015, followed by Chemicals and Plastics (11%) and Cement and Lime (10%).
- The Domestic Sector, which accounts for around 17% of FEC, has also seen significant changes in recent years. While in the decade from 1997 to 2006, consumption recorded AAGR of 2.1%, the following decade (2007-2016) saw AAGR of -2.4%. Of note among the factors contributing to this reduction are the contraction of the economy causing a slowdown in consumption, the increase in prices of electricity and natural gas, the implementation of energy efficiency measures such as replacing equipment with more efficient models and investment in more efficient solutions in housing. Following on from the Domestic Sector Energy Consumption Survey in 2010, there was an updating of figures for the consumption of biomass which also led to a reduction in energy use. Breaking down energy consumption in the Domestic Sector by type of product, it can be seen that electricity accounted for around 44% of total energy consumption in 2016, followed by renewables (31%) which include biomass and solar thermal, and oil products (16%) which are mostly LPG and natural gas (9%).
- The Services Sector, after a period in which energy consumption saw significant growth with an AAGR of 5.1% from 1997to 2006, the last decade (2007- 2016) has seen a drop in consumption with an AAGR of -1.4%. As of 2013, as a result of the improvement in the national economy, a slight increase in consumption was seen. However, after two years of increases, there was a slight decrease of 1.4% over figures for 2015. Breaking down energy consumption in the Service Sector by type of product, it can be seen that electricity accounted for around 74% of total energy consumption in 2016, followed by natural gas (12%) and oil products (9%). In recent years, the consumption of oil products has fallen significantly while there has been greater consumption of electricity and natural gas.
- The Agriculture and Fisheries Sector, which accounts for around 3% of FEC, has seen successive falls in consumption in recent decades with an AAGR of -0.8% in the period from 1997 to 2006 and AAGR of -0.6% in the period from 2007 to 2016. Since 2009, consumption in the sector has remained relatively stable. In 2016, there was an increase of 2.3% over figures for 2015. Breaking down energy consumption in Agriculture and Fisheries by type of product, it can be seen that oil products are the main source of energy accounting for 82% of total energy consumption in 2015, followed by electricity (16%) and natural gas (1%).
- The Energy Intensity of the economy in final energy in 2016 recorded a value of 88 toe/M€, where a reduction of 21.4% was seen with respect to 2005, the year in which energy intensity reached the highest value of recent years (112 toe/M€). Similarly, a decoupling between FEC and GDP can be seen as of 2008.

Figure 17 - Evolution in the energy intensity of the economy in final energy In Portugal (toe/M€ 2011) [Source: DGEG/INE]

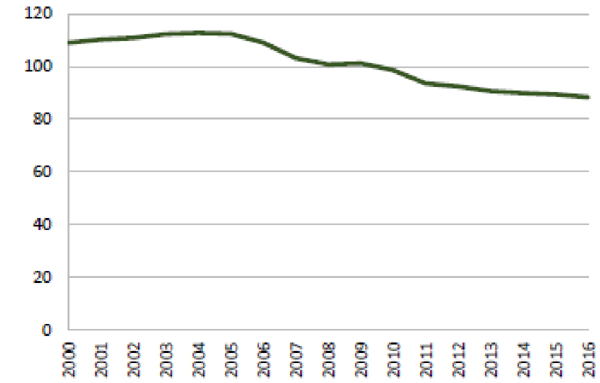
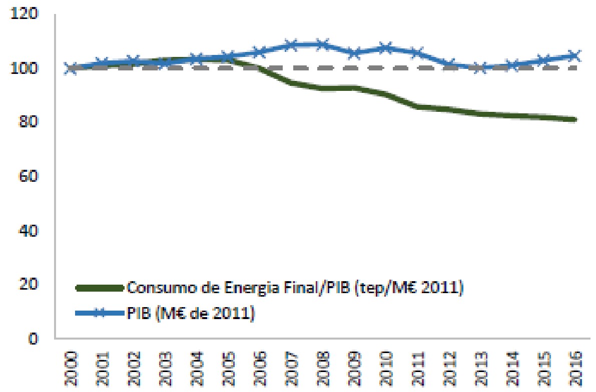


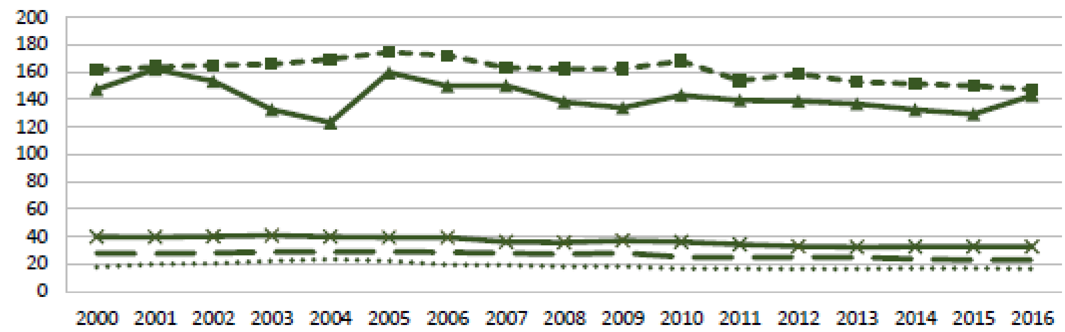
Figure 18 -Evolution of FEC and GDP in Portugal (2000 = 100) [Source: DGEG/INE]



Key:
Final Energy Consumption/GDP (toe/M€'2011)
GDP (prices 2011)

On a sector level, in 2016 the industry sector recorded energy intensity of 147 toe/M€ 2011, the Agriculture and fisheries sector recorded 143 toe/M€ 2011, the Transport sector recorded 33 toe/M€ 2011, the Domestic sector recorded 23 toe/M€ 2011 and the Service sector recorded and energy intensity of 17 toe/M€ 2011.

Figure 19 - Evolution in the energy intensity of the economy in final energy per sector of activity in Portugal (toe/M€ 2011) [Source: DGEG/INE]



Key: Agriculture Industry Services Transport Domestic

Shown in Table 28 are the figures for the energy intensity of the economy in final energy by sector of activity in Portugal.

Table 28 - Energy intensity of the economy in final energy per sector of activity in Portugal (toe/M€ 2011) [Source: DGEG/INE]

	2014	2015	2016	*% 2014/2015*	*% 2015/2016*
Industry	151.2	149.7	147.0	-1.0%	-1.8%
Services	17.0	17.1	16.5	+0.3%	-3.0%
Transport	32.7	32.7	32.7	-0.1%	+0.2%
Agriculture and Fisheries	132.6	129.2	142.6	-2.6%	+10.4%
Domestic	23.8	23.1	23.1	-3.0%	-

ii. Current potential for the application of high-efficiency cogeneration and efficient district heating and cooling

In accordance with Article 14 of Directive 2012/27/EU of 25 October 2012 on energy efficiency, in December 2016, Portugal conducted an assessment of the potential for the application of high-efficiency cogeneration and efficient district heating and cooling, taking into account the premises set out in Annex VIII of this Regulation for a 10-year timeline after the reference year used, within Portugal's case is 2014.

This study analysed the main energy sources of each sector with the aim of summarising energy requirements, more specifically with regard to demand for heating and cooling and thus obtain a detailed assessment. Based on this assessment, the charts indicated in Annex VIII of the Directive were created and a critical analysis of these charts was carried out.

From a brief description of the current situation of cogeneration in Portugal, the technical potential of cogeneration and efficient heating and cooling networks was analysed. The economic potential and an estimate of evolution in this potential were also analysed.

ii.1. Energy requirements - demand for heating and cooling

Demand for heating and cooling was determined based on average values of the needs of each sector, thus defining the heat replaceable by high-efficiency cogeneration.

<u>Agriculture and Fisheries</u>:

Energy consumption for this sector is highly diverse. The preferential areas in agricultural production with greater activity are those where the climate as well as the soils are more propitious and fishing activities are restricted to the coastal area.

<u>Industry:</u>

Industry is not considered dependent on climate variations from region to region as most energy requirements are in the manufacturing process and production itself, therefore it is important to consider the energy consumption patterns in the different sub-sectors.

Unlike agriculture and fisheries, heating in industry has greater weighting than cooling. Most production processes need or produce heat, so a large amount of consumption used in producing this heat could be replaced by cogeneration.

<u>Services Sector:</u>

The Services Sector is fairly diverse and ranges from small commercial units to large shopping centres and hospitals, as well as office buildings, schools, sports facilities, hotels, etc. Services vary in size (area, number of people) and in hours of use, so there is a broad spectrum of variation making it difficult to assess thermal needs per type of sub-sector. Consumption for climate control requirements is also highly influenced by climate area and by the activity the building is intended for.

Energy consumption by the sector is very varied and is normally associated with large towns and cities where there is a greater concentration of companies and services. In general, energy demand for cooling is predominant in this sector and heating needs are quite low.

<u>Residential Sector:</u>

Consumption in the residential sector in Portugal is very low when compared to consumption in other European countries, particularly with regard to consumption for heating and even for cooling. This is due a Portugal's mild climate, however, the situation does vary from region to region.

In terms of final consumption, kitchens contribute the largest parcel with around 39% of final consumption, followed by water heating with 23%. The main source of power for kitchens is electricity while water heating is predominantly LPG bottles. Lighting accounts for only a small amount of energy needs with only 4.5% of consumption and energy use for cooling is minimal.

The short winters and extended warm seasons together with financial limitations also explain why there are so few houses with central heating. There is even a significant number of homes for which there are no records of any type of heating, in any of the regions. A further important aspect refers to the energy source used in heating systems, where electricity is predominant, particularly in the Lisbon region. With the exception of new high-density housing estates, or proximity to services buildings which already have cogeneration, cases which are expected to have limited expression, there is insufficient demand to justify district heating networks for the residential sector.

It should be noted that has been a sharp drop in consumption in the residential sector, with an average rate of -4.4% per year since 2009. This is due to an increase in energy efficiency brought about by multiple measures implemented and the improvement in equipment as well as higher energy prices. Improved efficiency is apparently greater in ambient heating with a reduction of 31.7% from 2000 to 2013, and a drop of around 28.8% in kitchen energy and Domestic Hot Water (DHW).

However, the economic recovery, growth in housing requirements and the growth in the number of electrical appliances will drive new demand for energy in buildings.

Technical potential for high-efficiency cogeneration

Cogeneration units in operation in 2014 provided for 1 759 MW of installed electrical power, and 4 631 MW of thermal power, having produced a total of 7 484 GWh of electrical power and 19 249 GWh of thermal energy, thus corresponding to a T/E ratio of 2.57. Total yield is 79% and the average number 4 349 hours of power use. Applying the assumptions and associated reference values to the Directive, taking into account the fuels used by each unit and system losses with respect to location voltage, results in total savings estimated at 30 740 TJ (0.73 Mtoe) of primary energy, corresponding to savings of 33.5%.

The following table shows a technical potential of cogeneration for the production of heat (estimated based on maximum replacement percentages and values for replacement heat consumption) of approximately 2.7 Mtoe of potentially usable heat. The same table also shows estimates of cooling consumption requirements for Industry, the Residential Sector and Services, resulting in 0.5 Mtoe of final energy which would correspond to between 1.1 Mtoe and 2.2 Mtoe of additional heat to feed absorption *chillers*, thus resulting in 3.8 to 4.9 Mtoe of thermal production from cogeneration.

Assuming an average T/E ratio and an average number of hours of use seen at existing cogeneration units in 2014 (2.57 and 4 349 hours, respectively), the electrical power generated and the installed electrical power would correspond to 12 Tw (2.8 GW) just to satisfy heating requirements and 17.3 Tw to 22 Tw (4.0 GW to 5.1 GW) to meet cooling requirements.

However, achieving all of this potential is unrealistic as it does not take into account the operating schemes of cogeneration units, downtime for maintenance, or basic aspects such as minimum operating power. Therefore, the technical potential will be definitely higher than achievable potential.

Table 29 - Calculation of heating and cooling power to be supplied by cogeneration [Source: DGEG, Study on High-efficiency Cogeneration in Portugal, 2016]

Sector	**General Total**	**Total replaceable thermal energy**	**Replacement potential**		**Cooling consumption (estimate)**
	toe	toe	(%)	toe	toe
Final consumption	**15 166 780**	**3 930 121**	**66.21%**	**2 602 023**	**520 053**
Agriculture and Fisheries	**427 875**	15 124			
Agriculture	*338 172*	11 485	100.00%	11 485	
Fisheries	*89 703*	3 639			
Quarrying industries	**111 645**	28 503			
Manufacturing industries	**4 361 269**	2 811 963			174 451
Foodstuffs, beverages and tobacco	*445 139*	234 813	100.00%	234 813	
Textiles	*254 984*	161 532	81.00%	130 841	
Paper and Paper Items	*1 366 239*	1 062 925	100.00%	1 062 925	
Chemicals and Plastics	*432 372*	227 840	100.00%	227 840	
Ceramics	*268 395*	217 841	7.00%	15 249	
Glass and glass products	*242 745*	197 882	7.00%	13 852	

Cement and lime	*645 081*	493 032	10.00%	49 303	
Metal Working	*46 394*	25 222	19.00%	4 792	
Steel Industries	*165 875*	54 540	30.00%	16 362	
Clothing, Footwear and Leather	*45 625*	18 499	81.00%	14 984	
Wood and wood-based products:	*99 951*	21 818	81.00%	17 673	
Rubber	*35 171*	14 275	100.00%	14 275	
Metal-electrical-mechanical	*243 859*	69 488	69.00%	47 947	
Other manufacturing industries	*69 439*	12 256	81.00%	9 927	
Construction and Public Works	**260 285**	30 593	81.00%	24 780	
Domestic	**5 511 592**	0	0%	0	
Services	**2 552 909**	669 592	60.00%	401 755	2 009
Agriculture and Fisheries	**1 941 205**	374 346	81.00%	303 220	343 593

As such, for purposes of identifying cogeneration potential, the following sub-sectors were considered:

- Sub-sectors of the transformation industry with greater satisfaction potential, both with respect to figures for heating consumption as well as the replaceable heat parcel: Foodstuffs, Beverages and Tobacco, Textiles, Paper and Paper Items, Chemicals and Plastics, Wood and Wood-Based Products, Rubber.
- Services sub-sectors where the use of cogeneration is significant, corresponding to around 40% of electrical and thermal power consumption (excluding road fuels) in this sector.

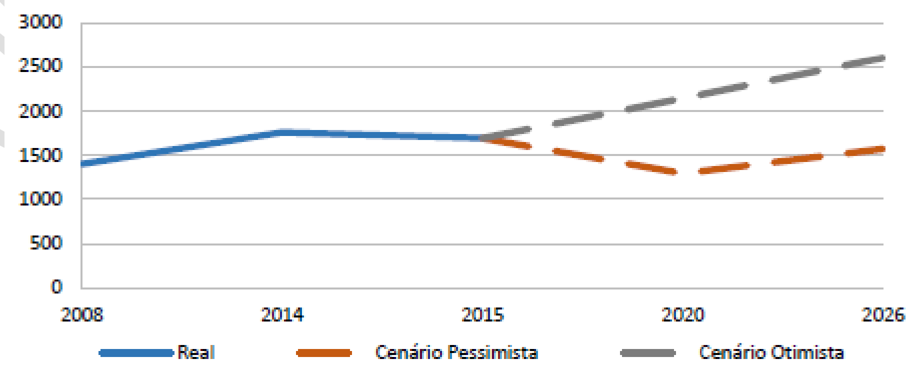
This consumption is around 1.8 Mtoe of potentially usable heat and 0.25 Mtoe of consumption for cooling, which would correspond to between 2.4 Mtoe and 2.9 Mtoe of thermal cogeneration production, or, based on the same assumptions, 11 Tw to 13 Tw of generation (29% of national consumption) and 2.4 GW to 3.0 GW of installed power. This would represent an increase of 700 MW to 1 300 MW in power in relation to current installed power of 1 759 MW.

A slight decrease in this potential can be expected due to the steep fall in consumption forecast for the industry sub-sectors of Pulp and Paper (-7.3%), and the Textiles Industry (-19.4%), precisely the two sub-sectors of greater relevance in cogeneration. There will also be a decrease in consumption for climate control in the Services Sector (-10.9%), notwithstanding a slight rise in overall consumption in this sector (1.7%). Therefore, in 2025 the achievable potential will be 2.2 Mtoe to 2.7 Mtoe in thermal cogeneration, or 10 Tw to 12 Tw of electricity generation and 2.3 GW to 2.8 GW of installed electrical power.

Economic potential for high-efficiency cogeneration

The following figure shows the evolution of economic potential for the period from 2008 to 2026.

Figure 20 - Potential economic evolution scenarios for cogeneration up to 2026 (MWe) [Source: Study on High-efficiency Cogeneration in Portugal, 2016]



Key: Real Pessimistic scenario Optimistic scenario

Taking into account that cogeneration units in operation in 2014 totalled 1 759 MW of installed electrical power, based on existing policies and measures, the evolution of cogeneration would be closer to the pessimistic scenario of the previous graph.

iii. Projections considering existing energy efficiency policies, measures and programmes as described in point 1.2.(ii) for primary and final energy consumption for each sector at least until 2040 (including for the year 2030)

Presented in Table 30 is the forecast evolution in total primary energy consumption in Portugal.

Table 30 - Forecast evolution in total primary energy consumption in Portugal. Scenario Existing Policies [Source: DGEG]

	2020	2025	2030	3035 (sic)	2040
Total primary energy consumption	22.9	23.8	23.9	24.9	25.4
Total Primary Energy Consumption without non-energy uses	21.9	22.7	22.7	23.7	24.2

Shown in Table 31 is the forecast for Final Energy Consumption per type and source and per sector of activity in Portugal.

Table 31 - Forecast for Final Energy Consumption per type and source and per sector of activity in Portugal (ktoe): Scenario Existing Policies [Source: DGEG]

	2020	2025	2030	3035 (sic)	2040
Total Final Energy Consumption	16 412	17 043	17 385	17 754	17 876
Oil	8 103	8 250	8 183	8 075	7 668
Electricity	4 172	4 474	4 753	5 083	5 445
Natural gas	1 712	1 786	1 837	1 892	1 954
Renewables	1 060	1 123	1 166	1 209	1 255
Heat	1 257	1 299	1 326	1 359	1 395
Other (includes hydrogen)	108	111	120	136	160
Total Primary Energy Consumption without non-energy uses	15 382	15 946	16 246	16 575	16 655
Transport	5 591				
National Air Transport	92	102	113	124	137
National Sea Transport	88	92	95	97	99
Railway transport	40	39	39	40	40
Road Transport	5 371	5 463	5 455	5 459	5 182
Industry	4 642	4 798	4 899	5 017	5 152
Domestic	2 707	2 880	2 999	3 116	3 240
Services	2 034	2 152	2 218	2 282	2 354
Agriculture and Fisheries	407	420	429	439	451

iv. Cost-optimal levels of minimum energy performance requirements resulting from national calculations, according to Article 5 of Directive 2010/31/EU

Directive 2010/31/EU on the energy performance of buildings, known as EPBD (Energy Performance of Buildings Directive), requires Member States to apply a comparative methodology to the calculation of cost-optimal performance levels for minimum energy performance requirements in buildings and components of buildings, with a view to maintaining national regulations up to date. A specific goal is for the energy performance of reference buildings in regulations is to not exceed 15% of the calculated cost-optimal levels of minimum energy performance requirements.

In Annex I, Delegated Regulation (EU) No 244/2012 which complements the EPBD, requires Member States to define reference buildings for single family buildings, apartment blocks and multi-family buildings, office buildings and also for other categories of non-residential buildings set out in Annex I, point 5, subparagraphs (d) to (i) of the EPBD, for which specific energy performance requirements exist.

In Portugal, regulatory requirements for the energy performance of buildings are established in several different Ministerial Implementing Orders and Official Orders associated to Decree-Law No 118/2013 of 20 August 2013 which lays down the National Building Certification System (SCE), the Energy Performance Regulations for Housing (REH) and the Energy Performance Regulations for Trade and Services Buildings (RECS).

With a view to meeting EPBD requirements in relation to cost-optimal issues, a series of studies was conducted on residential buildings, offices and hotels.

In general terms it was concluded that:

- Cooling needs are always greater than heating needs;
- Although the application of thermal insulation provides improvements in performance, it does not bring advantages to the overall cost of optimal solutions;
- The cost-optimal solutions encountered have lower thermal insulation indices than those set out in legislation;
- Solutions in glass with more demanding solar factor, with exterior shading correspond to lower energy consumption;
- However, the most efficient cost-optimal solution is double glazing in colourless glass with exterior shading;
- Cooling needs are significantly decreased when LED lighting is used, and the respective consumption also falls;
- The climate control system which has lowest energy consumption is S5 (VRV) (EV3 and EV18). The initial cost of this system is higher and although the corresponding COP and EER values are more efficient, the energy savings do not offset the investment;
- Ventilation solutions without heat recovery have the lowest energy consumption.

It should be noted that the reference building was chosen based on certificates analysed for hotels built before 1990. This resulted in a more compact shape with a consequent lower shape factor (envelope area/surrounding volume ratio). This aspect could explain why insulation-free solutions were cost-optimal.

The finding that no cost-optimal advantages are achieved with the solution using heat recovery is due to two main factors:

- Greater cooling requirements in the warm seasons;
- Height of buildings causing greater losses in extraction and subsequent increase in ventilator consumption.

Based on the methodology adopted, for average energy cost scenarios with a discount rate of 3% and an economic life cycle of 20 years, the overall cost for the variants selected were determined. The cost-optimal variant has an overall financial cost of between 388 €/m² in Faro and 425€/m² in Porto.

From a comparative analysis between optimal performance levels and regulatory requirements, it was concluded that the reduction in primary energy consumption of the cost-optimal variant, in relation to the reference building is 33% to 35%. This means that a review of construction solutions and minimum requirements for major renovation work on hotels built before 1990 is advised. Space exists to increase the regulatory requirements of the National Building Certification System (SCE) for major renovation in hotels.

4.4. Dimension Energy security

Current energy mix, domestic energy resources, import dependency, including relevant risks

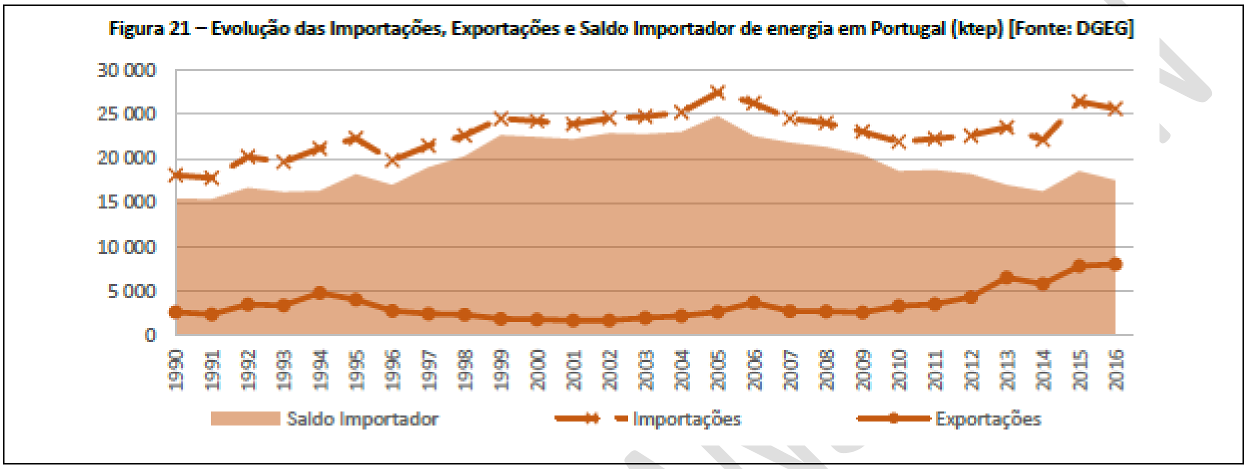
Current energy mix and domestic energy resources

Portugal does not have oil, natural gas or coal reserves. This means that these products are imported from third countries.

The energy import balance has fallen in recent years reversing the trend seen up to 2005. From 2007-2016 the AAGR was -2.4% while from 1997-2006 it was 1.9%. The reduction in the import balance, which has a positive impact in reducing external energy dependency and as a result, lower energy bills for the country, was brought about through the increase in domestic energy production.

This increase was particularly due to endogenous renewable sources, which led to a reduction in the imports of coal and natural gas to produce electricity. The increase in production capacity at national refineries, which provided greater response for internal consumption, also contributed to the reduction in oil product imports, and as a result, an improved import balance.

Figure 21 - Evolution in Imports, Export and Energy Import Balance in Portugal (ktoe) [Source: DGEG]



Key: Import Balance Imports Exports

Table 32 - - Imports, Exports and Energy Import Balance in Portugal (ktoe) [Source: DGEG]

	2014	2015	2016	*% 2014/2015*	*% 2015/2016*
Imports	22 125	26 442	25 630	*+19.5%*	*-3.1%*
Exports	5 824	7 851	8 073	*+34.8%*	*+2.8%*
Import Balance	16 301	18 591	17 556	*+14.0%*	*-5.8%*

In 2016 total imports of crude stood at 13.9 Mton (14 257 ktoe), representing a reduction of 0.8% over 2015. This was due to a slight fall in activity in the refinery sector. In 2016, the main origins of these imports were Angola (22%), Russia (20%), Azerbaijan (11%) and Kazakhstan (10%). There was less diversification of origins and no imports were recorded from Nigeria or the DR Congo. Only 1.5% of total imports originated in EU countries.

- In 2016, oil product imports totalled 3.5 Mton (3 493 ktoe), representing a reduction of 6.3% over 2015, and mainly involved diesel (27%), intermediate products (22%), LPG (19%) and petroleum coke (10%). Of note is the significant increase in imports of diesel, asphalts, aviation fuel and solvents, contrasting with a significant reduction in imports of jet fuel and naphtha. The main origins of oil product imports in 2015 were Spain (40.7%), Russia (20,6%) and the USA. (9.4%), where 66% of imports originated in EU countries.
- In 2015, coal imports totalled approximately 5.1 Mton (3 041 ktoe), representing a reduction of 8.4% when compared to 2015. Almost all of the coal originated in Colombia (92%). With respect to 2015, no imports from Russia were recorded.
- In 2016, imports of natural gas totalled approximately 4.9 109 Nm3 (4 278 ktoe), 32% of which was via LNG, 67% via gas pipeline and a small amount by tanker truck. With respect to 2015, imports increased 4.9%, and main countries of origin were Algeria (50%), Nigeria (18%) and Qatar (8%). No imports were recorded from EU countries. In 2016, LNG was imported from the USA (2% of all imports).
- In relation to electricity, in 2015 imports totalled 4 616 GWh (397 ktoe), representing a reduction of 42.9% over 2015. Portugal only imports electricity from Spain.

- Imports of renewables, which in 2016 involved mainly biomass (wood and plant waste) and biofuels, totalled 130 ktoe, representing a reduction of 9.72% over 2015.

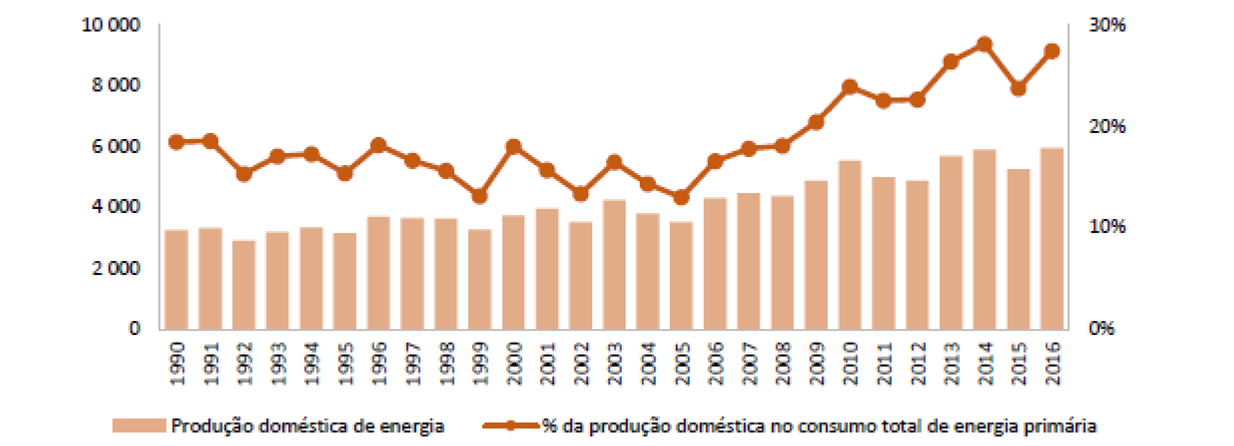
Analysis of energy product exports:

- With respect to oil products, in 2016 exports totalled approximately 7.5 Mton (6 768 ktoe), representing an increase of 7.6% over 2015. Exports mainly involved diesel (28%), fuel oil (23%) and petrol (19%). Of note is the significant increase in exports of biodiesel, naphtha and solvents. The main destinations of Oil Product Exports in 2016 were Spain (27%), U.S.A. (15%) and Holland (11%), and 62% of imports originated in EU countries.
- In relation to electricity, in 2016 exports totalled 9 701 GWh (834 ktoe), representing an increase of 66.9% over 2015. Portugal only exports electricity to Spain.
- Exports of renewables (biomass and biofuels) in 2016 totalled approximately 343 ktoe, representing a reduction of 2.6% over 2015.

Domestic energy production has grown in recent years, recording an AAGR of 3.3% from 2007 to 2016, higher than the growth seen in the previous decade (1.8% from 1997 to 2006). The increase in domestic energy production has had a positive impact on reducing external energy dependency through lower imports of coal and natural gas to produce electricity.

In 2016, domestic energy production was 5 949 ktoe, representing an increase of 13.5% over 2015, as a result of a highly favourable hydrological year with greater availability of hydro resources to produce electricity. With respect to PEC, domestic energy production represented around 27% (+3.6 p.p. over figures for 2015). In the last decade from 2007-2016, domestic production represented an average of approximately 23% of PEC against an average of 15% in the period from 1997 to 2006.

Figure 22 - Evolution of Domestic Energy Production in Portugal (ktoe) [Source: DGEG]



Key:
Domestic energy production % of domestic production in total primary energy consumption

Breakdown of domestic energy production by type of source. Of note is biomass which represented around 45% of total production in 2016, followed by hydro (24%) and wind (18%).

Table 33- Domestic energy production in Portugal per type of source (ktoe) [Source: DGEG]

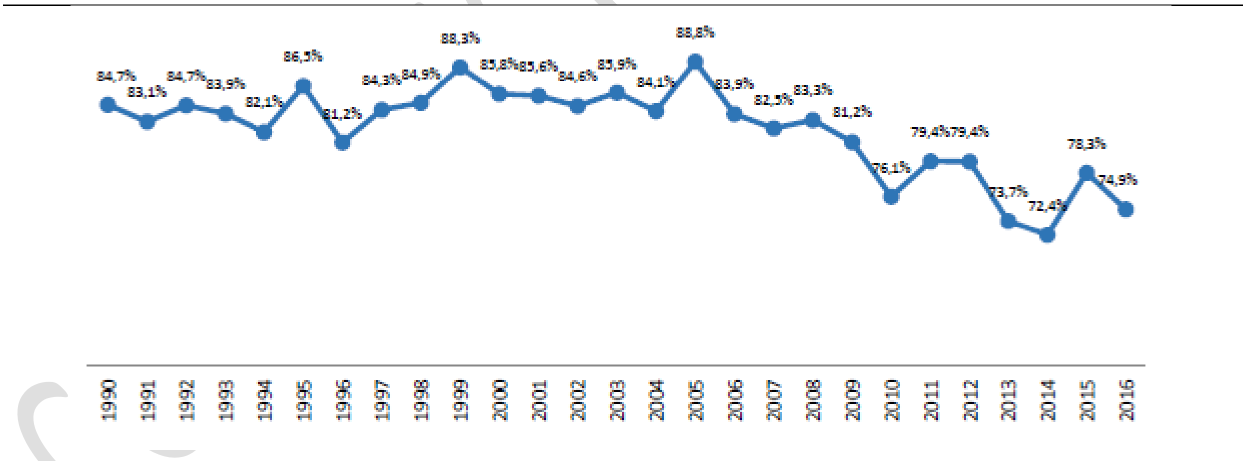
	2014	2015	2016	% 2014/2015	% 2015/2016
Domestic energy production	**5 880**	**5 243**	**5 949**	*-10.8%*	*+13.5%*
Hydro	1 411	843	1 454	*-40.3%*	*+72.5%*
Wind	1 042	998	1 073	*-4.2%*	*+7.5%*
Solar	131	149	155	*+13.5%*	*+4.0%*
Geothermal	18	18	15	*-0.9%*	*-16.7%*
Biomass[37]	2 701	2 677	2 672	*-0.9%*	*-0.2%*
Biogas	82	83	80	*+0.7%*	*-3.6%*
Biofuels	301	321	298	*+6.5%*	*-7.2%*
Other[38]	195	155	203	*-20.1%*	*+31.0%*
% of domestic production in PEC	28.1%	23.8%	27.4%	*-4.3 p.p.*	*-4.3 p.p.*

i.2. Energy dependency

One of the main challenges and the goal of current national energy policy is to reduce external energy dependency. Historically, Portugal has had high energy dependency of between 80% and 90%, as the country has no fossil fuels such as oil or natural gas, which have a significant weighting in the energy mix. The focus on renewable energies and energy efficiency in recent years has allowed Portugal to lower dependency to less than 80%. However, variability in hydro production, which accounts for a large share of national electricity production, worsens energy dependency in dry years, as was the case in 2005 and 2008.

In 2016, energy dependency stood at 74.9%, representing a reduction of 3.4 p.p. over 2015 and a reduction of 13.9 p.p. with respect to 2005, a year which saw the highest figure for energy dependency in recent years. This reduction in energy dependency is mostly due to greater production of electricity from renewable sources, particularly hydro and wind, leading to a reduction in use of coal to produce electricity with direct impact on reducing imports. A further factor which contributes to the reduction in energy dependency is the fall in oil product imports.

Figure 23 - Evolution in Portugal's External Energy Dependency [Source: DGEG]



i.3. Relevant risks for energy supply in Portugal

As already mentioned, Portugal does not exploit or produce coal, oil or natural gas, and as such, the supply of these energy sources to the Portuguese market is exclusively via imports from third countries.

The Herfindahl Hirschman Index applied to supply sources (HHIs) allows concentration of energy sources to be measured and consequently the level of diversification. The lower the value (on a scale of 0 to 1)[39],[39] the lower the degree of concentration, and therefore, the higher the degree of diversification of supply sources will be.

37 Includes Firewood and Plant Waste, Solid Urban Waste and Sulphite Liqueurs.

38 Includes Non-Renewable Waste and Other Renewables.

- In the case of coal, the HHIs in 2016 was 0.847 showing a high degree of supplier concentration, as Portugal had imported around 92% of the coal it used that year from a single supplier, Colombia. As the main supplier of coal does not pose great geopolitical risk, no significant disruptions are expected to take place. Moreover, after 2030 Portugal's two coal fired plants are to be decommissioned.
- In the case of crude, the HHIs in 2016 was 0.135 showing a low degree of supplier concentration. With regard to crude imports, Portugal has a highly diversified portfolio of suppliers. The main supplier accounted for 22% of oil imports in 2015. It should be noted that the main suppliers do not currently present significant geopolitical risks, and as such, no major disruptions to supply are forecast.
- In the case of oil products, the HHIs in 2016 was 0.239 showing a moderate degree of supplier concentration. With regard to oil product imports, Portugal has a highly diversified portfolio of suppliers. However, the main supplier accounted for 43% of oil imports in 2016. It should be noted that the main suppliers do not currently present any significant geopolitical risks, and as such, no major disruptions to supply are forecast.
- In the case of natural gas, the HHIs in 2016 was 0.336 showing a high degree of supplier concentration. With regard to natural gas imports, Portugal has a moderately diversified Portfolio of suppliers. The main supplier accounted for 50% of natural gas imports in 2016. It should be noted that the main suppliers present some geopolitical risks, in the case of Nigeria and Algeria. However, storage capacity exists and it is also possible to use the spot market to overcome possible failures in supply, and as such, no major disruptions to supply are forecast.

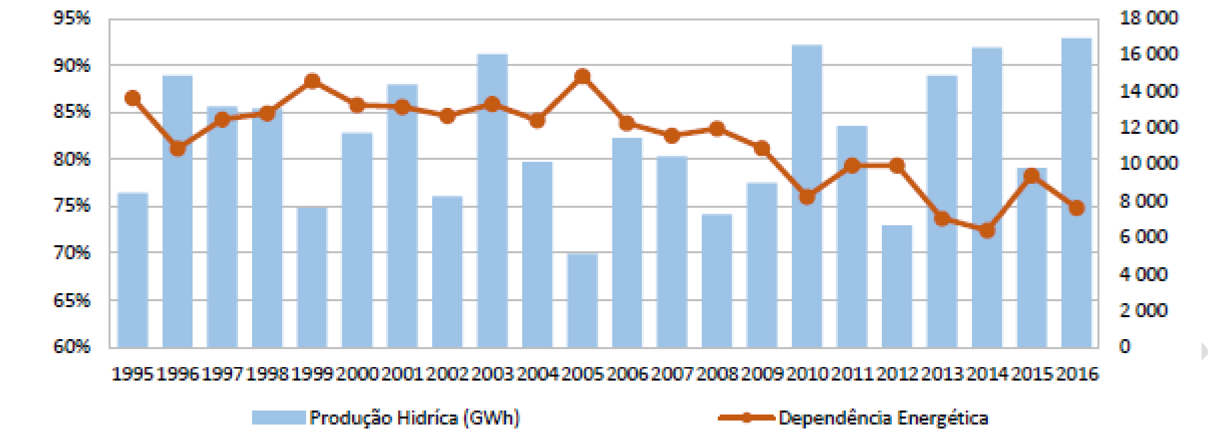
To assess issues relating to supply security and the proper functioning of the natural gas market, a Risk Assessment is carried out on the National Natural Gas Transmission System (SNGN). This assessment, which was undertaken every two years, but is now conducted every four years, after the publication of Regulation (EU) 2017/1938 of 25 October (see point 2.3 of this Plan), takes into consideration relevant national and regional circumstances, such as market size, network configuration, the input and output flows of the Member State, the presence of storage and the role of gas in the energy mix, focusing particularly on the use of gas for the production of electricity and the functioning of industry. The assessment involves scenarios of exceptionally high demand and disruptions to gas supply caused by failures in the supply infrastructure. After the Risk Assessment is carried out, a Preventive Action Plan is drawn up to define suitable measures to eliminate or attenuate the risks identified in SNGN risk scenarios, as well as an Emergency Plan which details measures to be taken during differing levels of crisis. This plan attributes responsibilities to those involved in the system so as to be able address the risk events identified and safeguard supply. It should be remembered that in accordance with the abovementioned regulation, the preparation of a common regional risk assessment is also provided for to identify and study the main risks affecting specific EU regions (referred to as Risk Groups).

The degree of diversification in supply points, measured through the Herfindahl Hirschman Index applied to capacity (HHIc) allows the degree of concentration of entry points in the Natural Gas Transmission System to be measured (on a scale of 0 to 1) and as such, the degree of capacity diversification provided to market agents and suppliers working in system supply. The lower the HHI value, the larger the degree of diversification of the supply points. In 2016, the HHIc was 0.560 showing a moderate degree of concentration of gas entry points in Portugal.

Historically, hydro power plants have always played a significant role in electricity production in Portugal. In 2016, the weighting of hydro power in gross electricity production was 28%, contrasting with 19% in 2015. This difference was due to 2016 being considered a wet year (IPH = 1.33) while 2015 was considered a dry year (IPH = 0.74). When there is less availability of hydro resources to produce electricity in dry years, Portugal has higher energy dependency as it has to import natural gas and coal. This leads to greater energy dependency and an increase in the energy bill. In recent years, there has been diversification of renewable sources for electricity production, particularly wind and the construction of new reversible hydro plants with pumping equipment allowing excess wind production produced at times of lower consumption to be used enabling energy to be stored for use at times of greater consumption. This diversification has allowed the impact of dry years on the electricity production system to be attenuated. The following figure shows the evolution in external energy dependency compared to gross hydro electricity production.

[39] HHIs < 0.15: Limited number of suppliers; 0.15 < HHIs < 0.25: Moderate number of suppliers; HHIs > 0.25: High number of suppliers;

Figure 24 - Relationship between external energy dependency and the production of hydro energy [Source: DGEG]



Key: Hydro Production (GWh) Energy Dependency

Applying the Herfindahl Hirschman Index (HHIc) to the supply capacity of the national Electricity Production System, it can be seen that in 2016 the HHIc was 0.232 showing a moderate degree of concentration in the sources of electricity production in Portugal.

With regard to other potential risks in the electricity sector, the production concentration index is assessed. The market share of the largest electricity producer in 2016 was approximately 47%, meaning that a single producer of electricity accounts for 47% of all electricity production. In the future, the European Regulation on preparation for risks in the electricity sector (publication expected at the end of 2018) will require risk assessment and crisis scenarios to be conducted. Plans will also be required to prepare for such risks by defining measures to be implemented to prevent and respond to supply disruption situations (see point 2.3 in this Plan).

i.4. National Electricity Production System

In 2016, the **national Electricity Production System** recorded gross electricity production of 60.3 Tw, representing a rise of 15.0% over 2015. 56% of total production came from renewable sources with greater incidence on hydro and wind power which together represented around 49% of all national electricity production in 2016, followed by coal (21%) and natural gas (21%). In the last decade, 2007-2016, total electricity production had an AAGR of 2.7%, while renewable production and non-renewable thermal production recorded AAGR of 8.1% and -1.5%, respectively. Of note is the fact that Portugal registered an export balance of 5 085 GWh in 2016, brought about by greater availability of renewable resources, particularly hydro, and a significant increase in electricity demand in Spain and France caused by the highly significant reduction in the contribution from nuclear power plants. Although production of electricity by cogeneration plants has fallen year after year, it still plays a significant role as it accounted for around 12% of electricity produced in Portugal in 2016.

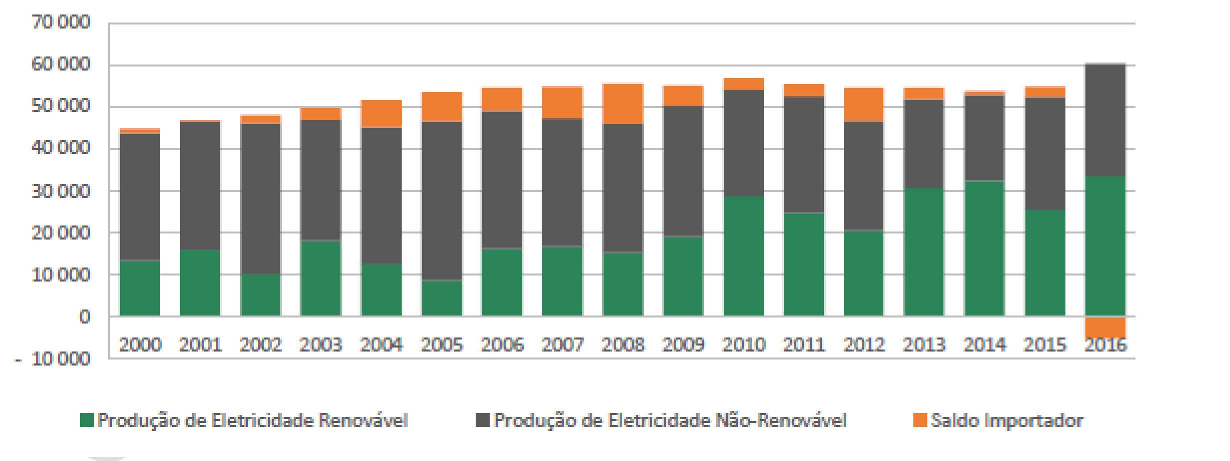
Table 34 - Gross Electricity Production in Portugal (GWh) [Source: DGEG]

	2014	2015	2016	*% 2014/2015*	*% 2015/2016*
Gross electricity production	**52 803**	**52 424**	**60 278**	*-0.7%*	*+14.7%*
Thermal non-renewable	20 399	26 910	26 831	*+31.9%*	*-0.3%*
Coal	11 952	14 727	12 630	*+23.2%*	*-14.2%*
Oil	1 484	1 312	1 299	*-11.6%*	*-1.0%*
of which in cogeneration	*616*	*466*	*420*	*-24.4%*	*-9.9%*
Natural gas	6 708	10 563	12 582	*+57.5%*	*+19.1%*
of which in cogeneration	*5 076*	*4 957*	*4 827*	*-2.3%*	*-2.6%*
Other non-renewables	255	308	320	*+20.8%*	*+3.9%*
of which in cogeneration	*14*	*16*	*15*	*+14.3%*	*-6.3%*
Renewable	32 404	25 514	33 447	*-21.3%*	*+31.1%*
Hydro	16 412	9 800	16 909	*-40.3%*	*+72.5%*
Wind	12 111	11 608	12 474	*-4.2%*	*+7.5%*
Biomass:	3 049	3 104	3 070	*+1.8%*	*-1.1%*
of which in cogeneration	*1 778*	*1 738*	*1 738*	*-2.2%*	-
Solar	627	799	822	*+27.4%*	*+2.9%*
Geothermal	205	204	172	*-0.5%*	*-15.5%*
Own consumption from power plants	1 276	1 480	1 469	*16.0%*	*-0.7%*
Hydro power pumping	1 081	1 460	1 520	*35.1%*	*+4.1%*
Import balance	902	2 266	-5 085	*151.2%*	*-324.4%*
Transmission and Distribution Losses	5 208	4 890	4 881	*-6.1%*	*-0.2%*
% RES (real)	61.6%	47.9%	55.5%	*-13.6 p.p.*	*+7.6 p.p.*
% of electricity production by cogeneration	14.2%	13.7%	11.6%	*-0.5 p.p.*	*-2.1 p.p.*
Available for Final Consumption	**46 140**	**46 860**	**47 323**	*+1.6%*	*+1.0%*

NOTE: Other non-renewables include industrial waste and the non-renewable part of solid urban waste. Biomass includes plant/forestry waste, sulphite liqueurs, biogas and the renewable part of solid urban waste.

NOTE: Renewable production includes production from wave power.

Figure 25 - Evolution in Gross Electricity Production and the Import Balance in Portugal (GWh) [Source: DGEG]



Key:

Production of Renewable Electricity

Production of Non-Renewable Electricity

Import Balance

In the renewable component of electricity production, hydro power accounted for around 51%, followed by wind with 37%, biomass with 9%, solar with 2% and geothermal, which is only produced in the Azores, with 1%. In the non-renewable component, coal and natural gas have equal weighting of 47%, while oil, used mainly for electricity production in the Autonomous Regions of Madeira and the Azores, represents only 5%.

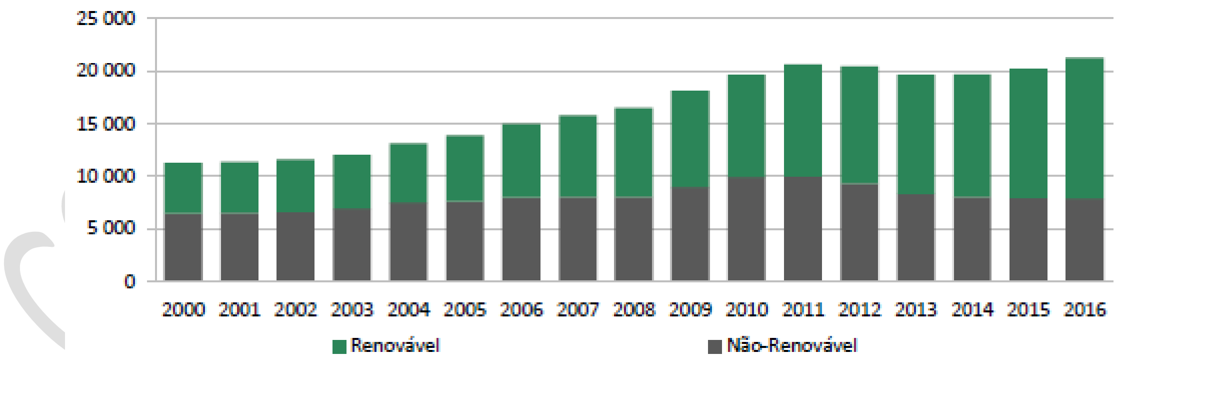
In 2016, Portugal recorded a total of 21 276 MW of installed capacity for electricity production, around 63% (13 388 MW) of which came from renewable technologies. This represents an increase of 5.3% over 2015, the equivalent of 1 075 MW, mainly as a result of the entry into operation of a new hydro power plant. Around 32% (6 838 MW) or total installed capacity corresponds to hydro power plants, with an important pumping component allowing excess production of approximately 25% (5 313 MW) of wind and approximately 24% (5 001 MW) of natural gas powered production to be stored. In the last decade, 2007-2016, an increase of 5.5 GW total installed capacity for electricity production was recorded, which in the case of renewables was 5.6 GW, while non-renewable thermal production saw a slight decrease of around 70 MW.

Table 35 - Installed capacity for electricity production per type of source in Portugal (MW) [Source: DGEG]

	2014	2015	2016	*% 2014/2015*	*% 2015/2016*
Total Installed Capacity	**19 682**	**20 201**	**21 276**	*+2.6% (+519 MW)*	*+5.4% (+1 075 MW)*
Thermal non-renewable	8 003	7 908	7 887	*-1.2% (-96 MW)*	*-0.3% (-20 MW)*
Coal	1 871	1 871	1 871	-	-
Oil	1 109	1 073	1 016	*-3.3% (-36 MW)*	*-5.3% (-57 MW)*
of which in cogeneration	*375*	*339*	*271*	*-9.6% (-36 MW)*	*-20.0% (-68 MW)*
Natural gas	5 023	4 964	5 001	*-1.2% (-59 MW)*	*+0.7% (+37 MW)*
of which in cogeneration	*961*	*905*	*942*	*-5.9% (-57 MW)*	*+4.1% (+37 MW)*
Renewable	11 679	12 293	13 388	*+5.3% (+615 MW)*	*+8.9% (+1 095 MW)*
Hydro	5 572	6 054	6 838	*+8.7% (+482 MW)*	*+12.9% (+784 MW)*
of which in pumping	*1 406*	*1 776*	*2 711*	*+26.3% (+370 MW)*	*+52.6% (+935 MW)*
Wind	4 953	5 034	5 313	*+1.6% (+81 MW)*	*+5.5% (+279 MW)*
Biomass:	706	726	742	*+2.8% (+20 MW)*	*+2.2% (+16 MW)*
of which in cogeneration	*423*	*436*	*442*	*+3.1% (+10 MW)*	*+3.2% (+14 MW)*
Solar	419	451	467	*+7.6% (+32 MW)*	*+3.6% (+16 MW)*
Geothermal	29	29	29	-	-
% RES	59.3%	60.9%	62.9%	*+1.6 p.p.*	*+2.0 p.p.*
% of cogeneration	8.9%	8.3%	7.8%	*-0.6 p.p.*	*-0.5 p.p.*

NOTE: Oil heavy fuel, refinery gas, diesel, industrial waste and propane. Biomass includes plant/forestry waste, sulphite liqueurs, biogas and solid urban waste (renewable part)

Figure 26 - Evolution in installed capacity for electricity production in Portugal per type of source (MW) [Source: DGEG]



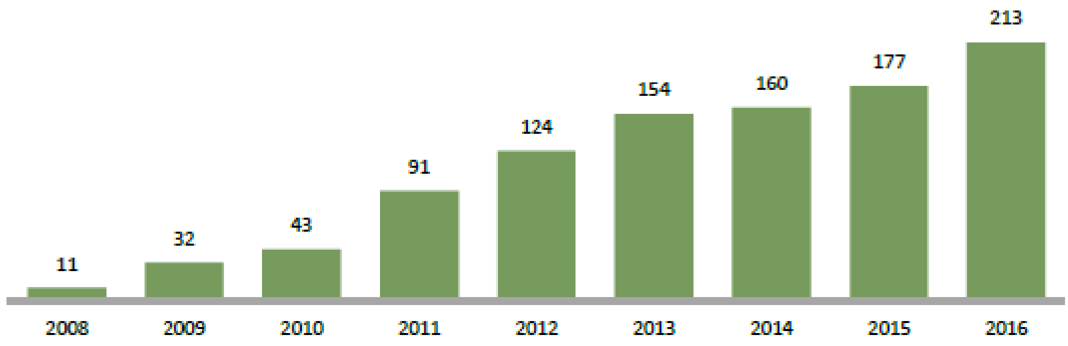
Key: Renewable Non-Renewable

In the renewable component of installed electricity production capacity, hydro power accounted for around 51%, followed by wind with 40%, biomass with 6%, solar with 3% and geothermal, located only in the Azores, with 0.2%. In the non-renewable thermal component, natural gas accounted for 63% of capacity, coal 24% and oil, used mainly in the Autonomous Regions, representing 13%. The figure below shows the mix of installed capacity for the production of electricity in Portugal in 2016.

Portugal has focused on the decentralised production of energy through production units and a single legal framework exists for the production of electricity, intended for consumption at the installation of use associated with the respective production unit, with or without connection to the Public Service Electricity Network (RESP). This production is based on renewable or non-renewable technologies and includes the production of electricity by small-power renewable resources, sold in total to (RESP). Production via decentralised production units corresponds to the production of electrical power as provided for in Decree-Law No 153/2014 of 20 October 2014, on a local level at the consumption installation (housing or industry), allowing production to be distributed. Production units are broken down into two schemes: (i) Own final consumption (Own Final Consumption Production Units - UPAC), meeting the installation's consumption needs, and where

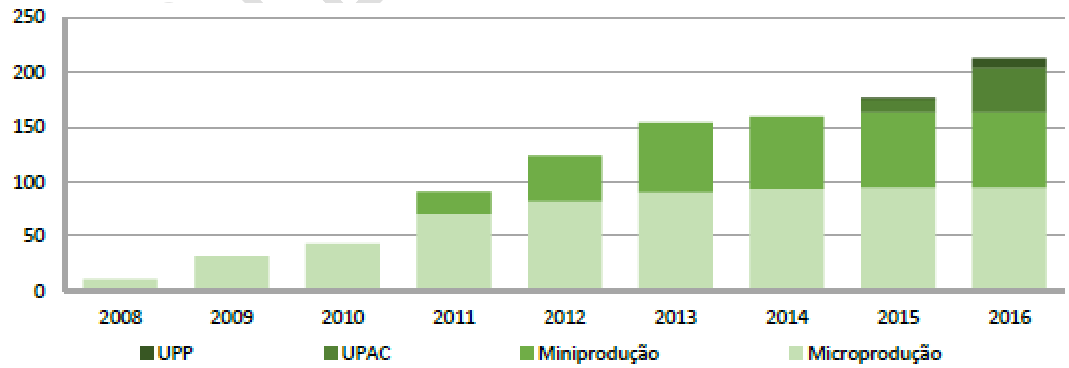
any surplus production may be input into the network, and (ii) Small-Scale Production (Small-Scale Production Units - UPP) where all power produced is sold directly to the network. At the end of 2016, the installed capacity of decentralised production which, in addition to UPP and UPAC, includes the former mini-production and micro-production schemes, totalled approximately 213 MW, as can be seen in the following figure.

Figure 27 - Evolution in installed capacity for electricity production through PU in Portugal (MW) [Source: DGEG]



With regard to the different decentralised production schemes, at the end of 2016, there was around 95 MW of installed capacity in micro-production, around 68 MW in mini-production, around 48 MW in UPAC and around 40 MW in UPP. The evolution of this capacity is shown in the following figure.

Figure 28 - Evolution in installed capacity for electricity production through PU in Portugal per type of scheme (MW) DGEG]



Key: UPP UPAC Mini-production Micro-production

The production of thermal energy in Portugal is exclusively via cogeneration plants. In 2016, total heat production was around 61.7 EJ, representing a reduction of 4.5% over 2015. Most of this production is for industrial processes and the production of heat in industry represented almost all thermal power production in 2016. Most of the heat produced is intended for local consumption, except for a few rare exceptions where heat feeds consumption points close to the production centres. Around 60% of total heat produced in 2016 came from renewable sources, in this case, biomass.

Table 36 - Thermal energy production in Portugal (TJ) [Source: DGEG]

	2014	2015	2016	*% 2014/2015*	*% 2015/2016*
Total Thermal Energy Produced	**62 344 751**	**64 657 685**	**61 733 267**	*3.7%*	*-4.5%*
Per type of source:	-	-	-	-	-
Oil	5 219 707	8 284 939	2 074 292	*58.7%*	*-75.0%*
Natural gas	23 608 636	21 538 137	22 855 388	*-8.8%*	*+6.1%*
Biomass:	33 516 409	34 834 609	36 803 587	*+3.9%*	*+5.7%*
% RES	53.8%	53.9%	59.6%	*+0.1 p.p.*	*+5.7 p.p.*
% of cogeneration	100%	100%	100%	-	-

NOTE: Distribution was via the main fuel used at the plant. In other words, even if a plant uses more than one fuel, the thermal power produced was all attributed to a single fuel.

Total energy consumption for the production of electricity and heat in 2016 stood at 7 328 ktoe, representing a slight decrease of 1.1% over 2015, 39% of which corresponds to use of coal, 33% natural gas, 22% biomass, 4% oil and 2% of non-renewable waste.

ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

Table 37 - Forecast evolution in installed capacity in the national Electricity Production System per type of source in Portugal (GW): Scenario Existing Policies [Source: DGEG]

	2015	2020	2025	2030	2035	2040
Thermal non-renewable	5.7	5.7	5.7	3.9	3.9	3.9
Renewable	11.7	14.7	17.1	18.0	18.0	18.1
Hydro	6.0	7.0	8.2	9.0	9.0	9.0
Wind	0.4	1.8	2.8	2.9	3.0	3.0
Solar	5.0	5.4	5.6	5.6	5.6	5.6
Other Renewables [1]	0.3	0.5	0.5	0.5	0.5	0.5
TOTAL [2]	17.4	20.4	22.7	21.9	21.9	22.0

[1] Includes Biomass, Biogas, Waste (50% of production via waste is not renewable), Geothermal and Wave

[2] Does not include cogeneration

4.5. Dimension Internal Energy Market

4.5.1. Electricity interconnections

i. Current interconnection level and main interconnections

With regard to RNT electricity interconnections, Portugal currently has six 400 kV lines and three 220 kV lines which connect Portugal and Spain, as can be seen in the following table.

Table 38 - Technical capacity of VHV interconnection lines between Portugal (PT) and Spain (ES) at 31/12/2017 [Source: REN, 'Indicative interconnection capacities for commercial purposes in 2017']

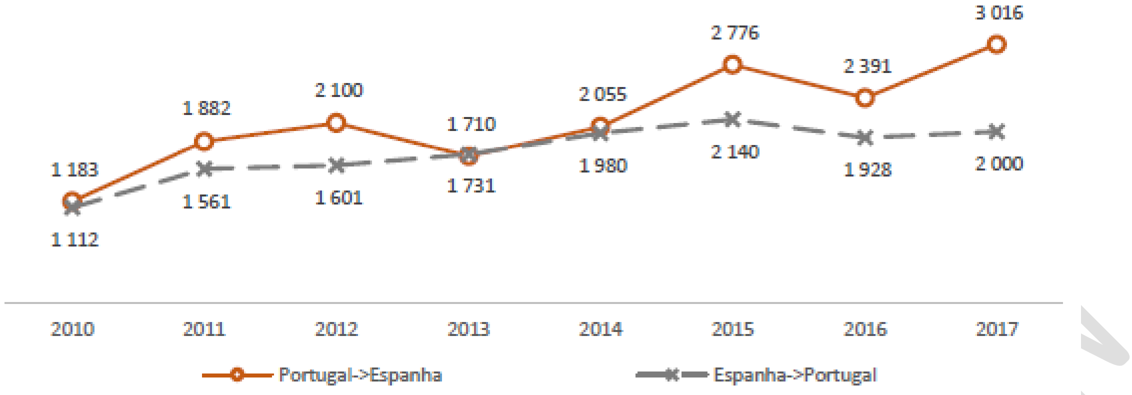
Interconnection	Voltage level (kV)	Winter capacity (MVA)	Summer capacity (MVA)
Alto Lindoso (PT) - Cartelle 1 (ES)	400	1 386	1 386
Alto Lindoso (PT) - Cartelle 2 (ES)	400	1 386	1 386
Lagoaça (PT) - Aldeadávila 1 (ES)	400	1 706	1 469
Falagueira (PT) - Cedillo (ES)	400	1 386	1 300
Alqueva (PT) - Brovales (ES)	400	1 386	1 280
Tavira (PT) - Guzman (ES)	400	1 386	1 386
Pocinho (PT) - Aldeadávila 1 (ES)	220	435	374
Pocinho (PT) - Aldeadávila 2 (ES)	220	435	374
Pocinho (PT) - Saucelle (ES)	220	430	360
Lindoso (PT) – Conchas (ES)[40]	130	131	90

Commercial interconnection capacity for electricity between Portugal and Spain has evolved favourably in recent years so as to satisfy requests from the Iberian Electricity Market (MIBEL)[41]. In 2017, the average commercial interconnection capacity was around 3 016 MW in the Portugal-Spain direction and around 2 000 MW in the Spain-Portugal direction, as can be seen in the following graph.

40 Line which under normal operation scheme is disconnected.

41 Note: Commercial interconnection with Spain (NTC 'Net Transfer Capacity') is defined as free capacity for commercial electrical power transactions between Portugal and Spain. In accordance with that stipulated by ENTSO-E, NTC represents the minimum most probable value of free commercial exchange capacity, imposed by transmission network restrictions. NTC is determined in accordance with assumptions for network functioning scenarios in a market environment in which there are conditions of acceptability and operational security of the interconnected Iberian system in contingency situations in line with previously established criteria. It should be noted that the figure for commercial capacity does not always arise from network restrictions, but from other conditions including the limitations of Portuguese and/or Spanish electricity production facilities and the value of consumption available to be supplied to the market.

Figure 29 - Evolution in the annual average value of commercial interconnection capacity between Portugal and Spain (MW) [Fonte: REN]



Key: Portugal>Spain Spain>Portugal

With regard to interconnection to comply with COM, which requires 10%[42] of electricity interconnection by 2020 and 15% by 2030, Portugal has recorded favourable evolution, as can be seen in the following table.

Table 39 - Ratio between interconnection capacity and installed capacity in the electricity production system in Portugal [Source: REN, analysis DGEG]

	2010	2011	2012	2013	2014	2015	2016	2017
Portugal– Spain[43]	5.0%	6.6%	6.9%	7.7%	8.9%	9.2%	7.9%	8.1%

However, although Portugal has seen favourable evolution with regard to the level of interconnection with Spain, this has not been the case in relation to interconnection between the Iberian Peninsula and France, which is still far from achieving 10% by 2020, as is shown in the following table. The ambition of Portugal and the Iberian Peninsula, to ensure an effective and robust connection to the European energy market is compromised due to the bottleneck which continues to exist in the interconnection between Spain and France through the Pyrenees.

Table 40 - Ratio between interconnection capacity and installed capacity in the electricity production system between the Iberian Peninsula and France [Source: REN, REE, analysis DGEG]

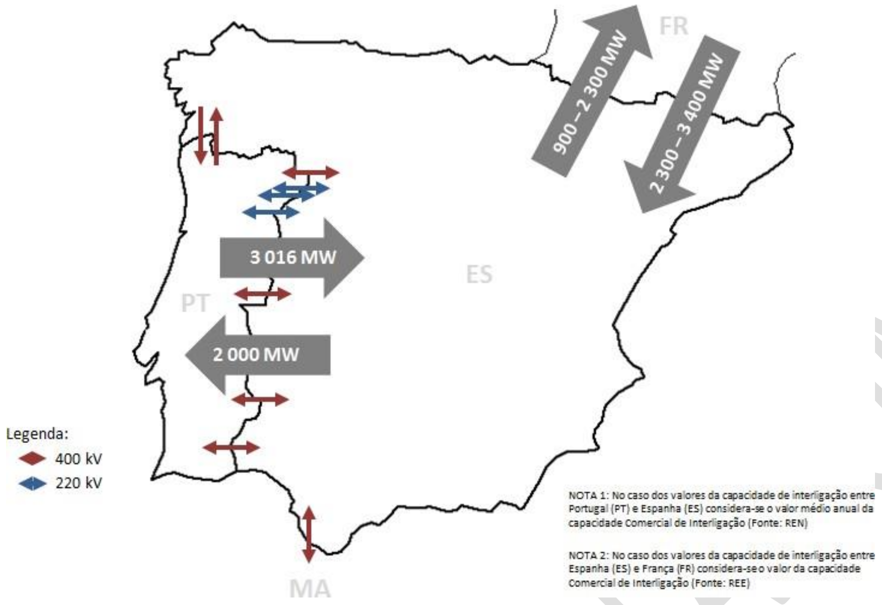
	2010	2011	2012	2013	2014	2015	2016	2017
Iberian Peninsula[44] – France	1.0%	1.1%	1.1%	1.1%	1.1%	1.0%	1.9%	1.9%

42 Objective measured by the ratio between total interconnection capacity in the import direction and installed capacity in the electricity production system. The calculation methodology is still under discussion at the European Commission,

43 Calculated in accordance with the ENTSO-E methodology based on the SOAF report ('For system adequacy purposes, Simultaneous Interconnection Transmission Capacity is based on 80 % of expected NTC between Portugal – Spain')

44 Includes installed capacity of both Portugal and Spain and also considers 100% of commercial interconnection capacity (NTC).

Figure 30 - Electricity interconnections in the Iberian Peninsula [Source: REN, REE]



KEY

NOTE 1: In the case of interconnection capacity values between Portugal (PT) and Spain (ES), the average annual value of Commercial Interconnection capacity is considered (Source: REN)

NOTE 2: In the case of interconnection capacity values between Spain (ES) and France (FR), the value of Commercial Interconnection capacity is considered (Source: REE)

ii. Projections relating to interconnection expansion requirements at least until 2040 (including for the year 2030)

As referred to in point 2.4.1 of this plan, in accordance with that set out in RMSA-E 2018, taking into account existing commitments, the following evolution is forecast in commercial interconnection capacity (in MW):

Table 41 - Forecast evolution in commercial interconnection capacity [Source: REN]

Year	Portugal > Spain (MW)	Spain > Portugal (MW)
2018	2 600	2 000
2022	3 000 (2)	3 000 (2)
2027	3 200 (3)	3 600 (3)
2030	3 200 - 3 500 (4)	3 600 – 4 200 (4)
2040	3 500 – 4 000 (5)	4 200 – 4 700 (5)

Notes:

(1) Estimated most likely minimum values through representative network simulation scenarios. In practice, in situations of generation deficit for the internal supply of each system, or relevant unavailability of network elements or high renewable production in periods of lower consumption, these figures may be lower.

(2) After completion of the future 400 kV interconnection line Ponte de Lima (PT) – Fontefría (ES).

(3) Estimate based on analyses conducted considering long-term expected evolution with regard to demand, supply, trans-border flows and the physical structure of the networks in the Portuguese and Spanish systems.

(4) Estimated interval based on analyses conducted under TYNDP 2016 and reconfirmed in TYNDP 2018.

(5) Estimated value based on analyses carried out in the 'Sustainable Transition' and 'Distributed Generation' scenarios of TYNDP 2018. Possible necessary network reinforcement not yet identified to achieve these interconnection capacity figures.

4.5.2. Energy transmission infrastructure

i. Key characteristics of the existing electricity and gas transmission infrastructure

i.1. Electricity

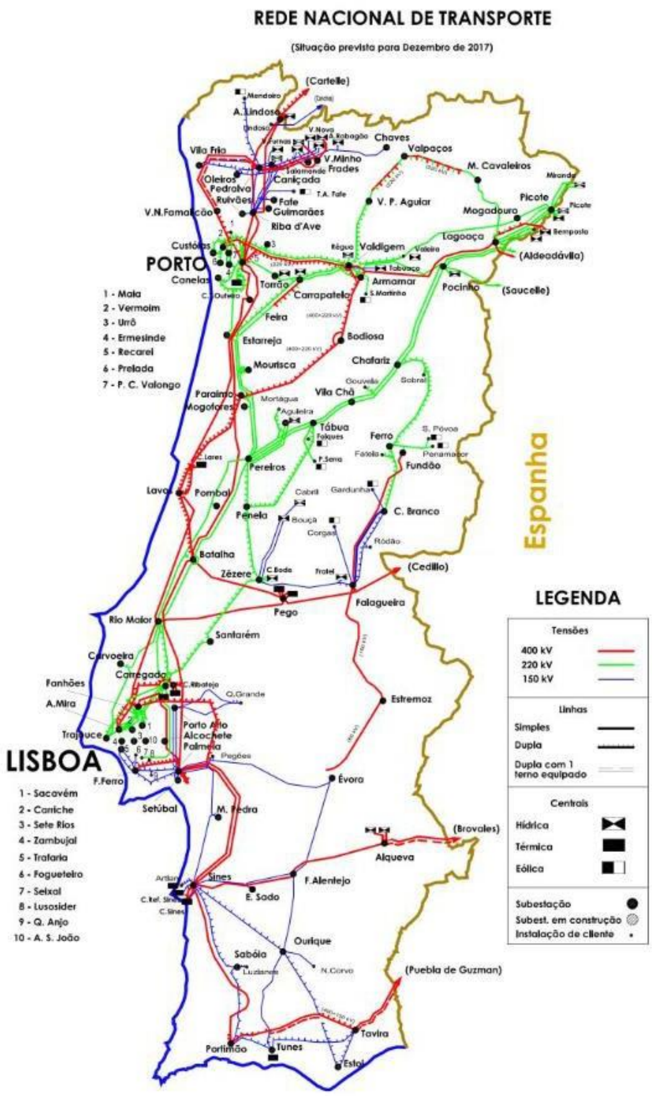
The National Electricity Transmission Network (RNT) includes installations in mainland national territory which ensure the transmission of power from high-voltage electricity production centres to high-density consumption areas, as well as to neighbouring countries (only Spain), through very high voltage lines and facilities which step down voltage levels and allow the control of power flow. Currently, the RNT has a total of 8 907 km of network, transformation power of 37 382 MVA, 66 substations, 12 step-down stations, 2 branching stations and 1 transition station. Evolution in the RNT can be seen in the following table and figure.

Table 42 - Main characteristics of the National Electricity Transmission Network [Source: REN]

	2015	2016	2017	*% 2015/2016*	*% 2016/2017*
Length of lines, km	**8 805**	**8 863**	**8 907**	*+0.7% (+58 km)*	*+0.5% (+44 km)*
400 kV	2 632	2 670	2 714	*+1.4% (+38 km)*	*+1.6% (+44 km)*
220 kV	3 611	3 611	3 611	*0%*	-
150 kV	2 562	2 582	2 582	*+0.8% (+20 km)*	-
Transformation power (MVA)	**36 673**	**36 636**	**37 382**	*-0.1% (-37 MVA)*	*2.0% (+746 MVA)*
Autotransformation (VHV/VHV)	14 040	13 890	14 340	*-1.0% (-150 MVA)*	*+3.2% (+450 MVA)*
Transformation (VHV/HV)	22 313	22 426	22 722	*+0.5% (+113 MVA)*	*+1.3% (+296 MVA)*
Transformation (VHV/MV)	320	320	320	-	-

The following figure shows the RNT map.

Figure 31 - Map of the National Electricity Transmission Network in 2017 [Source: REN, 'Indicative interconnection capacities for commercial purposes in 2017']



NATIONAL TRANSMISSION NETWORK

(Situation forecast for December 2017)

Voltages

Lines

Power Plants
- Hydro
- Thermal
- Wind

Substation
Substation being built
Client installation

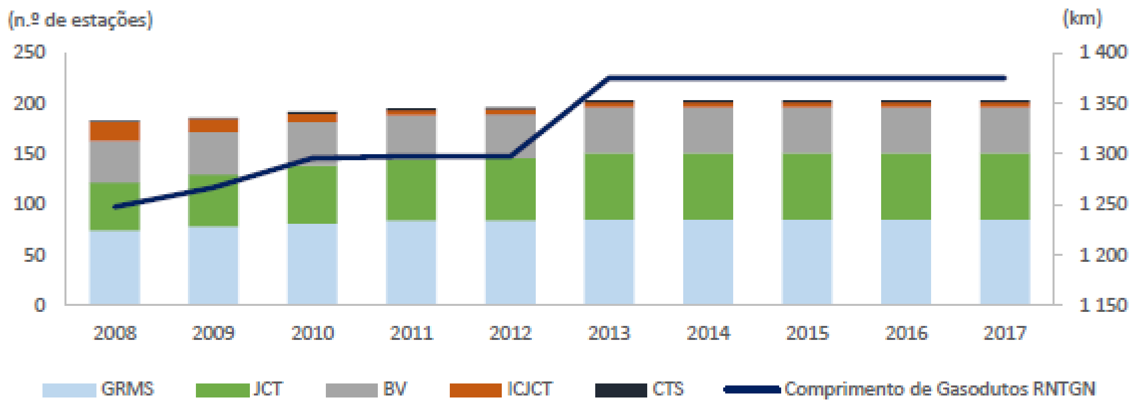
i.2. Natural gas

The National Transmission, Storage Infrastructure and Liquefied Natural Gas Terminal Network (RNTIAT) consists of all the infrastructure for receiving and transmitting natural gas (NG) by gas pipeline, underground storage and reception, storage and regasification of Liquefied Natural Gas (LNG). RNTIAT consists of the National Natural Gas Transmission Network (RNTGN), the Sines Liquefied Natural Gas Terminal (TGNL) and the Carriço Underground Storage facility (AS) in Pombal.

The RNTGN is the infrastructure used to receive, transmit and deliver high-pressure NG in Portugal, from input points to withdrawal points, and the concession is held by REN Gasodutos S.A. This system is formed by two main axes: a South-North axis which connects the Sines LNG Terminal to the Valença do Minho interconnection, supplying NG to the Portuguese coastline, where the most densely populated cities are located. There is also a take-off line to Mangualde; and an East-West axis between the Campo Maior interconnection and the Carriço US facility, with a take-off line to Guarda. In 2013, the connection was concluded between the take-off lines of both axes, connecting Mangualde to Guarda, which allowed a reinforcement of capability to satisfy demand in central and northern Portugal. All RNTGN delivery points (GRMS - *Gas Regulation and Metering Stations*) have total output capacity of 666 GWh/day, equivalent to 2 330 km^3(n)/h. The following facilities form part of the RNTGN:

- 1 375 Km of main high-pressure gas pipeline and branches varying in diameter from 150 to 800 mm for transmitting natural gas;
- 85 gas regulation and metering stations at the delivery points (GRMS) used to regulate pressure and then meter the natural gas delivered at high-pressure to distribution networks and high-pressure customers (HP);
- 66 Junction stations (JCT) for sectioning the main gas pipeline and/or respective take off branch;
- 45 Block valve stations (BV) for sectioning the main gas pipeline;
- T Interconnection junctions (ICJCT providing a T Interconnection Station*)* for connection to the main gas pipeline thus allowing the sectioning of only the respective associated branch line;
- 2 Custody Transfer Stations (CTS) for metering and transferring custody to the Spanish network.

Figure 32 - Characterisation of the RNTGN 2008-2017 [Source: REN, 'REN Technical Data 2017']



Key:
(No of stations)
GRMS JCT BV ICJCT CTS Gas Pipeline Length RNTGN

NG may be delivered directly to high-pressure connected clients, distribution networks which make up the national NG distribution network, the network interconnected to the Spanish gas system and to the Carriço underground storage caverns.

The most recent developments in the RNTGN have focused on connecting new delivery points and remodelling a number of pressure reduction and metering stations so as to adapt them to new operating conditions and gas flows to be supplied.

There are two interconnections between the RNTGN and the Spanish transmission network: Campo Maior - Badajoz and Valença do Minho - Tuy. Both interconnection points have input and output capacity, and total VIP capacity (Campo Maior + Valença do Minho) is 144 GWh/day.

Table 43 - NG interconnection capacities between Portugal and Spain. [Source: REN]

Interconnection	Daily Capacity
Campo Maior link	Input Capacity: 134 GWh/day, equivalent to 470 km^3(n)/h Output Capacity: 35 GWh/day, equivalent to 123 km^3(n)/h
Valença do Minho	Input Capacity: 10 GWh/day, equivalent to 35 km^3(n)/h Output Capacity: 25 GWh/day, equivalent to 88 km^3(n)/h

The Sines LNG Terminal, the concession for which is held by REN Atlântico, S.A., is strategically located on the European Atlantic coast and includes all of the infrastructures for receiving and dispatching methane carrier vessels, storage and regasification of LNG to the transmission network. It also loads tanker trucks with LNG. The main characteristics of the Sines LNG Terminal include:

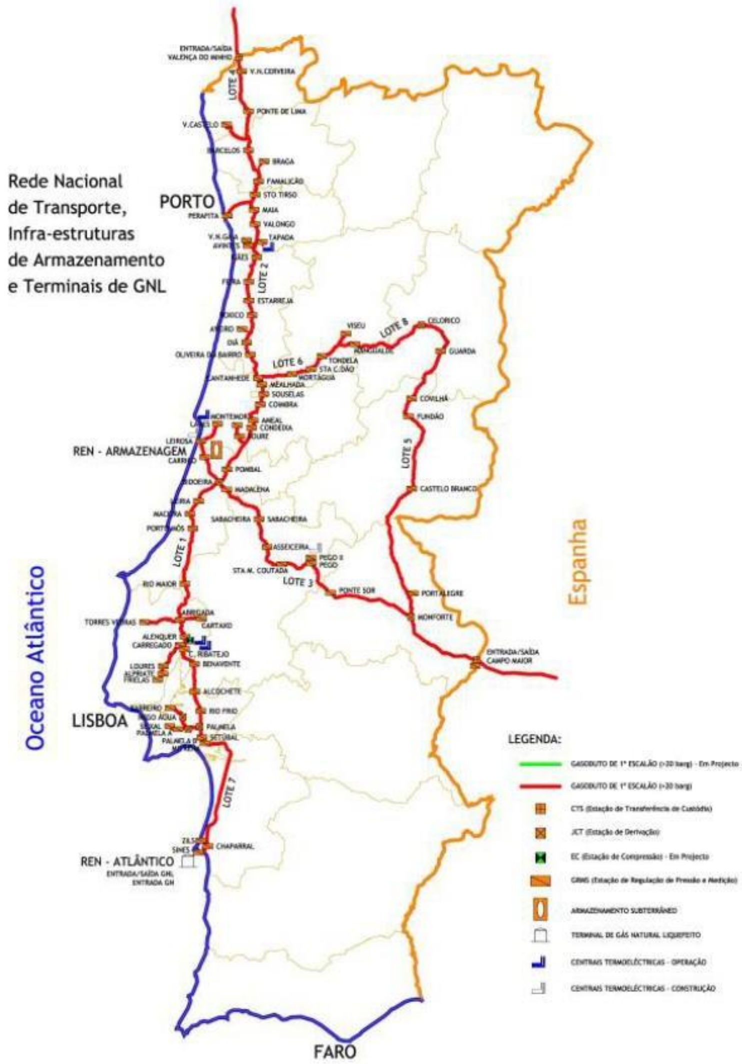
- Reception and unloading of methane carrier vessels: The port facility includes a mooring quay, articulated unloading arms and unloading lines and LNG vapour recirculation and return lines. Unloading capacity is 10 000 m^3/h of LNG for methane carrier vessels with volumes from 40 000 to 216 000 m^3 of LNG.
- LNG storage: After unloading, the LNG is stored in tanks. Storage capacity is 2 569 GWh, corresponding to two 120 000 m^3 tanks of LNG and one tank of 150 000 m^3 of LNG.
- Regasification to the RNTGN: Regasification is a physical process to vaporise LNG which uses heat exchange of the gas with sea water in atmospheric vaporisers. To carry out this process, the infrastructure has seven atmospheric vaporisers with a unit capacity of 64 GWh/day (equivalent to 225 000 m^3(n)/h). Injection capacity is 321 GWh/day (equivalent to 1 125 000 m^3(n)/h), and withdrawal capacity is 1 GWh/day (equivalent to 1 350 000 m^3(n)/h).
- LNG filling bays: The Sines LNG terminal allows LNG tanker trucks to be loaded, which transport gas to autonomous regasification units (UAG) in areas of Portugal which cannot be supplied by the high-pressure natural gas network. The Sines LNG terminal has three filling bays with a total capacity of 175 m^3/h of LNG.
- Loading of methane carrier vessels: The Sines LNG terminal is also capable of carrying out *the total* or partial loading of methane carrier vessels using the same port facility and vessel unloading equipment. Capacity for this activity is 1 500 m^3/h of LNG.

The expansion of the Sines LNG Terminal, which was concluded in July 2012, provided an increase in useful storage capacity of 62.5%, to 390 000 m^3 de GNL, an increase in gas issue capacity of 50%, to 1 350 000 m^3/h, adaptation of the jetty to receive large-capacity methane tankers, and the implementation of a series of procedural reinforcements to maximise infrastructure availability and provide a high level of operating safety. As a result, the Sines Terminal now has favourable access conditions for a greater number of agents, providing greater flexibility in the management of imported volumes and creating unique conditions to receive tankers of LNG from more remote and diversified sources. This has contributed to increasing the competitiveness of the sector in Portugal and to the supply security of the SNGN.

With regard to the underground storage (US) of natural gas at Carriço in the municipality of Pombal, NG is stored under high-pressure in caverns created in a saline mass, at depths of over one thousand metres. There are currently six caverns operated by REN Armazenagem S.A. with total storage capacity of 3 839 GWh (322.6 Mm^3), which use a surface gas station which provides bidirectional flow, or in other words, injection of gas from the transmission network to the caverns and the withdrawal of gas from the caverns to the transmission network. The Carriço US facility injection capacity is 24 GWh/day (83 000 m^3(n)/h) and withdrawal capacity is 129 GWh/day (450 000 m^3(n)/h). This infrastructure is vital for constituting the security reserves necessary to ensure supplies to the country in the event of a supply crisis. It also provides conditions to optimise logistics for commercial agents working in Portugal and in the Iberian Peninsula.

The following figure shows the RNTIAT map.

Figure 33 - Map of the National Transmission, Storage Infrastructure and Liquefied Natural Gas Terminal Network in 2017 [Source: REN]



National Transmission, Storage Infrastructure and Liquefied Natural Gas Terminal Network

Translator's note: Text of key illegible

ii. Projections of network expansion requirements at least until 2040 (including for the year 2030)

ii. 1 Electricity

In order to meet Community requirements on interconnections, as well as the need to reinforce internal networks, a wide-ranging series of actions and projects exists which include (as indicated in point 2.4. of this plan):

- In 2021-2022, with the entry into service of the 400-kV interconnection line between Minho (PT) and Galicia (ES) (as previously mentioned, identified under the Madrid Declaration, and also a European Commission Project of Common Interest), it will be possible to overcome the existing network restrictions and achieve, in both directions, minimum commercial interconnection capacity of 3 000 MW;
- By 2025, a slight increase is estimated in interconnection capacity, particularly in the Spain - Portugal direction. This estimate is based on forecast evolution for demand in both systems. In the Portuguese case, the entry into service of the new 400 kV Pedralva-Sobrado line is planned, which, in addition to avoiding a reduction in interconnection capacity, will also allow the flow of renewable origin electricity, essentially hydro;

- For the 2030 horizon, very long-term analyses have already been conducted by the PT and ES transmission system operators (REN and REE) under the *Ten-Year Network Development Plan 2016* (TYNDP), which led to estimated interconnection capacity values which were slightly higher than those forecast for 2023-2025;
- From a longer perspective up to 2040, commercial capacities are based on analyses conducted (with the scenarios 'Sustainable Transition' and 'Distributed Generation') under the TYNDP 2018 by REN and REE. Possible reinforcement of the network or new interconnections required to achieve these interconnection capacity figures have not yet been identified.

Also of note in the electricity sector are the projects to reinforce internal networks (transmission and distribution) to connect and accept renewable power production (to achieve national potential in this type of electrical power production) and other projects to satisfy large consumer needs, more specifically the following.

- 400 kV Fundão-Falagueira connection, to accommodate renewable energy from this region;
- Double 400 kV line between Vieira do Minho - Ribeira da Pena; Ribeira da Pena substation; 400 kV Ribeira da Pena – Feira connection to link the Tâmega hydro power plants.
- 400 kV passage of the Falagueira-Estremoz-Divor-Pegões axis, which is vital for meeting the technical feed specificities to the railway line between Évora-Elvas/Caia.

There are also investment projects to reinforce internal networks (transmission and distribution), more specifically the Portugal-Morocco interconnection project, which is currently being studied, with forecast installed capacity of 1 000 MW and which is expected to be completed by 2030.

With respect to the 2040 horizon, depending on the evolution seen in the Portuguese and Spanish electricity systems, more specifically with regard to renewable power generation, as well as in relation to the decision on the possible interconnection between Portugal and Morocco, it will be necessary to assess, in addition to possible network reinforcement, the need for new interconnections.

ii.2 Natural Gas

In order to meet commitments made on a European level and based on national energy policy, more specifically with respect to internal market integration and supply security, and with a view to creating a more robust, efficient and interconnected national natural gas system, Portugal intends to develop the respective transmission and distribution network, and currently has in hand projects which will contribute to this aim. In order to meet such requirements, a wide-ranging series of actions and projects exists which include (as indicated in point 2.4. of this plan):

- The 3rd Interconnection Project between Portugal and Spain (with recognised benefits in relation to supply security and integration of the European Market) which is dependent on the completion of the STEP/MIDCAT project for the new interconnection between Spain and France, both projects are expected to be completed by 2030;
- Also planned for the gas sector are projects which could increase the use of LNG and improve LNG reception capacity at the Sines Terminal, to strengthen Portugal's role as an 'entry point' for natural gas into the internal market/European gas system.

4.5.3. Electricity and gas markets, energy prices

i. Current situation of electricity and gas markets, including energy prices

i. 1 Electricity Market

Since September 2006, all electricity customers in mainland Portugal have been able to choose their supplier. In a total of around 6.2 million customers in the electricity market in Portugal at the end of 2017, the Free Market (FM) now represents around 4.96 million customers, corresponding to around 80% of all market customers. Remaining customers belong to the Regulated Market (RM) which are supplied by the Supplier of Last Resort (SoLR). Most customers which remain in the RM are domestic users. The vast majority migrated to the FM.

Table 44- Number of clients in the national electricity market per type of client in Dec. 2017 [Source: ERSE]

	Free market	Regulated market
Large Consumers	374	2
Industrial	23 606	871
Small businesses	33 925	1 824
Domestic	4 906 529	1 219 849
Total	**4 964 434**	**1 222 546**

A gradual increase has also been seen in the number of suppliers working in the different market segments including the retail market. It can be expected that the benefits of more competition through the greater choice available, better prices and more competition between agents will be enjoyed by industrial and retail consumers.

With the publication of Law No 42/2016 of 28 December and in accordance with the respective Article 171(1)(a), the Portuguese Government extended the deadline for abolishing transitional tariffs for the supply of electricity to normal low-voltage final consumers. The new termination date is 31 December 2020.

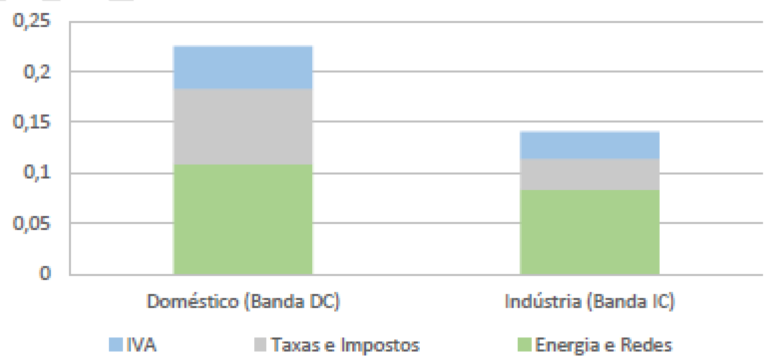
In 2016, average prices for electricity in the domestic sector stood at 0.226 €/kWh (band DC) representing a reduction of 2.9% over 2016 and 10.4% above the average price in the EU-28. Average prices for electricity in the industry sector stood at 0.141 €/kWh (band IC) representing a reduction of 1.6% over 2016 and 0.5% above the average price in the EU-28.

Table 45 - Electricity prices per sector in Portugal (€/kWh) [Source: DGEG]

		Domestic (DC band[45])			Industry (IC band[46])		
		Prices without charges	Prices without VAT	Prices with charges	Prices without charges	Prices without VAT	Prices with charges
2016	1st Semester	0.124	0.191	0.235	0.094	0.113	0.138
	2nd semester	0.125	0.192	0.236	0.095	0.114	0.140
2017	1st Semester	0.111	0.186	0.228	0.084	0.115	0.141
	2nd semester	0.108	0.181	0.223	0.084	0.115	0.141

Analysing the price of electricity in Portugal in the domestic sector, it can be seen that in 2017 the Power and Network component represented 29% of the Retail price (RP), Levies and Taxes represented 33% and VAT 19%. In industry, the Power and Network component represented 59% of RP, Levies and Taxes represented 22% and VAT 19%.

Figure 34 - Structure of the price of Electricity in Portugal per sector (€/kWh) [Source: DGEG]



Key: Domestic (DC band) Industry (IC Band)
VAT Charges and Taxes Energy and Networks

[45] 2 500 kWh < Consumption < 5 000 kWh.

[46] 500 MWh < Consumption < 2 000 MWh.

i. 2 Natural Gas Market

In Portugal, since the beginning of 2010, all consumers have had the right to choose their NG supplier. This liberalisation process in the NG market has meant that all large consumers (annual consumption greater than 1 million m^3 of NG) are now in the free market. Similarly, the vast majority of industrial consumers (annual consumption of between 10 000 m^3 and 1 million m^3 of NG), also opted for the more favourable conditions offered by suppliers. Moreover, significant numbers of residential consumers have also chosen free market suppliers.

In a total retail market of around 1.5 million customers, the free market accounted for approximately 1.1 million consumers at the end of 2016, representing 79% of all NG market customers in Portugal.

Table 46 - Number of clients in the national NG market per type of client in Dec. 2017 [Source: ERSE]

	Free market	Regulated market
Large Consumers	395	32
Industrial	3 771	631
SME	67 730	25 422
Residential	1 072 105	285 464
Total	1 144 001	311 459

A gradual increase has also been seen in the number of suppliers working in the different market segments including the retail market. It can be expected that the benefits of more competition through the greater choice available, better prices and more competition between agents will be enjoyed by industrial and retail consumers.

Ministerial Implementing Order No 144/2017 of 24 April 2017, amending Ministerial Implementing Order No 59/2013 of 11 February 2013, sets 31 December 2020 as the limit date for the requirement to supply NG, by suppliers of last resort, to end customers with annual consumption less than or equal to 10 000 m^3 who do not exercise their right to change to a free market supplier.

In 2016, average prices for NG in the domestic sector stood at 21.828 €/GJ (band D2) representing a reduction of 9.0% over 2015 and 12.5% above the average price in the EU-28. Average prices for NG in the industry sector stood at 9.386 €/GJ (band I3) representing a reduction of 10.8% over 2016 and 2.2% above the average price in the EU-28.

Table 47 - Natural Gas prices per sector in Portugal (€/GJ) [Source: DGEG]

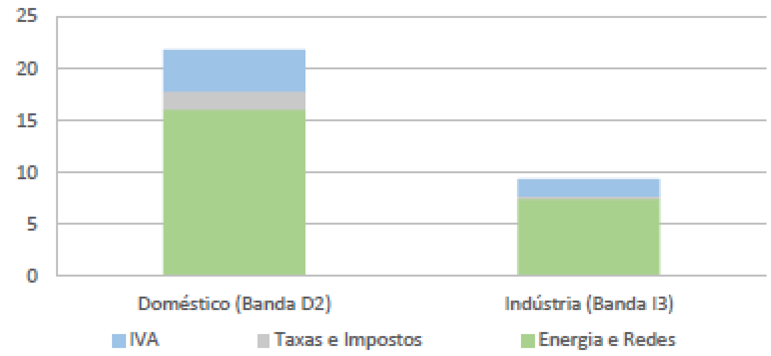
		Domestic (Band D2[47])			Industry (Band I3[48])		
		Prices without charges	Prices without VAT	Prices with charges	Prices without charges	Prices without VAT	Prices with charges
2016	1st Semester	19.380	20.610	25.350	9.240	9.440	11.610
	2nd Semester	17.550	18.660	22.960	7.510	7.670	9.440
2017	1st Semester	15.730	17.460	21.470	7.250	7.740	9.520
	2nd Semester	16.248	18.037	22.186	7.311	7.523	9.252

Analysing the price of NG in Portugal in the domestic sector, it can be seen that in 2017 the Power and Network component represented 73% of the Retail price (RP), Levies and Taxes represented 8% and VAT 19%. In industry, the Power and Network component represented 79% of RP, Levies and Taxes represented 2% and VAT 19%.

47 20 GJ < Consumption < 200 GJ

48 10 000 GJ < Consumption < 100 000 GJ

Figure 35 - Structure of the price of Natural Gas in Portugal per sector (€/kWh) [Source: DGEG]



i. 3 Prices of the main fuels

With respect to the prices of energy products in Portugal, the average RP for diesel stood at 1.242 €/litre in 2017, representing an increase of 11% over 2016 and 2% above the average price in the EU-28, while the average price for petrol stood at 1.463 €/litre, representing an increase of 7% over 2016 and 8% above the average price in the EU-28.

Table 48 - Price of Diesel[49] fuel in Portugal (€/litre) [Source: DGEG]

	2015	2016	2017	*% 2015/2016*	*% 2016/2017*
Price without fees (PWF)	0.550	0.458	0.543	-16.7%	+18.6%
Tax on petroleum and energy products (ISP)	0.278	0.324	0.338	+16.4%	+4.5%
Road Service Contribution	0.111	0.111	0.111	-	-
emissions	0.013	0.017	0.017	+31.0%	+2.7%
VAT	0.219	0.209	0.232	-4.5%	+11.0%
Retail price (RP)	1.171	1.119	1.242	-4.4%	+11.0%

Table 49 - Price of Petrol[50] in Portugal (€/litre) [Source: DGEG]

	2015	2016	2017	*% 2015/2016*	*% 2016/2017*
Price without fees (PWF)	0.546	0.444	0.538	-18.8%	+21.1%
Tax on petroleum and energy products (ISP)	0.519	0.566	0.549	+9.0%	-3.0%
Road Service Contribution	0.087	0.087	0.087	-	-
emissions	0.012	0.015	0.016	+31.1%	+2.7%
VAT	0.268	0.256	0.273	-4.5%	+7.0%
Retail price (RP)	1.432	1.368	1.463	-4.5%	+7.0%

i. 4 Social Tariff on Energy

In 2010, the social tariff was created for the supply of electrical power to be applied to economically vulnerable final customers, approved by Decree-Law No 138-A/2010 of 28 December 2010. As part of the liberalisation process for the energy sector and to protect consumers, the aim of this law was to ensure access by all consumers to the essential service of the supply of electrical power, regardless of which supplier was used. This guarantee led to the need to ensure supply to economically vulnerable consumers. The growing prices and volatility of energy costs internationally and the intention to further standardise the electricity market also justified the need to establish specific measures to protect such consumers in line with European guidelines on the internal electricity and natural gas markets. A social tariff protects the interests of families and other groups of economically vulnerable consumers through a tariff model providing them with stability through discounts.

49 Diesel.
50 Petrol 95.

In 2014, the concern was to ensure access by consumers considered to be more disadvantaged in the universe of final low-voltage electrical power consumers. The aim was to extend the number of beneficiaries of the social tariff to around 500 000 consumers with electrical power supply contracts and create conditions so that the discount applied to these beneficiaries was greater than that being applied at the time. With a view to increasing the number of social tariff beneficiaries, the social discounts for access to the essential service of electrical power and natural gas supply, implemented through Decree-Law No 138-A/2010 of 28 December 2010, amended by Decree-Law No 172/2014 of 14 November 2014, for electrical power, and Decree-Law No 101/2011 of 30 September 2011, for natural gas, started to be automatically granted to more economically vulnerable customers after applicable legislation was redesigned through Law No 7-A/2016[51] of 30 March 2016.

According to data provided by ERSE, this procedure contributed to the number of beneficiaries increasing from 154 648 in March 2016 to 820 527 in September 2017. This measure, was initially launched on 28 December 2010 via Decree-Law No 138-A/2010, and as of 1 July 2016, automatically assigned the required status to customers meeting economic and/or social vulnerability criteria, confirmed by the Tax and Customs Authority and/or the Social Security Institute, in accordance with Law No 7-A/2016 of 30 March 2016.

The automatic recognition system to assign the social tariff for energy removes the requirement from the customer to request recognition of such status. In truth, the creation of this automatic system allows economically vulnerable customers to access the social tariff and avoid unnecessary bureaucracy and costs, and provides a procedure with greater social fairness. It should also be noted that this discount provides savings of dozens of euros per year for many families. Automatic recognition is carried out by the I.T. System at the DGEG, which cross-references data in accordance with the protocols governing access and transmission of information among different agents in the energy sector and Public Administration bodies holding the required data, more specifically the Tax and Customs Authority and the Social Security Institute.

The discount applied to access tariffs to electricity networks, applicable as of 1 January 2018, as provided for in Article 3(2) of Decree-Law No 138-A/2010 of 28 December 2010, in the wording given by Decree-Law No 172/2014 of 14 November 2014, and Law No 7-A/2016 of 30 March 2016, is required to correspond to a value allowing a discount of 33.8 % on the transitional sale tariffs to final electricity customers, excluding VAT, other taxes, contributions, levies and late-payment interest which apply, in accordance with Official order No 9081-C/2017 of 11 October 2017. The discount applied to access tariffs to natural gas networks, applicable as of 1 July 2017, as provided for in Article 3(2) of Decree-Law No 101/2011 of 30 September 2011, in the wording given by Law No 7-A/2016 of 30 March 2016, is required to correspond to a value allowing a discount of 31.2% on the transitional sale tariffs to final natural gas customers, excluding VAT, other taxes, contributions, levies and late-payment interest which apply, and such application shall not be considered for purposes of other supports currently in effect, in accordance with Official order No 3229/2017 of 11 April 2017.

Table 50 - Number of consumers with Social Energy Tariff in Portugal

	2015	2016	2017
Electricity	**108 000**	**786 598**	**777 085**
Natural gas	12 000	36 819	34 403

ii. Projections of development with existing policies and measures at least until 2040 (including for the year 2030)

N/A

51 State Budget Law for 2016.

4.6. Dimension Research, innovation and competitiveness

i. Current situation of the low-carbon technologies sector and its position in the global market

Portugal has made considerable effort to apply low-carbon technologies to its energy mix, more specifically in relation to European commitments. Of note are areas such as environmental sustainability, renewable energies and energy efficiency. Investment in infrastructure, particularly to reinforce energy interconnections, plays a vital role in supply security, promoting integration into new energy markets and promoting cooperation between countries, allowing resources to be shared.

In the last decade, aware of the need to meet the challenges created by climate change and reduce its dependency on fossil fuels, Portugal has followed a policy to promote renewable energies under EU commitments, focusing on hydro, wind, biomass, solar and geothermal power. This focus has allowed the country to position itself near the top of the ranking for energy production from renewable sources.

This transitional process required a change in the energy production model where it became vital to develop policies and measures to support the generation of decentralised renewable energy. Strategies have been established for research, innovation and competitiveness so as to facilitate investment in low-carbon technologies and smart networks, allowing cooperation to be promoted among market players, maximising trans-national competition and supporting the setting up of innovative energy services companies.

This focus drives the development of the national economy, having created an entirely new industrial and corporate segment, generating employment, promoting regional development, stimulating the export of goods and services, driving regional and innovation which attracts international investment and stimulates the internationalisation of national companies. It has also allowed external energy dependency to be significantly reduced.

In relation to research and innovation, of note is the implementation of international groups as part of the European Strategic Energy Technology Plan (*SET Plan*) in areas of low-carbon technology with a view to applying clean technologies at lower costs. These technologies include: ocean energy, geothermal energy, solar energy focusing on concentrated solar power (CSP), energy efficiency in industry and buildings, energy systems, smart communities and solutions with focus on consumers, biofuels and bioenergy. The underlying vision is also aligned with Portugal's multi-level strategy where brainstorming among stakeholders has been promoted is areas such as energy efficiency, bioengineering and hydrogen to meet the different challenges facing society. Inter-institutional cooperation has also been promoted and networks have been established in technologies for renewable energy, energy storage, energy efficiency and also in the fields of hydrogen and biomethane.

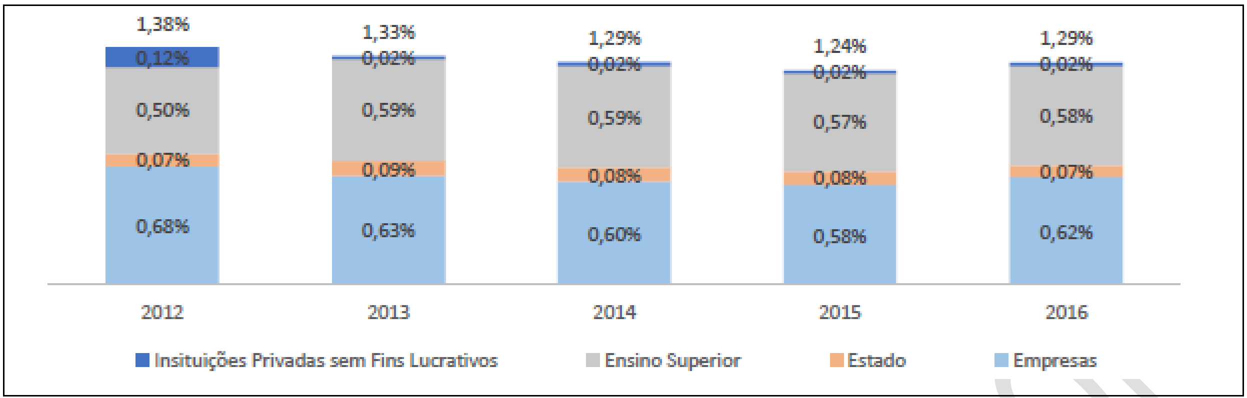
However, to achieve greater success, greater effort will be necessary on a technological level in solar and wave energy and in the development of a comprehensive portfolio of renewable technologies with good cost effectiveness. It will be necessary to go beyond the technologies which have already attained maturity and use resources to support more innovative technologies allowing substantial savings in costs and in terms of GHG emissions.

ii. Current level of public and private research and innovation spending on low-carbon-technologies, current number of patents, and current number of researchers

In Portugal, public investment in Research and Development (R&D) in recent years has fluctuated and is below EU and OECD averages. Total expenditure has fallen, dropping from a value corresponding to 1.46% of GDP in 2011 to 1.29% of GDP in 2016. This amount corresponded to EUR 2.389 billion[52]. The following figure shows investment levels by sector as a percentage of GDP, demonstrating the importance of effort by companies and universities in total investment in research and innovation.

52 Survey on national scientific and technological potential - IPCTN16: Main Results, Director-General of Education and Science Statistics

Figure 36 - R&D investment levels in relation to GDP by sector (%) [Directorate-General of Education and Science Statistics]



Key:
Private non-profit institutions Higher Education State Businesses

It should be noted that the impact of the financial crisis was greater in the corporate sector, whereas the level of R&D in the public sector has been more or less constant as a percentage of GDP. This is due to the reduction in both public expenditure and GDP.

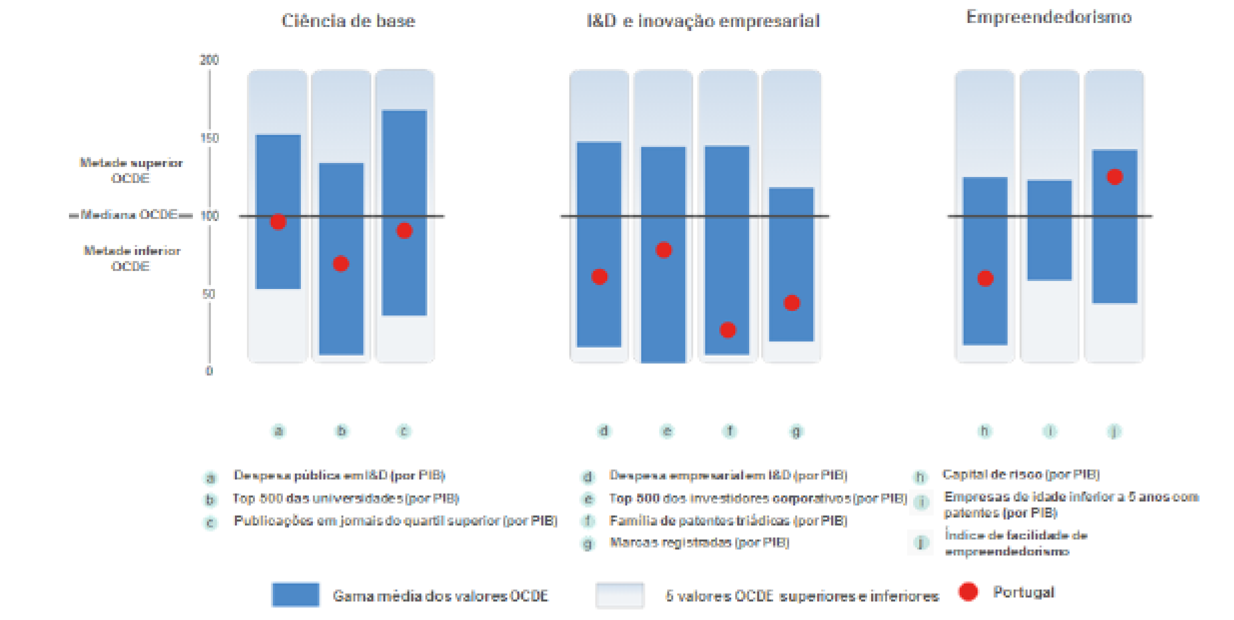
The following figure shows an OECD comparative analysis of a profile of competences and capacity to innovate. Data from 2011[53]. Using input, output and mixed indicators and a standardised performance index on mean values for the OECD area, the figure analyses the competences and capacities of three large areas: base science, a corporate R&DI, and entrepreneurship. In 2010, public expenditure in Portugal in R&D stood at 0.7% of GDP, while the production of scientific articles was slightly below the OECD average. The corporate sector plays a vital role in the strategy for Science, Technology and Innovation. Public support for this sector is mostly indirect. This orientation has been reinforced through the 2009 initiative for Growth and Employment which allowed the tax credit scheme (SIFIDE) to be expanded. Entrepreneurism is seen as a priority and facilitator for return on investment in R&D. There is a dedicated strategy for the development of a more entrepreneurial society where there are less administrative costs on corporate activity. Examples include the 'Simplex' (Simplification Programme for Companies)[54], 'Simplex Autarquico' (Simplification Programme for Local Government), and 'Empresa na hora' (On the Spot Firm) programmes[55].

53 OECD (2012). OECD Science, Technology and Industry Outlook 2012. OECD 13 Sept 2012 ISBN:9789264170391.

54 www.simplex.gov.pt/.

55 www.empresanahora.mj.pt/ENH/sections/PT_inicio.

Figure 37 - Competences and capacity to innovate in Portugal within the OECD [Source: OCED[56]]



<u>Key</u>

	Base Science	R&D and corporate innovation	Entrepreneurism
Upper half OECD Average OECD Lower half OECD			
	A Public expenditure in R&D (By GDP) B Top 500 universities (By GDP) C Publications in 1st Q. journals	D Corporate expenditure in R&D (By GDP) E Top 500 corporate investors (By GDP) F Triadic patent families (By GDP) G Registered trademarks (By GDP)	H Risk capital (By GDP) I Companies less than 5 years old with patents (By GDP) J Entrepreneurism facility index
	Average range of OECD values	5 upper and lower OECD values	Portugal

It is equally important to note Portugal's position in the OECD panorama in terms of technology and innovation for energy and the environment[57], given that the aims to reduce GHG Emissions and to protect the environment lead to the innovation, diffusion and large-scale implementation of technologies with improved energy and environmental performance.

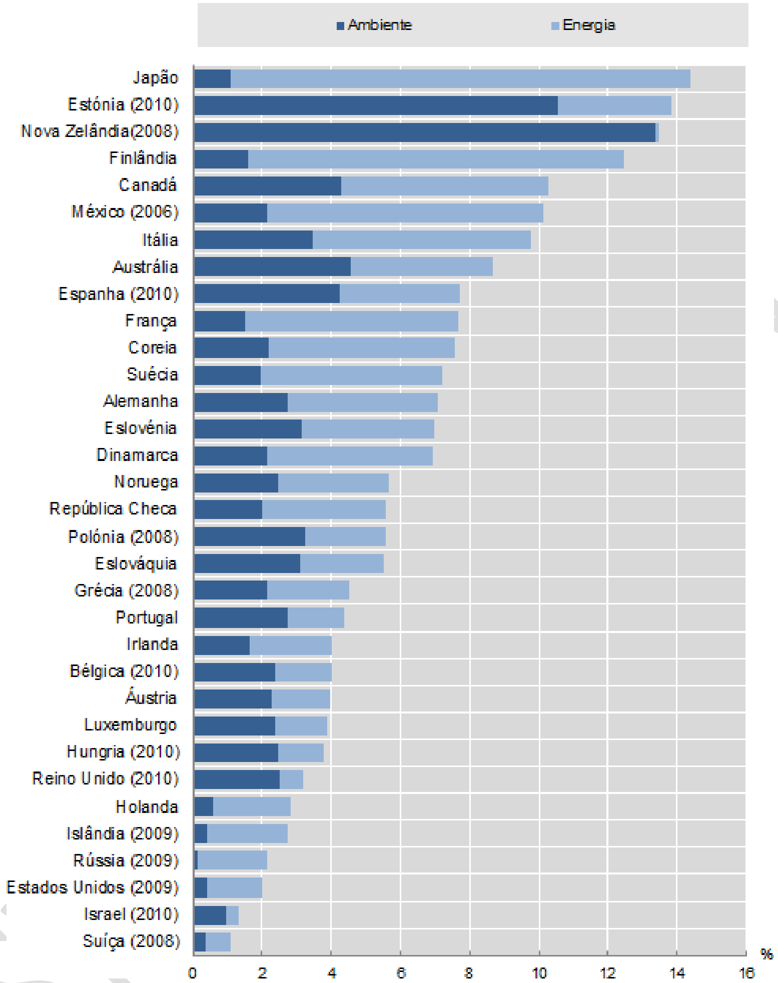
In the absence of these two mechanisms it will be very difficult to follow economic and social growth trajectories in an environmentally sustainable manner, and particularly with regard to 'Energy-Climate' commitments. In this regard, the role of the State is important, not just in direct R&D in innovation in energy and the environment, but also in defining a framework and public policy for companies and entrepreneurs which facilitate and stimulate private investment in energy innovation which is more environmentally sustainable. The following figure shows Portuguese investment as a percentage of GDP in dedicated R&D (2011), in energy and the environment in relation to total public expenditure (OECD, 2012b).

56 'Science and innovation in Portugal: Competences and capability to innovate in 2011' (OCDE, 2012)
57 OECD (2012b). Research and Development Statistics (RDS) Database, February 2012.

Figure 38 - Percentage of total public expenditure in dedicated R&D in energy and the environment in relation to total public expenditure in 2011 all OECD countries [Source: OECD]

Environment Energy

Japan
Estonia (2010)
New Zealand (2008)
Finland
Canada
Mexico (2006)
Italy
Australia
Spain (2010)
France
Korea
Sweden
Germany
Slovenia
Norway
Czech Republic
Poland (2008)
Slovakia
Greece (2008)
Portugal
Ireland
Belgium (2010)
Austria
Luxembourg
Hungary (2010)
UK (2010)
Holland
Iceland (2009)
Russia (2009)
USA (2009)
Israel (2010)
Switzerland



With respect to national figures, the following figure shows R&D investment in energy and the environment, broken down by sector, in 2016[58].

Table 51 - R&D expenditure in energy and the environment by sector of execution in Portugal in 2016 [Source: DGEEC[59]]

	Environment		Hydraulic	
	Euro in thousands	%	Euro in thousands	%
Total	138 030	100.0	99 213	100.0
Businesses	30 056	21.8	45 036	45.4
State	12 059	8.7	10 572	10.7
Higher Education	95 646	69.3	43 605	44.0
Private Non-Profit Institutions	269	0.2	-	-

58 Survey on National Scientific and Technological Potential 2016, Directorate-General of Education and Science Statistics.

59 Survey on national scientific and technological potential 2016

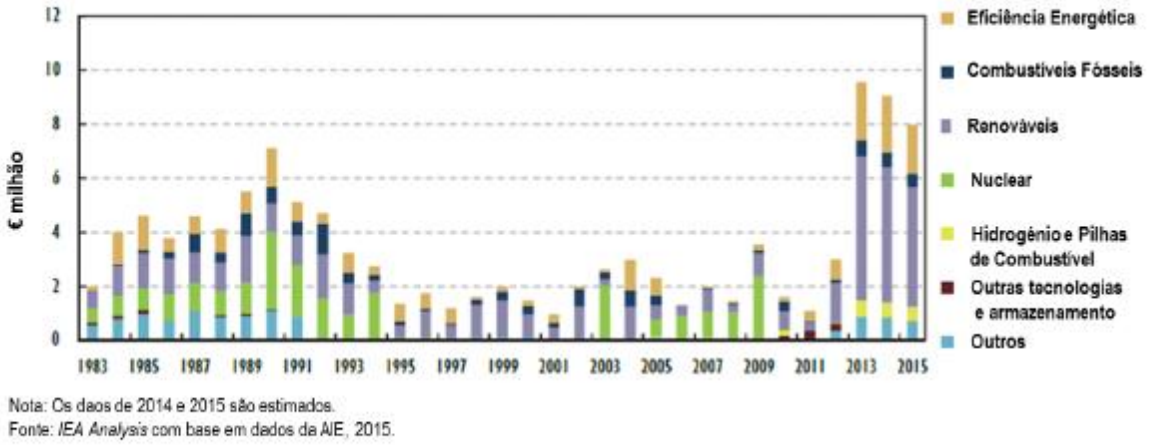
Of note under this general R&D framework is the importance of human resources. Over the last ten years, there has been a significant reduction in the total number of researchers in Portugal. The following table shows the breakdown in research personnel by sector of execution in full-time equivalent units (FTE). Similarly, the total values presented below may not correspond to the sum of the parcels due to rounding up.

Table 52 - Breakdown in research personnel by sector of execution [Source: DGEE]

	Total	Businesses		State		Higher Education		IPFL[60]	
	TSI	TSI	%	TSI	%	TSI	%	TSI	%
2012	42 498	11 931	28%	1,682	4%	23,825	56%	5,060	12%
2013[61]	37 813	10 025	27%	1,386	4%	25 760	68%	642	2%
2014	38 155	11 203	29%	1,447	4%	24,978	65%	527	1%
2015	38 672	11 785	30%	1,351	3%	25,043	65%	493	1%
2016	41 349	13 426	62%	1 340	3%	26 106	63%	478	1%

Investment in low-carbon technologies is recognised as necessary to comply with the targets which Portugal has set. Since 2013, there has been an increase in public financing of RD&I, as can be seen in the following figure.

Figure 39 - Public funding in RD&I from 1983 to 2015 [Source: IEA 'Energy Policies of IEA Countries: Portugal 2016']



Key:

Million € — Note: Data for 2014 and 2015 are estimated
Source: IEA Analysis using IEA database, 2015

- Energy Efficiency
- Fossil Fuels
- Renewables
- Nuclear
- Hydrogen and Fuel Cells
- Other technologies and storage
- Other

In 2013, the execution estimate obtained in RD&I in energy was 6.8 million euros, which rise to 8.1 million euros in 2014. This increase was mainly due to greater investment in renewables and energy efficiency. Data for 2015 are still being calculated.

[60] Private Non-Profit Institutions

[61] Break in series: final data for 2013 on human resources in R&D by function reflect a break in the series with respect to previous years due to a review of categories of personnel in R&D. The categories of researcher, technician and other support personnel are now defined as main functions performed in R&D activities, in accordance with ISCO classification criteria, instead of being defined exclusively by level of academic qualification.

Priority areas for RD&I are consistent with Portugal's commitments to the EU: (i) renewables, (ii) energy efficiency, (iii) smart networks, (iv) sustainable mobility, (v) electricity, (vi) natural gas and (vii) interconnections. Support strategies for national energy policy need to take into account short, medium and long-term targets, where priorities and objectives must be built on studies and differing scenarios incorporating technological targets to be accepted nationally. Participation by Portugal in international programmes is recognised as an important priority in the RD&I, strategy. Of note is the significant contribution of European programmes such as the 7th Framework Programme (FP7) in the period from 2007 to 2013 and 2020 Horizon as of 2014 up to 2020. In the future and within a European energy policy framework, the importance of the SET Plan should not be forgotten with strategic objectives and guidance on RD& leading to more efficient and less polluting technologies of lower cost.

Portugal participates in work for the SET Plan. This presents an opportunity to implement multi-lateral cooperation projects possibly with co-funding through European programmes such as H2020 in the abovementioned priority areas.

The Implementation Plan currently underway covers the following as actions and groups: (i) Concentrated Solar Power (CSP), (ii) Photovoltaic, (iii) Offshore Wind, (iv) Ocean Energy, (v) Deep Geothermal, (vi) Consumers/Cities and Smart Communities, (vii) Energy efficiency in buildings, (viii) Energy efficiency in Industry, (ix) Energy Systems, (x) Renewable Fuels Sustainable Transport/Bioenergy and (xi) Batteries and (xii) Carbon Capture and Sink/Use (CC(U)S).

With respect to registering patents in Portugal, the results obtained through the National Institute of Industrial Property (INPI) show that there is national competence in the field of low-carbon technologies. Excluded from this type of technology are those connected to nuclear fusion and fission as they are not considered to be within the scope of current or future national energy policy. Given that the aim is to discover which patents exist based on national competences, the search was based on key words (in Portuguese) in the different fields using the abstracts of the patents and did not consider any specific time period. The results are shown below:

Table 53 - Registration of patents in Portugal [Source: INPI]

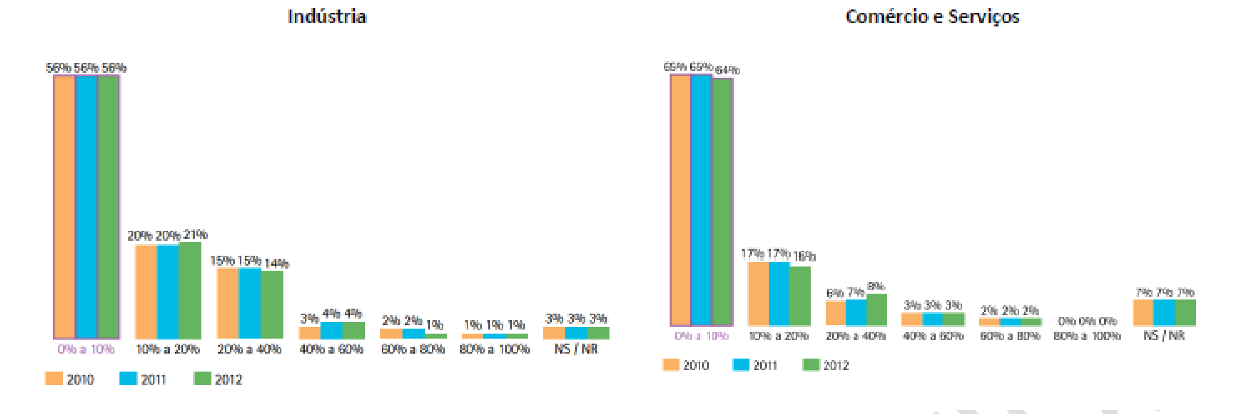
Technological Area/Units Registered													
Wind	No	Solar	No	waves	No	Biomass:	No	Hydro	No	Geothermal	No	Other	No
Wind	30	Solar	94	Wave energy	45	Biomass:	3	Hydro	5	Geothermal	2	Hydrogen production	21
Wind engines	3	Solar collector	25	Tidal energy	8	Bio fuel	6	Hydraulic power	8	-	-	Energy Storage	27
Wind turbine	18	Solar panel	26	Ocean energy	1	Biodiesel	8	-	-	-	-	-	-
-	-	Solar thermal	16	Sea currents	4	Bioethanol	4	-	-	-	-	-	-
-	-	Solar Photovoltaic	4	Wind power	3	Biogas	6	-	-	-	-	-	-
-	-	Concentrated Solar	5	Oscillating water column	3	Biomethane	2	-	-	-	-	-	-

iii. Current level of energy costs including the international context

The price of energy is a key factor in the competitiveness of companies. Competitive energy prices require an increase in the competitiveness of companies.

A study conducted by the Portuguese Energy Association found that in the last three-year period, energy costs have represented less than 10% of total costs for around 56% of industrial companies. For commerce and services companies, energy costs have represented less than 10% of total costs for around 64% and 65%, respectively.

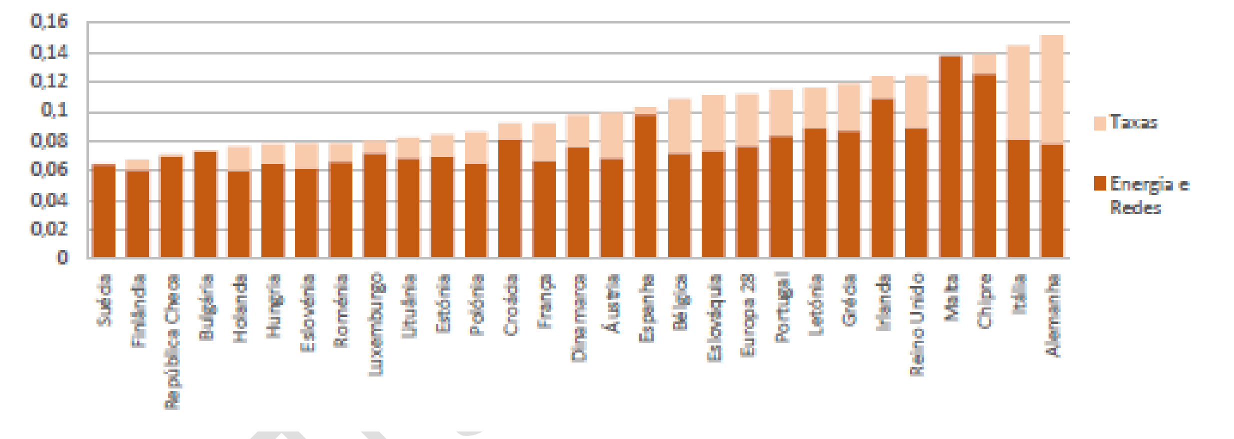
Figure 40 - Percentage of total energy costs with respect to total costs of the company [Source: APE 'Energy in Portugal: A User



Key: Industry Commerce and services

When considering the prices without VAT in industry in the EU-28 countries for the 2nd semester of 2017, it can be seen that in band IC (reference), Portugal is slightly above the average.

Figure 41 - Electricity price in industry excluding VAT and other recoverable taxes and in Band IC (500 MWh > < 2 000 MWh) in EU-28 countries relating to 2nd semester of 2017 (€/kWh) [Source: Eurostat]



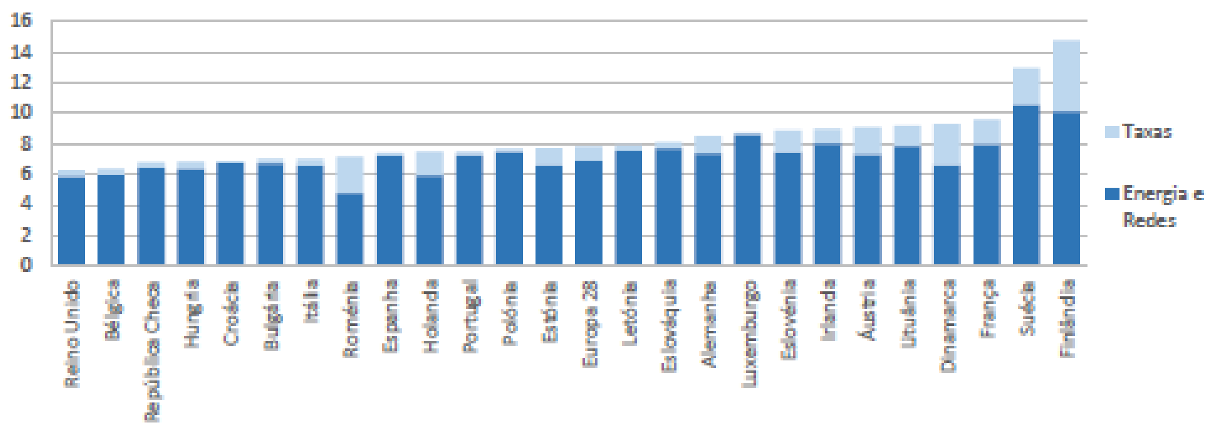
Key:

Charges
Energy and Networks

Sweden - Finland - Czech - Republic - Bulgaria - Holland - Hungary - Slovenia - Romania - Luxembourg - Lithuania - Estonia - Poland - Croatia - France - Denmark - Austria - Spain - Slovakia - Europe 28 - Portugal - Latvia - Greece - Ireland - United - Kingdom - Malta - Cyprus - Italy - Germany

When considering the prices of NG without VAT or other recoverable taxes and levies in industry in the EU-28 countries for the 2nd semester of 2017, it can be seen that in band I3 (reference), Portugal is below the average.

Figure 42 - NG price in industry excluding VAT and other recoverable taxes and in Band I3 (> 10 000 GJ and < 100 000 GJ) in the EU-28 countries for the 2nd semester of 2017 (€/GJ) [Source: Eurostat]



Key:

Charges
Energy and Networks

United Kingdom - Belgium - Czech - Republic - Hungary - Croatia - Bulgaria - Italy - Romania - Spain - Holland - Portugal - Poland - Estonia - Europe 28 - Latvia - Slovakia - Germany - Luxembourg - Slovenia - Ireland - Austria - Lithuania - Denmark - France - Sweden - Finland

iv. Projections of developments in i. to iii. with existing policies and measures at least until 2040 (including for the year 2030)

Nothing to note.

5. IMPACT ASSESSMENT OF PLANNED POLICIES AND MEASURES

5.1. Impacts of planned policies and measures on the energy system and on GHG emissions and removals, including comparison with projections based on existing policies and measures

i. Projections of the development of the energy system and GHG emissions and removals as well as, where relevant of emissions of air pollutants in accordance with Directive (UE) 2016/2284 under the planned policies and measures

With regard to projections of GHG emissions, in addition to the scenario of existing policies, a scenario of planned policies was developed based on the same macroeconomic assumptions for evolution of GDP, population and GVAs for 2020-2030, slightly more optimistic, more coherent with the macroeconomic scenario used in the national energy model (JANUS) presented in Section 4.1.

In the scenario of planned policies, unlike the case with existing policies, restrictions were imposed on emissions in the energy sector allowing Portugal to achieve carbon neutrality in 2050. This scenario allows the additional effort required by each sector to be assessed, so that overall neutrality is achieved, not exactly reflecting a scenario of planned policies and measures (which are still under discussion and development at this stage).

Table 54 - Potential GHG emissions reduction with respect to 2005 (%) in both scenarios developed under RNC2050

	Projected reduction of GHG emissions with respect to 2005 (%) – Scenario Existing policies		Projected reduction of GHG emissions with respect to 2005 (%) – Scenario Planned Policies	
Sectors	**2030**	**2040**	**2030**	**2040**
Energy	73	89	83	93
Industry	45	45	45	60
Transport	48	72	53	84
Services	64	82	65	100
Residential	27	29	29	74
Agriculture	19	19	19	20
Waste and Wastewater	57	69	57	69
Total without LULUCF	52	64	56	74

Shown in Table 55 is a results summary of modelling carried out on GHG emissions per sector for the 2030 and 2040 horizons, in a scenario of neutrality.

Table 55 - Projected GHG Emissions (kt CO) – Scenario Planned Policies

	GHG Emissions (kt CO2e)			
Sectors	**2005**	**2020**	**2030**	**2040**
Energy	26 167	16 239	4 521	1 832
Energy production and processing	23 039	12 942	1 751	363
Refining	2 466	2 220	1 861	986
Fugitive emissions	662	1 077	909	483
Industry	18 335	12 448	10 175	7 292
Combustion in Industry	10 758	7 631	5 886	3 392

Industrial processes	7 577	4 817	4 289	3 900
Transport	19 594	16 272	9 286	3 222
Services	3 166	1 178	1 114	7
Residential	2 724	2 427	1 934	717
F-gases	212	2 226	877	606
Agriculture	8 213	7 829	6 615	6 535
Agriculture	6 760	6 728	5 498	5 449
Combustion in Agriculture/Forestry/Fisheries	1 453	1 102	1 118	1 087
Waste and Wastewater	7 701	4 405	3 320	2 362
LULUCF	1 520	-4 642	-6 926	-7 795
Total without LULUCF	86 112	63 025	37 842	22 573
Total with LULUCF	87 632	58 383	30 916	14 778

It can also be seen that cost-effective potential exists to reduce GHG emissions more quickly with respect to the existing policies scenario, decarbonising almost all electricity production, mobility and transport and buildings in the coming two decades (2020-2040). In this regard, the role of the forest sink and other soil uses must be reinforced. Efficient agro-forestry management is a determining factor if the objective of carbon neutrality is to be achieved by 2050.

This neutrality also served to communicate the new targets for GHG emissions reduction, renewable energies and energy efficiency set out for the 2030 horizon, and specified in Chapter 2.

With respect to work under RNC2050, also to be drawn up are estimates of air pollutant emissions. Of note is that the current National Strategy for the Air (ENAR 2014-2020) is aligned with PNAC and was developed in parallel and based on the same energy demand scenarios and with a number of common measures with regard to sector initiatives for atmospheric emissions.

During work for NECP currently underway, a series of indicators was identified where the starting point were the references in Part 2 of Annex I of the draft Regulation on the Governance of the Energy Union and Climate Action, which allowed the impacts of planned policies and measures to be assessed, particularly in the energy system.

ii. Assessment of policy interactions[62]

With respect to work under RNC2050, preliminary results indicate that trajectory to reduce emissions that achieves reductions of 85% to 90% in 2050 when compared with 2005 levels, will bring about considerable effects in renewables and energy efficiency. It is forecast that it will be possible to achieve:

- significant levels of renewable energies in final energy consumption, reaching 85-90% in 2050, particularly in electricity production and transport which could achieve full electrification in 2050 (road and rail sectors);
- a significant increase in the efficiency of the economy with a reduction in the consumption of primary energy or around 40% by 2050 and a considerable reduction in the energy intensity of the economy.

iii. Assessment of interactions between existing policies and measures and planned policies and measures, and between those policies and measures and Union climate and energy policy measures

Not available at this stage.

62 (In existing policies and measures and planned policies and measures within a policy dimension and between existing policies and measures and planned policies and measures of different dimensions) at least until the last year of the period covered by the plan, in particular to establish a robust understanding of the impact of energy efficiency / energy savings policies on the sizing of the energy system and to reduce the risk of stranded investment in energy supply.

5.2. Macroeconomic impacts and, as far as it is viable, on health, the environment, employment, education, social competences and impacts, including transitory aspects[63]

Not available at this stage.

5.3. Overview of investment needs

i. Existing investment flows and forward investment assumptions with regard to the planned policies and measures

Not available at this stage.

ii. Sector or market risk factors or barriers in the national or regional context

Not available at this stage.

iii. Analysis of additional public finance support or resources to fill identified gaps identified under point ii

Not available at this stage.

5.4. Impacts of planned policies and measures in other Member States and on regional cooperation

i. Impacts on the energy system in neighbouring and other MS in the region (*)

Not available at this stage.

ii. Impacts on energy prices, public services and the integration of the energy market

Not available at this stage.

iii. If relevant, impacts on regional cogeneration

Not available at this stage.

[63] (With regard to costs and benefits and cost-effectiveness ratio) of the planned policies and measures described in Section 3, at least until the last year of the period covered by the plan, including a comparison with projections based on existing policies and measures.

Annex I

Cost of the main technologies considered in the JANUS model and in the TIMES_PT model

Table - Cost of the technologies considered in the Janus model

Version 18-12-2018	Investment **(€/W)**						MO fixed **(€/W)**						MO variable **(€/MWh)**			
	2016		**2030**		**2040**		**2016**		**2030**		**2040**		**2016**	**2030**	**2040**	
Coal	1.9	4	2.3	4	2.3	4	0.035	4	0.035	4	0.035	4	3.4	3.4	3.4	4
Fuel Oil	1.2	4	1.2	4	1.2		0.021	4	0.021	4	0.021		2.76	2.76	2.76	4
Diesel	1.2		1.2		1.2		0.021		0.021		0.021		2.76	2.76	2.76	
Natural Gas	0.8	4	0.765	4	0.765	4	0.022	4	0.021	4	0.020	4	1.99	1.90	1.81	4
Biogas	0.94	4	0.92	4	0.92	4	0.023	4	0.02	4	0.019	4	0.71	0.71	0.71	4
Incineration of biomass	4.7	4	4.7*0.9	4	4.7*0.9*0.9	4	0.047	4	0.04	4	0.039	4	3.56	3.56	3.56	4
Waste incineration	2.03	4	2.01	4	2.00	4	0.052	4	0.044	4	0.042	4	0.81	0.81	0.81	4
Solar	0.7	12	0.645	12	0.477	12	0.013	12	0.0122	12	0.0115	12	0	0	0	
Solar PV concentrated (CPV)	2.2	8	1.1	8	1.1*0.9		0.022	6	0.011	6	0,011*0,9		0	0	0	
Solar PV with storage	0.8*1.2		0,34*1,2		0.34*0.9*1.2		0,008*1,2		0,003*1,2		0.03*0.9*1.2		0	0	0	
Solar thermal concentrated (CSP)	5.1	7	5,1*0,9		4,59*0,9		5,1*0,02		5.1*0.9*0.02		5.1*0.9*0.9*0.02		0	0	0	
Ocean waves	5	5	2.4	5	2,4*0,9		0.15	5	0.072	5	0.072*0.9		0	0	0	
Floating off-shore wind	4.6	5	2.4	5	2,4*0,9		0.138	5	0.072	5	0.072*0.9		0	0	0	
On-shore wind	1.0	12	0.98	12	0,88*0,9		0.018	12	0.018	12	0,018*0,9		0	0	0	
On-shore wind with storage	1*1,2		0,88*1,2		0.88*0.9*1.2		0,03*1,2		0,017*1,2		0.017*0.9* 1.2		0	0	0	
Stimulated binary geothermal	4.97	4	4.47	4	4.37		0.095	4	0.095	4	0.095		0.32	0.32	0.32	4
Hydro - small	1.6	7	1.6	7	1.6	7	0.05	7	0.05	7	0.05	7	0.002	0.002	0.002	7
Hydro - large	1.3	7	1.3	7	1.3	7	0.03	7	0.03	7	0.03	7	0.0025	0.0025	0.0025	7
Hydro with pumping	2.8	2	2.8	2	2.8	2	0.06		0.06		0.06					
Batteries (Li)	2.1	10	1	10	0.9		0.0045	11	0.0045		0.0045					
PEM Electrolyser	1.2	4 10	0.7	4 10	0.7	4	1,2*0,02	4	0,7*0,02		0,7*0,02					
Pem Fuel cells	3.5	13	2	13	2*0,8	13										
Synthetic fuels (H2)	0.5	14	0.3	14	0.3* 0.8	14										
Biofuels - pyrolysis	1.2	9	1,2*0,8	9	1.5*0.8*0.8	9	1,5*0,03	7	1.5*0.8* 0.03	7	1.5*0.8*0.8**0.03	7	4	4	4	7
Biofuels - gasification	2	15	2*0.8	15	2*0.8* 0.8	15	2*0,03	7	2*0.8* 0.03	7	2*0.8*0.8** 0.03	7	4	4	4	7
Advanced biofuels	3	9	2.5	9	1.5	9	3.5*0.03	9	2,5*0,03	9	1,5*0,03	9				
Biogas	1.3	12	1.25	12	1.15	12	0.0288	12	0.0243	12	0.0238	12	2.56	2.56	2.56	12
H2 Injection	0.542	12	0.412	12	0.379	12	1.7	12	1.7	12	1.7	12				

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Table - Cost of the main technologies for generating electricity considered in the model TIMES_PT (prices €2 000)

Gas	**Investment Costs (2015)**	**Investment Costs (2030)**	**Investment Costs (2040)**	**Fixed costs (2015)**	**Fixed costs (2030)**	**Fixed costs (2040)**	**Variable costs (2015)**	**Variable costs (2030)**	**Variable costs (2040)**	**References**
	€/KW	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/GJ**	**€/GJ**	**€/GJ**	
Conventional combined gas cycle	759	759	759	18.96	18.96	18.96	0.48	0.48	0.48	JRC (2013)
Advanced combined gas cycle	488	488	488	9.01	9.01	9.01	0.52	0.52	0.52	EDP (2017)
Gas cycle combined with CO2 capture post combustion		888	864		31.74	31.05		0.20	0.20	JRC (2013)
Open Gas Cycle (Peaker) Advanced (OGCC)	373	366	364	9.39	9.20	9.16	0.46	0.46	0.46	JRC (2013)
Diesel	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/GJ**	**€/GJ**	**€/GJ**	
Fuel oil steam turbine (Supercritical)	1 399	1 113	1 012	17.94	17.86	17.83	0.58	0.58	0.58	JRC (2013)
Diesel Turbine (Peaker) Advanced	385	377	375	12.20	11.95	11.90	0.52	0.52	0.52	EDP (2017)
Coal (Anthracite)	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/GJ**	**€/GJ**	**€/GJ**	
Subcritical (Conventional)	1 049	1 049	1 049	20.98	20.98	20.98	0.27	0.27	0.27	JRC (2013)
Supercritical	1 307	1 307	1 307	26.13	26.13	26.13	0.55	0.52	0.49	JRC (2013)
Fluidized Bed	1 927	1 927	1 927	38.54	38.54	38.54	0.26	0.26	0.26	JRC (2013)
Integrated gasification combined cycle (IGCC)	2 014	1 727	1 558	40.28	34.53	31.17	1.23	1.23	1.23	JRC (2013)
IGCC with Pre Combustion CO2 Capture		1 880	1 712		30.58	27.60		0.25	0.25	JRC (2013)
Supercritical + Post Combustion CO2 Capture		1 732	1 698		31.16	28.12		0.63	0.61	JRC (2013)
Supercritical + Oxy Fuel CO2 Capture		1 758	1 486		28.70	25.90		0.96	0.91	JRC (2013)
Nuclear	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/GJ**	**€/GJ**	**€/GJ**	
Nuclear 3rd generation (Light Water reactor)	3 843	3 843	3 843	69.71	69.71	69.71	0.70	0.67	0.65	JRC (2013)
Nuclear 4th generation (Fast reactor)			5 019			57.41	0.70	0.67	0.65	JRC (2013)
Hydro	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/GJ**	**€/GJ**	**€/GJ**	
Run-of-river type hydropower	1 068	970	888	10.68	9.70	8.88				TIMES_PT Database; JRC/EDP
Hydro-electric Dam (High AF)	771	747	721	7.71	7.47	7.21	0.47	0.47	0.47	TIMES_PT Database; JRC/EDP
Hydro-electric Dam (Low AF)	771	747	721	7.71	7.47	7.21	0.47	0.47	0.47	TIMES_PT Database; JRC/EDP
Hydro-electric Dam with pumping	593	574	554	5.93	5.74	5.54	0.47	0.47	0.47	TIMES_PT Database; JRC/EDP
Geothermal	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/GJ**	**€/GJ**	**€/GJ**	
Enhanced Geothermal System (Hot dry rock)	6 096	4 612	4 612	213.36	161.40	161.40				JRC (2013)
Geothermal hydrothermal with flash	1 676	1 537	1 537	58.67	53.80	53.80				JRC (2013)
Wind	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/KW**	**€/GJ**	**€/GJ**	**€/GJ**	
Floating off-shore wind	3 596	2 194	1 938	115.07	70.22	62.02				IRENA (2018)
On-shore wind	826	736	721	30.04	30.04	30.04				EDP (2017)
Micro Wind	4 291	3 173	2 832	85.82	63.46	56.64	0.10	0.09	0.07	WWEA (2016); Distributed Wind

										market Report US (2016)