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Energy Union Factsheet Portugal

Accompanying the document

COMMUNICATION FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT, THE COUNCIL, THE EUROPEAN ECONOMIC AND SOCIAL COMMITTEE, THE COMMITTEE OF THE REGIONS AND THE EUROPEAN INVESTMENT BANK

Third Report on the State of the Energy Union

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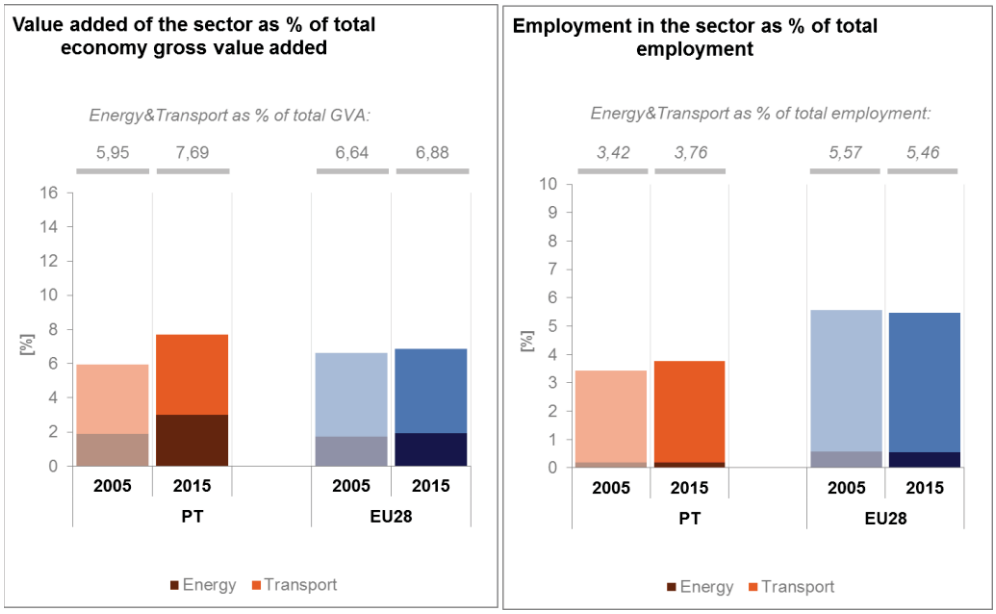
Portugal

Energy Union factsheet[1]

1. Macro-economic implications of energy activities

Energy and transport are key sectors for the overall functioning of the economy as they provide an important input and service to the other sectors of the economy. Together the activity in these two sectors[2] accounted for 7.7 % of the total value added of Portugal in 2015. Similarly, their share in total employment[3] was 3.8 % in 2015, of which 3.6 % in the transport sector and 0.2 % in the energy sector.



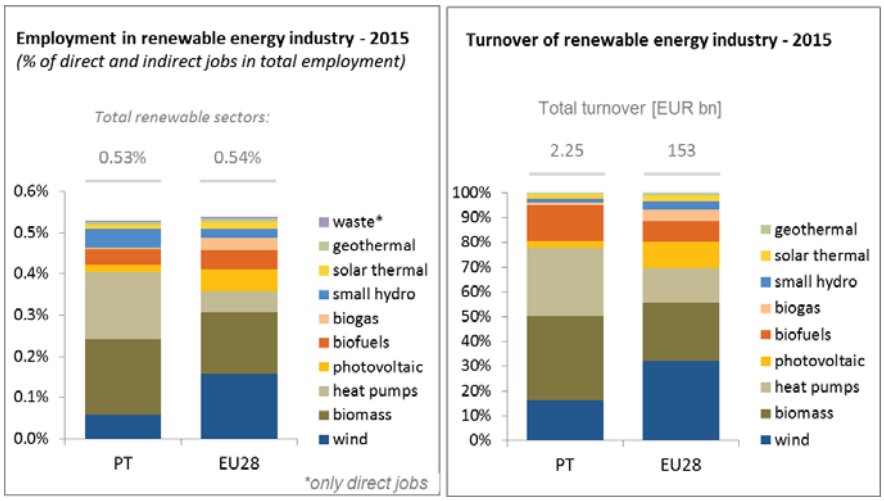
(source: Eurostat)

According to EurObserv'ER, in 2015, the share of direct and indirect renewable energy related employment in total employment of the economy in Portugal was at about 0.53 %, slightly below the EU average.

1 The indicators used in this country factsheet largely build on indicators developed for the Commission Staff Working Document "Monitoring progress towards the Energy Union objectives – key indicators" (SWD(2017) 32 final) https://ec.europa.eu/commission/sites/beta-political/files/swd-energy-union-key-indicators_en.pdf

2 Gross value added and employment in NACE sectors D-Electricity, gas, steam and air conditioning supply and H-Transportation and storage.

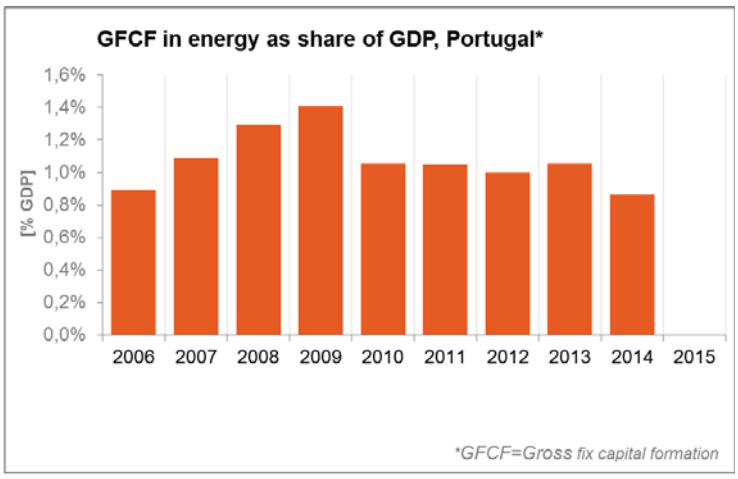
3 National Accounts, Eurostat



(source: EC based on Eurobserv'Er and Eurostat)

The decarbonisation of the energy and transport sectors will require significant investments and economic activity beyond the remit of these sectors themselves. The energy transition implies a structural shift in economic activity. Energy-related investment and jobs will in part migrate from traditional fossil fuel based activities towards construction, equipment manufacturing and other services related to the deployment of low carbon and clean energy technologies. At the moment, the efforts related to the low-carbon and clean energy transition in sectors beyond energy can only be partially quantified and are therefore not included in this analysis.

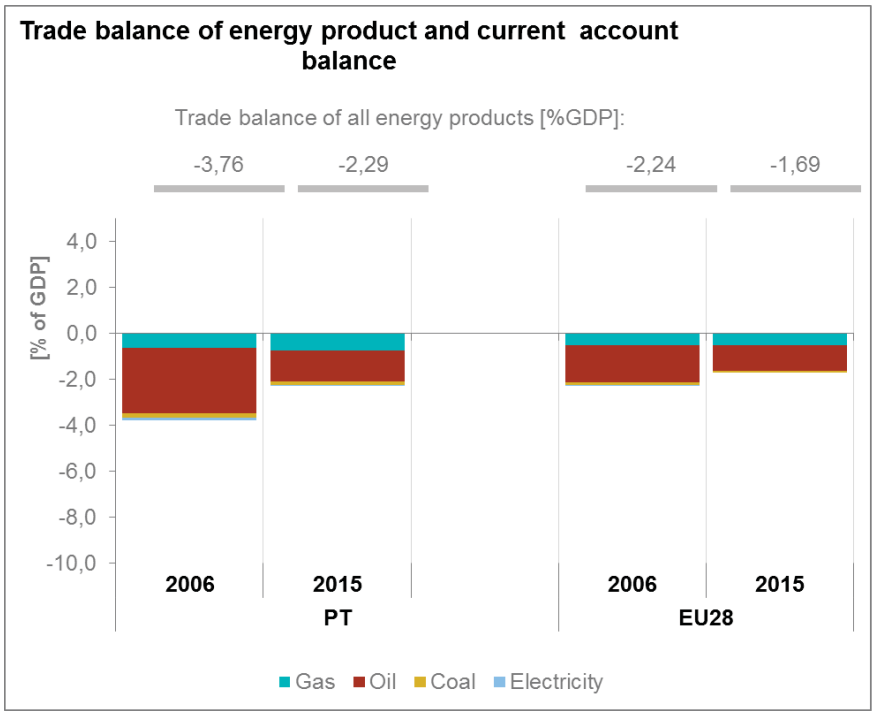
An indication of the level of efforts and challenges encountered by Portugal in the energy sector is given by the Gross fixed capital formation (GFCF)[4]. Investments in the electricity and gas sectors, which are taken as reference sectors, have been on an increasing trend from 2006 to 2009 and then declined marginally and remained broadly constant until 2014. In the latter year they represented around 0.9 % of the country's GDP, lower than in their peak in 2009 (1.4 %).



(source: Eurostat)

[4] Gross fixed capital formation consists of resident producers´ acquisitions, less disposals, of fixed tangible or intangible assets. This covers, in particular, machinery and equipment, vehicles, dwellings and other buildings. It also includes foreign direct investment (FDI). Steam and air conditioning supply are also included in the figures mentioned above as Eurostat reports electricity, gas, steam and air conditioning supply together.

In terms of trade, Portugal is a total net importer of fossil fuels. The trade deficit in energy products has fallen from about 3.8 % of GDP in 2006 to 2.3 % in 2015, influenced by improvements in energy efficiency, increase endogenous renewable energy use, and by falling fossil fuel prices. With the exception of natural gas, the trade deficit of the remaining energy commodities declined between 2006 and 2015. The largest decrease as a percentage of GDP is accounted for by petroleum products. By contrast the trade deficit of gas increased from 0.6 % to 0.7 % in the above mentioned period.

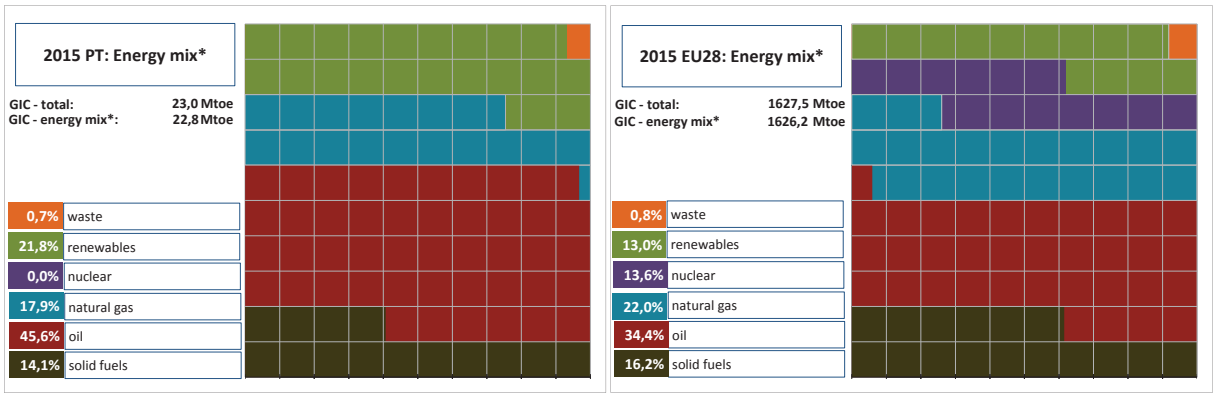


(source: Eurostat)

2. Energy security, solidarity and trust

2.1. Energy Mix

The Portuguese Energy mix of primary energy products has two particularities when compared to the European average; a significantly high share of renewable energy (21.8 % vs 13 %) and of oil (45.6 % vs 34.4 %). On the other components of its energy mix; the share of natural gas is slightly below EU average (17.9 % vs 22 %) as well as for solid fuels (14.1% vs 16.2 %).



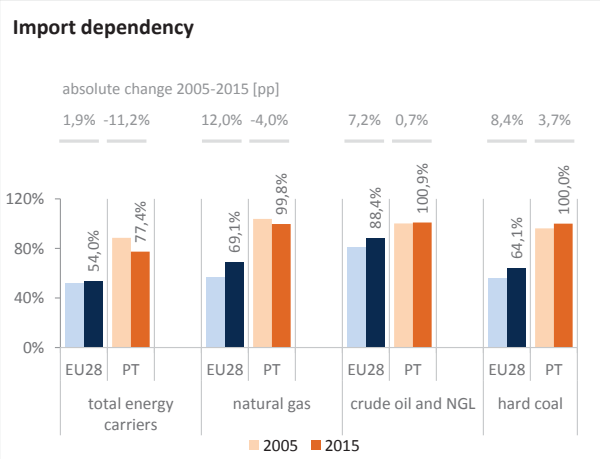
**energy mix as share share in GIC-excluding electricity and derived heat exchanges , GIC=gross inland consumption*

(source: Eurostat)

2.2. Import dependency and security of supply

Overall, Portugal's import dependency was 77.4 %, which is substantially higher than the EU average (54.1 %). Nevertheless, there has been a considerable decrease since 2005 (-11.2 %), mostly due to the increase of renewables participation in the energy mix (e.g. in 2015, more than 52 % of electricity consumption was supplied by RES sources, a new record high).

Portugal imports all its natural gas, oil and coal consumption. At the same time, it imports gas (and oil) from a relatively well diversified range of sources thanks to the LNG terminal in Sines and the possibility to take advantage of the supply diversification in the Spanish market. Portugal and EU main suppliers of natural gas and oil are rather different. Portugal relies mainly on Algeria and Nigeria for its natural gas supply and Angola and Saudi Arabia for its oil supply while the EU main suppliers of natural gas and oil are Russia and Norway.



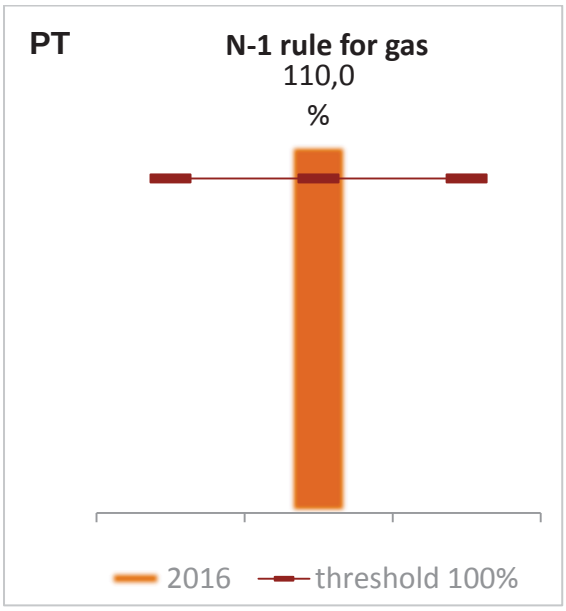
2015: Top non-EU suppliers for main energy carriers*

Natural gas		Crude oil and NGL		Hard coal	
PT	**EU28**	**PT**	**EU28**	**PT**	**EU28**
Algeria 52,0%	Russia 37,3%	Angola 23,4%	Russia 28,8%	Colombia 97,6%	Russia 29,1%
Not specified 20,1%	Norway 32,8%	Saudi Arabia 14,0%	Norway 12,4%		Colombia 24,3%
Nigeria 19,2%	Algeria 10,7%	Kazakhstan 9,7%	Nigeria 8,3%		United States 16,0%

*share in total imports for the MS and in total non-EU imports for the EU28

(source: Eurostat)

The Regulation concerning measures to safeguard security of gas supply requires that, if the single largest gas infrastructure fails in one Member State, the capacity of the remaining infrastructure is able to satisfy total gas demand during a day of exceptionally high gas demand. Portugal complies with this rule.

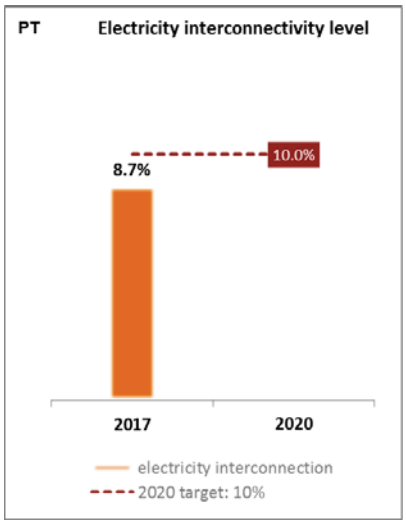


(source: gas coordination group)

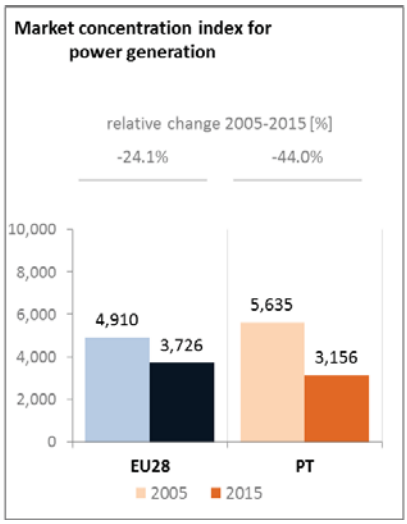
3. Internal market

3.1. Interconnections and wholesale market functioning

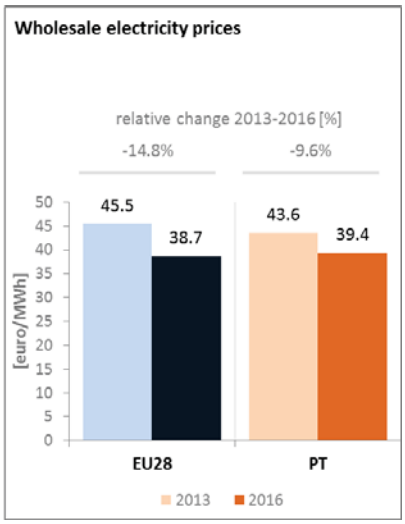
3.1.1. Electricity



(source: EC services based on ENTSOE European power exchanges)



source: EC services based on Eurostat



source: EC services based on Platts and

Portugal is part of the MIBEL wholesale electricity market (integrated market for electricity between Spain and Portugal). The Portuguese electricity system is directly connected to the Spanish system and indirectly to France. In 2017, the electricity interconnection level[5] was 8.7%, below the 2020

[5] The interconnectivity level is calculated as a ratio between import interconnection and net generation capacities of the country (i.e. the 2017 value is the ratio between simultaneous import interconnection capacity [GW] and net generating capacity [GW] in the country at 11 January 2017, 19:00 pm as resulted from ENTSO-E Winter Outlook 2016/2017)

target of 10 %, which should nevertheless be achieved with the finalisation of the ongoing Projects of Common Interest (internal line between Pedralva and Sobrado, the internal line between Vieira do Minho, Ribeira de Pena and Feira and new Portugal — Spain interconnection, between Beariz — Fontefría — Ponte de Lima — Vila Nova de Famalicão). Good progress is underway to complete by the end of 2018 the electricity interconnection between the two countries which will allow Portugal to attain the 10% level of interconnections by increasing the current interconnection capacity level to 3.2 GW.

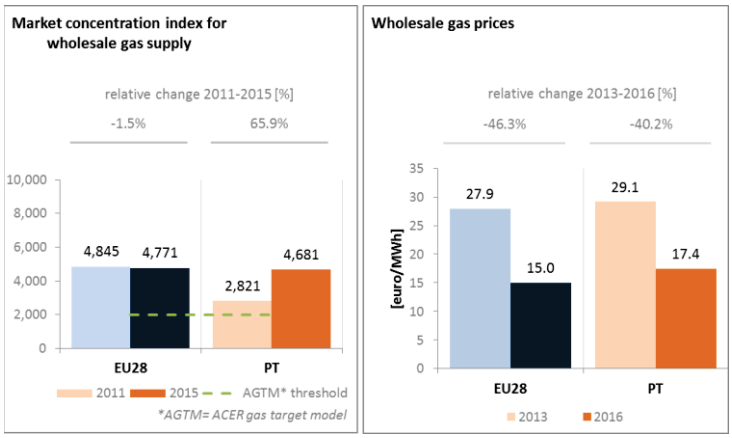
Since 2005 the concentration level of the power generation market has improved substantially (-44 %) and is now slightly below the EU average.

The evolution of the wholesale market in Portugal is intrinsically related to the integration of the Iberian Peninsula in the internal market and the participation of Portuguese agents in the MIBEL increasing competition. The wholesale electricity prices are above the EU average; between 2013 and 2016 they decreased by 9.6 % (while the EU average was -14.8 %).

3.1.2. Gas

The MIBGAS ("Mercado Ibérico do Gas"/ Iberian Gas Market) started operation in December 2015, as the operator of Spain's organised gas market and with the aim of achieving in the future one single market with Portugal, similarly to the electricity sector (based on bilateral agreements between both Member States). During its first year of operation, some progress has been made, but MIBGAS liquidity is still far below the liquidity levels of the main European gas hubs (only 2 % of the domestic demand was negotiated in MIBGAS in 2016). Several measures have been taken to increase market liquidity, including the appointment in January 2017 of a market creator (Gunvor International BV). MIBGAS' completion requires further regulation and political efforts.

The market concentration in the Portuguese gas supply market is high but below the EU average.
The wholesale gas prices are above the EU average and between 2013 and 2016 decreased 40.2 % but less than the EU average price decrease (46.3 %).



(source: ACER for the left graph and EC services based on Platts, gas hubs, Eurostat for the right graph)

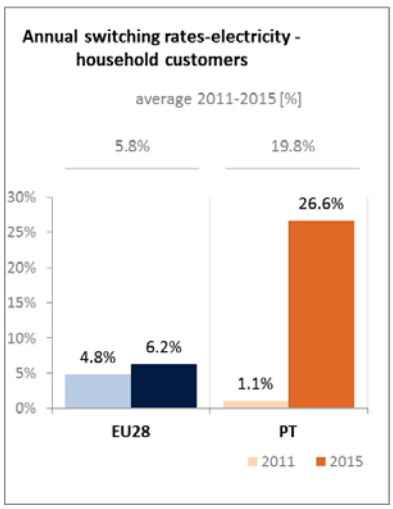
In terms on Projects of Common Interest, Portugal has a key natural gas project: the 3rd interconnection point with Spain, which will increase Portugal's security of supply in case of failure of

its biggest infrastructure. CEF co-financed study is ongoing, notably on the Portuguese part of the frontier.

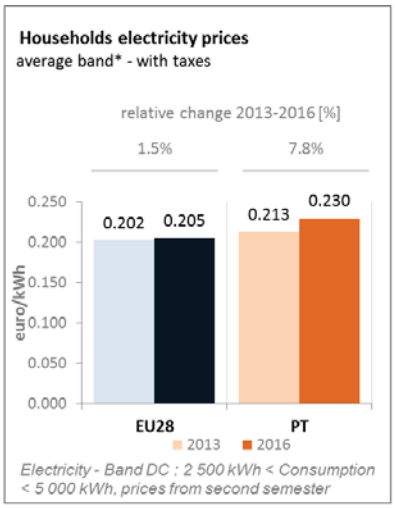
3.2. Retail electricity and gas market

3.2.1. Electricity

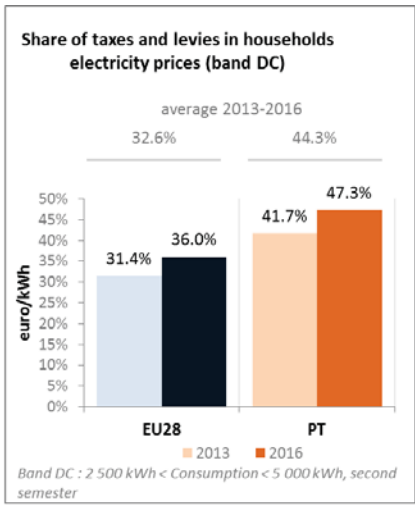
Retail electricity and gas prices are above the EU average. In the period 2013-2016, household electricity prices increased in nominal terms by 7.8 %. One of the major drivers of this increase were taxes and levies, which in 2016 represented almost half of the total final price of electricity. Portugal now has one of the highest annual supplier switching rates in Europe (26.6 % up from 1.1 %), significantly above the EU average (6.2 %).



(source: ACER)



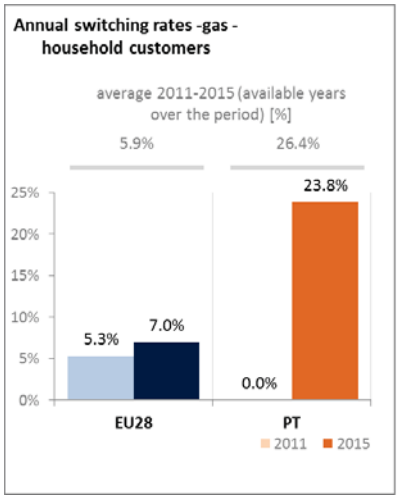
(source: Eurostat)



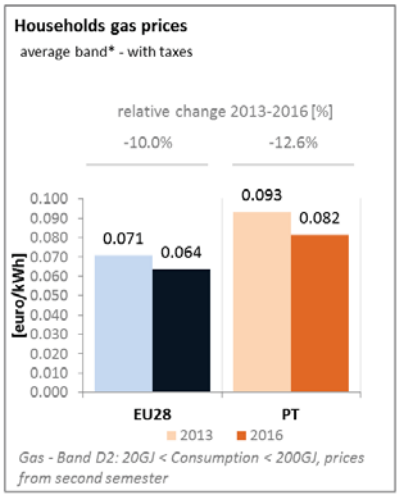
(source: Eurostat)

3.2.2. Gas

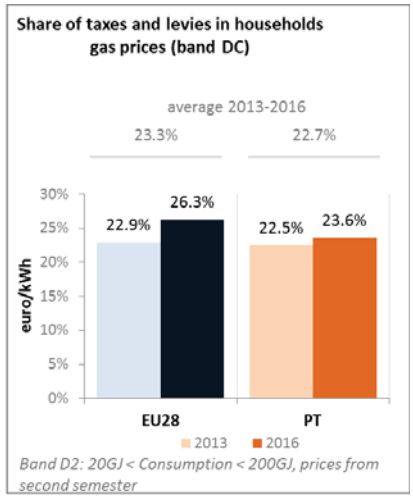
National gas prices for households are also amongst the highest in the EU, which can be explained mainly by lack of competition and a limited development of the MIBGAS. For the period 2013-2016, nominal gas prices decreased 12.6 %, while the EU average was 10.0%



(source: ACER)



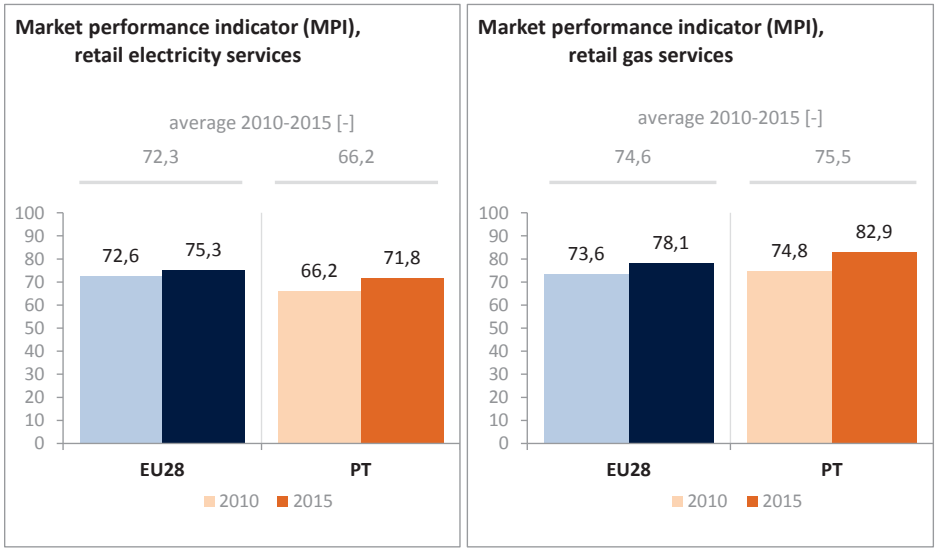
(source: Eurostat)



(source: Eurostat)

3.2.3. Market performance indicators

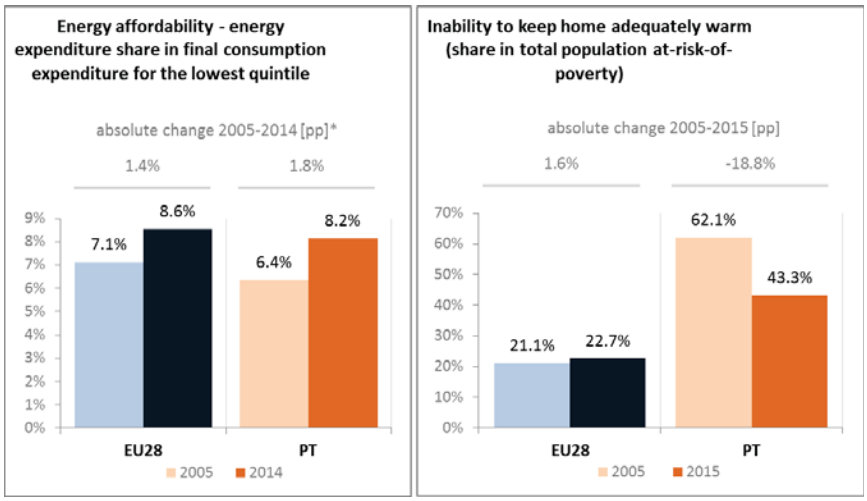
According to the periodical survey of DG JUST on customer satisfaction on energy retail markets, the Portuguese consumers are less satisfied than the EU average about the retail electricity services, despite a positive trend observed since 2010. Conversely, they are more satisfied than the EU average when it comes to retail gas services.



(source: DG JUST survey)

3.3. Energy affordability

High retail electricity and gas prices have an impact on the affordability of energy services, especially for those in the lower income quintile. In Portugal, energy expenditure as a share of total consumption expenditure reached 8.2 % for the lowest quintile of the population (a 1.8 % increase as from 2005) and is below EU average. About 43.3 % of the population could not keep its home adequately warm, which is still significantly above the EU average (22.7 %). Having that in mind, since 1st July 2016 the attribution of the so-called "social tariffs" (indexed to families' revenues) is automatic In Portugal. In the gas sector it is cross subsidized by all gas consumers, in proportion to the energy consumed. For electricity, it is borne by electricity producers in proportion to the installed power in each centre electricity generation.



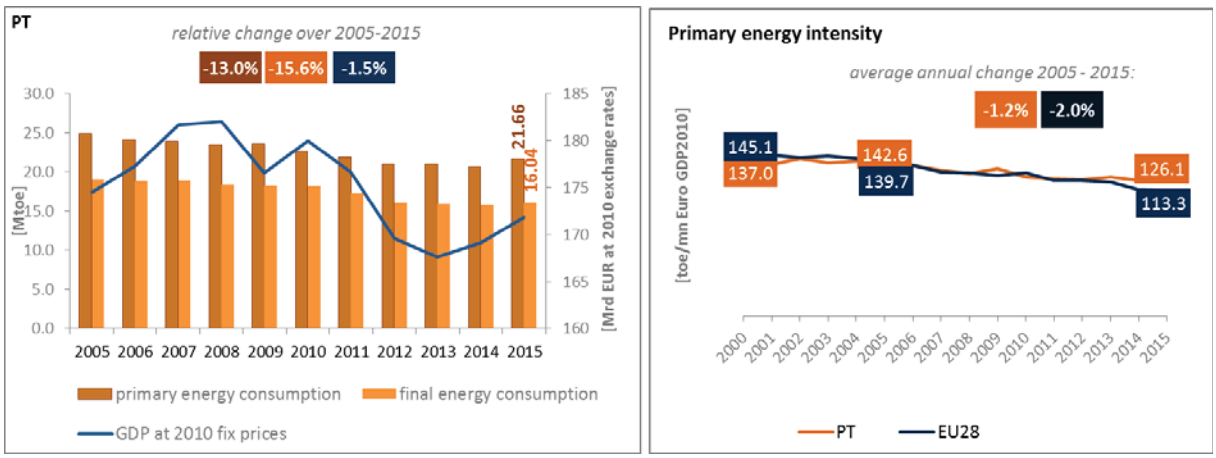
(source: ad-hoc data collection of DG ENER based on HBS with the support of Eurostat and national statistics)

4. Energy efficiency and moderation of demand

Portugal has set an indicative national energy efficiency target of 25 % reduction of primary energy consumption in 2020. Portugal is on track for meeting its national target. The primary and final energy consumption has been decreasing between 2005 and 2015. However, the slowdown of the economic activity might also have contributed to this.

Since 2005, Portugal decreased its primary energy consumption by 13 % to 21.66 Mtoe in 2015. Over the same period, final energy consumption also decreased by 15.6 % to 16.04 Mtoe in 2015.

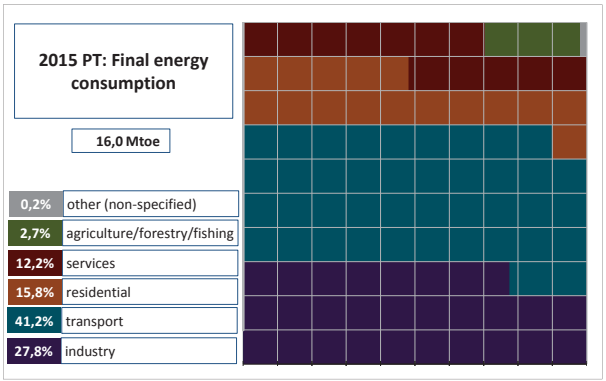
Even if Portugal has already achieved levels of primary and final energy consumption which are below the indicative national 2020 targets, it would need to make an effort to keep these levels until 2020.

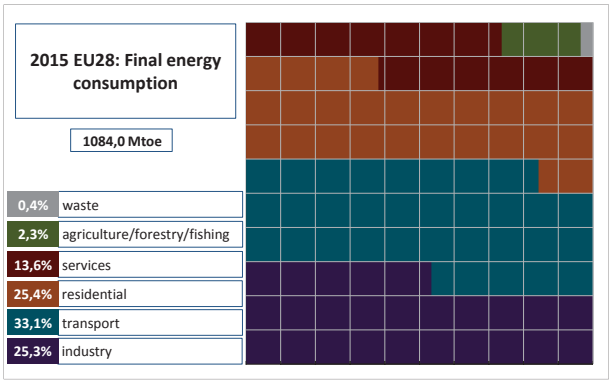


(source: Eurostat)

Primary energy intensity in Portugal has decreased in line with EU28, and remains close to average. However, only a minor energy intensity reduction was recorded in the industrial sector, which remains above EU average.

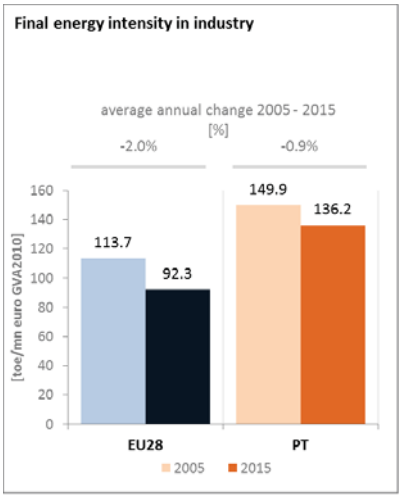
In 2015 in Portugal, transport was the largest energy consuming sector representing a 41.2 % share in the total final energy consumption, which is well above than the EU average (33.1 %). The energy consumption of Portugal's industry sector was in 2015 at around 27.8% in total final energy consumption. The energy consumption of the residential sector (15.8 %) is substantially below the EU average (25.4 %) which can be explained by a conjunction of factors including mild climate, high energy prices which impact in affordability and consequently impact the level of the energy poverty. On the services sector the consumption is slightly below the EU average, with a share in total final energy consumption of 12.2 %.

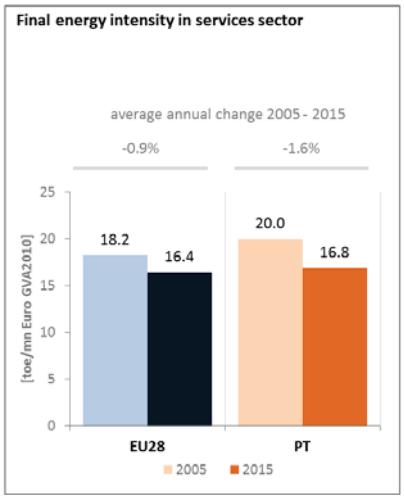


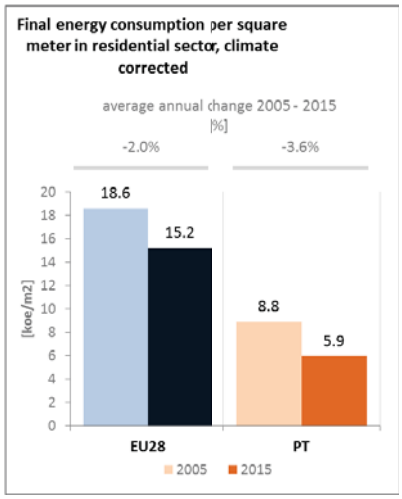


(source: Eurostat)

Additional efforts could therefore be envisaged to improve energy intensity of the industry sector and the high energy consumption in the transport sector. A positive development concerns the use of European Funds for Strategic Investments (EFSI) funds to finance the construction of nearly-zero-energy buildings in Portugal. The use of EU Cohesion policy funds for the renovation of buildings, including public infrastructure, households and SMEs, is progressing in line with its operational programme, and is also expected to deliver important energy savings.

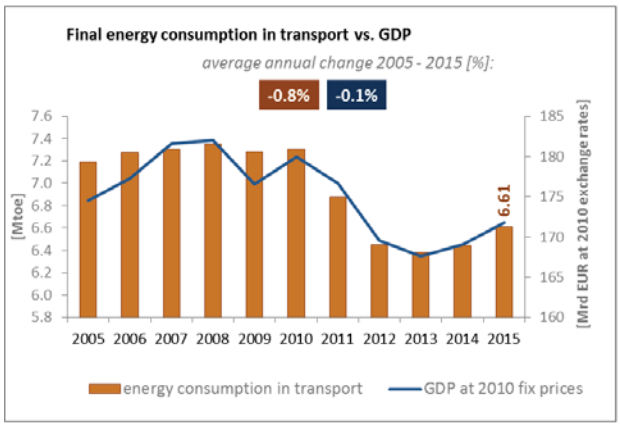




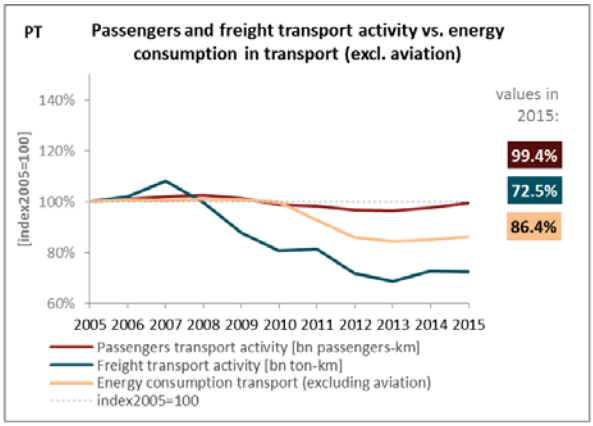


(source: Eurostat) *(source: Eurostat)* *(source: Odyssee database)*

Between 2005 and 2015, the final energy consumption in transport recorded an average annual decrease of 0.8 %, compared to the 0.1% average annual decrease of the GDP. Over the period 2005 – 2014, passenger transport activity in Portugal was almost at 2005 levels, while freight transport activity diminished more than the energy consumption in transport.



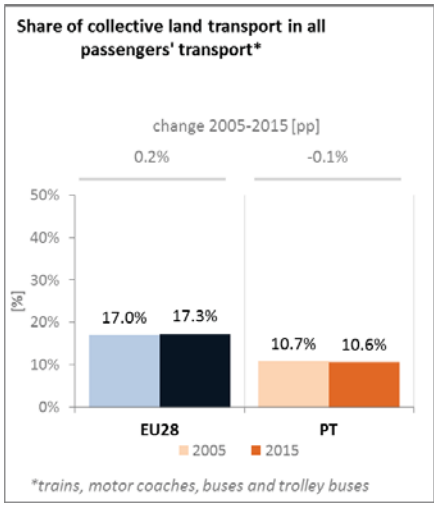
(source: Eurostat)



passengers transport activity=Private cars + bus + rail + tram & metro
freight transport activity=road+rail+inland waterways+pipeline

(source: Eurostat and DG MOVE pocketbook)

The share of collective land transport into total passengers' transport remained stable between 2005 and 2015 (from 10.7 % to 10.6 %), indicating that the use of private transport means in Portugal has not substantially increased.



(source: Eurostat)

In Portugal, several policy measures were adopted in the latest years to encourage the use of sustainable vehicles, including a revision of the circulation tax, which benefits vehicles with less CO_2 emissions and the introduction of Low Emission Zones in the capital, Lisbon.

To promote the use of collective modes of transport new urban public transport services were introduced in small and medium-sized cities and financial support was provided for the implementation of Intelligent Transport Systems (ITS) in collective modes (contactless ticket systems and real-time passenger information systems). Intermodal integrated services were also introduced in the Lisbon and Oporto regions, with a single information service, ticketing scheme and timetable. Support was given for the implementation of taxicab centrals, for a more simple and efficient use of this mean of transport.

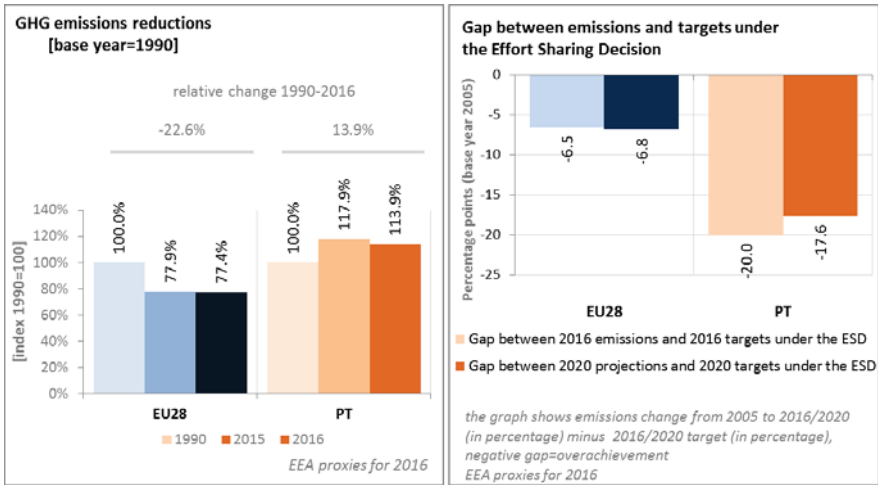
Measures to stimulate the energy efficiency in transports included the implementation of an electric vehicle recharging network in 25 cities and in the main motorways, eco-driving support services and tax reductions for heavy goods public transportation services.

5. Decarbonisation of economy

5.1. GHG emissions

In 2016, GHG emissions in Portugal were 13.9% above their 1990 levels (based on 2016 estimates), with an EU average of -22.6%.

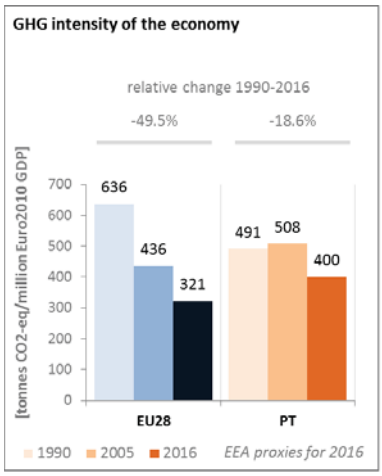
Portugal non-ETS emission decreased by 17 % between 2005 and 2016, and has achieved its 2016 target (an emissions increase of no less than 3 %) by a 20 pps gap. According to the latest national projections based on existing measures, non-ETS emissions will decrease by 17 % between 2005 and 2020. The 2020 target is consequently expected to be achieved by a 18 pps gap.

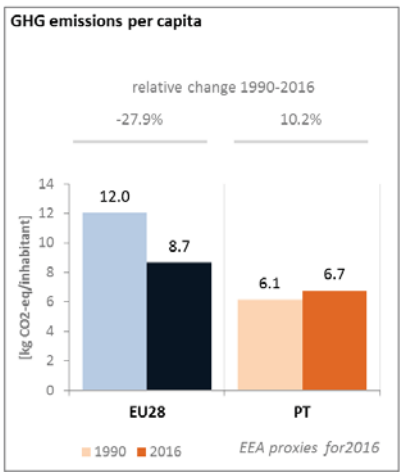


(source: EC and EEA)

In 2015 in Portugal, the largest sectors in terms of GHG emissions were the energy sector (28.5 % of the total GHG emissions) followed by transport (23.5 %), industry (22.4 %) and agriculture & fishery (11.3 %).

The key strategies currently being implemented are the Framework for Climate Policy (QEPiC) and the National Program for Climate Actions for the period 2020-2030 (PNAC 2020/2030).



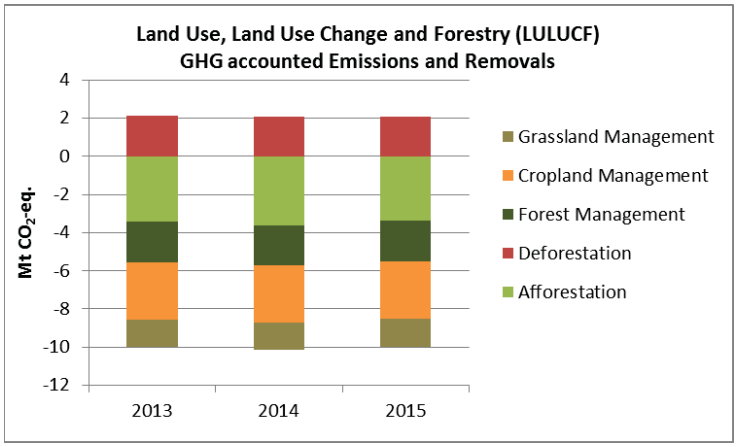


Largest Sectors of GHG Emissions in 2015	PT	EU28
Energy/power industry	28.5%	30.9%
Transport	23.5%	21.0%
Industry	22.4%	19.9%
Agriculture (incl. forestry & fishery)	11.3%	12.0%
Residential & Commercial	4.7%	12.8%
Waste	9.3%	3.2%
Other	0.4%	0.2%

(source: EC and EEA)

Preliminary accounts under the Kyoto Protocol for Portugal show overall removals of -7.9 Mt CO_2-eq. as an annual average in the period 2013-2015. For comparison, the annual average of the EU-28 accounted for removals of -119.0 Mt. CO_2-eq. It should be noted that in this preliminary simulated accounting exercise, removals from Forest Management were capped to -2.1 Mt CO_2-eq per year, due to significantly exceeding the limit of the difference between the reported sink and the accounting forest management reference level.

Removals by Afforestation are higher than emissions by Deforestation. The second highest share of removals is due to Cropland Management, followed by Forest Management and Grassland Management; all contributing with noteworthy amounts. Overall, there is no trend in removals; in fact all activities show no particular trend over the course of the three-year period.

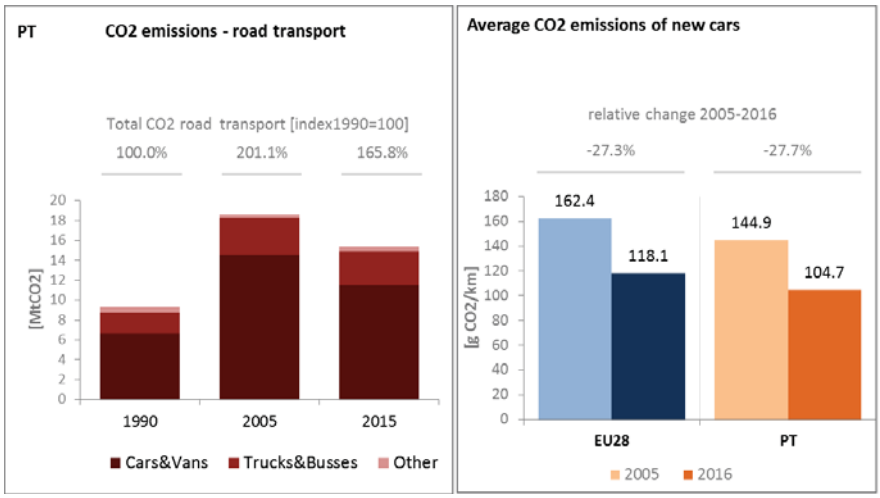


Note: Forest Management credits are capped and presented as yearly averages when the total Forest Management credits of the considered period exceed the simulated cap over the same period.

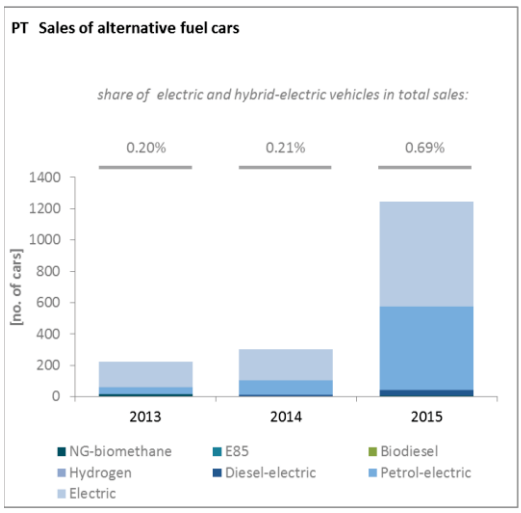
(source: EC and EEA)

CO_2 emissions in transport and alternative fuelled vehicles

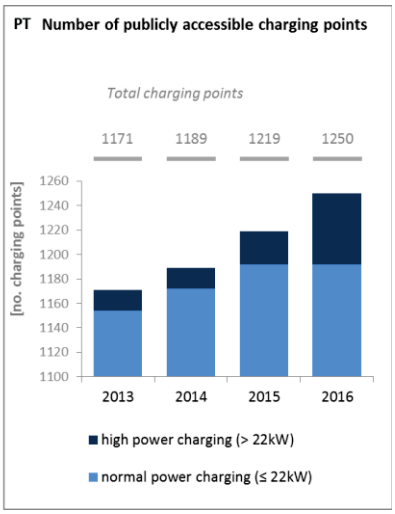
The average CO_2 emissions of new passenger cars in Portugal in 2016 amounted to 104.7 g CO_2/km, being lower than the EU average.



(source: European Environment Agency)



(European Environment Agency)



(European Alternative Fuels Observatory)

National Policy Frameworks under Directive 2014/94/EU on alternative fuels infrastructure have to establish targets, objective and measures for the development of the market of alternative fuels in the transport sector and the deployment of the relevant infrastructure. Portugal has submitted its National Policy Framework as requested under article 3 of the Directive 2014/94/EU.

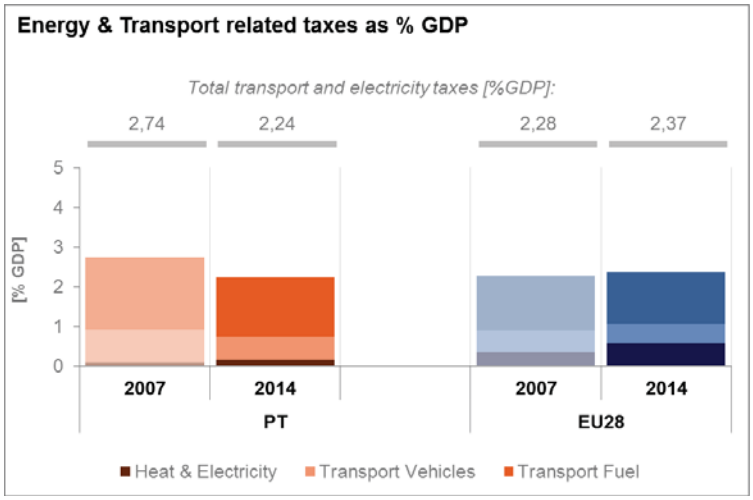
A detailed assessment of the Portuguese National Policy Framework in terms of its compliance with the requirements of Directive 2014/94/EU on alternative fuels infrastructure, its contribution to achievement of long-term energy and climate objectives of the Union and coherence of its targets and objectives in terms of cross-border continuity has been published as part of the Communication on Alternative Fuels Action Plans (COM(2017)652) and the related staff working document SWD(2017)365.

5.2. Adaptation to climate change

In Portugal, a First National Adaptation Strategy (ENAAC) was adopted in 2010 (2010-2015) and revised in 2015 (ENAAC 2020 for 2015-2020). No Adaptation Action Plan is defined at national level; instead, it is promoted in sectorial, local and/or regional planning. Nine priority sectors have been identified: agriculture, biodiversity, economy, energy, forests, health, safety of people and assets, transport and communications, and coastal areas/sea. Presently the monitoring has been guaranteed for reporting purposes through ENAAC's Coordination Group. A more formal procedure is addressed in ENAAC 2020 in order to establish a monitoring and review system for the overall adaptation process, particularly with close collaboration with sectorial groups following a mainstreaming approach.

5.3. Taxes on energy and transport and fossil fuel subsidies

The overall tax burden on energy and transport in Portugal amounts to 2.2% of GDP, which is 0.2 p.p. lower than the EU average. The tax burden on transport vehicles and fuels is slightly above the EU average, while the tax burden on heat and electricity is considerably lower than the EU average. Since 2007, the tax burden on transport vehicles and fuels declined slightly in Portugal, while the taxes on heat and electricity have increased. Portugal has a carbon tax as part of their tax framework of energy products which is applied to all fuels. It amounts to €6/ton of CO_2. The car registration and the annual circulation taxes for vehicles have both a CO_2 component.



(source: Eurostat)

In Portugal, there is a wide array of measures granting either tax exemptions or tax rate reductions for specific fuels used for specific purposes. A significant part of these benefits is due to reduced tax rates on coloured and marked diesel fuel used by authorised agricultural equipment, whose tax expenditure is estimated at EUR 71.8 million in 2013. In 2014, this amount decreased to EUR 71.2 million. VAT rates are reduced for fuels used in agricultural inputs and machinery (13%), and for waste collection and water supplies (6%), from a standard rate of 23%.

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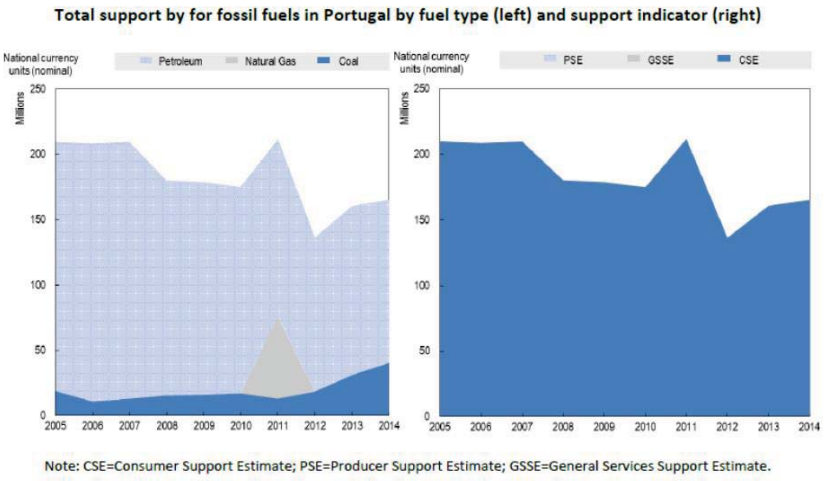


(source: OECD Inventory of Support Measures for Fossil Fuels 2015)

5.4. Renewable energy

In the renewables' sector, Portugal has high potential and a high target for 2020 (31 %) and so far is on track to meet it.

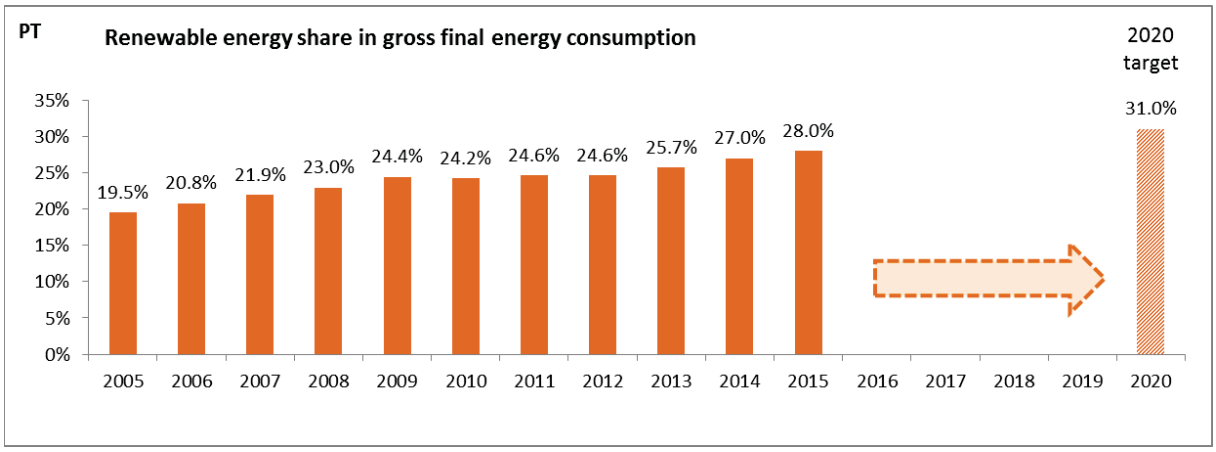
Considerable efforts have been made in the past years namely in Wind and Hydro and the high potential of Portugal for Solar PV is starting to attract investors in this Renewable technology.

In 2013/2014 Portugal was above its anticipated RES deployment and kept up this trend in 2015, reaching a renewables share in gross final energy consumption of 28.0%. Portugal is on track to meet its 2020 renewable energy target.

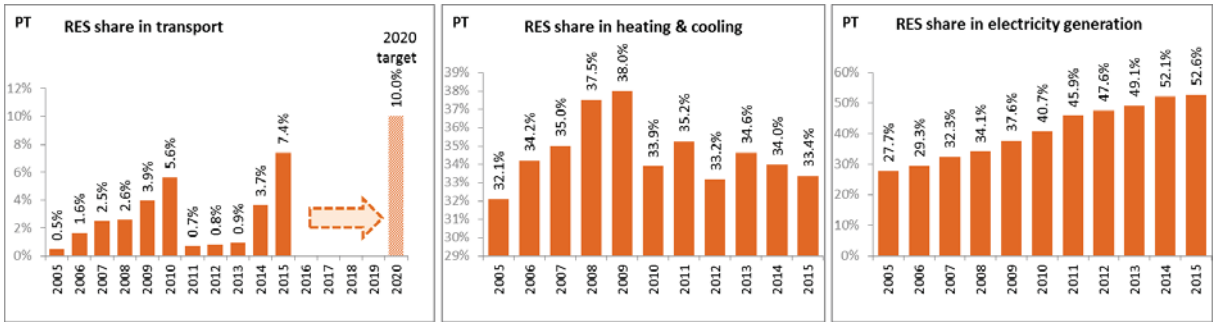
2015 was the highest renewable electricity producing year with more than half of consumption (52.6%) coming from renewable sources, mostly hydro and wind. In May 2016, the country's electricity demand was met by renewable energy alone for four and a half days straight on.

In the heating and cooling sector, the renewables share (33.4 %) is above the level planned in the NREAP (30.6 %) but a careful monitoring is required as the penetration of RES in this sector has been falling since 2009. The reasons for this decrease can be explained by the lack of a long term RES-H&C strategy, lack of certification schemes for installers and equipment in case of biomass technologies. In case of heating there has also been a trend that consisted of replacing the usage of traditional biomass (wood) by air-condition systems.

On the transport sector, even though levels in 2015 (7.4 %) have shown a significant increase on the previous year (+3.7 p.p.), Portugal still has to make an effort to reach the 10% target for biofuels by 2020.



(source: Eurostat-SHARES)



(source: Eurostat-SHARES)

In Portugal, electricity from renewable sources from existing plants is mainly promoted through a feed-in tariff (FiT). Support to new RES plants can be provided through a general regime (i.e. energy market) or under the guaranteed remuneration system.

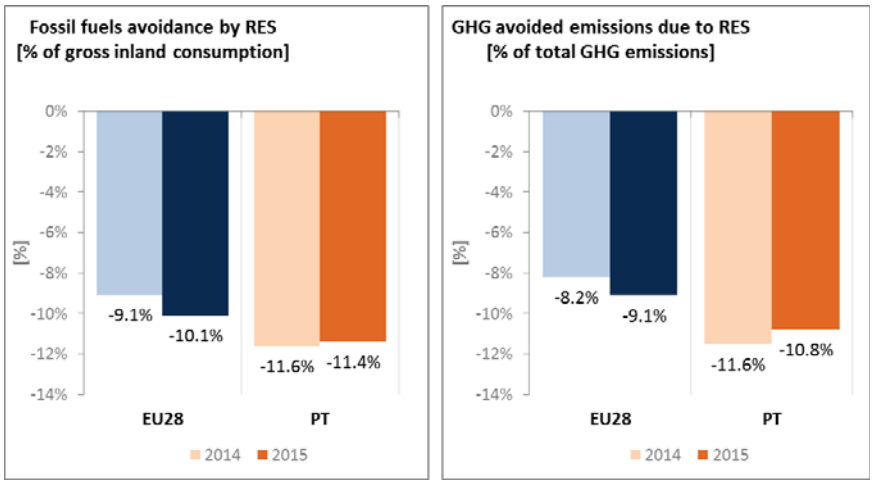
Portugal has already authorized more than 500 MW of new solar photovoltaic projects, and there are shown of interest of more than 1000 MW of new solar photovoltaic projects. All of this new plants will have no Feed-in Tariff, their remuneration will be only market based

A unique remuneration regime for electricity produced from small production (UPP) and self-consumption (UPAC) units came into force in January 2015 and it is based on a bidding model in which producers offer discounts to a reference tariff. UPPs and UPACs have common regulations and certain particularities.

There is currently no direct support mechanism, or fiscal benefits for RES-H in place (as of January 2017); only indirect support.

In the transport sector, the main incentives are a biofuel quota system and a tax exemption to small producers of biofuels (PPDs).

Due to a consistent deployment of renewables since 2005, it is estimated that Portugal avoided in 2015 about 11.4 % of the fossil fuel in gross inland consumption and about 10.8 % of GHG emissions at national level[6].



(source: EEA)

5.5. Contribution of the Energy Union to better air quality

Air quality in Portugal continues to give cause for concern. For the year 2013, the European Environment Agency estimated that about 6,070 premature deaths were attributable to fine particulate matter ($PM_{2.5}$) concentrations and 150 to nitrogen dioxide (NO_2) concentrations[7].

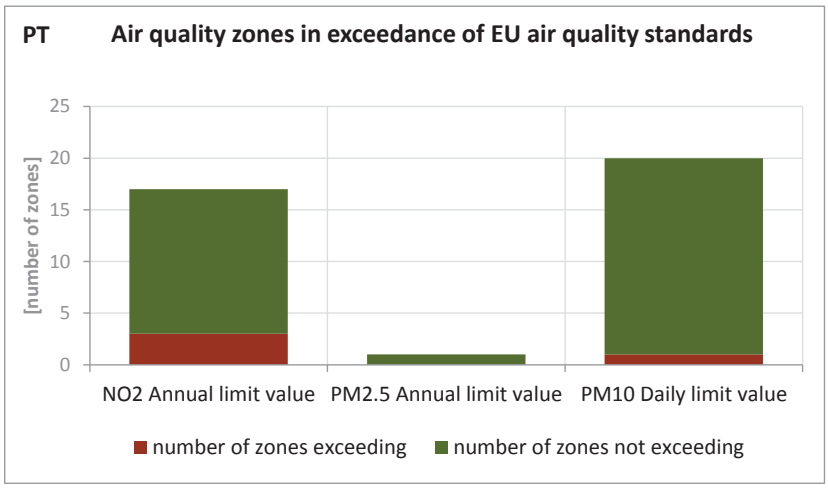
For both pollutants Portugal reported exceedances of the binding EU air quality standards[8]. For the year 2015, Portugal reported exceedances of the limit value for PM_{10} in 1 out of the 20 air quality zones in Portugal, while exceedances of the limit value for NO_2 were reported in 3 of the 17 zones as shown in the figure below[9].

[6] Avoided GHG emissions mentioned here have a theoretical character as these contributions do not necessarily represent 'net GHG savings per se' nor are they based on life-cycle assessment or full carbon accounting.

[7] European Environment Agency, 2016, Air Quality in Europe – 2016 Report, table 10.2. The report also includes details as regards the underpinning methodology for calculating premature deaths.

[8] Directive 2008/50/EC of the European Parliament and of the Council of 21 May 2008 on ambient air quality and cleaner air for Europe, OJ L 152, 11.6.2008, p.1-44

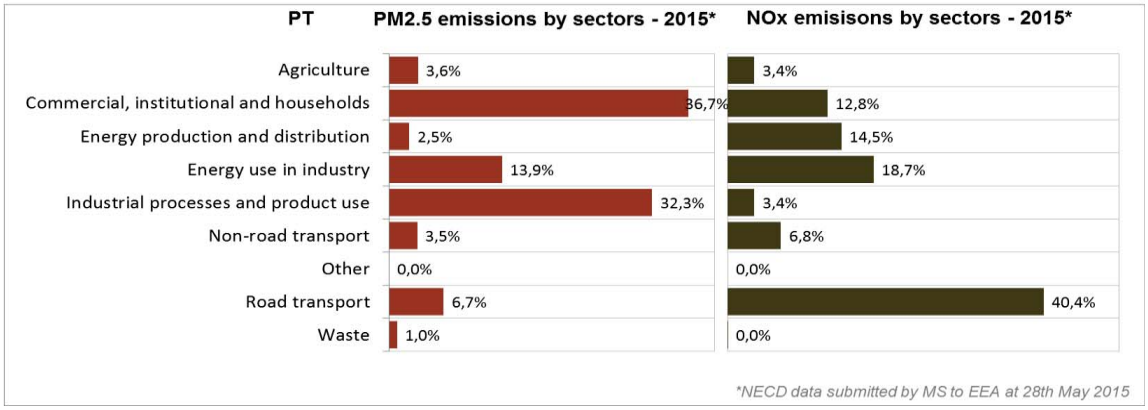
[9] Compliance data as reported by the Member States as part of their official annual air quality report for the calendar year 2015 (available on the European Environment Agency's (EEA) Eionet/Central Data Repository), http://cdr.eionet.europa.eu/pt/eu/aqd



(source: EEA)

The health-related external costs from air pollution in Portugal have been estimated to be more than EUR 4 billion/year (income adjusted, 2010), which includes the intrinsic value of living a healthy life without premature death as well as the direct costs to the economy such as healthcare costs and lost working days due to sickness caused by air pollution[10].

The Energy Union can substantially contribute to addressing these air quality problems through measures reducing emissions of both GHG and air pollutants such as PM and nitrogen oxides (NO_x) from major contributing sectors such as (road) transport, energy production, industry and residential heating (e.g. stoves and boilers) as shown in the figure below[11].



(Source: EEA. This table reflects only sources of primary $PM_{2,5}$ emissions.)

[10] See also the EU Environmental Implementation Review Country Report for Portugal, SWD(2017)54 final of 3.2.2017

[11] National emission data as reported by the Member States to the EEA (available on the EEA's Eionet/Central Data Repository), http://cdr.eionet.europa.eu/pt/eu/nec_revised

6. Research, innovation and competitiveness

6.1. Research and innovation policy

The Science and Technology Foundation (FCT), the key science policy and implementation agency in Portugal, has recently launched a process to elaborate a national Research and Innovation Agenda on sustainable energy systems, as part of a wider effort to develop Agendas in fourteen different research fields. The aim of the Agenda is to identify challenges and opportunities, and to articulate a long-term collaborative perspective for different R&I stakeholders in the country. The Agendas are also intended to identify strong emergent sectors for the Portuguese R&I community to focus on. FCT is involving relevant stakeholders in a public consultation process to prepare these Agendas, including members of the national scientific and industrial communities as well as citizens with relevant expertise.

Portuguese R&I institutions are active in almost all energy technologies, including nuclear fission and fusion. Portugal is an active contributor to the ongoing work of the Strategic Energy Technology (SET) Plan. It participates in nine (out of fifteen) temporary working groups for the implementation of the integrated SET Plan.

Regarding the Horizon 2020 programme, Portugal has received so far 2.3 % of the EU contribution devoted to the 'secure, clean and efficient energy' part of the programme. As of September 2017, 113 participations from Portuguese organisations have been awarded EUR 41 million in Horizon 2020 energy projects. This includes a grant of EUR 3.6 million to A. Silva Matos – Energia for its participation in project DEMOGRAVI3 (innovative gravity foundations for offshore wind turbines) and eight grants totalling almost EUR 6.5 million to Portuguese beneficiaries participating in project SHAR-LLM (smart cities).

6.2. Investments and patents in the Energy Union R&I priorities

In 2015, public (national) investments in the Energy Union R&I priorities reached EUR 8 million, having decreased by 12% compared to 2014. The Renewables and Sustainable Transport R&I priorities of the Energy Union attracted the largest shares of these investments (31% each), followed by the Efficient Systems (22%). In the period 2007-2015, the maximum annual public investment was EUR 9.5 million, reported in 2013[12]. In 2014, the most recent year for which data for most Member States are available, public investment per GDP in Portugal was lower than the EU average.

Private investment in the Energy Union R&I priorities in 2013 was estimated at EUR 14 million (0.1% of the private R&I investment in Energy Union R&I priorities in the EU). The focus was on Renewables, which received 39% of these investments, followed by Smart System with 34% and Sustainable Transport with 27%.

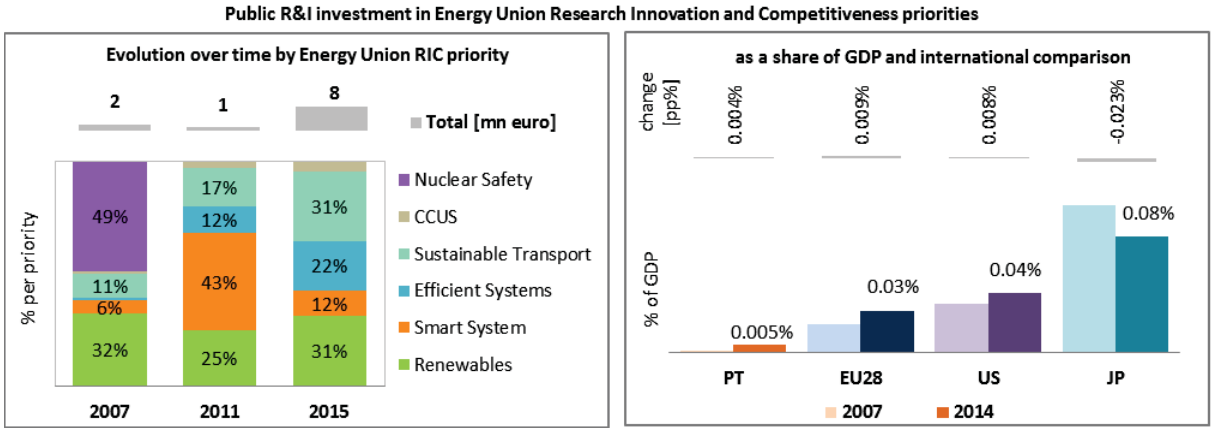
In 2013, the most recent year for which complete patent[13] statistics are available, 10 companies and research organisations based in Portugal filed 9 patents in low-carbon energy technologies (0.1% of

[12] From 2013 onwards, the reported figures are three times higher than previous years due to a change in methodology.

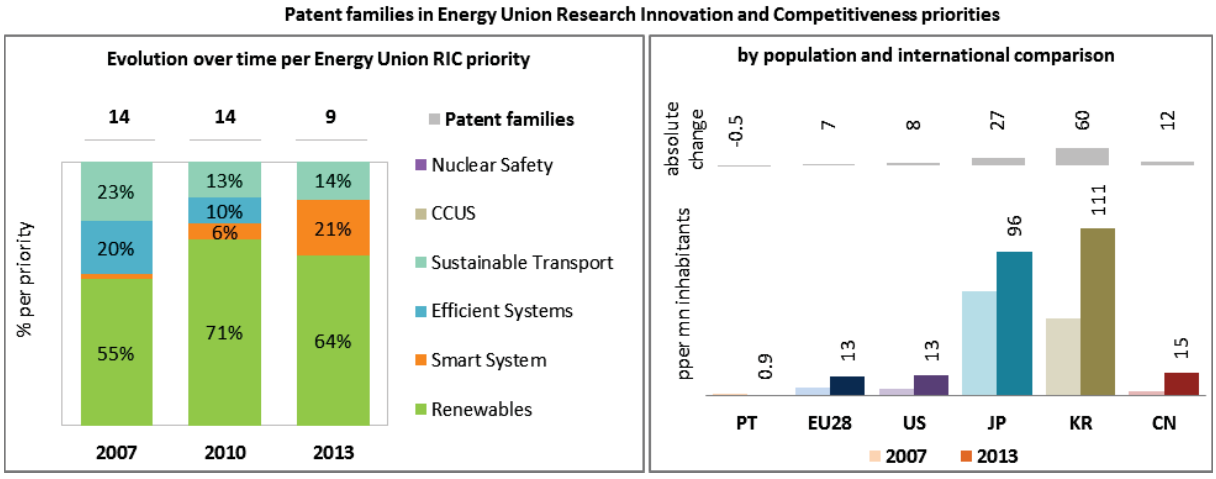
[13] In the context of this document, the term 'patent' refers to patent families, rather than applications, as a measure of innovative activity. Patent families include all documents relevant to a distinct invention (e.g.

the EU total). The focus was on Renewables (64%), followed by Smart System (21%) and Sustainable transport (14%).

In 2013, private R&I investments and patents in Energy Union R&I priorities were lower than the EU average when normalised by GDP and by population respectively. In the period 2007-2013, both private R&I investments and number of patents indicators have decreased on average by 13% and 7% per year, contrary to the same indicators at EU level that, on average, increased by of 6% and 15% respectively.



Note: The international comparison (right) is shown for 2014 (Portugal had reported EUR 9 million). Reporting at EU level is not as complete for 2015, and very few countries have reported for 2016.



(Data sources: Public investment as available in the International Energy Agency RD&D Statistics database[14] for codes relevant to Energy Union RIC priorities. Patent data based on the European Patent Office PATSTAT database[15]. Private investment as estimated by JRC SETIS. Detailed methodology available from the JRC[16].)

applications to multiple authorities), thus preventing multiple counting. A fraction of the family is allocated to each applicant and relevant technology.

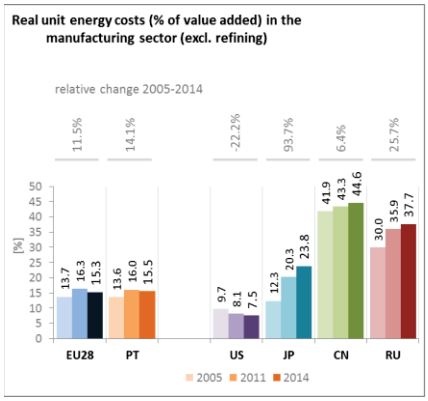
[14] http://www.iea.org/statistics/RDDonlinedataservice/

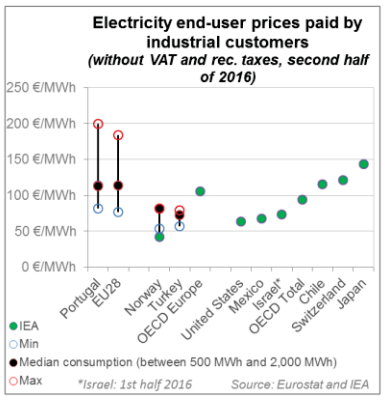
[15] https://www.epo.org/searching-for-patents/business/patstat.html#tab1

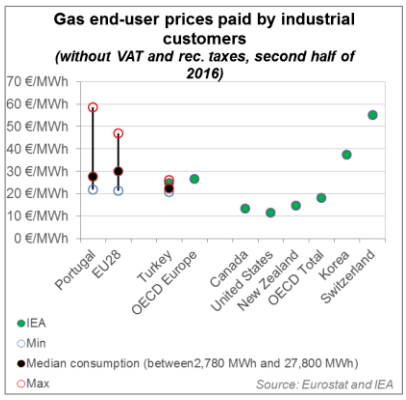
[16] https://setis.ec.europa.eu/related-jrc-activities/jrc-setis-reports/monitoring-ri-low-carbon-energy-technologies

6.3. Competitiveness

The real unit energy costs in Portugal are slightly above the EU average, but well above the US average. No reliable data can be used to break down this trend between energy prices and energy intensity factors.
However, it can be noted that electricity prices paid by industrial customers, although slightly superior are in line with EU average, while gas prices are among the highest, and well above OECD average and other main trading partners.





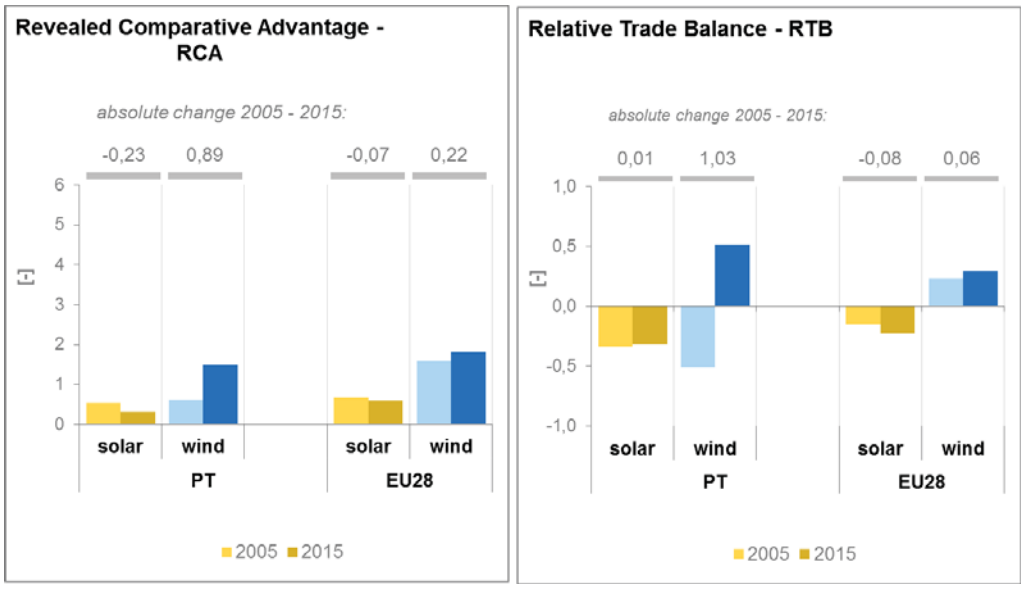


(source: ECFIN) *(source: Eurostat and IEA)*

Regarding the competitiveness in wind and solar energy, Portugal is performing quite well in the wind sector due to a comparative advantage in key components of wind turbines such as towers and power electronics. As indicated by the revealed comparative advantage indicator[17] below 1, the Portuguese economy is overall not specialised in solar PV. Nonetheless, it exhibits a comparative advantage in power electronics for solar PV panels. The relative trade balance[18] confirms that Portugal is a net exporter of wind components, well above the EU average in 2015. In particular, Portugal has recorded a significant increase in the relative trade balance of wind between the period 2005 and 2015, by turning the relative significant trade deficit into a sizeable trade surplus.

[17] The RCA index for product "i" is defined as follows: $RCA_i = \frac{X_{j,i} / \sum_i X_{j,i}}{X_{w,i} / \sum_i X_{w,i}}$ where X is the value of exports, and j is the country and w is the reference group, the World economy. 2005 refers in the text to the indicator average over the 2000-2009 period, while 2015 represents the average over the 2010-2016 period. The same applies for the RTB indicator - see below.

[18] The RTB indicator for product "i" is defined as follows: $RTB_i = \frac{X_i - M_i}{X_i + M_i}$ where X_i is the value of product's "i" exports and M_i imports.



(source: UN comtrade)

7. Regional and local cooperation

Regional cooperation on infrastructure development is necessary to optimize the identification of regional infrastructure priorities and to coordinate cross-border investments. Portugal is a member of two regional cooperation groups which have been established under the TEN-E Regulation: North-South Gas interconnections in Western Europe and North- South electricity interconnection in Western Europe.

Portugal is also a member of the High Level Group for South West Europe on interconnections , formalized in the Madrid Summit in which the a Declaration, which aims to tackle the existing interconnection issues both for electricity and gas through the adoption of an Action Plan, was adopted. Furthermore, Spain and Portugal are part of the electricity market coupling of regions since May 2014. This coupling now spans 19 countries, covering almost 85 % of European power consumption.

European Territorial Cooperation – 'Interreg' – under EU cohesion policy provides further opportunities for cross-border, transnational and interregional cooperation, including in the Energy Union areas.
Cities and urban areas have a key role in the energy and climate challenge. The Urban Agenda for the EU, established by the Pact of Amsterdam in May 2016, better involves cities in the design and implementation of policies, including those related to the Energy Union. It is implemented through Partnerships, in which the Commission, Member States, cities and stakeholders work together on a number of important areas, including on Energy Transition, Urban Mobility, Air Quality, Climate Adaptation and Housing. Portugal is participating in the partnerships on Urban Mobility, with the city of Torres Vedras as member, Climate Adaptation, with the city of Loule as member, and Housing, with the city of Lisbon as member.

By 2016, in the context of the Covenant of Mayors, the sustainable energy action plans delivered by 111 Portuguese municipalities had been assessed. Overall, these municipalities cover more than 5.7 million inhabitants. These municipalities committed to reducing GHG emissions by 23.1% by 2020 (as compared to the 1990 baseline), a lower percentage reduction than at EU level, but leading to higher emissions per capita.

	No. of SEAPs submitted	Population covered by SEAPs [million]	Average GHG emissions [t CO2-eq/capita*year]		Relative GHG savings by 2020
Portugal	111	5.78	Baseline emissions 4.84	by 2020 3.73	GHG -23.1%
European Union	5332	160.06	Baseline emissions 5.50	by 2020 4.00	GHG -27.2%

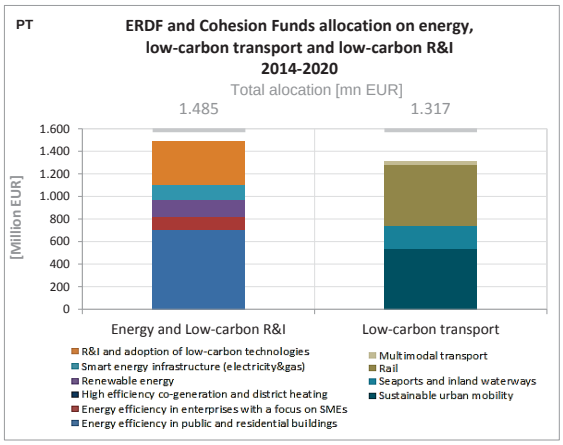
(Source: JRC 2016. Notes: SEAP=sustainable energy action plan, GHG=greenhouse gas emissions)

In Portugal, by September 2016, 17 cities (covering 1.49 million inhabitants) have committed to conduct vulnerability and risk assessment and develop and implement adaptation plans in the framework of the Covenant of Mayors for Climate and Energy.

8. Cohesion policy and EU clean energy investments

EU cohesion policy makes a key contribution to delivering the Energy Union objectives on the ground, including important investment possibilities to implement energy policy objectives in Portugal which are complemented by national public and private co-financing, aiming at optimal leverage. It also ensures integrated territorial solutions to energy and climate challenges, supports capacity building and provides technical assistance.

Over 2014-2020, cohesion policy is investing some EUR 1,102 million in energy efficiency improvements in public and residential buildings and in enterprises, as well as in renewable energy and smart energy infrastructure (energy storage pilot-projects and natural gas supply stations to urban collective public transport vehicles) in Portugal. Cohesion policy is also investing significantly in R&I and in SME competitiveness in Portugal based on the national strategy as well as regional strategies for smart specialisation. For Portugal, the strategies include a focus on innovative technologies for the production of renewable energy, more efficient industrial processes in terms of use of energy and promoting R&I applications for low-carbon urban mobility. At this stage, at least EUR 383 million is foreseen for investments in R&I and adoption of low-carbon technologies in Portugal, but this might increase further in line with the evolving content of the smart specialisation strategy. A further estimated EUR 1,317 million is invested in supporting the move towards an energy-efficient, decarbonised transport sector.



(source: DG REGIO)

These investments are expected to contribute to around 28,000 households with improved energy consumption classification and a decrease of around 830,463,000 kWh per year of decreased primary energy consumption of public buildings, around 80 MW of additional capacity of renewable energy production, around 1,200,000 additional users connected to smart grids, as well as to around 260 km of reconstructed or upgraded railway lines. Overall, the cohesion policy investments in Portugal over 2014-2020 are expected to contribute to an estimated annual decrease of GHG emissions of around 215,000 tonnes of CO2eq.

For example, the "Centro Bio: Bio-Industries, Biorefineries and Bioproducts" project, inspired by agricultural and forestry waste and residues that were a local hazard but have the potential to interact into different value-chains, worked with researchers and local farmers, foresters and entrepreneurs to develop new industries from by-products, improve businesses efficiency and train future scientists and entrepreneurs. The project was working towards a sustainable 'circular economy' for the area – one where businesses interact and share resources to avoid waste, with a cutting-edge bio-refinery able to produce biofuels from leftover plant matter, for a reliable local source of low-carbon energy. The project also prevented forest fires in the area by providing a market for flammable biomass residues and reducing inhabitants' need to harvest plants for fuel. The total investment was EUR 3,159,000, with the European Regional Development Fund (ERDF) contributing EUR 2,640,000 through the "Centro" Operational Programme for the 2007-2013 period; the project duration was from April 2014 to September 2015. This project was awarded a "RegioStars Award".

As another example, the "Energy and environmental efficiency in Dão-Lafões urban centers" project aimed to improve energy and environmental efficiency in the urban centers Dão-Lafões, including Viseu, Tondela and Mangualde. The implemented actions went from, among others, the development of promotional and outreach activities to spread the use of electric vehicles in urban centres and awakening of ecological awareness of the citizens, and also the creation of pilot plants for supply points to electric or hybrid vehicles in public spaces of the three urban centres, with these points being fed primarily from photovoltaic installations. The total investment was EUR 564,520, with the European Regional Development Fund (ERDF) contributing EUR 364,896 through the national thematic OP "Territorial Enhancement" for the 2007-2013 period; the project was concluded in July 2013.

Through its support to sustainable transport systems, the Connecting Europe Facility (CEF) also contributes to the goals of the Energy Union. Following Portuguese participation in the CEF – Transport 2014-2015 Calls, the Portuguese action portfolio comprises 33 signed grant agreements, allocating EUR 572.9 million of actual CEF Transport Funding to Portuguese beneficiaries (state-of-play February 2017)[19]. The transport mode which receives the highest share of funding is rail (89.5 % of actual funding). Portugal participates in four rail actions covering studies and works, both for national and cross-border rail infrastructure. Portugal expects to finalise an upgrade of the Pampilhosa-Vilar Formoso section in the Beira Alta rail line by 2020, which will reinforce the Portuguese sea ports' competitive position by benefiting from an interoperable and effective railway connection with the Spanish border that will improve the infrastructure and speed for freight trains as well as passenger transport.

Portugal is also active in several multi-beneficiary maritime actions. The objectives of the maritime portfolio are to support the development of LNG bunkering facilities and services, to contribute to the development of sea traffic management and improved services, a better integration of the maritime transport in the logistics chain and design of innovative incentive schemes to promote the

[19] Note that European Economic Interest Groups and International Organisations are excluded from the analysis.

use of Motorways of the Sea. The Portuguese action portfolio also includes CEF investments in the field of inland waterways (IWW), which are mainly addressing the severe safety constraints of the core inland port of Oporto. The objective is to design solutions to improve the port accessibility, modernise its infrastructures, better respond to emergency situations and increase the use of clean energies and ICT tools.[20].

[20] Source: INEA