Task 1 Strategic PV Analysis and Outreach

PVPS

National Survey Report of PV Power Applications in Portugal 2018

Prepared by:

António Joyce, Carlos Rodrigues, LNEG
Susana Serôdio, José Medeiros Pinto, APREN

PHOTOVOLTAIC POWER SYSTEMS
TECHNOLOGY COLLABORATION PROGRAMME

LNEG
APREN
Direcção Geral de Energia e Geologia

Cover picture:

EDP Renováveis, 2018

WHAT IS IEA PVPS TCP

The International Energy Agency (IEA), founded in 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD). The IEA carries out a comprehensive programme of energy cooperation among its 30 member countries and with the participation of the European Commission. The IEA Photovoltaic Power Systems Programme (IEA PVPS) is one of the collaborative research and development agreements (technology collaboration programmes) within the IEA and was established in 1993. The mission of the programme is to "*enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems*."

In order to achieve this, the Programme's participants have undertaken a variety of joint research projects in PV power systems applications. The overall programme is headed by an Executive Committee, comprised of one delegate from each country or organisation member, which designates distinct 'Tasks,' that may be research projects or activity areas. This report has been prepared under Task 1, which deals with market and industry analysis, strategic research and facilitates the exchange and dissemination of information arising from the overall IEA PVPS Programme.

The IEA PVPS participating countries are Australia, Austria, Belgium, Canada, Chile, China, Denmark, Finland, France, Germany, Israel, Italy, Japan, Korea, Malaysia, Mexico, Morocco, the Netherlands, Norway, Portugal, South Africa, Spain, Sweden, Switzerland, Thailand, Turkey, and the United States of America. The European Commission, Solar Power Europe, the Smart Electric Power Alliance (SEPA), the Solar Energy Industries Association and the Copper Alliance are also members.

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WHAT IS IEA PVPS task 1

The objective of Task 1 of the IEA Photovoltaic Power Systems Programme is to promote and facilitate the exchange and dissemination of information on the technical, economic, environmental and social aspects of PV power systems. Task 1 activities support the broader PVPS objectives: to contribute to cost reduction of PV power applications, to increase awareness of the potential and value of PV power systems, to foster the removal of both technical and non-technical barriers and to enhance technology co-operation. An important deliverable of Task 1 is the annual "Trends in photovoltaic applications" report. In parallel, National Survey Reports are produced annually by each Task 1 participant. This document is the country National Survey Report for the year 2018. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

Authors:

Writing: António Joyce and Carlos Rodrigues from LNEG and Susana Serôdio and José Medeiros Pinto from APREN
Data: DGEG, LNEG, APREN.
Analysis: António Joyce, Carlos Rodrigues, Susana Serôdio, José Medeiros Pinto.

DISCLAIMER:

Data for non-IEA PVPS countries are provided by official contacts or experts in the relevant countries.
Data are valid at the date of publication and should be considered as estimates in several countries due to the publication date.

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1 INSTALLATION DATA

The PV power systems market is defined as the market of all nationally installed PV applications with a PV capacity of 40 W or more. A PV system consists of modules, inverters, batteries and all installation and control components for modules, inverters and batteries. Other applications such as small mobile devices are not considered in this report.

For the purposes of this report, PV installations are included in the 2018 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2018, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

Since 2009 Portugal has been developing an active and innovative policy concerning the deployment of PV systems. Since 2014, the PV market in Portugal has been dominated by self-consumption projects pushed by the Decree-Law (DL) 153/2014 that promotes the installation of small-scale units (until 1 MW) for prosumers and small and medium-sized business.

With the publication of this DL, the aim was to introduce new solutions for the deployment of decentralized units and technological innovation, introducing the figure of producer-consumer of electricity (or producer in self-consumption) within the scope of the Electric System.

This law establishes the legal regime applicable to the production of electricity sold in its entirety to the utility public network (RESP), through small production units (UPP) from renewable resources. The production is based on a single technology whose net power is 250 kW or less and allows the producer to sell all the electricity produced to RESP, based on a tender model based on a discount offer at a reference tariff value.

It also established the legal regime applicable to the production of electricity for self-consumption in the installation associated with its production unit (UPAC), with or without connection to RESP, based on renewable or non-renewable production technologies. This regime is predominantly for consumption in the facility associated with the production unit, with the possibility of connecting to RESP for the sale at the wholesale market the non-self-consuming electricity, with a 10% discount in reference to the average hourly market price.

The total installed capacity of PV in the Portuguese market reached 673 MW at the end of 2018.

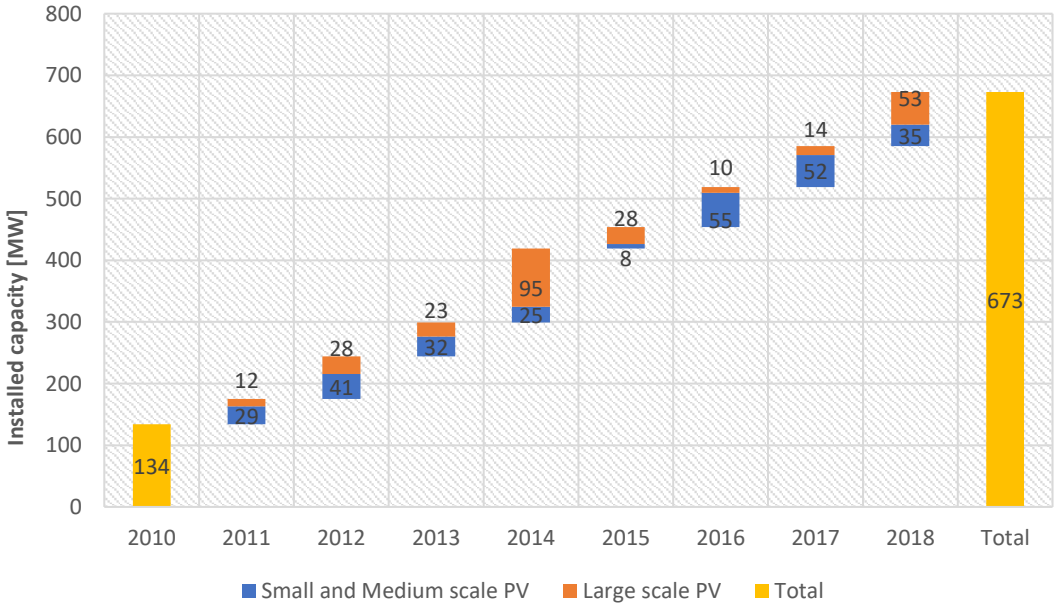


Figure 1: Portuguese PV market development (source: APREN's analysis, 2018)

Despite this framework, since 2015, there has been a large quest for PV large scale permits, with already reach 1,8 GW of power authorized to build. Nevertheless, only 53 MW of it was installed during 2018. All developers are struggling to find financing, since energy gross market price is very volatile and uncertain, giving no security and undermining financing agreements. Given this picture the government announced the launch of tenders in 2019 for 1,4 GW of capacity.

1.2 Total photovoltaic power installed

The total installed PV power data was obtained from the National Directorate of Energy and Geology (DGEG) of the Portuguese Ministry of Environment and Energy Transition.

Table 1: Annual PV power installed during calendar year 2018.

		Installed PV capacity in 2018 [MW]	AC or DC
PV capacity	Off-grid	NA	
	Decentralized	35	DC
	Centralized	53	DC
	Total	**88**	DC

Table 2: Data collection process.

If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	Usually 10-20% above the AC value to compensate losses within the PV power plant
• The data collection process is done by the National Directorate of Energy and Geology (DGEG), the National Laboratory of Energy and Geology (LNEG) and the Portuguese Renewable Energy Association (APREN). • DGEG is the body responsible for the development and implementation of policies related to energy and geological resources within a framework of sustainability and security of energy supply. It is in the direct dependency of the Secretary of State of Energy of the Ministry of Environment and Energy Transition. It is the entity responsible for the licensing administrative process of electricity producers, operators and consumers. The data collection is presented in the monthly's report "Estatísticas Rápidas – Renováveis" which presents the renewable energy statistics. • LNEG is a State Laboratory belonging to the Ministry of Environment and Energy Transition and performs Research and Development related to Renewable Energies namely Photovoltaics. • The Portuguese Renewable Energy Association, APREN, that aggregates more than 90% of the Portuguese RES-E power plants, representing	

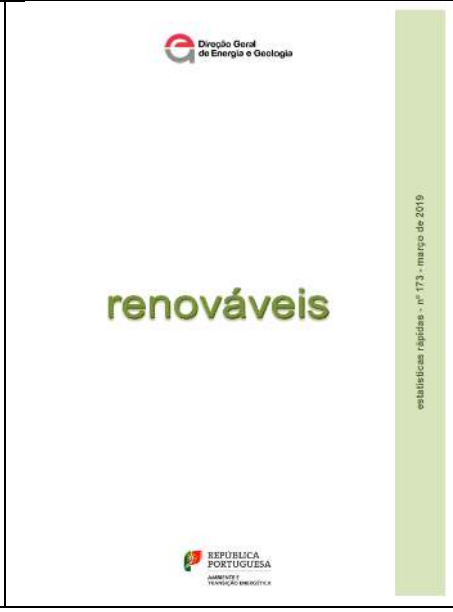
more than 400 power plants with an accumulated power of 12 665 MW in 2018.	
Official statistics according to the National Directorate of Energy and Geology (DGEG) www.dgeg.gov.pt	

Table 3: The cumulative installed PV power in 4 sub-markets.

Year	Off-grid [MW] (including large hybrids) (mandatory)	Grid-connected distributed [MW] (BAPV, BIPV) (mandatory)	Grid-connected centralized [MW] (Ground, floating, agricultural…) (mandatory)	Total [MW] (mandatory)
2015	…	…	…	454
2016	123 (p)	114	283	520
2017	143 (p)	146	295	585
2018	143 (p)	183	346	673

Table 4: PV power and the broader national energy market.

	2017 numbers (mandatory)	2018 numbers (mandatory)
Total power generation capacities [GW]	21,631	21,854
Total renewable power generation capacities (including hydropower) [GW]	13,762	13,982
Total electricity demand [TWh]	46,649	47,058
Total energy demand [TWh]	181,568	183,234
New power generation capacities installed [GW]	0,360 (net value) (p)	(NA)
New renewable power generation capacities installed (including hydropower) [GW]	0,347	0,220
Estimated total PV electricity production (including self-consumed PV electricity) in [GWh]	993	1006
Total PV electricity production as a % of total electricity consumption	2,1%	2,1%

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 5: Typical module prices for a number of years.

Year	Lowest price of a standard module crystalline silicon (optional)	Highest price of a standard module crystalline silicon (optional)	Typical price of a standard module crystalline silicon (mandatory)
…			
2015	0,5	0,6	0,5 - 0,6 €/W
2016	0,5	0,6	0,5 - 0,6 €/W
2017	0,3	0,6	0,3 - 0,6 €/W
2018	0,3	0,5	0,3 - 0,5 €/W

2.2 System prices

Table 6: Turnkey PV system prices of different typical PV systems.

Category/Size	Typical applications and brief details	Current prices [€/W]
Off-grid 1-5 kW	A stand-alone PV system is a system that is installed to generate electricity to a device or a household that is not connected to the public grid (self-consumption units up to 1,5 kW))	2
Residential BAPV 5-10 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected households. Typically roof-mounted systems on villas and single-family homes.	1,4
Residential BIPV 5-10 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected households. Typically, on villas and single-family homes.	-
Small commercial BAPV 10-100 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1,2
Small commercial BIPV 10-100 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	-
Large commercial BAPV 100-250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected large commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	1,1
Large commercial BIPV 100-250 kW	Grid-connected, building integrated, distributed PV systems installed to produce electricity to grid-connected commercial buildings, such as public buildings, multi-family houses, agriculture barns, grocery stores etc.	-
Industrial BAPV >250 kW	Grid-connected, roof-mounted, distributed PV systems installed to produce electricity to grid-connected industrial buildings, warehouses, etc.	1,0
Small centralized PV 1-20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	0,7-0,8
Large centralized PV >20 MW	Grid-connected, ground-mounted, centralized PV systems that work as central power station. The electricity generated in this type of facility is not tied to a specific customer and the purpose is to produce electricity for sale.	0,6-0,7
Floating Centralized PV < 10 MW	Floating PV system, installed in a hydro power plant reservoir. The electricity generated in this type of facility is tied to the hydro production, functioning as a “hybrid” project. .	0,9 (estimated)

Table 7: National trends in system prices for different applications

Year	Residential BAPV Grid-connected, roof-mounted, distributed PV system 5-10 kW	Small commercial BAPV Grid-connected, roof-mounted, distributed	Large commercial BAPV Grid-connected, roof-mounted, distributed	Small centralized PV Grid-connected, ground-mounted,

	[€/W] (mandatory)	PV systems 10-100 kW [€/W] (mandatory	PV systems 100-250 kW [€W] (mandatory	centralized PV systems 10-20 MW [€/W] (mandatory)
…				
2015				
2016	2,2	1,4	1,4	0,8
2017	1,6	1,3	1,2-1,3	0,8
2018	1,4	1,2	1,1	0,7-0,8

2.3 Cost breakdown of PV installations

Information not available for this year.

2.4 Financial Parameters and specific financing programs

Table 8: PV financing information in 2018.

Different market segments	Loan rate [%]
Average rate of loans – residential installations	0% *
Average rate of loans – commercial installations	8%
Average cost of capital – industrial and ground-mounted installations	6%

* There are some companies that offer commercial deals (namely a fixed monthly rent) without rates

2.5 Specific investments programs

Table 9: Summary of existing investment schemes.

Investment Schemes	Introduced in country (mandatory)
Third party ownership (no investment)	Some developers allow its customers to choose a contract of third-party ownership, more specifically to self-consumption systems in Commercial and Industry.
Renting	n/a
Leasing	n/a
Financing through utilities	The Portuguese electricity utility EDP has a financing program that enables the consumers to install a small-scale self-consumption unit.
Investment in PV plants against free electricity	n/a
Crowd funding (investment in PV plants)	Coopernico is the first solar cooperative in Portugal, based on a crowdfunding model. They have already more than 500 members and several solar power plants around the country. Coopernico's website: http://www.coopernico.org/ Last year a new investment platform - GoParity - for sustainable energy projects was founded, based in a crowdfunding model, aiming to share benefits among their members.

	GoParity website: https://www.goparity.com/about
Community solar	n/a
International organization financing	n/a

2.6 Additional Country information

Table 10: Country information.

Retail electricity prices for a household [€/kWh]	0,2230 €/kWh (with taxes and VAT) 0,1028 €/kWh (without taxes and VAT) 2500 kWh < Consumption < 5000 kWh Source: EUROSTAT, 2019			
Retail electricity prices for a commercial company [€/kWh]	0,1870 €/kWh (with taxes and VAT) 0,1520 €/kWh (without taxes and VAT) 20 MWh < Consumption < 500 MWh Source: EUROSTAT, 2019			
Retail electricity prices for an industrial company [€/kWh]	0,1440 €/kWh (with taxes and VAT) 0,0814€/kWh (without taxes and VAT) 500 MWh < Consumption < 2 000 MWh Source: EUROSTAT, 2019			
Population at the end of 2018	10 276 617			
Country size [km^2]	92 225,6			
Average PV yield in [kWh/kW]	1 600			
Name and market share of major electric utilities		Electricity Consumption [%]	Share of grid Subscribers [%]	Number of retail customers [%]
	EDP	42		81
	Endesa	16,8		5,7
	Galp	7,6		5,1
	Iberdrola	17,1		4,9
	Goldenergy	-		1,7
	GN Fenosa	2,6		0,6
	PH	-		0,2
	Outros	14,2		1,0

3 POLICY FRAMEWORK

This chapter describes the support policies aiming directly or indirectly to drive the development of PV. Direct support policies have a direct influence on PV development by incentivizing, or simplifying, or defining adequate policies. Indirect support policies change the regulatory environment in a way that can push PV development.

Table 2: Summary of PV support measures.

	On-going measures in 2018 – Residential	**Measures introduced in 2018 – Residential**	**On-going measures in 2018 – Commercial + Industrial**	**Measures introduced in 2018 – Commercial + Industrial**	**On-going measures in 2018 – Centralized**	**Measures introduced in 2018 – Centralized**
Feed-in tariffs	Yes	No	Yes	No	No	No

Feed-in premium (above market price)	No	No	No	No	No	No
Capital subsidies	No	No	No	No	No	No
Green certificates	No	No	No	No	No	No
Renewable portfolio standards (RPS) with/without PV requirements	*Yes*	No	*Yes*	No	*Yes*	No
Income tax credits	No	No	No	No	No	No
Self-consumption	Yes	No	Yes	No	Yes	No
Net-metering	No	No	No	No	No	No
Net-billing	No	No	No	No	No	No
Collective self-consumption and virtual net-metering	No	No	No	No	No	No
Commercial bank activities e.g. green mortgages promoting PV	No	No	Yes	No	Yes	No
Activities of electricity utility businesses	No	No	No	No	No	No
Sustainable building requirements	Yes	No	Yes	No	No	No
BIPV incentives	No	No	No	No	No	No
Other (specify)						

3.1 National targets for PV

The Portuguese National Renewable Energy Action Plan 2013-2020 (NREAP) is reaching its end. So, the development of new strategies for renewable policies for the decade 2020-2030 are now being discussed under the umbrella of the Clean Energy Package for All Europeans issued by the European Commission and seeking the climate goal agreed in the 2015 Paris Agreement.

In December 2018, preliminary results of the Portuguese National Carbon Neutrality Roadmap for 2050 (RNC2050) were presented, setting the targets from 2030 to 2050, which underline the government ambition to reach the carbon neutrality in 2050, supported by well-defined trajectories for the different economy sectors. In January 2019 the preliminary report of the National Energy and Climate Plan (NECP) was presented, setting a challenging 2030 target of 47 % RES share in final energy consumption and covering the measures and activities to reach that goal.

Table 1 presents the major targets of NECP 2030 and RNC2050:

Targets of the Decarbonization until 2050 (Source: NECP 2030 and RNC2050)

	2030	**2040**	**2050**
GHGs Reduction (without LULUCF) (% relative to 2005)	-45 % to -55 %	-65 % to -75 %	-85 % to -90 %

Renewable energy sources (RES)	47 %	70 % to 80 %	85 % to 90 %
RES – Electricity	80 %	90 %	100 %
RES - Transports (without aviation and navigation)	20 %	64 % to 69 %	100 %
RES – Heating and cooling	38 %	58 % to 61 %	69 % to 72 %
Energy efficiency	35 %	n.d.	n.d.

For the achievement of the above targets it was settled a total installed capacity of solar PV of 9 GW, that the government intends to promote throughout tender procedures.

3.2 Direct support policies for PV installations

There are no direct support policies in place for large scale PV, only Feed-in-Tariffs of existing power plants awarded before 2012, when the FiT Regime was suspended. Although, it is in place a FiT scheme for small scale units under the self-consumption regulation.

3.3 Self-consumption measures

Table 12: Summary of self-consumption regulations for small private PV systems in 2018.

PV self-consumption	1	Right to self-consume	Yes
	2	Revenues from self-consumed PV	Savings on the electricity bill
	3	Charges to finance Transmission, Distribution grids & Renewable Levies	No
Excess PV electricity	4	Revenues from excess PV electricity injected into the grid	Yes, 90% of Iberian market price
	5	Maximum timeframe for compensation of fluxes	Some credits can be rolled over to the following billing cycle or, if very low, in a yearly basis.
	6	Geographical compensation (virtual self-consumption or metering)	None
Other characteristics	7	Regulatory scheme duration	10 years contract extendable for periods of 5 years
	8	Third party ownership accepted	Yes
	9	Grid codes and/or additional taxes/fees impacting the revenues of the prosumer	Yes, self-consumption system when they reach 1% of total installed capacity start to pay a share of General Economic Interest Costs (CIEGs)
	10	Regulations on enablers of self-consumption (storage, DSM…)	No
	11	PV system size limitations	The PV system capacity cannot exceed the contracted capacity with electricity supplier
	12	Electricity system limitations	For grid injection, only if there are limitations into the local electricity system where the PV system is connected.

	13	Additional features	The prosumer may sell the surplus of electricity in market conditions.

3.3.1 Support scheme Self-Consumption Regulation

In 2014, the new self-consumption and FiT regime regulation for small units was published (decree-law 153/2014), which substituted the old FiT scheme of micro and minigeneration systems. It defines rules for self-consumption systems with grid-connection, which had no regulation before, and new rules for FiT scheme (systems under 250 kW). This regulation was fully operational during 2018 but it is expected that in 2019 a new legislation on the subject of self consumption will appear.

3.4 Collective self-consumption, community solar and similar measures

No specific measures, though the current regulation of self-consumption is being reviewed, in 2019 to include also collective self-consumption and energy communities.

3.5 Tenders, auctions & similar schemes

No tenders in placed, but the government announced one tender of 1.4 GW for solar PV in the middle of 2019.

3.6 Other utility-scale measures including floating and agricultural PV

No specific measures, but the government is working in new regulation for hybrid systems.

3.7 Social Policies

There has been a huge concern in Portugal with cost of the electricity bill. Besides the social tariff in place, in 2018 it was launched the Efficient House Program that promotes energy performance improves for households.

3.7.1 Efficient House 2020

The "Efficient House 2020" Program aims to provide concessional lending for operations that promote the improvement of the environmental performance of private residential buildings, with a special focus on energy and water efficiency, as well as on urban waste management. Interventions may cover the envelope of the building and its systems, including solar PV.

Residents can apply for residential property owners or their fractions, as well as the respective condominiums. The operations may concern the private parties or the common parts.

3.8 Retrospective measures applied to PV

3.8.1 CESE

In the end of 2018, enter enforce the extraordinary contribution on the energy sector (CESE), which covers, inter alia, electricity generation power plants that use renewable energy sources (including solar PV) covered by guaranteed remuneration schemes (EESC). With this contribution the government aims to ensure the systemic sustainability of the energy sector through the establishment of a fund that aims to contribute to the reduction of tariff debt and to the financing of social and environmental policies in the energy sector.

This extraordinary contribution has huge effects on the rentability of the projects in place and steadiness and predictions of future investments, showing policy and regulation instability and consequently, higher risk.

Though, the government affirms that it is a temporary measure, it is not settled when the CESE will be over and since, it is applied to liquid assets of the projects it has major implications mainly in newer projects that the amortization level is still low.

3.8.2 Parliamentary Committee of Inquiry into the Payment of Excessive Income to Electricity Producers

In 2018, it was requested a Parliamentary Inquiry to the energy sector regarding previous subjects and decisions on the energy sector namely related to excessive payments to electricity producers.

3.8.3 Rural electrification measures

No measures taken. The population rate with access to electricity is 100% (source: World Bank, https://data.worldbank.org/indicator/EG.ELC.ACCS.ZS)

3.8.4 Support for electricity storage and demand response measures

No specific support measures for Storage apart the increased level of integration of pumping storage in Hydro systems and innovative projects with RedOx batteries in the City of Évora and Lithium Ion batteries in Graciosa Island in Azores. Demand Response is being addressed in some innovative projects like INOVGRID in the City of Évora or LiSCool project in the City of Lisbon.

Nevertheless, the self-consumption regulation, DL 153/2014, allows to install PV systems with storage, namelly without any taxes or grid costs.

In 2010 Portugal launched the Portuguese Programme for Electric Mobility – Mobi.E which aimed to offer an open-access and market-oriented concept, with the goal of attracting private investors, benefiting the users and promoting the fast expansion of electric mobility in Portugal.

Through Mobi.E a pilot recharging infrastructure system was implemented. This network comprises 1 300 normal recharging points (fully recharges a battery in 6 to 8 hours) and 50 fast recharging points (recharges 80 % of a battery in 20-30 minutes).

The scenarios for the reduction of GHG emissions forecast a reduction ranging from 772 kton of CO2e to 3 894 kton of CO2e between 2011 and 2020, depending on the number of EVs and the emission factor considered (Source: Mobi.E, 2018).

Moreover, in 2014 it was launched Green Taxation Reform, which includes incentives for electric mobility, namely tax incentives in the form of vehicle tax (ISV) return and the tax exemption of the circulation duty.

The Instituto da Mobilidade e dos Transportes, IMT, reported that by the end of 2018 Portugal had a total fleet of EV passenger cars registered of 10 030 Battery Electric Vehicles (BEV) and 9 659 Plugin Hybrid Electric Vehicles (PHEV). At the same time, the EUROPEAN ALTERNATIVE FUELS OBSERVATORY reported that the network in Portugal comprises 1 596 recharging points in which 256 have fast charging.

3.8.5 Curtailment policies

Portugal has curtailment regulation since 2019, published in dispatch that established the order to curtail renewable energy in the special regime that must be given by the grid operator and how the revenues losses must be split between producers.

3.9 Financing and cost of support measures

The cost of PV incentives (feed-in-tariffs) in Portugal is supported by electricity consumers throughout a contribution paid in the electricity bill.

4 INDUSTRY

4.1 Production of feedstocks, ingots and wafers (crystalline silicon industry)

Information not available.

4.2 Production of photovoltaic cells and modules (including TF and CPV)

There is a considerable experience in module assembling in Portugal with some factories operating, mainly on crystalline silicon technologies. Examples are Open Renewables (www.openrenewables.com), the pioneer of PV modules manufacturing in Portugal, with a 75 MWp/year rate and Moura Fábrica Solar (MFS) with a production rate of 38 MWp/year, that was closed in the beginning of 2019.

Thin Film technologies like amorphous silicon had some industry development during some years but are no longer operating.

An important PV Industry development in Portugal is related with Concentrated Photovoltaics, CPV, with a totally Portuguese Engineering developed product on HCPV at Magpower (www.magpower.eu) with a production rate of 54 MWp and with an internationalization process with several projects installed abroad.

Total PV module manufacturing capacity information was not possible to obtain.

4.3 Manufacturers and suppliers of other components

Power electronics industry is important in Portugal namely through EFACEC, a well-known and internationally established company. For the PV sector it is important to mention grid- connected inverters and also controllers.

Several manufactures of PV supporting structures exist.

There is also a considerable amount of expertise of Portuguese companies in planning and engineering PV plants with already an important portfolio of installations in Portugal and abroad.

5 PV IN THE ECONOMY

This chapter aims to provide information on the benefits of PV for the economy.

5.1 Labour places

The investment in the renewable sector has contributed significantly to the creation of specialized jobs and to territorial cohesion, since the majority of the projects are located in less favourable economic and social places.

In 2014, APREN developed a study in partnership with the consultancy company Deloitte regarding the macroeconomic impact of renewables in Portugal, which points out the impact in jobs deployment. Through surveys conducted in this study that inquired more than 90% of the different type of companies acting in the renewable electricity sector in Portugal it was concluded that, in 2013, the sector contributed to employ more than 40 000 people (direct and indirect jobs).

Based on the foreseen renewable electricity sector development it was estimated the increase of jobs until 2020 and 2030 as shown in the next figure.

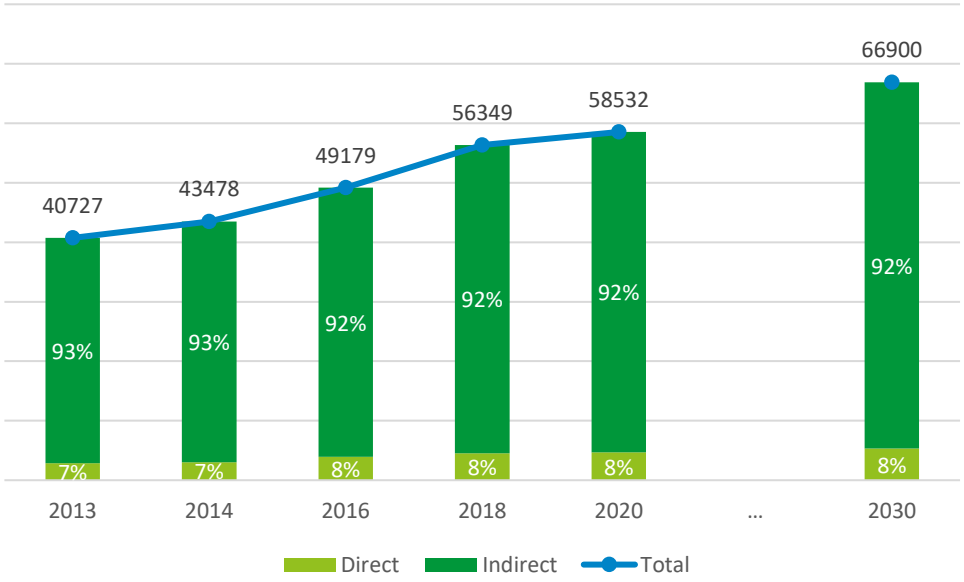


Figure 2: Jobs in the Portuguese renewable energy sector. (Source: Macroeconomic impact of the renewable electricity sector in Portugal, Deloitte)

The economic conjuncture contributed severely to the unemployment in Portugal in last years. To fight this scenario and promote the industry sector the government in 2013 published the Fostering Industrial Strategy for Growth and Jobs 2014-2020, which settles the target of 75% of employment rate for 2020 (in 2012 was 66%) through the promotion of strategy economic-industrial clusters such as renewable energy.

By the data collected in the study Macroeconomic impact of the renewable electricity sector in Portugal we also concluded that the solar sector contributes around 12,1 Jobs by each MW of Solar PV installed.

5.2 Business value

Information not available

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

The Portuguese Electricity System incorporates six major functions: production of electricity, transmission, distribution, operation of the electricity market and the logistical operations between producers and consumers of energy.

The Portuguese Electricity System is nowadays totally unbundled, a process that started in 1995 inspired in the same principles of the European Directive 96/92/EC, December 19th that defines common rules towards the founding of the Internal Electricity Market. The former vertical structure of the state-owned company EDP was privatized under a holding Company.

The Energy Services Regulatory Authority (ERSE) was created in 1995 with the aim to protect the consumers, to guarantee an adequate commercial and technical quality of supply, to promote an open access to information among all the actors of the system, namely market players, producers and network operators, ensuring a fair remuneration for the market stakeholders through the definition of a transparent tariff for consumers.

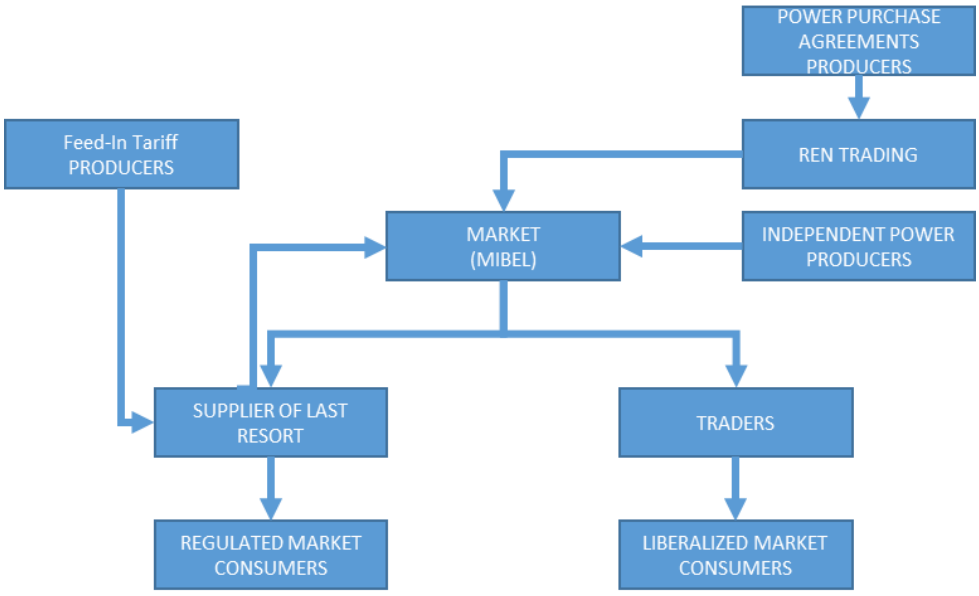


Figure 3: Portuguese Electricity Market Organization (Source: APREN's analysis, 2016)

Supply to final consumers is also fully liberalized, although a regulated supplier of last resort is being kept.

OMIE and OMIP[1] are the regional daily and forward electricity trading platforms, respectively. As from 1 July 2011 OMIE assumed the management of the bidding system for the purchase and sale of electricity on the spot market within the sphere of MIBEL (Iberian electricity market). OMIP, constituted on June 16th 2003, is the derivatives exchange market for Iberian and non-Iberian products (including MIBEL), that ensures the management of the market jointly with OMIClear, a company constituted and totally owned by OMIP.

[1] To regulate MIBEL it was approved on 1 October 2004 an organisational structure by virtue of which the Iberian Market Operator (OMI) has become an entity comprising two parent or holding companies, with 10 % cross-ownership, with each one of them also holding 50 % of the capital of the two market management companies, with the Portuguese management company, OMI-Polo Portugués, SGMR (OMIP), operating the forward market, and the Spanish management company, OMI, Polo Español S.A. (OMIE), operating the spot market.

The Transmission and Distribution activities are regulated and developed through a concession endorsed, respectively, to REN (Transmission System Operator) and EDP Distribution (Distribution System Operator), both are, nowadays, private companies and are regulated by ERSE.

The Directorate General of Energy and Geology (DGEG) is the body responsible for the development and implementation of policies related to energy and geological resources within a framework of sustainability and security of energy supply.

6.2 Interest from electricity utility businesses

Not Available at time

6.3 Interest from municipalities and local governments

Not Available at time

7 HIGHLIGHTS AND PROSPECTS

7.1 Highlights

PV installations in Portugal, namely grid connected systems had a continuous increase since 2007 firstly driven by FIT and by Independent Power Producers dynamics.

Solar photovoltaic installed capacity has grown from very small numbers to 673 MW at the end of 2018, registering the largest relative growth rate, comparing to other renewable energy sources. In the 8 years, between 2010 and 2018, PV energy production grew from 215 GWh to 1006 GWh, with an average growth near 99 GWh/year.

At the end of 2018, the region of Portugal with more installed PV power is Alentejo (south of Portugal) with 248 MW, accounting for 38 % of the total solar photovoltaic energy production.

In the period of 2008-2016 micro PV (below 3,68 kW) and mini PV systems (between 3,68 kW and 250 kW) installed capacities raised from 10 MW to near 174 MW.

Decree-Law 153/2014 defines the rules for the self-consumption regime. There are two kinds of solutions for promotors: one is the self-consumption of the energy produced, designated UPAC – Unit of Production for Self-Consumption - and another is the selling of all the energy to the grid, the designated UPP – Small Producer Units. At the end of 2018 the PV capacity installed in this new regime, UPAC and UPP units, totalise 141 MW.

An Industry exists and, though still small, it is strongly related to Research and Innovation.

Also in terms of Training, a considerable effort is being made, mostly related to PV installation in Buildings, towards having qualified trained installers for PV systems. Examples are the Portuguese participation in the Build Up Skills initiative and in project FORMAR for sustainable buildings.

In terms of Research and Development it is important to notice the growing intervention of Portuguese Research Groups from Universities and Research organizations, namely through National and European projects. Examples are the intervention in the framework of the European Energy Research Alliance (EERA) and in the PV Joint Programme and in the CHEETAH Integrated Research Programme with work on silicon technologies but also on new PV conversion technologies like CZTS, CTS, organic cells and perovskites and on new PV/T modules.

The commitment of the Portuguese governments of the last 30 years with the business framework of the electricity generation from renewable energy sources has turnout in a successful experience placing today Portugal as a world reference in the field of renewable electricity.

It must also be stated that the renewable electricity sector has given the most decisively contribution for the reduction of the national energy dependency and by the end of 2018, the renewable electricity supplied more than 53 % of the overall electricity consumption in Portugal (according to the methodology of directive 2009/28/EC).

However, with the last economic crisis the renewable energy sector suffered some drawn backs in regulation so to reach the 2020 target and start on-track the 2030 targets it is imperative to have a market pick-up in short-medium time.

Regardless the drawbacks, there has been a huge quest in last two years for PV solar power plants in Portugal. Currently, in pipeline there are around 1,8 GW of PV projects that will enter in operations between 2020 and 2021, giving an important boost for the market deployment and for the creation of a steadier value chain.

In November 2018, it was launched the preliminary results of Portuguese National Carbon Roadmap for 2050 (RNC2050) and announced the targets from to 2030 to 2050, which underline the government ambition to reach the carbon neutrally in 2050 supported by well-defined

trajectories for the different economy sectors. It was announced also that the National Energy and Climate Plan (PNEC 2030) would be in line with these targets.

7.2 Prospects

RNC 2050 and PNEC 2030 have very ambition trajectories for solar PV, being expected that Solar PV by 2030 will be technology with more installed capacity (9 GW), split between centralized and decentralized units. In 2050, to reach carbon neutrality, solar PV will represent almost 50 % of the total installed capacity.

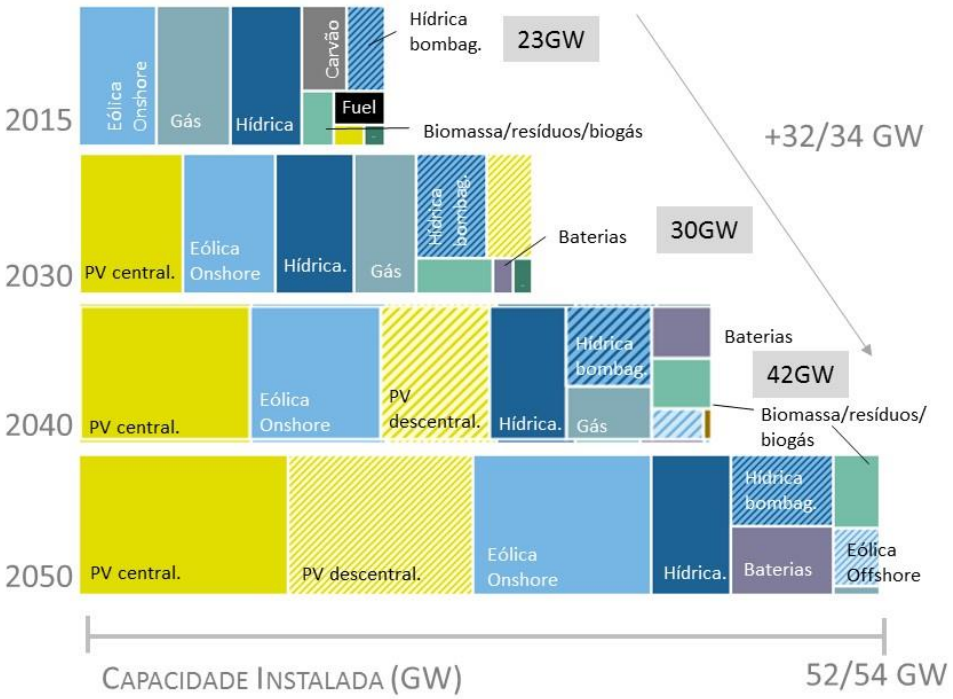


Figure 4: RNC 2050 Trajectory for RES-E (Source: RNC2050)

For the deployment of this capacity, the government announced the launch of capacity tenders being the first one to be held in middle 2019 for a 1,4 GW capacity.