IEA INTERNATIONAL ENERGY AGENCY

National Survey Report of Photovoltaic Applications in Portugal

2017

PHOTOVOLTAIC POWER SYSTEMS PROGRAMME

PVPS

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Cover photo: 200 kW Car shading device installed at Campus do Lumiar of IAPMEI belonging to the Ministry of Economy.

TABLE OF CONTENTS

Foreword

The International Energy Agency (IEA), founded in November 1974, is an autonomous body within the framework of the Organisation for Economic Co-operation and Development (OECD) which carries out a comprehensive programme of energy co-operation among its member countries

The IEA Photovoltaic Power Systems Technology Collaboration Programme (IEA-PVPS) is one of the collaborative R & D agreements established within the IEA and, since 1993, its participants have been conducting a variety of joint projects in the applications of photovoltaic conversion of solar energy into electricity.

The participating countries and organisations can be found on the www.iea-pvps.org website.

The overall programme is headed by an Executive Committee composed of one representative from each participating country or organization, while the management of individual Tasks (research projects / activity areas) is the responsibility of Operating Agents. Information about the active and completed tasks can be found on the IEA-PVPS website www.iea-pvps.org

Introduction

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 2017. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

The PVPS website www.iea-pvps.org also plays an important role in disseminating information arising from the programme, including national information.

1 INSTALLATION DATA

The PV power systems market is defined as the market of all nationally installed (terrestrial) 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 2017 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2017, 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 production of PV energy. Since 2014, the PV market in Portugal has been dominated by self-consumption projects with publishing of the Decree-law 153/2014 that promotes the installation of small scale units (until 1 MW) for prosumers and small and medium-sized businesses.

With the publication of this DL, the aim was to introduce new solutions for the production of decentralized energy and technological innovation, accommodating the figure of producer-consumer of electricity (or producer in self-consumption) within the scope of the Independent 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 facilities (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 model of discount offer at the reference tariff.

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 market price of the non-self-consuming electricity.

Total installed capacity of PV in Portuguese market reached 584 MW at the end of 2017. Despite this framework, since 2015, there has been a large quest for PV large-scale permits, with already reach 968 MW of power authorized to build. Nevertheless, only 4 MW of it has been materialized so far. All developers are struggling to find financing, since energy gross market price is very volatile and uncertain, giving no security and undermining financing agreements.

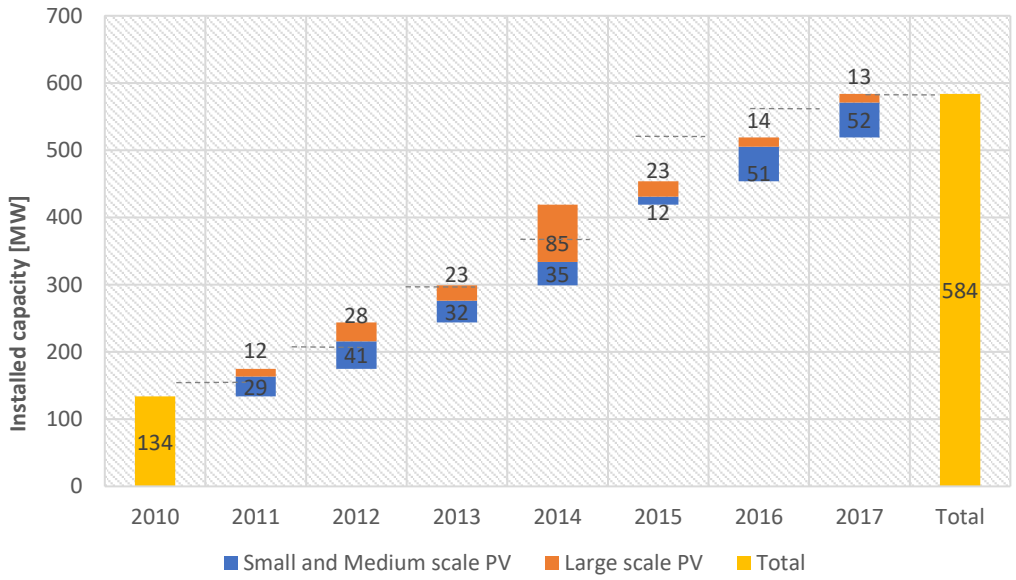

Figure 1: Portuguese PV market development (source: APREN's analysis, 2017)

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 Economy.

Table 1: PV power installed during calendar year 2017

AC			**MW installed in 2017**	**MW installed in 2017**	**AC or DC**
Grid-connected	BAPV	Residential	32.1 (p)	0.4 (p)	DC
		Commercial		3.5 (p)	DC
		Industrial		28.2 (p)	DC
	BIPV (if a specific legislation exists)	Residential	No specific legislation exists		DC
		Commercial			DC
		Industrial			DC
	Utility-scale	Ground-mounted	12 (p)	12(p)	DC
		Floating			DC
		Agricultural			DC
Off-grid		Residential (SHS)	20 (p)	4.6 (p)	DC
		Other		15.4 (p)	DC
		Hybrid systems			DC
		Total	64.1 (p)		

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 General Secretary of Energy. 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 Economy 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 350 power plants with an accumulated power of 12 643 MW in 2017.	 
Official statistics according to the National Directorate of Energy and Geology (DGEG) www.dgeg.pt	
	Additional comments on market and data collection, especially the estimated accuracy of data.

Table 3: PV power and the broader national energy market.

MW-GW for capacities and GWh-TWh for energy	2017 numbers	2016 numbers
Total power generation capacities (all technologies)	21 631 (MW) (p)	21 276 (MW)
Total power generation capacities (renewables including hydropower)	13 864 (MW) (p)	13 388 (MW)
Total electricity demand (= consumption)	47 973 (GWh) (p)	47 323 (GWh)
Total energy demand (= final consumption)	Not yet available for 2017	179062 (GWh)
New power generation capacities installed during the year (all technologies)	360 (MW, net value) (p)	577 (MW, net value)
New power generation capacities installed during the year (renewables including hydropower)	481 (MW, net value) (p)	669 (MW, net value)
Total PV electricity production in GWh-TWh	968 (GWh) (p)	871 (GWh)
Total PV electricity production as a % of total electricity consumption	2.0% (p)	1.7%

Table 4: Other informations

	2017 Numbers
Number of PV systems in operation in your country (a split per market segment is interesting)	**134 (only commercial PV systems)** (p)
Capacity of decommissioned PV systems during the year in MW	**0.2 MW** (p)
Total capacity connected to the low voltage distribution grid in MW	**20** (p)
Total capacity connected to the medium voltage distribution grid in MW	**32** (p)
Total capacity connected to the high voltage transmission grid in MW	**12** (p)

Table 5: The cumulative installed PV power in 4 sub-markets (MWp).

Year	Off-grid (including large hybrids)	Grid-connected distributed (BAPV, BIPV)	Grid-connected centralized (Ground, floating, agricultural…)	Other uses (VIPV, wearables…)	Total
1992					
…					
…					
2016	123 (p)	114 (p)	283 (p)		520 (p)
2017	143 (p)	146 (p)	295 (p)		584 (p)

1.3 Key enablers of PV development

Table 6: information on key enablers

	Description	Annual Volume (Units)	Total Volume (Units)	Source
Decentralized storage systems	n.a	n.a	n.a	
Residential Heat Pumps	n.a	n.a	n.a	
Electric cars (and light weight)	n.a	n.a	n.a	
Electric buses/trucks	n.a	n.a	n.a	
Other	n.a	n.a	n.a	

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 7: Typical module prices for a number of years**Year**	**1992**				**2015**	**2016**	**2017**
Standard module crystalline silicon price(s): Typical					0.6 €/W	0.6 €/W	0.5 €/W
Lowest prices					0.5	0.5	0.3
Highest prices					0.6	0.6	0.6

2.2 System prices

Table 8: **Turnkey Prices of Typical Applications [€]**

Category/Size	**Typical applications and brief details**	**Current prices per W**
OFF-GRID Up to 1 kW (SHS)		2
OFF-GRID > MW scale		1.6
Grid-connected Rooftop up to 5-10 kW (residential BAPV)		1.4
Grid-connected Rooftop from 10 to 250 kW (commercial BAPV)		1.2
Grid-connected Rooftop above 250kW (industrial BAPV)		1.0
Grid-connected Ground-mounted above 10 MW		0.6 to 0.8
Other category (hybrid diesel-PV, hybrid with battery…)		6
Floating PV		2
Agricultural PV		n.a.
Residential BIPV (tiles, or complete roof).		n.a.
Industrial BIPV		n.a.

Table 9: National trends in system prices (current) for different applications – local currency

Price/Wp	1992					2016	2017
Residential PV systems < 5-10 kW						2.2 €/W	1.6 €/W
Commercial and industrial BAPV						1.0 to 1.4 €/W	1.0 to 1.4 €/W
Ground-mounted > 10 MW						0.7 to 0.8 €/W	0.6 to 0.8 €/W

2.3 Cost breakdown of PV installations

2.3.1 Residential PV System < 5-10 kW

Table 10: Cost breakdown for a residential PV system – local currency

Cost category	Average (€/W)	Low (local currency/W)	High (local currency/W)
Hardware			
Module	0.60		
Inverter	0.35		
Other (racking, wiring…)	0.35		
Soft costs			
Installation	0.30		
Customer Acquisition			
Profit			
Other (permitting, contracting, financing…)			
Subtotal Hardware	1.3		
Subtotal Soft costs	0.3		
Total	1.6		

2.3.2 Utility-scale PV systems > 10 MW

Table 11: Cost breakdown for an utility-scale PV system – local currency

Cost Category	Average (€/W)	Low (local currency/W)	High (local currency/W)
Hardware			
Module	0.40		
Inverter	0.08		
Other (racking, wiring, etc.)	0.20		
Soft cost			
Installation Labor	0.05		
Customer acquisition			
Profit			
Other (contracting, permitting, financing etc.)			
Subtotal Hardware	0.68		
Subtotal - Soft cost	0.05		
Total Installed Cost	0.73		

2.4 Financial Parameters and specific financing programs

Table 12: PV financing scheme

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 13: Specific investment programs

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
Crowdfunding (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
Other (please specify)	

2.6 Additional Country information

Table 14: Country information

Retail Electricity Prices for an household (range)	0.2230 €/kWh (with taxes and VAT) 0.1080 €/kWh (without taxes and VAT) 2500 kWh < Consumption < 5000 kWh Source: EUROSTAT, 2018

Retail Electricity Prices for a commercial company (range)	0.1870 €/kWh (with taxes and VAT) 0.1520 €/kWh (without taxes and VAT) 20 MWh < Consumption < 500 MWh Source: EUROSTAT, 2018
Retail Electricity Prices for an industrial company (range)	0.1411 €/kWh (with taxes and VAT) 0.0837€/kWh (without taxes and VAT) 500 MWh < Consumption < 2 000 MWh Source: EUROSTAT, 2018
Population at the end of 2017 (or latest known)	10 309 573
Country size (km^2)	92 225.6 km^2
Average PV yield (according to the current PV development in the country) in kWh/kWp	1 600
Name and market share of major electric utilities.	The major electric utilities in Portugal operating in the free market regime and the share in terms of number of consumers are: EDP (83 % market share) Galp (5.1 % market share) Endesa (4.9 % market share) Iberdrola (3.3 % market share) Goldenergy (1.8 % market share) GN Fenosa (0.7 % market share) PH (0.4 % market share) Others (1.0 % market share) In terms of energy delivered the share is : EDP (45 %), ENDESA (17 %), IBERDROLA (16%), GALP (9.2 %), Fortia (3.1 %), GN Fenosa (3.0%), PH (2.2%), Others (7.7%)

3 POLICY FRAMEWORK

Portugal, in order to respond to the challenges created by climate change and to reduce its dependence on fossil fuels, has been pursuing a policy of promoting renewable energy sources for more than a decade within the framework of the commitments made at EU level. This allows Portugal to be at one of the top places in the ranking of the production of electricity from renewable sources.

For more than a decade, Portugal has defined a regulatory framework that has enabled to develop a strategy for promoting renewable energies and set specific objectives for technology and in recent years has remained committed to a medium- and long-term policy, creating conditions for intelligent, sustainable and inclusive growth.

In 2013, the energy strategy was reviewed which launched Portugal to a very good position on the topic of Renewable integration on the electricity sector. The actions described in the National Renewable Energy Action Plan together with the actions of the National Energy Efficiency Action Plan allow Portugal to comply with the Overall and National Objectives of the European Renewable Energies Directive 2009/28/EC on the promotion of the use of energy from renewable sources. The NREAP was defined by the Council of Ministers' Resolution nº 20/2013 from 10th of April 2013.

Since then Portugal has pursued a policy of promoting renewable energy through an energy model based on economic rationality and sustainability, combining the adoption of energy efficiency measures and the use of energy from endogenous renewable sources in order to ensure compliance with the objective of incorporating 31% of renewable energy into final gross energy consumption by 2020, contributing to reducing the country's energy dependency and ensuring security of supply by promoting a balanced energy mix and reducing CO_2 emissions, coupled with efforts to reduce energy costs.

This strategy made a readjustment of supply to the new energy demand scenarios, reviewing the targets for the contribution of the various renewable energy sources to the national energy mix, with a special emphasis on the use of technologies in terms of their maturity and competitiveness, in conjunction with measures to improve energy efficiency.

In the future, Portugal intends to increase the percentage of use of renewable sources, and it is foreseeable that a greater use of photovoltaic energy will take place.

In this perspective and in a framework of decentralization of energy production and technological innovation, in 2014, the Decree-Law 153/2014, of October 20, sought new solutions, accommodating the figure of producer-consumer of electric energy in low voltage (or the producer in self-consumption) within the scope of the Independent Electric System.

This new regulatory framework is applicable to small and medium scale RES generation for self-consumption with or without grid injection (up to 1 MW) and small-scale with FIT (up to 250 kW) based on any kind of source, though the great majority of installations already done are photovoltaics.

At the level of the remuneration scheme, until 2014, the remuneration system guaranteed through the production tariff system was maintained. From 2015, and according to the policy guidelines defined by the current Government, the goal is to ensure a gradual and progressive transition from the Feed-in model to a renewable market remuneration system at market prices. However, according to article 15 of Decree-Law no. 215-B / 2012 – Revoking rules, the tender procedures launched until 2015, maintained the remuneration conditions established.

More recently, concerning the policy of renewable energy sources promotion and in the case of photovoltaic solar energy, Portugal has been continuing investing in PV, having a total installed capacity in 2017 of 584 MW.

At this point, it is impossible to predict how much PV will be installed in 2018. There is no tendering procedure active and it is not foreseen any kind of competitive procedure to stimulate renewables.

As mentioned, new projects are only accepted under market conditions. This means that the new PV installations (as any new renewable power plant) should offer in the day ahead energy market with no other chance of getting revenues. The Portuguese Government has already approved the installation of 968 MW (till June 2018) of PV power plants without any financial support.

3.1 Direct support policies for PV installations

3.1.1 New, existing or phased out measures in 2017

3.1.1.1 Climate change Commitments

Portugal ratified the Paris Agreement through the European Union's nationally determined contribution, which includes a collective target to reduce greenhouse gas emissions by at least 40% by 2030 compared to 1990 levels.

To contribute to this target Portugal has already committed to the following targets:

- National GHG Emission reduction target (without LULUCF) of 54 to 60 Mt CO_2eq. in 2030;
- Carbon neutrality by 2050
- National objective for Renewables in the final energy consumption of at least 40% in 2030
- National objectives for improvement in Energy Efficiency of 30% energy consumption in the economy by 2030

Moreover, Portugal is one of the 25 parties that has signed the Powering Past Coal Alliance, launched in the COP23 in Germany, committing to phase out the coal power plants until 2030.

PV will have a huge role mainly the roadmap for neutrally in 2050, being expected to have highest growth rate among all renewable technologies, reaching a share of around 30% in the electricity generation and contributing vastly for jobs development.

3.1.1.2 Description of support measures (excluding BIPV, VIPV and rural electrification)

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). The regulation is fully operational.

3.1.1.3 BIPV development measures

The most important driver for BIPV development in Portugal is the EPBD (Energy Performance of Buildings Directive) stating the objective for 2020 of having nearly Zero Energy Buildings (nZEB). Several initiatives towards the implementation of this Directive have been taken in Portugal specifically in the last two or three years, from Dissemination activities (Workshops and Conferences on nZEB), Training Actions (European Build Up Skills initiative from H2020 Programme and FORMAR project supported by the Lifelong Learning European Programme.

3.1.1.4 Utility-scale measures including floating and agricultural PV

No measures adopted in 2017 in this item.

3.1.1.5 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*)

3.1.1.6 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 installing PV systems with storage without any taxes or grid costs.

3.1.1.7 Support for electric vehicles (and VIPV)

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 was implemented a pilot recharging infrastructure system. 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).

It is estimated that between 2010 and 2016 a total of 2042 pure Electric Vehicles and 1811 Plugin (PHEV+EREV), were sold in Portugal. The scenarios for the reduction of GHG emissions forecast a reduction ranging from 772 kton of CO_2e to 3 894 kton of CO_2e 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.

Table 15: PV support measures (summary table)

	On-going measures residential	Measures that commenced during 2017 - residential	On-going measures Commercial + industrial	Measures that commenced during 2017 – commercial + industrial	On-going measures Ground-mounted, including floating	Measures that commenced during 2017 – ground mounted, including floating
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)	*Yes*	No	*Yes*	No	*Yes*	No

with/without PV requirements						
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						

3.2 Self-consumption measures

Table 16: Self-Consumption Schemes.

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	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	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 Collective self-consumption, community solar and similar measures

3.4 Tenders, auctions & similar schemes

3.5 Financing and cost of support measures

The cost of PV incentives in Portugal are mainly supported by electricity consumers.

The support schemes are financed by a contribution paid by household electricity consumers included in the electricity bill.

3.6 Indirect policy issues

4 INDUSTRY

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

No industrial production of silicon feedstock, ingots and wafers.

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.

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

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.

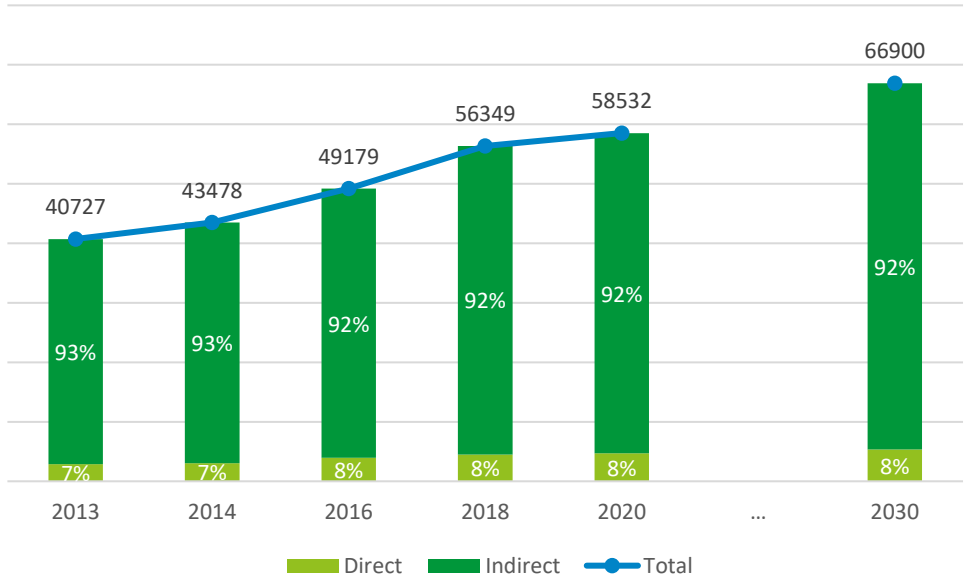

Figure 2: Jobs in the Portuguese renewable energy sector. (Source: Macroeconomic impact of the renewable electricity sector in Portugal, Deloitte)

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

No data available.

6 INTEREST FROM ELECTRICITY STAKEHOLDERS

6.1 Structure of the electricity system

Short description of the electricity industry landscape	- Structure – separated generation, transmission, distribution. There is an obligation for legal separation of these entities. - retailers and network businesses are separated; - Ownership: The grid is public, owned by the state for transmission and distribution grid and by municipalities for low voltage distribution grid. These grids are concessioner to private operators for some periods of time. - Generation is private or public with a private concession. - Electricity regulator exists: ERSE.

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.

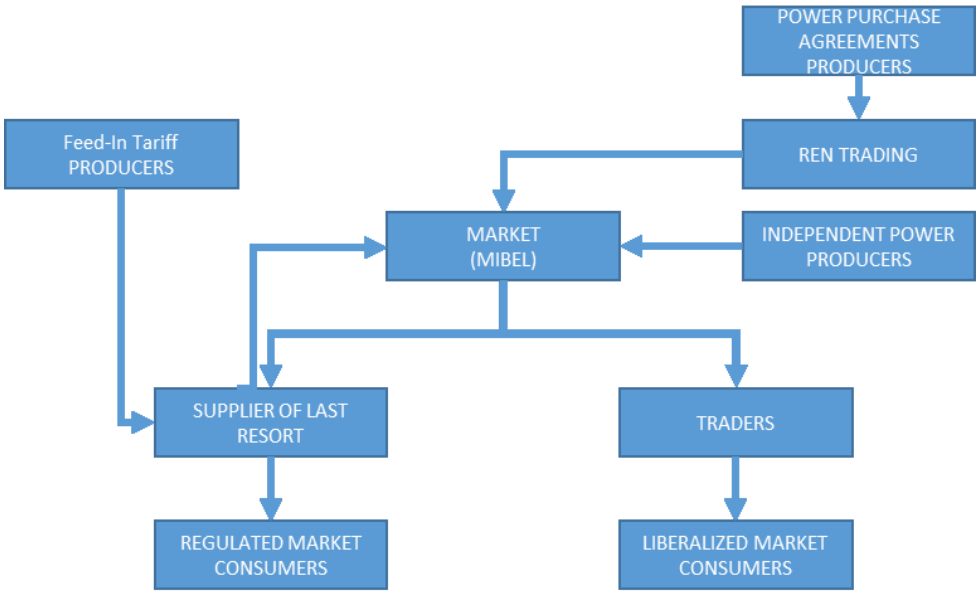

Figure 3: Portuguese Electricity Market Organization (Source: APREN's analysis, 2016)

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.

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 nowadays private companies and 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

[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.

7 HIGHLIGHTS AND PROSPECTS

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 584 MW at the end of 2017, registering the largest relative growth rate, comparing to other renewable energy sources. In the 12 year period of 2006-2017, PV energy production grew from 5 GWh to 968 GWh, with an average growth near 88 GWh/year.

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.

The new regulatory framework (Decree-Law 153/2014, Oct 20) 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.

By the end of 2017 the PV capacity installed in this new regime, UPAC and UPP units, totalise 88 MW. The region of Portugal with more installed PV power is Alentejo (south of Portugal) with 186 MW, accounting for 37% of the total solar photovoltaic energy production.

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. A network of the Portuguese Research institutions working in the PV sector is being organized, gathering practically all groups involved in PV Research.

Portugal has a big potential for PV installations both distributed in the framework of the Self Consumption but also in a more centralized way taking advantage of the high levels of Irradiance practically all over the Country but more intensive in the Southern part of Portugal (Alentejo and Algarve) and a Solar Plan was developed in 2017 for that region that will surely regain the previous impetuous of the market, with studies on the PV integration in the national grid but also on the increase of the level of interconnections, namely with Morocco, in order to allow a better flow of Solar PV power from that region.

In the period 2010-2017, the reduction of fossil fuel imports due to all kinds of RES-E production reached the amount of EUR 6 billion, while gains from the beneficial impact in the marginal spot market of energy due to the merit order effect of RES-E was 6.6 billion. Furthermore, the value of the CO_2 avoided licenses was about EUR 0.5 billion in the same period.

These benefits clearly exceed the over cost (evaluated according ERSE rules as the difference between the energy spot market price and the remuneration received) of RES-E on the same period that were evaluate in EUR 6.5 billion, according to ERSE published data between 2010 and 2017.

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.

Portugal is, in terms of consumption, the second worldwide country with the highest penetration of wind electricity production, establishing a technical mark of relevancy for a peripheral country. 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 2017, the renewable electricity supplied more than 51 % 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 2030 target it is imperative to have a market pick-up in short-medium time.

It is necessary that solar PV takes a bigger share in the renewable electricity if Portugal wants to meet its 2020 target of 60% of renewable sources in the electricity.

For residential and commercial sectors, we believe that self-consumption will be the main driver; it is already being seen electricity suppliers acting as self-consumption unit's retailers.

Nevertheless this is not enough to achieve the national 2030's RES objectives, it is also essential to invest in large-scale systems to reach around 6 000 MW of installed PV capacity. This capacity estimation, representing an important growth to current 584 MW value, relies in the fact that the solar technology is nowadays the best-positioned renewable energy source to growth cost-efficiently in Portugal, since the other RES-E technologies have already reached a reasonable level of exploitation according to their potential.