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IEA-PVPS

National Survey Report of PV Power Applications in PORTUGAL

2015

PVPS

PHOTOVOLTAIC
POWER SYSTEMS
PROGRAMME

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Cover Photo: The new Fatima Sanctuary Church PV system

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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 2015. 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 system 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 2015 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2015, although commissioning may have taken place at a later date.

1.1 Applications for Photovoltaics

Market for PV in Portugal during 2015 was mainly driven by large scale ground mounted installations, though small and very small installations in the framework of the new Self Consumption Law (DL 153/2014) from 2014, started to be implemented.

These are all on-grid systems, with installations related to independent power producers or utility scale systems, but with several new applications in the Commercial (some big surface Commercial areas and retail parks) and Residential sectors. Building integration of PV, with some few examples in Portugal, starts to caught the attention of Architects and of the Construction Sector, namely because of the European Directive of Energy Performance of Buildings and the objective of reaching the goal for 2020 of nearly Zero Energy Buildings. However there is still an important work to do in this sector.

1.2 Total photovoltaic power installed

The total installed PV power data was mainly obtained through the Portuguese Association of Renewable Energies Producers (APREN) that gathers the most important players in the market of Renewables, from the National Direction of Energy and Geology (DGEG) of the Portuguese Ministry of Economy and from data published by the Portuguese TSO (REN) and it is supposed to have a confidence level above 90 %.

Table 1: PV power installed during calendar year 2014

AC			**MW installed in 2015 (mandatory)**	**MW installed in 2015 (optional but HIGHLY NEEDED)**	**AC or DC**
Grid-connected	BAPV	Residential	14		DC
		Commercial			DC
		Industrial			DC
	BIPV (if a specific legislation exists)	Residential	No specific legislation exists		DC
		Commercial			DC
		Industrial			DC
	Ground-mounted	cSi and TF	32	29	AC
		CPV		3	AC
Off-grid		Residential	3		DC
		Other			DC

	Hybrid systems			DC
	Total	49		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 Directorate General 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, presently included in the umbrella of the Ministry of Economy, but former belonging to the Ministry of Energy and Environment and Spatial Planning. 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 11 023 MW in 2015, also collects data from its members. Some data is used to enrich DGEG's stats.	 

Official statistics according to the Portuguese General Directorate of Energy and Geology (DGEG) **www.dgeg.pt**	

Table 2b: PV power installed during calendar year 2015 – System size

Ground Standing:

System size (kW)	Number of installations in 2015	Installed capacity 2015 (MW)	Number of installations up to 2015	Global installed capacity up to 2015 (MW)
Micro < 5.75 kW	3.279	3	29.508	104
Min 5.75 < Size < 250	417	17	1.684	84
Remaining > 250 kW	14	26	74	282

These numbers include self-consumption, off-grid, small PV building integrated and stand alone power plants.

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

MW-GW for capacities and GWh-TWh for energy	2015 numbers	2014 numbers
Total power generation capacities (all technologies)	20.2 GW	19.7 GW
Total power generation capacities (renewables including hydropower)	12.3 GW	11.7 GW
Total electricity demand (= consumption)	50.6 TWh	50.4 TWh
New power generation capacities installed during the year (all technologies)	0.5 GW	0.1 GW

New power generation capacities installed during the year (renewables including hydropower)	0.6 GW	0.4 GW
Total PV electricity production in GWh-TWh	797 GWh	627 GWh
Total PV electricity production as a % of total electricity consumption	1.6 %	1.2%

Table 4: Other informations

	2015 Numbers	
Number of PV systems in operation in your country (a split per market segment is interesting)	**Type of System**	**Cumulative**
	Residential (<= 10 kW)	> 35 000
	Commercial (< 10 kW, <= 250 kW)	(self consumption systems)
	Industrial (> 250 kW, <= 1000 kW)	10
	Utility (> 1000 kW)	59
Capacity of decommissioned PV systems during the year in MW	n/a	
Total capacity connected to the low voltage distribution grid in MW	**na**	
Total capacity connected to the medium voltage distribution grid in MW	**na**	
Total capacity connected to the high voltage transmission grid in MW	**na**	

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

Sub-market	2007	2008	2009	2010	2011	2012	2013	2014	2015
Stand-alone domestic									
Stand-alone non-domestic									
Grid-connected distributed									
Grid-connected centralized									
TOTAL (MW)	15	62	110	134	175	244	299	419	465

2 COMPETITIVENESS OF PV ELECTRICITY

2.1 Module prices

Table 6: Typical module prices for a number of years

Year	2014	2015
Standard module crystalline silicon price(s): Typical		0.5 to 0.6 €/W
Lowest prices		0.5 €/W
Highest prices		0.6 €/W

2.2 System prices

Table 7: **Turnkey Prices of Typical Applications – local currency**

Category/Size	Typical applications and brief details	€/W
OFF-GRID Up to 1 kW		3.0
OFF-GRID >1 kW		2.7
Grid-connected Rooftop up to 10 kW (residential)	Residential in the framework of Self Consumption Law	2.2
Grid-connected Rooftop from 10 to 250 kW (commercial)	Commercial in the framework of Self Consumption Law	1.4
Grid-connected Rooftop above 250kW (industrial)		1.0
Grid-connected Ground-mounted above 1 MW	Utility scale systems in the frame work of Independent Power Producers Law.	0.7 to 0.8
Other category (hybrid diesel-PV, hybrid with battery…)		

Table 8: National trends in system prices (current) for different applications – local currency

Price/Wp	1992						2014	2015
Residential PV systems < 10 KW								2.2 €/W
Commercial and industrial								1.0 to 1.4 €/W
Ground-mounted								0.7 to 0.8 €/W

2.3 Cost breakdown of PV installations

2.3.1 Residential PV System < 10 kW

Table 9: Cost breakdown for a residential PV system – local currency

Cost category	Average (€/W)	Low (€/W)	High (l€/W)
Hardware			
Module	1.0		
Inverter	0.35		
Other (racking, wiring…)	0.35		
Soft costs			
Installation	0.5		
Customer Acquisition	na		
Profit	na		
Other (permitting, contracting, financing…)	10%-15% overall costs		
Subtotal Hardware	1.7		
Subtotal Soft costs	0.5		
Total	2.2		

2.3.2 Utility-scale PV systems > 1 MW

Table 10: Cost breakdown for an utility-scale PV system – local currency

Cost Category	Average €/W		
Hardware			
Module	0,45-0,50		
Inverter	0,08		
Other (racking, wiring, etc.)	0,20		
Soft cost			
Installation Labor	0,05		
Customer acquisition	n/a		
Profit	n/a		
Other (contracting, permitting, financing etc.)	n/a		
Subtotal Hardware	n/a		
Subtotal - Soft cost	n/a		
Total Installed Cost	0,75-0,85		

2.4 Financial Parameters and specific financing programs

Table 11: PV financing scheme

Average rate of loans – residential installations	10%
Average rate of loans – commercial installations	8%
Average cost of capital – industrial and ground-mounted installations	6%

2.5 Specific investments 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/
Other (please specify)	n/a

2.6 Additional Country information

Table 12: Country information

Retail Electricity Prices for an household (range)	0.1634 – 0.1641 €/kWh

	(Lower or higher prices exist for peak or empty hours.)
Retail Electricity Prices for a commercial company (range)	0.0733 – 0.2192 €/kWh (depending on the peak or empty hours and consumption type)
Retail Electricity Prices for an industrial company (range)	0.0646 – 0.2135 €/kWh (depending on the peak or empty hours and consumption type)
Population at the end of 2014 (or latest known)	10 374 822
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 are in terms of number of consumers: EDP (85 % market share) Galp (6,1 % market share) Endesa (3,9 % market share) Iberdrola (2,1 % market share) Goldenergy (1,4 % market share) GN Fenosa (0,9 % market share) YCLE (0,2 % market share) Others: Coopérnico, Elusa, Enat, Hen, Logica Energy, Luz Boa, Simples Energia, Rolear (0,4 % market share) In terms of energy delivered the share is : EDP (45 %), ENDESA (17 %), IBERDROLA (17%), GALP (8 %)

3 POLICY FRAMEWORK

The Policy framework for Renewable Energies in Portugal leaded 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, published in the Portuguese Official Journal, 1st Series, Nº 70 from 10th of April 2013. This official document foresees, that the contribution of PV for 2020 is 670 MW of installed capacity and 1039 GWh of produced energy, respectively. Solar energy is expected to have an important role in the increase of decentralized power production;

For the specific PV sector some important legislation is depicted below.

- Decree Law 312/2001 - defining the conditions for attribution of the grid connection points to Independent Power Producers.
- Decree Law 225/2007 - establishing the Feed In Tariffs for Renewable Energy Sources.
- Decree Law 363/2007 - establishing the regime of Micro production of electricity.
- Decree Law 25/2013 - Reviews the regimes of Micro and Mini production of electricity till 250 kW.
- Decree Law 153/2014 – Self Consumption Law

The Feed in Tariffs (FIT) were the main supporting measure to the implementation of Renewable Energy Sources for electricity production.

The economic and finance crisis of the last years and the phasing out of the FIT process leaded to a certain decrease in 2015 of the installations of PV related to the previous year.

However the Self Consumption Law that actually started to be effective in the second quarter of 2015, and also the important decrease of PV prices in the market hopefully will return Portugal to the previous growth rates in PV installations.

The new regulatory framework (Decree-Law 153/2014 of 20 October) is applicable to small-scale RES generation with grid injection and with a FIT (up to 250 kW) and to generation based on any kind of source for own consumption (no capacity limit), though the great majority of installations already done are Photovoltaics.

This Law provides the same simplified licensing procedures as the previous programmes of micro- and mini-generation for local grid-connected energy producers. In effect Licensing is conducted online via Internet, using the Electronic System of Registration of Generation Units (SERUP), allowing two regimes:

- The small generation is applicable to any type of systems up to a limit of 250 kW, where a reference FIT is established and applied to each RES according to a different percentage: 100% for solar, 90% for biomass and biogas, 70% for wind and 60% for hydro. The reference FIT for new producers in 2015 is valid for 15 years, and has a value of 95 €/MWh, to which an amount of 5.0 €/MWh is added if at least 2 m^2 of solar thermal panels are used in the consumer's installation or

an amount of 10 €/MWh is added if there is an electric vehicle charging power outlet connected to the mobility grid in the consumer facility.

- Self-consumption is applicable to any kind of source since it does not benefit from a FIT, and has the possibility of injecting the surplus into the grid, which is paid by the last-resort supplier at 90% of the average monthly Iberian market (MIBEL) price. Optionally, renewable energy generators in self-consumption (either grid connected or off-grid) can also trade the electricity surplus or the generated electricity by green certificates.

3.1 Direct support policies for PV installations

3.1.1 New, existing or phased out measures in 2015

3.1.1.1 Description of support measures excluding BIPV, and rural electrification

No specific support measures for BIPV or Rural electrification.

Utility scale PV Power plants don't have a FiT scheme due to the decree-law 215-B/2012, this decree allows capacity auctions however to date no procedure was launched, being applied the regular energy market prices to new power plants.

In 2014, the new self-consumption and FiT regime regulation for small units was published (decree-law 153/2014), which repeals the old FiT scheme (micro and minigeneration). 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.

3.1.1.2 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).

3.1.1.3 Rural electrification measures

No measures taken. Portugal is practically all grid- connected.

3.1.1.4 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.

Table 13: PV support measures (summary table)

	On-going measures residential	Measures that commenced during 2015 - residential	On-going measures Commercial + industrial	Measures that commenced during 2015 –	On-going measures Ground-mounted	Measures that commenced during 2015 –

				commercial + industrial		ground mounted
Feed-in tariffs	Yes	No	Yes	No	Yes	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	*No*	No	*No*	No	*No*	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
Commercial bank activities e.g. green mortgages promoting PV	No	No	No	No	No	No
Activities of electricity utility businesses	Yes	No	Yes	No	Yes	No
Sustainable building requirements	No	No	No	No	No	No
BIPV incentives	No	No	No	No	No	No
Other (specify)						

3.2 Self-consumption measures

The self-consumption measures are depicted in the table below.

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	Additional costs associated to self-consumption such as fees or taxes may exist
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	Real time (15 minutes of integration period).
	6	Geographical compensation	None
Other characteristics	7	Regulatory scheme duration	10 years contract extendable for periods of 5 years
	8	Third party ownership accepted	No. The producer has to be the consumer
	9	Grid codes and/or additional taxes/fees impacting the revenues of the prosumer	None, except for number 3 (above)
	10	Regulations on enablers of self-consumption (storage, DSM…)	No
	11	PV system size limitations	No limit. It should be dimensioned according to the consumption characteristics.
	12	Electricity system limitations	For grid injection, only if there are limits to substation where the local area is connected.
	13	Additional features	The prosumer may sell the surplus of electricity in market conditions.

3.3 Tenders, auctions & similar schemes

There is a considerable experience of Portugal in Tenders and Auctions for Renewable Energies namely for Wind energy and this experience was also extended to the PV sector during the last five years namely with reverse auctions.

In 2001, the Decree-Law 312/2001 gave a huge boost to the renewable sector defining a system to obtain grid connection access and in 2005 a three phases tender for wind 1 800 MW was released. The installation of the power granted by this tender only started in 2008 and continued until 2014. Other tenders for biomass, small hydro and solar were released but in a smaller scale.

In 2011, following the economic crisis of Portugal, the International Monetary Fund, the Central European Bank and the European Commission signed The Memorandum of Understanding with the Portuguese Government. This memorandum established rules and conditions for the financial assistance to Portugal defining measures to be taken on the energy sector.

Due to this in 2012 was published the decree-law 215-B/2012, and FiT for large scale renewable power plants was extinguished. New RES-E projects have no incentive mechanisms; they were integrated in the regular energy market. However, this 2012's decree-law considers capacity auctions but to date no new procedures were opened.

3.4 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.

3.5 Indirect policy issues

The major indirect policy issue regarding PV installations is the effort that is being made recently towards the simplification of the licencing process. Also the effort on the Training and Qualification of installers is expected to be an important indirect policy issue.

The presence of Portugal in important international PV *Fora* namely the groups of IEA can be considered also an indirect policy issue.

In January 1st of 2015, the Green Tax Reform was implemented. It was established that a new value for the maximum tax depreciation of solar was set at 8%, which represents twelve and half years. The proposal of reducing 50% of the Municipal Real Estate tax (IMI) for RES power producing buildings was accepted and will be carried out within five years.

4 HIGHLIGHTS OF R&D

4.1 Highlights of R&D

In the last years PV R&D in Portugal had a strong development with an important scientific community with a significant number of researchers working in different aspects of photovoltaics. These are mostly Public Research groups related to Universities and National Research centres but some important private companies in Portugal are also addressing the innovation process on PV.

Some of the most important players in R&D activities are:

University of Minho working on PV conversion materials namely on thin Film; amorphous/nanocrystalline silicon solar cells; Silicon nanowire solar cells; Oxygen and moisture protective barrier coatings for PV substrates; Photovoltaic water splitting.

INL (International Iberian Nanotechnology) working on Solar fuel production; Inorganic-organic hybrid solar cells, sensitized solar cells, perovskite solar cells, Cu_2O, $Cu(In,Ga)Se_2$ Solar Cell Devices and Materials, quantum dot solar cells, thin film Si, encapsulation barrier, Si-NW solar cells.

University of Oporto (Faculdade de Engenharia da Universidade do Porto) working on Solar PV cells and modelling processes.

University of Aveiro working on Semiconductor Physics; Growth and characterization of thin films for photovoltaic applications.

University of Coimbra (Faculdade de Ciências e Tecnologia) working on Dye-sensitized Solar Cells Perovskite solar cells, Bulk heterojunction organic solar cells, Metal oxide photoelectrodes for solar fuel applications.

University of Lisbon (Faculdade de Ciências) working on silicon technologies namely ribbon cells, and modelling.

University of Lisbon (Instituro Superior Técnico) working in organic cells.

New University of Lisbon (UNL) (Faculdade de Ciências e Tecnologia, UNINOVA and CENIMAT) working on thin film technologies and tandem cells.

LNEG (Laboratório Nacional de Energia e Geologia) working on conversion technologies namely organic cells, perovskites, kesterites (CZTS) and CTS and also on new PV/T modules and modelling.

Also private companies as for example EFACEC, Martifer Solar, Open Renewables and MagPower have their own Research and Innovation groups.

4.2 Public budgets for market stimulation, demonstration / field test programmes and R&D

Table 14: Public budgets for R&D, demonstration/field test programmes and market incentives.

	R & D	Demo/Field test
National/federal	Not available	
State/regional	Not available	
Total		

5 INDUSTRY

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

There is no feedstock ingot or wafer production in Portugal, though initiatives for Ribbon production of Silicon appeared recently.

Table 15: Production information for the year for silicon feedstock, ingot and wafer producers

Manufacturers (or total national production)	Process & technology	Total Production	Product destination (if known)	Price (if known)
Not available	Silicon feedstock	tonnes	n.a	
Not available	sc-Si ingots.	tonnes	n.a	
Not available	mc-Si ingots	tonnes	n.a	
Not available	sc-Si wafers	MW	n.a	
Not available	mc-Si wafers	MW	n.a	

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

There is a considerable experience in Module production in Portugal with some factories highly automated, mainly on crystalline silicon technologies. Examples are:

Open Renewables – The oldest manufacturer of PV modules in Portugal with a 60 MWp/year rate.

Martifer Solar – with a production rate of 50 MWp/year.

Jinko – with a production rate of 30 MWp/year.

Thin Film technologies like amorphous silicon had some industry development during some years but are no long 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** with a production rate of 54 MWp and with an internationalization process with several projects installed abroad.

Total PV cell and module manufacture together with production capacity information is summarised in Table 9 below.

Table 16: Production and production capacity information for 2014

Cell/Module manufacturer (or total national production)	**Technology** (sc-Si, mc-Si, a-Si, CdTe)	**Total Production (MW)**		**Maximum production capacity (MW/yr)**	
		Cell	Module	Cell	Module
Wafer-based PV manufactures					
Open Renewables					60
Martifer solar					50
Jinko					30
Total					***140***
Thin film manufacturers					
na					
na					
Cells for concentration					
Magpower					*54*
TOTALS					**194**

5.3 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 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.

6 PV IN THE ECONOMY

6.1 Labour places

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

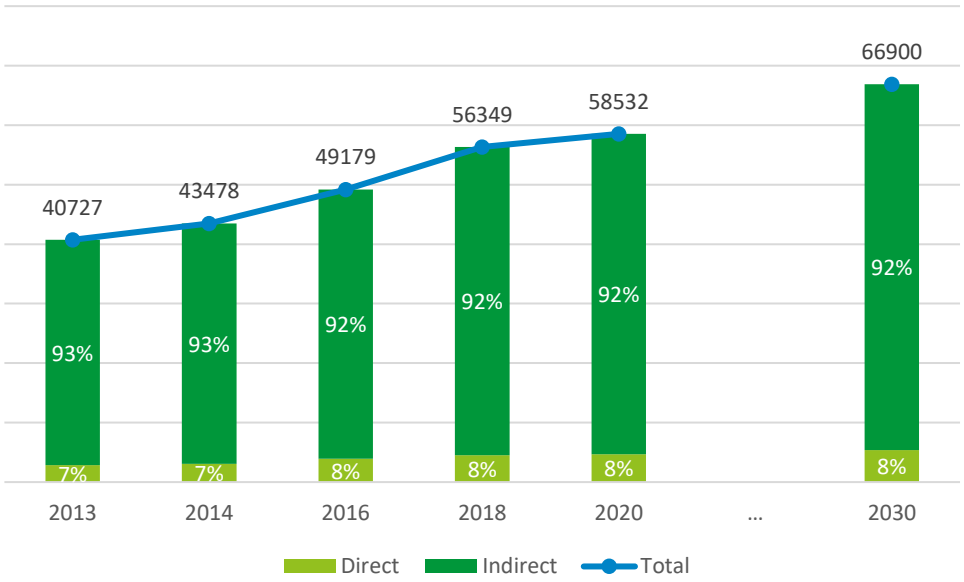

Figure 1: Jobs in the Portuguese renewable energy sector. (Source: Macroeconomic impact of the renewable electricity sector in Portugal, Deloitte)

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.

Table 17: Estimated PV-related labour places in 2014

Research and development (not including companies)	Not available
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	
Distributors of PV products	
System and installation companies	Not available
Electricity utility businesses and government	Not available
Other	Not available
Total	

6.2 Business value

Table 18: Value of PV business

Sub-market	**Capacity installed *in 2014* (MW)**	**Price per W** *(from table 7)*	**Value**	**Totals**
Off-grid domestic	*Na*	*Na*		
Off-grid non-domestic			*Na*	
Grid-connected distributed			*Na*	
Grid-connected centralized			*Na*	
Export of PV products				*Na*
Change in stocks held				*Na*
Import of PV products				*Na*
Value of PV business				

By the data collected in the study Macroeconomic impact of the renewable electricity sector in Portugal we conclude that each MW installed in Portugal contributes to 558 k€ to the national GDP.

7 INTEREST FROM ELECTRICITY STAKEHOLDERS

7.1 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 separate; - ownership: The network is public, owned by the state for transmission and distribution grid and municipal for low voltage distribution grid. These grid are concessioned 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.

The production activity was liberalized, and the former Company EDP had to give away the management of some production assets to be accomplished an effective production's competitiveness (Figure 2). For the renewable power plants, other than the large hydro, was a FiT (Feed in tariff, guaranteed tariff) was defined, deemed necessary to launch the new emergent renewable power production technologies, like wind and solar, as well as to promote the efficiency, through cogeneration of Heat and Power (CHP).

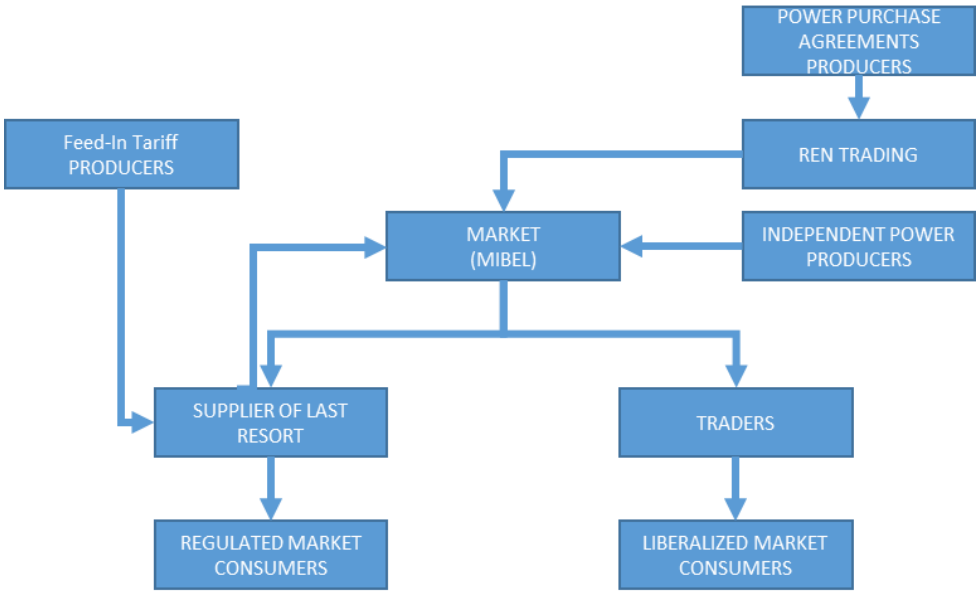

Figure 2: Portuguese Electricity Market Organization (Source: APREN's analysis, 2016)

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.

7.2 Interest from electricity utility businesses

Not Available at time

7.3 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.

8 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 460 MW, registering the largest relative growth rate, comparing to other renewable energy sources. In the 10 year period of 2006-2015, PV energy production grew from 5 GWh to 755 GWh, with an average growth near 80 GWh/year.

In the period of 2008-2015 micro PV (below 3.68 kW) installed capacity raised from 10.4 MW to 100.9 MW.

In the period of 2010-2015, mini PV systems (between 3.68 kW and 250 kW) installed capacity raised from 0.6 MW to 72.5 MW , a value representing 29%.The micro and mini production represents about 34% of the total PV *production.*

In 2015 ten new solar parks went into production. In this year, Alentejo (south of Portugal) accounted for 38% of the total solar photovoltaic 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 is being developed 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 2005-2015, the reduction of fossil fuel imports due to all kinds of RES-E production reached the amount of EUR 12 billion, while the energy dependence decrease from the range 86-88% to 72%. Furthermore the value of CO_2 licenses avoided was about EUR 1.2 billion in the same period.

The RES-E growth also impacted significantly the falling of the Portuguese energy market prices, which represents an additional benefit for the overall economy evaluated around EUR 8.8 billion. This benefit alone clearly exceed the over cost of the FiT on the same period that, as said, is evaluate in EUR 6.0 billion, according to ERSE published data.

The commitment of the Portuguese governments of the last 30 years, and of the business framework on 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 2015, the renewable electricity supplied more than 52 % of the overall electricity consumption in Portugal (according to the methodology of directive 2009/28/EC).

However, with the current 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.

Actually 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 units retailers.

Although, this is not enough to achieve the national 2030's RES objectives, it is also essential to invest in large-scale systems in order to reach around 6 000 MW of installed PV capacity. This capacity estimation relies in the fact that the solar technology is at present moment the only with potential to growth cost-efficiently, since the other technologies are reaching their full exploit potential.

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