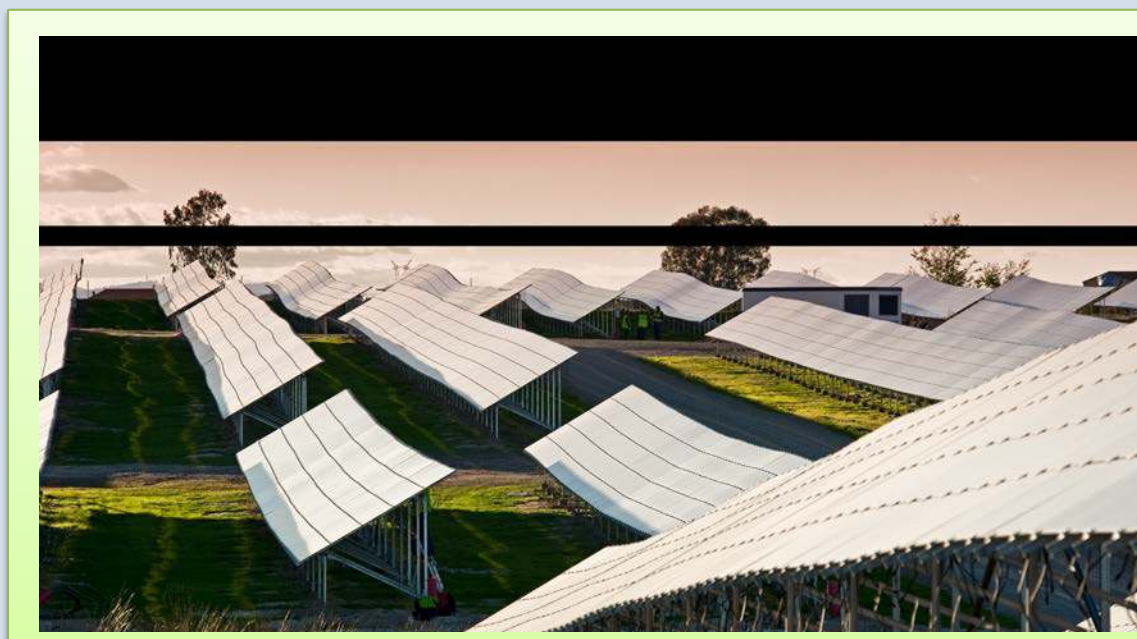




# National Survey Report of PV Power Applications in Spain 2014



PVPS

PHOTOVOLTAIC  
POWER SYSTEMS  
PROGRAMME

Prepared by José Donoso and Pedro Palencia

## TABLE OF CONTENTS

<b>Foreword .....</b>	<b>2</b>
<b>Introduction.....</b>	<b>3</b>
<b>1 Installation Data.....</b>	<b>4</b>
1.1 Applications for Photovoltaics .....	4
1.2 Total photovoltaic power installed .....	4
<b>2 Competitiveness of PV electricity.....</b>	<b>8</b>
2.1 Module prices.....	8
2.2 System prices.....	8
2.3 Financial Parameters and programs (leasing...) .....	9
2.4 Additional Country information .....	9
<b>3 Policy Framework.....</b>	<b>10</b>
3.1 Direct support policies.....	10
3.2 Direct Support measures.....	10
3.2.1 Support measures exiting in 2014.....	10
3.2.2 Support measures phased out in 2014.....	14
3.2.3 New support measures implemented in 2014 .....	14
3.2.4 Measures currently discussed but not implemented yet .....	14
3.2.5 Financing and cost of support measures .....	14
<b>4 Highlights of R&amp;D.....</b>	<b>15</b>
4.1 Highlights of R&D .....	15
4.2 Public budgets for market stimulation, demonstration / field test programmes and R&D	15
<b>5 Industry.....</b>	<b>16</b>
5.1 Production of feedstocks, ingots and wafers (crystalline silicon industry) .....	16
5.2 Production of photovoltaic cells and modules (including TF and CPV) .....	16
5.3 Manufacturers and suppliers of other components .....	16
5.4 Manufacturers and suppliers of other components .....	16
<b>6 PV in the economy .....</b>	<b>17</b>
6.1 Labour places.....	17
<b>7 Interest from electricity stakeholders.....</b>	<b>18</b>
7.1 Structure of the electricity system .....	18
<b>8 Highlights and prospects .....</b>	<b>20</b>
<b>Definitions, Symbols and Abbreviations.....</b>	<b>21</b>

## **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 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](http://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](http://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 2014. Information from this document will be used as input to the annual Trends in photovoltaic applications report.

The PVPS website [www.iea-pvps.org](http://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 2014 statistics if the PV modules were installed and connected to the grid between 1 January and 31 December 2014, although commissioning may have taken place at a later date.**

### 1.1 Applications for Photovoltaic

PV industry in Spain has mainly developed medium to big ground-mounted installations. Self-supply regulation was little developed in Spain until recent times. Due this lack of regulatory support not much is been done in the residential or commercial sectors.

Spain has supported PV development through a “feed-in-tariff” scheme as a chapter of the renewals promotion strategy. While the first part of the last decade could be seen as the PV golden years in Spain reality was not so bright. Until 2007 average installation speed was not even 100 MW/year. 2007 is a key period for PV industry in Spain. A new piece of regulation (RD 661/2007) brought a singular PV expansion that lasted until 2008. Since then several regulatory modifications has undermine PV investor’s expectations. Since 2013, market is very limited.

### 1.2 Total photovoltaic power installed

Until 2014 4.672 MW PV were installed in Spain.

**Table 1: PV power installed during calendar year 2014**

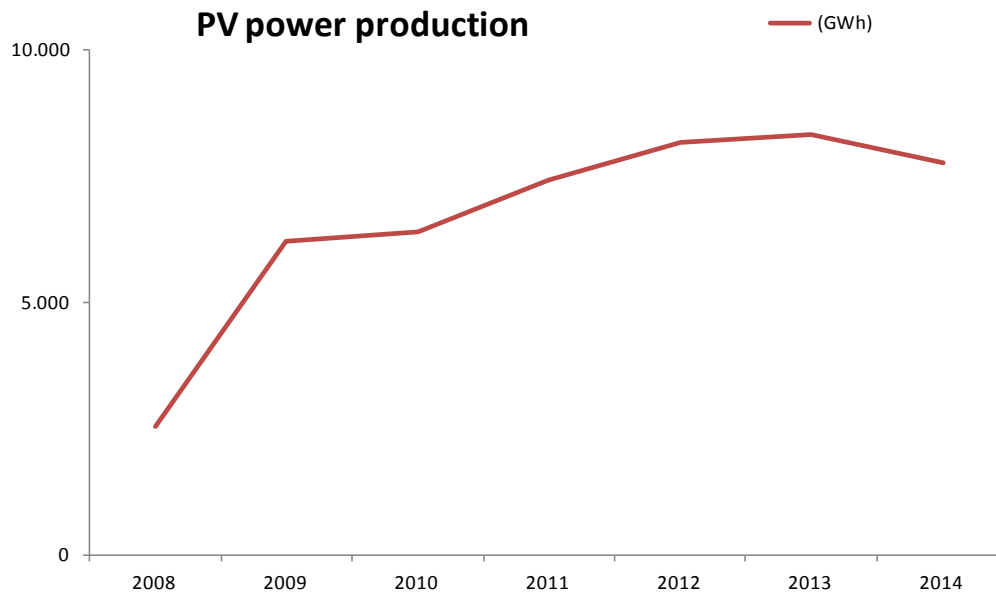
MW installed in 2014			AC or DC
GRID CONNECTED	Residential	0	AC
	Commercial	3	AC
	Industrial	2	AC
OFF-GRID	Residential	4	AC
	Hybrid systems	13	AC

**Table 2: Data collection process:**

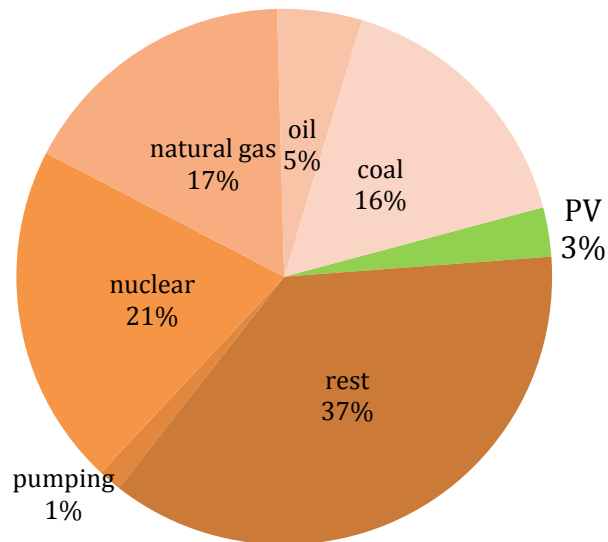
If data are reported in AC, please mention a conversion coefficient to estimate DC installations.	AC
Is the collection process done by an official body or a private company/Association?	collection process is done by UNEF using public and private sources.
Link to official statistics (if this exists)	www.unef.es www.ree.es www.cnmc.es/ www.ree.es www.omie.es

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

<i>MW-GW for capacities and GWh-TWh for energy</i>	2014 numbers	2013 numbers
Total power generation capacities (all technologies)	108.143	108,148
Total power generation capacities (renewables including hydropower)	50.883	50.689
Total electricity demand (= consumption)	223.012	235.507
New power generation capacities installed during the year (all technologies)	68	646
New power generation capacities installed during the year (renewables including hydropower)	59	510
Total PV electricity production in GWh-TWh	8.068	8,397
Total PV electricity production as a % of total electricity consumption	3,1	3,07



**Power Production by source 2014**  
**277.758 Gwh**

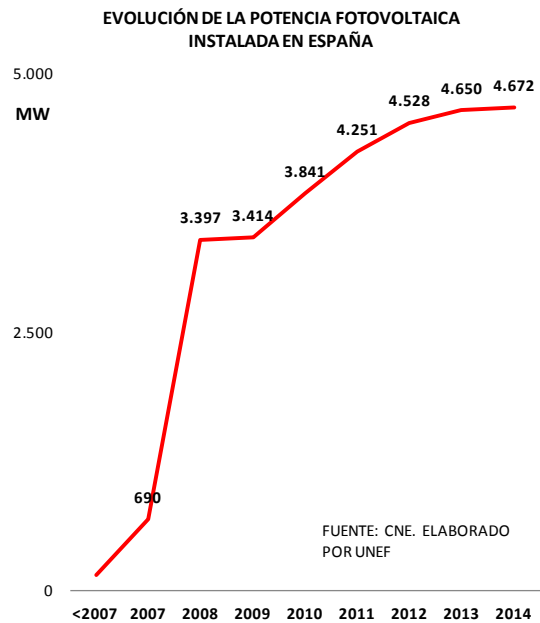
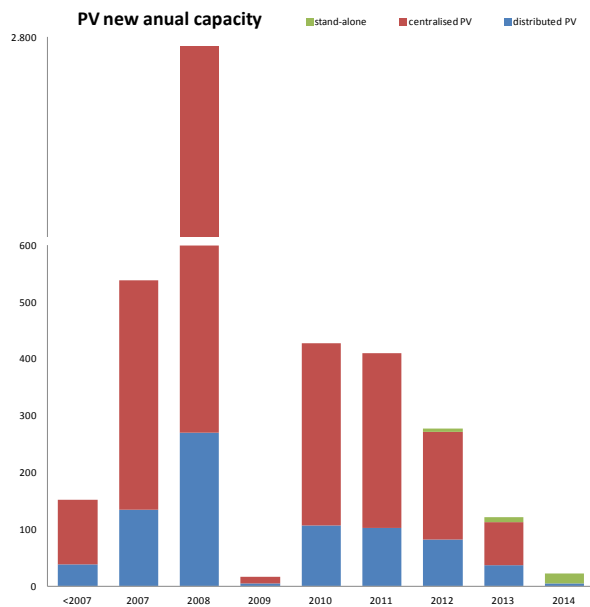


**Table 4: Other information's**

	2014 Numbers
Number of PV systems in operation in your country (a split per market segment is interesting)	<b>64,422</b>
Capacity of decommissioned PV systems during the year in MW	<b>0</b>
Total capacity connected to the low voltage distribution grid in MW	<b>n.d.</b>
Total capacity connected to the medium voltage distribution grid in MW	<b>n.d.</b>
Total capacity connected to the high voltage transmission grid in MW	<b>5</b>

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

Sub-market	Stand-alone domestic	Stand-alone non-domestic	Grid-connected distributed	Grid-connected centralized
2013	28	65	2,714	1,953
New 2014	4	8	5	0
TOTAL 2014	32	73	2719	1,953

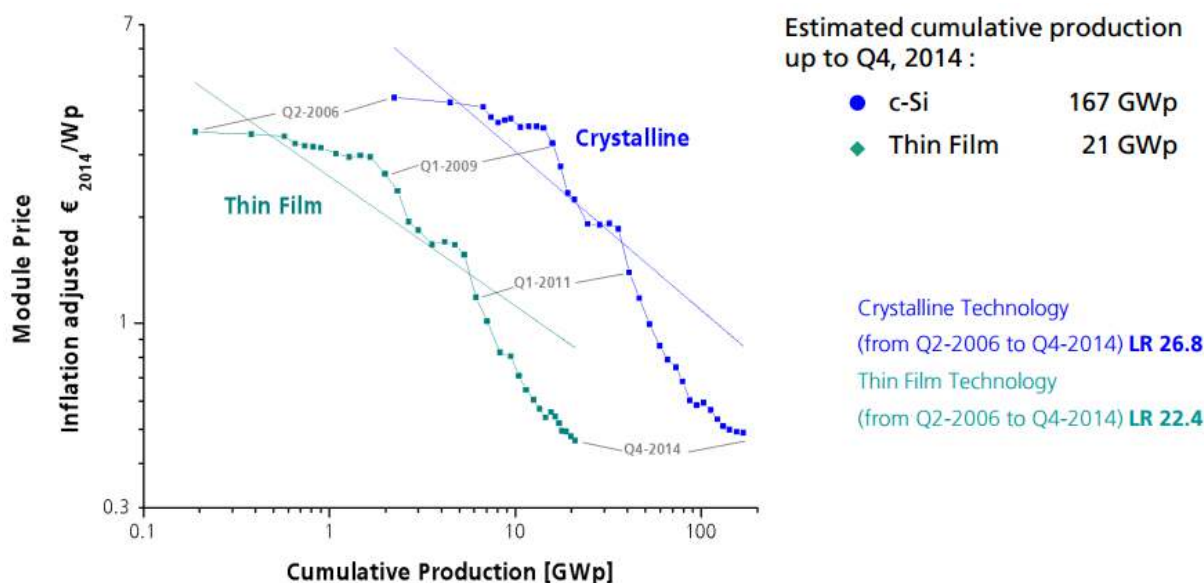




## 2 COMPETITIVENESS OF PV ELECTRICITY

### 2.1 Module prices

Accounting severe PV market condition in Spain in 2014, the price of modules have followed the global trend that can be seen in the following graph of Fraunhofer.



Data: from 2006 to 2010 estimation from different sources : Navigant Consulting, EUPD, pvXchange; from 2011 to 2014: IHS. Graph: PSE AG 2015

**Table 6: Typical module prices for a number of years**

Year	2014
Standard module price (Typical)	0,60€/Wp
Best price	0,50€/Wp

### 2.2 System prices

A summary of typical system prices is provided in the Tables 7 and 8.

**Table 7: Turnkey Prices of Typical Applications**

Category/Size	Typical applications and brief details	Current prices per W
OFF-GRID Up to 1 kW	domestic applications	4.8
OFF-GRID >1 kW	Agriculture ( diesel motor's alternative)	3.8
Grid-connected Rooftop up to 10 kW (residential)	Residential buldog	2.2
Grid-connected Rooftop from 10 to 250 kW (commercial)	shopping center	1.5
Grid-connected Rooftop above 250kW (industrial)		1.2

Grid-connected Ground-mounted above 1 MW		0.45
---	--	------

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

Price/Wp	2011	2012	2013	2014
Residential PV systems < 10 KW	2.7	2.6	2.4.	2.2
Commercial and industrial	2	1.8	1.6	1.5
Ground-mounted	1.6	1.4	1.2	1.2

### 2.3 Financial Parameters and programs (leasing...)

Currently, funding schemes for photovoltaic systems are virtually paralyzed due to the current crisis.

### 2.4 Additional Country information

The Table 12 provides additional information regarding the country's population and additional parameters linked to its electricity system.

**Table 12: Country information**

Retail Electricity Prices for an household	0.1852 €/kWh
Retail Electricity Prices for a commercial company (range)	0.1852 €/kWh
Retail Electricity Prices for an industrial company (range)	0.125 €/kWh
Population at the end of 2014 (ine.es)	46.464.000 hab
Country size (km <sup>2</sup> )	504 645 km
Name and market share of major electric utilities.	ENDESA, IBERDROLA, GAS NATURAL FENOSA, EDP, EON

### 3 POLICY FRAMEWORK

#### 3.1 Direct support policies

**Table 13: PV support measures (summary table)**

	On-going measures	Measures that commenced during 2014
Feed-in tariffs (gross / net?)	No	
Capital subsidies for equipment or total cost	YES	24/2013 Power Sector Act finish with feed in tariffs and swift to direct complement to ensure return over investment at a fix price.
Green electricity schemes	No	
PV-specific green electricity schemes	No	
Renewable portfolio standards (RPS)	No	
PV requirement in RPS	No	
Investment funds for PV	No	
Income tax credits	yes	
Prosumers' incentives (self-consumption, net-metering, net-billing...)	No	
Commercial bank activities e.g. green mortgages promoting PV	No	
Activities of electricity utility businesses	No	
Sustainable building requirements	No	

#### 3.2 Direct Support measures

##### 3.2.1 Support measures exiting in 2014

###### 3.2.1.1 Description of support measures excluding prosumers, BIPV, and rural electrification

Since 2008 regulatory instability undermines PV industry's capacity to deploy Spanish solar potential:

- Royal Decree 1578/2008: A year-long market paralysis ensued, with the loss of 46,000 jobs.
- Royal Decree Law 14/2010: Limit clamped on generation hours eligible for the production incentive.
- Royal Decree Law 1/2012: Indefinite moratorium placed on renewable. In force since January 2012
- Law 15/2012: 7% tax clamped on all generation
- Royal Decree Law 2/2013: The inflation index applicable to the production incentive changed.
- Royal Decree Law 9/2013: Renewable support system changed and legal and economic mechanisms for plant owners annulled.
- Law 24/2013: Persist on the new support system and limits self-supply- to the most restrictive schemes.

2014 is a complex year regarding regulatory framework. Until July a classic "feed in tariff" scheme was in place. With several reforms it was the main support mechanism since 1994. After the

Decree-law 9/2013 (Later with some changes became 24/2013 Power Sector Act) everything changes. A shift from remunerating production (kW/h) to remunerating installed capacity is established as the element to support renewables technologies.

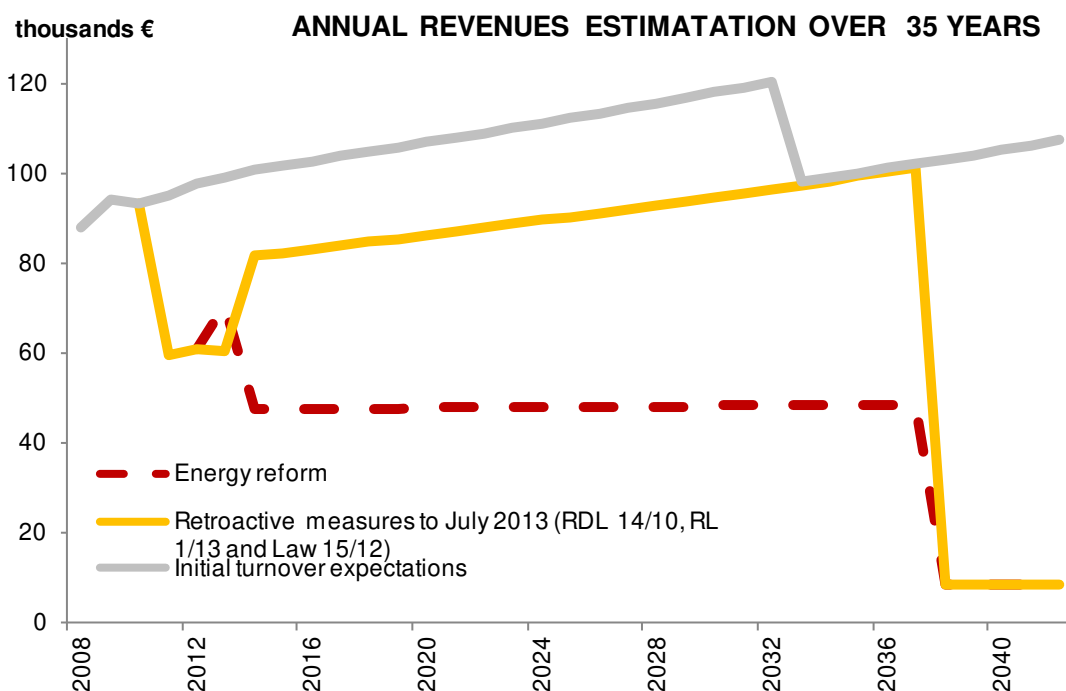
To fully deploy 24/2013 Power Sector Act, Government approved two pieces of new regulation to set renewable energy remuneration mechanisms:

- Royal Decree 413/2014, of June 6 2014 (RD 413/2014) regulating the activity of generation from renewable sources, and
- Ministerial Order IET/1045/2014 (the Parameters Order), of June 16, 2014, regulating the the remuneration parameters for standard installations, applicable to electricity production facilities based on renewable energy, cogeneration and waste.

The new Spanish regulation alters the return on investments already made and undermines investors' legitimate expectations in Europe and erodes legal security due:

- Shift from remunerating production (kW/h) to remunerating installed capacity. This has a critical effect efficiency punished and the most advanced PV plants are the ones that suffer the most with the new regulatory framework.
- Remuneration according to "reasonable profitability" based on government "standard cost" parameters, which do not reflect reality
- Recalculation of profitability dated from the start of plant life cycle

As an example the following graph shows the impact on a typical PV plant due successive retroactive changes in Spain:



The new system not only is based on estimated standard costs but gives a legal possibility to change the amounts paid every four years. The new regulations, in effect, have led to a complete lack of new investments in the renewable sector and have placed serious obstacles to the refinancing of existing projects due to the extremely high regulatory risk as well as, in general, to the prospective purchase and sale of renewable projects or assets. In 2014 all new capacity was self-consumption generation projects.

Impacto de la reforma en ingresos (con modificaciones informe Ministerio a Consejo de Estado del 22 de mayo de 2014)															
Horas	≤ 5kW			5Kw<P≤100kW			100Kw<P≤2.000kW			2.000Kw<P≤10.000kW			P≥10.000kW		
	fijo	1 eje	2 ejes	fijo	1 eje	2 ejes	fijo	1 eje	2 ejes	fijo	1 eje	2 ejes	fijo	1 eje	2 ejes
1500	-9%			-17%			-16%			-24%			-35%		
1550	-12%			-20%			-18%			-26%			-37%		
1600	-14%			-22%			-21%			-28%			-38%		
1650	-16%			-24%			-22%			-29%			-40%		
1700	-19%	-9%		-26%	-10%		-25%	-13%		-31%	-23%		-41%	-34%	
1750	-21%	-11%		-28%	-13%		-26%	-15%		-33%	-25%		-43%	-36%	
1800	-23%	-13%	-9%	-29%	-15%	-18%	-28%	-17%	-16%	-35%	-26%	-23%	-44%	-37%	-35%
1850	-25%	-15%	-11%	-31%	-17%	-20%	-30%	-19%	-18%	-36%	-28%	-25%	-45%	-38%	-37%
1900	-26%	-17%	-13%	-33%	-19%	-22%	-32%	-21%	-20%	-37%	-30%	-27%	-46%	-40%	-38%
1950		-19%	-15%		-20%	-24%		-22%	-22%		-31%	-28%		-41%	-39%
2000		-21%	-17%		-22%	-26%		-24%	-23%		-32%	-30%		-42%	-41%
2050		-23%	-19%		-24%	-27%		-25%	-25%		-34%	-31%		-43%	-42%
2100		-24%	-20%		-25%	-29%		-27%	-26%		-35%	-32%		-44%	-43%
2150		-26%	-22%		-27%	-30%		-28%	-28%		-36%	-34%		-45%	-44%
2200		-27%	-23%		-28%	-31%		-30%	-29%		-38%	-35%		-46%	-45%
2250			-25%			-33%			-31%			-36%			-46%
2300			-26%			-34%			-32%			-37%			-47%

### 3.2.1.2 Prosumers' development measures

24/2013 Act only permits very restrictive self-supply with PV technology. Net Balance is not permitted and Grid Backup Toll (SUN TAX) is in study in-house produced electricity. Self-supply consumers will contribute more to electricity system's maintenance than a standard consumer.

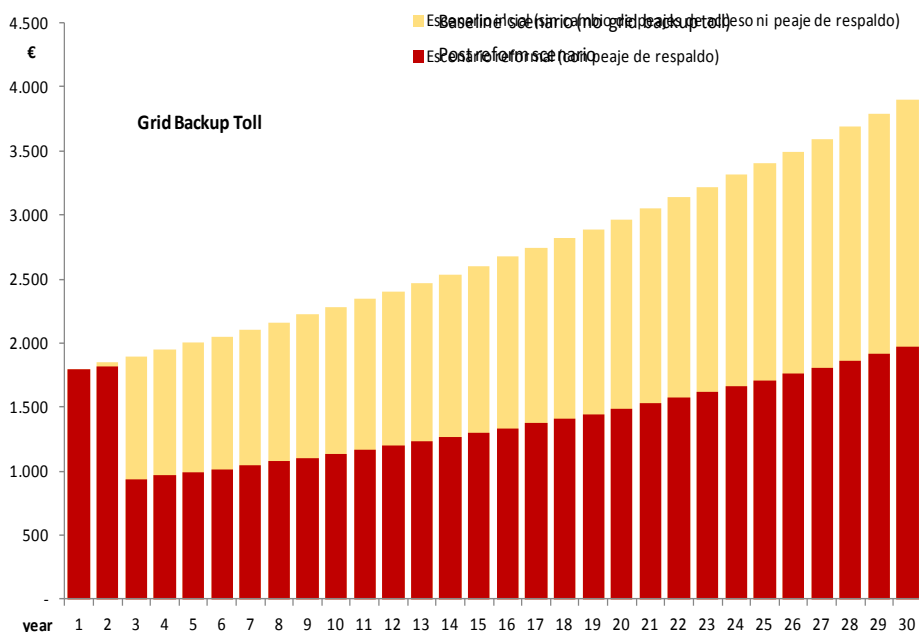
After de 24/2103 Act4 no piece of regulation was adopted to offer a suitable regulatory framework for net-metering.

On the contrary, discussions were ongoing in 2014 and 2015 with regard to allowing self-consumption, under a constraining frame-work and especially additional fees that would make self-consumption hardly competitive.

So far this framework hasn't been adopted formally and self-consumption with no compensation for the excess PV electricity injected into the grid is allowed below 100 kW and with no restriction in o injection cases. The target of this dilatory strategy was the demotivation of possible investments in self-consumption projects. In any case, the release of this draft had the effects of stopping the market. In the year 2014, only 22MW were installed. 70,6% of this new capacity are off-grid projects, outside of the proposed self- consumption proposed regulation under discussion.

In July 2015 the government started the procedure of approval of a new draft. This new draft not only turns one "sun-taxes" into several "Sun levys", but also includes a new tax in the battery use.

## annual saving in a SMB's self-supply project



As the following image shows the main intention of 2015 self-consumption regulation is to discourage potential investors.

### Payback periods under different self-consumption regulation drafts

Payback periods under different self-consumption regulation drafts

Consumidor	UNEF's proposal with Net Balance (not existing in ESP)	Actual framework no net balance no "sun tax"	2013 JULY draft main land w/ sun tax	2015 JUNE draft main land w/ subsidiary levys	2015 AUGUST draft main land w/ subsidiary levys	2015 JUNE draft Canary Island w/ subsidiary levys 2020	2015 AUGUST draft Canary Island w/o subsidiary levys
Domestic (2,0) <sup>2</sup>	13	16	28	31	<b>16</b>	28	<b>16</b>
retail shop (3,0) <sup>3</sup>	5,4	8	10	12	<b>12</b>	10,6	<b>9,3</b>
SME (3.1) <sup>4</sup>	4,4	5	7	7,5	<b>7,5</b>	7,1	<b>6,5</b>

<sup>2</sup> 4,000kWh anual and a 1.8kW PV instalation

<sup>3</sup> 72,000kWh anual and a 99kW PV instalation

<sup>4</sup> 268.000kWh anual w with a 85kW PV instalation

Under latest proposal August 2015, families have it a little bit easier but still the biggest potential prosumer (enterprises) would doubles their payback period compared to a net-balance model.

The latest proposal offers an exception for self-consumption projects in the Canary Islands opening a period until 2020 subsidiary levys. Government has not given any information regarding self-consumption project's post 2020.

In the year 2014, only 22MW were installed. 70,6% of this new capacity are off-grid projects, outside of the proposed self-consumption regulation under discussion.

### 3.2.2 Support measures phased out in 2014

In 2013 the feed in tariff system in place since 1994, and key part of the successful renewals deployment in Spain, was eliminated.

### 3.2.3 New support measures implemented in 2014

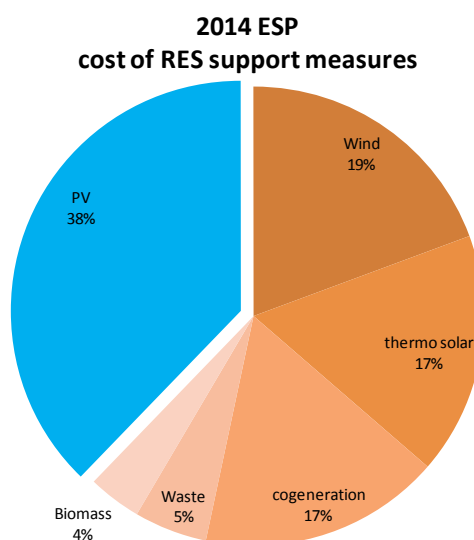
It has been already described in the point 3.2.1.1. A shift from remunerating production (kW/h) to remunerating installed capacity is established as the element to support renewals technologies.

### 3.2.4 Measures currently discussed but not implemented yet

It has been already described in the point 3.2.1.2. After the 24/2013 Act, the self-consumption royal decree is still missing. It is an essential regulatory piece to deploy PV potential in Spain.

### 3.2.5 Financing and cost of support measures

2014 ESP cost of RES support measures	MM€
Thermo solar	1.098,40
PV	2.441,36
Wind	1.253,02
Small Hydro	33,78
Biomass	242,66
Cogeneration	1.098,40
Waste	332,35
Others	0,233
Total	6.536,31



## 4 HIGHLIGHTS OF R&D

### 4.1 Highlights of R&D

Spain has significant infrastructure and R & D across the value chain.

Today, there are around 10 research groups working on crystalline silicon, 63 work areas, 155 institutions engaged in R & D in PV, and more than 700 people working in the areas of R & D + i. On average there are twenty scientific publications and several patents and knowledge transferred to the PV industry. Some of the most significant one in 2013 were:

- Development of silicon, to a solar standard, purified via metal, reaching standards similar to those of silicon purified by conventional ways.
- 40 % reduction in radiation losses in the Siemens reactor through the use of heat shields.

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

This data are approximate.

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

	R & D	Demo/Field test
National/federal	18 M €	
Total	18 M €	



## 5 INDUSTRY

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

List by name: Silicio Ferrosolar, is a company dedicated to the production of silicon metal with quality solar electrometallurgical procedures

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

Module manufacturing is defined as the industry where the process of the production of PV modules (the encapsulation) is done. A company may also be involved in the production of ingots, wafers or the processing of cells, in addition to fabricating the modules with frames, junction boxes etc. The manufacturing of modules may only be counted to a country if the encapsulation takes place in that country.

a) **List by name all manufacturers operating in Spain:**

- Atersa,
- Helios Energy Europe,
- Isofoton and
- Tamesol

b) **Type of technology:** Thin film and crystalline cells

c) **Total production** was 350 MW crystalline cells in total. It is not possible to provide this information by company. 75 MW were thin film.

### 5.3 Manufacturers and suppliers of other components

Balance of system component manufacture and supply is an important part of the PV system value chain in Spain, with the next actors:

1. **PV inverters: for a total of 1 670 MW market the biggest manufacturers are**

- Ingeteam (34,7 % market share),
- Power Electronics (27,5 %), and
- GPTech (11,8 %).
- From Gamesa there is no data.

2. **Supporting structures:** 650 MW market, the biggest manufacturers are

- Hiasa (18,5 % market share),
- Isowat Made (15,4 %),
- Clavijo (12,3 %).

### 5.4 Manufacturers and suppliers of other components

Balance of system component manufacture and supply is an important part of the PV system value chain. Please briefly comment on the nature of this industry in your country, paying particular attention to recent trends and industry outlook, under the headings of:

1. PV inverters (for grid-connection and stand-alone systems) and their typical prices

- <http://www.ingeteam.com/>
- [www.sma.es](http://www.sma.es)
- [www.fronius.es/](http://www.fronius.es/)
- [www.circutor.es/](http://www.circutor.es/)

2. Storage batteries

- <http://www.tudor.es/>

## 6 PV IN THE ECONOMY

### 6.1 Labour places

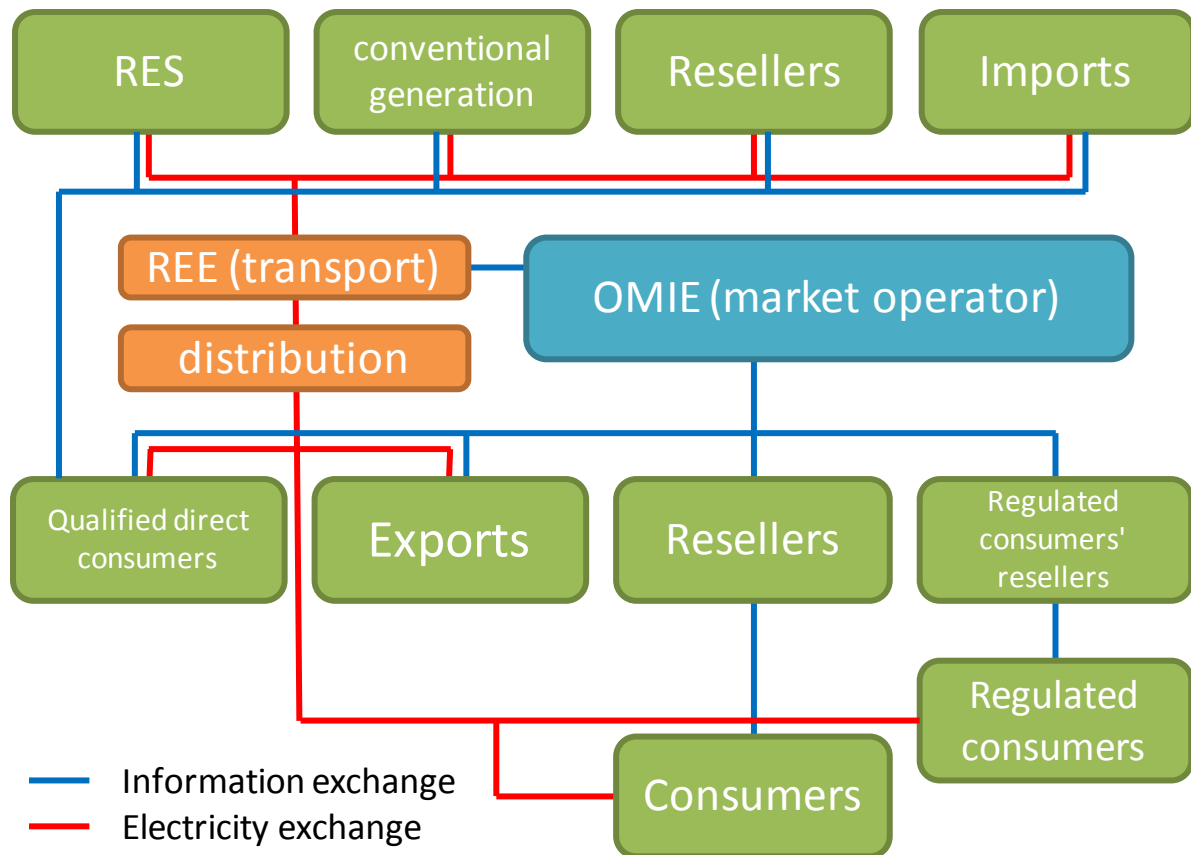
The number of workers in Spain, is devoted primarily to the work of operation and maintenance of existing facilities, and facilities development work in other countries.

**Table 17: Estimated PV-related labour places in 2014**

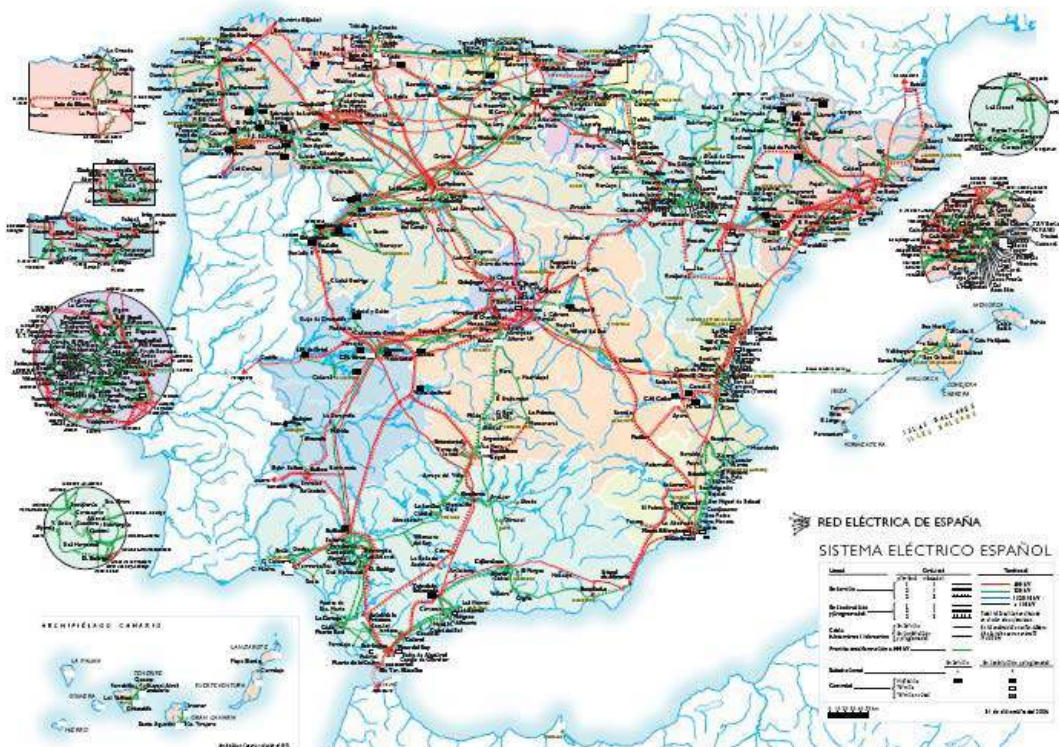
Research and development (not including companies)	200
Manufacturing of products throughout the PV value chain from feedstock to systems, including company R&D	
Distributors of PV products	
System and installation companies	7,000
Electricity utility businesses and government	200
Other	100
<b>Total</b>	<b>7,500</b>

## 7 INTEREST FROM ELECTRICITY STAKEHOLDERS

### 7.1 Structure of the electricity system



Transport is a regulated activity controlled by Red Eléctrica de España under the TSO system:



Distribution is a regulated activity controlled by the 5 big power companies:



## **8 HIGHLIGHTS AND PROSPECTS**

Prospects in Spain are very negative. The Spanish Government has created a scenario in which that led to a complete lack of new investments in the renewable sector and have placed serious obstacles to the refinancing of existing projects due to the extremely high regulatory risk.

Spanish PV industry has suffered from several retroactive reforms since 2010, but by approving the 24/2013 Act Spanish Government has already created legal uncertainty by retroactively applying the new remuneration model to pre-existing facilities. The government's actions, therefore, seriously jeopardise not only existing PV plants' existence but the future of an important share of the forthcoming projects due unmanageable regulatory risk.

Self-supply landscape is no better. 24/2013 Act only permits very restrictive self-supply with PV technology. Since December 2013 until nowadays discussions were ongoing in 2014 with regard to allowing self-consumption, under a constraining frame-work and especially additional fees that would make self-consumption hardly competitive. The Spanish Government is using this dilatory strategy to demotivate any possible investments in self-consumption projects.

Latest self-consumption regulatory proposal (August 2015) persist in the idea of imposing new polemical procedures and levys to discouraging most potential projects. This is especially true for the biggest potential prosumer sector (enterprises). If the proposed regulation is approved as written most self-consumption project on enterprises facilities would doubles their payback period compared to a net-balance model.

Under new scenario the Kingdom of Spain's ability to reach the objectives set by Directive 2009/28/EC is clearly under threat.

## DEFINITIONS, SYMBOLS AND ABBREVIATIONS

For the purposes of this and all IEA PVPS National Survey Reports, the following definitions apply:

PV power system market: The market for all nationally installed (terrestrial) PV applications with a PV power capacity of 40 W or more.

Installed PV power: Power delivered by a PV module or a PV array under standard test conditions (STC) – irradiance of 1 000 W/m<sup>2</sup>, cell junction temperature of 25°C, AM 1,5 solar spectrum – (also see ‘Rated power’).

Rated power: Amount of power produced by a PV module or array under STC, written as W.

PV system: Set of interconnected elements such as PV modules, inverters that convert d.c. current of the modules into a.c. current, storage batteries and all installation and control components with a PV power capacity of 40 W or more.

CPV: Concentrating PV

Hybrid system: A system combining PV generation with another generation source, such as diesel, hydro, wind.

Module manufacturer: An organisation carrying out the encapsulation in the process of the production of PV modules.

Off-grid domestic PV power system: System installed to provide power mainly to a household or village not connected to the (main) utility grid(s). Often a means to store electricity is used (most commonly lead-acid batteries). Also referred to as ‘stand-alone PV power system’. Can also provide power to domestic and community users (plus some other applications) via a ‘mini-grid’, often as a hybrid with another source of power.

Off-grid non-domestic PV power system: System used for a variety of industrial and agricultural applications such as water pumping, remote communications, telecommunication relays, safety and protection devices, etc. that are not connected to the utility grid. Usually a means to store electricity is used. Also referred to as ‘stand-alone PV power system’.

Grid-connected distributed PV power system: System installed to provide power to a grid-connected customer or directly to the electricity grid (specifically where that part of the electricity grid is configured to supply power to a number of customers rather than to provide a bulk transport function). Such systems may be on or integrated into the customer’s premises often on the demand side of the electricity meter, on public and commercial buildings, or simply in the built environment on motorway sound barriers etc. They may be specifically designed for support of the utility distribution grid. Size is not a determining feature – while a 1 MW PV system on a rooftop may be large by PV standards, this is not the case for other forms of distributed generation.

Grid-connected centralized PV power system: Power production system performing the function of a centralized power station. The power supplied by such a system is not associated with a particular electricity customer, and the system is not located to specifically perform functions on the electricity grid other than the supply of bulk power. Typically ground mounted and functioning independently of any nearby development.

Turnkey price: Price of an installed PV system excluding VAT/TVA/sales taxes, operation and maintenance costs but including installation costs. For an off-grid PV system, the prices associated

with storage battery maintenance/replacement are excluded. If additional costs are incurred for reasons not directly related to the PV system, these should be excluded. (E.g. If extra costs are incurred fitting PV modules to a factory roof because special precautions are required to avoid disrupting production, these extra costs should not be included. Equally the additional transport costs of installing a telecommunication system in a remote area are excluded).

Field Test Programme: A programme to test the performance of PV systems/components in real conditions.

Demonstration Programme: A programme to demonstrate the operation of PV systems and their application to potential users/owners.

Market deployment initiative: Initiatives to encourage the market deployment of PV through the use of market instruments such as green pricing, rate based incentives etc. These may be implemented by government, the finance industry, electricity utility businesses etc.

Final annual yield: Total PV energy delivered to the load during the year per kW of power installed.

Performance ratio: Ratio of the final annual (monthly, daily) yield to the reference annual (monthly, daily) yield, where the reference annual (monthly, daily) yield is the theoretical annual (monthly, daily) available energy per kW of installed PV power.

Currency: The currency unit used throughout this report is Euro.

PV support measures:

Feed-in tariff	an explicit monetary reward is provided for producing PV electricity; paid (usually by the electricity utility business) at a rate per kWh that may be higher or lower than the retail electricity rates being paid by the customer
Capital subsidies	direct financial subsidies aimed at tackling the up-front cost barrier, either for specific equipment or total installed PV system cost
Green electricity schemes	allows customers to purchase green electricity based on renewable energy from the electricity utility business, usually at a premium price
PV-specific green electricity schemes	allows customers to purchase green electricity based on PV electricity from the electricity utility business, usually at a premium price
Renewable portfolio standards (RPS)	a mandated requirement that the electricity utility business (often the electricity retailer) source a portion of their electricity supplies from renewable energies
PV requirement in RPS	a mandated requirement that a portion of the RPS be met by PV electricity supplies (often called a set-aside)
Investment funds for PV	share offerings in private PV investment funds plus other schemes that focus on wealth creation and business success using PV as a vehicle to achieve these ends
Income tax credits	allows some or all expenses associated with PV installation to be deducted from taxable income

	streams
Compensation schemes (self-consumption, net-metering, net-billing...)	These schemes allow consumers to reduce their electricity bill thanks to PV production valuation. The schemes must be detailed in order to better understand if we are facing self-consumption schemes (electricity consumed in real-time is not accounted and not invoiced) or net-billing schemes (the electricity taken from the grid and the electricity fed into the grid are tracked separately, and the electricity account is reconciled over a billing cycle). The compensation for both the electricity self-consumed and injected into the grid should be detailed. Net-metering schemes are specific since they allows PV customers to incur a zero charge when their electricity consumption is exactly balanced by their PV generation, while being charged the applicable retail tariff when their consumption exceeds generation and receiving some remuneration for excess electricity exported to the grid
Commercial bank activities	includes activities such as preferential home mortgage terms for houses including PV systems and preferential green loans for the installation of PV systems
Activities of electricity utility businesses	includes 'green power' schemes allowing customers to purchase green electricity, operation of large-scale (utility-scale) PV plants, various PV ownership and financing options with select customers and PV electricity power purchase models
Sustainable building requirements	includes requirements on new building developments (residential and commercial) and also in some cases on properties for sale, where the PV may be included as one option for reducing the building's energy foot print or may be specifically mandated as an inclusion in the building development



