

## PVPS Report A Snapshot of Global PV 1992-2012

Preliminary information from the IEA PVPS Programme



PVPS

PHOTOVOLTAIC  
POWER SYSTEMS  
PROGRAMME

Report IEA-PVPS T1-22:2013

## What is IEA-PVPS

The International Energy Agency (IEA), founded in 1974, is an autonomous body within the framework of the Organization for Economic Cooperation and Development (OECD). The IEA carries out a comprehensive programme of energy cooperation among its 28 members and with the participation of the European Commission. The IEA Photovoltaic Power Systems Programme (IEA PVPS) is one of the collaborative research and development agreements within the IEA and was established in 1993. The mission of the programme is to “enhance the international collaborative efforts which facilitate the role of photovoltaic solar energy as a cornerstone in the transition to sustainable energy systems.”

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



China, Yushu Valley, 2 MW PV Plant – Courtesy of Lu Fang.

The participating countries are Australia, Austria, Belgium, Canada, China, Denmark, France, Germany, Israel, Italy, Japan, Korea, Malaysia, Mexico, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom and the United States of America. The European Commission, the European Photovoltaic Industry Association, the Solar Electric Power Association, the Solar Energy Industries Association and the Copper Alliance are also members. Thailand is in the process of joining the programme.

## A Snapshot of Global PV: Introducing the next “Trends on Photovoltaic Applications” Report 1992-2012

IEA-PVPS has distinguished itself throughout the years by producing unbiased reports on the development of PV all over the world. In addition to its trusted yearly publication on “Trends in PV Applications,” which has already been published 17 times, this new “Snapshot of Global PV” aims at providing preliminary information about how the PV market developed in the last year.

The 18<sup>th</sup> edition of the PVPS “*Trends in Photovoltaic Applications*” report will be published in Q3 2013. It will once again deliver accurate information about the evolution of support policies for PV in the major markets, together with a clear analysis of best practices and updated numbers.



### 2012 Highlights

Preliminary market data reported shows a roughly stable PV market in 2012, compared to 2011. At least 28.4 GW of PV systems have been installed in the world last year. While these data will have to be confirmed in the coming months, some important trends can already be extracted:

- The global PV market has **stabilized in 2012** at levels similar to 2011.
- The market in **Europe has decreased** significantly from 22 to 16.9 GW, but still remains number one by far with **59%** of the PV market.
- Germany and Italy have now enough PV capacity to produce respectively **5.6 %** and **5.75 %** of their annual electricity demand with PV.
- The **Asian markets had the highest growth (+66%)** and China entered the top 3 in the second place for installed PV capacity in 2012. In the top 10 countries, there are 5 European countries, 4 Asia-Pacific countries and one country in the Americas region.
- Parity with retail electricity prices has been reached in several more countries in 2012 due to PV system price decreases and electricity prices increases.
- **Thirteen countries had at least 1 GW** of cumulative PV systems capacity at the end of 2012 and nine countries installed close to 1 GW in 2012.

## How much PV capacity is producing electricity in the world today?

The 23 IEA-PVPS countries represented 89.5 GW of cumulative PV installations together, mostly grid-connected, at the end of 2012. Six countries that are not part of the PVPS programme represent 7 additional GW, mostly in Europe: The Czech Republic with 2.1 GW installed, Greece with 1.5 GW, and below the GW mark, Bulgaria, Slovakia, Ukraine and Thailand. Next to these countries, India has installed more than 1.2 GW. While other countries around the world have reached various PV installations levels, the total of these remains hard to quantify with certainty. Some could argue the 100 GW mark worldwide has been passed, but evidence remains limited. At present it seems that 96.5 GW represents the minimum installed by end 2012 with a firm level of certainty.

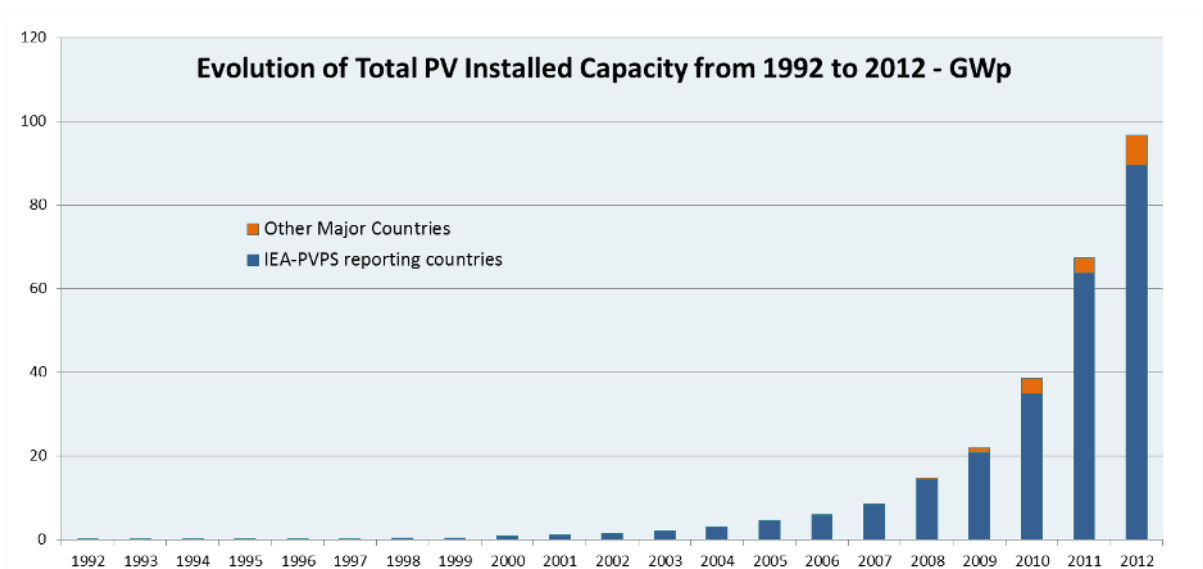


Figure 1 – Evolution of Total PV Installed Capacity from 1992 to 2012

## How much was installed in 2012?

The PVPS countries have installed 25.2 GW of PV, with a minimum worldwide installed capacity in 2012 totalling 28.4 GW. While they are hard to track with a high level of certainty, installations in non-PVPS countries are pushing the installed capacity above 28 GW in 2012. While some new countries have reportedly installed some PV, installations numbers for 2012 have stabilized in 2012 compared to 2011. Final numbers will reveal later in 2013 whether PV installed really grew in 2012 stabilized or fell short of about a hundred MW below those of 2011.

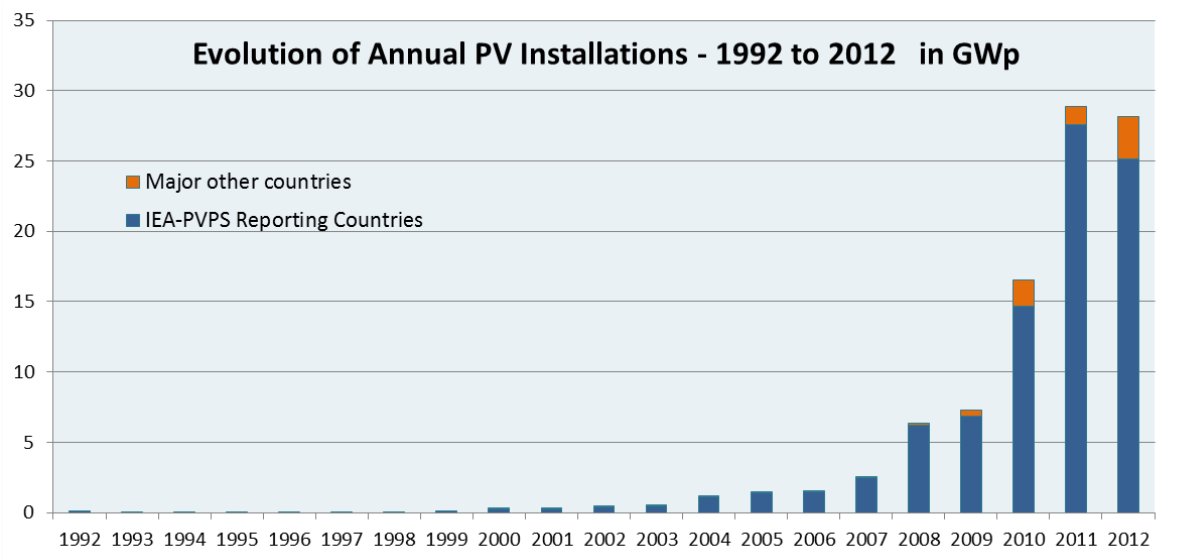


Figure 2 - Evolution of Annual PV Installations – 1992 to 2012 – in GW

**Germany** installed 7.6 GW, after two years at similar levels of PV installations. This happened in a context of reduced feed-in tariffs, pushing self-consumption as a natural driver of PV development in this country where the total installed PV capacity now tops more than 32 GW. Behind the German leader, **China** reached the second place, with at least 3.5 GW installed (some sources believe installations topped 5 GW): This performance is in line with the ambitions of the Chinese authorities to continue developing its internal PV market, pushing for 35 GW by the year 2015, starting now at 7 GW. In third place, **Italy** installed 3.3 GW of PV systems, after the tremendous 9.3 GW in 2011. Now the financial cap set by the Italian authorities as a limit for the cost to be borne by electricity consumers has been passed and the future of Italian PV development will have to rely more on self-consumption than feed-in tariffs. The 16.2 GW installed in Italy will produce at least 5.75% of the electricity demand of the country in 2013, an undisputed world record.

Close to the third place, the **USA** reached the 3.3 GW mark and now has about 7.2 GW of installed capacity. The fifth place goes to **Japan**, with around 2 GW installed. This performance puts the total installed capacity in this country at 7 GW, roughly the same as China. Together, these five countries represent 70% of all installations recorded in 2012 and slightly more in terms of installed capacity.

The five following places go to three European countries, **France** (1.1 GW), the **UK** (1 GW) and **Greece** (0.9 GW), with **India** and **Australia** reporting preliminary numbers close to 1 GW in both cases. With these 10 countries, 88% of the 2012 world market has been covered.

Smaller size country markets have performed quite significantly and raised their total installed capacity above the GW mark: **Belgium** installed 600 MW and has now reached 2.5 GW while **Korea** stayed just below that mark with a more vigorous market than in the last few years. Some countries that grew dramatically in the last years have now stalled or experienced very small additions: **Spain** totals now more than 5 GW of PV systems (4.44 GW reported by the authorities<sup>1</sup>) followed by the Czech Republic at 2.1 GW.

<sup>1</sup> Spain reports PV installations in AC while most countries report DC power.



In Europe, net-metering systems allowed the market to grow quickly in **Denmark** (310 MW added) and the **Netherlands** (125 MW are expected to be installed), with significant additions in **Switzerland** (200 MW) and **Austria** (230 MW).

In Asia, next to China, Japan and Korea, **Thailand** is progressing fast with preliminary data showing around 210 MW installed in 2012. **Malaysia** installed 22 MW for the first year of its feed-in tariff system.

In America, preliminary data for **Canada** shows the installation of 268 MW while the appetite for PV in Latin and Central America hasn't transformed into a real market yet. Several GW of PV plants have been validated in Chile, but except in Peru with some 50 MW and **Mexico** with 15 MW, the real PV development of grid-connected PV plants hasn't started yet in the region.

In the Middle East, **Israel** progressed rapidly, with close to 0.7% of its electricity already coming from PV while the PV installations in Turkey have started more slowly with around 2 MW installed in 2012.

## Evolution of Total Installed PV Capacity per Region

While Europe still represents a major part of all installations globally, the share of Asia and America started to grow rapidly in 2012.

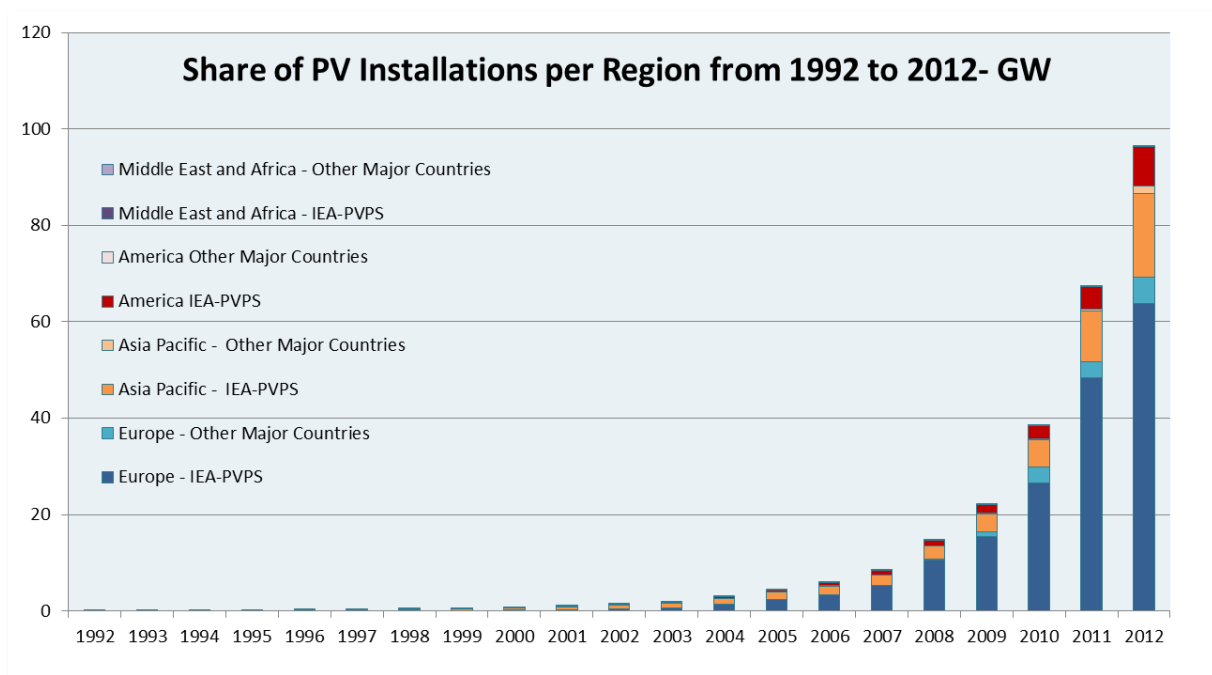


Figure 3 – Share of PV Installations per Region from 1992 to 2012 – in GW

This evolution is quite visible from 2010 to 2012, with the share of Asia Pacific growing from 17% to almost 30%, whereas the European share of the PV market went down from 82% to 59% in two years.

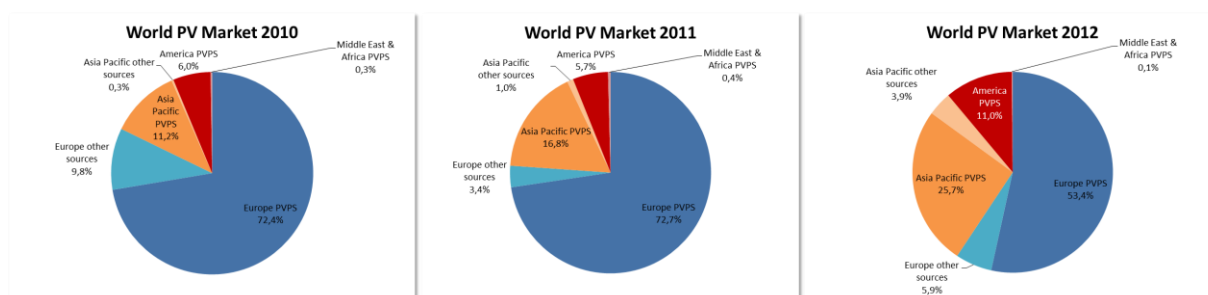


Figure 4 - Evolution of regional share of PV installations from 2010 to 2012

## AC & DC numbers, grid-tied and off-grid

PVPS counts all PV installations, both grid-connected and off-grid installations. By convention, the numbers reported refer to the nominal power of PV systems installed. These are expressed in W (or Wp). Some countries, such as Spain, are reporting the power output of the PV inverter (the device converting DC power from the PV system into AC electricity compatible with standard electricity networks). The difference between the standard DC Power (in Wp) and the AC power can range from as little as 5% (conversion losses) to as much as 30%, for instance (some grid regulations in Germany limits output to as little as 70% of the peak power from the PV system).

## The Top 10 Countries in 2012

In the major evolutions, 9 of the top 10 markets for PV in 2012 have installed at least 1 GW of PV systems. Looking at the total installed capacity, 13 countries are entering the 1 GW club. The third place on the podium has to be shared among the USA, Japan and China; all at around 7 GW. The numbers for Spain refer to DC capacity (Wp) while Spanish authorities report AC numbers that are significantly lower.

2012 installations – MW			Total installed capacity – MW	
1	Germany	7.604	Germany	32.411
2	China	3.510	Italy	16.250
3	Italy	3.337	USA	7.221
4	USA	3.313	Japan	7.000
5	Japan	2.000	China	7.000
6	France	1.079	Spain**	5.100
7	UK	1.000	France	4.003
8	Australia	1.000	Belgium	2.567
9	India*	980	Australia	2.400
10	Greece*	912	Czech Republic*	2.085
8 GW countries			13 GW countries	

\* Non-PVPS Countries / \*\* Spain data delivered in AC, this number is a DC recalculation.

Table 1 – Top 10 Countries for Installations and Total Installed Capacity in 2012 – in MW

## Electricity Production from PV

PV electricity production is easy to measure at a power plant but much more complicated to compile for an entire country. In addition, the comparison between the installed base of PV systems in a country at a precise date and the production of electricity from PV are difficult to compare: A system installed in December will have produced only a small fraction of its regular annual electricity output. For these reasons, the electricity production from PV per country that is showed here is an estimate based on the following methodology:

- Estimated PV installed and commissioned capacity at 31-12-2012
- Average theoretical PV production in the capital city of the country (using solar irradiation databases: JRC's PVGIS, SolarGIS, NREL's PVWATT, country data)
- A 10% decrease is applied to consider sub-optimal orientation
- Electricity demand in the country based on the latest available data (2011 European Data provided by ENTSO-E)

This following figure shows how PV theoretically contributes to the electricity demand in PVPS countries, based on the PV base at end 2012.

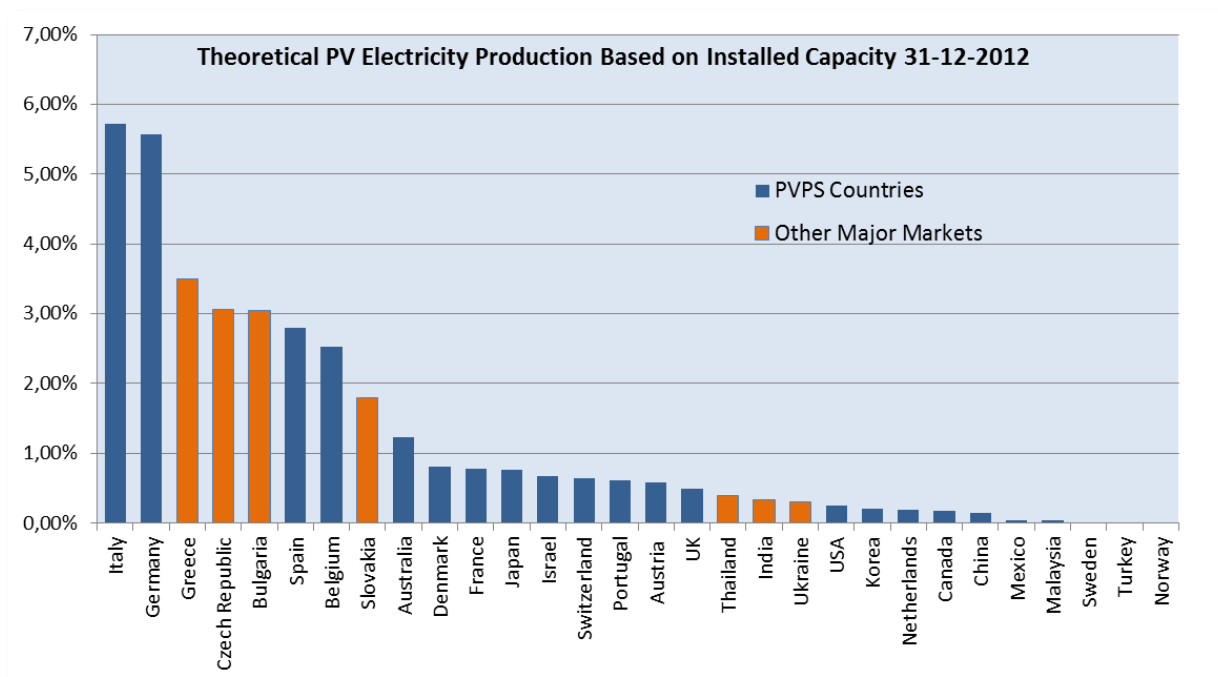


Figure 5 – Theoretical PV Electricity Production Based on Installed Capacity in 2012



## Conclusion

PV technology today has become a major actor in the electricity sector globally. At least 110 TWh, or 110 billion kWh will be produced in 2013 by PV systems already installed. If this represents about 0.5% of the electricity demand of the planet, some countries have reached rapidly significant percentages. These 110 TWh represent the annual consumption of countries such as The Netherlands or Egypt.

In Europe, for the second year in a row, PV was the first source of electricity installed (power-wise), ahead of wind and gas, and ahead of all other sources of electricity, from coal to nuclear. This is accompanied by several countries where the PV contribution to the electricity demand has passed the 1% mark with Italy at the top with 5.7% and the overall European PV contribution amounting to around 2.5% of the electricity demand of Europe. Australia has also passed the 1% mark but larger consumers of electricity such as Japan, China or the USA will require more installations to reach this threshold.

However, PV now represents some impressive numbers: The surface covered by PV panels represents roughly 700 square kilometers, or the size of Singapore.

After several years of rapid growth, the PV market stabilized in 2012, above the 28 GW mark. While Europe still represents 59% of this global market, 2012 saw the rapid growth of the Asia Pacific region and the Americas. The Middle East and Africa remains a region in development.

The very fast decline in PV system prices in 2012 has allowed the market to maintain itself at the very high level it first experienced in 2011. Moreover, the current system price levels are unlocking new possibilities for PV development in numerous countries.

While the three regions or countries where grid-connected PV developed first continue to dominate the installations history, China has progressed so quickly that it represented the second market in 2012, ahead of Italy or the USA. In terms of total installations; it has already reached third position.

With the development in Europe slowing down after years of vigorous growth, the Asia Pacific region is positioning itself to become the major region for PV installations in the coming years.

Finally, PV has become a major source of electricity extremely rapidly in several countries all over the world. The speed of its development holds in its unique ability to cover most market segments, from the very small individual system for rural electrification to utility-size power plants (above 100 MW). From the built environment to large ground-mounted installations, PV finds its way depending on various criteria that make it suitable for most environments.

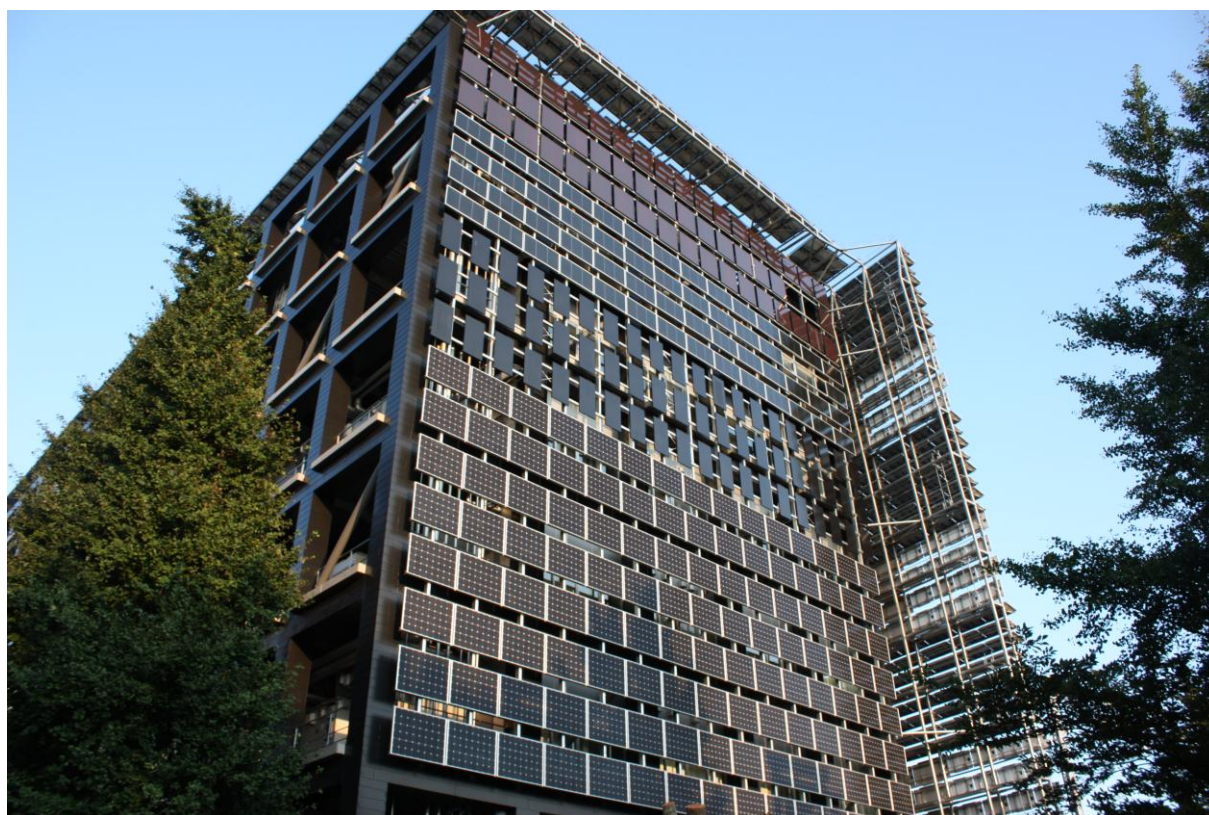
## Synthesis table

This table compiles information valid on 15 March 2013. PVPS countries' data are issued by national experts. Data related to countries that are not members of IEA-PVPS have been delivered by the European Photovoltaic Industry Association and the Solar Energy Industry Association. For some countries, data could still be updated by national authorities. Updated data will be published in the next edition of the complete TRENDS report.

Solar irradiation data have been provided by member countries or GIS data providers.

Electricity production is a theoretical calculation based on average irradiation data and the installed capacity at 31 December 2012. Real production data could differ due to differences in irradiation across the countries themselves and the characteristics of the PV power plants considered.

Electricity consumption data have been provided by official authorities. In most cases, 2011 or 2010 data have been used when 2012 data were not yet available.



BIPV application in Japan – Courtesy of RTS Corporation

Country	Final Electricity Consumption in 2012	Installed PV capacity 31-12-2012	PV Installations in 2012	Theoretical PV Production with 2012 installed base	PV Contribution to Electricity Consumption
	GWh	MW	MW	GWh	%
Australia	229.000	2.400	1.000	2.800	1,23%
Austria	68.500	412	230	400	0,58%
Belgium	87.000	2.567	599	2.195	2,52%
Canada	504.800	765	268	860	0,17%
China	4.693.000	7.000	3.510	6.678	0,14%
Denmark	34.500	327	316	280	0,81%
France	479.000	4.003	1.079	3.750	0,78%
Germany	544.000	32.411	7.604	30.300	5,57%
Israel	45.600	237	43	310	0,68%
Italy	335.000	16.250	3.337	19.150	5,75%
Japan	859.700	7.000	2.000	6.600	0,77%
Korea	455.100	981	252	920	0,20%
Malaysia	95.000	25	22	34	0,04%
Mexico	203.800	52	15	83	0,04%
Netherlands	118.000	256	125	220	0,19%
Norway	122.000	9	0	7	0,01%
Portugal	50.500	223	66	310	0,61%
Spain	255.000	5.100**	223	7.115	2,79%
Sweden	139.000	24	8	19	0,01%
Switzerland	58.000	410	200	370	0,64%
Turkey	242.000	9	2	10	0,01%
UK	329.000	1.830	1.000	1.600	0,49%
USA	3.889.000	7.221	3.313	9.750	0,25%
Bulgaria	33.380	908	767	1015	3,05%
Czech Republic	63.000	2.085	113	1.930	3,07%
Greece	53.000	1.536	912	1.850	3,50%
India	637.600	1.205	980	2.115	0,33%
Slovakia	27.000	523	15	480	1,79%
Thailand	131.900	360	210	530	0,40%
Ukraine	134.000	373	188	410	0,31%

\*\* Spain delivered data in AC, this number is a DC recalculation.

Table 2 – Synthesis Table for PV Installations and Installed Capacity in 2012



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