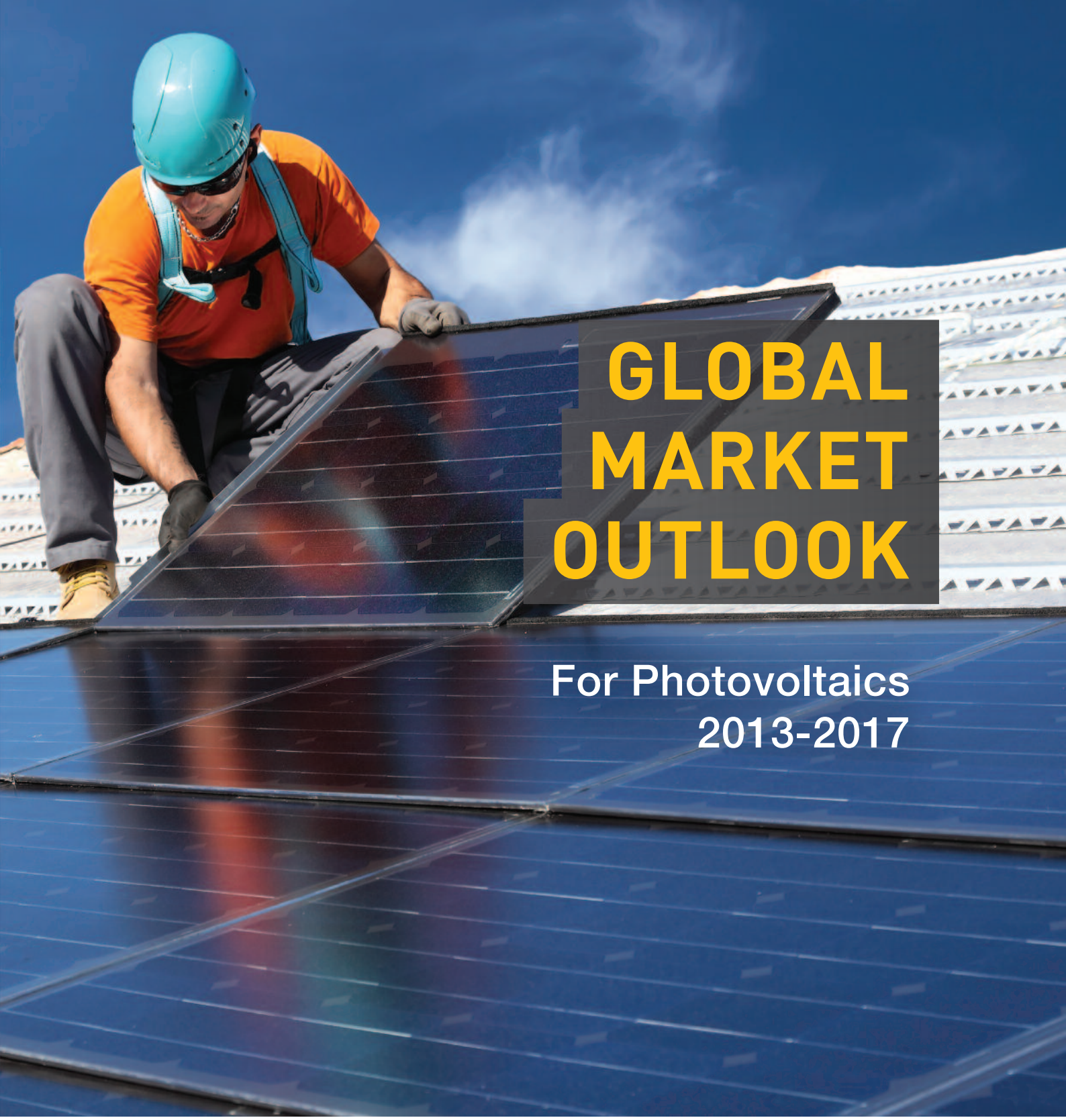

GLOBAL MARKET OUTLOOK

For Photovoltaics 2013-2017

EPIA
European Photovoltaic Industry Association

Principal authors and analysts: Gaëtan Masson, Marie Latour, Manoël Rekinger, Ioannis-Thomas Theologitis, Myrto Papoutsi

Editor: Craig Winneker

Publication coordination: Benjamin Fontaine, Marie Latour

External contributors: 3E, APER, APESF, APEU, APISOLAR, APREN, APVIA, ATERSA, Australian PV Association, BPVA, BSW-Solar, CREIA, CZEPHO, Danish PV Association, EDORA, First Solar, Fronius, GENSED, GIFI, Goldbeck, HELAPCO, Holland Solar, HUPIA, IEA-PVPS Task 1, JPEA, KOPIA, Latvian PV Association, Martifer, Photovoltaic Technology and Business Association, PV AUSTRIA, PV Poland, PV Vlaanderen, REC, Renewable Association of Israel, RBF, RTS Corporation, SAPI, SEIA, SMA, Solar Trade Association, SunEdison, SvenskSolenergi, Swissolar, TRINA Solar, UNEF, Wacker

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1 INTRODUCTION

1. INTRODUCTION

The year 2012 was another historic one for solar photovoltaic (PV) technology, which has experienced remarkable growth over the past decade and is on the way to becoming a mature and mainstream source of electricity. **The world's cumulative PV capacity surpassed the impressive 100-gigawatt (GW) installed electrical power mark, achieving just over 102 GW**. This capacity is capable of producing as much annual electrical energy as 16 coal power plants or nuclear reactors of 1 GW each. Each year these PV installations save more than 53 million tons of CO2.

Remarkably, even during a time of economic crisis, an estimated 31 GW of new PV capacity was commissioned around the world in 2012 – roughly the same as in the record-setting year of 2011. But even if the headline numbers remain stable, the story behind them is changing dramatically. The results of 2012 signal a turning point in the global PV market that will have profound implications in the coming years. For the first time in more than a decade, the European market for PV declined compared to the previous year. More vigorous growth in markets outside of Europe helped keep the global development of PV on an upward trajectory. Other factors – the approaching competitiveness of PV compared to other electricity sources, the changing nature of electricity markets, trade conflicts and the turmoil facing the PV industry due to consolidation – are also already affecting the market outlook for the near future.

This report assesses the European and global markets for PV in 2012, and makes forecasts for the next five years. It is based on an internal analysis of data[1] from industry members, national associations, government agencies and electric utilities. The figures presented were discussed and analysed by key players from the PV industry at our 8th EPIA Market Workshop in Brussels in March 2013.

→ EPIA's major findings for 2012 include:

- **Around the world 31.1 GW of PV systems were installed in 2012, up from 30.4 GW in 2011;** PV remains, after hydro and wind power, the third most important renewable energy source in terms of globally installed capacity
- **17.2 GW of PV capacity were connected to the grid in Europe in 2012, compared to 22.4 GW in 2011;** Europe still accounts for the predominant share of the global PV market, with 55% of all new capacity in 2012
- **Germany was the top market for the year, with 7.6 GW of newly connected systems;** followed by China with an estimated 5 GW; Italy with 3.4 GW; the USA with 3.3 GW; and Japan with an estimated 2 GW
- For the second year in a row, **PV was the number-one new source of electricity generation installed in Europe**
- Under a pessimistic Business-as-Usual scenario, the global annual market could reach 48 GW in 2017; under a Policy-Driven scenario, it could be as high as 84 GW in 2017

1 EPIA bases its analysis on PV systems that have been connected to the grid; the implications of this choice for how market growth is assessed and the differences between installations and connections are discussed in the Methodology section.

→ A new world order

It is clear from the results of 2012 and the forecast for the coming years that Europe's leading role in the PV market is coming to an end. In 2011, Europe accounted for 74% of the world's new PV installations; in 2012 this number was around 55%. In 2013 it is almost certain that the majority of new PV capacity in the world will be installed outside of Europe. Part of the reason for the decline in Europe's numbers is a natural cooling down period after very strong growth in the previous two years. To be sure, there are still markets in Europe which have strong and still-untapped potential and room for significant PV growth. But this will occur at a more stable – and sustainable – rate than it has in the last few years. Going forward, the driving forces will be in countries like China, the USA, Japan and India. **The PV market is becoming truly global.**

→ Increasing competitiveness

PV markets in Europe and around the world continued making rapid progress in 2012 toward competitiveness in the electricity sector. The strong price decreases of PV technology, and increased electricity prices in general, have helped drive momentum toward what is often called "grid parity".

The moment is near when the savings in electricity cost and/or the revenues generated by selling PV electricity on the market could be equal to or higher than the long-term cost of installing and financing a PV system. This so-called "dynamic grid parity" appears within range in several EU countries, and has been reached already in some segments of some countries. In most countries, PV market deployment still depends on the political framework in place. Various national schemes – whether they are being introduced, modified, or phased out – have a significant influence on EPIA's forecasts and scenarios as they have serious consequences on national PV markets and industries. As shown by the substantial regulatory changes introduced by policymakers in several countries in 2012, dedicated financial support as the main driver for PV development is progressively vanishing. In the coming years, deployment strategies will depend much more on the capacity of PV power to actively participate in the electricity system.

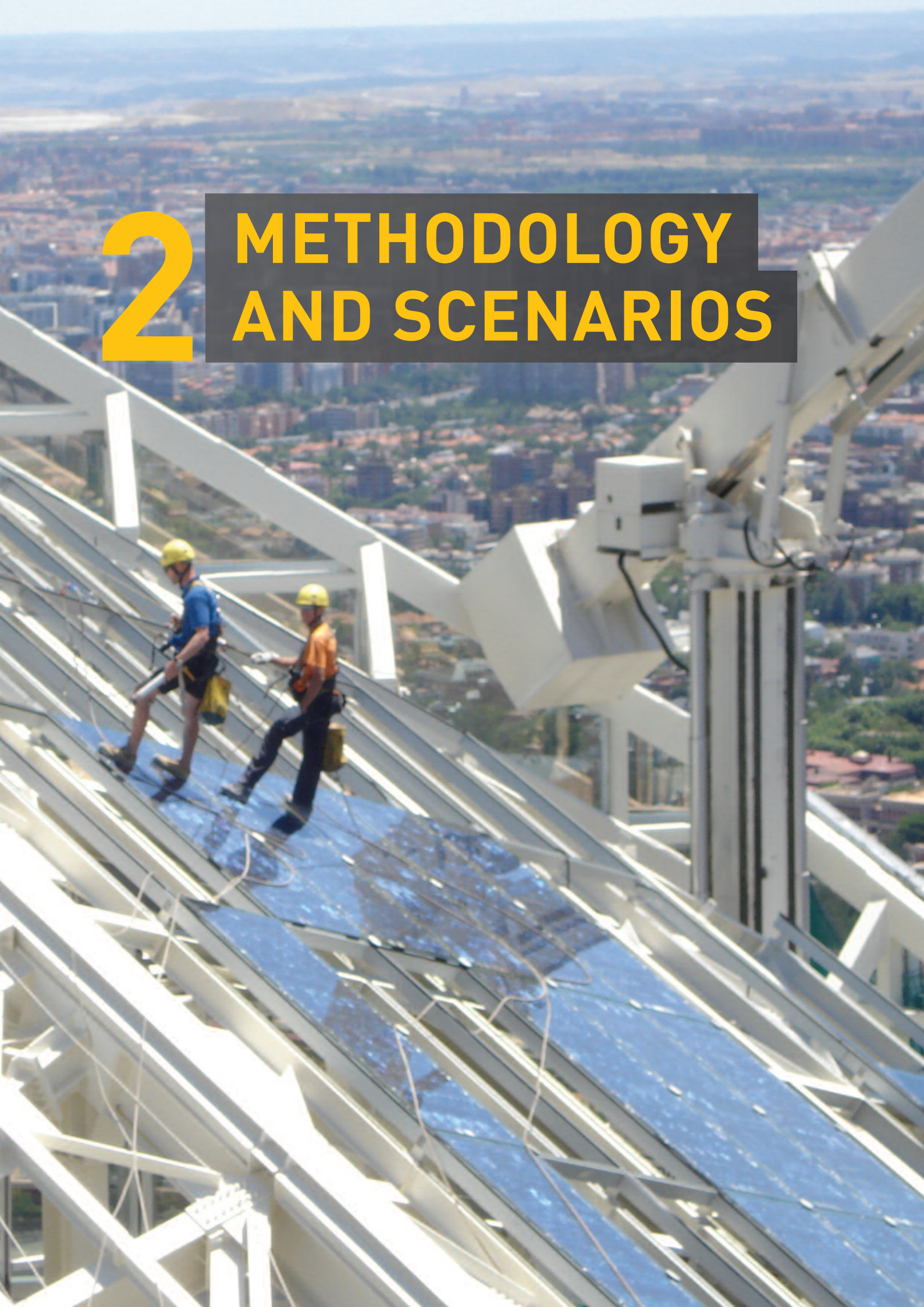
→ PV in the electricity mix

For the second year in a row and the second time in history, PV in 2012 was the number-one electricity source in the European Union (EU) in terms of newly installed capacity. **PV now covers 2.6% of the electricity demand and 5.2% of the peak electricity demand in Europe**. As a result, it is already starting to have an effect on the structure and on the management of the electricity system. Grid and market integration challenges will therefore shape, much more than in the past, the capability to develop PV markets in the coming years.

The factors lined up against the continued strong growth of PV in Europe and around the world are formidable: a continuing economic and financial crisis; industry consolidation; a global market rebalancing; political and regulatory instability as governments reconsider their commitment to renewable energy sources and climate-change mitigation. But even in the face of all of this, the following report shows how, under the right conditions, the prospects going forward for solar PV – a clean, safe and infinitely renewable power source – remain solid.

The main questions are how and where continued PV growth will occur, and how committed policymakers are to making it happen.

More detailed information per country – including the evolution of support schemes; administrative procedures; national renewable energy objectives; and potential for PV – is available for EPIA Members at www.epia.org/news/publications/global-market-outlook-for-photovoltaics-2013-2017/



2 METHODOLOGY AND SCENARIOS

2. METHODOLOGY AND SCENARIOS

The dynamics of PV development are well known in a market driven by incentives. But in a post-incentive era, when the market potential of PV depends on electricity savings and/or potential sales on the wholesale electricity market, forecasting market evolution becomes more complex than it was even a year ago. While EPIA's latest analyses indicate that in 2013, a large part of the European market will still be driven by specific support measures, several key markets are already entering the transition phase from an investor-driven market to an energy savings-driven market in the building segments (residential, commercial and industrial).

In addition, the economic uncertainty in several European markets has in some cases pushed policymakers to make decisions that have a negative effect on the market, such as imposing retroactive measures. Such decisions severely erode investor confidence even as PV technology and competitiveness improve – slowing market development in a way that is not easily predictable. Moreover, these measures harm these countries' credibility not just for PV but for their whole financing sector.

In March 2013, EPIA completed an extensive data-collection exercise from among a highly representative sample of the PV industry, electric utilities, national associations and energy agencies. Based on the cross-checking of data and the consolidation of complementary market projection methods, EPIA has derived two scenarios for the future development of PV markets:

- The **Business-as-Usual scenario** assumes rather pessimistic market behaviour with no major reinforcement or adequate replacement of existing support mechanisms, or a strong decrease/limitation of existing schemes. In this scenario, it is assumed that in countries close to transition, markets are significantly slowing down when Feed-in Tariffs (FiTs) are phased out
- The **Policy-Driven scenario** assumes the continuation, adjustment or introduction of adequate support mechanisms, accompanied by a strong political will to consider PV as a major power source in the coming years. Achieving this will also require removing unnecessary administrative barriers and streamlining grid connection procedures. Although market booms caused by inadequate support mechanisms are less likely to happen because of the growing exchange of best practices when designing support policies, they can still be observed in some cases, similarly to the Business-as-Usual scenario

Under these two scenarios, this report analyses the historical development of the PV market and its potential for the future. Based on a bottom-up approach at country level, it presents aggregated figures and scenarios.

In this bottom-up approach, consolidated forecasts should be understood as a range of possible PV market developments, with a high probability between the Business-as-Usual scenario as the lower boundary and the Policy-Driven one as the higher one. Lower or higher forecasts are of course possible as the history of PV market development has shown, but with a lower probability.

→ Installations and connections

EPIA's methodology includes only systems connected to the grid and not those that have been installed but not yet connected. Therefore, the cumulative installed capacity refers to installations that can make a real contribution to meeting the energy demand. This also reflects both the energy system point of view and the regulatory point of view, as PV electricity tariffs are paid only to systems that are connected and producing electricity. The difference between installations and systems connected to the grid can be quite significant in some cases.

→ The role of off-grid installations

Long before PV became a reliable source of power connected to the grid, it was largely used to provide electricity in remote areas that lay out of the reach of electricity grids. While off-grid systems in Europe account for less than 1% of the installed PV capacity, they represent a significant power source in other parts of the world. For this reason, off-grid systems are also taken into account in the total installed capacity. In the USA, off-grid systems represented 10% of the overall market in 2009 and declined since then. In Australia and Korea, dozens of megawatts of off-grid capacity are installed every year and are accordingly taken into account in the total installed capacity in those countries. In countries such as India, the development of PV in the coming years could originate at least partially from hybrid systems and micro-grid applications. In that respect the notion of on-grid or off-grid installations could be more difficult to assess outside Europe.

→ AC-DC numbers: counting comparable numbers

PV panels generate direct-current (DC) electricity; electricity systems are based on alternating-current (AC) electricity. Most countries refer to installed PV systems by counting DC power, but some report AC power. The major difference lies in the small percentage of energy lost during the DC-AC conversion in the inverters, which could deliver non-comparable data. This report presents data as they are produced by national authorities to ensure the compatibility of historical data, whatever the conventions used. However, in the case of countries reporting AC power, this report also calculates DC power numbers. All forecasts and consolidated data are presented in DC power, while electricity production data must consider AC power. In such cases, a realistic loss during conversion is assumed. In Europe, Spain falls in this category.

3 MARKET EVOLUTION

3. MARKET EVOLUTION

A. HISTORICAL PV MARKET DEVELOPMENT

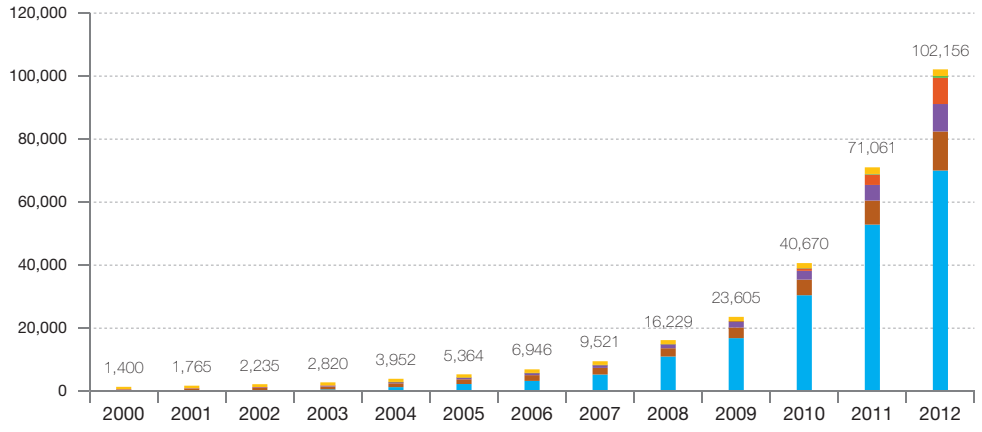
PV technology has grown over the past decade at a remarkable rate – even during difficult economic times – and is on the way to becoming a major source of power generation for the world. After record growth in 2011, the global PV market stabilised, with capacity additions in 2012 slightly above those achieved in 2011.

At the end of 2009, the world's cumulative installed PV capacity was approaching 24 GW. One year later it was 40.7 GW and at the end of 2011 it was 71.1 GW. **In 2012, more than 100 GW of PV are installed globally — an amount capable of producing at least 110 TWh of electricity every year.** This energy volume is sufficient to cover the annual power supply needs of over 30 million European households.

1. World

Europe remains the world's leading region in terms of cumulative installed capacity, with more than 70 GW as of 2012. This represents about 70% of the world's cumulative PV capacity (compared to about 75% of the world's capacity in 2011). Next in the ranking are **China (8.3 GW)** and **the USA (7.8 GW)**, followed by **Japan (6.9 GW)**. Many of the markets outside EU – in particular China, the USA and Japan, but also Australia (2.4 GW) and India (1.2 GW) – have addressed only a very small part of their enormous potential; several countries from large Sunbelt regions like Africa, the Middle East, South East Asia and Latin America are on the brink of starting their development. Even so, the cumulative installed capacity outside Europe reached 30 GW as of 2012, demonstrating the ongoing rebalancing between Europe and the rest of the world and reflecting more closely the patterns in electricity consumption.

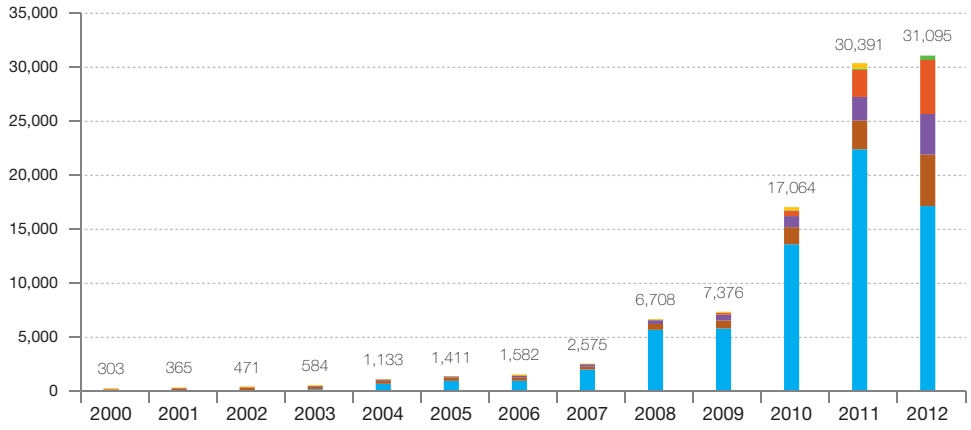
Figure 1 - Evolution of global PV cumulative installed capacity 2000-2012 (MW)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ROW	751	807	887	964	993	1,003	1,108	1,150	1,226	1,306	1,590	2,098	2,098
MEA	n/a	n/a	n/a	n/a	1	1	1	2	3	25	71	192	601
China	19	24	42	52	62	70	80	100	140	300	800	3,300	8,300
Americas	146	178	225	290	394	501	650	863	1,209	1,752	2,780	4,959	8,717
APAC	355	495	686	916	1,198	1,500	1,825	2,096	2,631	3,373	4,956	7,628	12,397
Europe	129	262	396	598	1,305	2,289	3,281	5,310	11,020	16,850	30,472	52,884	70,043
Total	**1,400**	**1,765**	**2,235**	**2,820**	**3,952**	**5,364**	**6,946**	**9,521**	**16,229**	**23,605**	**40,670**	**71,061**	**102,156**

ROW: Rest of the World. MEA: Middle East and Africa. APAC: Asia Pacific.

Figure 2 - Evolution of global PV annual installations 2000-2012 (MW)



	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012
ROW	88	56	80	77	29	10	105	42	76	80	284	508	-*
MEA	n/a	n/a	n/a	n/a	1	n/a	n/a	1	1	22	46	121	410
China	19	5	19	10	10	8	10	20	40	160	500	2,500	5,000
Americas	24	32	47	66	104	106	150	213	346	543	1,029	2,179	3,758
APAC	117	140	191	230	282	303	324	271	535	742	1,583	2,672	4,769
Europe	56	133	135	202	707	984	992	2,028	5,710	5,830	13,622	22,411	17,159
Total	**303**	**365**	**471**	**584**	**1,133**	**1,411**	**1,582**	**2,575**	**6,708**	**7,376**	**17,064**	**30,391**	**31,095**

* From 2012 onwards, these figures are directly integrated into those of the relevant regions.

Europe's market has progressed rapidly over the past decade: from an annual market of less than 1 GW in 2003 to a market of over 13.6 GW in 2010 and 22.4 GW in 2011 – even in the face of difficult economic circumstances and varying levels of opposition to PV in some countries. But the record performance of 2011, driven by the fast expansion of PV in Italy and again a high level of installations in Germany, was not repeatable in 2012 and the market went down to 17.2 GW. For the first time in the last 12 years, the PV market in Europe decreased in terms of new connected capacity.

Even so, in 2012 the PV market in Europe again exceeded all expectations. However, due to variable delays in connecting PV systems to the grid depending on the country, some installations from 2010 were not connected until 2011 and this repeated again in 2012. This has an impact on market perception.

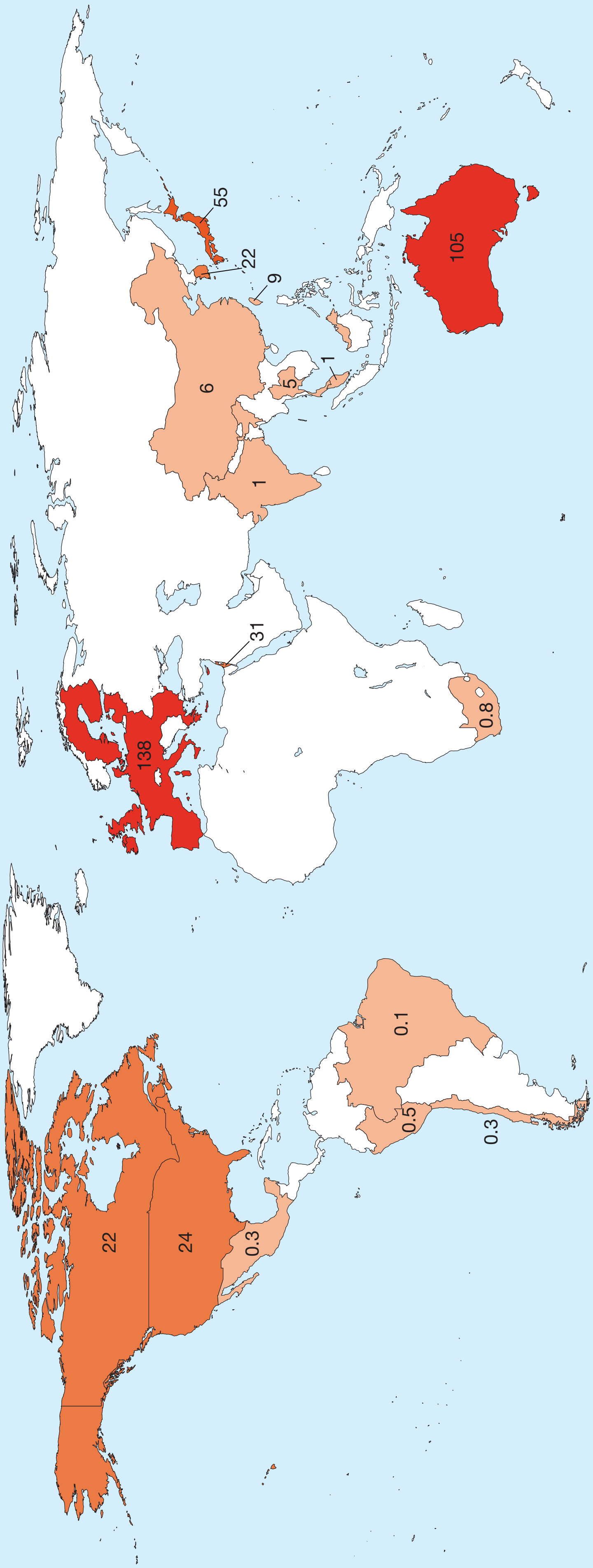
For the seventh time in the last 13 years, **Germany was the world's top PV market, with 7.6 GW of newly connected systems; China was second with an assumed 5 GW, followed closely by Italy (3.4 GW), the USA (3.3 GW) and Japan with an estimated 2 GW**. Together, Germany, China, Italy, the USA and Japan accounted for nearly 21.3 GW, or two-thirds of the global market during last year. These five markets were followed by France (1.1 GW), Australia and India (close to 1 GW each) and the United Kingdom (925 MW). The performance of France, India and the United Kingdom (UK) was surprisingly moderate compared to expectations. Many other markets have started to show significant development.

Regionally, Europe is followed by the **Asia-Pacific (APAC) region**, which in addition to Japan and China includes Korea, Australia, Taiwan and Thailand. The third leading region is **North America**, with Canada developing steadily alongside the USA. Elsewhere, the Middle East and North Africa (MENA) region represents untapped potential for the medium term. PV also shows great potential in South America and Africa, where electricity demands will grow significantly in the coming years and where numerous projects have popped-up and will lead to installations in 2013 and after.

Figure 3 - Global PV power map (MW)

Legend

- 100-150 W/habitant
- 50-100 W/habitant
- 10-50 W/habitant
- 0-10 W/habitant
- N/A



China	Market 2011	Cumulative 2011	Market 2012	Cumulative 2012	W/habitant 2012
	2,500	3,300	5,000	8,300	6

EU 27	Market 2011	Cumulative 2011	Market 2012	Cumulative 2012	W/habitant 2012
	22,117	52,428	16,672	69,100	138

APAC	Market 2011	Cumulative 2011	Market 2012	Cumulative 2012	W/habitant 2012
Australia	837	1,412	1,000	2,412	105
India	190	225	980	1.205	1
Japan	1,296	4,914	2,000	6,914	55
Korea	157	812	252	1,064	22
Malaysia	0.9	14	22	36	1
Taiwan	70	102	104	206	9
Thailand	121	149	210	359	5

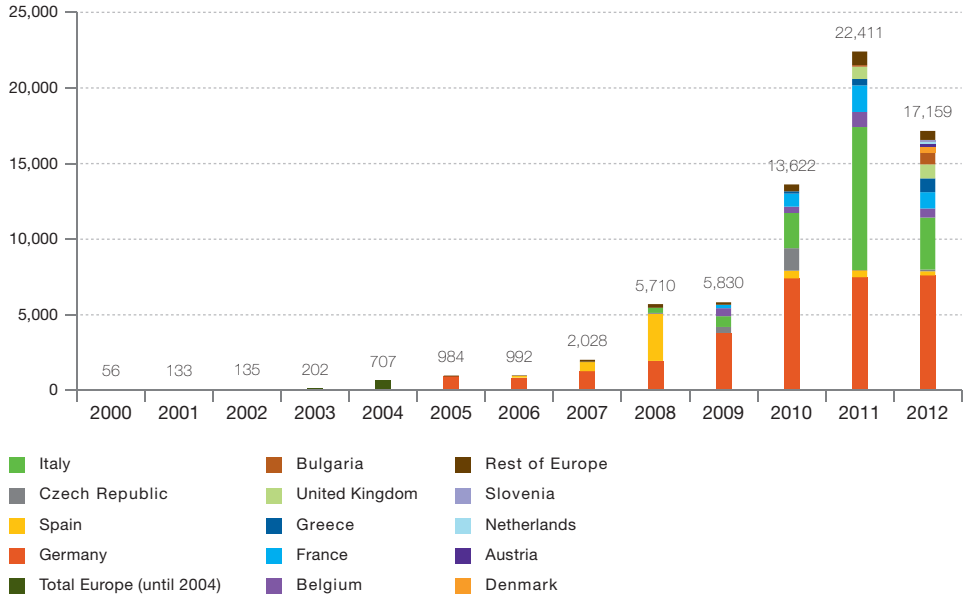
MEA	Market 2011	Cumulative 2011	Market 2012	Cumulative 2012	W/habitant 2012
Israel	120	190	60	250	31
South Africa	1	1	40	41	0.8

Americas	Market 2011	Cumulative 2011	Market 2012	Cumulative 2012	W/habitant 2012
Brazil	5	5	12	17	0.1
Canada	297	497	268	765	22
Chile	4	4	2	6	0.3
Mexico	7	23	15	38	0.3
Peru	0	0	15	15	0.5
USA	1,867	4,431	3,346	7,777	24

2. Europe

Europe's market development is the result of a few countries that have taken the lead year after year, with Germany showing a constant commitment from policymakers to support the development of PV.

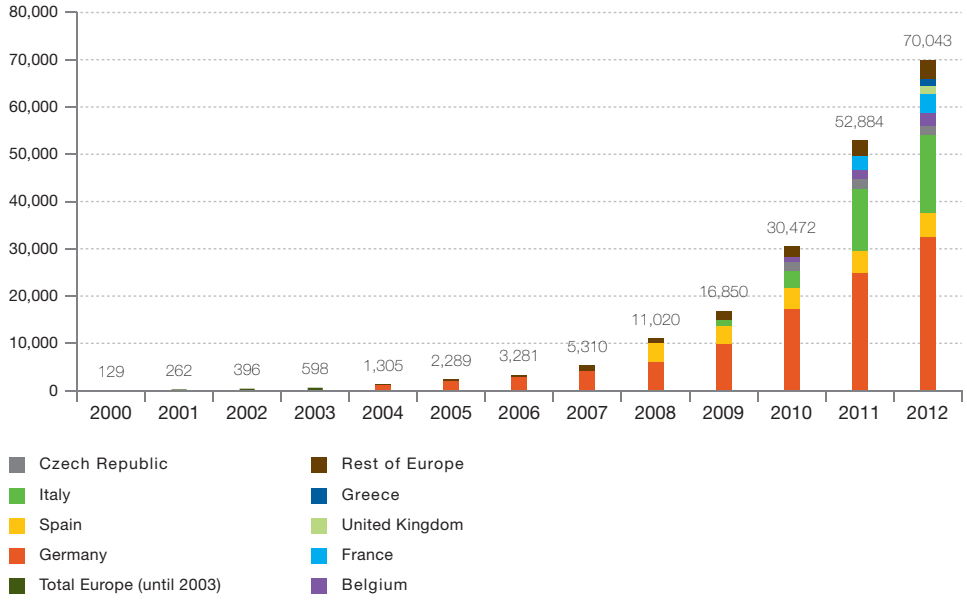
Figure 4 - Evolution of European new grid-connected PV capacities 2000-2012 (MW)



After the Spanish boom in 2008, Germany was the only leading market in 2009, and consequently European growth as a whole was limited. This can be seen in retrospect as a consequence of the first phase of the financial crisis but also a year of stabilisation after the boom PV experienced in 2008. Major growth returned in 2010, with Germany scoring unprecedented installation numbers, and Italy and the Czech Republic adding together close to 3.8 GW of PV systems. As in Spain and the Czech Republic, overheated market development can produce a boom in one year and a bust in the next, as a result of pressure from conventional energy producers and policymakers concerned about the rapid growth of the market. In 2011, the combined boom of Italy's connections and Germany's installations led again to huge growth. France's growth in 2011 was at least partly due to its connection of projects installed in 2010 and consequently in 2012, the French market went down as expected. In 2012, the record year of Germany allowed the European market to keep a reasonable level of 17.2 GW, with 11 GW coming from this country and Italy alone. Behind these two, the UK, Greece, Bulgaria and Belgium provided a large part of the market development.

The cumulative evolution shows a similar story, with countries stabilising their installed capacity after major growth events as Germany continues to expand its PV base.

Figure 5 - Evolution of European PV cumulative installed capacity 2000-2012 (MW)

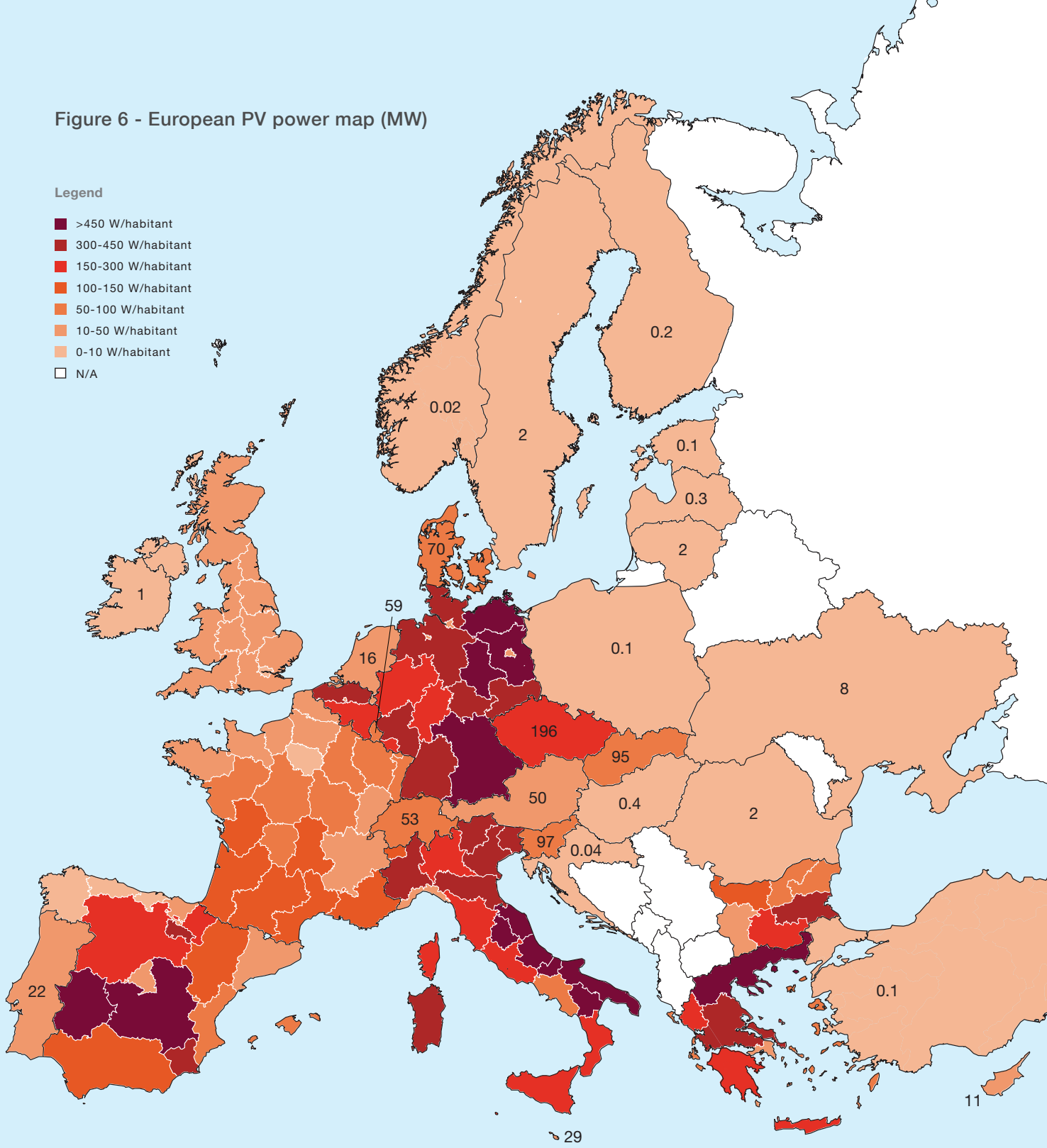


The geographical split of the PV market in Europe is linked to the speed at which the technology developed in recent years. Germany saw steady growth for nearly a decade and represents clearly the most developed PV market. But some countries that got a later start – the Czech Republic, Italy, Greece and Belgium – quickly reached high levels. Next to these leaders, Spain now appears quite low since its market has been constrained; the French and British results continue to reveal an untapped potential in both countries.

From a PV perspective, Europe's development is unrivalled. The USA and Japan, once PV pioneers, are now years behind Europe in terms of PV penetration and China has caught up to their level in just a few years of fast development. Apart from Australia, the rest of the world scores quite low in terms of PV markets, though in many countries there remains great untapped potential.

For the most part, the development of PV has until now corresponded with economic development: After taking root in OECD countries (Europe, North America, Japan, Australia), it started to reach emerging countries. Though as a bloc, BRIC scores low, China and India will show the way to Brazil and possibly to Russia. Africa scores last on the development list, though there is some short-term potential in South Africa.

Figure 6 - European PV power map (MW)



	Market 2011	Cumulative 2011	Market 2012	Cumulative 2012	W/habitant 2012
Austria	92	188	230	418	50
Belgium	996	2,051	599	2,650	241
Bulgaria	105	141	767	908	123
Croatia	0	0	0.2	0.2	0.04
Cyprus	3	9	0	9	11
Czech Republic	6	1,959	113	2,072	196
Denmark	10	16	378	394	70
Estonia	0.1	0.2	0	0.2	0.1
Finland	1	1	0	1	0.2
France	1,756	2,924	1,079	4,003	61
Germany	7,485	24,807	7,604	32,411	398
Greece	426	624	912	1,536	144
Hungary	3	4	0	4	0.4
Ireland	3	3	0	3	1
Italy	9,454	12,923	3,438	16,361	273
Latvia	0.2	0.2	0.4	1	0.3

	Market 2011	Cumulative 2011	Market 2012	Cumulative 2012	W/habitant 2012
Lithuania	0.1	0.3	6	6	2
Luxembourg	5	30	0	30	59
Malta	10	12	0	12	29
Netherlands	58	141	125	266	16
Norway	0	0.1	0	0.1	0.02
Poland	1	3	4	7	0.1
Portugal	47	195	49	244	22
Romania	2	4	26	30	2
Slovakia	321	508	15	523	95
Slovenia	46	81	117	198	97
Spain	472	4,889	276	5,166	110
Sweden	4	11	8	19	2
Switzerland	105	216	200	416	53
Turkey	1	7	2	9	0.1
Ukraine	188	191	182	373	8
United Kingdom	813	904	925	1,829	29

B. THE MARKET IN EUROPE IN 2012 AND THE FORECAST UNTIL 2017

With more than 17 GW of new PV capacity in 2012 (compared to 22.4 GW in 2011), Europe has increased its cumulative capacity base to 70 GW. This impressive performance was driven mainly by two markets: Germany and Italy. France also performed below the level achieved in 2011 (which was inflated by a number of past installations that remained to be connected). UK improved its market situation with 925 MW of systems installed and connected in 2012. Greece (912 MW) and Bulgaria (at least 767 MW) boomed in 2012. There was also a strong showing in Belgium (599 MW), where the Wallonia region contributed much more than in past years with 269 MW. Next to these markets, Denmark (378 MW) is the major surprise of 2012 thanks to a net-metering system, followed by Spain (276 MW), Austria (230 MW) and Switzerland (200 MW).

1. "Installed" vs. "commissioned capacity" figures

While most market reports present installation figures, EPIA reports newly grid-connected capacities ("commissioned systems"). This is because there is no reliable methodology for counting installations and most official bodies report systems connected to the grid. Installation figures are interesting for the PV industry (they describe the demand for PV systems), but grid-connection data are more relevant when considering the increasing share of PV in the electricity mix (and the expenditures in FiTs).

The 2012 edition of EPIA's "Global Market Outlook for Photovoltaics" report showed that the gap between installations and connections is not new, that discrepancies have been noted in France, Belgium and Italy in recent years. Had those numbers been confirmed, the European demand for PV systems would have shifted up by as much as 5 GW in 2010. Instead of some 13 GW connected in 2010 in Europe, we would have had then some 18 GW of installations (reflecting the demand for PV systems). In 2011, we would have seen only 16.9 GW instead of 22.4 GW – completely changing the interpretation of market evolution during those two years.

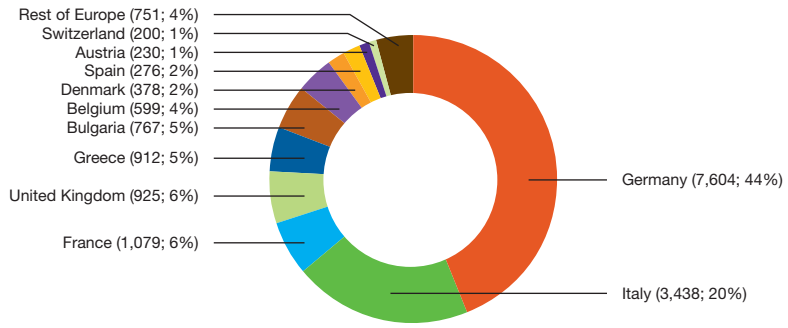
In 2012, at least three markets experienced possibly huge discrepancies between installations and commissioning. In Germany, the concept of "commercial commissioning" of PV systems – which can allow reporting systems that are not yet installed or connected – allows the argument that part of the 3 GW reported in December 2011 in Germany was not really connected, lowering the 2011 connections but increasing 2012 ones. The huge activity in Germany in the first quarter of 2012 did not materialise in installations numbers because of the 3 GW already counted in 2011. Depending on how they are considered, these discrepancies affect the way we perceive the market over the last three years.

2. Relevant European markets in 2012

The decline overall in Europe's PV market in 2012 hides various realities at national level; the market evolution was very different from one country to another. Even in **Germany**, the apparent market stability is the result of a chaotic evolution, due to regulatory changes and hectic responses from investors. Germany has seen three consecutive years with a roughly stable 7.4-7.6 GW of connections, leading to a total installed capacity in the country of a record 32.4 GW. This was accompanied by a progressive evolution in market dynamics, with 2012 showing PV gradually becoming self-sustainable. With PV's Levelised Cost of Electricity (LCOE) now lower than the price of retail electricity, at least in the residential and commercial segments in Germany, PV development can be at least partially driven by self-consumption rather than only FiTs. Also, it should be remembered that the 7.5 GW connected in 2011 included 3 GW that had already been reported as installed in December 2011, but that were only physically connected in the first part of 2012; in other words, there is not really a constant level of 7.5 GW. A more realistic view of Germany's market in the last months shows a relative stabilisation at around 5-6 GW a year, quite far from the government expectations.

In **Italy**, 3.4 GW of PV were connected to the grid in 2012. This is a significant decrease from the major boom seen in 2011, with 9.45 GW. But as was the case with Germany in 2011, many systems connected to the grid in Italy that year had actually been installed at the end of 2010. The numbers are different when analysing the market from an installation point of view; in this case, the Italian market was closer to 4-5 GW in 2010, 6-7 GW in 2011 and around 3.5 GW in 2012. After the rush of 2011, the Italian market has returned to a level that nevertheless remains high. Having reached a financial cap for FiTs, the Italian market will experience the transition to the post-FiT era faster than many expected.

Figure 7 - European PV market split in 2012 (MW; %)



France scored third place among European countries in 2012, thanks again to previously installed projects finally being connected in 2012 along with a limited contribution from new installations. With 1.08 GW of PV in 2012, the country is still performing well below its theoretical potential and below 2011 when it scored 1.76 GW. While the government pushed recently for an additional 1 GW of capacity, the constraints on market development remain significant.

In the **UK**, which installed 925 MW in 2012, the long-term prospects remain quite positive even if the speed at which the market develops is not so impressive. **Greece** installed almost 1 GW (912 MW), a record level for this country hit by an extremely hard recession, and 2013 could be a good year as well despite more restrictive conditions. **Bulgaria** experienced a boom in 2012, with 767 MW installed before the government reacted with harsh retroactive measures to slow the market growth; in 2013 the country's market will most probably slow down significantly. **Belgium** installed again a quite high level with 599 MW (with Wallonia's impressive 269 MW in the residential segment only), in a context of strong political concern over the cost of support schemes. This could lead to a relatively low market in 2013. **Denmark** was one of the surprises of the year with 378 MW, but the boom could be stopped in 2013. **Austria** installed 230 MW and **Switzerland** 200 MW. They have contributed marginally to market development, even if the numbers they have reached are the result of a major market growth.

Some countries, notably **Poland**, failed to fulfil expectations in 2012 and the prospects for 2013 remain weak. In **Spain**, the government imposed an unexpected moratorium on FiTs, destroying what remained of the PV market; only 276 MW were connected to the grid in 2012 in this country, which should be among the European leaders. The long-expected net-metering scheme was never introduced and there are doubts as to whether it ever will be, given the government's fear of creating another boom.

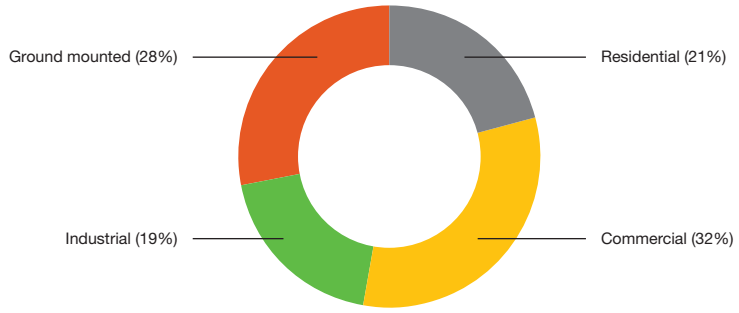
Ukraine experienced impressive growth in 2011 with almost 190 MW connected, thanks solely to the development of two very large power plants realised by one company. In 2012, 182 MW were installed again and the potential remains interesting. The **Czech Republic** finally installed 113 MW, a more important achievement than expected but very far from the booming levels of 2009 and 2010. **Slovakia**, which experienced a relative boom at the end of 2011 and the first semester of 2012, went down to only a few megawatts while the market in **Slovenia** grew once again, this time to 117 MW. **Romania** also has a certain untapped potential and the market in 2012 brought only 26 MW to the counter but many expect this market could grow in 2013.

Russia remains quite low with only a few megawatts installed and little perspective on the short term. **Sweden** sees each year some megawatts being installed but without significant policies and prospects.

3. Segmentation

The European PV market remains quite heterogeneous, with diverse segmentation from one country to another. The market segmentation has been split to distinguish among ground-mounted systems, commercial and industrial rooftop applications and residential applications. The segmentation is not classified according to standard sizes, since the size of system largely depends on the respective structure of support schemes, country by country. In general, the commercial segment should be distinguished from the residential segment not only according to the system size but also the nature of the investor (private or public person) and the regime of retail electricity prices he is submitted to. The same classification can be applied to distinguish between commercial and industrial segments, according to the electricity price contracts.

Figure 8 - European PV market segmentation in 2012 (%)



Market segmentation in Europe remained roughly stable in 2012 compared to 2011. But given the recent changes in regulatory frameworks, the ground-mounted segment will probably decline considerably in Europe in 2013. Overall a large share of the market in Europe is concentrated in the commercial and industrial rooftop segments; this trend will continue, based on the foreseen evolution of the legal framework. The residential segment has developed rapidly in some countries, such as Belgium, Greece and the UK.

Figure 9 - European PV market segmentation by country in 2012 (%)

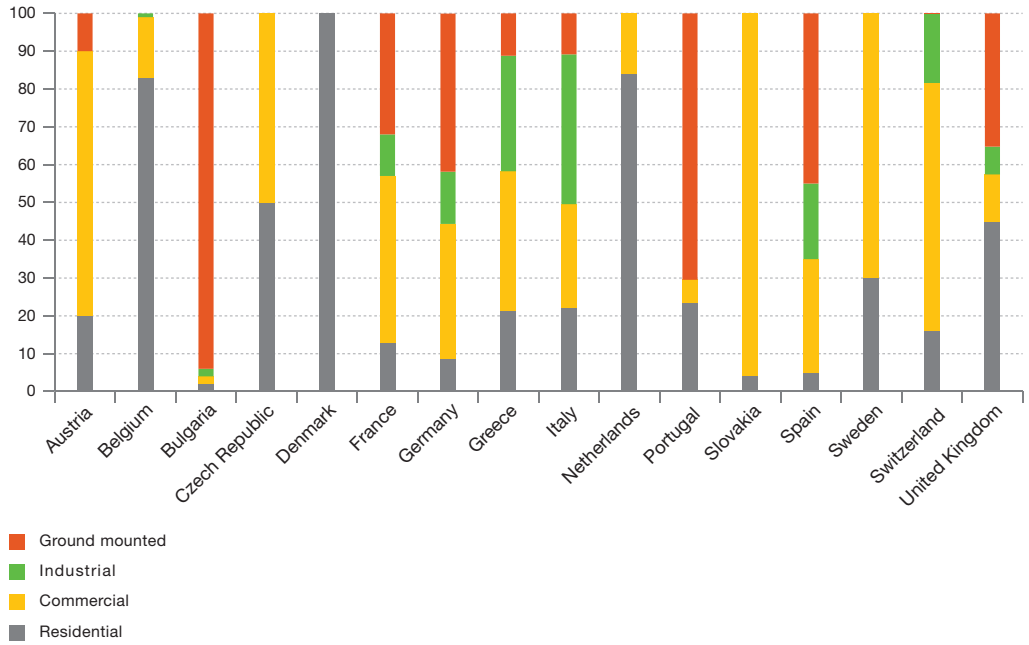
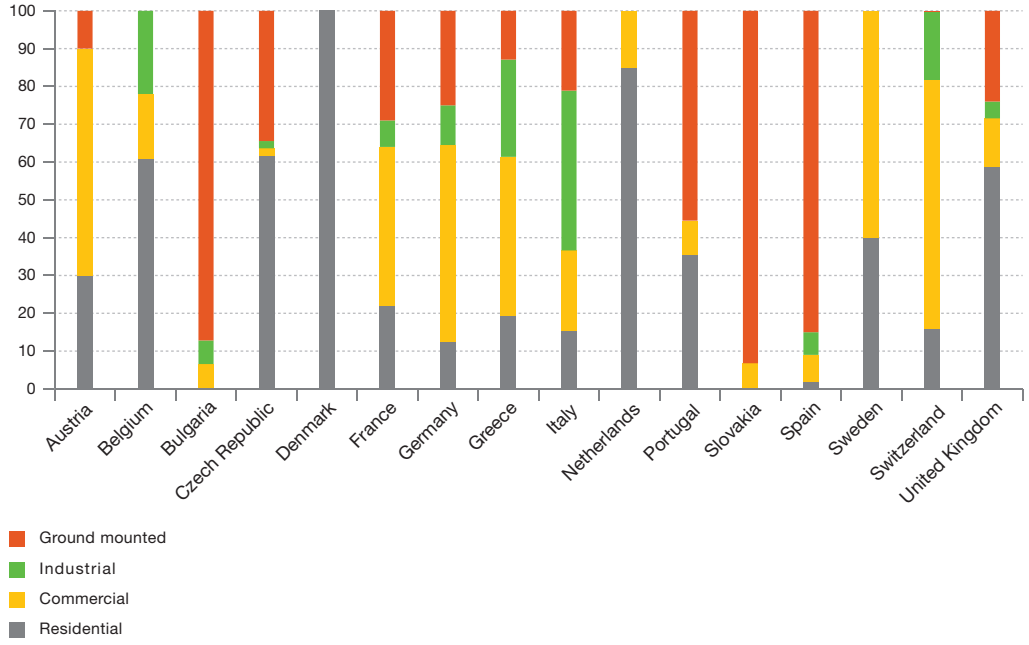


Figure 10 - European PV cumulative capacity segmentation by country in 2012 (%)



The top-five countries per segment show the continued domination of the largest markets (Germany, Italy, France, UK).

Figure 11 - Top 5 European residential PV markets in 2012 (%)

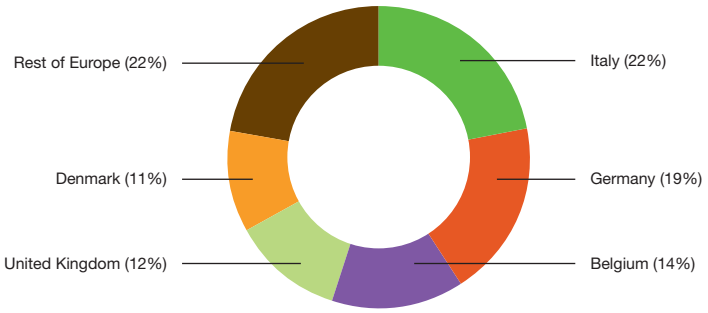


Figure 12 - Top 5 European commercial PV markets in 2012 (%)

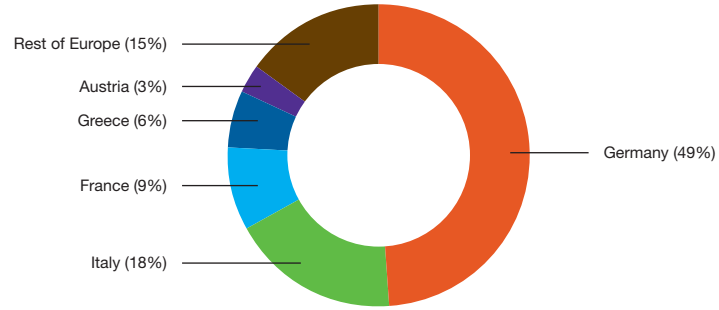


Figure 13 - Top 5 European industrial PV markets in 2012 (%)

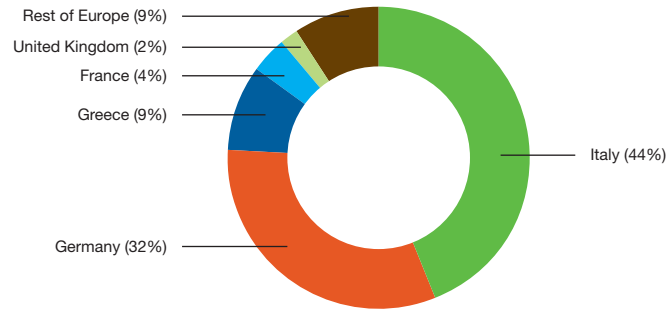
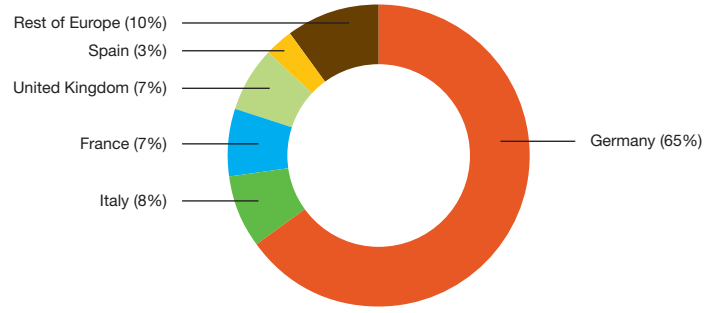


Figure 14 - Top 5 European ground mounted PV markets in 2012 (%)



4. Forecasts of PV in Europe until 2017

Considering newly connected systems, 2012 showed the first PV market decline in Europe since 2000, mainly due to the end of the boom in the Italian market (which was the world's largest in 2011) while the rest of the European market stabilised. Had Italy experienced a more reasonable market level in 2011, the PV market would have stabilised from 2010 to 2012 or experienced slight growth. Overall, the future of the European market is uncertain for the coming years. The drastic decrease of some FiT programmes will push some markets down in 2013, even though a few emerging markets in Europe could offset any major decline. Given these new conditions, the short-term prospects for the European markets are stable in the best case or declining. In a Business-as-Usual scenario, without support from policymakers to PV, the transition could be quite painful over the next two or three years. In a Policy-Driven scenario, the market could stabilise in 2013 and grow again from 2014 onwards, driven by the approaching competitiveness of PV and emerging markets in Europe.

Figure 15 - European annual PV market scenarios until 2017 - Business-as-Usual and Policy-Driven (MW)

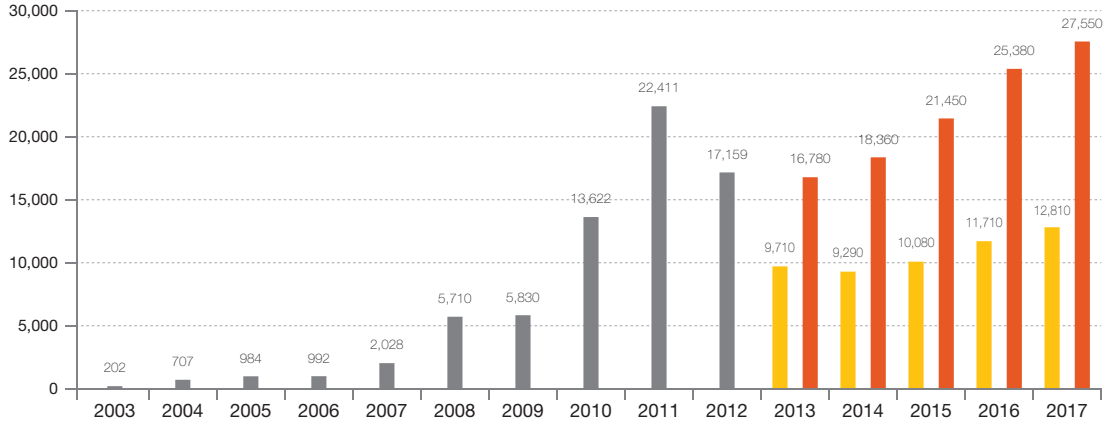
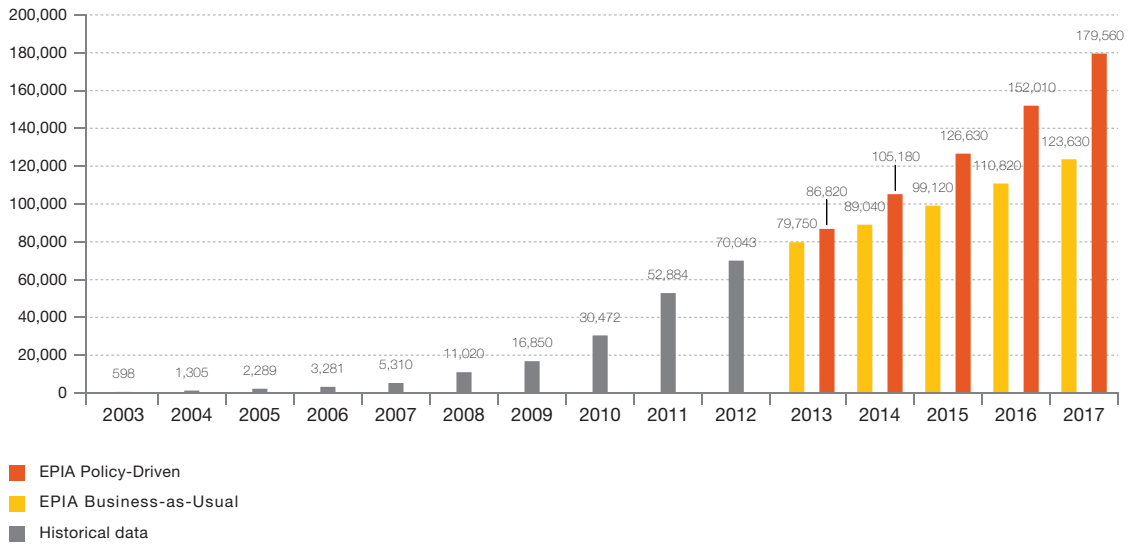


Figure 16 - European PV cumulative scenarios until 2017 - Business-as-Usual and Policy-Driven (MW)



5. 2020 potential and targets in the EU

→ Potential vs. market reality for PV deployment in the EU

EPIA's report "Connecting the Sun: Solar photovoltaics on the road to large-scale grid integration", published in 2012, identifies three possible PV deployment scenarios to 2020 and 2030 that represent the technology's real potential:

- The **Baseline scenario** envisages 4% of the electricity demand in Europe provided by PV in 2020. This represents about 130 GW of cumulative capacity by 2020. In 2030, PV could represent up to 10% of the electricity demand
- The **Accelerated scenario**, with PV meeting 8% of the demand, is based on the maximum PV growth in Europe that is possible with the current market trends. This represents about 200 GW of cumulative capacity by 2020. In 2030, PV could target up to 15% of the electricity demand
- A third case, which assumes that all regulatory, perceptual and technical barriers are lifted to allow the PV market to grow in most countries at a very fast speed, is called the **Paradigm Shift scenario**. This foresees PV supplying up to 12% of EU electricity demand by 2020. This represents about 390 GW of cumulative capacity by 2020

Table 1 shows the potential per country by 2020. In each case one of the three scenarios has been chosen, depending on how the market has developed until now and how EPIA predicts it can continue to grow in the coming decade if appropriate policy measures are in place and barriers are removed. A corresponding linear annual market potential from now until 2020 is then derived and compared to last year's market size. In blue are the countries which underperformed and in red the countries which exceeded this annual potential. Overall the EU market was at an appropriate level, but the results are not sustainably balanced.

Table 1 - PV potential in the EU 27 until 2020 vs. 2012 reality (MW)

	Potential cumulative installed capacity in 2020	Type of scenario	Potential annual market until 2020	Actual newly connected capacity in 2012
Austria	4,000	Accelerated	448	230
Belgium	7,000	Accelerated	544	599
Bulgaria	3,000	Accelerated	262	767
Czech Republic	4,000	Accelerated	241	113
Denmark	1,000	Accelerated	76	378
France	30,000	Accelerated	3,250	1,079
Germany	80,000	Paradigm Shift	5,949	7,604
Greece	8,000	Accelerated	808	912
Hungary	2,000	Accelerated	249	n/a
Italy	42,000	Accelerated	3,205	3,438
Netherlands	8,000	Paradigm Shift	967	125
Poland	5,000	Accelerated	624	4
Portugal	3,000	Accelerated	344	49
Romania	5,000	Accelerated	621	26
Slovakia	3,000	Accelerated	310	15
Slovenia	1,500	Accelerated	163	117
Spain	18,000	Accelerated	1,604	276
Sweden	1,000	Accelerated	123	8
United Kingdom	22,000	Paradigm Shift	2,521	925
Rest of EU 27*	1,850		226	20
Total EU 27	**249,350**		**22,534**	**16,672**

* Rest of EU 27 includes Cyprus, Estonia, Finland, Ireland, Latvia, Lithuania, Luxembourg and Malta.

Market exceeded the annual potential.
Market was at a right level according to potential.
Market was lower than actual potential.

→ National Renewable Energy Action Plans (NREAPs) vs. the reality of PV markets

Table 2 compares the cumulative installed capacity at the end of 2012 in most EU markets, the official National Renewable Energy Action Plan target for PV by 2020 and the necessary yearly market to reach this 2020 target (linear projection).

Table 2 - NREAPs vs. reality of PV markets in the EU 27 (MW)

	Cumulative installed capacity in 2012	NREAPs' 2020 target for PV	Necessary yearly market until 2020	Target reached in…	Market in 2011	Market in 2012
Austria	418	322	n/a	reached in 2012	92	230
Belgium	2,650	1,340	n/a	reached in 2011	996	599
Bulgaria	908	303	n/a	reached in 2012	105	767
Czech Republic	2,072	1,695	n/a	reached in 2010	6	113
Denmark	394	6	n/a	reached in 2010	10	378
France	4,003	4,860	107.1	2013-2014	1,756	1,079
Germany	32,411	51,753	2417.8	2016-2020	7,485	7,604
Greece	1,536	2,200	83	2013-2014	426	912
Hungary	4	63	7.4	2013-2015	2.5	n/a
Italy	16,361	8,000	n/a	reached in 2011	9,454	3,438
Netherlands	266	722	57	2014-2016	58	125
Poland	7	3	n/a	reached in 2012	1	4
Portugal	244	1,000	94.4	2016-2020	47	49
Romania	30	260	28.7	2013-2016	1.6	26
Slovakia	523	300	n/a	reached in 2011	321	15
Slovenia	198	139	n/a	reached in 2012	46	117
Spain	5,166	8,367	400.2	2016-2020	472	276
Sweden	19	8	n/a	reached in 2011	4	8
United Kingdom	1,829	2,680	106.4	2013-2014	813	925
Rest of EU 27*	62	360	37.3	2016-2020	22	7
Total EU 27	**69,100**	**84,381**	**1910.12**	**2013-2014**	**22,117**	**16,672**

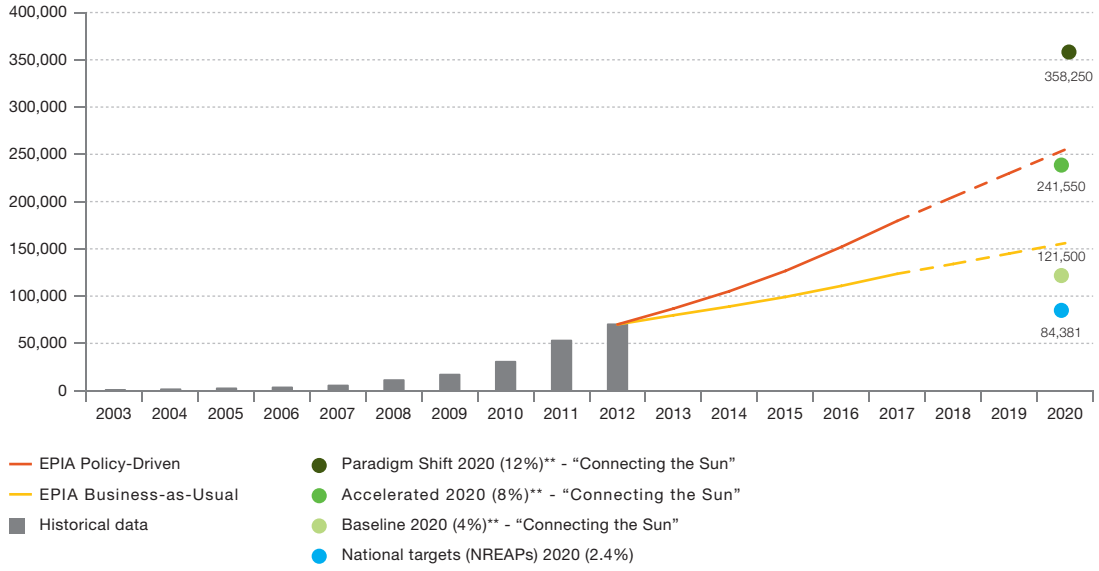
* Rest of EU 27 includes Cyprus, Estonia, Finland, Ireland, Latvia, Lithuania, Luxembourg and Malta.

Target already reached in 2010-2012: Country has significantly underestimated PV's potential.
Target to be reached by 2013-2015: Country has underestimated PV's potential.
Target to be reached by 2016-2020: Country has either properly estimated PV's potential (Germany) or has set measures constraining the market to meet the set target not earlier than 2020 (Netherlands, Portugal, Spain).

→ Potential, national targets and the reality

EPIA has compared various PV market forecasts until 2017 against the three scenarios developed in the "Connecting the Sun" report as well as the NREAPs.

Figure 17 - European PV cumulative capacity forecasts compared with EPIA's new 2020 scenarios* and NREAPs targets (MW)



* EPIA, "Connecting the Sun: Solar photovoltaics on the road to large-scale grid integration", 2012.
** The percentage indicates the share of electricity demand.

The **Business-as-Usual scenario** for PV until 2017 that used to be aligned with the 4% target (Connecting the Sun's Baseline scenario) appears now to be slightly higher. This represents an improvement from previous EPIA forecasts, which estimated that growth would not quite reach the 4% target by 2020. Thus, it looks reasonable to expect that 4-5% penetration for PV could be reached even in the low growth case.

The **Policy-Driven scenario** for PV until 2017 appears almost in line with the Accelerated scenario presented in "Connecting the Sun". It targets to cover about 8% of the electricity demand by 2020. While this scenario of reaching 8% by 2020 looks coherent and in line with optimistic market expectations, reaching 12% would require a real Paradigm Shift in the way PV is supported and incentivised, even after competitiveness is reached in many countries and market segments. It is clear today that this 12% scenario is no longer a realistic option and would require tremendous market developments, unsupported by public policies in Europe for the time being.

The **NREAPs** as devised in 2009 are far from the reality of today's PV market. Apart from in Germany and Greece, market evolution in most countries could easily overtake the action plans. Future expectations largely reflect the current balance of installations, with Germany and Italy dominating the market. In the EU forecasts, the NREAPs targets with the intermediary value for 2015 have been taken into account. The extent to which they have underestimated the market developments in 2010, 2011 and even further in 2012 is obvious.

Put simply, the potential for 2020 is at least twice as high as the levels foreseen in the NREAPs, pushing towards 200 GW capacity or even more in Europe by 2020. Possible revisions of the action plans will have to take into account the fast increases in installations over the last year.

6. Support schemes in Europe and prospects for PV

Table 3 - European PV support schemes assessment (early 2013 status)

	General political support situation	Political support environment
Austria		Clear FiT evolution in 2013. Existing reasonable cap still limiting market growth.
Belgium		Changing environment due to increased grid costs and the end of attractive past support. Reduced support to PV for all segments. Streamlined administrative processes. Reduced political support. Support levels in Flanders also reduced in some segments to maintain a market. In Wallonia, very high levels until 2012, leading to a complete review of the scheme.
Bulgaria		Very unstable environment with repeated FiT decreases in 2012 combined to retroactive grid fees that have now been revoked by the Supreme Court. Investment environment very unsecure.
Czech Republic		FiT limited to very small applications (< 30 kWp), triggering a small market. Clear evolution of FiTs. Still a very strong adverse lobbying from conventional stakeholders, including grid operators. Retroactive law passed in 2010, another one expected in 2013. Grid operator blocking new licencing.
Denmark		Net-metering under revision since November 2012. No market expected until new scheme is approved by the EC. Lower support due to a move from yearly to hourly net-metering; but should be open to larger segments.
France		Clear FiT evolution in 2013 for systems up to 100 kWp. Improved transparency on tendering schemes for larger systems. Doubling of yearly objective at the beginning of 2013, but actual support potentially not sufficient to reach objective. Adverse lobbying from conventional stakeholders. Willingness to limit development to control cost. Slow administrative processes still in place.
Germany		Clear FiT evolution in 2013. Restrictions on utility-scale installations to reduce market. Federal elections year making the future of support beyond 2013 unsure with a willingness to reduce cost of FiTs, including retroactively. Simple and lean administrative process. Risk coming from grid operators to finance the grid and overall cost of the support to RES.
Greece		Clear FiT evolution in 2013. Past committed projects to develop market. Adverse financial environment limiting development of new projects. Residential PV favoured over large-scale PV plants. Licensing of new large projects frozen since August 2012, retroactive taxation adopted in Q4 2012, huge delays for producers' payments.
Italy		New FiT scheme since August 2012 with short lifetime due to cap on overall support system cost. No visibility after financial cap reached (probably mid-2013). Willingness to limit development to control costs with the introduction of a register. Improving administrative processes. No direct support after financial cap is reached, leading to a market contraction.
Netherlands		Net-metering and high electricity prices allowing for a residential market to develop rapidly together with an investment grant. Adequate support for a market close to grid parity in the residential segment.
Poland		New FiT and Green Certificate scheme under discussion for over a year; long decision process still ahead, probably until 2014. Possible lack of investor confidence due to lack of formal government decision.
Portugal		Clear FiT evolution for small - to medium-size market segments. Financial crisis limiting market growth. Administrative process simplified for smaller segments. No visibility for larger segments. Competitiveness in the residential segment in sight, so market could develop soon without support schemes anyway.
Romania		Favourable conditions for large-scale systems, support expected to be reduced in the future. Improved legal environment in 2012. FiT for small-scale systems pending approval. Could lead to an overheated market if support not adapted timely.
Slovakia		Very low FiT and heavy administrative barriers. No profitability expected from any investment. Ongoing review of support for small-scale system which could be adopted by the end of 2013.
Spain		Support to PV frozen at the beginning of 2012 and not reintroduced. Overall Spanish electricity tariff cumulative deficit (multi-billion-euro debt) blocking any new development. Net-metering scheme long awaited. Few projects starting independently from support schemes (self-consumption for commercial system with high self-consumption rate, large scale plants to sell on the electricity market), within an unclear regulatory framework. Heavy and slow administrative processes. Many attempts to revitalise the utility-scale segment without incentives, but no significant development so far.
Switzerland		Clear FiT evolution in 2013. Expected increased cap to be adopted this year. Long waiting list progressively being cleared. Market to remain stable this year or even increase.
Turkey		Net-metering scheme for systems up to 500 kW. Large-scale project expected to be approved in 2013. Administrative process unclear. Market should take off in 2013 or 2014.
United Kingdom		Drastic reduction of FiT in 2012. Support scheme regularly adapted now. Green Certificate (GC) scheme for larger systems expected to be reviewed to align itself with FiT levels for smaller-scale installations. Clear and lean administrative processes. Road to competitiveness still long.

More detailed information per country – including the evolution of support schemes; administrative procedures; national renewable energy objectives; and potential for PV – is available for EPIA Members at www.epia.org/news/publications/global-market-outlook-for-photovoltaics-2013-2017/

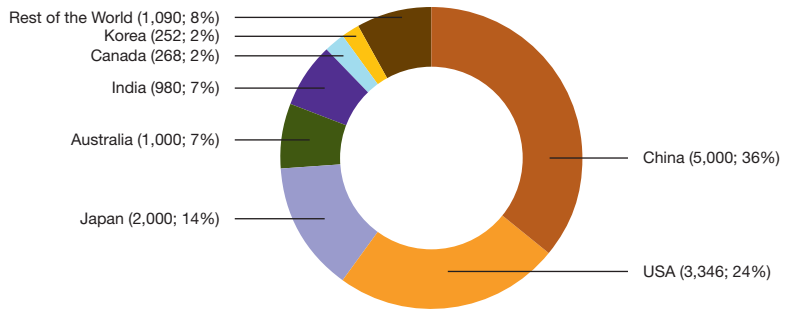
C. THE GLOBAL MARKET IN 2012 AND FORECAST UNTIL 2017

Europe has dominated the global PV market for years but the rest of the world clearly has the biggest potential for growth. This was highlighted by market developments that saw **Europe's share of the global market being reduced from 74% in 2011 to 55% in 2012.**

Driven by local and global energy demand, **the fastest PV growth is expected to continue in China and India, followed by Southeast Asia, Latin America and the MENA countries**. The PV potential of the Sunbelt countries – where PV can already compete with diesel generators for peak power generation without financial support – could range from 60 to 250 GW by 2020, and from 260 to 1,100 GW in 2030. And with the faster than expected price decrease that the industry experienced in 2011 and 2012, even more countries will see PV becoming competitive before the end of this decade.

New installations of PV systems in the rest of the world accounted for 13.9 GW in 2012, compared to 8 GW in 2011 and 3 GW in 2010. China took first place among these countries with most probably 5 GW[2], followed by the USA with 3.3 GW and Japan with a maximum of 2 GW. All are expected to continue growing in 2013, with China as one of the two top markets in 2013. Australia expanded rapidly in 2012 with around 1 GW of new installations. India installed 980 MW, finally realising a part of its huge potential. In Korea, 252 MW were installed, a sign that the market has restarted but it remains at a low level compared to Europe, constrained by a quota system. Taiwan reached for the first time the 100-MW mark with 104 MW while Thailand, with a huge pipeline of projects, commissioned 210 MW. Malaysia, where several manufacturers are producing, appears on the map with 22 MW. In the Americas, Canada has expanded slower than some have expected with 268 MW and Mexico and Peru installed several megawatts. Brazil and Chile, with their huge potential, haven't commissioned many systems yet. In the Middle East region, Israel remains the only country with a significant market, while Saudi Arabia showed in 2012 some interest for PV development. The Turkish market remains quite low for the time being despite its potential.

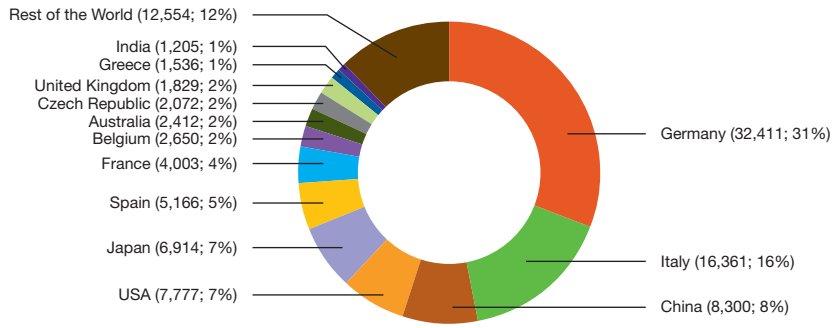
Figure 18 - PV market share outside Europe in 2012 (MW; %)



2 Official sources continue to report 3.5 GW but many analysts believe 5 GW is more in line with the market reality.

An examination of the total installed capacity reveals greater contrasts. Outside Europe, the market is well-balanced; three countries with a huge potential lead the pace, followed by an emerging secondary market. Except for the Australian boom in 2011 and 2012, the market remains under control in most countries. With that potential progressively unleashed, **the share of PV installations outside Europe can only increase**, rebalancing in such a way **Europe will represent less than half of the global PV market in 2013**.

Figure 19 - Global PV cumulative installed capacity share in 2012 (MW; %)



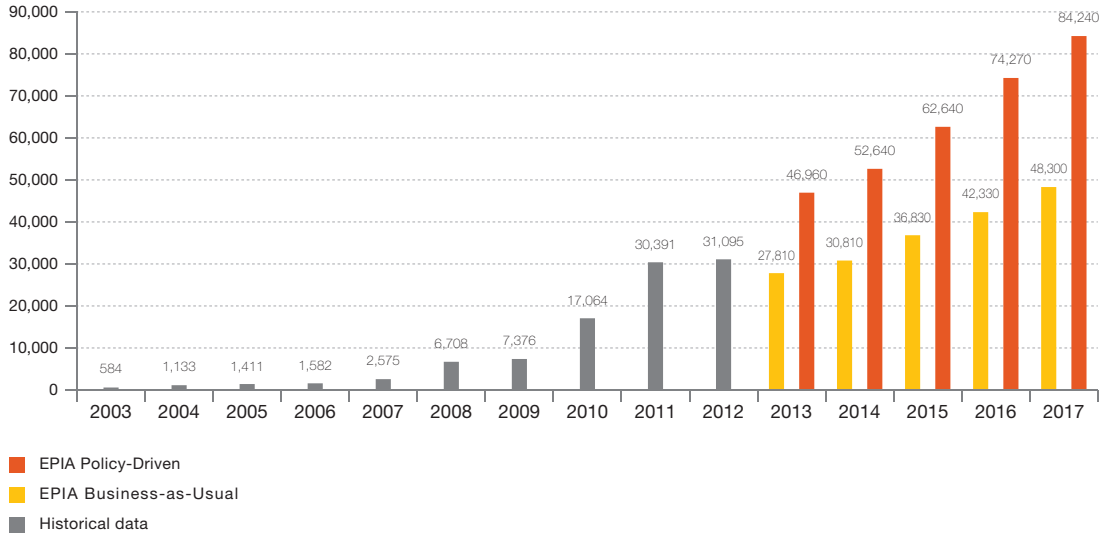
It is important to note that China climbed to third place in terms of total installed capacity in 2012, ahead of the USA and Japan, two of the pioneers of PV development.

1. Forecasts until 2017

In the Business-as-Usual scenario, the expected growth of markets outside Europe is not likely to compensate fast enough for the slowdown of the market in Europe in the two coming years. This assumes a negative perspective in most markets in the near future, especially in Europe. But even in this scenario, the global market could be as high as 48 GW in 2017.

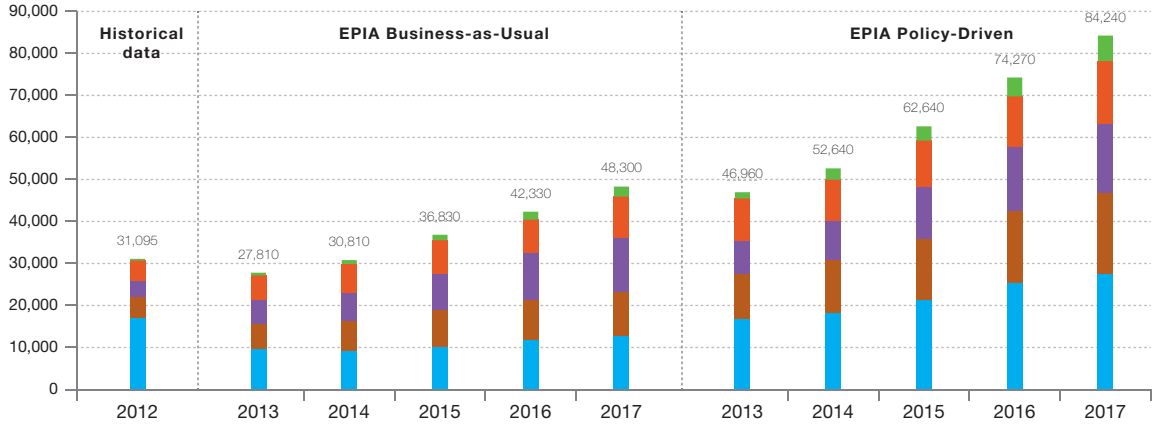
In 2012, the rapid decline of PV system prices in all markets triggered installations that compensated for the decline of the Italian market. But given the current uncertainty in the manufacturing segment of the PV industry, the stability of module prices remains an open question in the coming years – with implications for system price decreases and the opening of new markets for PV. The link between price decrease and the unlocking of new markets is the key to market development. But the inability of existing markets to absorb more gigawatts pushed prices even lower in 2012, due to overcapacity in the PV industry – itself a result of the time gap between the price decrease and the reaction of policymakers in some countries. This vividly illustrates how **PV remains a policy-driven business, where political decisions influence considerably the potential market off-take.**

Figure 20 - Global annual PV market scenarios until 2017 - Business-as-Usual and Policy-Driven (MW)



Market evolution over the next five years will depend mainly on developments in Europe and the ability of policymakers to maintain market conditions at an acceptable level. **In the Policy-Driven scenario, the European market would stabilise first around 16-17 GW in 2013 before growing slowly again to around 25-28 GW five years from now. In that case, the global market could top more than 84 GW in 2017**, with two-thirds of this coming from new markets outside Europe. The new markets could help ensure major growth even in 2013, and robust market development in the following years. EPIA expects the **APAC region (without China) to represent between 10 and 20 GW each year until 2017. China alone could add 10 GW of PV installations each year, as announced by the Chinese authorities.**

Figure 21 - Evolution of global annual PV market scenarios per region until 2017 (MW)



	2012	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
MEA	410	660	920	1,300	1,900	2,400	1,500	2,700	3,400	4,500	6,050
China	5,000	6,000	7,000	8,000	8,000	10,000	10,000	10,000	11,000	12,000	15,000
Americas	3,758	5,720	6,660	8,790	11,210	12,730	8,090	9,100	12,500	15,390	16,590
APAC	4,769	5,730	6,940	8,660	9,510	10,360	10,590	12,480	14,290	17,000	19,050
Europe	17,159	9,710	9,290	10,080	11,710	12,810	16,780	18,360	21,450	25,380	27,550
Total	31,095	27,810	30,810	36,830	42,330	48,300	46,960	52,640	62,640	74,270	84,240

The surpassing of the 100-GW mark in terms of cumulative global PV capacity in 2012 represents a major achievement of the PV industry in just a few years. Depending on the conditions of the Business-as-Usual scenario, the 200 GW mark could be reached in between 2014 and 2016, while in the Policy-Driven scenario, more than 420 GW of PV systems could be connected to the grid over the next five years.

Figure 22 - Global PV cumulative scenarios until 2017 - Business-as-Usual and Policy-Driven (MW)

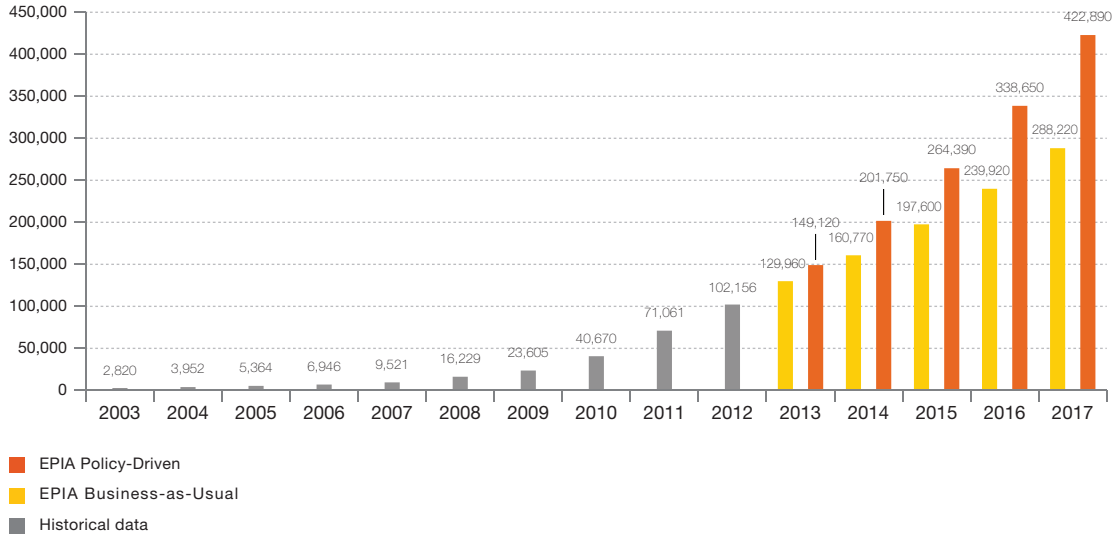
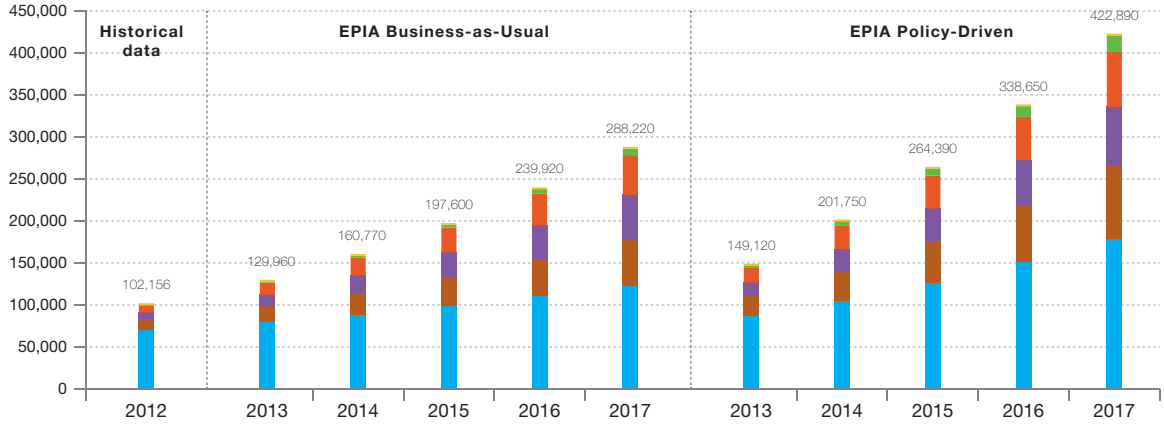


Figure 23 - Evolution of global PV cumulative installed capacity per region until 2017 (MW)



	2012	2013	2014	2015	2016	2017	2013	2014	2015	2016	2017
ROW*	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098	2,098
MEA	601	1,260	2,180	3,480	5,380	7,780	2,100	4,800	8,200	12,700	18,750
China	8,300	14,300	21,300	29,300	37,300	47,300	18,300	28,300	39,300	51,300	66,300
Americas	8,717	14,430	21,090	29,880	41,090	53,820	16,810	25,900	38,400	53,790	70,380
APAC	12,397	18,130	25,060	33,720	43,230	53,590	22,990	35,470	49,760	66,760	85,810
Europe	70,043	79,750	89,040	99,120	110,830	123,640	86,820	105,180	126,630	152,010	179,560
Total	102,156	129,960	160,770	197,600	239,920	288,220	149,120	201,750	264,390	338,650	422,890

* From 2012 onwards, these figures are directly integrated into those of the relevant regions.

2. Forecasts per segment

In 2012 rooftop segments represented around 22 GW of the total installations, while utility-scale applications reached more than 9 GW. But this segmentation will shift in the coming years. With the development of PV in the Sunbelt markets, **EPIA expects utility-scale plants to grow much faster than rooftop applications. The rooftop market could in the Policy-Driven scenario double from 2012 to 2017 while the utility-scale market could in the same scenario quadruple from 9 to 37 GW**. This can be explained by the nature of the investors in the most promising markets and the reduced opposition to ground-mounted PV systems compared to Europe. In the Business-as-Usual scenario, the rooftop market could decline in 2013 and 2014 and stagnate around the levels of 2012 until 2017.

Figure 24 - Global rooftop PV development scenarios until 2017 (MW)

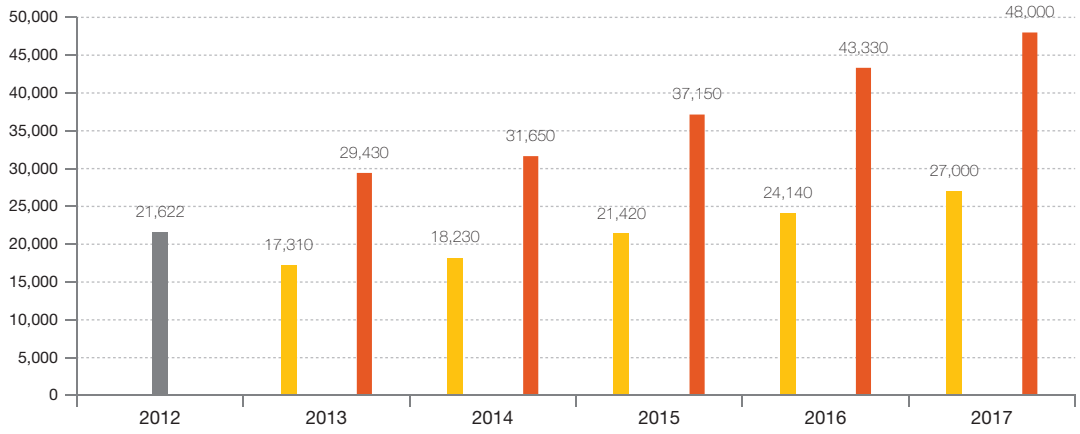
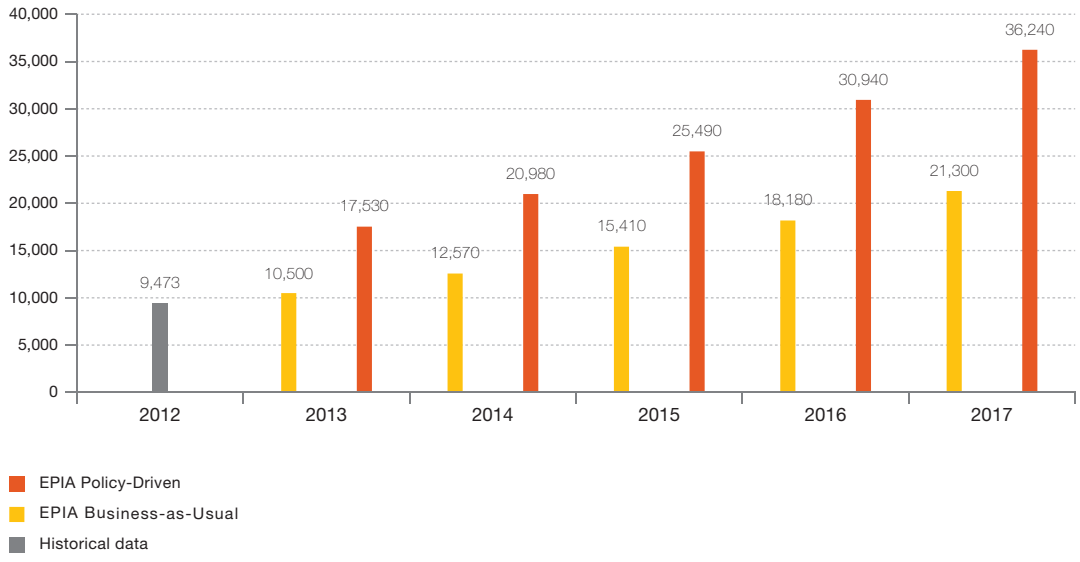


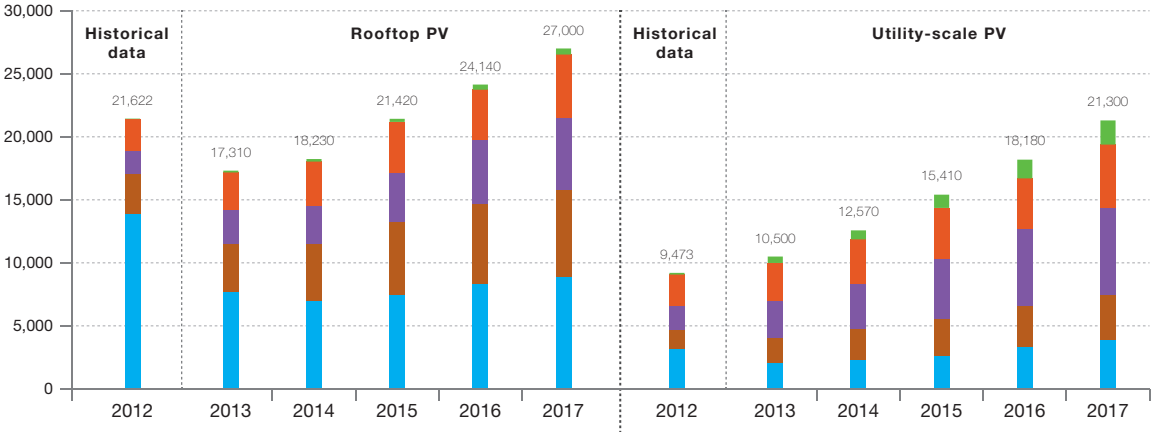
Figure 25 - Global utility-scale PV development scenarios until 2017 (MW)



In the Business-as-Usual scenario, the global utility-scale market would more than double in the next five years.

At the regional level, the utility-scale segment is expected to at best stagnate in Europe even as it booms in the Americas and Asia including China. In both scenarios, the APAC region including China should see the largest share of new utility-scale applications, ahead of the Americas.

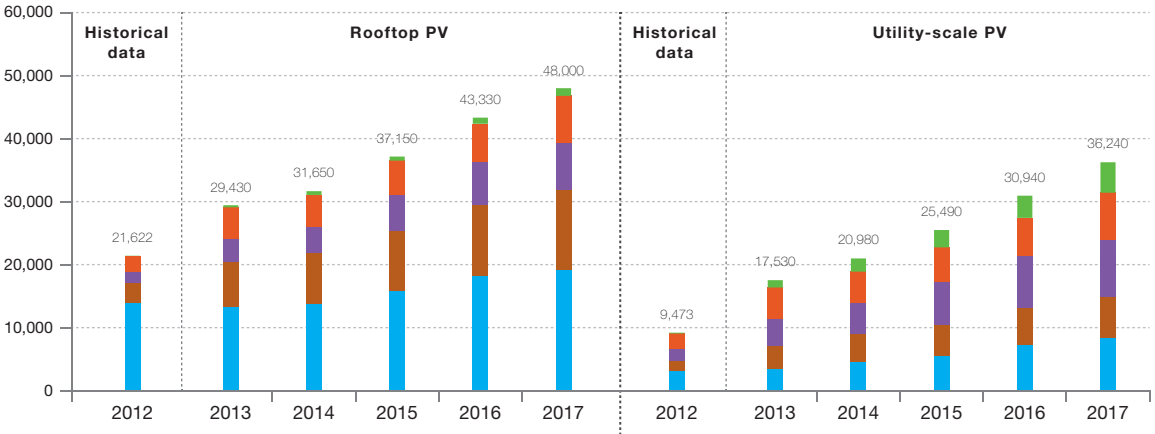
Figure 26 - Global rooftop and utility-scale PV market by region until 2017 - EPIA Business-as-Usual scenario (MW)



	2012	2013	2014	2015	2016	2017	2012	2013	2014	2015	2016	2017
MEA	47	150	200	250	410	480	362	510	720	1,050	1,490	1,920
China	2,500	3,000	3,500	4,000	4,000	5,000	2,500	3,000	3,500	4,000	4,000	5,000
Americas	1,872	2,710	3,050	3,980	5,070	5,750	1,886	3,010	3,610	4,810	6,140	6,980
APAC	3,225	3,780	4,500	5,730	6,290	6,850	1,544	1,950	2,440	2,930	3,220	3,510
Europe	13,977	7,680	6,980	7,460	8,370	8,920	3,182	2,030	2,310	2,620	3,340	3,890
Total	21,622	17,310	18,230	21,420	24,140	27,000	9,473	10,500	12,570	15,410	18,180	21,300

In the rooftop segment, Europe could still account for 30 to 40% of the global market, with the APAC region including China taking first place with 40-42% in the coming five years.

Figure 27 - Global rooftop and utility-scale PV market by region until 2017 - EPIA Policy-Driven scenario (MW)

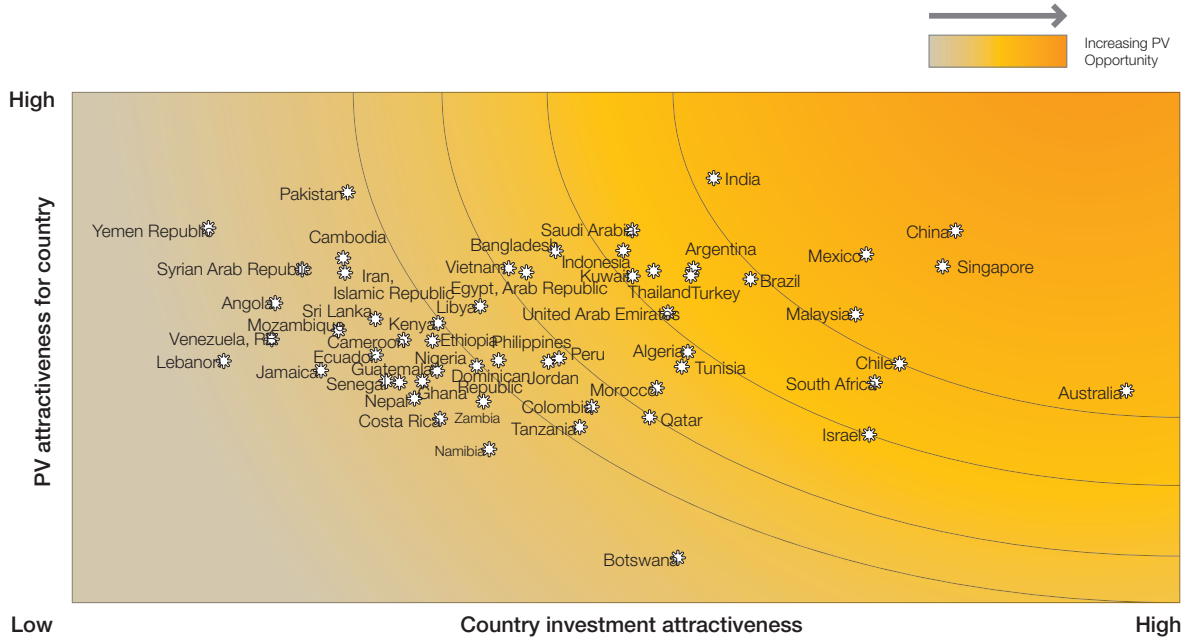


MEA	47	330	600	650	980	1,220	362	1,170	2,100	2,750	3,520	4,830
China	2,500	5,000	5,000	5,500	6,000	7,500	2,500	5,000	5,000	5,500	6,000	7,500
Americas	1,872	3,830	4,170	5,660	6,960	7,490	1,886	4,260	4,930	6,840	8,430	9,100
APAC	3,225	6,990	8,090	9,460	11,250	12,600	1,544	3,600	4,390	4,830	5,750	6,450
Europe	13,977	13,270	13,800	15,880	18,140	19,190	3,182	3,510	4,560	5,570	7,240	8,360
Total	21,622	29,430	31,650	37,150	43,330	48,000	9,473	17,530	20,980	25,490	30,940	36,240

3. Future prospects for market development

In 2010 and 2011 EPIA published the "Unlocking the Sunbelt Potential of Photovoltaics" report, aiming at paving the way for the development of PV outside its initial developed markets. The development of PV was estimated according to two sets of drivers: the attractiveness of PV for the country and the attractiveness of the country for investors. While the country attractiveness for investors can change rapidly, the accuracy of the figure below remains quite important. Since 2010, the following markets have indeed experienced some PV market development: China, Australia, India, Israel. Several others are expected to grow fast in 2013 and 2014: Mexico, South Africa, Chile.

Figure 28 - PV opportunity mapping of Sunbelt countries*



* Following countries are not shown on the mapping due to poor availability of data: Chad, Côte d'Ivoire, Congo Democratic Republic, Cuba, Iraq, Madagascar, Mali, Myanmar, Somalia, Sudan, Uganda.

Source: EPIA, Unlocking the Sunbelt Potential of Photovoltaics, 2010

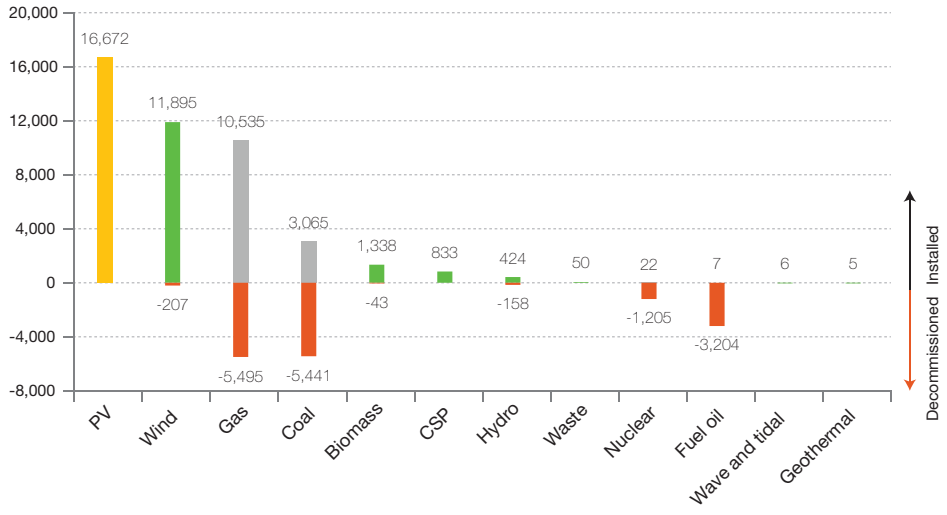
4 PHOTOVOLTAICS IN THE ENERGY SECTOR

4. PHOTOVOLTAICS IN THE ENERGY SECTOR

A. PV: THE FIRST NEW GENERATION CAPACITY IN THE EUROPEAN UNION IN 2012

For the second year in a row and the second time in history, **PV in 2012 was the number-one electricity source in the EU in terms of added installed capacity. With 16.7 GW connected to the grid**, PV outscored gas and wind. The remarkable progress made by PV over the last four years (it placed third among electricity sources for added capacity in 2009, and second in 2010) should be compared with the stability of wind penetration and the fluctuating development of gas power plant commissioning in Europe. Gas reached a peak in 2010, with more than 20 GW newly connected to the grid, before falling to slightly less than 10 GW in 2011 and above 10 GW of new installations in 2012.

Figure 29 - Power generation capacities added in the EU 27 in 2012 (MW)

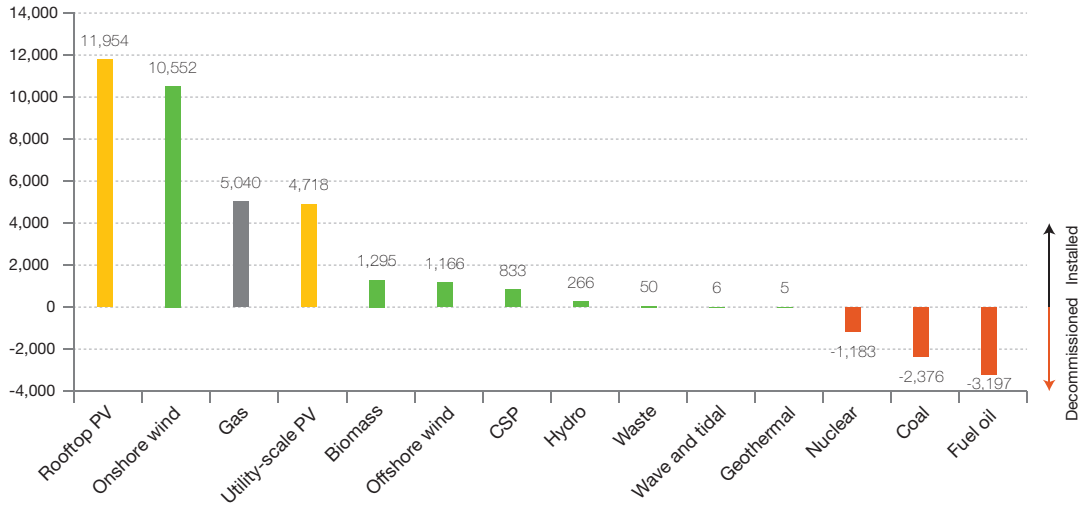


Source: EPIA, ESTELA, EWEA, Platts

Including decommissioning (which remains marginal in the PV sector so far), power generation capacities from gas rose by just 5 GW in 2012. All other production sources, renewables and conventional, are far behind. Traditional electricity sources such as nuclear, coal and fuel oil have been decommissioned more than newly installed. Fuel oil lost the most in 2012, followed by coal and nuclear. The only sources of electricity that saw capacity grow in 2012 were renewables and gas.

Figure 30 shows a slightly different perspective if PV and wind are split according to the category of the installation: Rooftop PV takes first place while large PV installations (utility-scale PV) take the fourth place. Onshore wind, which remains an important source of new electricity installations, stayed in second place while the fast growing offshore wind positions itself at the level of biomass, with a bit more than 1 GW installed and commissioned.

Figure 30 - Net power generation capacities added in the EU 27 in 2012 (MW)

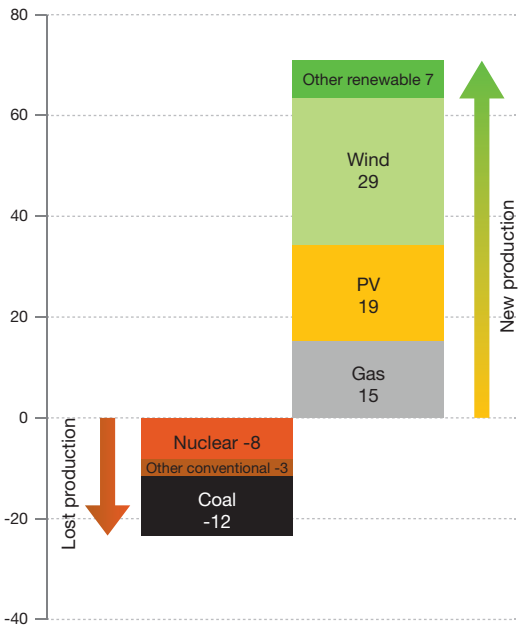


Source: EPIA, ESTELA, EWEA, Platts

B. PV CONTRIBUTES ALMOST 30% OF NEW GENERATION IN 2012

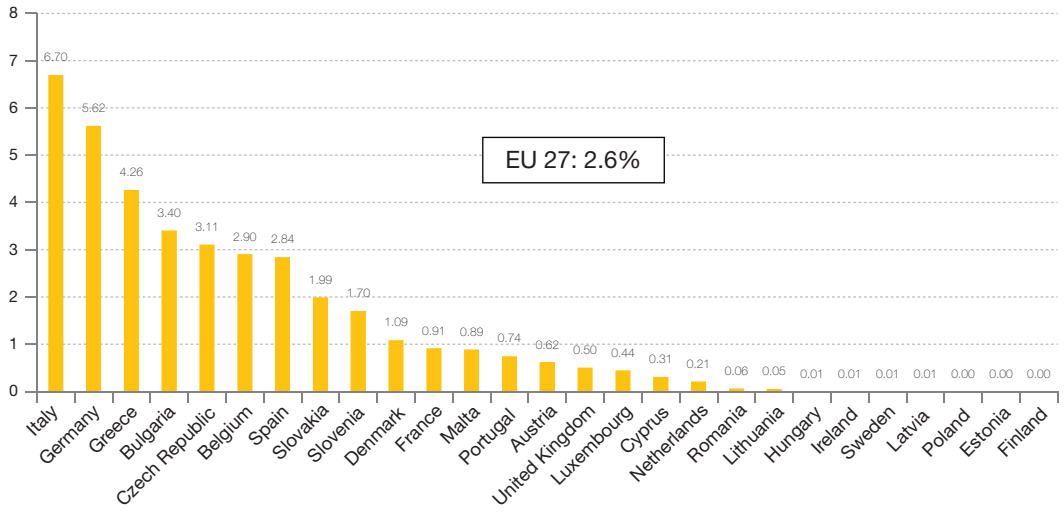
In terms of the electricity production coming from new generators connected in 2012, PV comes second, ahead of wind, after having scored first place in 2011. Due to the reduced operating hours of PV compared to wind and gas, PV additions will provide around 19 TWh of new electricity during a complete operation year, compared to 29 TWh from the new wind installations and 15 TWh from gas power plants running in average 3,000 hours a year.

Figure 31 - Theoretical balance of new electricity production in the EU 27 in 2012 (TWh)



It could be argued that gas power plants running only 3,000 hours a year are being operated at less than their theoretical production level; this reflects the reality of the electricity market in Europe in 2011 and 2012. More interesting, the energy that will be produced by new PV and wind installations in 2012 based on 2011 additions represents enough electricity to compensate for the decommissioning of nuclear, fuel oil and coal power plants in 2012. **PV continues to prove its ability to compete in the energy sector as mainstream power generation source.**

Figure 32 - PV contribution to the electricity demand in the EU 27 in 2012* (%)



* Based on 2012 cumulative installed capacity.

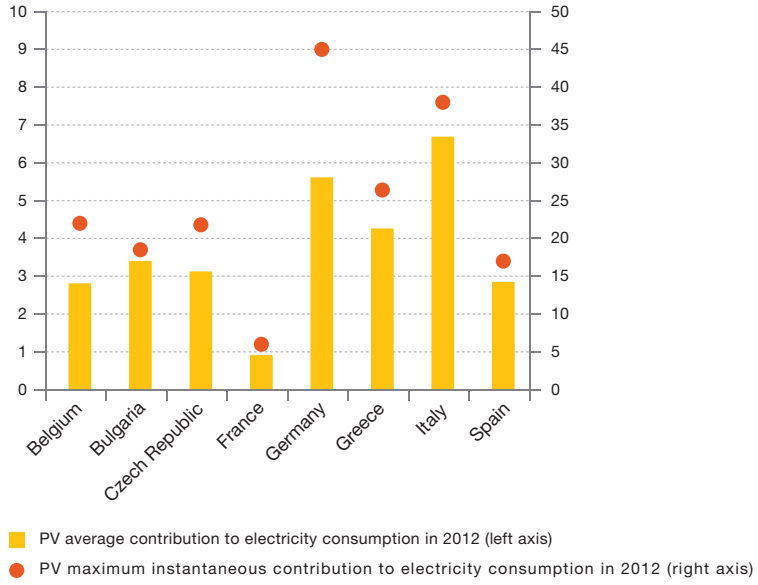
Based on the capacity installed and connected to the grid at the end of 2012, **PV can currently provide roughly 2.6% of the electricity demand in Europe, up from 1.15% at the end of 2010 and 2% at the end of 2011. In Italy, more than 6.7% of the electricity will come from PV systems connected until 2012. In Germany, this figure is more than 5.6%, while Greece reached more than 4%**. Belgium, Bulgaria and other countries are progressing rapidly as well.

In most EU countries today, PV can be considered as peak power generation. Indeed, it produces during the day, at the time of the mid-day peak, competing directly with other peak generators. If we assume that peak power generation represents roughly 50% of the electricity demand in Europe, we should look at these percentages in another way: **PV can produce today 5.2% of the peak electricity demand in the EU 27 and more than 13.5% in Italy, more than 11% in Germany**, and so on. This achievement came in just a few years and shows again how the development of PV electricity in Europe is occurring at a faster rate than almost anyone had expected.

→ PV and the electricity system

The speed at which PV developed until now introduces new challenges for the management of the electricity system. Figure 33 compares the level of contribution of PV with regard to the electricity demand (which remains quite low) and the maximum instantaneous contribution for a set of countries. The maximum ratio of power provided by PV has been compared to the load at that precise moment. In Germany 45% has been already reached while numbers above 20-25% have been recorded in several countries.

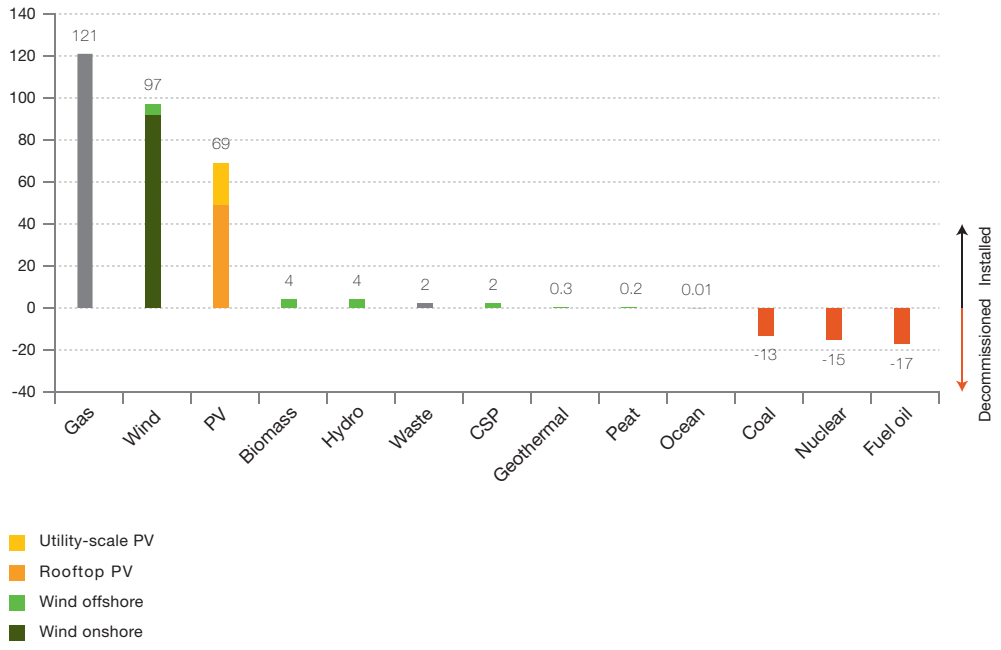
Figure 33 - Annual average and maximum instantaneous PV contribution to electricity consumption in 2012 (%)



This is the signal that power system operators, regulators and also the PV industry have to work together to integrate large amounts of PV electricity into the grids. This subject and the consequences and solutions for this large-scale integration have been developed in detail in the “Connecting the Sun” study released by EPIA in September 2012.

C. PV POSITIONING IN THE ELECTRICITY GENERATION CAPACITY OVER THE LAST 12 YEARS

Figure 34 - Net generation capacity added in the EU 27 2000-2012 (GW)



Source: EPIA, ESTELA, EWEA, Platts

Looking at the trends since 2000, PV is positioning itself in Europe as a major player, gaining on gas and wind. **With more than 70 GW installed, the PV development is only at its beginning** and more remains to be added in the coming years. Over the long term, PV market development forecasts show that **PV will most probably stay in the top three technologies in Europe**. Indeed, no other technology has reached or will reach in the five coming years enough maturity to challenge PV, wind or gas.

→ Global PV electricity production

Globally, PV represented at the end of 2012 roughly 110 TWh of electricity or 0.6% of electricity demand and 1.2% of the peak power demand. Given the speed at which markets outside Europe can develop, PV could in the coming years score the same percentage as in the best European countries.

5 INDUSTRY EVOLUTION

5. INDUSTRY EVOLUTION

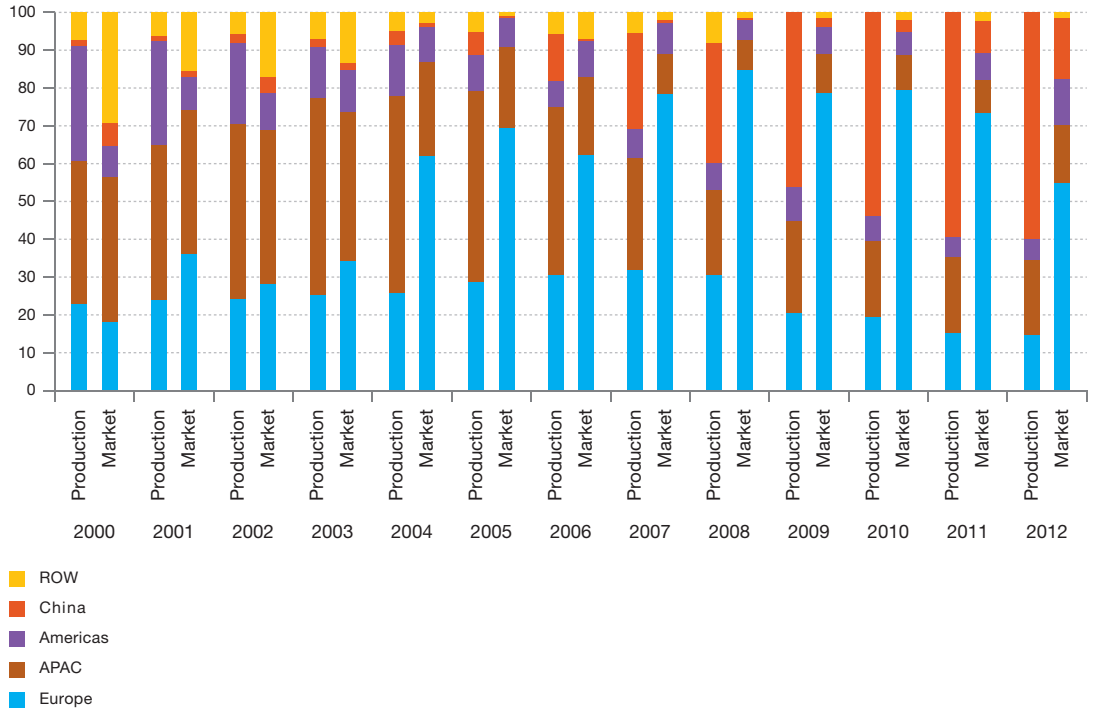
In 2012, the PV industry went again through a challenging period, with political, market and industry factors affecting business along the whole value chain. Important manufacturers disappeared, were acquired or had to adapt their business plan, decrease the utilisation rate and consequently reduce significantly their production. The tough market environment in Europe has forced many important players out of the PV business.

The PV global market capacity has evolved mainly in a context of production overcapacity. Many players entered the business ramping up very quickly their production capacity to increase their share of what in most cases was wrongly forecast, volatile and policy-driven PV demand. Despite some cases of specific material/component shortage that have been seen **in the last three years, module production capacity was in between 150-230% higher than annual global installations**.

Besides the supply and demand mismatch at a global level, the growing regional imbalance between the demand and the supply of PV modules that was observed until 2011 raised concerns. In 2012 however there were signs, still meagre, towards balancing PV market with regional supply mainly driven by the Chinese market growth.

Figure 35 highlights the evolution of the global PV module supply (or Production) and demand share (or Market) since 2000. With market in MW scale only until 2003, production met demand quite sufficiently at regional level. However, from 2004 and with the booming market, Europe became a main importer mainly from Asian countries. **Today, similarly to 2011, European industry represents only around 13% of the global market in terms of actual module production and around 24% of its own market. The rest is imported mainly from China and APAC countries which supply around 70% of the global PV demand**. China is the only country that can cover its own growing market, with 320% more production than its need. That figure is expected to go down due to local absorption of PV production.

Figure 35 - Historical PV market vs. production by region (%)



Source: EPIA, IHS Solar and Navigant Consulting

A. PRODUCTION CAPACITY VS. ACTUAL PRODUCTION

→ Regional distribution of production capacity and actual production of the upstream value chain components

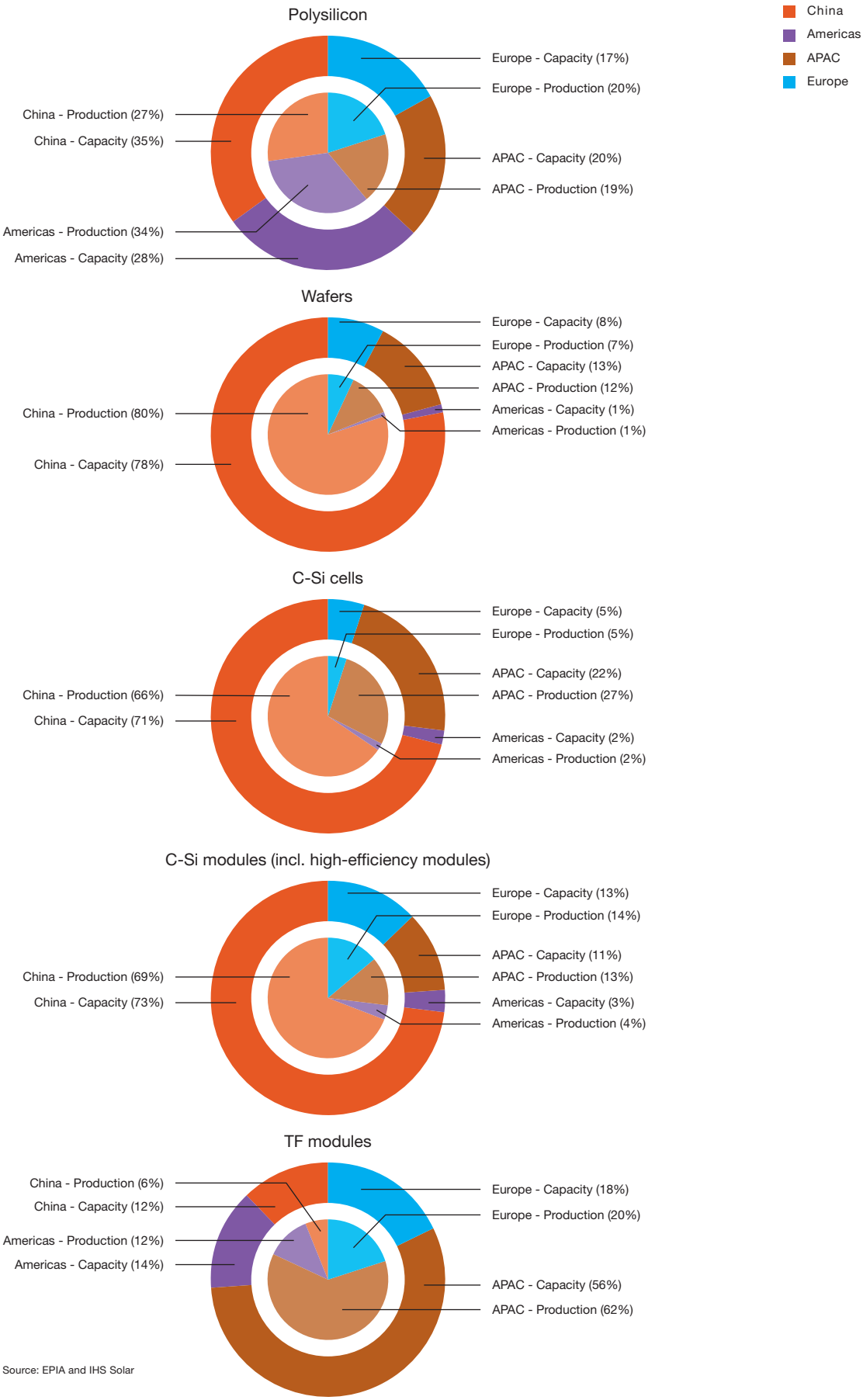
Apart from the module supply/demand regional imbalance, there has been an attempt to map the supply of the main upstream value chain parts of PV and identify the regional distribution for 2012.

Figure 36 presents the regional share of the global production capacity (outer circle) for polysilicon, wafers, c-Si cells and modules and Thin Film (TF) modules for 2012. The inner disc in each graph presents the actual production from this region, implying different utilisation rates.

The distribution of production capacities remained in general terms similar to the one of 2011 in the different value chain parts. However, the differences among the regions remained significant depending on the type of product and its position in the value chain. In all cases though, the PV industry remained strong in Asia. **Especially in wafers, c-Si cells, and c-Si modules China played and will continue playing a leading role. European production capacity remained competitive in the polysilicon business with annual capacity share reaching 17% and actual production share reaching 20% due to higher utilisation rates. The USA (included in the Americas in Figure 36), kept high shares in the polysilicon business, coming first in actual production**.

With respect to TF production capacities, Europe played an important role in 2012 by keeping above 20% shares in actual production. Germany with mainly CIGS and some CdTe technology shares contributed significantly to this share. The USA followed with a 12% share, while China kept a low profile in this sector with low production capacities and utilisation rates. The APAC region however with Japan and Malaysia as top producers covered more than 60% of the actual production of 2012.

Figure 36 - Global PV capacity vs. production in 2012 by region (%)



Source: EPIA and IHS Solar

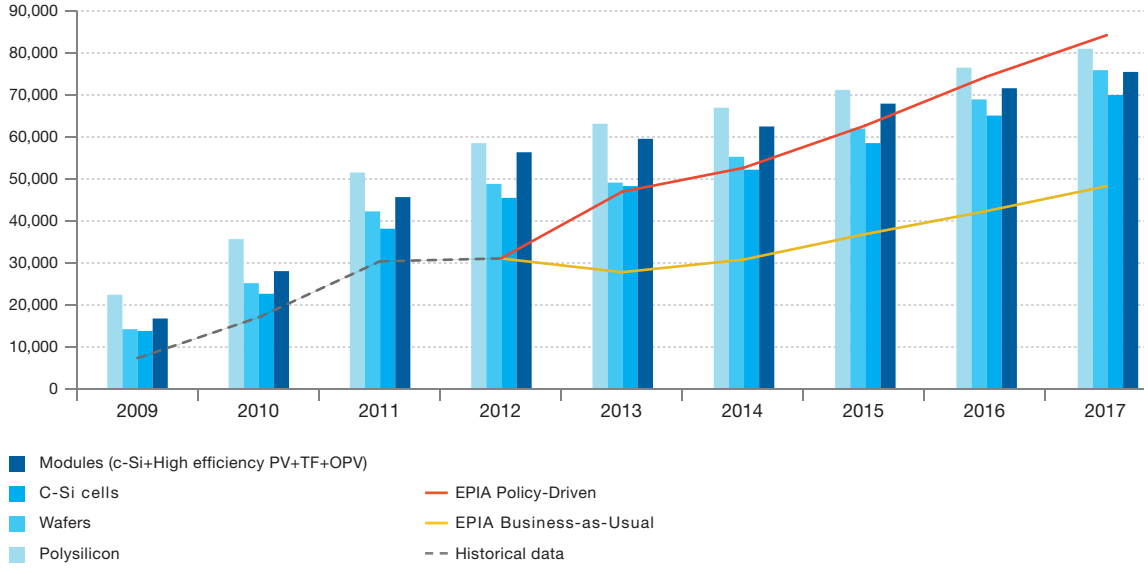
B. GLOBAL PV PRODUCTION CAPACITY OUTLOOK UNTIL 2017

→ Compound annual growth rate (CAGR) across the PV value chain

The data on overcapacity allow for a correlation between demand and production capacity in the main parts of the value chain. Figure 37 is based on IHS Solar data and should be considered as one possible indication of the current production capacities. In general, production capacities refer to announced production capacities, which are typically higher than the actual capacity (due to industrial factors, obsolete or non-competitive production lines or production incidents resulting in downtime). Finally contract manufacturing complicates the risk of double counting production capacities. Published numbers vary widely depending on the source, with production capacities sometimes reaching between 5-35 GW more than what IHS is reporting. In the worst case, overcapacity could last longer than many expect and continue to put pressure on prices.

With all due caution, **despite the consolidation phase that the PV industry is facing today, the yearly production capacity could continue growing along the whole main value chain**. This growth will happen only in case of some further market growth globally. Given the necessary time to ramp-up production capacities, capacity evolutions after 2015 should be considered as an indication of optimistic market developments in 2013 and 2014. Figure 37 should then be considered as indicative, especially given the potential gap between both market development scenarios.

Figure 37 - Global PV production capacity vs. annual PV market until 2017 (MW)



Source: EPIA, IHS Solar and SNE Research

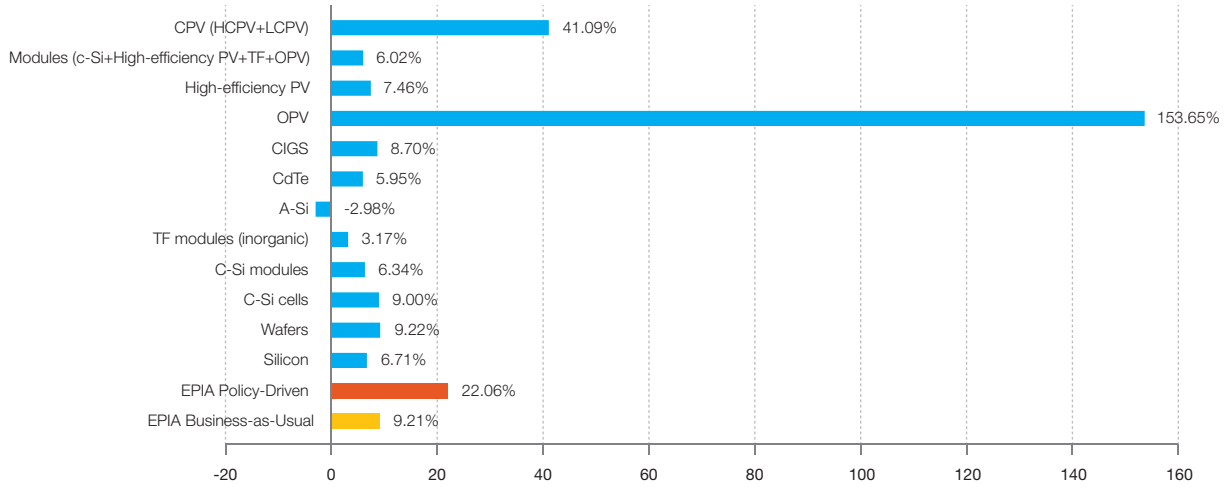
The arrival on the market of new and improved products will also create dynamics that can influence the market and industry development patterns. However, EPIA believes the future capacity growth rates will become steadier and more sustainable than in recent years, going away from the boom-and-bust cycle and disturbing mismatches between demand and production, linked to the history of market development until now.

Figure 37 shows also the overcapacity in the polysilicon sector and explains better the rationale behind the rapid price decline polysilicon experienced in 2012. While this price decline cannot be disconnected from the module price decline, it is even more acute in a sector where the European share continues to be slightly higher than in other segments of the value chain.

Figure 38 shows that at least for the next five years no major changes should be expected as far as the main technologies, crystalline silicon (c-Si) and TF, are concerned. A slightly higher growth rate is expected for c-Si mainly due to the uncertainty of amorphous silicon (a-Si) technologies, for which the growth rate might be reduced by around 3% until 2017. The reason for this negative CAGR is the lower module efficiency of a-Si in comparison with the rapid evolution of Cadmium telluride (CdTe) and Copper Indium Gallium Selenide (CIGS), limiting the market for TF modules with efficiencies below 10% on module level.

Also, it is anticipated that Concentrated Photovoltaics (CPV) will start to represent a sustainable market niche in the coming years, with many projects coming in the Sunbelt region and the USA, which will finally allow the CPV industry to develop. Other emerging technologies such as Organic Photovoltaics (OPV) will gain a respective share in the market achieving high growth rates since the current production capacity is very small. Some see as a scenario around 300 MW of produced OPV and close to 1 GW of yearly production capacity globally until 2017. But due to the low efficiency and the characteristics of this technology, it could take years to transform OPV into a viable competitor of existing technologies.

Figure 38 - PV CAGR until 2017 (%)



Source: EPIA, IHS Solar, PV Insider and SNE Research

C. TECHNOLOGY DEVELOPMENT

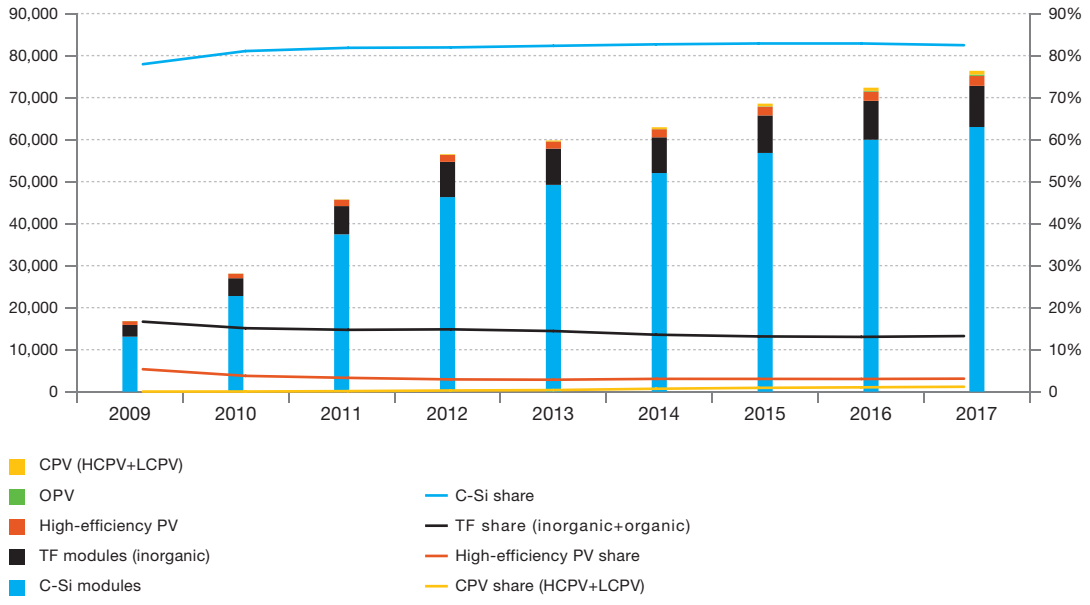
According to IHS Solar, the level of production capacity in 2012 reached 56.5 GW including all major technologies. Those capacities are likely to grow continuously, reaching a growth rate of around 6% until 2017: in the case of a fast-growing market, the production capacity could grow up to 75 GW in 2017.

The predominant c-Si technology is expected to maintain its market share at levels of around 80% (blue line in Figure 39) principally because of the maturity of the technology and also because of the existing and growing capacity in China and APAC countries, which favour wafer-based technologies. The low production costs of c-Si technologies will allow it to remain the top PV technology in the coming years. Cost reductions and record efficiencies on cell and module level keep the LCOE values low and the attention of the existing and new industry players high, making c-Si appear to be a less risky investment under healthy market conditions.

After the huge growth expectations of TF technologies some years ago, the competing market price of c-Si has slowed the development of TF. The latter are expected to grow anyway at a lower rate, and therefore will stabilise their market share over the next five years. Among emerging technologies, OPV technologies and especially CPV technologies (both Low CPV (LCPV) and High CPV (HCPV)) are expected to enjoy around 1% of the market share by 2017.

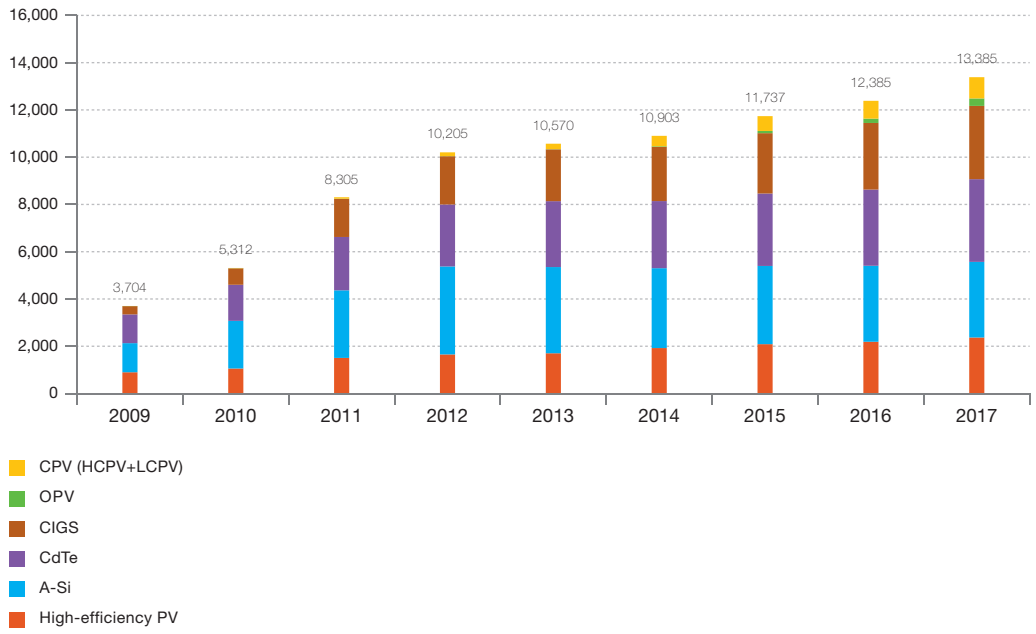
As far as high-efficiency (above 20%) modules are concerned, due to lower competition within the respective players a 3% share could easily be reached. In addition the overall efficiency of PV modules should increase thanks to the generalisation of 20%-efficiency cells, in between the traditional c-Si and the high efficiency mentioned here.

Figure 39 - PV modules production capacity until 2017 (MW; %)



Source: EPIA, IHS Solar, PV Insider and SNE Research

Figure 40 - Non c-Si PV production capacity until 2017 (MW)



Source: EPIA, IHS Solar, PV Insider and SNE Research

CPV, mainly HCPV, is considered by some as a sleeping giant. CPV is expected to reach around 1 GW of production capacity by 2017 (Figure 40) meeting mostly HCPV installation demand. Emerging markets with high irradiation levels will provide market momentum to the technology, which has become very interesting to investors by achieving LCOE numbers similar to mainstream technologies.

OPV and other emerging technologies are expected to create their own niche markets in the coming years, at a very low level compared to the global PV market. EPIA expects such technologies to make a stronger presence but not before 2015 at soonest, assuming that current R&D will push down the costs (around 10 times higher today than conventional PV), and adapt them better to new customer needs to be served, possibly BIPV or totally new uses such as the automotive industry. The expectations are based on the assumption that after 2015 the PV industry will have emerged from today's consolidation period and there will be a healthier arena for such investments.

6 CONCLUSION

6. CONCLUSION

After many years of unfettered growth and innovation, the PV industry is now going through a challenging period, with shifting market dynamics and changing political support creating a climate of uncertainty. Still, even in 2012, in the midst of an economic crisis, the market for PV in Europe and around the world was strong – with more than 31 GW of new capacity.

Going forward, key questions will play a role in determining how market evolution takes place:

- **Policy:** The PV market remains in most places a policy-driven one, linked to changing political environments and commitments from government in a rather limited set of countries; **with the right decisions to create smart and sustainable support schemes for PV, markets can continue to grow**
- **Competitiveness: PV is rapidly becoming competitive**, in terms of LCOE, with other power sources – and in some countries in some segments, it already is; **grid and especially market integration challenges will however increasingly hamper future PV deployment**
- **Industry consolidation:** The current world overcapacity in PV modules is having a severe effect on companies all along the solar value chain; how this plays out will have an effect on market development
- **Trade:** trade disputes in parts of the PV value chain are creating uncertainty that may affect markets forecasts in the next few years

Amid all these questions, what remains unchanged is the enormous potential and undeniable benefits solar PV is already bringing to the power system – where it is becoming a mainstream player – and the promise it holds for helping achieve vital energy, environmental and economic goals.

The results of 2012 bear this out. But they also reveal that a shift is taking place in PV markets – from one driven mostly by Europe to one that also depends on countries around the world with varying degrees of solar potential and the political will to exploit it.

How much more the global market can grow in 2013 remains a question: The economic situation in Europe makes the moderate scenario more likely for the short term. A 15 GW showing in Europe could bring the world market easily above 35 GW, depending on the reaction of emerging markets. But a low market in Europe will most likely prolong the imbalance between supply and demand of PV components, making 2013 a difficult year for PV companies. **Renewed political resolve is needed to restore investor confidence, remove bottlenecks and maintain a reliable but dynamic framework for the remuneration of PV.**

But under even the most pessimistic scenario, PV will continue to increase its share of the energy mix in Europe and around the world, becoming a reliable source of clean, safe and infinitely renewable energy for all.

GLOSSARY

Alternating Current (AC): Electric current that periodically reverses its direction of flows - 50 times per second (Hz) for Europe, China, East Japan among others and 60 times per second for the USA, West Japan, Brazil. Solar PV power must be converted from DC (see below) to AC using a power inverter.

Connected capacity: Refers to generating systems (e.g. PV generators) that have been installed and allowed to inject electricity into the grid.

Direct Current (DC): Electric current that flows only in one direction. Solar PV power starts as DC and is normally converted to AC using a power inverter.

Dynamic grid parity: Refers to the moment at which, in a particular market segment in a specific country, the present value of the long-term net earnings (considering revenues, savings, cost and depreciation) of the electricity supply from a PV installation is equal to the long-term cost of receiving traditionally produced and supplied power over the grid.

Feed-in Tariff (FiT): Policy mechanism created and regulated by government to promote investment in RES (e.g. PV technology). Under FiT schemes renewable electricity producers are offered long-term contracts under which a guaranteed fixed amount of money is paid to them, usually by the utility provider (national or local), for the energy fed into the grid. The FiT rate is typically set above market rates, offsetting inherent risks in renewable energy production.

Green Certificate (GC): Tradable certificate that represents the environmental or social benefits of (green) electricity generated from RES such as PV. Green certificates can be purchased both from electricity producers and consumers as a proof of producing or consuming renewable electricity.

Installed capacity: Refers to systems put in place but awaiting the approval of the grid operator to inject electricity into the grid. It should not be confused with connected capacity (see above).

Net metering: Compensation scheme that allows electricity consumers to reduce their electricity bills by giving them credit for the electricity produced by their PV system over a certain period of time (usually one year).

Self-consumption: Possibility for any kind of electricity producer to directly use/consume part or all of the electricity produced at the same location (on-site consumption), instantaneously.

LIST OF FIGURES AND TABLES

EPIA
European Photovoltaic Industry Association

EPIA - the European Photovoltaic Industry Association - represents members active along the whole solar PV value chain: from silicon, cells and module production to systems development and PV electricity generation as well as marketing and sales. EPIA's mission is to give its global membership a distinct and effective voice in the European market, especially in the EU.

European Photovoltaic Industry Association
Renewable Energy House
Rue d'Arlon 63-67, 1040 Brussels - Belgium
T +32 2 465 38 84 - **F** +32 2 400 10 10
info@epia.org - www.epia.org

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