SOLARTECHNIK PAUL

Example of a 600 kWcp solar plant on the roof of an agricultural building, in Sittensen, Germany.

94,568 MWp

in the European Union at the end of 2015

PHOTOVOLTAIC BAROMETER

A study carried out by EurObserv'ER

EurObserv'ER

The European Union solar photovoltaic market picked up in 2015 after three successive years of decline. It registered 3% growth over the twelve-month period, by installing 7 226 MW, which took Europe's installed capacity to date to 94.6 GW. The global market soared by comparison, gaining 25% year-on-year and connecting at least 50 GW, which took global PV capacity past the 227-GW mark.

100.5 TWh

Photovoltaic electricity generated in the EU in 2015

7,226.4 MWp

Photovoltaic capacity connected in the EU in 2015

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The Centinela Solar Energy project, 170 MWp, in Imperial County, California (USA).

The global photovoltaic market as expected, posted further steady growth. According to Solar Power Europe, it increased by 25% to stand at 50.1 GWp (40.2 GWp in 2014). World installed photovoltaic capacity was put at 177 GWp in 2014 by IEA-PVPS experts in the publication Trends 2015 in Photovoltaic Applications, and rose to at least 227 GWp by the end of 2015. There are higher estimates from other sources such as BNEF (Bloomberg New Energy Finance) which puts it at 57 GW, for about 30% annual growth of and consultants IHS, who reckon it rose to as much as 59 GW, namely a 35% increase over its 2014 level.

GOOD PROSPECTS FOR THE GLOBAL SOLAR MARKET

China's photovoltaic market is light years ahead of the rest of the world. Its National Energy Administration (NEA) claims that at least 15 GW of capacity was connected to the grid in 2015, which takes the Chinese installed photovoltaic base to 43.2 GW. The country can now lay claim to the installed solar capacity record, as it overtook Germany (39.8 MW) in 2015. The NEA also predicts that in line with its 13th five-year plan, China should triple its capacity by 2020, by adding 15–20 GW of solar capacity per annum, which should raise its capacity to more than 140 GW.

Initial estimates from PV Market Alliance suggest that Japan was runner-up to China in the global market stakes, with about 10 GW installed in 2015, which took its PV capacity to at least 33.4 GW. The Japanese PV sector's growth prospects look rosy as METI (Ministry of Economy, Trade and Industry) has approved at least 79.8 GW of photovoltaic projects since the Japanese programme rolled out in 2012. This market growth is coupled with a fall in production subsidies. Accordingly the government reduced the Feed-in Tariff by 11% on April 1 2016 from 27 to 24 yen/kWh (€ 0.22 to 0.19/kWh) for >10-kW installations, and by 35 to 33 yen/kWh (€ 0.276 to 0.26/kWh) for <10-kW installations with inverters.

The US market is also in good shape. The US Solar Market Insight report jointly published by Solar Energy Industries Association (SEIA) and consultants GTM Research, states that the USA installed 7.3 GW in 2015, which equates to a 16% annual growth rate. Cumulative on-grid capacity now stands at 26.5 GW, with more than 900 000 individual installations. The report states that in the first quarter of 2016, the figure should rise to one million. These new installations break down into 4 150 MW (a 6% rise) of large solar parks, 2 099 MW in the residential sector (a 66% annual rise) and 1 011 MW in the non-residential sector (a 5% decline). Prospects for US market expansion are looking very good because they are boosted by the extension of the Federal Investment Tax Credit and the rate will be maintained at 30% until 2019 (it will then drop gradually until 2022). In practice, this extension includes a construction kick-off clause that extends the completion deadlines through to 2023, providing the solar industry with eight years of visibility.

According to GTM Research, the resulting cumulative capacity is likely to be 97 GW by the end of 2020, with an additional 16 GW expected as soon as 2016. The reason for this predicted installation rush is that a number of states, such as California, are setting up net metering. Another factor is the expected reduction in ITC to 10% after 2016, which at the end of the day the Federal Government finally dropped.

Lastly, the Indian market is so on the up-and-up. Consultants Indian Mercom Capital claim that it grew by 142% in 2015 to reach 2.1 GW (833 MW in 2014 and 1 004 MW in 2013). The market should exceed 4 GW in 2016 and could rise to 8 GW as early as 2017. India is thus set to become a future growth driver of the global solar market.

THE EUROPEAN MARKET PUTS ON A SPURT

The European Union market picked up in 2015 putting an end to a three-year slump by increasing its connection rate slightly. According to EurObserv'ER, more than 7.2 GW of capacity was installed in 2015, which equates to 3% year-on-year growth **(table 1).** However the installation is a far cry from the levels of 21.9 GW and 17.5 GW respectively witnessed in 2011 and 2012 reported by Eurostat. Notwithstanding, with cumulative capacity standing at 94.6 GW **(table 2),** the European Union's installed base is still more than twice that of China thanks to past investment. The European market suffers from over-concentration as three countries – the UK, Germany and France – accounted for 79.9% of the connections made in 2015. For the second year running, the UK was the European market leader with 3 537.8 MW… twice the size of the German market (1 355 MW) and 4 times that of the French market (879.5 MW). The Netherlands (357MW) and Italy (302 MW) are ranked 4th and 5th.

The low number of actors in the European Union PV market does not bode well for its sustainable recovery. The photovoltaic development context has deteriorated politically in contrast to most of the world's major markets. Europe's electricity market is in crisis, beset by generating capacities surplus to requirements.

Many companies, whose operating rationale was based on their national requirements, find it hard to adapt to Europe-wide integrated approach to the electricity markets advocated by the politicians. The construction of this market, which in practice has stepped up EU grid coupling, has resulted in sharing existing production capacities and reducing peak capacity requirements. Yet at the turn of the century, many companies invested heavily in gas power plants to meet peak demand, in expectation of an increase in electricity demand but their assumptions have been dashed. Electricity needs since the 2007 financial crisis and the current deindustrialisation of Europe have been dwindling all the time. Concomitantly renewable project developers enjoyed preferential access to the grid and took full advantage of the guaranteed incentive systems. PV power of all the renewable electricity sectors is the highest performer in terms of output. According to EurObserv'ER it passed the 100-TWh mark, namely 100.5 TWh, and enjoyed 9.2% annual growth in 2015 **(table 3).** Sector output in 2008, was only 7.4 TWh.

The major energy operator lobby is now exerting very strong pressure on politicians to limit the growth of new renewable energy production capacities. These operators they need to delay RES development so that they can maximize the amortisation of their past investments. Some unamortized power plants are in such dire financial straits that they will have to be closed to cut losses.

This situation has prompted a number of European countries to call on the European Commission to change its renewable energy strategy and the change of direction was formalised in 2014 by the publication of a document that established new "Guidelines on State aid for environmental protection and energy 2014-2020". To encourage RES integration into the electricity market, beneficiaries of incentives since 1 January 2016, have been obliged to sell their electricity directly in the market and are subject to the same obligations as the other players. The incentives must be granted in the form of a premium added to the market price. The beneficiaries are subject to standard balancing responsibilities and measures must be put in place to ensure that the generators have no incentive to generate electricity under negative prices. These conditions do not apply to installations with less than 500 kW of installed capacity, or to demonstration projects. A new phase will start on 1 January 2017, when applicants for aid will have to go through a clear, transparent and non-discriminatory competitive bidding process.

The purpose of these measures, which are already in force in Germany **(see below),** is to facilitate the integration of solar photovoltaic into the European

electricity market, but it will effectively curb new high-capacity ground-based solar power park projects.

SELF-CONSUMPTION TAKES OVER

According to Solar Power Europe, which represents the interests of the European photovoltaic sector, the European market is currently in transition, changing from a market whose growth was driven by the implementation of guaranteed Feed-in Tariffs to a new market structure, where "prosumers" (producing consumers) will use solar electricity for self-consumption in residential, commercial or industrial sectors. The plummeting cost of solar power offers consumers new opportunities, as they have every interest in producing their own electricity for less than price charged by the grid.

Many European Union countries have already made provisions for developing self-consumption. However, the raft of measures taken to promote or manage this development is a minefield for PV development. Authorized self-consumption installation capacities vary from country to country. In March 2016 the IEA-PVPS published a report entitled Review and Analysis of PV self-consumption policies, which summarizes the various policies that aim to manage or promote self-consumption and facilitate understanding of this market.

In Germany, self-consumption was initially encouraged by a premium system for each self-consumed kilowatt hour. It was subsequently replaced by a simpler system, which boosted development. Any surplus electricity injected into the grid benefits from payment of a market premium, or from the Feed-in Tariff system. Only 90% of the electricity generated by installations with installed capacity of 10 kW–10 MW is likely to benefit from a tariff, which effectively allocates 10% of the production to self-consumption. Since 2014, new systems operating in self-consumption mode must pay an electricity bill tax, which is earmarked for contributing to financing renewable electricity. Installations with less than 10 kW of capacity are exempt, whereas the others have to pay 30% tax, and this rate will rise to 40% in 2017. The German government has also decided

Tabl. n° 1

Photovoltaic capacity installed and connected in European Union during the years 2014 and 2015 (in MWp)*

	2014			2015*		
	On-grid	Off-grid	Total	On-grid	Off-grid	Total
United Kingdom	2,526.6	0.0	2,526.6	3,537.8	0.0	3,537.8
Germany	2,006.0	0.0	2,006.0	1,354.8	0.0	1,354.8
France	952.0	0.1	952.1	879.5	0.0	879.5
Netherlands	302.0	0.0	302.0	357.0	0.0	357.0
Italy	189.0	1.0	190.0	301.0	1.0	302.0
Denmark	29.2	0.4	29.6	180.3	0.2	180.5
Austria	159.0	0.3	159.3	150.0	0.0	150.0
Belgium	218.0	0.0	218.0	88.0	0.0	88.0
Hungary	42.7	0.1	42.8	60.0	0.0	60.0
Poland	25.0	0.5	25.5	57.0	0.0	57.0
Sweden	35.1	1.1	36.2	50.1	0.5	50.6
Spain	2.0	17.0	19.0	0.0	49.0	49.0
Portugal	119.0	1.2	120.2	37.0	0.0	37.0
Romania	270.5	0.0	270.5	32.4	0.0	32.4
Malta	26.6	0.0	26.6	18.4	0.0	18.4
Czech Republic	0.0	0.0	0.0	15.6	0.0	15.6
Luxembourg	15.0	0.0	15.0	15.0	0.0	15.0
Croatia	14.0	0.2	14.2	10.5	0.2	10.6
Greece	16.9	0.0	16.9	10.4	0.0	10.4
Lithuania	0.0	0.0	0.0	5.0	0.0	5.0
Cyprus	29.7	0.2	30.0	4.7	0.0	4.7
Estonia	0.0	0.0	0.0	4.0	0.0	4.0
Finland	0.0	2.0	2.0	0.0	3.5	3.5
Slovenia	7.7	0.0	7.7	1.4	0.0	1.4
Slovakia	2.0	0.0	2.0	1.0	0.0	1.0
Ireland	0.0	0.0	0.1	1.0	0.0	1.0
Bulgaria	1.3	0.0	1.3	0.1	0.0	0.1
Latvia	0.0	0.0	0.0	0.0	0.0	0.0
European Union	6,989.4	24.2	7,013.6	7,172.1	54.4	7,226.4

*Estimate. **Overseas department not included for France. **Source: EurObserv'ER 2016**

Tabl. n° 2

Connected and cumulated photovoltaic capacity in the European Union countries at the end of 2014 and 2015 (in MWp)*

	2014			2015*		
	On-grid	Off-grid	Total	On-grid	Off-grid	Total
Germany	38,343.0	65.0	38,408.0	39,697.8	65.0	39,762.8
Italy	18,609.0	13.0	18,622.0	18,910.0	14.0	18,924.0
United Kingdom	5,377.6	2.3	5,379.9	8,915.4	2.3	8,917.7
France**	5,669.1	30.0	5,699.1	6,548.5	30.0	6,578.5
Spain	4,761.8	110.0	4,871.8	4,761.8	159.0	4,920.8
Belgium	3,140.0	0.1	3,140.1	3,228.0	0.1	3,228.1
Greece	2,595.8	7.0	2,602.8	2,606.2	7.0	2,613.2
Czech Republic	2,067.4	0.4	2,067.8	2,083.0	0.4	2,083.4
Netherlands	1,043.0	5.0	1,048.0	1,400.0	5.0	1,405.0
Romania	1,292.6	0.0	1,292.6	1,325.0	0.0	1,325.0
Bulgaria	1,019.7	0.7	1,020.4	1,019.8	0.7	1,020.5
Austria	779.8	5.5	785.2	929.8	5.5	935.3
Denmark	600.2	1.8	602.0	780.5	2.0	782.5
Slovakia	590.0	0.1	590.1	591.0	0.1	591.1
Portugal	418.0	5.0	423.0	455.0	5.0	460.0
Slovenia	255.9	0.1	256.0	257.3	0.1	257.4
Hungary	77.0	0.7	77.7	137.0	0.7	137.7
Sweden	69.9	9.5	79.4	120.0	10.0	130.0
Luxembourg	110.0	0.0	110.0	125.0	0.0	125.0
Poland	27.0	2.9	29.9	84.0	2.9	86.9
Malta	54.8	0.0	54.8	73.2	0.0	73.2
Lithuania	68.0	0.1	68.1	73.0	0.1	73.1
Cyprus	63.6	1.1	64.8	68.4	1.1	69.5
Croatia	33.5	0.7	34.2	44.0	0.9	44.8
Finland	0.2	11.0	11.2	0.2	14.5	14.7
Estonia	0.0	0.1	0.1	4.0	0.1	4.1
Ireland	0.2	0.9	1.1	1.2	0.9	2.1
Latvia	1.5	0.0	1.5	1.5	0.0	1.5
European Union	87,068.5	273.1	87,341.5	94,240.5	327.4	94,567.9

* Estimate. **Overseas department included for France. **Source: EurObserv'ER 2016**

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to foster photovoltaic systems equipped with storage batteries. It has set up a new incentive system funded to the tune of 30 million euros that will run until the end of 2018. The programme, which exclusively applies to <30 kW-capacity systems, will award aid on a sliding scale. For the period from March to June 2016, the subsidy will be 25% of the system and installation cost. It will then drop to 22% from July to December 2016, then to 19% from January to June 2017, and so on to the lowest rate of 10% applicable from July to December 2018. Furthermore, these installations are eligible for preferential financing rates via the German Development Bank, KfW. Self-consumption is also authorized in Italy, via the implementation of its Scambo Sul Posto (SSP) programme. Under this system, electricity injected into the grid is remunerated via an "energy quota" based on the market price and a "service quota", which is tied to the grid costs.

The Swedish government chose to support self-consumption starting in 2015. The mechanism is a tax credit that works like a Feed-in Tariff and is fixed at 0.60 SEK/kWh (0,07 c€/kWh) with an injection ceiling of 30 000 kWh. In the Netherlands, net metering has been adopted, thus self-consumption is encouraged but not actually subsidised. When electricity production exceeds consumption, the prosumer is paid a relatively low Feed-in Tariff; however the government does promote collective projects. Individual consumers are eligible for a form of virtual net metering if they take part in a residential PV project within their community or neighbouring community boundaries[1]. Belgium has also opted for a net metering system for <10-kWp installations. Denmark has its own net metering system based on energy compensation calculated on an hourly basis. France has authorized self-consumption, but its unattractively low electricity prices have cramped development. PV systems operating in self-consumption mode are eligible for a Feed-in Tariff that pays for the electricity injected into the grid. Discussions are in progress to increase the fixed part of grid access costs and reduce the variable costs, which obviously make self-consumption less attractive. Some countries have an even stricter view on self-consumption development that works against the interests of electricity suppliers and distribution grid operators.

In October 2015, the Spanish government passed a highly controversial decree introducing taxation on solar self-consumption, which will be applied retroactively and to new installations. The tax couples a fixed contribution based on installed capacity with a variable output-related contribution. The decree provides for sparing small consumers (<10-kWp) by exempting them from the output tax, but making them pay the capacity tax. However 10–100-kWp capacity power plants will receive no payment for any surplus electricity that they inject into the grid. Lastly, operators of large power plants will only be paid the market rate for their surplus. Enactment of the decree can only follow its publication in the *Official Bulletin*, and this is expected to occur in the coming weeks. The text, which has been debated since 2013, has stalled the development of Spain's self-consumption market. The Spanish solar industry players claim that to avoid the "sun tax", the current self-consumption market essentially comprises off-grid systems whose market volume was about 49 MWp in 2015.

Tabl. n° 3

***Electricity production from solar photovoltaic power** in European Union in 2014 and 2015* (in TWh)*

	2014	2015*
Germany	36.056	38.432
Italy	22.306	22.847
Spain	8.218	8.264
United Kingdom	4.050	7.556
France	5.905	6.700
Greece	3.792	3.818
Belgium	2.883	2.865
Czech Republic	2.123	2.261
Romania	1.295	1.328
Bulgaria	1.244	1.305
Netherlands	0.785	1.052
Austria	0.785	0.935
Portugal	0.627	0.789
Denmark	0.596	0.724
Slovakia	0.625	0.626
Slovenia	0.257	0.284
Sweden	0.072	0.117
Luxembourg	0.095	0.108
Hungary	0.056	0.108
Malta	0.068	0.096
Cyprus	0.061	0.087
Lithuania	0.073	0.073
Poland	0.019	0.056
Croatia	0.036	0.054
Finland	0.008	0.010
Estonia	0.001	0.002
Ireland	0.001	0.001
Latvia	0.000	0.001
European Union	92.037	100.498

Estimate. **Overseas department not included for France.* ***Source: EurObserv'ER 2016*

1) Details on this initiative are given in The State of Renewable Energies in Europe, *2015, p. 190 www.eurobserv-er.org/15th-annual-overview-barometer/*

NEWS FROM AROUND THE MAJOR EUROPEAN MARKETS

The UK plans to restrain its market

The UK was the European Union photovoltaic market leader for the second year running. According to the Department of Energy & Climate Change (DECC), 3 537.8 MWp of photovoltaic capacity was connected up in 2015 (2 526.6 MWp in 2014), taking the UK's cumulative capacity to 8 915.4 MWp. The highest increase came in March 2015, before the RO (Renewables Obligation) system closed to high-capacity plants (on 1 April 2015). The sectors' players considered closure of the RO scheme to be harmful because the remaining Contracts for Difference (CfD) system only applies to >5-MWp plants. Consequently, the Feed-in Tariff system is intended to apply to <5-MWp plants for 20 years. However, the paltry FiT rates make the scheme unviable. Furthermore, as previously announced, DECC made drastic cuts to its Feed-in Tariffs from 8 February 2016 onwards. For the residential sector the tariff dropped from 12 p to 4.39 p/kWh (€ 0.058/kWh), while the rate for small-scale commercial projects was cut to 4.59 p from 10.9 p/kWh and the <5-MW ground-mounted power plant FiT tariff was slashed to a token 0.87 p/kWh (€ 0.011/kWh) from 4.44 p.

Under the new mechanism, new PV capacity will also be capped with ceilings of

The DHL "hub" in Leipzig airport (Germany), has photovoltaic modules producing more than 100 000 kWp per year.

RUEDIGER NEHMZOW

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205 MW per quarter for the residential sector and 70 MW for the commercial sector. The UK government justifies its new tariff policy on the basis that renewable energy achievements have greatly outstripped expectations and refuses to allow the cost that it passes on to tax payers via their electricity bill to exceed its set acceptability limits.

The German market slips again

Data released by AGEE-Stat, the Working Group on renewable energies statistics for the Federal Ministry, shows that amount of newly installed capacity decreased again. This is the third successive annual drop. Newly connected capacity slipped from 2 006 MWp in 2014 to 1 355 MWp in 2015. Now 39 698 MWp of Germany's installed photovoltaic capacity benefits from production incentives.

Accordingly, Germany has once again dipped below its annual target of 2.4–2.6 GW. One of the consequences of the German market's poorer performance is that the monthly reduction in Feed-in Tariffs, which is calculated on the capacity installed over the last 12 months, was put on hold in September and should not change until at least the end of March. Since 1 January 2016, the Feed-in Tariff has only applied to ≤100-kWp capacity systems instead of the previous 500 kWp. German Feed-in Tariffs range from € 0.1231/kWh (<10-kWp roof-mounted systems), to € 0.0853/kWh for ≤100-kWp ground-based power plants. Larger PV systems, i.e. ≥100-kWp capacity systems must sell their electricity on the electricity market (the threshold was 500 kWp in 2015) via the market price plus "premium" system, which is optional for 100-kWp installations. Under this model, the (target) remuneration level is € 0.127/kWh for <10-kWp systems, € 0.1236/kWh for <40-kWp systems, € 0.1109/kWh for<1-MWp systems and € 0.0891/kWh for>1-MWp which applies to <10-MWp systems.

Under the terms of the Renewable Energies Law (EEG 2014), which came into force on 1 August 2014, The Federal government has amended the renewable electricity support mechanisms to bring the EEG Law in line with the European Commission's guidelines on ≥1-MW capacity installations. Under the terms of the law, the reference value (the Feed-in Tariff or "target value" in the case of direct sales into the market) defined for paying for electricity produced by renewable energy facilities will change to a tender-based system by 2017.

The German government decided to test this new support mechanism by launching a series of pilot offers exclusively for ground-mounted photovoltaic power plants with installed capacity ranging from 100 kWp to 10 MWp. The Federal Grid Agency manages these tenders directly and they are spread over three application periods every year. The newly auctioned capacity volumes put up for tender decrease every year: starting with 500 MWp in 2015, 400 MWp in 2016 and 300 MWp in 2017.

If no bids are entered for any of this capacity, this remainder will be carried over to following tenders. It should be remembered that since 2 September 2015, ground-mounted plants eligible for tenders have lost their eligibility for the support mechanisms they previously enjoyed (either the Feed-in Tariff for <500-kWp plants or compulsory sale plus market premium for the higher-capacity plants). They must now go through the tendering system, which will have the effect of limiting installation volumes.

Three calls for tender were made in 2015, with respective target volumes of 150 MWp, (submission date for applications: 15 April 2015), 150 MWp (submission date: 1 August 2015) and 200 MWp (submission date: 1 December 2015). The "pay as bid" procedure was chosen for the first tender launched on 24 February 2015. Under the scheme, successful bidders are awarded the value specified in their own offers. Hence, the reference value proposed by each bidder matches the allocated reference value. It resulted in 25 projects for a combined capacity of 157 MWp and a mean pay-out price of € 0.0917/kWh. This price was slightly higher than the payment to ground-mounted plants under the market premium model of € 0.0902/kWh in April 2015.

The "uniform pricing" procedure was trialled for the second and third tenders. Under this procedure, the highest reference value is used as the reference value for all the successful bidders, and the highest price applied to all projects. In the case of the 2nd tender, the final price adopted was € 0.0849/kWh, which is lower than the Feed-in Tariff of € 0.0893/kWh that applied until 1 September 2015. The first tender of 2016 (the fourth since 2015), launched early in February, reverted to the pay as bid procedure for a target capacity volume of 125 MWp was oversubscribed 4 times with offers of a volume of 540 MW. The Ministry (BMWi) evaluated this procedure as a success as again in this round, the average price dropped to € 0.0741/kWh.


FRAUNHOFER CSP

PV cell-diagnosis at Fraunhofer Center for Silicon Photovoltaics (CSP), Germany.

More visibility over the French market

The solar photovoltaic trend chart for 4Q15 published by the Sustainable Development Ministerial Statistical Department (SOeS), shows that with the addition of 879 MW in 2015 (951 MW in 2014), the capacity of France's solar photovoltaic base, including the Overseas Territories, increased to 6 549 MWp. SOeS points out that if the commissioning of the huge solar park in Cestas, Gironde (230 MWp) during 3Q15 is excluded from the figures, the year's connection level would have been on a par with that of 2013, when the moratorium on photovoltaic took a heavy toll. The 4Q15 data gives more cause for concern, with only 83 MW installed (figure subject to revision), compounded by a sharp drop of about 24% in the number of connection agreements signed, which will hit the connection pace at the start of 2016.

As a result of the connection figures for the previous quarter, the Feed-in Tariff that applied during the first quarter of 2016, dropped by 1.5% for building-integrated systems (€ 0.2501/kWh) and by 4% for simplified integrated systems (€ 0.1382/kWh up to 36 kWp and (€ 0.1313/kWh up to 100 kWp) respectively. Development of the market for higher-capacity systems is subject to tendering.

In March 2015, the French government launched its third tender to cover medium-capacity photovoltaic installations (100–250 kWp) on buildings and car park canopies. Its specifications were changed in September 2015 with a view to doubling the capacity to a total of 240 MWp, spread over three successive 80-MWp bidding processes. The closing dates are 21 September 2015 for the first tranche, 21 March 2016 for the second and 21 July 2016 for the third tranche. In March 2016, the ministry published the results of the first tender. A total of 349 projects were chosen and could benefit from guaranteed Feed-in Tariffs at a weighted electricity price of € 139/MWh.

The last tender for >250-kWp installations (more than 2 500 m² of panels) was launched in November 2014 with an initial target of 400 MWp. Following on from the very low prices proposed by the bidders, it was also doubled to 800 MWp in August 2015. The mean purchase price in the bids was € 99.26/MWh, but no price information has been released on the successful bids.

On 13 November 2015, during the Ministry for Ecology, Sustainable Development and Energy (Medde) press conference, Minister Ségolène Royal presented the tendering schedule through to the first

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quarter 2019. The solar sector has welcomed the visibility given to investors through this detailed timetable. The schedule initially plans to accept bids for 800 MWp of capacity in 2016, including 500 MWp for ground-based plants. The volume will be raised to 1 450 MWp in 2017 and likewise in 2018, including 1 000 MWp per annum for ground-based plants. All in all the tendering schedule provides for 4 350 MWp of PV by 2019.

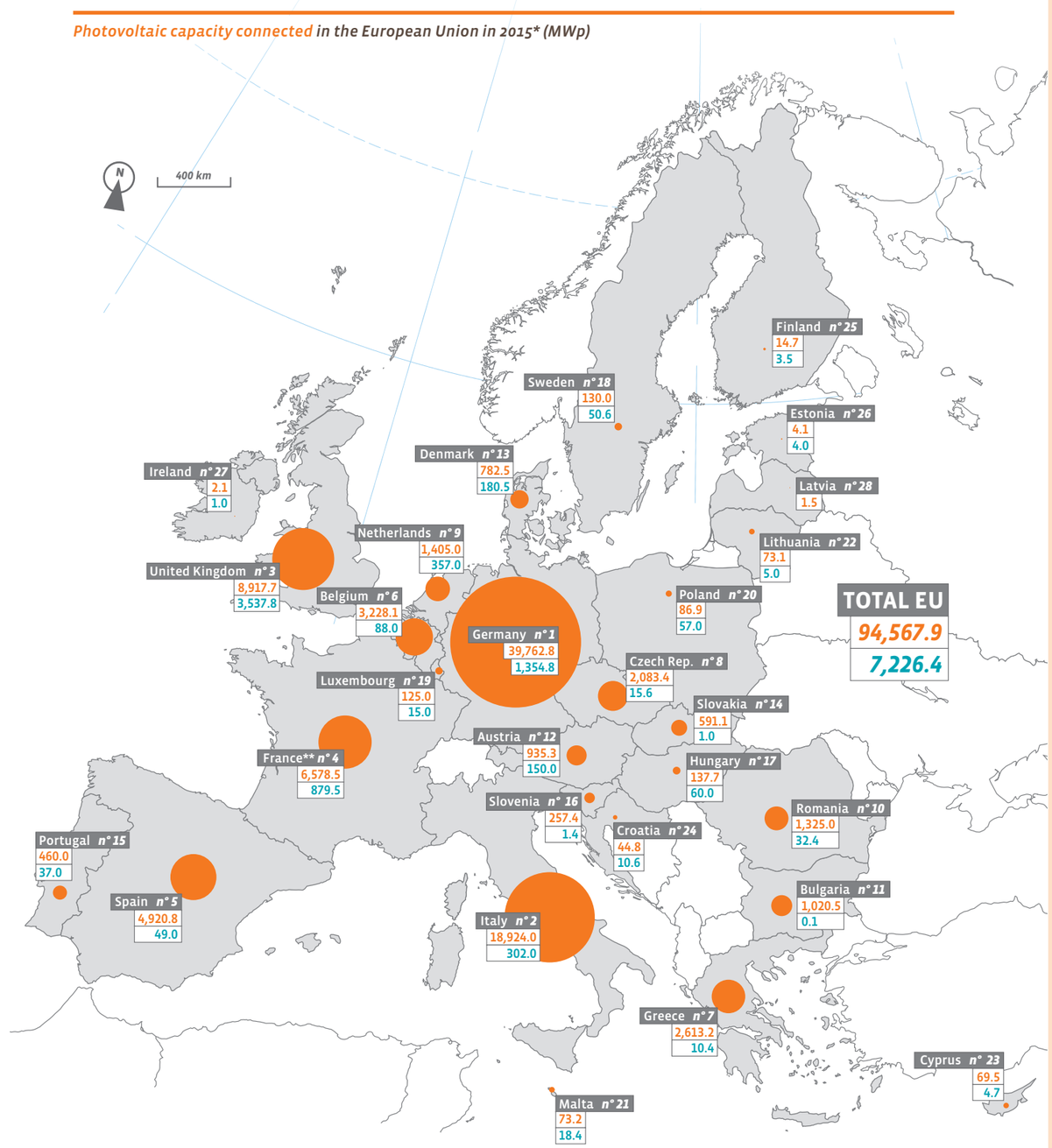
THE INDUSTRY BECOMES MORE COMPETITIVE EVERY YEAR

The global photovoltaic industry is in good shape, with two trends moving in parallel. Firstly, production costs and sales prices are decreasing and secondly, the average efficiency of panels is increasing.
According to Greentechmedia, the average panel price worldwide slipped from € 0.63/W in December 2013 to € 0.52/W in December 2015, which equates to a 17% drop driven by low production costs in China, which is home to about 70% of global production. This reduction affects all aspects of the PV value chain, from raw silicon to modules. The only exceptions are cells, whose dearth made them slightly more expensive in 2015. Nonetheless the price of cells has been falling in 2016, because the pvXchange registered a 6% drop in the price of Chinese cells and a 2% drop in their Taiwanese counterparts at the beginning of the year.
At the same time, the average efficiency of panels is increasing across all technologies, starting with multicrystalline modules whose average efficiency is about 16%. It is the most widespread technology in use with a 55% share of the PV market, followed by monocrystalline (36%) and thin-layer technology (9%) (Source: Fraunhofer 2014). However, multicrystalline offers lower efficiency than the other technologies. The main top-of-the-range solar suppliers have entered a race for efficiency to establish a clear competitive lead. In November 2015, SunPower announced that it was ready to sell a monocrystalline panel with 22% efficiency. First Solar announced that it had achieved 18.6% efficiency in the laboratory for a thin-layer panel (the average efficiency of its panels is 16%). Panasonic announced that it had achieved 23.8% efficiency in the laboratory for a module using its HIT technology, which combines monocrystalline with amorphous silicon (the average efficiency of the panels it sells is 19%).
Europe is a special case in this context, as price falls are not geared to cost reductions **(cf. chart 1).**


The gigantic photovoltaic plant of Cestas, Gironde (France), has a capacity of 230 MWp. It was commissioned in late 2015.

KRINNER CESTAS

Photovoltaic capacity connected ***in the European Union in 2015* (MWp)***



Key

94,567.9 Cumulated photovoltaic capacity in the European Union countries in 2015* (MWp)

7,226.4 Photovoltaic capacity connected in the European Union countries during the year 2015* (MWp)

Estimate. **Overseas departments included for France.* ***Source: EurObserv'ER 2016*

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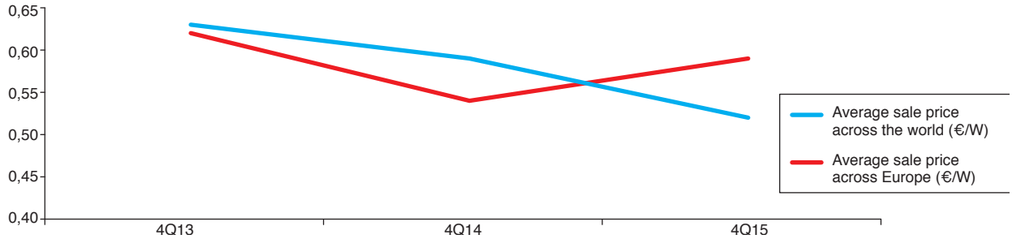
Chart 1

Evolution of the average sale prices ***of multicristalline panels***



Note: These sale prices were recorded in December of the same year, excepted the average sales price in Europe 2015, which was raised in November 2015.
Source : Greentechmedia & Photon International

This phenomenon is due to the antidumping measures introduced by the European Union in July 2013. China and the European Union had entered into an agreement providing for a minimum and a ceiling price in volume terms for imports of Chinese photovoltaic modules into the EU. A few months later, the EU supplemented this "friendly" agreement with antidumping and anti-subsidy measures that it took against Chinese companies that flouted the terms of the agreement. In 2015, a number of them, including global leaders such as Canadian Solar and ReneSola, were subjected to these measures. The European Commission criticized them for having side-stepped the agreement by using subcontracting and by conveying cells and modules via third countries such as Taiwan and Malaysia, thus bypassing the agreement framework. Incidentally, Trina Solar refused to sign the agreement in protest at European Union policy.

In December 2015, the European Commission decided to extend these antidumping measures for a further 15 months. This extension equates to the time that the Commission has given itself to re-examine the measures and assess their relevance. There are two opposing views, as the measures have their supporters and opponents.

The proponents of antidumping measures are the European cell and module producers. The leading company in this camp is SolarWorld (Germany). These producers fear unfair competition could bring down their businesses.

The other camp consists of many actors who advocate ending these antidumping measures. They are purchasers of cells and modules, who say that the measures increase their procurement costs, claiming that lifting the measures would reduce photovoltaic project costs by about 10%.

The Commission needs time to deliberate because the situation has moved on since 2013. At the time, the European cell- and module-producing industry bore the full brunt of the emergence of its Chinese competitors. Implementation of the measures took a long time and in the interim, many European players folded. Since then, European companies in the sector are few and far between. Solarworld is the only one of a size comparable with the international giants. Furthermore, the added value of a photovoltaic project has moved from upstream to downstream and towards specialisation products. So while cell production was the photovoltaic sector's growth driver for a long time, project implementation, support or tracker system construction and maintenance are the value generators of today. Lastly, a number of European module producers do not manufacture their own cells and so are forced to import them. The Commission is considering separating cells from modules when it does (or does not) extend these measures. A conclusive response should be given during the first six months of 2017.

Tabl. n° 4

Main manufacturers ***of solar components across the world in 2015***

Company	Products	Country	Production sites location	Production capacity (MWp)	Shipment (MWp)	Net revenues (€M*)	Employees
Trina Solar	Ingots, wafers, cells, modules	China	China	5,000	5,740	2,762	14,200
Jinko Solar	Ingots, wafers, cells, modules	China	China, Malaisia, South Africa, Portugal	4,000	4,512	2,258	15,000
Canadian Solar	Ingots, wafers, cells, modules	Canada, China	China, Canada	4,330	4,384	3,156	8,673
JA Solar	Wafers, cells, modules	China	China	3,500	3,673	1,900	12,300
Hanwha Q-cells	Ingots, wafers, cells, modules	Korea, Germany	China, Germany	3,500	3,306	1,638	1,400
First Solar	Thin film modules (CdTe)	USA	Malaisia, USA	2,800	2,900	3,265	6,350
Yingli Green Energy	Ingots, wafers, cells, modules	China	China, Thailand	2,450	2,400	1,371**	19,000
Renesola	Ingots, wafers, cells, modules	China	China and though joint ventures : Poland, South Africa, India, Malaisia, South Korea, Turkey, Japan	1,700	1,600	1,167	6,950
SunPower	Cells, modules	USA	Philippines, USA	1,400	969	2,370	8,300
Solar World	Cells, modules	Germany	Germany, USA	1,500	1,159	763	2,950

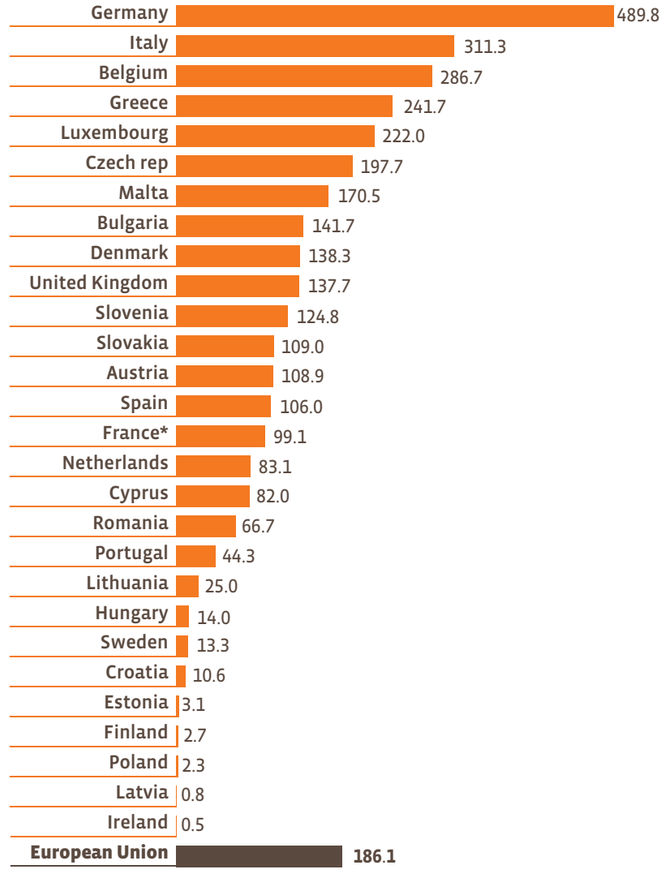
*Shipment figures may be higher than production capacity due to stocks and undisclosed outsourcing. **4Q15 revenues have been estimated based on Yingli's shipment outlook of 3Q15. Final results may differ.* ***Source: EurObserv'ER 2016***

THE PRODUCER COMPANIES ARE DOING WELL

Over the year, the main solar system manufacturers increased their production capacities significantly **(table 4).** Trina Solar, now the leading manufacturer, increased its module production capacity from 4 to 5 GWp. This trend should continue through 2016. For instance, JA Solar plans to raise its capacity from 3 GWp to 5 GWp by the end of the year and Canadian Solar has set its sights on 5.7 GWp. Some experts take this increase in production, which is faster than the installed capacity rate, as a portent that there will be a module overproduction scenario in 2016, in other words that the whole industry could be hit when the bubble bursts. Others stress that the increase in wafer production is not keeping up pace with the increase in module manufacturing capacity. So in 2016, the industry is likely to be hit by a dearth of wafers, which could perversely raise module

Graph. n° 1

Photovoltaic capacity per inhabitant ***(Wp/inhab.) for each EU country in 2015***



French overseas department included.* ***Source: EurObserv'ER 2016*

sales prices. The scenario would play into the hands of vertically-integrated companies, who can source their wafers at low prices.
The major manufacturers are increasingly switching their focus to downstream activities in order to generate value. They are becoming solar park constructers or operators. Cases in point are SunPower and First Solar, who have joined forces to create and operate a yieldco. Canadian Solar has also moved into downstream integration and now has 10 GWp of projects in the pipeline.

Understanding company announcements

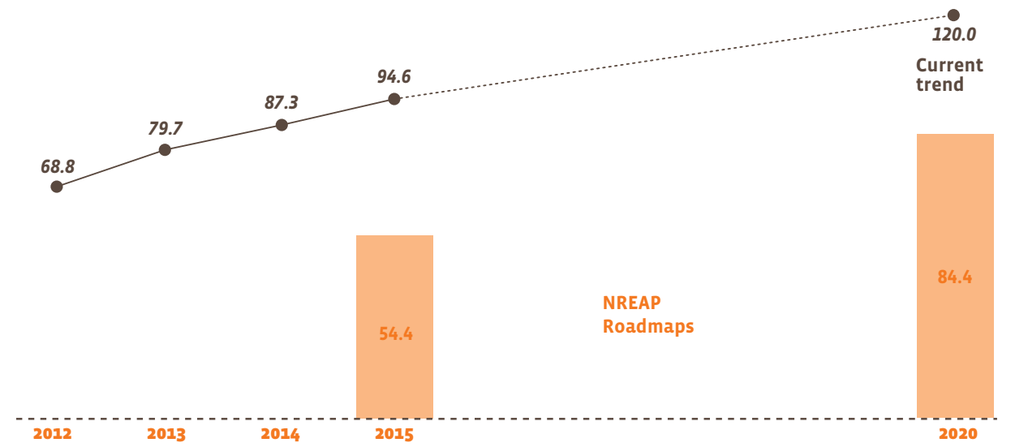
Every company announces its various successes. However results tend to be hard to compare. We first need to be able to distinguish between the efficiency of a cell and that of a module. The efficiency of cells is more important than the module which is made up of those cells. To convert cell efficiency into module efficiency, just multiply the cell efficiency figure for multicrystalline technology by 0.89 and by 0.87 for monocrystalline technology. Furthermore, many announcements report on records measured under laboratory conditions (R&D). While these records promise a rosy future for the industry, it will take several years for these new products to be manufactured and sold on an industrial scale.

EUROPEAN GROWTH PROSPECTS DASH EXPECTATIONS

While the global market continues on its expansion course, the European Union market is stuck in the downward spiral started in 2012. The British government's decision to slam the brakes on the deployment of solar even though it accounted for almost half of the European Union market in 2015 will put it under downward pressure. The German government also appears to have scaled down its ambitions. The country did not meet the targets it set for 2014 and 2015 under the terms of its Renewable Energies Law, and the situation is unlikely to improve for 2016. Over the first two months of the year, the Federal Grid Agency only registered 133.7 MW of connections (83.2 MW in January and 50.5 MW in February) yet its target objective calls for at least 200 MW per month. The situation in France appears more promising but sector experts do not forecast a return to growth before 2017. The lack of national public policy cohesion on the development of solar power makes projection work very hard. Solar Power Europe presented its growth forecasts for the next five years (up to 2019) in its publication Global Market Outlook 2015-2019 published in June 2015. At the time, the professional body's forecast for the 2015 market level (i.e. the publication year) pitched somewhere between a low scenario of 6 GW and a high scenario of 11 GW (almost double!). Then it predicted a return to growth for the following years, but at a much slower pace – with a market level of 7–17 GW in 2019. So at the end of 2019, the cumulative capacity of Europe's base could be 121–158 GW according to Solar Power Europe. The low scenario is more realistic in the current context. The 2016 installation level could even be at an all-time low, below or close to that of 2008 (5.1 GW according to Eurostat). Taking all these elements into consideration, EurObserv'ER has once again revised its 2020 forecasts downward from 130 to 120 GWp **(graph 2).**
While the openings for solar power plants solely intended to supply the grid have been restricted, the photovoltaic market should continue to take advantage of its price advantage on the self-consumption market. In Germany, self-consumption carries a large share of the roof-mounted installation market. It also plays a lead role on the Danish and Dutch markets, and similarly on Belgian and Italian markets. But once again, its growth rate is uncertain, because the public authorities have found it very difficult to establish the balance between the interests of the grid users and the prosumers. The absence of Europe-wide regulatory uniformity and common vision on this issue does nothing to promote the deployment of this market. □

Graph. n° 2

Comparison of the current trend of photovoltaic capacity installed against the NREAP (National Renewable Energy Action Plans) roadmap (in GWp)



Source: EurObserv'ER 2016

Sources tables 1 et 2 : AGEE-Stat (Germany), GSE (Italy), REE (Espagne), SOeS (France), DECC (United Kingdom), PV AUSTRIA, Transelectrica (Romania), DGGE (Portugal), APERE (Belgium), PA Energy Ltd. (Denmark), Cyprus Energy Regulatory Authority (Cyprus), MRA (Malta), Helapco (Greece), Svensk Solenergi (Swenden), University of Zagreb (Croatia), HROTE (Croatia), APEE (Bulgaria), Ministry of Industry and trade (Czech Republic), Litgrid (Estonia), Becquerel Institute (others).

Translation: Shula Tennenhaus – Parlance.


The biggest solar plant of Hungary, 18.5 Mwp, located near a lignite mining area, is operationnel since October 2015.

The next barometer will cover solar thermal sector

This barometer was prepared by Observ'ER in the scope of the "EurObserv'ER" project with the collaboration of RENAC (DE). Sole responsibility for the publication's content lies with its authors. It does not represent the opinion of Ademe nor that of Caisse des dépôts. Ademe and Caisse des dépôts may not be held responsible for any use that may be made of the information published. This action benefits from the financial support of Ademe and Caisse des dépôts.

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