



Photovoltaic canopies at the Leclerc car park, Saint-Aunes, in the Hérault.



106 606 MW

Cumulative photovoltaic capacity in the European Union at the end of 2017

PHOTOVOLTAIC BAROMETER

A study carried out by EurObserv'ER



The spectacular growth of solar power based on solid industrial bases, makes photovoltaic one of the mainstays of global energy transition. In 2017, roughly 100 GW was installed worldwide, and just over half of that in China. The global market amounted to slightly less than half the European Union's installed base. The EU ended the year at 106.6 GW, i.e. 5.6 GW more than in 2016. While at just over 2% in 2017 solar photovoltaic output may still seem negligible on a global level, photovoltaic already supplies about 6% of the electricity mix in Japan, and more than 7% in Germany and Italy.

113.9 TWh

Photovoltaic electricity generated in the EU in 2017

5 562.2 MW

Photovoltaic capacity connected in the EU during the year 2017

Sector analysts continued to be perplexed by the solar photovoltaic market. Although most of them at the start of 2017 expected the market to stabilize after a year of overheating (50% growth between 2015 and 2016). At the end of the day, the market increased by almost 30% in 2017, equating to 99 GW of newly-installed capacity (compared to 76.6 GW in 2016 according to SolarPower Europe). As for global photovoltaic capacity to date, it passed the 405 GW mark at the end of 2017 (306.6 GW at the end of 2016).

According to the 2018 data released by the Frankfurt School-UNEP Centre/BNEF in the Global Trends in Renewable Energy Investment report, investments in renewable energies production facilities, and solar power in particular, literally eclipsed those of conventional fossil and nuclear power. Leaving large-scale hydropower out of the balance, renewable energies accounted for 61% of the net newly-installed capacity worldwide in 2017. Solar power alone accounted for 38% (including CSP). A total of 265 billion dollars was invested in green electricity excluding large-scale hydropower, and of that total, 160.8 billion dollars were invested in solar power. These figures should be compared to the 103 billion dollars of investment in thermal power stations, 45 billion dollars in major hydroelectric dams and 42 billion dollars in nuclear reactors. The same source claims that as much as 2.9 trillion dollars has been invested in green energies since 2004, nearly 1.4 trillion of which has been invested in solar power (including CSP).

We also note that the solar energy globalization process is picking up speed, while the European Union's share of the total in terms of market and installed base is contracting. The European Union top seeds have been ousted from top 5 global markets, for behind the triumvirate consisting of China (52.9 GW), the USA (10.6 GW) and India (9.6 GW), come Japan (7 GW) and Turkey (2.6 GW). Three EU countries – Germany ranked 6th (1.7 GW), France ranked 9th (0.9 GW) and the UK ranked 10th (0.9 GW) – are left in the top 10 flanked by Australia (1.3 GW), South Korea (1.2 GW).

NEWS FROM THE MAIN GLOBAL MARKETS

THE CHINESE MARKET STANDS AT 53 GW

The unpredictability of the Chinese market is largely to blame for the analysts' difficulty in projecting global market growth. The National Energy Administration (NEA) figures issued very early in 2018 reported that China installed 52.9 GW in 2017 compared to 34.5 GW of installed capacity in 2016 (a 53% increase). The additional capacity takes China's installed base to 130.2 GW at the end of 2017, when it overtook the European Union's installed capacity base for the first time (see below). During 2017, China installed 10 GW more capacity than Germany's cumulative installed base.

The Becquerel Institute analysts compared the Chinese market with others, to estimate orders of magnitude of the place of solar electricity in China by factoring in the population size criterion. Accordingly, it equates to 3.2 GW in Germany or 400 MW in Belgium. This indicator illustrates that the thrust of China's solar photovoltaic market is currently much higher than it is in Europe and can no longer be described as negligible.

THE USA INTRODUCES ANTI-DUMPING MEASURES

The US market contracted in 2017 as expected. Data published by the SEAI (Solar Energy Industries Association), produced in partnership with GTM Research, shows that 10 608 MW of capacity was newly connected in 2017 compared to 15 128 MW in 2016, which is a drop of about 30%. There was a peak in 2016 caused by the massive flow of projects applying for the 30% federal tax credit before it expired at the end of the year. However, the 2017 installation level far outstripped that of 2015 (7 500 MW). Turning to the market structure, at 59%, the major utility companies still represent more than half of the installed capacity (6 234 MW), compared to 41% for distributed solar (2 227 MW in the residential and 2 147 MW in the non-residential sector). The new US government's federal policy does solar energy no favours. On 22 January

2018, President Trump announced the introduction of an ad valorem tariff (a tax expressed as a percentage of the goods entering a country) levied at 30% on imported crystalline silicon cells and modules. The tax will drop by 5 percentage points per annum for four years, which will bring the ad valorem tariff down to 15% in 2021. The tariff should expire then unless the scheme is extended. According to the report, this measure should lead to a price increase of about \$0.10 per Wp for modules in the first twelve months. However, a 2.5 GWp quota of cells will be exempt from this tax to avoid penalizing the US module manufacturers who do not produce their own cells. GTM Research has trimmed its installation forecasts for 2018–2022 by about 13% in view of this protectionist measure. Yet it reckons that the US market should gradually double over the next 5 years with >15 GW of capacity installed annually starting from 2023.

INDIA WANTS TO PROTECT ITS INDUSTRY

India is one of the most promising emerging countries. The Mercom Capital Group consultancy says it installed 9 629 MW of photovoltaic capacity in 2017, which is a massive 123% more than in 2016 (4 313 MW). The growth level is higher than it was between 2015 and 2016 (86.5%, i.e. 2 313 MW installed in 2015). Mercom claims that photovoltaic accounted for the equivalent of 45% of India's newly-installed electricity capacity. Now the analysts disagree on how the Indian market will fare in 2018, as the outcome depends on the application of anti-dumping measures announced by its government. Mercom expects the market to shrink to 7.5 GW, i.e. a 22% drop, while IHS Market thinks it could seize the No. 2 global market slot from the USA as early as 2018 with 11 GW installed.

In September 2017 the Indian government launched an inquiry into allega-

tions of cell and module dumping from China, Taiwan and Malaysia. The government has already proposed a safeguard duty of 70% for 200 days. It also plans to impose a 7.5% import duty on imported cells and modules. In February 2018, an anti-dumping inquiry was launched on the glazed part of panels sourced in Malaysia following a complaint from the Indian glass manufacturer Gujarat Borosil Ltd. In August 2017, anti-dumping taxes were introduced for 5 years on solar glass imported from China (\$ 52.85–136.21 per tonne). The PV Tech website claims that Indian manufacturers have only a 7% share of their domestic market

THE JAPANESE MARKET IS HELD BACK BY ITS GRID

Japan's government hopes to avoid overheating but is sticking to its solar electrification plan. Domestic demand for installing photovoltaic systems has soared since the Fukushima nuclear

disaster, yet the authorities are trying to keep the demand in check because of the restrictions imposed by the grid's absorption capacities. Thus in 2017 METI (the Ministry of Economy, Trade and Industry) refused some 260 000 projects totalling 16.4 GW of capacity of the 84.5 GW of projects approved under the former Feed-in Tariff system. These refusals are administrative and are based on the fact that the developers of these projects failed to get connection authorization before the government-imposed deadline. The Tokyo consultant RTS still puts the authorized capacity awaiting connection at 30 GW, but agrees it is hard to predict how many of these applications will be connected in 2018. Nonetheless it expects Japan's residential market to grow strongly as the market for photovoltaic systems combined with battery storage builds up and because of the increasing number of



Floating photovoltaic power plant at Okegawa, Japan.

zero-energy dwellings. Last December, it reckoned that as Japan's accumulated capacity to date was already 49 GW, the government goal of 64 GW planned for 2030 could be achieved early in 2020. So, it also believes that the government could raise its targets to 150 GW by 2030. In April 2017, METI overhauled its incentive system and has already approved 45.4 GW of capacity, namely 274 979 >20 kW systems under the new framework. However, it remains to be seen how much capacity will be effectively connected. The government has promised to do its best to enable the maximum number of installations to be connected, and to provide greater transparency on the issue of restriction to help investors gauge the feasibility of their potential projects.

THE EU MARKET IS STILL IN TRANSITION

According to the data gathered by EurObserv'ER, which is based wherever possible on official data, and for the less structured markets on estimates given by the solar photovoltaic energy industry associations (sources available at the end of this barometer), 5 562 MW of additional capacity was connected in the European Union in 2017, i.e. a year-on-year drop of 10.8%. This additional capacity took the European Union's connected solar photovoltaic capacity of more than 106.6 GW at the end of 2017. As early in April some countries were still putting the finishing touches to their installation data for the 4th quarter, this must be viewed as provisional data and it is likely to be revised upwards in the next few weeks. Yet data consolidation is unlikely to change the downward trend in grid connections for 2017. These preliminary results show that the European Union market is still in transition, dominated less by the rapid development of large photovoltaic power plants, but governed by a policy of tendering, and increasingly geared to commercial and residential roof-mounted systems, that are taking greater advantage of solar power production costs that are frequently lower than the electricity supply price.

The situation is a little more encouraging when we enlarge the European market to include Turkey, for its market growth was exceptional in 2017. According to the Turkish Electricity Transmission Com-

pany (TEIAS) statistics, Turkey installed 2 558 MW during 2017. While its installed photovoltaic capacity to date at the end of 2016 was only 832.5 MW, it had risen to 3 420 MW by the end of 2017.

European Union output stands at 114 TWh

Electricity output in 2017 marked an improvement on 2016, aided by better sunshine conditions and the commissioning to almost 12 GW of capacity over the past two years. EurObserv'ER believes that European Union output should reach 113.9 TWh in 2017, which equates to 8.3% growth over 2016. Solar electricity accounts for about 3.5% of the European Union's gross electricity production.

Germany wrests back leadership of the EU

Last year Germany wrested back the reins of the European Union market after having left the UK to do the driving for three years running. According to the German renewable energy statistics working group (AGEE-Stat), Germany connected 1 678 MW to the grid in 2017 compared to 1 492 MW in 2016 (revised figure), posting a 12.5% rise in the amount of capacity connected. So, at the end of 2017 the country's installed capacity stood at 42 394 MW, which equates to about 1.6 million on-grid installations.

During 2017, photovoltaic electricity output rose to 39.9 TWh (4.7% more than in 2016) and accounted for 7.2% of the country's gross electricity production. AGEE-Stat claims that the share of self-consumed electricity continued to rise and reached 10% in 2017 (9.5% in 2016 and 9.1% in 2015). The self-consumption market is now supported by the solar power storage market. The Franco-German Energy Transition Office (OFATE) photovoltaic barometer reports that 40 000 small photovoltaic battery systems had been sold in Germany by 31 December 2017, 32 000 of which took advantage of the KfW financial support programme (Reconstruction Credit Institute). This programme, which was set up by the Federal Economy and Energy Ministry (BMWi), enables individuals to benefit from a preferential rate loan from the German public investment bank (KfW) to cover up to 100% of the investment costs of a storage battery coupled to a photovoltaic

panel with a maximum peak capacity of 30 kW and a grant that can cover up to 10% of eligible costs.

Several support mechanisms currently operate in Germany. A remuneration top-up premium (Marktprämie) applies to <750 kW installations. The reference value depends on the type of installation and is set at between 8.84 and 12.6 euro cents per kWh from 1 December 2017. The same value also applied on 1 January 2018. Communal self-consumption installations in multi-occupancy dwellings with capacities of up to 100 kW remain subject to a Feed-in Tariff, which is revised every month. The Feed-in Tariff calculated for the period from 1 November 2017 to 1 January 2018 was between 8.44 and 12.20 euro cents per kWh depending on the type of installation.

Plants with capacities equal to or greater than 750 kW, are subject to a tendering process. The fourth period of tendering for ground-mounted photovoltaic plants with a minimum capacity of 750 kW, published on 1 February 2018, was marked by a further drop in prices. Of the 79 bids for a total volume of 546 MW, 24 were retained for 200 MW of capacity. The reference value of these tenders was 4.33 euro cents per kWh. The lowest bid price was 3.86 euro cents per kWh. The previous tender's reference value was 4.91 euro cents per kWh. The next results will be announced on 1 June and 1 October 2018.

On 1 April 2018, the Federal grid agency also published the results of the first bi-technology tender launched in February combining solar and wind energy. All the successful bids for this tender were for photovoltaic plant projects, testifying to the competitive advantage of solar power in Germany. In all, 32 photovoltaic plant projects were retained for a total capacity of 210 MW. The average price was set at 4.67 euro cents per kWh (a little higher than the last tender that was for photovoltaic only), with the lowest bid made at 3.96 euro cents per kWh and the highest at 5.76 euro cents per kWh.

France enjoys positive momentum

According to provisional data released by the Data Service and Statistical Studies (SDES) photovoltaic trend chart, the capacity of the French solar photo-



15 000 m² of photovoltaic panels cover the Sogebras Warehouses in the Chevéré area near Nantes.

voltaic base reached 8 044 MW at the end of December 2017 including 7 568 MW in mainland France (386 MW in its overseas territories). According to the estimate, 875 MW of capacity was connected to the grid in 2017 compared to 587 MW in 2016. The fourth quarter's installation volume was considerably higher (provisionally put at 394 MW) and posts a positive trend for the sector. These figures mark both a rebound for the sector after the disappointment of 2016 and the return to comparable levels enjoyed in 2014 and 2015. The market is expected to recover fully in 2018 as eight calls for tender were launched in 2017 for a total of 1 503 MW of capacity. Two of them were for ground-mounted plants and carports; 535 MW of capacity were awarded in March (average tariff € 70.6 per MWh) and 508 MW in June (average tariff € 63.9 per MWh), three were for self-consumption projects; 20 MW awarded in March on the mainland (average premium of € 19.4 per MWh), 12 MW in August for non-interconnected zones (average premium of € 24.2 per MWh) and 51 MW in December

on the mainland (average premium of € 7.9 per MWh), two for roof-mounted projects; 150 MW in June (average tariff € 106.7 per MWh) and 164 MWh in September (average tariff € 93.4 per MWh) and a tender for plants with storage dedica-

ted to non-interconnected zones for a volume of 63 MW (average tariff € 113.6 per MWh).

On 11 December 2017 the Environment

Tabl. n° 1

Photovoltaic capacity installed by the main EU partners in 2017*

Countries	Newly added capacity in 2017 (MW)
China	52 830
USA	10 608
India	9 629
Japan	7 000
Turkey	2 600
Norway	180
Canada**	143
Russia***	70

* Estimate. **In 2015. *** In 2016. Source: EurObserv'ER.

Ministry announced that the annual tender volume for solar photovoltaic would be increased to 2.45 GW, namely by 1 GW, to accelerate solar photovoltaic development and meet the ambitious goals of the Multi-annual Energy Programme (10 200 MW in 2018). The volume increase will be gradually introduced starting with the tendering periods in March 2018 for building-mounted installations and in June 2018 for ground-mounted plants.

The Ministry also promised that with the help of the solar sector players, new arrangements would be set up to reduce installation lead times and increase the implementation rates of winning projects. On the same day the Environment Minister announced the launch of an experimental bi-technology call for tenders pitching photovoltaic and wind energy against each other, in line with the European Commission's demand. It

covers a total volume of 200 MW for per project capacity of 5 to 18 MW. It will identify the strengths and weaknesses of this competitive call. Project support will be in the form of top-up remuneration and the selection will be made exclusively on the basis of economic competitiveness. The Environment Ministry also plans to launch a photovoltaic tender specifically for the Haut-Rhin department before the end of 2018, for 300 MW of capacity, as part of a

future local "post-nuclear" project, following the programmed closure of the Fessenheim nuclear power plant (whose fate is tied to the start-up of the Flamanville EPR nuclear power plant). In March 2018, the main news item was the national energy ombudsman's (CRE) statement on self-consumption that the industry felt seriously undermined the development of this market, at least for its collective segment. In particular, the

CRE declared it was in favour of limiting exemption from the CSPE (contribution to the public service charges for electricity) to <9 kW installations, although this exemption currently applies to <1 MW installations. The industry claims that if this measure is implemented, it will jeopardise the economic viability of projects already started and will send a negative signal to investors. The CRE also adopted a very narrow stance by opposing an extension

to the scope of collective self-consumption operations beyond a single public distribution substation. This latitude would have enabled owners to allow additional customers to benefit from the electricity produced by their plant, and thus make the model more resilient and more attractive to the banking sector for funding. Self-consumption has also become an

Tabl. n° 2
Photovoltaic capacity installed and connected in European Union during the years 2016 and 2017 (in MW)*

	2016			2017		
	On-grid	Off-grid	Total	On-grid	Off-grid	Total
Germany	1 492,0	0,0	1 492,0	1 678,0	0,0	1 678,0
France**	588,0	0,5	588,5	875,0	n.a.	875,0
United Kingdom	2 363,8	0,0	2 363,8	861,0	0,0	861,0
Netherlands	534,0	0,0	534,0	700,0	0,0	700,0
Italy	382,0	0,0	382,0	409,4	0,0	409,4
Belgium	179,0	0,0	179,0	285,0	0,0	285,0
Austria	158,4	0,5	158,9	152,0	0,0	152,0
Spain	55,0	0,0	55,0	134,3	0,7	135,0
Hungary	105,0	8,0	113,0	85,0	5,0	90,0
Sweden	47,0	2,0	49,0	78,0	n.a.	78,0
Poland	97,7	0,0	97,7	77,3	n.a.	77,3
Portugal	55,0	8,0	63,0	44,0	15,0	59,0
Denmark	68,4	0,4	68,8	58,6	0,3	58,9
Finland	20,0	0,0	20,0	26,0	0,0	26,0
Slovenia	0,0	0,0	0,0	25,0	0,0	25,0
Cyprus	8,0	0,0	8,0	21,3	0,0	21,3
Malta	19,6	0,0	19,6	15,6	0,0	15,6
Luxembourg	5,7	0,0	5,7	5,0	0,0	5,0
Ireland	3,8	0,1	3,9	3,0	0,0	3,0
Croatia	2,4	0,1	2,4	2,0	0,1	2,1
Lithuania	7,0	0,0	7,0	2,0	0,0	2,0
Greece	0,0	0,0	0,0	1,1	0,7	1,8
Romania	46,3	0,0	46,3	1,7	0,0	1,7
Bulgaria	0,0	0,0	0,0	0,2	0,0	0,2
Slovakia	0,0	0,0	0,0	0,0	0,0	0,0
Estonia	0,0	0,0	0,0	0,0	0,0	0,0
Czech Republic	0,0	0,0	0,0	0,0	0,0	0,0
Latvia	0,0	0,0	0,0	0,0	0,0	0,0
European Union	6 238,1	19,5	6 257,6	5 540,5	21,8	5 562,2

*Estimate. **Overseas departments included for France. Source: EurObserv'ER 2018

Tabl. n° 3
Connected and cumulated photovoltaic capacity in the European Union countries at the end of 2016 and 2017 (in MW)

	2016			2017		
	On-grid	Off-grid	Total	On-grid	Off-grid	Total
Germany	40 716,0	n.a.	40 716,0	42 394,0	n.a.	42 394,0
Italy	19 283,0	n.a.	19 283,0	19 692,4	n.a.	19 692,4
United Kingdom	11 898,7	n.a.	11 898,7	12 759,7	n.a.	12 759,7
France**	7 169,0	30,6	7 199,6	8 044,0	30,6	8 074,6
Spain	4 944,2	28,7	4 972,9	5 078,5	29,4	5 107,9
Belgium	3 561,0	n.a.	3 561,0	3 846,0	n.a.	3 846,0
Netherlands	2 049,0	n.a.	2 049,0	2 749,0	n.a.	2 749,0
Greece	2 444,3	159,5	2 603,7	2 445,0	160,5	2 605,5
Czech rep	2 067,9	n.a.	2 067,9	2 040,3	n.a.	2 040,3
Romania	1 372,3	0,0	1 372,3	1 374,0	0,0	1 374,0
Austria	1 090,0	6,0	1 096,0	1 242,0	6,0	1 248,0
Bulgaria	1 028,0	n.a.	1 028,0	1 028,2	0,0	1 028,2
Denmark	848,4	2,6	851,0	907,0	2,9	909,9
Portugal	497,0	13,0	510,0	541,0	28,0	569,0
Slovakia	533,0	0,0	533,0	533,0	0,0	533,0
Hungary	273,0	15,0	288,0	350,0	18,0	368,0
Poland	191,0	2,9	193,9	268,3	2,9	271,2
Slovenia	233,0	0,1	233,1	258,0	0,1	258,1
Sweden	140,0	13,0	153,0	218,0	13,0	231,0
Luxembourg	122,0	0,0	122,0	127,0	0,0	127,0
Malta	93,6	0,0	93,6	109,2	0,0	109,2
Cyprus	84,0	n.a.	84,0	105,3	n.a.	105,3
Lithuania	80,0	0,1	80,1	82,0	0,1	82,1
Finland	35,0	n.a.	35,0	61,0	n.a.	61,0
Croatia	49,5	0,9	50,4	51,5	0,1	51,5
Ireland	5,0	1,0	6,0	8,0	1,0	9,0
Latvia	1,3	0,0	1,3	1,3	0,0	1,3
Estonia	0,0	0,0	0,0	0,0	0,0	0,0
European Union	100 809,1	273,4	101 082,5	106 313,7	292,6	106 606,2

*Estimate. **Overseas departments included for France. Source: EurObserv'ER 2018

issue for homeowners. In the case of residential installations (up to 3 kW), costs are a third of their 2010 level and solar power cost prices are now on a par with the electricity supply price (15 euro cents per kWh) in the South of France. This situation has created a keen appetite for self-consumption systems in the sunniest regions of France. Enedis claims that at the end of 2017 roughly 20 000 homes were producing their own energy for part of their consumption (about 20%), compared to 8 000 at the beginning of

the year. According to EDF Energies Nouvelles, the number of households opting for self-consumption is likely to double every year and reach 600 000 by 2023. In Germany, where the price of electricity is considerably higher, the figure is already about 1.5 million households.

The large power plant market has stalled in the UK

After a three-year run as Europe's top photovoltaic performer, the UK's major solar power plant market has gradually

stalled. According to the Department for Business, Energy and Industrial Strategy (BEIS), 861 MW of capacity were connected 2017 compared to 2 364 MW in 2016 (and 4 057 MW in 2015). This additional capacity takes the total to date at the end of 2017 to 12 760 MW. Most of the capacity installed in 2017 was on sites accredited through the former Renewable Obligation incentive system and was installed in the first quarter of the year before the device was finally curtailed (720 MW was installed in the first quarter, then 43 MW in the second, 55 MW in the third and 45 MW in the last quarter). The tens of MW installed over the last quarters were in the small installation market which continued to benefit from a Feed-in Tariff.

The reason for this situation is that not a single solar project has qualified since the second auction under the Contract for Difference (CfD) system. Only one solar farm from the first CfD auction was registered at the very beginning of 2017. It is the Triangle Solar Farm, at Soham near Cambridge, with 10 MW of capacity that benefitted from a strike price of £ 79.23 per MWh. It is the second and last solar farm to be retained during the first CfD auction in February 2015. Of the 5 successful bids, two farms were cancelled because the agreed strike prices were unviable (£ 50 per MWh), while a third project was unable to meet the legal deadline to take up the mechanism despite being awarded a grace period through to March 2017.

Turning to output, solar power supplied 11 479 GWh in 2017 (10.2% more than in 2016) and now accounts for 3.2% of the UK's electricity output. The solar sector has made spectacular progress compared to the situation in 2010 when solar power contributed a mere 40 GWh.

Spain has its first subsidy-free project

Monitoring the Spanish solar market has been confounded by the significant gap between official estimates and the industry's claims. According to UNEF (the Spanish photovoltaic industry association), which defends the sector's interests, solar photovoltaic is rising from its ashes. It claims that Spain installed 145 MW during 2017, compared to 55 MW in 2016 and 45 MW in 2015. Provisional



Photovoltaic rooftop power station on the General Motors car plant in Zaragoza, Spain.

CHRISTOPHE MAJANI / D'INQUERRA / D'INQUERRA / VEGA

Tabl. n° 4

Electricity production from solar photovoltaic power in European Union in 2016 and 2017* (in GWh)

	2016	2017
Germany	38 098	39 895
Italy	22 104	25 200
United Kingdom	10 420	11 479
Spain	8 070	8 820
France*	8 160	8 607
Greece	3 930	3 991
Belgium	3 086	3 149
Czech Republic	2 131	2 189
Netherlands	1 559	2 100
Romania	1 820	1 882
Bulgaria	1 386	1 390
Austria	1 096	1 248
Portugal	822	968
Denmark	744	842
Slovakia	533	534
Hungary	201	365
Slovenia	267	286
Sweden	143	200
Poland	124	177
Cyprus	146	160
Malta	127	155
Luxembourg	102	110
Croatia	61	74
Lithuania	67	67
Finland	18	30
Ireland	4	6
Estonia	0	0
Latvia	0	0
Total EU 28	105 222	113 924

* For electricity generation overseas departments not included for France. Source: EurObserv'ER 2018

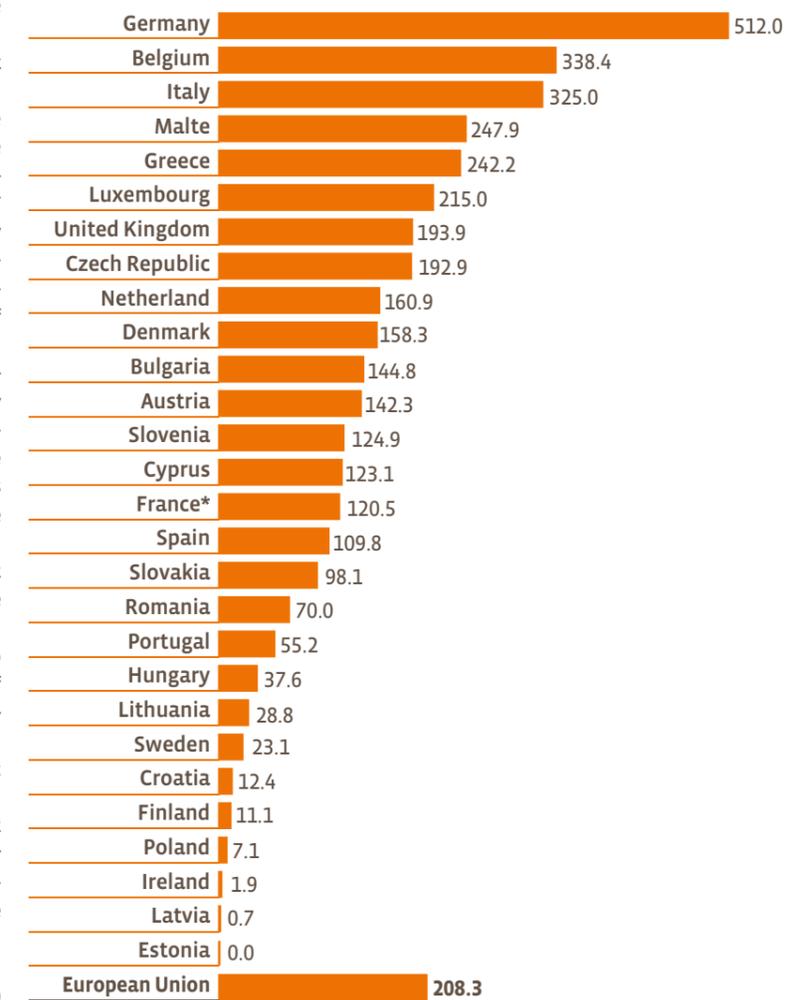
data released by IDAE indicates 12.5 MW of additional capacity for an installed base to date of 4 985.4 MW, but the figure is likely to be consolidated in the next few weeks. According to UNEF, the Spanish photovoltaic market's rebound should be ascribed to the development of the self-consumption installation segment, the connections of a few large solar farms and the development of the electrification of isolated, mainly agricultural and rural electrification sites. UNEF claims that the reason for this headway is that costs have now come down sufficiently to offset the measures implemented to control the development of self-consumption including the "sun tax" ... a charge that targets >10 kW self-consumption installations. Thus, many sectors such as the hotel industry, distribution, agri-food and agriculture are again investing in photovoltaic systems to reduce their energy costs and increase their competitiveness.

Another contributory factor is that renewable electricity has returned to the government's good books as witnessed by the July 2017 launch of a tender to cover the construction of 5 037 MW of renewable energy capacity to be installed before the end of 2019, that awarded 3 909 MW of projects to the photovoltaic sector.

A further underlying element is that construction of several large power plant projects is being undertaken without resort to subsidies. In April 2018, the German company BayWa r.e., specialized in renewable energies, signed an initial 15 year PPA (Power Purchase Agreement)

Graph. n° 1

Photovoltaic capacity per inhabitant (W/inhab.) for each EU country in 2017



* DOM inclus, French overseas departments included. Source: EurObserv'ER 2018.



Wafer production line for photovoltaic modules at the Yingli Solar plant in China.

with the Norwegian utility Statkraft, to build a 170 MW photovoltaic solar farm with a design output of 300 GWh at Don Rodrigo, south of Seville in Spain whose commissioning is scheduled for the end of the year. Given Spain's generous supply of sunshine, PPA contracts could proliferate and attract investors from all over Europe. According to IDAE, solar photovoltaic capacity's annual load factor rose to 1770 hours in 2017 (1623 hours in 2016), equating to 8.8 TWh of electricity output. In Germany, the same annual load factor was put at 941 hours in 2017.

SOUND INDUSTRIAL BASES

PHOTOVOLTAIC MODULE PRODUCTION IS A CHINESE INDUSTRY

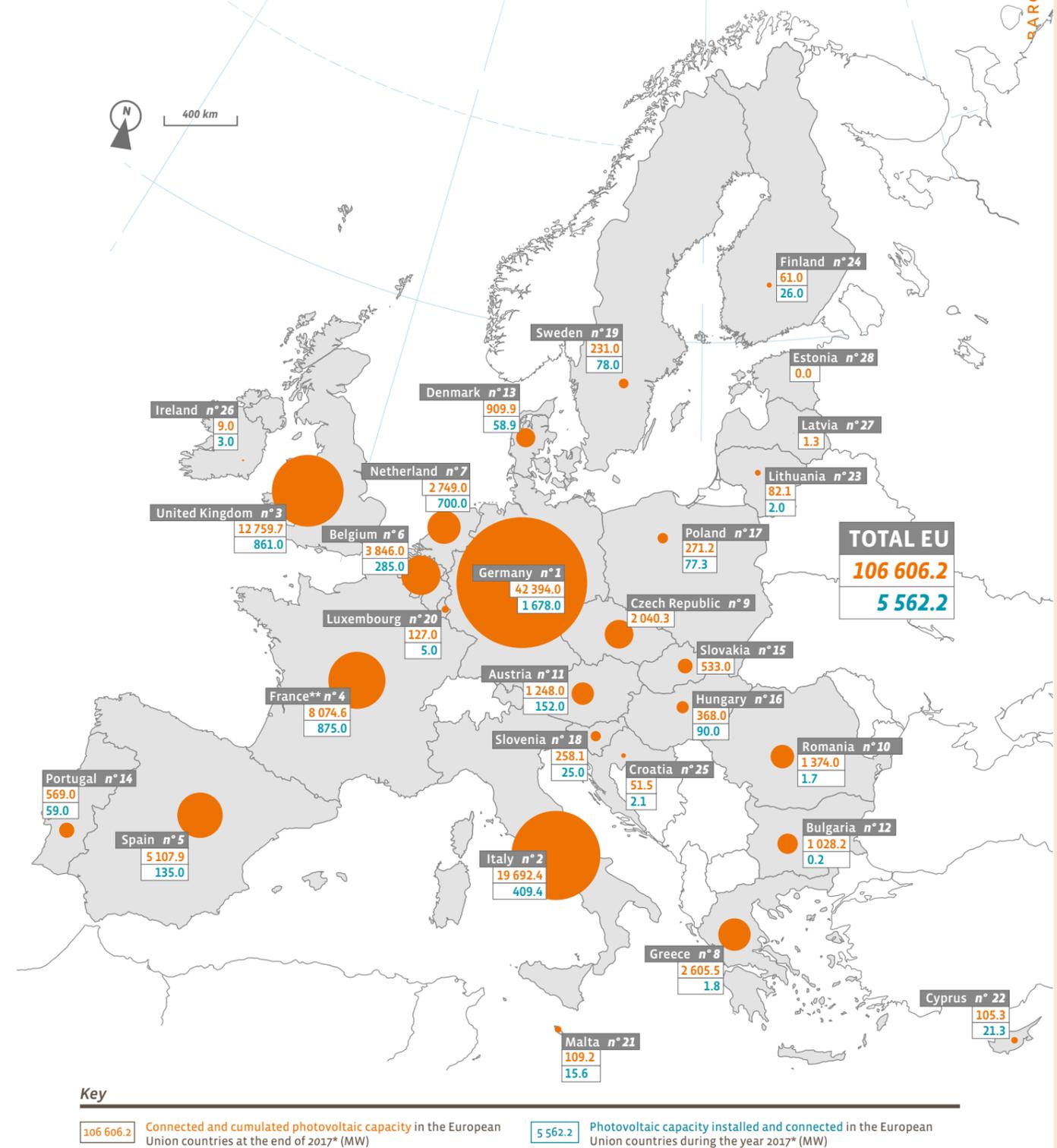
The customs duties introduced by Europe and the USA have not upset the industrial landscape as far as photovoltaics is concerned. The sector's upstream part, which ranges from raw material extraction to module production, is more Chinese than ever. Nine out of the

ten companies that delivered the most modules in 2017 (JinkoSolar, Trina Solar, Canadian Solar, JA Solar, Hanwha Q-CELLS, GCL-SI, LONGi Solar, Risen Energy, Shunfeng et Yingli Green), are Chinese and one is Korean (Hanwha Q-CELLS). Together they delivered 57 GW in 2017, to supply 58% of the year's installations. The top company, Jinko Solar, delivered almost 10 GW alone, or 10% of the global market, while the top three – Jinko Solar, Trina Solar and Canadian Solar – also succeeded in the feat of creating a worldwide, brand identity. Their panels are known and even recognised globally by the purchasers, which gives them a distinct advantage over their top 10 rivals. Incidentally, many of these companies have engaged in project development and operation to diversify their revenues and thus create outlets for part of their production. For example, Canadian Solar already operates a 1.2 GW project portfolio and has a further 11.1 GW in the pipeline. On the other side of this value chain, GCL has bolstered its dominance. It specializes in ingot and wafer production, the stage prior to cell production. Now the company has

announced that it is investing 1.4 billion dollars in the construction of a mono-crystalline ingot factory with annual production capacity of 20 GW. Not only is this production capacity colossal, but it also broadens GCL's field of competence. Up to the present time it specialized in multi-crystalline products. The move will ensure the company covers any demand made by the silicon market. This latest operation coincides with the improvement of photovoltaic panel quality, while the amount of raw material used to make them is falling. The most important material for crystalline panels, is silicon and this is borne out by a recent PVCellTech study that quantified the reduction in its use. It shows that in the first quarter of 2015, 5.20 grams of silicon per watt (g/W) were needed, compared to 4.16 g/W in the first quarter of 2018. The figure could drop to 3.92 g/W in the fourth quarter of 2018. The main reason for this reduction is the increasing use of diamond wire to slice the ingots to make them into wafers. Hence, thinner wafers,



Photovoltaic capacity connected in the European Union in 2017* (MW)



and thus thinner, resource-saving cells can be manufactured, which creates a new source of competitiveness for the producers. The next few years could be marked by a race to produce the “thinnest” cells with the concomitant reduction the use of resources, and technology’s costs. This is just one of many initiatives that is bringing down the Levelized Cost of Energy (LCOE) of photovoltaic power, which fell by 10% between 2016 and 2017, according to consultants, Lazard. The LCOE of solar farms worldwide, is thus \$ 50 per MWh, making photovoltaic power cheaper than coal (\$ 102 per MWh) and new nuclear (\$ 148 per MWh).

THE USA AND EUROPE STILL HAVE A ROLE TO PLAY

For the module producers elsewhere in the world, eking out a living alongside the Chinese hegemony is an uphill struggle. In the case of the American manufacturers, First Solar, the global leader for thin film modules, which was still in the global 10 global last year, lost its place this year. Not only that, it recorded its second year of losses, posting a negative income of -\$ 165 615 k in 2017 (and -\$ 416 112 k in 2016). Nonetheless the company has put a manufacturing capacity expansion plan to its investors, which should rise from 2 GW in 2017 to 5.7 GW in 2020, while

changing its product range for more efficiency. SunPower is apparently in even greater difficulty, posting a \$ 851 200 k loss in 2017, following a \$ 471 100 k loss in 2016. Europe’s SolarWorld seems to be lurching from one crisis to another, filing for bankruptcy twice in a single year. The first time, in the summer of 2017, the company was saved by Qatar Solar Energies. Incidentally, the suspension of payments by its American subsidiary was one of the factors that triggered Donald Trump’s decision to impose trade barriers on imports of photovoltaic products. What is more, despite the protective barriers for the European Union, the company filed bankruptcy for the second time at the end of the Q1 2018, blaming the rock bottom market prices that have put it out of business in the competitive context. Be that as it may, while the module manufacturing market is tough, other photovoltaic-related markets have their champions. One example, Germany’s SMA, an inverter specialist for photovoltaic projects, had a 14% share of this market in 2017. Its income is stable and positive (€ 30 million in 2017 and 2016) and its liquidity reserves are building up. It hopes to increase its sales by 10% in 2018 over the previous year, while adapting to a market that is increasingly driven by “smart” technologies and

more exacting interconnections between producer(s) and consumer(s). SMA profited from the growth in the number of projects in Europe in 2017. Market analysts GTM Research pointed out that in Europe, the growth in inverter sales outpaced capacity installation (34% to 8%) in 2017. This means that project bearers are forward planning and stockpiling inverters for the coming years. In other words, they expect the European market to grow steadily, which will equally benefit the inverter segment. Leaving aside specific company cases, the European photovoltaic sector representatives want the EU to adopt an ambitious industrial policy. Accordingly, the European photovoltaic Industry Association, SolarPower Europe (SPE), has set up an Industrial Competitiveness Task Force, to revive the industry. One of the Task Force’s aims is to support photovoltaic-oriented R&D and its stated intention is to maintain 70% of the photovoltaic value chain within the European Union. The latter has as-yet undervalued assets, primarily a research excellence sector, a building-integrated photovoltaics (BIPV) sector and a Balance of System offer. SPE views that the targets set by the EU for renewable installations will be decisive in how these assets are deployed and will prosper in Europe and for export. It

Tabl. n° 5

Main photovoltaic module manufacturers in 2017

Company	Country	Manufacturing capacity (MW)	Shipment (MW)	Revenues 2017 (\$M)
Jinko Solar	China	8 000	10 000*	3 949
Trina Solar**	China	n.c.	9 100	nc
Canadian Solar	China	8 110	6 828	3 390
JA Solar***	China	5 500	6 755	4 205
Hanwha Q-cells	Korea	4 300	5 438	2 117
Risen Energy	China	4 500	n.c.	n.c.
Ynigli Green	China	4 000	2 953	1 285,5
Talesun	China	2 800	2 500	n.c.
First Solar	USA	2 200	n.c.	2 941
SunPower	USA	1 900	1 380	1 872

* Shipment is over the capacity. It may be due to stocks or the outsourcing of module production. ** As Trina is not listed anymore, the groupe doesn't publish any data. It is assumed the groupe is n°2 as of production capacity worldwide. *** Fourth quarter shipments are based on company outlook and fourth quarter revenues are calculated on the outlook time the 2017 9-months average selling price. Source: EurObserv'ER.



Intelligent energy storage system combining solar panels and electric mobility.

feels that a 35% renewable target set for 2030 would enable the industry to grow sufficiently to meet the sector’s industrial challenges and sustain a pool of 300 000 jobs.

NEW PLAYERS, NEW MODELS

Photovoltaics is now a leading energy source and its growth prospects are attracting more and more businesses. This fact was manifest in 2017, as two major oil companies, Shell and BP, re-entered the market. They had already tested it at the start of the millennium but pulled out just before the 2010s. It should be remembered that in 2011, Total had taken a big step by acquiring 66% of SunPower’s shares. In December 2017, BP announced it was investing \$ 200 m to acquire 43% of the share capital of Lightsource, a British firm specializing in large-scale solar farm operations and management. The company will be renamed Lightsource BP. Shell acquired 43.83% of the American company Silicon Ranch, which builds and operates solar farms early in 2018. Its portfolio, which is USA-centred, totals 880 MW. Some industry commentators feel that

because of their project management experience, these new entrants could contribute a form of “operational excellence” and their arrival will force the photovoltaic industry players to adapt

their strategies to integrate them into the competitive context.

Car manufacturers are also entering the

Tabl. n° 6

Main European solar photovoltaic developers in 2017

Company	Country	Installed photovoltaic capacity (MWp)
Juwi AG / MVV Energie AG	Germany	> 2 300
Enerparc	Germany	2 000
Lightsource Renewable Energy	United Kingdom	2 000
EDF énergies nouvelles	France	1 648
Belectric	Germany	> 1 500
Voltaia	Portugal	1 400
Enel Green Power	Italy	1 200*
Scatec Solar	Norway	1 000
Engie	France	900
Saferay	Germany	784

* As of 31 december 2016. Source: EurObserv'ER

photovoltaic market. As the photovoltaic business models made a quantum leap in 2017, primarily centred on offers made to private individuals, strategic reflection on this segment now revolves around a triangle comprising photovoltaic electricity, electric mobility and storage systems, borne by the rapid roll-out of numerical and digital solutions. Offers encompassing all these areas are starting to emerge. Nissan, for instance, launched an offer in Japan, linking its cars to solar panels – customers purchasing one of their Leaf cars were offered a free photovoltaic installation. Since January 2018, the group has been using an offer, called Nissan Energy Solar, to enhance its presence in the UK home photovoltaic segment. It proposes to sell photovoltaic panels to its customers, together with a smart energy management system that can be coupled to its xStorage battery solution, and the price for the Nissan Energy Solar solution is pitched particularly low for this photovoltaic installation to generate interest. The price for a 1.5 kW installation is £3800. In the coming years, competition

between major groups from different sectors is likely to increase. But already, photovoltaics has opened its doors to new, more dematerialized electricity consumption modes that consumers find easier to control.

GOOD PROSPECTS AT THE MERCY OF POLITICAL CONSIDERATIONS

Despite a further drop in the number of connections in the EU, the downward spiral should be reversed at least for the next three years. Solar photovoltaic power has, without a doubt, become the most popular, least expensive and most easily accessible form of renewable energy for economic players. Many governments intend to rely on solar power to achieve their national target for 2020. Laggards such as France and the Netherlands have been spurred into action now that costs have been slashed, and that has already made the EU market much more upbeat. The Spanish tenders should also perk up the European mar-

ket from 2019 onwards, aided by the fruition of new, subsidy-free PPA projects. Germany, helped by the establishment of a stable regulatory framework and an annual installation target of 2.5 GW, should continue to act as the European market's backbone. For the eleven EU states that have already met their targets, the European political obligation to develop their renewable sectors has weakened. They are only motivated by national proactive policy. This may be why markets that were previously buoyant, such as the Czech Republic, Romania and Bulgaria are now in the doldrums. But EurObserv'ER reckons that newly installed capacity across Europe could gradually increase to at least 10 GW by 2020.

Another aspect that will boost the solar power market is the growing appetite of different economic business sectors (retail distribution, food-processing, agriculture, and so on) for the new models. Yet, regulatory questions and the contribution of these installations to the development and maintenance of the distribution grid is causing tensions between the stakeholders in the collective solar self-consumption segment of the countries in question. The implementation of a "solar tax" is a spectre that is encouraging many investors to exercise prudence and apply their brakes.

Another issue that has not reached consensus is the European Commission's intention, announced in February 2017, to phase out the anti-dumping duties on panels made in China over an 18 month period. A notice of impending expiry of the "compensatory measures" applied to Chinese modules and cells was published to this effect on 13 March 2018 in the European Union official journal. The notice indicates that if the affected European producers do not request re-examination of the situation, the measures will cease to apply on 3 September 2018. According to SolarPower Europe, lifting these protection measures should mechanically give the European self-consumption market a boost, but other analysts, such as those at the Becquerel Institute believe that there is no firm basis for any positive impact and that the curbs to the self-consumption market are essentially regulatory and less dependent on module prices which have

sunk to very low levels on the European market.

A fundamental point for the sector is the regulatory framework's adaptation to the on-going digitalization of the solar electricity market. The digital revolution serving energy transition opens up the range of possible options to optimizing the functioning of a more decentralized electricity system and setting up new commercial models that link solar power, storage and mobility, with the prospect of highly vibrant wealth creation potential. The longer-term market growth forecasts are more tentative because they largely depend on the new legal framework currently being drawn up by the European bodies. This particularly applies to the reassessment of the binding collective target for the renewable energy share by the 2030 timeline. For the time being, the renewable energy target is set at a feeble 27% minimum of the

final energy consumption total. Today, solar energy is the most popular energy source. If the politicians choose to encourage the economic players and local and territorial institutions to espouse it, solar energy could plausibly act as the catalyst for environmental and energy transition. □

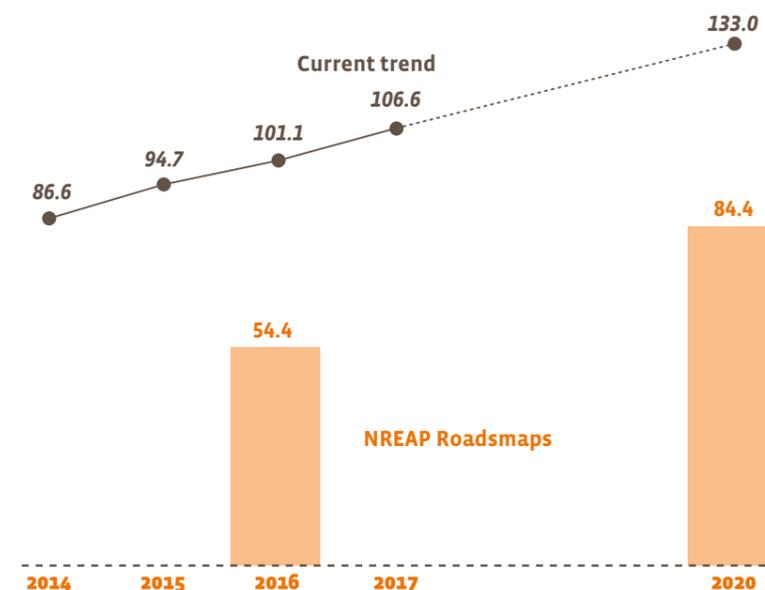
Sources: AGEE-Stat (Germany), SDES (France), BEIS (United Kingdom), Statistics Netherlands, Anie Rinnovabili (Italy), Terna (Italy), APERE (Belgium), Statistics Austria, University of Miskolc (Hungary), PV Polska (Poland), Swedish Energy Agency, DGGE (Portugal), PA Energy (Denmark), Cyprus Energy Regulatory Authority, NSO (Malta), HROTE (Croatia), Litgrid (Lithuania), CRES (Greece), RPIA (Romania), Statistics Estonia, Ministry of Industry and Trade (Czech Republic), Observ'ER, IEA PVPS.



The next barometer will cover solar thermal.

Graph. n° 3

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



Source: EurObserv'ER 2018.



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