



The Fukushima Hydrogen Energy Research Field (FH2R) uses a 20-MW solar generator, powered by renewable energy from the grid, to run a 10-MW electrolyser on the Namie Town site in Fukushima Prefecture.

TOSHIBA



130 670 MW
Cumulative photovoltaic capacity
in the EU 28 at the end of 2019

PHOTOVOLTAIC BAROMETER

A study carried out by EurObserv'ER 

The amount of solar photovoltaic capacity installed across the world in 2019 is lower than expected. It will just pass the 100-GW threshold, which is much the same as in 2018 (which the IEA PVPS experts reassessed at 103.6 GW in December 2019), and enough to pass the half-million installed megawatts threshold worldwide.

In 2019, the Chinese market's continuing and greater than forecast decline, was offset by strong growth in the other markets, the United States and European markets in particular. The global Covid-19 pandemic, its effects on the global production, distribution and installation circuits, and the ensuing global economic recession will naturally have an impact on the 2020 market, even if it is too early to quantify.

131.8 TWh

Photovoltaic electricity generated
in the EU 28 in 2019

15 634.9 MW

Photovoltaic capacity connected
in the EU 28 during the year 2019



BayWa r.e. has built a 14.5-MWp floating solar power plant in the Netherlands near the town of Zwolle. It was developed in partnership with another Dutch company Zimmermann PV-Stahlbau, to install and fix some 40,000 solar panels.

Before the Covid-19 crisis, 2020 was forecast to be an excellent year for the global photovoltaic market. The US market was promised a particularly prolific year because the main incentive was due to be curtailed at the end of 2020, and also thanks to the large volume of projects in the pipeline (see below). In the European Union, 2020 is also critical, as it is the last year that can be used to make up shortfalls by countries that are behind on their binding renewable energy targets set by the 2009/28/EC Directive. In India, renewable energy funding and development should have sharply accelerated from this year onwards to enable the country to achieve its 2022 targets (175 GW of renewable energy including 100 GW of solar). The Chinese market, initially

expected to enjoy high growth in 2020, became harder to interpret when confirmation came in March 2020 that the aid allocated to the solar sector would be severely cut back.

Like other industries, the solar industry has been exposed to confinement and social distancing measures. While in mid-April the risk of the pandemic in Asia seemed to have been brought under control, accompanied by the gradual resumption of their solar sector (manufacturing and installation), the situation was still difficult in Europe and the USA, with many workers laid off or working part-time and projects postponed or moved. Hence, it is very hard to predict the global installation volume for 2020. Early in April, the consultancy

Wood Mackenzie lowered its global solar photovoltaic market estimates for 2020, from its initial figure of 129.5 to 106.4 GW. According to EurObserv'ER subsequent assessments are likely to reduce this further. Wood Mackenzie more specifically expects a decline in distributed solar power in the residential sector, and delays in the large power plant sector. Wood Mackenzie also expects solar module prices to come down in the American and European markets explained by the many Chinese manufacturing plants having restarted production a few weeks ago, some of which are running at full capacity, while the pandemic, whose virulence has geographically shifted towards Europe and America, is reducing activity on these two continents.

THE 200-GW THRESHOLD PASSED IN CHINA

On 6 March 2020, the National Energy Administration held a quarterly press conference to report on the operation of the renewable energy sectors connected to the grid in 2019. Newly-installed solar photovoltaic capacity was put at 30.11 GW, spread between 17.91 GW of new centralized and decentralized (a.k.a. "distributed") capacity, mainly consisting of 12.2 GW of roof-mounted or roof-integrated installations. Thus, newly-installed capacity is lower for the second year running (32.2% less between 2018 and 2019, 16% less between 2017 and 2018). It had reached 44.38 GW in 2018 and 52.8 GW in 2017. At

the end of 2019, cumulative installed photovoltaic capacity had reached 204 GW (174.6 GW at the end of 2018). The NEA points out that it is the first year that wind and solar power have both passed the 200-GW threshold (the wind power base is 210 GW).

A new fall in the connection level was expected, but perhaps not quite so marked. The underlying reason is the government's intention to slash incentive levels for major solar plant electricity production, by introducing tendering systems, similar to those of Europe. It hopes to control the volumes and drive prices down as far as possible while shifting the priority to the installation of "network parity" projects that offer lower electricity production costs than coal-fired power plants.

The NEA launched its first tender in July 2019 that covered a volume of 22.7 GW comprising 3 921 centralized and distributed projects. The successful bids range from 0.2795 to 0.5500 RMB/kWh (€ 0.0358 to 0.0715/kWh), depending on the size of the systems, with a mean price of 0.03281 RMB/kWh (€ 0.0427/kWh). The lowest offer was awarded to a 100-MW power plant in the autonomous Ningxia region and the highest to a 24-kW system in the municipality of Chongqing. A few months prior to that in May 2019, the authorities had approved a list of 168 subsidy-free solar projects for a combined capacity of 14.8 GW, of which 4.9 GW were due to go on-grid before the end of 2019, 8.9 GW in 2020 and 1.7 GW in 2021-2023.

The NEA also confirmed in March 2020 that it had slashed national subsidies for new solar energy projects by 50% for 2020, to 1.5 billion yuan (215.8 million dollars) compared to 3 billion yuan allocated in 2018. Of the total awarded in 2020, 1 billion yuan was allocated to major solar projects that will be shared by auction. The remainder will be allocated to residential solar systems. As the Chinese government considers that its renewable energy industry is competitive enough to get along without state protection, this measure effectively reduces the amount of aid awarded to renewable energy projects.

China's photovoltaic electricity output

reached 224.3 TWh. For the first time it crossed the 200-TWh threshold, having increased by 26.3% over its 2018 output (equating to a load factor of 1 169 hours, which is a year-on-year increase of 54 hours). Centralized photovoltaic electricity output amounted to 169.7 TWh of this 224.3 TWh total (i.e. a load factor of 1 260 hours and a 22.7% increase on the previous year). Distributed (decentralized) photovoltaic electricity output, reached 54.5 TWh, a 39.4% year-on-year increase (961 hours' use at full load, i.e. an annual increase of 67 hours). The NEA points out that only 4.6 TWh of photovoltaic electricity output, or 2% of total electricity output, had to be offloaded through local electricity distribution infrastructure shortcomings. This residual amount proves that investments in solar electricity distribution infrastructures are now keeping up with the increased production capacities.

Given the damage wreaked on companies by the Covid-19 epidemic, the NEA has extended the auction submission closing date until mid-June 2020. It has also awarded solar and wind energy farm operators an additional month to file their applications for connecting their projects to the country's electricity grid, which is essential if their power plants are to sell electricity. However, the manpower shortages and supply chain disruptions caused by the epidemic have already delayed the construction of many major power plants. The distributed solar segment, located in or near major densely populated centres, is likely to suffer particularly badly from the confinement and workers' health and safety measures.

AMERICA'S SOLAR INDUSTRY RESILIENCE IS SORELY TESTED

According to the annual report published in March 2020, jointly produced by the Wood Mackenzie consultancy and the Solar Energy Industries Association (SEIA) of the US, solar capacity installations surged in 2019. The report claims that installed capacity grew by 13.3 GW in 2019, i.e. a 23% increase on the installation figure for 2018. This capacity equates to 40% of the United States' additional electricity capacity, which

is the largest share ever observed in the country (the coal-fired power plant load factor is higher). The report also states that the country's cumulative operational capacity is now more than 76 GW, compared to its share of around one GW at the end of 2009. The report goes on to say that the demand for solar photovoltaic power is still high, with a total of 30.4 GW of new projects supported and announced in 2019 by the public electricity service companies. This takes contracts in the pipeline to a new record level of 48.1 GW. It is too early to gauge the impact of the global Covid-19 pandemic on the American market. The forecast given in the March report by Wood Mackenzie and the SEAI, before the pandemic hit the North-American continent, was for annual growth of 47% in 2020, i.e. about 20 GW of additional capacity. Events have unfortunately overtaken this forecast. It also predicted that total installed photovoltaic capacity in the USA would more than double over the next five years, with an installation level of 20.4 GW in 2021 before the expiry of the federal Investment Tax Credit granted for residential systems. The report also conjectured that by 2025 one in every three residential solar systems and one out of every four

non-residential solar systems would be equipped with a storage system. Once again, it is hard to know whether or not these forecasts can be achieved. According to Abigail Ross Hopper, the President and CEO of SEIA, the solar industry's resilience capacity provides cause for hope: "This once again is testing our industry's resilience but we believe over the long run we are well positioned to out-compete (...) in the Solar+ decade and to continue growing our market share." The aim of the SEIA Solar + plan presented in May 2019 is for a 20% target share of solar in the United States' electricity mix by 2030. This ambition does not seem far-fetched given the solar sector's ability to reduce production costs. By way of example, in March 2020 Andrew Cuomo, New York's governor, unveiled the details of New York State's third public procurement auction for solar, wind and energy storage projects set up by NYSERDA (the New York Energy Research and Development Authority). Solar energy accounted for 17 of the 21 selected projects (1 090 MW of a total of 1 278 MW) with a weighted average award price of \$ 18.59/MWh for a 20-year period (about 1.7 euro cents per kWh). A law signed by the governor in July 2019, the Climate Leadership and

Community Protection Act (CLCPA), stipulates that by 2030, 70% of New York State's electricity supply will be provided by renewable energies.

THE EU OF 28 INSTALLED 15.6 GW IN 2019

Like the USA, newly-installed capacity surged in the European Union in 2019. The robust German solar market, the return to the fore of the Spanish market and the capacity build-up of the Dutch, Belgian, Polish, Hungarian and Greek markets have clearly changed the game. According to EurObserv'ER, at least 15.6 GW was installed during 2019 (8.5 GW in 2018) in the European Union of 28. If we subtract the decommissioned capacity, the base of the EU of 28 reached 130.7 GW at the end of 2019 (table 1). Leaving the UK aside, which officially left the European Union at midnight on 31 January 2020, newly-installed capacity is put at 15.1 GW in 2019 and the installed base of the EU of 27 at 117.1 GW at the end of 2019.

The reasons for this increase are a more incisive auctioning policy by countries that have failed to reach their 2020 renewable energy targets, the capacity build-up of PPA – Power Purchase Agreements (especially in Spain) – and the achievement of grid parity by some countries that gives distributed photovoltaic and self-consumption a boost. What is more, European legislation strongly encourages the development of solar self-consumption. The Renewable Energy Directive of 11 December 2018 specifically asks the Member States to set up a regulatory framework to ensure that individuals have the right to produce, use their own output, store, and sell electricity, without having to bear unreasonable charges. The Member States are under obligation to adopt the self-consumption provisions before 30 June 2021. Another reason for the recovery of the EU market, is that the price competitiveness of solar photovoltaic was improved by the decision enacted at the end of 2018 to lift the anti-dumping barriers on Chinese modules, which has increased the profitability of very large projects.

Tabl. n° 1

Capacity installed in 2019* by the main non-EU photovoltaic markets

Countries	Newly added capacity in 2018 (GW)
China	30.1
United States	13.3
India	7.7
Japan	7.0
Vietnam	5.6
Australia	4.6
Ukraine	3.9
Mexico	1.9
United Arab Emirates	1.3
Turkey	0.9

* Estimation Sources : NEA (China), SEIA (United States), RTS Group (Japan), IRENA (others).

Tabl. n° 2

Installed and cumulated solar photovoltaic capacity* in the European Union at the end of 2019** (MW)

	2018 cumulated	2019 cumulated	2019 installed
Germany	45 181.0	49 016.0	3 856.0
Italy	20 107.6	20 864.0	759.0
United Kingdom	13 118.3	13 616.0	497.7
France	9 617.0	10 575.9	965.6
Spain	5 239.9	9 232.8	3 992.9
Netherlands	4 522.0	6 924.0	2 402.0
Belgium	3 986.5	4 530.5	544.0
Greece	2 645.4	2 793.8	148.4
Czechia	2 075.1	2 100.0	24.9
Austria	1 437.6	1 660.6	223.0
Romania	1 385.8	1 385.8	0.0
Poland	562.0	1 317.0	755.0
Hungary	726.0	1 277.0	653.0
Denmark	995.0	1 080.0	85.0
Bulgaria	1 032.7	1 065.0	32.3
Portugal	667.4	907.0	220.0
Sweden	428.0	698.0	270.0
Slovakia	472.0	472.0	0.0
Slovenia	221.3	222.0	0.7
Finland	140.0	215.0	75.0
Malta	131.3	150.6	20.0
Luxembourg	130.6	140.6	10.0
Cyprus	118.5	128.7	10.2
Estonia	31.9	107.0	75.1
Lithuania	82.0	83.0	1.0
Croatia	67.7	69.0	1.3
Ireland	24.2	36.0	11.8
Latvia	2.0	3.0	1.0
Total EU 28	115 148.9	130 670.4	15 634.9
Total EU 27	102 030.6	117 054.4	15 137.2

* off-grid included ** Estimation Note: 21 MW decommissioned in Germany, 6.7 MW in France, 5.1 MW in the Czech Republic, 2.8 MW in Italy and 0.5 MW in Malta. Source: EurObserv'ER 2020

131.8 TWH OF ELECTRICITY PRODUCED IN THE EUROPEAN UNION OF 28

European Union output, based on the first official estimates, should reach 131.8 TWh in 2019 (122.9 TWh in 2018), i.e., 7.2% annual growth in 2018 (table 2), which is slightly lower than in 2017 (8.3% growth between 2017 and 2018), when output was measured at 113.5 TWh. Leaving aside the UK, the European Union of 27's solar electricity output is put at 119.1 TWh, which equates to 8.2% annual growth (110.1 TWh in 2018). Thus, in 2019, solar photovoltaic accounted for just over 4% of the European Union of 28's gross electricity output (compared to 3.8% in 2018 and 3.4% in 2017). Some countries' solar electricity share is about twice the European mean... examples are Germany and Italy. Some countries that encourage self-consumption, monitor the directly self-consumed solar electricity share. Terna, the Italian grid manager, claims it reached 19.9% in Italy (which is less than in 2018 when the share was 22.7%), the Directorate General for Energy and Geology in Portugal put it at 17.2% (15.2% in 2018) and AGEE-Stat the working group on renewable energy statistics reporting to the Federal Ministry for Economic Affairs and Energy (BMWi) unofficially put it at 11% for Germany (10.9% in 2018).

NEWS FROM AROUND THE MAIN EU MARKETS

The Spanish "reconquista"

In 2019, Spain returned to snatch the European Union lead from Germany for new solar photovoltaic installations, by eclipsing Germany's figure by 136.9 MW. Data released by the Spanish Ministry for Ecological Transition confirms that during 2019 it connected almost 4 GW of capacity (3 992.9 MW to be precise), taking its photovoltaic base capacity to 9 232.8 MW. The total capacity of the photovoltaic base increased by 76.2% in a single year. The reason for this result can be partly ascribed to the government's new auctioning policy. Two successive renewable energy auctions (wind and solar) were launched in May and July of

Tabl. n° 3

Electricity production from solar photovoltaic in the European Union countries in 2018 and 2019* (in TWh)

	2018	2019
Germany	45.784	47.517
Italy	22.654	23.688
United Kingdom	12.857	12.677
France	10.569	11.357
Spain	7.841	9.351
Belgium	3.902	4.256
Greece	3.791	3.962
Netherlands	3.693	5.189
Czechia	2.359	2.387
Romania	1.771	1.831
Austria	1.438	1.661
Bulgaria	1.343	1.400
Portugal	1.006	1.395
Denmark	0.953	1.080
Hungary	0.620	0.950
Slovakia	0.585	0.600
Sweden	0.407	0.500
Poland	0.300	0.730
Slovenia	0.255	0.260
Cyprus	0.199	0.200
Malta	0.190	0.203
Luxembourg	0.120	0.122
Finland	0.090	0.178
Lithuania	0.087	0.081
Croatia	0.075	0.080
Estonia	0.031	0.100
Ireland	0.017	0.020
Latvia	0.001	0.002
Total EU 28	122.936	131.776
Total EU 27	110.079	119.099

*Estimation Source: EurObserv'ER 2020



The Gridserve project partly funded by the British authorities, plans to set up a national network of 100 recharging stations.

2017. The Spanish ministry thus awarded 3.9 GW of contracts to 2017 projects, the first of which was commissioned in September 2019 (the 85-MW Totana solar power plant). Achieving grid parity is also favourable to developing distributed solar power and self-consumption, as the ill-famed solar tax that aimed to curb the development of self-consumption was repealed on 5 October 2018 by Royal Decree No. 15/2018 on energy transition.

Alongside the auctions, new business models have been set up that no longer require subsidies. Spain is the most attractive European market for solar projects linked to PPA agreements between producers and major consumers, with 4.39 GW of capacity under contract (see below).

To mark the Spanish photovoltaic sector's revival, Spain completed the construction of the European Union's biggest solar power plant close to the small town of Usagre (Badajoz) at the end of 2019. The Nuñez de Balboa power plant (named after a famous Spanish conquistador) covers 1 000 hectares and has 500 MW (or 1 430 000 photovoltaic

panels) and maximum grid connection capacity of 392 MW. It is the result of a partnership between Iberdrola and the specialist group Ecoenergías del Guadiana and required 290 million euros of investment. Its annual output will be 832 GWh which is enough to supply 250 000 individuals with clean energy, while avoiding 215 000 tonnes of annual CO₂ emissions. The power plant took up 145 and 140 million euros of funding respectively from the European Investment Bank (EIB) and the Instituto de Crédito Oficial (ICO). The project is part of Iberdrola's plan to install an additional 2 000 megawatts of solar and wind energy in Extremadura by 2022, of which more than 1 700 MW are already under construction or awaiting administrative approval. Projects that are well advanced include the Ceclavín, Arenales and Campo Arañuelo I and II photovoltaic power plants. Iberdrola has negotiated private agreements with several companies to supply them with 100% renewable energy from the Extremadura power plant over the long term. So far, it has signed PPA agreements with three major Spanish companies: Kutxabank,

Euskatel the telecoms operator and Uvesco, the major distribution chain (BM Supermercados) to ensure the return on investment of this macro-project.

By way of comparison, the biggest solar photovoltaic power plant was commissioned in July 2019 in Abu Dhabi, the Noor Abu Dhab project, with 1 177 MW of capacity. At the time, the project set another record when the bids were made, that of the world's most competitive tariff of 2.42 dollar cents per kilowatt-hour.

Photovoltaic electricity output has obviously increased sharply, officially rising from 7.84 to 9.35 TWh. If we assume that all the installed capacity worked over a full year, the output would be about 14 TW.

New record low price for solar power in Germany

The German photovoltaic market picked up in 2019. According to official AGEE-Stat statistics, almost 3.9 GW (3 856 MW to be exact) was connected during 2019. The capacity of the German photovoltaic base is thus quantified at 49 016 MW (after deductions for 21 MW of capacity

decommissioned during 2019). The additional capacity that went on-grid in 2019 is 3 835 MW, compared to 2 288 MW in 2018.

The results of the last two solar PV auctions show that today solar is the country's most competitive renewable energy. In February 2020, the Federal Network Agency announced that 18 projects for a combined capacity of 100.6 MW had been selected from a total of 493 MW of projects submitted for the auction (directed at photovoltaic projects ranging from 750 kW to 10 MW covering a volume of 100 MW).

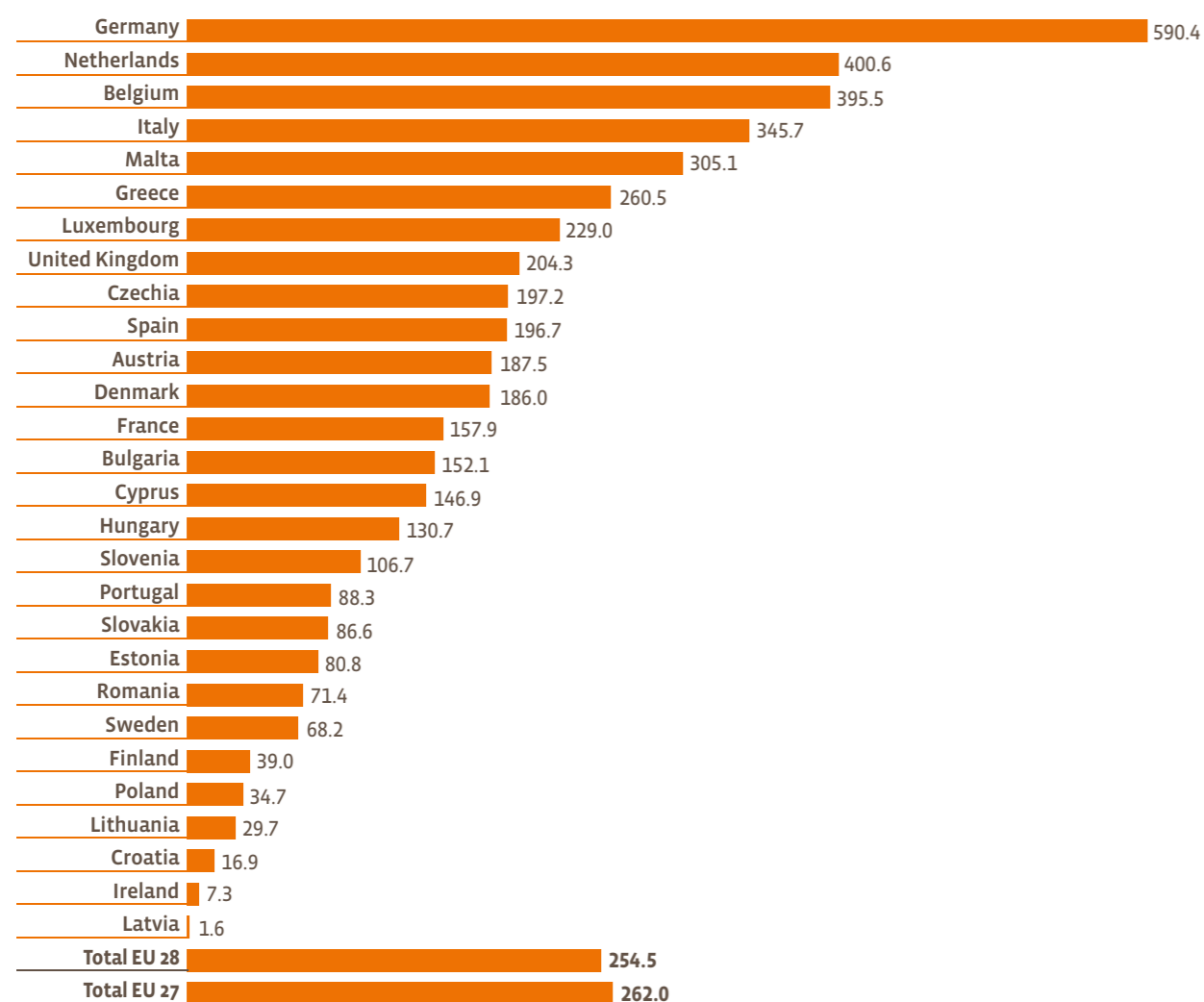
The lowest successful bid was for 3.55 euro cents per kWh, which set a new country record, while the highest was for 5.21 euro cents per kWh. The final price, averaged out, was 5.01 euro cents per kWh, which is much lower than the allocated price of the previous auction of the same type (5.68 euro cents per kWh), finalized in December. Bidding ended in March 2020, this time for a volume of 300 MW (301.2 MW retained) and resulted in slightly higher prices. The lowest successful bid was for 4.64 euro cents per kWh, the highest for 5.48 euro cents per kWh, and the average price

for the 51 projects was 5.18 euro cents per kWh.

Roof-mounted PV is still Germany's main market driver. Systems of up to 750 kWp still enjoy a guaranteed feed-in tariff, which is revised every month and came down by 1.4% on 1 April 2020. As for <100 kWp systems that do not sell electricity directly to the market, the tariffs have been set at 9.44 euro cents per kWh (<10 kWp) for residential and non-residential systems, 9.18 euro cents per kWh (>10 kWp to <40 kWp), and at 7.21 euro cents per kWh (>40 kWp to <100 kWp). Non-residential systems located outside

Graph. n° 1

Photovoltaic capacity per inhabitant (W/inhab.) for each EU country in 2019



* Estimation Source: EurObserv'ER 2020

and in open spaces (<100 kWp) are paid at 6.50 euro cents per kWh. Systems with capacities below 750 kWp, can opt for top-up remuneration (Marktprämie), when selling directly into the market. Since 1 January 2016, this regime has been compulsory for all >100-kWp installations. The premium is calculated on the basis of a reference value. On 1 April 2020, the amount ranged from 9.84 to 6.90 euro cents per kWh, applying the above nomenclature.

AGEE-Stat puts solar power output for 2019 at 47.5 TWh, compared to 45.8 TWh in 2018 (3.8% growth). The proportion attributable to self-consumption is put at 11% of the 2019 total, i.e. a little less than 5.3 TWh. BSW, the German Solar Industry Association, has done a count of solar installation storage systems and reckons that about 60 000 storage systems were installed in 2019 (for 100 800 new solar systems) which increases the cumulative storage system base to about 180 000. Solar photovoltaic still has room for improvement over the next decade. In its latest draft climate protection programme ("Klimaschutzprogramm 2030"), the German government states its aims to achieve a total installed photovoltaic capacity of 98 GW in 2030.

The Netherlands' photovoltaic rush

If we consider the size of the population (17.3 million inhabitants), the Netherlands was the most active European Union country for installing new solar photovoltaic capacity in 2019. According to Statistics Netherlands data, the country connected 2 402 MW in 2019 (compared to 1 618 MW in 2018), thus increasing the capacity of its total installed base by 53.1% or 6 924 MW by the end of 2019. Thus, in the space of a year, the Netherlands installed 139 Watts peak of photovoltaic capacity per inhabitant. If we consider the cumulative installed base at the end of 2019, the Netherlands has the second best ratio of any European Union country at just over 400 Wp per inhabitant (table 3), behind Germany which has a ratio of 590 Wp per inhabitant. This spectacular rush by the Netherlands may be ascribed to the country's determination to get as close as possible to its 2020 renewable energy targets, as in 2018, the scoreboard showed that it was one of the countries lagging furthest behind (with a 7.4% share of gross final energy consumption against its 14% target).

Naturally, solar electricity output has risen sharply (by 40.5% year-on-year).

Statistics Netherlands assessed it at 5.2 TW in 2019, compared to 3.7 TW in 2018. Simultaneously, the solar power share in the country's gross electricity output rose from 3.2% in 2018 (total output of 114.5 TWh) to 4.3% in 2019 (total output of 121 TWh).

The coronavirus crisis will have an impact on the projects that were due to be commissioned before the end of the year. In view of this, the Dutch solar industry association, Holland Solar, asked its government on 30 March to extend the connection dates beyond the deadline for large-scale installation projects taking up the SDE+ incentive programme. As for the residential sector, the Dutch government wrote to its Parliament, to announce that it envisages reducing "net metering" tariffs by 9% per annum between 2023 and 2030, but that it intends to maintain this system in place throughout the next decade. From 2031, no tariff will be paid for surplus electricity sourced from residential systems sent to the grid. If this plan is adopted, it should hit the dimensioning and installation of storage systems to increase the share of self-consumed electricity.

In the autumn, the government also announced the launch of a new SDE++ "Stimulation Scheme Sustainable Energy

Tabl. n° 4

Top 10 Solar Panel Manufacturers In 2019 (modules shipment, in GW)

Company		2018 shipments	2019 shipments	Growth 18/19
JinkoSolar	China	11,4	14,3	26%
JA Solar	China	8,8	10,3	17%
Trina Solar	China	8,1	9,7	20%
Longi Solar	China	7,2	9,0	25%
Canadian Solar	Canada-China	6,6	8,6	30%
Hanwha Q Cells	South Korea	5,5	7,3	33%
Risen Energy	China	4,8	7,0	46%
First Solar	United-States	2,7	5,4	100%
GCL	China	4,1	4,8	17%
Shunfeng Photovoltaic	China	3,3	4,0	21%

Source: 2019 Annual reports (First Solar, Canadian Solar, JinkoSolar), others Globaldata 2020 (preliminary results)

Most of the Chinese photovoltaic players have delisted from the American stock exchange. As they are no longer subject to the same communication obligations, information about them has become much scarcer. This primarily applies to their annual delivery figures, total manufacturing capacity and turnover. Of the top ten manufacturers, 7 are Chinese with the exception of Q Cells (South Korea), Canadian Solar (Canada) and First Solar (USA). However, all manufacturers have production capacity in China, with the exception of First solar which has capacity in the United States, Malaysia and Viet-nam.

Transition” programme with a budget of 5 billion euros. SDE++, the successor to SDE+, which subsidized renewable energy production technologies, broadens the scope to include energy transition with the funding of new technologies to reduce CO₂ (hydrogen by electrolysis, carbon capture and storage, heat pump, industrial waste heat, etc.). SDE ++ is based on the reduction subsidy requirement costs per tonne of CO₂ capped at € 300 per tonne, in contrast with SDE + whose project classification was based on the kWh cost price.

France protects its sector players

The preliminary data for 2019 released by the French Data and Statistical Studies Department (SDES) of the Ministry of Ecological and Solidarity Transition, shows that France connected 965.6 MW of capacity, just below its 2018 level (when it added 1 006 MW). Imminent consolidation of this figure is likely to raise it nearer to the one GW threshold. If we deduct the decommissioned capacity (5.1 MW in 2019), the country’s peak capacity (i.e. the maximum capacity deliverable to the grid) crossed the 10-GW threshold (10 575.9 MW at the end of 2019) for the first time.

The French government has been highly responsive in taking measures to assist and support the renewable electricity sectors’ actors during the current health crisis. As early as 1 April, the Environment Ministry undertook to award additional time for the commissioning of renewable energy installations, to avoid penalising them for Covid-19 related delays. The ministry also announced that the electricity purchase tariffs for small, roof-mounted solar photovoltaic projects that were due to drop on 1 April 2020, would be frozen for three months. The next auction rounds’ timetables will also be wholly or partly postponed.

Incidentally, the government has published the list of successful wind and solar energy bids for several auctions. Thus, 88 projects have been successful for the “ground-based solar photovoltaic” auction (from 500 kWp to 30 MWp and over), that amount to a volume of 649 MWp for a bidding volume of 850 MWp. The winning bids have been retained with an average price of € 62.11/MWh.

Another 39 projects have made successful bids for the “innovative solar photovoltaic” auction, that amount to a volume of 104 MWp. Of those, more than 40 MWp are for “agrivoltaic” projects that combine agricultural and photovoltaic land use. The successful bids are retained at an average tariff of € 82.8/MWh. Another 12 projects have successfully bid for “solar photovoltaic” projects in the Haut-Rhin, launched to make up for the closure of the Fessenheim nuclear power plant. These projects, that amount to 94.2 MWp of installed capacity, were retained at an average price of € 55.78/MWh for ground-based projects, € 92/MWh for >500 kWp roof-mounted projects and € 98.5/MWh for <500 kWp roof-mounted projects. As for the “self-consumption solar photovoltaic” auction, 30 projects bid successfully for 11.8 MWp of the 25-MWp bidding volume. The average weighted premium awarded to the successful bidders is € 15.97/MWh. Lastly, as for the specific auctions for Corsica and the French Overseas Territories, 38 solar photovoltaic projects with storage, amounting to 54.8 MW of capacity, were successful at an average tariff of € 108.2/MWh, 37 solar photovoltaic projects without storage bid successfully for 44.1 MWp of capacity at an average tariff of € 96.2/MWh and 9 self-consumption solar photovoltaic projects for a volume of 2.8 MW bid successfully at an average premium of € 44.1/MWh. The total volume of successful solar photovoltaic project bids is 960.7 MWp.

With a little delay, France published on the 23 April 2020 its new multiannual energy program (PPE), which is the tool for steering the energy policy created by the energy transition law for green growth, for the years 2019-2023 and 2024-2028. For the photovoltaic sector, France has set a target of 20.1 GW by 2023 and between 35.1 GW and 44 GW by 2028.

PPA AGREEMENTS ARE BOOMING

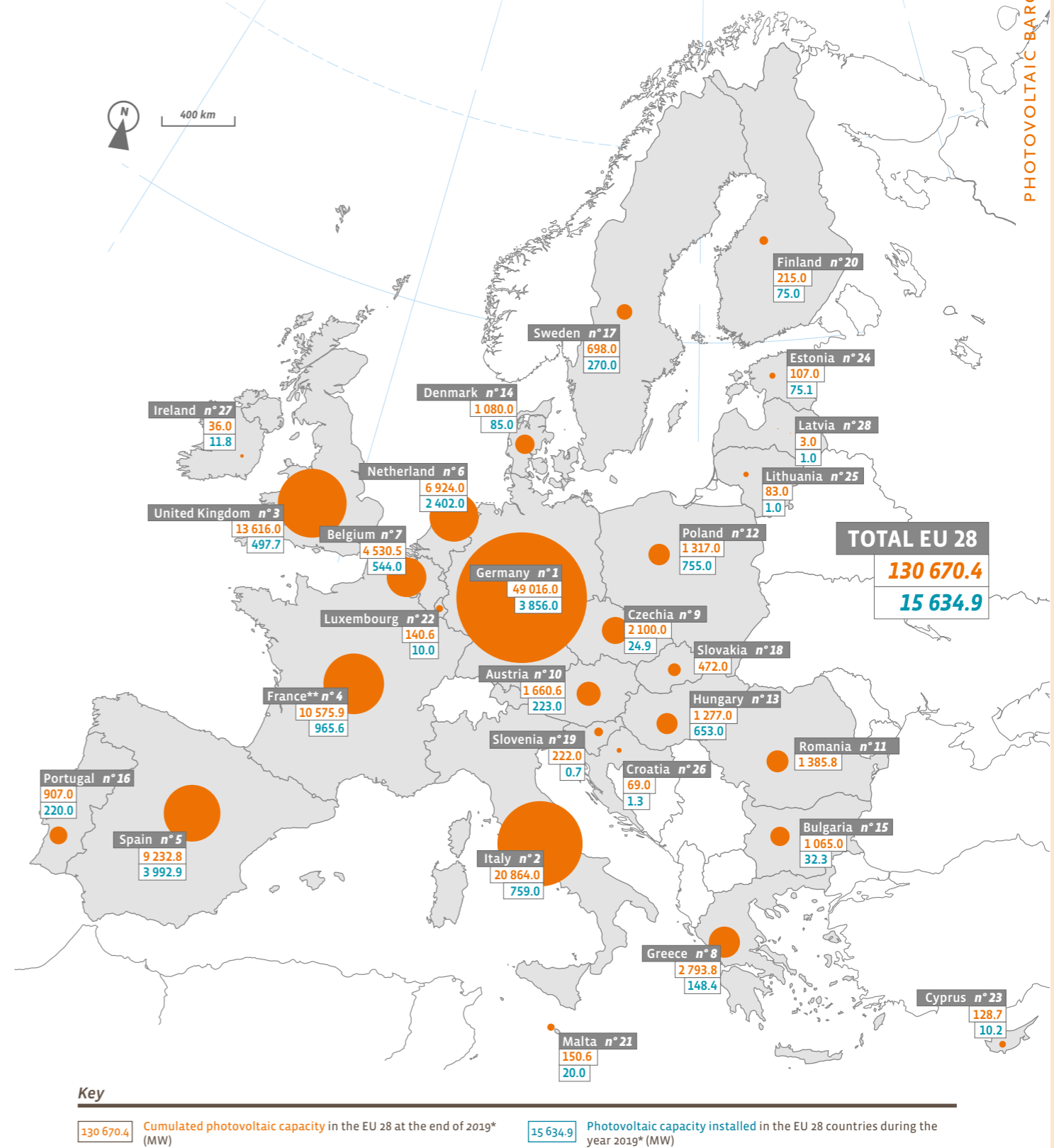
Before the Covid-19 crisis put the development of the European market on hold, 2019 saw the commissioning of the first major solar power plants without aid, top-up remuneration, and did so outside the volumes allocated for

auctions. According to the German market research consultancy Enervis Energy Advisors’ Status quo: Market Parity of PV and Onshore Wind in Europe report, there are 21 GW of wind and solar power projects in the pipeline in Europe. The study points out that Spain is currently Europe’s most attractive market for PPA-type photovoltaic projects, where 4.39 GW of capacity was announced in 2019 alone. Italy and Germany are runners-up with 1.91 GW and 1.05 GW of projects, respectively. But demand for this type of project is emerging in other countries such as Portugal, Denmark, France, Poland, Sweden, and the UK. It is still too soon to gauge the impact of the Covid-19 crisis on the execution of these projects. As electricity market prices have plummeted, it is likely that many of the projects will be postponed. According to a Bloomberg report on the prevailing PPA prices in Europe, that it released early in April 2020, the lowest prices negotiated for solar photovoltaic electricity are in Spain at 35.3 euros/MWh.

Many PPA projects were announced in 2019 and at the beginning of 2020. In Spain, the Talayuela (300 MW) PV power plant project, in Caceres province, Extremadura, was one of Spain’s first projects to be funded without subsidies. The project is being developed by the British solar project specialist Solarcentury, and Encavis, the German operator. Construction started in the autumn and the plant should be up and running in the 2nd half of 2020. In February 2020, Iberdrola clinched a long-term electricity purchase deal with telecoms services provider Orange for a 328-MW solar farm that will be constructed in the municipalities of Ceclavin and Alcántara. The project is part of a 3-GW pipeline of renewable energy projects that Iberdrola hopes to install by 2022.

At the beginning of 2020, the energy service company EnBW also launched the construction of a solar power plant in excess of 180 MW, Germany’s biggest, at Weesow-Willmersdorf with no feed-in tariff or top-up remuneration. It will sell this electricity directly on the electricity market to its customers. In February 2019, EnBW and Energiekontor signed the first long-term subsidy-free PPA contract, for 15 years, for the 85-MW Marlow/Dettmannsdorf solar project (annual output of 88 GWh).

Photovoltaic capacity connected in the European Union in 2019* (MW)



*Estimate. **Overseas departments included for France. Source: Eurobserv'ER 2020



Núñez de Balboa in Spain, is now Europe's biggest photovoltaic power plant with 500 MW of capacity deployed over 1 000 hectares.

NASA

NEW PLANTS ANNOUNCED IN CHINA FOR FACTORIES OF SEVERAL TENS OF GW

Some Chinese players have said that they intend to ramp up their production capacity considerably to take even more advantage of scale effects and meet the global market's expected surge. LONGi Green Energy technology, the world's biggest monocrystalline silicon wafer producer, has signed an agreement to construct a new 20-GW manufacturing facility in the city of Chuxiong, Yunnan province, with the possibility of raising the factory's capacity to 40 GW. The initial investment in this facility will be about RMB 2 billion. LONGi's current wafer capacity expansion plans aim for about 65 GW by 2021, with a possible extension to more than 100 GW in years to come. In April 2020, at the height of the global pandemic, GCL-System Integration Technology, which currently has about 7.2 GW of manufacturing capacity (mono- and polycrystalline modules) announced the construction project of a 60-GW module factory at Hefei, Anhui province's capital in Eastern China. Under the terms of agreement with the local authorities, the group will invest a total of 18 billion yuan (2.4 billion euros) in the project that will be built in four 15-GW phases from

2020 to 2023. The first phase should be up and running in 2020. The company claims that on completion of the project, CGL-SI will have the world's highest module manufacturing capacity. These announcements confirm that China's industry players are confident about global growth prospects on all five continents, as solar energy has become a pillar of the global energy industry.

THE ISSUE OF INDUSTRIAL RELOCATION IN EUROPE

In Europe, the issue of relocating the manufacturing of specific strategic activities is no longer implausible during this global health crisis caused by Covid-19, especially as the European Union still leads the way on very high performance cells primarily with silicon heterojunction technology. Heterojunction entails putting different materials in contact (monocrystalline silicon and amorphous silicon) in contrast with classic cells that only work with one material (poly-, monocrystalline or amorphous silicon). By way of example, in December 2019 a new record was set in the race for industrializing heterojunction cells. While the photovoltaic cells on the market offer a 20% yield in solar energy conversion performance, the teams at Liten, a

CEA laboratory (the French Alternative Energies and Atomic Energy Commission) succeeded in delivering 2 400 units per hour at an industrial pace from a pilot production line. The cells offer a yield of 24%, measured over the whole surface of the industrial-size cells (244 cm²).

EMERGING FROM THE CRISIS WITH NEW MOMENTUM

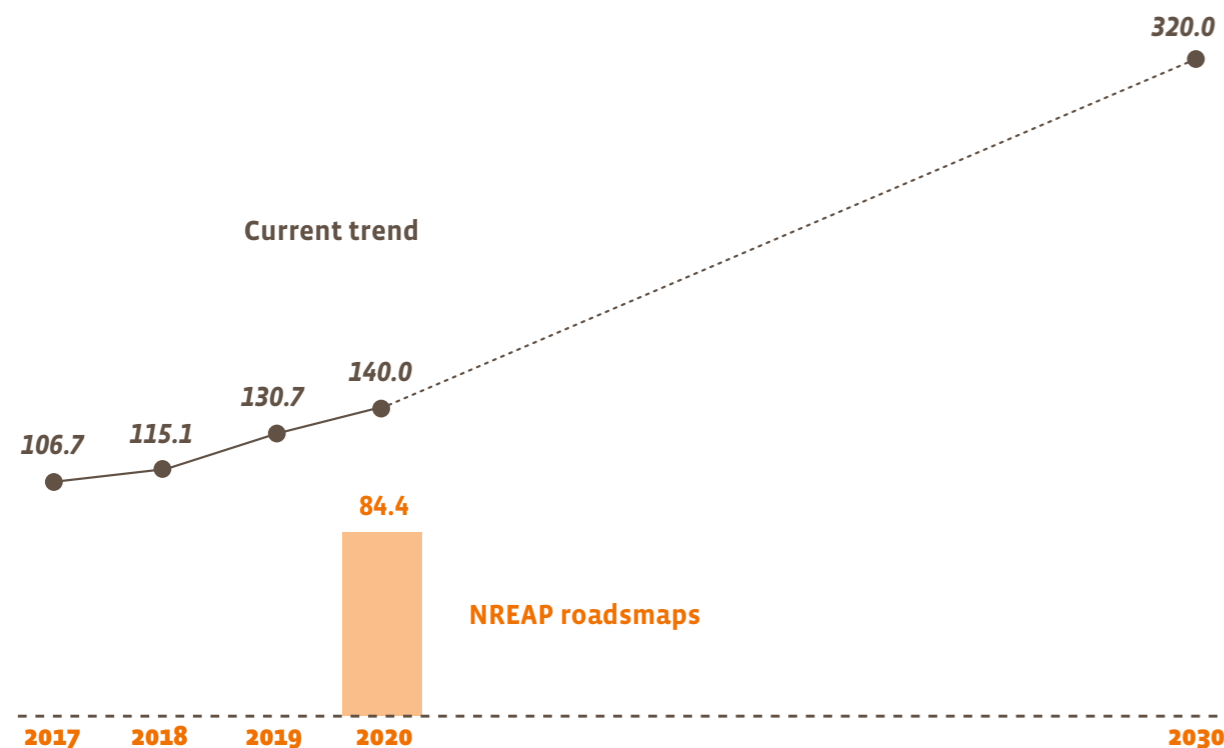
The sector's growth prospects were looking good until the unexpected hit it. The year 2020 should have been a springboard for the European solar photovoltaic sector opening up the field to a new decade of growth, taking advantage of the continuing drops in production costs, a positive image with the general public, political support, and a favourable legal framework. At the end of 2019, Michael Schmela, Executive Advisor and Head of Market Intelligence at SolarPower Europe association, that represents the interests of the European solar photovoltaic sector, forecast that the coming years "are looking truly phenomenal for solar deployment in Europe". Taking up the "Medium Scenario" projections of SolarPower Europe's "EU Market Outlook - 2019-2023" published on 10 December 2019, he declared that the



CEMOSA

Graph. n° 3

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



Due to the COVID-19 crisis, which is causing uncertainties on construction sites in progress, the EurObserv'ER estimate for the EU 28 cumulated capacity at the end of 2020 remains indicative. Source: EurObserv'ER 2020

EU (of 28) was on track to add up to 21 GW of additional capacity in 2020 and 21.9 GW in 2021. “The record-breaking year is expected to be 2022”, he added, “with an anticipated all-time high of 24.3 GW of installations, and again in 2023 with 26.8 GW of newly-installed solar capacity”. According to the report, the Medium Scenario would have probably raised the European Union of 28 countries’ cumulative capacity to 226 GW by 2023. Two other scenarios are also presented in the report, a “Low Scenario” which limits progress by the same timeline to 180.1 GW and the “High Scenario” that raises the annual market size to 276.8 GW. If we again consider the new European Union of 27, i.e. by taking the UK out of the projections, cumulative capacity should settle at 210.5 GW by 2023 adopting the Medium Scenario (the UK’s share is estimated at 15 473 MW by 2023). The reason for this optimism is the fact that in many EU countries, solar is the

cheapest energy production source, and the easiest and fastest renewable energy technology to install. That makes photovoltaic the preferred solution for many EU countries for achieving their national renewable energy targets for 2020. By the way, these targets that include the situation in 2020 will obviously be muddled, as confinement has already lasted several weeks in most European Union countries and economic activity has slowed down (which means a drop in fossil electricity production, a drop in gas consumption by industry and of oil in transport), which would mechanically improve the renewable energy share. As for electricity production, if “merit order” is applied, renewable energies such as solar and wind energy have priority access to the grid because their marginal costs are lower (marginal cost is the additional cost of the last unit produced), ahead of nuclear, hydropower, gas, coal and fuel oil.

Covid-19 has upset these plans and since March, the European solar sector has been faced with major challenges that are likely to weaken some players and have the potential to derail the growth of renewable energies for a long time. The challenges that must be addressed by the European sector include the logistical disruptions to the supply chain that are delaying projects, the impossibility of adhering to deadlines to be eligible for the planned incentives, uncertainties about the future electricity demand, the future outlets and electricity market price levels if the economic crisis is protracted. Not all the players will be affected in the same way. The major developers backed by strong liquidity and cashflow, will be in a better position to manage these construction delays and additional costs. The financial situation is quite different for small developers who have less liquidity and the smallest solar

businesses specializing in the distributed solar segment and smallest solar systems. These players will necessarily need responsiveness from the public powers to get through this crisis. Another major challenge will be to maintain demand at a sufficient level once the solar sector can return to work on the sites. There could be a huge, drawn-out supply shock in the roof-mounted systems segment and self-consumption installations. Many households facing unemployment and small businesses in economic difficulty could be forced to delay or cancel their projects. The role of the governments and European institutions will be crucial in countering the onset of this negative spiral and get renewable energies back on track. The joint declaration on 9 April 2020, by 13 ministers of the environment, climate and ecological transition, (France, Germany, Italy, Spain, Portugal, the Netherlands, Austria, Sweden, Denmark, Finland, Greece, Latvia and Luxembourg) on the need to make allowance for the enduring climate and environmental crisis in the post Covid-19 pandemic economic recovery plans, demonstrates that awareness and political determination are present. The declaration recalls that

the Green Deal is a new growth strategy for the EU, which is in a position to take up the combined benefits of stimulating the economies and creating jobs while profitably fast-tracking the green transition. The Covid-19 pandemic is a major threat for the rapid roll-out of renewable energies, but governments can enable these technologies to emerge from the crisis with new momentum and play a major role in global economic recovery.

Several solutions are already on the drawing board such as coordinating a European Union-wide relaunch by planning and accelerating the setting up of major grid infrastructure projects capable of absorbing vast quantities of variable energies, fast-tracking the deployment of industrial capacities in the energy storage area and producing low-carbon hydrogen, taking advantage of the synergies with the needs for low-carbon mobility and industrial needs for hydrogen. The synergies and complementarities between renewable electricity and renewable gas are also a major challenge for the European carbon neutrality goal by 2050. This calls for thought to be given to the construction of a real production and low-carbon hydrogen transport

network that makes hydrogen easily available, not only for transport needs but for industrial activities and even for heating. The Member States’ governments have the opportunity to liaise to plan the bases of a carbon-neutral economy before 2050, the only possible outcome to respond to the global climate change challenge. □

Sources: AGEE-Stat (Germany), GSE-Terna (Italy), BEIS (United Kingdom), SDES (France), Ministry for the Ecological Transition (Spain), Statistics Netherlands, APERE (Belgium), CRES (Greece), Ministry of Industry and trade (Czechia), Statistics Austria, DGE (Portugal), Association of the Photovoltaic Industry - SBF POLSKA PV (Poland), Swedish Energy Agency, Finnish Energy, Danish Energy Agency (Denmark), NSO (Malta), STATEC (Luxembourg), Cyprus Energy Institut, IRENA.

The next barometer will cover solar thermal.



This barometer was prepared by Observ'ER in the scope of the EurObserv'ER project, which groups together Observ'ER (FR), TNO Energy Transition (NL), RENAC (DE), Frankfurt School of Finance and Management (DE), Fraunhofer ISI (DE) and Statistics Netherlands (NL). This document has been prepared for the European Commission however it reflects the views only of the authors, and the Commission cannot be held responsible for any use which may be made of the information contained therein.