

EDP

The outcome of Portugal's first auction round for floating photovoltaic projects was made public on 5 April 2022.

# 158 911.4 MW

Cumulative photovoltaic capacity  
in the European Union in 2021

## PHOTOVOLTAIC BAROMETER

A study carried out by EurObserv'ER. 

The solar photovoltaic market upturn held up well in spite of the increase in energy and solar system component prices that characterised 2021 across the globe. The International Renewable Energy Agency (IRENA) put worldwide maximum net installed solar capacity at 843.1 GW at the close of the year, which equates to 133.6 GW of new capacity in 12 months. More than half of this additional capacity was installed in Asia (53.7%), while Europe and North America ran neck and neck with 17.2% and 16.5% respectively. The EurObserv'ER consortium's calculations conclude that the European Union of 27 added maximum net capacity of 22.8 GW, which takes the European base to date to 158.9 GW after subtracting decommissioned capacity.

### 157.5 TWh

Photovoltaic electricity generated  
in the EU in 2021

### 22 817.6 MW

Photovoltaic capacity installed  
in the EU during the year 2021



During the course of 2021, solar photovoltaic stepped up its expansion in all the world's regions, despite the tough post-COVID economic context of disrupted supply chains and more expensive solar system components. Data released by the International Renewable Energy Agency (IRENA) on 11 April 2022 shows that at the end of 2021, maximum net installed solar capacity across the globe reached 843.1 GW, which is a 133.6 GW year-on-year increase. IRENA claims that for the first time, maximum net installed solar photovoltaic capacity across the world overtook that of wind energy put at 824.9 GW at the end of 2021, which had increased by 93.1 GW over its 2020 figure. Asia accounted for just over half of the additional global capacity (53.7%), while Europe and North America ran neck and neck with 17.2% and 16.5% respectively. Incidentally, this indicator, the same as the one used by EurObserv'ER and Eurostat, represents

*In 2019, Statkraft, the Norwegian utility company signed a 12-year PPA with BayWa RE for the subsidy-free 50-MWp Don Rodrigo 2 solar park near Seville (Spain).*



the maximum net electrical capacity as alternating current (AC) and is thus a little lower than the nominal capacity indicators of photovoltaic panels (also expressed in Watts peak) expressed in direct current. Direct current indicators ( $GW_{DC}$ ), are generally used by solar panel manufacturers, industry associations such as SolarPower Europe and certain national and international organizations such as the IEA PVPS but should not be directly compared with output capacity in alternating current delivered to the grid, because of conversion losses and regulations that limit this. For example, SolarPower Europe uses a ratio conversion hypothesis of 1.25 DC/AC ( $1 GW_{AC} = 1.25 GW_{DC}$ ). Worldwide maximum net installed photovoltaic capacity will probably exceed the symbolic threshold of one TW at the end of 2022. This may even happen as early as the end of Q1 2022 if we consider the direct current capacity indicator. Bloomberg NEF forecasts that in 2022, the solar market could pass the 200  $GW_{DC}$  threshold (204–252  $GW_{DC}$ ), driven by a drop in module prices and the commissioning of new polycrystalline silicon production plants in China.

## ROUND-UP OF THE WORLD'S MAIN PV MARKETS

### CHINA CONNECTS ALMOST 55 $GW_{DC}$ IN 2021

The National Energy Administration of China's data published at the beginning of the year attests to about 54.93  $GW_{DC}$  of newly installed capacity hooked up to the grid in 2021 (compared to 48.2  $GW_{DC}$  in 2020). On-grid solar energy capacity was at least 306.6  $GW_{DC}$  at the end of 2021 (253.7  $GW_{DC}$  in 2020), after subtracting decommissioned capacity. The corresponding electricity output was 327 TWh in 2021 (261.1 TWh in 2020) – a load factor of about 14.6% equating to 1 281 hours operating at full capacity over the year. The Chinese photovoltaic industry Association forecasts 75–90  $GW_{DC}$  of additional capacity for 2022 and expects annual installation to average at 86–99  $GW_{DC}$  of additional capacity between 2022 and 2025. The same source claims that China plans to stimulate roof-mounted solar energy in its central and eastern regions that are close to consumers and offer easier access to the grid. Larger-scale solar station construction projects in the Gobi Desert and other western desert regions with

the construction of about 100  $GW_{DC}$  of solar energy capacity already underway.

### THE UNITED STATES ADDED 23.6 $GW_{DC}$ IN 2021

The US Solar Market Insight report, produced by the American Solar Energy Industries Association (SEIA) in conjunction with the Wood Mackenzie consultancy, claims that the United States installed up to 23.6 gigawatts ( $GW_{DC}$ ) of solar photovoltaic capacity in 2021, which is a 19% year-on-year increase in volume. The total breaks down into 17  $GW_{DC}$  for three major units, 4.2  $GW_{DC}$  for roof-mounted residential installations (equating to 514 000 residential systems), 1.4  $GW_{DC}$  for commercial systems (commercial sector, industry, schools, public buildings) and just under 1  $GW_{DC}$  (957  $MW_{DC}$ ) for community systems, namely collective self-consumption projects involving several customers subscribing to a local solar project to reduce their energy bills. Total installed capacity stood at 121.4  $GW_{DC}$  at the end of 2021. According to the SEIA, this capacity is enough to supply 23.3 million American households. The equipment rate of individual homes is put at 5%. The report claims that solar energy accounted for 46% of all new electricity-generating capacity added in the United States in 2021 (44% for wind power and 10% for natural gas). This is the third year running that solar energy has accounted for most of the country's new on-grid capacity. The report forecasts that despite the slew of projects, this year's market will be slightly quieter because of volatile raw materials prices and uncertainties hanging over the supply chain that has led developers to hold back on some of their projects. The customs duties on Chinese-made panels that were introduced by the Trump Administration in 2018 and renewed for a further four years in February 2022 by the Biden Administration (levied at about 15%) are another factor. Nonetheless, a concession has been made for bifacial modules that are extensively used in major land-based projects in the US. Wood Mackenzie, proffers a cautious estimate of a 15  $GW_{DC}$  connection volume of major power plant facilities in 2022. Yet the long-term solar energy outlook is good and the federal state's support for solar

energy should spur activity from 2023 onwards. The consultancy reckons that if the federal incentives for clean energy are adopted, including proposed extensions and modifications to tax credits, the solar industry could install a further 210  $GW_{DC}$  by 2032 for a total of 454  $GW_{DC}$  from now until then.

### INDIA TRIPLES ITS MARKET TO 10 $GW_{DC}$

The Solar Market Update published by Mercom India Research reports that

India added 10  $GW_{DC}$  during the course of 2021, which amounts to a 210% increase on 2020, when 3.2  $GW_{DC}$  went on-grid. Major projects accounted for 8.3  $GW_{DC}$  (83% of the installed capacity), i.e., 230% growth. Roof-mounted distributed solar made up the rest – namely 1.7  $GW_{DC}$  (17%). This spike can be partly ascribed to many projects that were postponed from 2020 to 2021 because of the COVID epidemic. At the end of 2021, the capacity of the Indian solar base stood at about 49  $GW_{DC}$ .

**Table No. 1**

Installed and cumulated solar photovoltaic capacity\* in the European Union at the end of 2021\*\* (MW)

|                    | 2020 cumulated   | 2021 cumulated   | 2021 installed  |
|--------------------|------------------|------------------|-----------------|
| Germany            | 53 721.0         | 58 728.0         | 5 015.0         |
| Italy              | 21 650.0         | 22 600.0         | 950.0           |
| France             | 12 022.2         | 14 780.1         | 2 792.2         |
| Netherlands        | 10 949.7         | 14 249.0         | 3 299.3         |
| Spain              | 10 285.5         | 13 104.9         | 2 820.5         |
| Poland             | 3 955.0          | 7 670.0          | 3 715.0         |
| Belgium            | 5 574.8          | 6 300.0          | 725.2           |
| Greece             | 3 287.7          | 3 961.9          | 674.2           |
| Austria            | 2 042.9          | 2 809.4          | 766.5           |
| Hungary            | 2 131.0          | 2 131.0          | 0.0             |
| Czechia            | 2 122.7          | 2 119.0          | 0.0             |
| Portugal           | 1 071.0          | 1 648.0          | 577.0           |
| Sweden             | 1 107.0          | 1 604.5          | 497.5           |
| Denmark            | 1 340.0          | 1 597.0          | 257.0           |
| Romania            | 1 382.5          | 1 398.0          | 15.5            |
| Bulgaria           | 1 097.4          | 1 186.0          | 88.6            |
| Slovakia           | 535.0            | 535.0            | 0.0             |
| Estonia            | 207.7            | 414.0            | 206.3           |
| Finland            | 318.0            | 404.0            | 86.0            |
| Slovenia           | 369.8            | 367.0            | 0.0             |
| Cyprus             | 229.1            | 316.0            | 86.9            |
| Luxembourg         | 186.6            | 276.3            | 89.7            |
| Lithuania          | 164.0            | 255.0            | 91.0            |
| Malta              | 187.9            | 204.9            | 18.1            |
| Ireland            | 92.8             | 136.0            | 43.2            |
| Croatia            | 108.5            | 108.5            | 0.0             |
| Latvia             | 5.1              | 8.0              | 2.9             |
| <b>Total EU 27</b> | <b>136 145.0</b> | <b>158 911.4</b> | <b>22 817.6</b> |

\* Net maximum electrical capacity, off-grid included. \*\* Estimation.  
Note: 34.4 MW decommissioned in France, 8.0 MW in Germany, 3.7 MW in Czechia, 2.8 MW in Slovenia, 1.1 in Spain, 1.1 in Malta. Sources: EurObserv'ER 2022

### JAPAN PRODUCES ALMOST 10% OF ITS ELECTRICITY THROUGH SOLAR POWER

Although most of the major solar markets are developing at a fast pace, the Japanese market is bucking the trend. Preliminary estimates made by the RTS Corporation are that its 2021 figure should settle at about 6.5 GW<sub>DC</sub> (3.2 GW<sub>DC</sub> for major plants, 2.6 GW<sub>DC</sub> for business projects and 0.7 GW<sub>DC</sub> for residential projects). This capacity includes projects that take up the feed-in tariff and those that do not. Most of this volume of activity stems from projects that enjoy feed-in tariffs approved two to three

years ago. This new capacity puts the country's cumulative total at 78.5 GW<sub>DC</sub>, which is enough for Japan to retain its No.3 world ranking. The RTS consultancy expects a further 5–6 GW<sub>DC</sub> contraction in 2022. The new feed-in tariffs and feed-in premiums of the auction systems unveiled by the Japanese government are unlikely to stimulate demand. The tariffs are 11 JPY/kWh (€ 0.08/kWh) for 10–50-kW installations and 10 JPY/kWh (€ 0.073/kWh) for 50–250-kW systems. The expert Takeshi Magami feels that because of increased costs, commercial viability can only be guaranteed at a price of 14 JPY/kWh (€ 0.10/kWh). The

feed-in premium ceiling price has also been set at 10 JPY/kWh. In 2021, METI (Japan's Ministry of Economy, Trade and Industry) allocated 675 MW of photovoltaic capacity to three separate auctions, at an average price of 10.31–10.82 JPY/kWh. Solar photovoltaic accounted for 9.3% of the country's electricity production in 2021 (8.5% in 2020) and a little less than half its renewable electricity production (22.4% in 2021), according to the Tokyo-based Institute for Sustainable Energy Policies (ISEP). The government's most ambitious scenario aim is to achieve 117.6 GW of alternating current capacity, which equates to almost 140 GW<sub>DC</sub> of direct current capacity.

### Table No. 2

Gross electricity production from solar photovoltaic in the European Union countries in 2020 and 2021\* (in TWh)

|                    | 2020           | 2021           |
|--------------------|----------------|----------------|
| Germany            | 49.496         | 49.992         |
| Italy              | 24.942         | 25.466         |
| Spain              | 15.675         | 21.582         |
| France             | 13.398         | 15.092         |
| Netherlands        | 8.765          | 11.436         |
| Belgium            | 5.105          | 5.600          |
| Greece             | 4.447          | 4.902          |
| Poland             | 1.958          | 4.600          |
| Hungary            | 2.459          | 2.460          |
| Austria            | 2.043          | 2.809          |
| Czechia            | 2.287          | 2.280          |
| Portugal           | 1.716          | 2.177          |
| Romania            | 1.733          | 1.701          |
| Sweden             | 1.051          | 1.507          |
| Bulgaria           | 1.481          | 1.500          |
| Denmark            | 1.181          | 1.377          |
| Slovakia           | 0.663          | 0.660          |
| Cyprus             | 0.296          | 0.408          |
| Slovenia           | 0.368          | 0.387          |
| Estonia            | 0.123          | 0.352          |
| Finland            | 0.218          | 0.305          |
| Malta              | 0.237          | 0.269          |
| Luxembourg         | 0.161          | 0.244          |
| Lithuania          | 0.129          | 0.191          |
| Croatia            | 0.096          | 0.109          |
| Ireland            | 0.064          | 0.097          |
| Latvia             | 0.005          | 0.007          |
| <b>Total EU 27</b> | <b>140.095</b> | <b>157.510</b> |

\* Estimation Source: EurObserv'ER 2022

### THE EUROPEAN UNION STEPS UP ITS ENERGY TRANSITION

The European Union's solar photovoltaic market remained buoyant in 2021 in spite of difficult development conditions as photovoltaic system component supply chains disruptions led to higher module prices while economies were recovering from COVID measures. High prices in the 2021 electricity market ensured that solar photovoltaic lost none of its lustre. Russia's invasion of Ukraine on 24 February 2022 caused a sea change in the approach to broad energy issues and renewables in particular. As soon as 9 March, the European Commission proposed to the EU Member States that they slash their Russian gas imports by two-thirds and it started to draw up plans to gradually phase out these imports by 2027. However, by mid-April, neither the European Union as a body, nor Europe's major consumers of Russian hydrocarbons had taken decisions on embargoing gas imports, which the European Union relies on for up to 45% (48.1% in the first six months of 2021 according to Eurostat) nor on oil, about 25% of which comes from Russia (25.4% in the first six months of 2021). This situation effectively bears out the fact that the European Union cannot manage without Russian hydrocarbons in the short term. On 7 April a coal embargo was announced that will come into effect early in August 2022. After two months of conflict, only the three Baltic States announced at the beginning of April that they would cease importing natural gas

from Russia. While the European Union countries have been unable to agree on an embargo on Russian hydrocarbons (gas and oil), some of them have already announced that they will be stepping up their energy transition, with new ambitions and undertakings for photovoltaic energy.

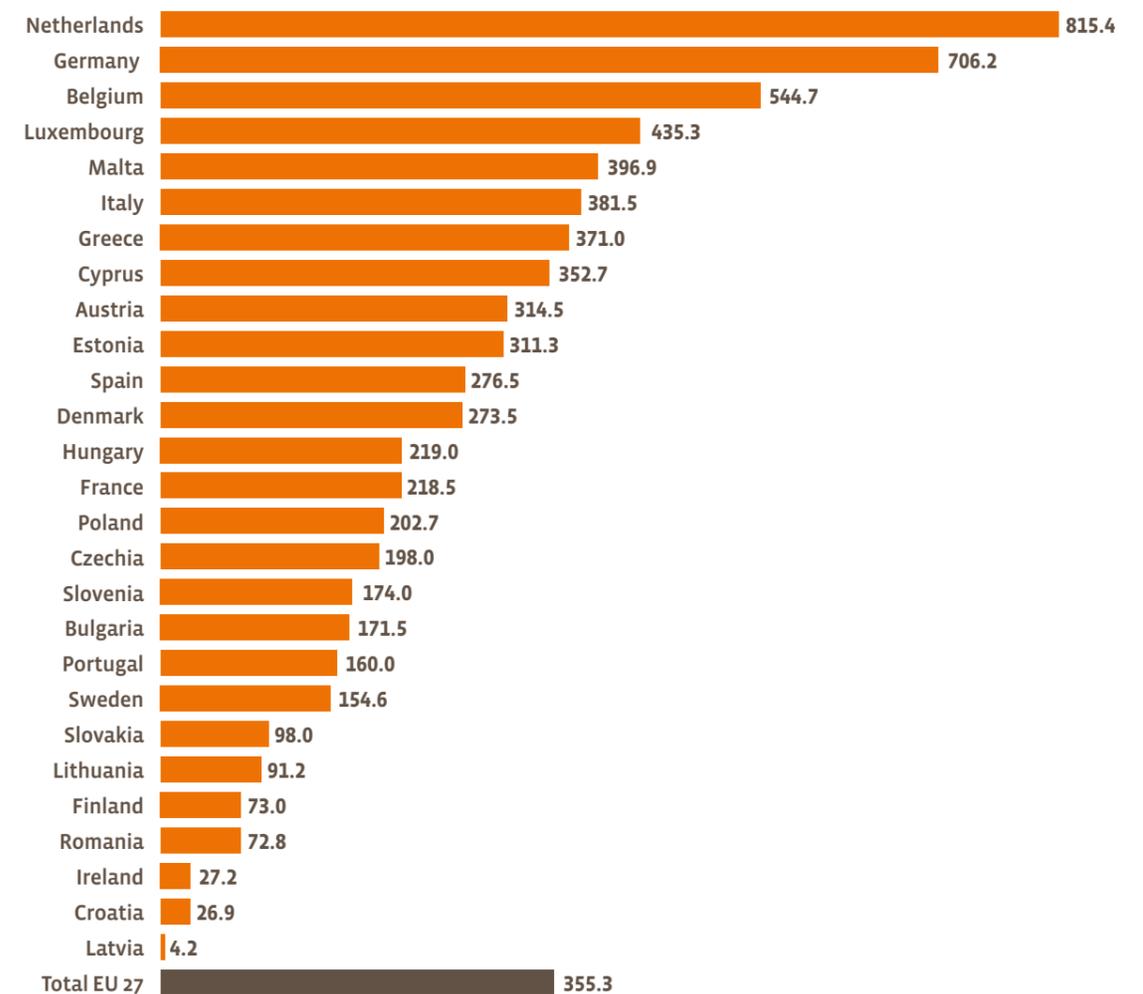
EurObserv'ER reckons that the maximum net capacity of the EU-27 increased by at least 22 766.5 MW in 2021 (equating to 22 817.6 MW of newly-installed capacity less 51.1 MW of decommissioned capacity). This 24.9% year-on-year rise pushed up the European Union's annual cumulative capacity by 16.7%

for the year to 158.9 GW. Net additional capacity for 2021 exceeds 2011 record (when 22 253 MW was added over the 12-month period). The main difference is that in 2011, the market's installations peaked only to suffer a downturn in activity, whereas the 2021 level should be regarded as a stepping stone to very much higher installation levels. The solar electricity payment situation has radically changed since 2011. The rush to install towards the end of the 2000s was largely speculative, as developers sought to take up the attractive guaranteed feed-in tariffs while they waited for photovoltaic module prices to come

down. Growth is healthier and more sustainable nowadays because it is based on market mechanisms and benefits from solar electricity's competitive edge over other electricity generating sources. Consequently, the sharp rise in production capacities has led to considerable growth in solar power production output. EurObserv'ER puts the European Union's solar electricity output at 157.5 TWh in 2021, i.e., 12.4% year-on-year growth. The best performances for the year came from Poland (134.9% growth, equating to a rise of 2.6 TWh), Sweden (43.4% growth, or 456 GWh), Spain (37.7% growth,

### Graph No. 1

Photovoltaic capacity per inhabitant (W/inhab.) for each EU country in 2021



\* Estimation. Source: EurObserv'ER 2022.



or 5.9 TWh), the Netherlands (30.5% growth, or 2.7 TWh) and Portugal (26.9% growth, or 461 GWh).

### RENEWABLE ENERGIES MAKE A FRESH START IN GERMANY

Germany remained the liveliest EU solar photovoltaic market in 2021. Data from AGEE-Stat shows that it added 5 GW (5 015 MW) of photovoltaic capacity – a similar installation volume to that of 2020 (4.8 GW). This took the capacity of its photovoltaic base to 58.7 GW by the end of 2021, but the increase in solar output – 50 TWh – was only half a terawatt hour because sunshine conditions were so mediocre. AGEE Stat points out that the solar photovoltaic output figures were revised upwards because it used a calculation method that is more accurate for gauging “economically motivated” self-consumption solar power. Thus, the solar electricity output initially estimated at 48.6 TWh for 2020 was revised upwards to 49.5 TWh. The share of self-consumed solar electricity was put at 10.9% in 2021 (10% in 2020).

Germany’s intention to wean itself off Russian natural gas as fast as possible has prompted it to apply new means to speed up its renewable energy sector developments and increase installations volumes as early as this year. On 6 April 2022, to set the ball rolling, the Bundestag announced that it would be raising its clean energy goal from the previous 65% share to 80% of the electricity mix from 2030 onwards, and to about 100% as soon as 2035. Thus, a minimum of 600 terawatt hours per annum should come from renewable energies by that timeline. To put this into perspective, this production level is significantly higher than France’s total electricity output (522.9 TWh in 2021). The decision serves as a response to the climate challenge and Germany’s dependence on Russian natural gas. The publication of the new renewable energy act, due to come into effect on 1 July 2022, was brought forward because of Russia’s invasion of Ukraine. Robert Habeck, the minister for Economic Affairs and Climate Action declared, “It is the largest energy policy revision for decades”. The law includes a clause that identifies renewable energies as being in the interest of public security. The volumes

up for auction, which in previous years have tended to be under-subscribed, will be considerably increased. In the case of solar photovoltaic, they will rise from about 6 GW in 2022 to 22 GW per annum starting in 2026 and continue through to 2035 if not later. This growth rate should take Germany’s photovoltaic capacity to at least 215 GW by the end of this decade. The German government has made a central plank of this new law that the use of renewable energies should be recognized as being of overriding public interest until carbon neutrality is achieved, so that these goals are not trammelled by long-winded planning procedures, local opposition and clashes with other regulations. The government has also decided to encourage the rollout of citizens’ projects to garner strong approval from the population. As a result, <6 MW citizens’ solar projects will no longer have to go through tendering procedures but will be eligible to go through the “on tap” system. In addition, roof-based feed-in tariffs will be upgraded in particular for total injection, which will further boost citizens’ projects. Agrivoltaics has not been overlooked, with the introduction of a specific bonus to ensure that these projects are competitive.

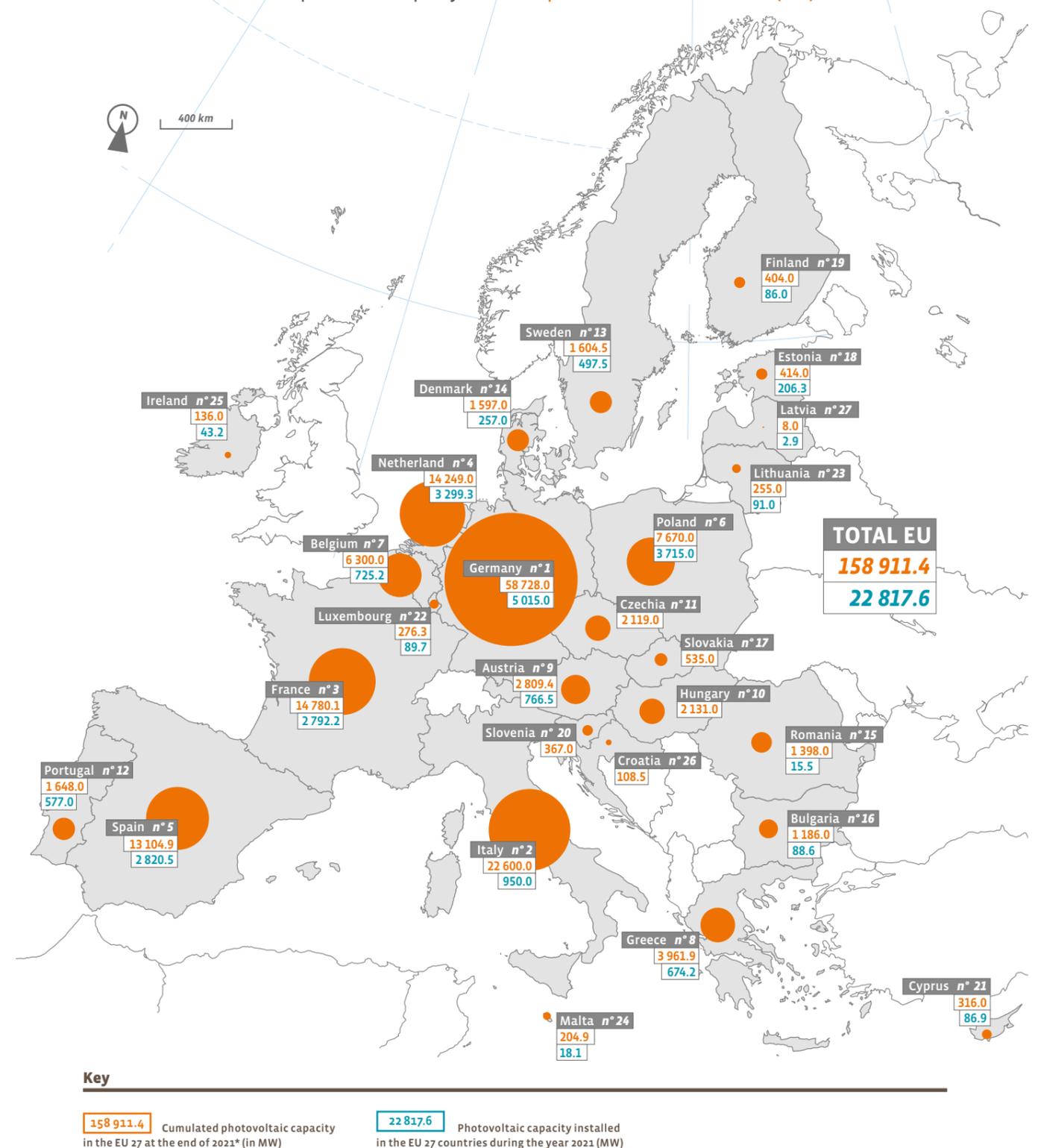
### POLAND DOUBLES ITS INSTALLATION CAPACITY IN 2021

According to Agencja Rynku Energii Spółka Akcyjna (ARE SA), the Polish energy market agency, Poland’s installed photovoltaic base stood at 7 670 MW on 31 December 2021. The country installed 3 715 MW of capacity in 2021. The Eurostat installed capacity figure for Poland at the end of 2020 was 3 955 MW, thus in just twelve months its capacity was all but doubled. The agency also confirmed that there was no let-up in the installation pace early in the year, logging an interim score of 8 768.1 MW on 28 February 2022. This strong momentum can be credited to its attractive self-consumption system for the residential sector that combines net invoicing with tax incentives (reduced rate of VAT and lower rate of income tax), and also a more enterprising tendering system for >1-MW installations. The ARE expects that the number of prosumers should pass the one million mark this year.

### PORTUGAL BRINGS FORWARD ITS 80% RENEWABLE ELECTRICITY TARGET BY 4 YEARS

According to Portugal’s Directorate General for Energy and Geology (DGEG) the country added 577 MW of solar capacity in 2021, taking its cumulative capacity to 1 648 MW at the end of the year. Its annual solar electricity output exceeded 2 TWh, 2 177 GWh to be exact, compared to the previous year’s output of 1 716 GWh. Early this April, as it left the first Council of Ministers meeting, the newly appointed Portuguese government announced that its aim of raising the renewable energy share of electricity production to 80% would be achieved by 2026, which is 4 years earlier than initially scheduled in its 2030 National Energy and Climate Plan. In 2021, the renewable energy share of electricity production already amounted to 58%. The minister, Mariana Vieira da Silva, declared, “Portugal has already taken very significant energy transition measures, but the evolution and duration of the war in Ukraine must necessarily imply new measures”. The government also intends to raise the renewable energy share of final gross energy consumption to 47% by 2030. The new government also indicated that its energy plans should mobilise more than 25 billion euros of investment over the next 10 years to more than double its renewable energy capacity. The country is banking on launching new solar tenders to achieve this and has stated that it will curtail environmental impact studies for <50-W capacity sites. The country’s first auction round for floating photovoltaic projects, whose outcome was made public on 5 April 2022 signals this new resolve. Tendering is for 263 MW deployed on 7 major national dam holding lakes: Alqueva, Castelo de Bode, Cabril, Alto Rabagão, Paradelas, Salamonde and Tabuaço, to be commissioned before 2025, accompanied by a 30-year connection licence. The successful bidders will be awarded a 15-year-long electricity purchase contract followed by a further 15 years when they will be free to sell their electricity on the market. The biggest project on the Alqueva dam was clinched by EDP renewable (EDPR) which submitted a negative bid. Its Alqueva floating photovoltaic power plant will be constructed to operate under a contract

Installed and cumulated solar photovoltaic capacity\* in the European Union at the end of 2021\*\* (MW)



\* Net maximum electrical capacity, off-grid included. \*\* Estimation. Source: EurObserv'ER 2022.

for difference (CfD) system at a negative price of €4/MWh through the initial 15-year term. In other words, EDP will pay a €4 entry fee for every MWh that the power plant injects into the grid for the first 15 years of the plant's activity. EDPR points out that thanks to this auction, it obtained 70 MWA of connection capacity, which should enable it to install up to 154 MW of renewable capacity, including 70 MW of floating solar PV as part of the above-mentioned CfD, plus 14 MW of solar overcapacity and 70 MW of hybrid wind energy capacity, both of which fall outside the scope of the CfD. This project is a clear example of value creation by the hybridization of renewable technologies to optimize grid connection possibilities to their utmost.

#### PPA AND TENDERS – SPAIN'S WINNING DUO

Ministry for the Ecological Transition and the Demographic Challenge (MITECO) data shows that Spain installed 2.8 GW of net photovoltaic capacity in 2021, which is more than in 2020 (1.5 GW). The main part of this total was installed through electricity purchase contracts, which makes the Spanish markets one of the biggest solar markets to operate without subsidies or state-guaranteed prices.

Spain's grid access capacities are holding back the market, leading to a very long PPA project waiting list. In 2023, the solar photovoltaic market will be boosted as the REER (Renewable Energy Economic Regime) tenders regulated by Royal Decree 23/2020 of 23 June 2020) launched in 2021 come on line. The first tender in January 2021 secured the installation of 2 036 MW of solar photovoltaic capacity at a mean price of €24.47/MWh (minimum and maximum prices of €14.89/MWh and €28.9/MWh respectively), another launched in October secured the installation of 866 MW of solar photovoltaic capacity at a mean price of €31.65/MWh (minimum and maximum prices of €24.4/MWh and €36.88/MWh respectively). This mean price is a €7.18/MWh or 29% rise on the first tender. These prices are guaranteed for a 12-year term. A third auction for 140 MW was made public at the close of 2021 for local <5-MW installations where aspects such as crowdfunding are considered. The government has put democratizing the electricity system to the fore by seeking active participation from citizens, firms and local authorities in renewable technology deployment. Another observation to make is that the self-consumption roof-mounted solar market has started to pick up over the

last two years since a royal decree was adopted in April 2019 abolishing the solar tax while accompanying and promoting collective and individual self-consumption. As stated by the APPA (the Spanish Renewable Energy Association), 1 151 MW of photovoltaic installations operating as self-consumption systems were deployed in 2021 (85% more than in 2020) including 253 MW in the residential sector. Photovoltaic self-consumption, that already amounts to a combined capacity of 2.5 GW in Spain should expand well in the next few years because of the electricity price hike. The Spanish government's roadmap for solar self-consumption, published in December 2021, set a target objective of 9 GW in 2030, which could rise to 14 GW in a more optimistic scenario. For the time being, Spain's integrated National Energy and Climate Plan (PNIEC) is set at 39.2 GW for the end of 2030.

#### MORE THAN 14.2 GW INSTALLED AT THE END OF 2021 IN THE NETHERLANDS

The Netherlands remained very active during 2021 according to Statistics Netherlands data, with 3 299.3 MW of net additional capacity, which was just below its 2020 installation record of 3 723.7 MW. This additional capacity



At the end of March 2022, Alliander and Groenleven completed construction on a green hydrogen plant in the Netherlands that will be linked to 50-MW solar park.

challenge back in March 2021 with the launch of the European Solar Initiative (ESI) by the European institute of innovation and technology EIT InnoEnergy and SolarPower Europe. The ESI aims to redeploy a European photovoltaic manufacturing industry “across the entire value chain from raw materials to recycling”. This European industry renaissance has become viable again because of the growing pressure of environmental criteria and CO<sub>2</sub> emissions throughout the production chain, as well as the cost of transporting panels from China which amount to about 10% of their cost. Lastly, the enactment of a “Carbon Border Adjustment Mechanism (CBAM)”, is emerging, as on 15 March 2022, the 27 Ministers for the Economy and Finance finally agreed to a common approach with a text that could be presented to the European Parliament by June. Its principle is to impose a surcharge on products imported into the European Union, calculated on the basis of the CO<sub>2</sub> emissions generated by their production. The price of carbon paid by European firms under the quota exchange system between domestic products and imports – the European carbon market – will be equalized. The inclusion of environmental criteria in tenders has also become possible. The new European Commission Guidelines on State Aid for Climate, environmental Protection and Energy now enable governments to base up to 30% of the claim on non-price criteria and thus reward the added value contributed by European industry. We will have to see whether the governments use these possibilities. Some European manufacturers have already decided to take the plunge by announcing increases in their production capacities on European soil with “gigafactory” projects. Early in April 2022, ENEL announced that it had signed a subsidy agreement with the European Commission enabling it to increase the manufacturing capacity of its “3Sun” heterojunction module plant in Catania, Southern Italy from 200 MW to 3 GW. The European Commission will contribute

took its cumulative solar photovoltaic capacity to 14 249 MW. Naturally, solar electricity production rose sharply (by 30.5% between 2020 and 2021). It stood at 11.4 TWh in 2021 compared to 8.8 TWh in 2020. Solar energy's two main drivers in the Netherlands are net metering for the residential and small business segments, while the business markets and major power plants rely on the SDE+ auctioning system, where solar is in competition with the other renewable energy sources. According to SolarPower Europe, the Dutch market would be bigger, but at least 12 GW worth of projects are stuck in the pipeline, beset by challenges to secure grid connections and sites. A possible solution is the implementation of hybrid power plants. The first such hybrid park in the Netherlands, the “Haringvliet” combines a 38-MW photovoltaic park with a 22-MW wind farm, connected to 12 MWh of storage capacity in 288 batteries installed in 12 sea containers. One of its aims is to exploit the complementarity of solar and wind energy production, as the PV installation generates an abundance of power from spring to autumn while the wind turbines produce more during the winter months. The batteries provide grid stability and are used as temporary storage for the electricity produced. Apart from the fact that hybrid parks enable grid connection

capacity to be optimised, sharing the same cables, transformer station and service roads makes for financial savings.

#### BRINGING BACK PRODUCTION TO EUROPE

While dependency on Russian natural gas has galvanised the European Union countries into refocussing their energy policies by accelerating the rollout of renewables energies, geopolitical questions remain about Europe's dependency on Chinese supply chains. Kadri Simson, the Commissioner for Energy raised this issue at the opening of the SolarPower Summit organized by SolarPower Europe on 31 March 2022 in Brussels borrowing from the Italian Prime Minister's words on the financial crisis in these terms, “We need to bring manufacturing back to Europe, and the Commission is willing to do whatever it takes to make it happen”. Joaquim Nunes de Almeida, the Director of Mobility and energy intensive industries at the European Commission reporting to the Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) also warned against dependency on energy imports being replaced by dependency on module imports. The solar power sector seized on the

Table No. 3

Examples of announcements of plans to create and expand module and cell factory capacity in the European Union\*

| Company                | Plant location                           | Actual plant capacity | Manufacturing plans   | Technology               |
|------------------------|--|-----------------------|---|--------------------------|
| Meyer Burger           | Freiberg (Germany)<br>Thalheim (Germany) | 400 MW                | 1400 MW (cell) (year 2022)<br>1000 MW (module) (year 2022)<br>5000 MW (long term objective) | HJT Heterojunction       |
| Greenland Giga Factory | Sevilla(Spain)                           | -                     | 5000 MW (module)(year 2023)   | PERC**                   |
| Enel Green Power       | Catane (Italy)                           | 200 MW                | 3000 MW (module) (year 2024)  | HJT Heterojunction       |
| REC Solar              | Hambach (France)                         | -                     | 2000 MW (module) (first stage)<br>4000 MW (module) (year 2025)                              | HJT Heterojunction       |
| Solarge B.V.           | Eindhoven (Netherlands)                  | -                     | 300 MW (module) (year 2022)   | PERC**                   |
| Kioto Energy           | St. Veit/Glan (Austria)                  | 150 MW                | 450 MW (module) (year 2022)<br>750 MW (module) (year 2023)                                  | Mono Mono bifacial       |
| Saule Technologies     | Wroclaw (Poland)                         | Pilot production line | 100 MW (module)(not specify)  | Perovskite Solar Modules |

\* Examples of capacity expansion plans that have officially been communicated. \*\* PERC: Passivated Emitter and Rear Cell. Sources: EurObserv'ER 2022





On 23 March 2022, Vattenfall inaugurated the Haringvliet Energy Park in the Netherlands – a hybrid project that integrates wind and solar technologies with storage batteries.

Since the Indian conglomerate Reliance Industries bought out the Norwegian solar panel manufacturer REC Solar, the latter's decision to site its 2-GW photovoltaic panel gigafactory in the French town of Hambach in the Moselle is shrouded in uncertainty, as the Indian group is tight-lipped about its French ambitions.

**WILL THE EUROPEAN UNION'S SOLAR POWER CAPACITY RISE TO 1 TW BY 2030?**

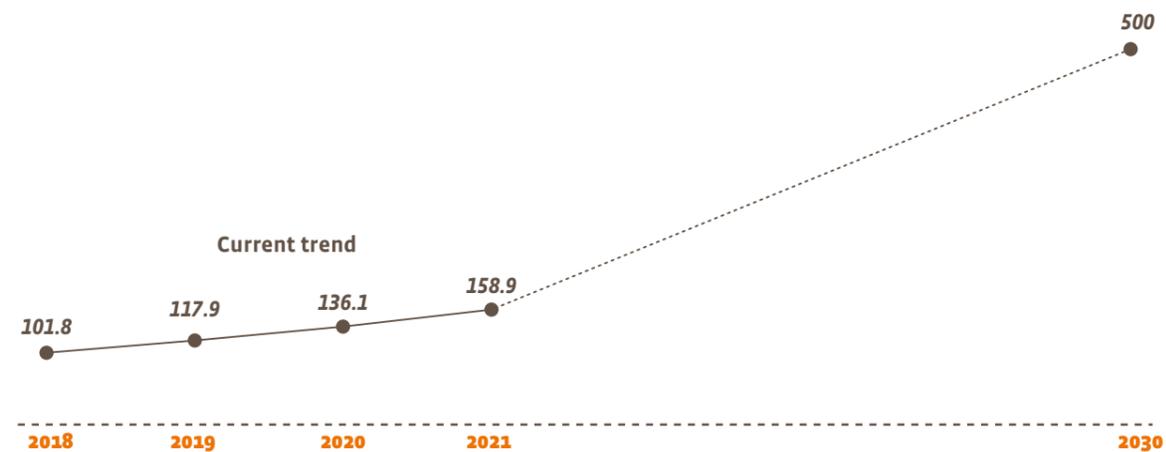
The SolarPower Europe association was quite open about its ambitions on solar photovoltaic's contribution to ensuring Europe's energy independence and supporting the gradual phasing-out of Russian gas imports at the SolarPower Summit on 31 March 2022. The European association presented a plan geared to raising the European Union's photovoltaic capacity to 1 TW<sub>dc</sub> (1 050 MW<sub>dc</sub>) for the high scenario and to 672 GW<sub>dc</sub> in a BAU (Business as Usual) scenario. SolarPower Europe's high scenario ambition is at least three times higher than currently

up to 118 million of the 600 million euros required to build this extension. This expenditure will be made as part of the First Innovation Fund call for large-scale projects. According to ENEL, the installation of 3 GW should be fully commissioned by July 2024 with an initial 400-MW extension in September 2023. Other gigafactory projects have been announced in Europe. The Spanish start-up, Greenland, in conjunction with the Fraunhofer Institute (ISE) and Bosch (Rexroth), has reported on the construction of a 5-gigawatt vertically-integrated solar module factory in the free-zone of the Port of Seville in Andalusia. Greenland intends

to manufacture monocrystalline silicon wafers for PERC technology solar cells that will be integrated into modules with a capacity of at least 540 Wc. The heterojunction manufacturer Meyer Berger, which bought up Solarworld's manufacturing sites (after the latter collapsed in 2017), declared in March 2022 that it was making progress in expanding its manufacturing capacity on the Thalheim cell manufacturing site and on the Freiberg module manufacturing plant. It intends to increase its Thalheim module plant's manufacturing capacity to 1.4 GW while the Freiberg cell production site should reach 1 GW in the fourth quarter of 2022.

**Graph No. 2**

EurObserv'ER projection of the evolution of photovoltaic capacity\* installed in the EU 27 (in GW)



\* Net maximum electrical capacity, off-grid included. Source: EurObserv'ER 2022.

forecast in the current national energy climate plan goals, put at 335 GW<sub>dc</sub> and more than twice as much as the European Commission's MIX scenario that aims at 420 GW<sub>ac</sub> (equating to 479 GW<sub>dc</sub> according to SolarPower Europe). The MIX scenario has been recalculated on the basis of a new 40% renewable energy target share of final energy consumption (under discussion). SolarPower Europe also believes installed solar capacity could increase to 30 GW by the end of 2022, including 1.5 million solar roofs.

On 8 March 2022, the European Commission outlined a plan (REPower EU) to wean Europe off Russian fossil fuels long before 2030. The plan aims to step up ecological transition which would reduce CO<sub>2</sub> emissions, dependency on fossil fuel imports and hedge against price rises. As for solar photovoltaic, the proposals target the accelerated deployment of solar roofs of up to 15 TWh over a year, the accelerated deployment of wind and solar energy with a 20% increase in the deployment rate and additional capacities of 80 GW by 2030 to take account of the increased production of renewable hydrogen. The European Commission reckons that annual gas savings of 170 billion m<sup>3</sup> could be made by trebling the European Union's wind and solar energy capacity by 2030, and adding 480 GW of wind energy and 420 GW of solar energy. A REPower EU package

finalized by the European Commission should be published on 18 May with stronger measures on renewable energies, backed by a legal component that aims to streamline renewable energy project authorization processes. A new directive (No. 2022/542), published on 5 April 2022, in the Official Journal of the European Union should also accelerate the deployment of roof-mounted solar capacity. The Directive stipulates that from now on Member States will be able to promote the use of renewable energies by applying a reduced rate of VAT (0 to 5%). Member States may reduce value added tax (VAT) on certain products and services relating to environmental and health policies. This measure applies directly to solar panels intended for the residential sector. The Member States have until 7 July 2022 to state the conditions for applying the reduced VAT rates. It is hardly a coincidence that the geopolitical agenda on issues of energy sovereignty have clashed with the climate agenda. The third part of the United Nations' Intergovernmental Panel on Climate Change (IPCC) report, that deals with the means still available to us for limiting further climate warming, was released on 4 April 2022. This third section demonstrates that all sectors have solutions for reducing emissions by more than half by 2030, in line with a 1.5°C climate warming scenario, but

their deployment must be much faster. It reminds us that renewable energy technology costs have plummeted and that the rollout of climate solutions such as solar and wind energies, electric vehicles or energy storage by battery has accelerated in recent years. The report also contends that natural ecosystem protection and restoration offers enormous mitigation potential by absorbing and storing the atmosphere's carbon. So, everything is in place for much faster development of renewable energies and of solar photovoltaic energy in particular. □

Sources: AGEE-Stat (Germany), GSE-Terna (Italy), SDES (France), MITECO (Spain), Statistics Netherlands, Statistics Austria, SPF Economie (Belgium), CRES (Greece), ARE (Poland), DGEG (Portugal), INSSE (Romania), Statistics Sweden, Statistics Lithuania, Finnish Energy, Danish Energy Agency (Denmark), NSO (Malta), STATEC (Luxembourg), IRENA.

the next barometer will cover solar thermal and concentrated solar power.



This barometer was prepared by Observ'ER in the scope of the EurObserv'ER project, which groups together Observ'ER (FR), TNO (NL), Renewables Academy (RENAC) AG (DE), Fraunhofer ISI (DE), VITO (Flemish Institute for Technological Research) (BE) 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.

