The first nacelle of the first French offshore wind farm of Saint-Nazaire leaving the factory.

GE RENEWABLE ENERGY

384.9 TWh

The estimated electricity production from wind power in the EU of 27 in 2021

WIND ENERGY BAROMETER

A study carried out by EurObserv'ER.

Although an improvement was made on the European Union's wind energy development 2020 level, the pace is much too low to meet the EU climate targets for 2030. According to EurObserv'ER, the additional capacity installed in the European Union of 27 increased by only 11 GW including 0.6 GW of offshore capacity. The wind energy industry reckons that in order to achieve the new goal being discussed of 40% of renewable energy in final energy consumption in 2030, almost three times as much capacity needs to be installed every year. After enjoying an exceptional year for installation, with 72.1 GW in 2020, China's installation pace slowed down in 2021 with 47.6 GW of new wind energy capacity. Part of this was 16.9 GW of offshore wind energy, with the result that China now dominates global offshore wind energy market segment.

187.8 GW

Cumulative wind power capacity installed in the EU of 27 at the end of 2021

15.1 GW

Cumulative wind offshore capacity installed in the EU of 27 at the end of 2021

Kincardine Offshore Floating Wind Farm was commissioned in 2021 off the coast of Aberdeen, Scotland.

The energy dependency of several European Union countries on Russian gas and oil was dramatically shown in its true light when Russia invaded Ukraine on 24 February 2022, bringing war to Europe. European economies' reliance on fossil energies means that despite the crisis situation and retaliatory economic measures taken, Europe continues to import this gas and oil at soaring prices. Entsog statistics (transparency.entsog.eu/#/map) show that the EU imported more than 2.65 billion m³ of gas alone from Russia over the week up to 7 March 2022 (week 9). At the current price of gas (€120 per MWh), Russia has been paid about 3.3 billion euros in the space of a single week. Hence, every imported kilowatt-hour that is not saved, goes towards funding Russia's war effort.
On 28 February, the Intergovernmental Panel on Climate Change (IPCC) published Part 2, "impacts, adaptation and vulnerability" of its 6th report, that covers the effects of climate change on human societies and ecosystems. The report stresses that there is now unequivocal scientific proof that climate change poses a serious threat for human well-being and the planet. It details the disruption already caused (forest fires, flooding, heat waves, farming losses, losses of biodiversity, migration of species, damage to ecosystems and human activities). All these symptoms are likely to intensify and worsen unless strong and immediate measures are taken. A third IPCC research group working on how to mitigate climate warming and its consequences, is due to publish Part 3 this coming April. Increased development of renewable energies and restraint will certainly feature large in its list of proposed solutions.

GARGANTUAN NEEDS WORLDWIDE

International bodies such as the International Energy Agency (IEA), acknowledge wind energy, along with solar energy, as the key to decarbonizing the world's electricity mix. The IEA's Net Zero Emission scenario submitted in May 2021 outlines the ideal trajectory to follow if worldwide carbon neutrality is to be achieved in 2050, on the basis that temperature rises are limited to 1.5°C. While the assumptions of this scenario are obviously debatable, it has the merit of establishing orders of magnitude. It predicts that the wind and solar energy share of global electricity production will reach 40% in 2030 (61% for renewable) and 68% in 2050 (88% for renewable). Global wind energy capacity would thus rise from 737 GW in 2020 to 3 101 GW in 2030, to 6 525 GW in 2040 then to 8 265 GW in 2050. The corresponding wind energy outputs would be 1 592 TWh in 2020 to 8 008 TWh in 2030, 18 787 TWh in 2040 and 24 785 TWh in 2050. Wind energy output needs to increase by an annual average of 18% from 2021 to 2030 to reach the 8 008 TWh of wind energy required in 2030, while annual new capacity will have to rise concomitantly to 310 GW of land-based and 80 GW of offshore wind energy capacity.
The global wind energy capacity installation figures for 2021 will be released in a few weeks' time, but they fall far short of this figure. In 2020, installed capacity approached the 100-GW threshold (93 GW according to the Global Wind Energy Council). Bearing in mind the sluggish installation paces of the United States and especially China (see below), it is unlikely that this threshold will be crossed. Even if efforts are focused on restraint policies, much greater efforts are required to achieve a growth level commensurate with tackling the climate emergency. The IEA concurs with WindEurope on the fact that unless the construction permit standstill is resolved, wind energy will be unable to play its part in the transition.

Table No. 1
Wind power capacity installed* in the European Union at the end of 2021 (MW)

	2020	Of which Offshore	2021	Of which Offshore
Germany	62 188.0	7 774.0	63 865.0	7 774.0
Spain	26 819.2	–	27 575.1	–
France	17 484.0	–	18 548.0	–
Sweden	9 976.0	203.0	12 080.0	203.0
Italy	10 870.6	–	11 100.0	–
Netherlands	6 618.8	2 459.5	7 800.0	2 459.5
Poland	6 298.3	–	7 116.7	–
Denmark	6 259.5	1 700.8	6 995.2	2 305.6
Portugal	5 122.3	25.0	5 627.0	25.0
Belgium	4 680.9	2 261.8	4 740.9	2 261.8
Greece	4 119.3	–	4 649.1	–
Ireland	4 306.7	25.2	4 339.0	25.2
Austria	3 226.0	–	3 300.0	–
Finland	2 586.0	73.0	3 257.0	73.0
Romania	3 012.5	–	3 029.0	–
Croatia	801.3	–	990.2	–
Bulgaria	702.8	–	707.0	–
Lithuania	540.0	–	671.0	–
Czechia	339.4	–	339.4	–
Hungary	321.0	–	329.0	–
Estonia	317.0	–	320.0	–
Luxembourg	152.7	–	160.0	–
Cyprus	157.7	–	157.7	–
Latvia	77.9	–	77.9	–
Slovenia	3.3	–	3.3	–
Slovakia	3.0	–	3.0	–
Malta	0.1	–	0.1	–
Total EU-27	176 984.2	14 522.3	187 780.7	15 127.1

** Net maximum electrical capacity. The total installed net capacity installed at the end of 2021 takes into account the decommissioned capacity during the year 2021: Germany (248 MW), Austria (103 MW), the Netherlands (60 MW), Denmark (26.2 MW), Belgium (40 MW), France (8 MW), Luxembourg (2 MW).*
Sources: EurObserv'ER 2022

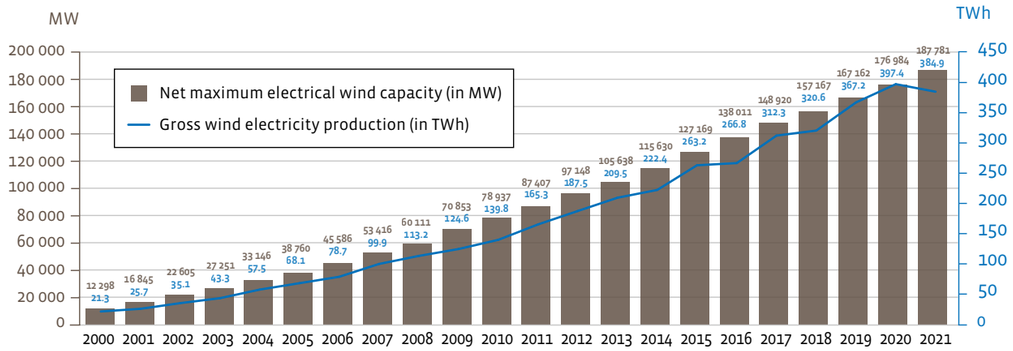
AMERICAN WIND ENERGY LOOKS TO THE SEA

The United States' declarations of intent appear to match the challenges. In April 2021, the Biden administration announced a new GHG reduction target of 50-52% in 2030 compared to its 2005 level, to move towards a completely decarbonized electricity system by 2035 and carbon neutrality by 2050. The American renewable energy players reorganized themselves, anticipating this call. The members of the American Wind Energy Association (AWEA) decided to form a new renewable energy company federation in September 2020 – American Clean Power (ACP). It aims to turn clean energy into the United States' main electricity source by uniting and including energy from solar, wind energy, storage and transmission companies, enlisting manufacturers, construction firms, developers and owners/operators, public services, financing companies and corporate buyers in the clean energy value chain. Its goal is to work more closely together and accelerate clean energy development as the dominant energy source in America. In its Q4 2021 report, which now uses common indicators for wind energy, solar and storage, ACP indicates that the wind energy sector put on the third best performance of its history in 2021 with 12 747 MW of newly-installed capacity. However, this is 25% less than in 2020. The reason for this huge difference is the American production incentive system (Production Tax Credit), which in some years, encourages developers to bring forward their projects to benefit from better financing terms. US land-based wind energy capacity stood at 135 GW (134 996 MW) at the end of 2021, together with two small offshore wind farms for a total of 42 MW.
The offshore wind energy segment is on the verge of moving up a scale with several major offshore wind farms programmed, according to CleanPower. For example, Ørsted's 846-MW Skipjack Wind 2 project will supply 250 000 homes in the Delmarva region (Delaware-Maryland-Virginia) and be constructed with the Skipjack Wind 1 project (120 MW). It should come on stream in 2026. Construction of the Vineyard Wind (800 MW) wind farm off the Massachusetts coast kicked off in November 2021 and it is due to come on stream in 2023. As it stands, nine American states have set offshore wind energy supply aims for a total of almost 45 GW (44 593 MW). Further proof of the United States' interest in offshore wind energy came on 25 February 2022, when the federal government published the results of auctions to operate six offshore wind farm blocks off the New Jersey and New York coasts that amount to a 2000-km² triangular expanse known as New York

WIND ENERGY BAROMETER – **EUROBSERV'ER** – MARCH 2022

Graph No. 1

Evolution of net maximum electrical wind capacity (in MW) and gross wind electricity production (in TWh) from 2000 to 2021 in the EU 27



Source : Years 2000-2020 (Eurostat), Year 2021(EurObserv'ER)

Bight. They drew bids for a record sum of 4.37 billion dollars. The biggest block went to Bight Wind Holdings for the sum of 1.1 billion dollars. The five other successful bidders were Attentive Energy (a JV between EnBW and TotalEnergies), Atlantic Shores Offshore Wind Bight (a JV between Shell and EDF), OW Ocean Winds East (a JV between EDP Renewables, Engie and New York-based GIP), Invenergy Wind Offshore and Mid-Atlantic Offshore Wind. The Biden administration aims to create the right conditions to enable 30 GW of offshore wind energy to be installed by 2030.

CHINA'S INSTALLED WIND TURBINE BASE NOW STANDS AT 328.5 GW INCLUDING 26.4 GW OF OFFSHORE CAPACITY

Rapid deployment is one of wind energy's great assets that is equally applicable to solar energy. This gives it the edge over other decarbonized electricity production sectors. On 25 January 2022, the National Energy Administration (NEA) published the China Electricity Council statistics for 2021. In 2021 it installed at least 47.6 GW of land-based and offshore wind turbine capacity, but the installation figure was down on the previous year's (72.1 GW), taking China's installed base to 328.5 GW (281.7 GW in 2020). Wind power output for 2021 is put at 655.6 TWh (466.5 TWh in 2020), which far exceeds the total electricity output of Germany or France.

China's offshore wind energy segment's performance is one of giddy ascent as it connected a massive 16.9 GW of offshore wind turbine capacity to the grid in 2021 compared to its 2020 figure of 3.06 GW. Its offshore wind turbine capacity stood at 26.4 GW. December 2021 was a particularly fruitful month for connections, in particular for China Three Gorges that connected 3.1 GW of offshore wind turbine capacity on 25 December. Developers forged ahead with installations to avoid forfeiting the attractive offshore wind power feed-in tariff that expired on 31 December 2021. Land-based wind power has not been side-lined, as the NEA confirms that an additional 30.67 GW of land-based wind energy capacity was connected to the grid.
China, the world's biggest CO_2 emitter plans to increase its non-carbon energy consumption to about 20% of primary energy in 2025 and about 25% in 2030. The NEA's intends to raise the wind and solar power share of electricity consumption from 9.7% in 2020 to 11% in 2021 and achieve a 16.5% share by 2025.

THE EUROPEAN UNION'S INSTALLATION PACE HAS FALTERED

EurObserv'ER reports that the European Union's new net usable additional wind turbine capacity failed to make the 11-GW mark in 2021. The EU installed 10 796.5 MW including 0.6 GW (604.8 MW) offshore, which amounts to a year-on-year capacity increase of 6.1%. According to Eurostat data, it is the fourth best performance of the decade. The best performance was recorded in 2015 (when 11 538.2 MW was added). The combined capacity of the European Union countries stood at 187.8 GW at the end of 2021.This estimate is primarily based on questionnaires filled in and data provided by the ministries and statistics offices responsible for monitoring renewable energy capacity (sources listed on the last page of this barometer). Nonetheless, several admitted that some of their data was provisional and could be consolidated later in the year.
This increase in net usable capacity factors in related decommissioning and repowering activity, and so does not match the total usable capacity of the turbines installed in 2021. As developers can restrain the capacity of their turbines to comply with the connection contracts, it does not equate to the sum of the nominal (peak) capacity of wind turbines in service, which is a little higher.
We should point out that repowering denotes the "full replacement" of electricity production units by new, more powerful units. A repowering operation enables operators to take advantage of the latest technological innovations to replace old wind turbines with bigger models with more powerful and longer blades that offer better yield. A key benefit is increasing a site's electricity output while reducing its running costs. The EurObserv'ER survey finds that 487.2 MW of EU capacity was decommissioned in 2021 (248 MW in Germany, 103 MW in Austria, 60 MW in the Netherlands, 40 MW in Belgium, 26.2 MW in Denmark, 8 MW in France and 2 MW in Luxembourg). Thus, the total capacity of the newly-installed turbines is closer to 11.3 GW.
The sector's players consider this additional capacity to be far below requirements. The WindEurope association, which has its own indicators, explains in its ***Wind Energy in Europe 2021 Statistics*** report that less capacity was installed in 2021 than forecast in February 2021. The association warns that the installation pace of the European Union countries is too low to meet the 2030 climate and energy targets. It insists that to do so, the European Union must install 32 GW every year and achieve a 40% RES share of final energy consumption.

Table No. 2

Electricity production from wind power in the European Union in 2020 and 2021 (TWh)

	2020	Of which Offshore	2021	Of which Offshore
Germany	132.102	27.306	113.848	24.374
Spain	56.444	–	62.009	–
France	39.792	–	36.800	–
Sweden	27.526	0.633	27.368	0.629
Italy	18.762	–	20.778	–
Netherlands	15.339	5.484	17.894	7.952
Denmark	16.330	6.603	16.083	7.593
Poland	15.800	–	15.867	–
Portugal	12.299	0.051	13.147	0.052
Belgium	12.764	6.974	11.876	6.926
Greece	9.310	–	10.483	–
Ireland	11.549	–	9.721	–
Finland	7.938	0.293	8.114	0.299
Austria	6.792	–	6.723	–
Romania	6.945	–	6.576	–
Croatia	1.721	–	2.071	–
Bulgaria	1.477	–	1.403	–
Lithuania	1.552	–	1.362	–
Estonia	0.844	–	0.800	–
Hungary	0.655	–	0.640	–
Czechia	0.699	–	0.602	–
Luxembourg	0.351	–	0.327	–
Cyprus	0.240	–	0.240	–
Latvia	0.177	–	0.156	–
Slovenia	0.006	–	0.006	–
Slovakia	0.004	–	0.004	–
Malta	0.000	–	0.000	–
Total EU-27	397.418	47.344	384.899	47.826

Source : EurObserv'ER 2022.

EUROPEAN UNION OFFSHORE WIND POWER HITS A SOFT PATCH

The European Union offshore wind power segment had nothing to write home about in 2021. Denmark was the only country to get things moving according to the EurObserv'ER breakdown. It added 604.8 MW of capacity. In 2021, four times less offshore wind power capacity was connected than in 2020 (2 452.8 MW). The extra capacity comprises the commissioning of the Kriegers Flak (605 MW) wind farm with its 72 Siemens-Gamesa SG 8.4-167 DD turbines. By the end of 2021, the EU's total offshore wind turbine capacity amounted to 15 127.1 MW, spread across the waters of 8 countries (Germany, the Netherlands, Denmark, Belgium, Sweden, Finland, Portugal and Ireland), namely 8.1% of its total installed wind turbine capacity. We could add the 2 MW of the Floatgen floating wind turbine installed and generating power off the coast of Le Croisic on the Centrale Nantes engineering school's multi-technology offshore test site. The Floatgen wind turbine will be dismantled in the autumn of 2023 and replaced by a 5-MW Eolink wind turbine. Likewise, we could add the 5-MW Elisa prototype that went on stream in 2019 off the coast of Gran Canaria (Canary Islands, Spain).
The 2021 offshore wind turbine installation pace was stronger elsewhere in Europe. WindEurope reports that the UK connected all the turbines of three new wind farms – Triton Knoll (875 MW), Moray East (950 MW) and the Kincardine (48 MW) floating wind farm off the Scottish coast. Part of the Hornsea Two wind farms have been connected (i.e., 462 MW in 2021 of a total of 1 386 MW). Hornsea Two, which will be spread over an area of 462 km² will comprise 165 Siemens Gamesa 8.4-MW turbines and will be the world's biggest offshore wind farm when it becomes fully operational in 2022. Norway installed a 3.6 MW floating wind turbine demonstrator in 2021 (Tetra Spar foundation).

GRADUAL BUILD-UP OF OFFSHORE CAPACITY BETWEEN 2022 AND 2026

Many major projects are under construction in the European Union, which will significantly increase installed capacity over the next three years. They include the Dutch Hollandse Kust Zuid I-II (scheduled to start up in 2022/2023) and Hollandse Kust Zuid III-IV (2023)

WIND ENERGY BAROMETER – **EUROBSERV'ER** – MARCH 2022

projects each with 770 MW of capacity, and the French projects at Saint Nazaire (480 MW, 2022), Fécamp (497 MW, 2023), Saint-Brieuc (496 MW, 2023) and Calvados (448 MW, 2024). France's multi-annual energy programme energy (PPE) for 2019-2028 was finally adopted on 21 April 2020. Its offshore wind energy capacity targets have been raised from 5.2 to 6.2 gigawatts (GW) by 2028, compared to the previous plan's 4.7–5.2 GW target. However, ambitions for land-based wind energy have been pared back from 34.1–35.6 GW to 33.2–34.7 GW. The energy transition information website, www.revolution-energetique.com, has identified 16 wind farms (under construction, pending and on the drawing board) likely to come on stream by 2030 amounting to 6 139 MW of capacity. The commissioning dates of a further 4 000 MW of proposed projects are unknown or will run over into the next decade. Recently, on March 14, 2022, the French state and the French wind industry signed an "Offshore Wind Pact" in which France undertakes to: Aim for a minimum volume of tender allocation of 2 GW per year for offshore wind from 2025; In this dynamic, set the objective of 20 GW allocated in 2030 to reach a capacity of 18 GW in service in 2035 and 40 GW in 2050. On this occasion, the Prime Minister announced the launch of two floating wind projects in the Mediterranean of 250 MW each, the first off the Narbonnaise, the second off the Gulf of Fos, both located more than 22 km from the coast.

No new turbines or foundations were installed in Germany during 2021. The offshore wind farms allotted during the first auction rounds in 2018 will gradually be installed between 2022 and 2025 as their connection is held up by grid infrastructure work. The offshore wind farms awarded during the 2021 bidding rounds should start up in 2026. The Deutsche WindGuard "Status of Offshore Wind Energy Development in Germany – Year 2021" report states that the Kaskasi (342 MW) project should be the first to go on stream at the end of 2022, followed by Arcadis Ost1 (247 MW) in 2023, Baltic Eagle (476.3 MW) and God Wind 3 (241.8 MW) in 2024, Borkum Riffgrund 3 (900 MW) and EnBW He Dreiht (900 MW) in 2025 and N-3.7 (225 MW), Nordsee Two (433 MW) and Windanker (300 MW) in 2026. If all the awarded projects are fully realized, Germany's offshore wind turbine capacity will rise to almost 12 GW by the end of 2026 (7.8 GW in 2021). Attention will soon turn to the Netherlands and its upcoming tenders for the IJmuiden Ver Wind Farm (IJVWFZ) maritime zone located 62 km off its west coast. Four wind farm sites accommodating 4 000 MW of capacity will be designated in the area: IJV Wind Farm Site I, II, III and IV, over an area of roughly 400 km². A tender to develop IJVWFS I and II is planned for 2023. A second round of tendering to IJWFS III and IV is planned for 2025. The new government could revise the Netherlands' aim of increasing its current 2030 offshore wind turbine capacity target of 11.5 GW by to 22 GW. The Infrastructure Ministry is examining the possibility of opening up new areas in the North Sea to accommodate 17 GW of new capacity. Denmark also plans to increase its offshore wind energy targets, having planned to add up to 7.2 GW of capacity by 2030 that includes the 3 GW of capacity on the North Sea Energy Island, the 2 GW on the Baltic Sea Bornholm Energy Island, 1.2 GW in the Baltic Sea Hesselø site and 1 GW in the North Sea Thor area. In December 2021, the Danish government agreed to develop additional development capacity before 2030 up to 3 GW. Under the terms of the green sub-agreement to the 2022 Finance Act, 2 GW of offshore wind capacity must be offered for development before 2030 with the potential for another 1-GW capacity tender.

Poland also has ambitions for offshore wind energy with projects in the Baltic Sea under development such as OWF Bałtyk I (1560 MW), II (720 MW) and III (720 MW). The government plans to install 5.9 GW by 2030 and 11 GW by 2040, and the first tenders are expected in 2025. Spain has announced a 3-GW target in 2030 as part of its first offshore wind energy roadmap published in December 2021. The Estonian and Latvian governments signed a protocol agreement in July 2020 for the JV construction of a wind farm of up to 1 GW in the Gulf of Riga, due to go on stream in 2030. As part of its climate energy plan, Belgium intends to raise its offshore wind turbine capacity to 4 GW (4011 MW) by 2030, to put out an initial tender for 700 MW in the first quarter of 2023 due to start up in 2025, and a second tender for 1050 MW in 2025 due to start operating in 2027.

The keys to the successful development of offshore wind energy are international cooperation, pooling resources, setting up joint infrastructures, interconnection capacities and cross-border electricity exchange systems. This underlies the 2016 creation of the North Seas Energy Cooperation (NSEC), a regional energy cooperation forum comprising 10 countries (Belgium, the Netherlands, Luxembourg, France, Germany, the UK, Ireland, Norway, Sweden and Denmark, as well as the European Commission) that aims to coordinate and promote the profitable development of offshore renewable energy, create synergies and encourage common policies whenever possible and beneficial. In this vein, the Belgian Ministry of Energy signed an agreement in Copenhagen in November 2021 to create a high-voltage undersea cable connection to transport Danish offshore wind farms' surplus energy to Belgium. The agreement ratified by the Danish Minister of Energy, Dan Jørgensen, plans to build a 600 kilometre-long cable interconnector, to be known as "*Triton Link*" named after the sea god. In its Communication dated 19 November presenting "An EU Strategy to harness the potential of offshore renewable energy for a climate neutral future", the European Commission asserts that the target of at least 60 GW of offshore wind energy and at least 1 GW of ocean energy by 2030, and of 300 GW and 40 GW by 2050 is realistic and achievable. The investment budget required to achieve this is about 800 billion euros.

WIND POWER PRODUCTION BUCKS THE TREND

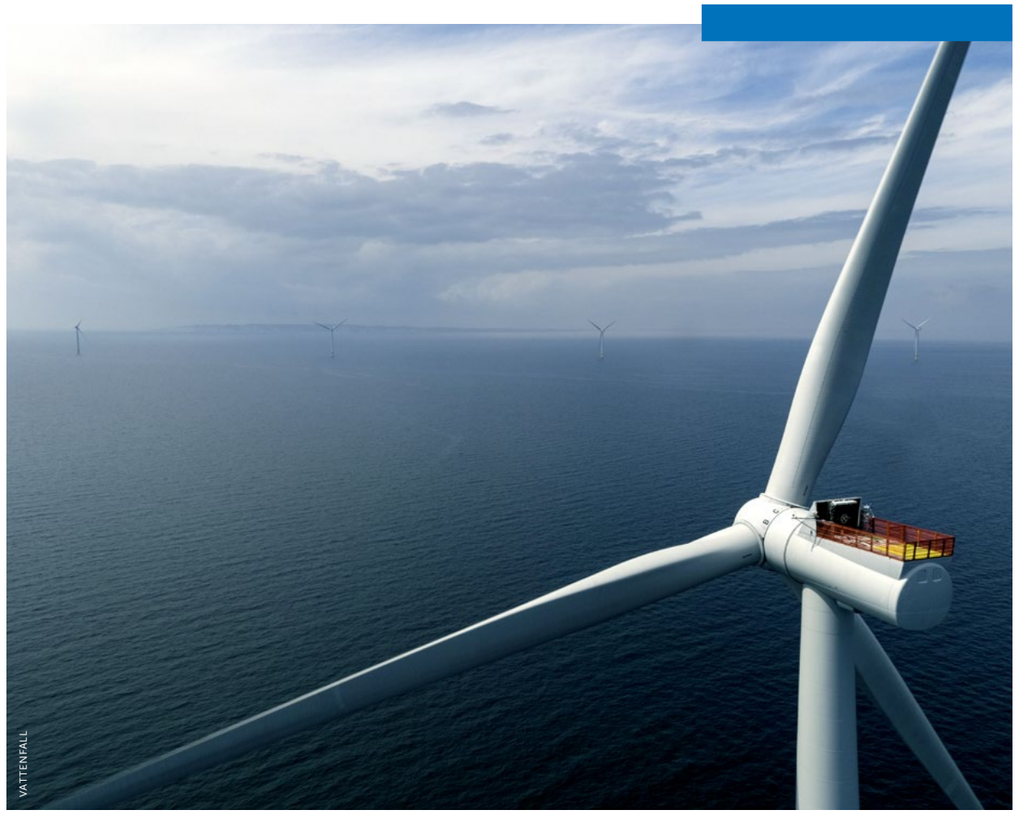
Wind power production is weather-dependent. In contrast with 2020, many European Union countries had poor winds, and Germany suffered particularly badly. Land-based and offshore wind power output contracted by 3.2% between 2020 and 2021, according to EurObserv'ER, from 397.4 to 384.9 TWh, despite the commissioning of new production capacities. This contrasts with wind power output in 2020 when much stronger winds prevailed, generating an 8.2% year-on-year increase on its 2019 level of 367.2 TWh. Offshore wind power output is steadier and less prone to variations. It increased by 1% year-on-year (from 47.3 to 47.8 TWh), despite the considerable deficit of the German wind farms. The offshore wind power share of total wind power output increased by 11.9% in 2020 to 12.4% in 2021. This share was as high as 58.3% in Belgium, 47.2% in Denmark, 44.4% in the Netherlands and 21.4% in Germany in 2021.

NEWS FROM THE MAIN MARKETS

Change of gear on the cards in Germany

The year 2021 was in keeping with previous years for Germany's wind power sector. According to AGEE-Stat data, the country installed 1 926 MW of wind turbine capacity over the 12-month period while decommissioning 248 MW, resulting in 1 677 MW of additional capacity or total usable capacity of 63 865 MW (including 7 774 MW of offshore capacity). Despite the capacity increase, output dropped by 13.8% to 113.8 TWh for the year because of extremely poor winds.

The new government's stated ambitions and the war in Ukraine should put pressure on the installation schedule. Germany has launched the first stages of a vast renewable energy law reform that should bring forward the 100% renewably sourced target for the country's electricity supply within sight as early as 2035, instead of 2050. With its sights set on doubling current capacity to 110 GW, the annual land-based wind energy volumes up for auction should be raised to 10 GW from 2027 to 2035. In the case of offshore wind energy, the draft law plans to introduce Contracts for Difference type support contracts for tenders that will be devised and strengthened to raise the 2030 target from 20 to 30 GW (almost four times as high as today's target). For 2023 to 2026, offshore wind energy tenders should be raised to about 5 to 7 GW and from 2027 onwards, about 4 GW will be put up for tender every year. A 200-GW target for solar photovoltaic has also been set for 2030 through tenders and improved incentives for the smallest projects. This new draft EEG law should raise renewable electricity production to 572 TWh, to achieve an 80% target. The proposal is part of the government's January 2022 climate emergency programme (Easter package). Germany



Kriegers Flak Wind Farm, in Scandinavia, started up on 6 September 2021. It comprises 72 no. Siemens Gamesa SG 8.4 167 DD wind turbines with total production capacity of 605 MW.

WIND ENERGY BAROMETER – **EUROBSERV'ER** – MARCH 2022

In September 2021 Siemens Gamesa announced the market launch of the first recyclable offshore wind turbine blade, the "RecyclableBlade".

also plans to abolish the renewable energy tax on the electricity price to curb invoice hikes from July 2022 instead of the beginning of 2023.
Renewable energy promotion will be funded by the Energy and Climate Fund (EKF), a special German federal government fund. The government has indicated that it will spend an additional 6.6 billion euros because it is phasing out the EEG tax earlier than originally planned.
The wind energy industry's association (BWE) believes Germany can go further by 2050. It feels that the installation of 252 GW can be achieved in 2050 (198 GW land-based and 54 GW offshore), which is enough to produce 960 TWh (770 TWh land-based and 260 TWh offshore) or cover about 185% of German electricity consumption. That equates to the installation of 38 375 wind turbines (35 000 on land and 3 375 offshore) installed on about 2% of the country's surface area.

Sweden, the European Union's leading market in 2021

Data released early in February by the Swedish Wind Energy Association (SWEA) shows that Sweden commissioned 2 104 MW of exclusively land-based capacity during 2021. This additional capacity took the Swedish wind turbine base in service to about 12.1 GW at the end of 2021. The association reckons that commissioning should improve by another 2.2 GW in 2022 and could reach aggregate capacity of 18 GW in 2024. Statistics Sweden, which had yet to publish its installed capacity figures at the beginning of March, provisionally estimates wind power output at 27.4 TWh at the end of 2021, which is slightly (0.6%) less than the previous year. More recently, in February, the Swedish government unveiled a plan and zoning of offshore wind power plant construction projects to produce up to 30 TWh per annum. The zones are in the Gulf of Bothnia, the Baltic and North Seas. The government also tasked the Swedish Energy Agency with identifying the areas that lend themselves to producing an additional 90 TWh of offshore electricity, to provide a total of 120 TWh. The government has given the agency until March 2023 to complete its mission. Once the offshore zones have been earmarked, the Swedish maritime authorities will propose changes to the country's maritime plans. The final decision on which zones will probably be used will be taken by December 2024.

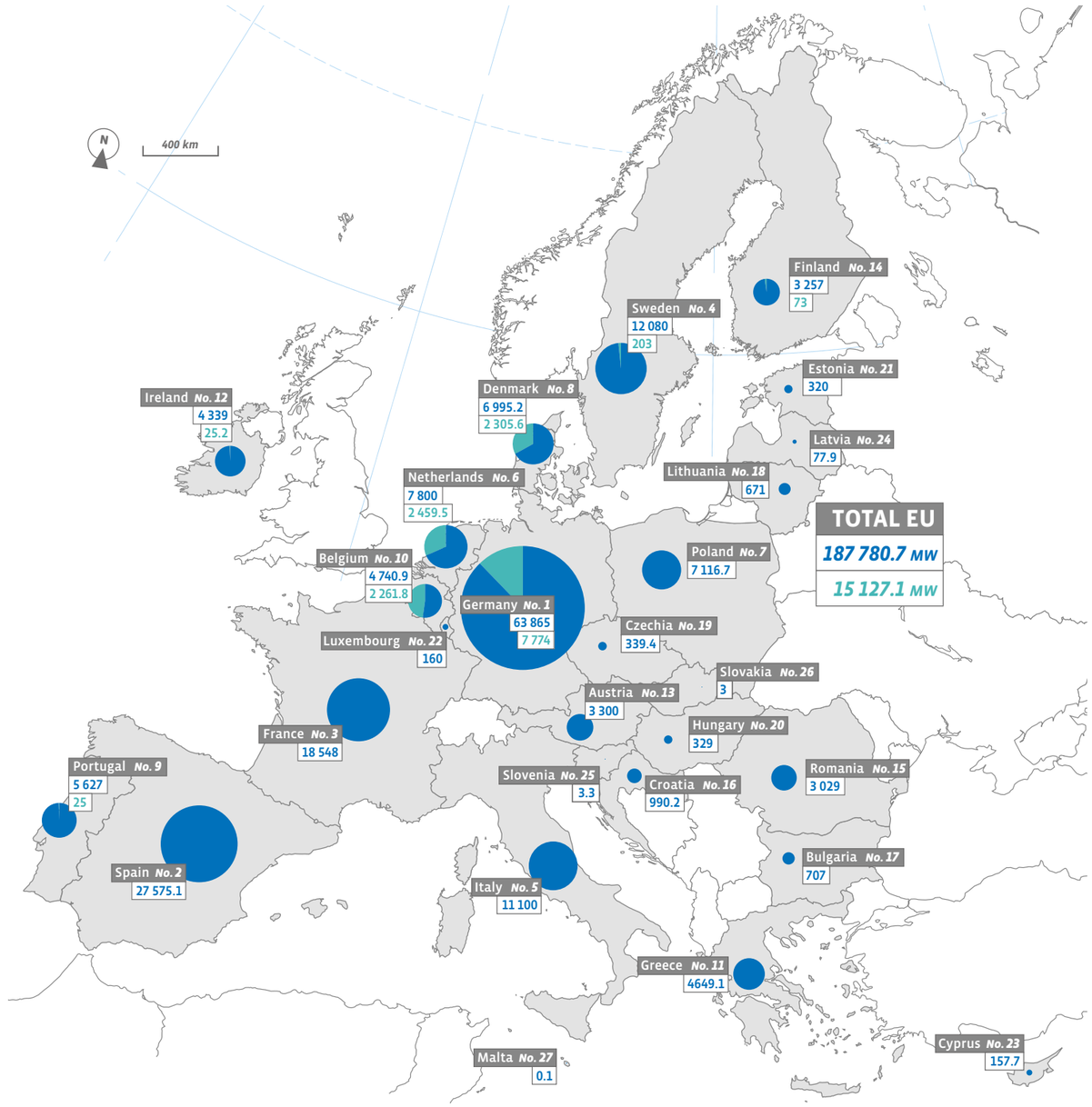
The Dutch government seeks to expand its offshore wind energy areas

Statistics Netherlands reports that the Netherlands installed 1 241 MW of wind energy capacity and decommissioned 60 MW during 2021. This puts the capacity hooked up to its grid at 7 800 MW at the end of 2021 (including 2 459.5 MW of offshore capacity), namely 1 181.3 MW of additional capacity compared to 2020. Statistics Netherlands points out that this data is still provisional and likely to be consolidated in June/July. Incidentally, Statistics Netherlands does not include the Fryslan wind farm (389 MW) that comprises 89 SWT-DD-130, 4.4-MW turbines in its figures because it is in the middle of IJssel Lake, a freshwater lake separated from the Wadden Sea by the Afsluitdijk, a 32 km-long dam causeway. Hence, although the wind farm "stands in water", it has been included in the land-based statistics for 2021. WindEurope includes it in its "offshore" statistics, which explains the discrepancy with the EurObserv'ER indicators.
Since taking office, the new government has decided to raise its climate and wind energy ambitions considerably. It plans to reduce the country's CO_2 emissions by at least 55-60% in 2030 compared to its 1990 level and reduce them further by 70% by 2035 and 80% by 2040. This reduction level implies significant increases in both the renewable share of the country's electricity mix and installed wind energy capacity. In November 2021, the Dutch government published a new plan that envisages almost doubling its 2030 offshore wind energy targets. The new plan expands the eight areas currently earmarked for offshore wind farm development in the North Sea and provides for the construction of an additional 10.7 GW of wind energy capacity over and above the initial target for 2030, which would raise capacity to 22 GW of offshore wind energy in 2030. The government envisages that offshore capacity will be at least 38 GW by 2050.

EUROPE'S INDUSTRY WARNS THE COMMISSION

The occurrence is rare enough to warrant a mention: the CEOs of the five biggest European-based wind turbine manufacturers, Enercon, GE Renewable Energy, Nordex, Siemens Gamesa

Wind power capacity installed* in the European Union at the end of 2021 (MW)



Key

187 780.7 Total wind power capacity (onshore and offshore) at the end of 2021 (in MW)

15 127.1 of which offshore wind power capacity at the end of 2021 (in MW)

Estimate.* ***Source: EurObserv'ER 2022.*

Renewable Energy, Vestas Wind System A/S and the CEO of WindEurope sent in a joint letter to the President of the European Commission warning her of the critical situation in which the European wind energy supply chain finds itself and of its consequences for the European Green Deal. The European wind energy industry explained that it was going through unprecedented tough times, closing factories and halting investments in the European Union at the very moment when the industry needed to be expanding. They stated that in the space of two years, the industry had been forced to close turbine and component manufacturing plants in Germany, Spain and Denmark, which are the traditional bastions of Europe's wind energy industry.
The authors explained that the problem is not one of lack of ambition on the part of the Member States, that have all stressed their willingness to develop wind energy, nor the issue of public acceptance. However, the rules and procedures used by the public powers to authorize wind energy projects are too long and complex. They feel that the dearth of construction permits available is thwarting the Member States' climate ambitions. As a result, wind farm developers bid in government auctions at the lowest possible price to secure the small volumes of the permitted projects on offer. This damages the European Union's supply chain which is struggling to stick to these cost levels. At the same time, the wind energy industry is hindered by high prices for steel and other raw materials, disrupted supply chains and uncoordinated trade defence measures. The CEOs also point to the fact that the Chinese wind energy industry enjoys unflagging growth and is installing many more wind farms than Europe.

Table No. 3

Main European wind farm developers and operators 2021

	Country	Wind capacity developed or operated in 2021 (1)
Iberdrola	Spain	19 479 MW onshore 1 258 MW offshore
Enel	Italy	14 903 MW
EDP renewables	Portugal	12.4 GW onshore 0.3 GW offshore
ENGIE	France	11 315 MW onshore 512 MW offshore
Orsted	Denmark	3.4 GW onshore 7.6 GW offshore
RWE	Germany	6 596 MW onshore 2 318 MW offshore
ACCIONA	Spain	8 787 MW
EDF renewables	France	7.4 GW
SSE Renewables	Scotland	1 936 MW onshore 579 MW offshore
Vattenfall	Sweden	1 562 MW onshore 2 602 MW offshore

1) Worldwide figure. Note: Large energy companies are well represented in this ranking because of their size and their ability to raise capital, but besides these type of players, there are a large number of private developers specialized in renewable energy, with substantial portfolios.
Source: EurObserv'ER 2022 based on diverse sources.

While European industry exports 8 billion euros' worth of technology and equipment every year, it is losing ground because of the inroads Chinese manufacturers are making in Asia, South America and Africa. Furthermore, China is starting to win orders in Europe, primarily in France, Italy and Croatia. The CEOs go on to set out four action points for the European Union: firstly, to streamline and accelerate the national authorization processes, and the grid investments needed because grid expansion is a prerequisite for more renewable energy, secondly to strengthen the European wind energy industry's position in government auctions for new wind farms by introducing non-price related criteria. So far, auctions have been awarded on the basis of price only, and as their Chinese competitors position themselves on this criteria, the European bidders are in a no-win situation. The new Guidelines on State Aid for Climate, Environmental Protection and Energy defined by the European Commission are a step in the right direction. They now enable governments to base up to 30% of the score on criteria other than tariff and thus reward the added value contributed by the European industry such as more sustainable and circular economy-friendly turbines, grid balancing technologies and providing European jobs. The third point put forward is to discourage governments from holding negative auctions. Effectively, developers pay the governments for the right to construct a wind farm, however they should not have to do so unless the market price of electricity is higher than the auction price. Negative auctions incur additional costs for developers that have to be passed on to the consumer, which puts even more pressure on the wind energy supply chain. The fourth and last point raised is a demand for innovation support to ensure that Europe retains its technological lead in wind energy… not only in the emergence of new technologies such as floating wind turbines, but also in gradual improvements to keep Europe's lead in the land-based and fixed bottom offshore wind farm sphere.

The first V236-15 MW prototype will be installed at Denmark's Østerild National Test Centre in the second half of 2022.

OUTSTANDING TECHNOLOGICAL LEAP

The industry players are committed to the vital issue of wind energy's environmental credentials. In September 2021, Siemens Gamesa announced its market launch of the first recyclable wind turbine blade for commercial use offshore, the "RecyclableBlade", designed to be recycled at the end of its lifecycle. Siemens Gamesa aims to make wind turbines fully recyclable by 2040. The first 81 metre-long RecyclableBlades were produced in the Siemens Gamesa blade manufacturing facility at Aalborg, Denmark. Siemens Gamesa has announced that it has signed agreements with three of its main clients. The first is with RWE to install, and for the first time, pilot the recyclable blade in Germany's Kaskasi offshore wind farm, due to be commissioned at the end of 2022. The second is with EDF Renewables and WPD. These Siemens Gamesa wind turbine blades are manufactured from a combination of materials cast with resin to form a lightweight, solid, flexible structure. The chemical structure of this new type of resin makes it possible to separate the resin from the other components at the end of the blade's working life efficiently. This mild process protects the blade materials' properties, in contrast with existing conventional wind turbine blade recycling methods. After separation, the materials can be reused in new applications. In March 2022, the ZEBRA consortium (Zero wastE Blade ReseArch), associating the French research center IRT Jules Verne and several manufacturers (Arkema, CANOE, Engie, LM Wind Power, Owens Corning and SUEZ) also announced the production of the first prototype of its 100% recyclable wind turbine blade. The 62-meter blade was made from Arkema's Elium resin, a thermoplastic resin well known for its recyclable properties. LM Wind Power belongs to the manufacturer GE Renewable Energy.
In a communiqué released in June 2021, WindEurope called for a Europe-wide ban on dumping decommissioned wind turbine blades by 2025. Europe's wind energy industry is actively committed to reusing, recycling or recovering 100% of decommissioned blades. A dumping ban of this sort would further speed up the development of sustainable recycling technologies for composite materials. At the same time, the sector has undertaken to not send decommissioned wind turbine blades for dumping to non-European countries. The WindEurope communiqué claims that the standard life expectancy of a land-based

wind farm is about 20–25 years. As it stands, 85–90% of the total mass of a wind turbine can be recycled. There are recycling circuits for most of the components – including the steel, cement, copper wire, electronic and gears. However, turbine blades are harder to recycle as they contain complex composite materials… a combination of reinforced fibres (generally glass- or carbon-fibre) and a polymer matrix that enhance blade performance levels by making them lighter and longer.

TESTING IN PROGRESS ON 15 MW+ PROTOTYPES

The installation of offshore wind farms further out to sea allows manufacturers to design bigger and higher capacity turbines, suitable for strong wind speeds and with very high load factors approaching 60%. Some of these sea monsters are in test or assembly phase at the Denmark's Østerild national test centre on the Technical University of Denmark's (DTU) Risø Campus, that has facilities to test offshore wind turbines up to 330 metres high.

Siemens-Gamesa is experimenting with its SG 14-222 DD prototype which has 14 MW of capacity and can achieve 15 MW using its Power Boost function. Its rotor is 222 metres in diameter, its 108 metre-long blades sweep a surface of 39 000 m². the SG 14-222 DD will go on sale in 2024. A version with a 236 metre diameter rotor is planned (the SG 14-236 DD). Siemens Gamesa claims to have signed preferred supplier agreements for this new turbine, for the 300-MW Hai Long 2 project off the coast of Taiwan and for the Dominion Energy utility company's 2.6-GW Coastal Virginia Offshore Wind (CVOW) commercial project in the United States.

Assembly of the Vestas V236-15 MW offshore wind turbine prototype is on the same site, and it will be trialled later this year. The wind turbine, fitted with 115.5 metre-long blades will stand 280 metres high and be capable of producing about 80 GWh per annum, i.e., its annual load factor will be about 60%. This turbine is one of the models in the running for Germany's He Dreit project (900-MW wind farm) and has been chosen by Equinor and BP for their 2.1-GW Empire Wind and Empire Wind 2 wind farms off the coast of New York State.

The Chinese wind turbine industry is also in the race for very high capacity turbines. In August 2021, MingYang announced the launch of the MySE 16.0-242, the world's most powerful wind turbine. This model, fitted with 118 metre-long blades will stand 264 metres high. Its 242-metre rotor will sweep a surface of 46 000 m². According to the manufacturer, it could generate 80 GWh of electricity per annum. The first prototype will be built in 2022 and be commissioned in 2023. Commercial-scale manufacturing is planned for the first half of 2024. MingYang announced that it wants to install two of these turbines in the MingYang Yangjiang Qingzhou Four offshore wind farm in the South China Sea, that will also have 59 no. 8-MW turbines… a wind farm that could be up and running as soon as 2026.

The most powerful wind turbines installed in commercial-size wind farms currently have 10 MW of capacity. Examples are the first Vestas V164-10.0MW turbines whose installation started at the end of 2021 in the Scottish Seagreen (1.1 GW) wind farm. The wind farm is designed to produce 5 TWh per annum – enough to supply 1.6 million households and save 1.6 millions tonnes of CO_2 per annum.

A RACE AGAINST TIME

The European Union governments have no alternative but to take drastic measures, given the fact that they have been backed into a corner by the climate imperative and the vital need to wean themselves off their dependency on fossil fuels supplied by overtly hostile countries. The war in Ukraine sparked off by the world's largest natural gas exporter and the resulting energy price hike, will prove to be the catalyst. The European Union, with its Green Deal, has already outlined its vision… that of a climate-neutral, fair and prosperous society, with a modern, competitive economy that uses resources efficiently. To fulfil this ambition, the European Commission published its "Fit for 55" climate energy package on 14 July 2021, that presents 12 legislative proposals that affect all the economy's sectors and aim for a root-and-branch overhaul of Europe's economies to achieve at least 55% emissions reduction by 2030. The gravity of the situation and the need for swift, coordinated actions, led the European Commission to propose a draft "REPowerEU" plan on 8 March 2022 that it will submit to Europe's governments to liberate Europe from its dependency on Russian fossil fuels well before 2030. It aims to finalize this plan this coming summer in cooperation with the Member States.

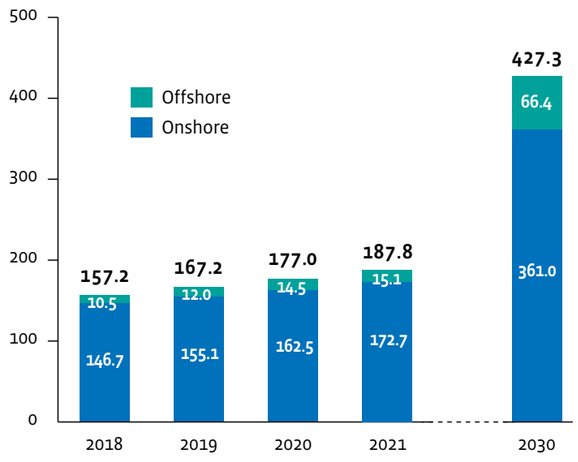
As a matter of urgency, REPowerEU aims to diversify the gas supply, accelerate the rollout of renewable gas and replace the gas used for space heating and generating electricity. The Commission says that it is likely to reduce the EU's demand for Russian gas by two thirds before the end of the year. In the electricity sector, the plan provides for faster rollout of wind and solar power, entailing a 20% increase in the average deployment rate, and 80 GW of additional capacities by 2030 to support the increased production of renewable hydrogen. The Commission stresses in this document that the "Fit for 55" package already plan to double the EU's photovoltaic and wind energy capacities by 2025 and treble them by 2030, which amounts to a 170-BCM (billion m3) saving in annual gas consumption by 2030. For the end of 2030, that implies the deployment of 480 GW of wind energy capacity, 420 GW of solar capacity and production of 5.6 million tonnes of green hydrogen.

At the same time, the Commission will seek to implement the means to make renewable energy production projects easier. It will focus on the main obstacles to rolling out these projects, such as lengthy authorization procedures, the complexity of the site selection rules and processes and administrative authorizations, grid connection issues and staffing those authorities responsible for assessing permits.

The space race of 1957– 1975, in which the United States and the Soviet Union rivalled each other in space exploration, is behind us. A new **technological and peaceful** race is now underway to overcome fossil fuel dependency, within a timeframe to curb global warming to less than 2°C. The most responsible and least cynical global leaders have no option but to accelerate decarbonation of the economy, starting with our energy systems. □

Graph No. 2

EurObserv'ER projection of the evolution of wind power net capacity in the EU 27 (in GW)



Source: EurObserv'ER 2022

Sources : UBA (Germany), AGEE-Stat (Germany), Ministry for the Ecological Transition and the Demographic Challenge (Spain), SDES (France), Terna (Italy), Svenska Vindenergi (Sweden), SCB (Sweden), ENS (Denmark), ARE (Poland), DGEG (Portugal), CBS (Netherlands), SEAI (Ireland), SPF Economie (Belgium), CRES (Greece), HOPS (Croatia), Litgrid (Lithuania), STATEC (Luxembourg), Ministry of Industry and Trade (Czechia), NSO (Malta), Cyprus Energy Regulatory Authority, Finnish Energy (Finland), Statistics Austria, INSSE (Romania), EurObserv'ER, WindEurope.

The next barometer will cover photovoltaics.

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