



Wind energy in Europe

2021 Statistics and the outlook for 2022-2026

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This report summarises new installations and financing activity across Europe's wind farms from 1 January to 31 December 2021. It also analyses how European markets will develop over the next five years (2022 to 2026). The outlook is based on WindEurope's internal analysis and consultation with its members.

The data represents gross installations per site and country unless otherwise stated. Rounding of figures is at the discretion of the author.

DISCLAIMER

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CONTENTS

Executive summary	7
1. Wind power installations	12
1.1 Overview	12
1.2 2021 Installations by Country	13
1.3 Europe's Total Wind Power Capacity	16
1.4 Decommissioning and Repowering of Wind Farms	18
1.5 Wind Energy Generation in 2021	19
1.6 Wind Turbine Size	24
1.7 Auctions and Tenders in 2021	25
2. Market outlook 2022-2026	27
2.1 Introduction	27
2.2 Realistic Expectations Scenario	29
2.3 Low Scenario	36
2.4 Reaching 2030 Energy and Climate Targets.....	37
Annex 1	38



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EXECUTIVE SUMMARY

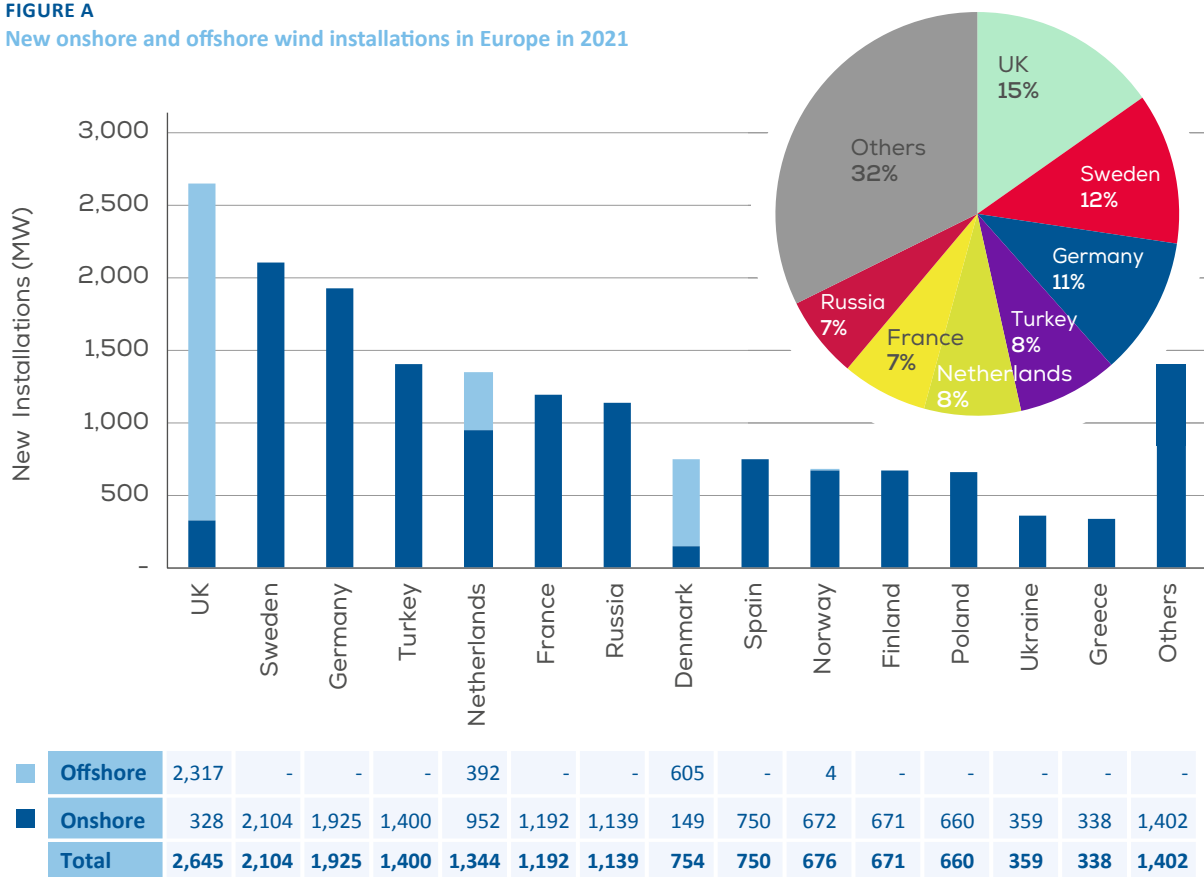
Europe installed 17 GW of new wind energy capacity in 2021. The EU-27 installed 11 GW. This is not even half of what the EU should be building to be on track to deliver its 2030 Climate and Energy goals.

onshore wind. The UK had the highest total new wind installations, because they accounted for most of the new offshore wind installations.

81% of the new wind installations in Europe last year were onshore wind. Sweden, Germany and Turkey built the most

Europe now has 236 GW of wind capacity.

FIGURE A
New onshore and offshore wind installations in Europe in 2021



Source: WindEurope

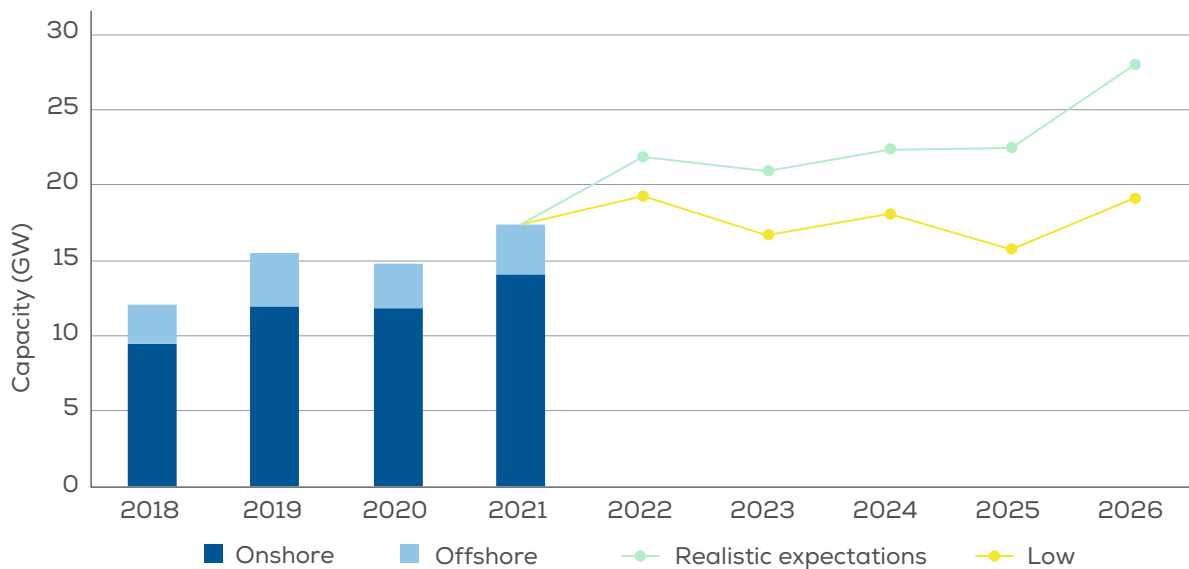
We expect Europe to install 116 GW of new wind farms over the period from 2022-2026. That’s 23 GW a year on average. Three quarters of these new capacity additions will be onshore wind. We expect the EU-27 to build on average 18 GW of new wind farms between 2022-26. They need to build 32 GW a year in order to meet the EU’s new 40% renewable energy target.

The aforementioned expectations for 2022-26 assume that Governments deliver on the firm (and still fairly modest) commitments they have already made to improve

their permitting of new wind farms. If they fail to do so and continue to restrict the spatial and planning requirements for wind farms, then Europe would install just 89 GW over the 2022-2026 period. In any event, Governments need to simplify and significantly accelerate the permitting of wind projects for Europe to meet its 2030 targets.

We expect Germany to install the most new wind capacity between 2022-2026: 25 GW, most of it onshore. The UK will follow with 15 GW, most of it offshore. France, Spain, and Sweden will provide the next largest contributions.

FIGURE B
2022-2026 new onshore and offshore wind installations in Europe – WindEurope’s scenarios



Source: WindEurope

2021 annual figures

- Europe installed 17.4 GW of new wind power capacity in 2021. This was 18% more than 2020. 11 GW of the new installations were in the EU-27.
- Onshore wind made up 81% of the new installations with 14 GW. In the EU-27, onshore represented 91% of the new capacity.
- Offshore wind installations were 3.4 GW.
- Europe's wind farms generated 437 TWh of electricity in 2021. They covered 15% of the electricity demand in the EU-27+UK.

Trends and cumulative installations

- Europe now has 236 GW of installed wind power capacity: 207 GW onshore and 28 GW offshore. The EU-27 has 189 GW installed: 173 GW onshore and 16 GW offshore.
- Europe decommissioned 396 MW of wind capacity in 2021. At the same time it commissioned 515 MW of repowered capacity.
- The average power rating of new onshore turbines was 4 MW. For offshore wind it was 8.5 MW.

Country highlights

- The UK installed the most wind power capacity in 2021 (2.6 GW). 88% of that was offshore wind.
- Sweden (2.1 GW), Germany (1.9 GW), Turkey (1.4 GW) and France (1.2 GW) led the installation of onshore wind farms.
- Denmark and Ireland remain the countries with the highest share of wind in their electricity mix with 44% and 31% respectively.

- Wind was above 20% of the electricity demand in another four countries: Portugal (26%), Spain (24%), Germany (23%) and the UK (22%).

2022-2026 outlook

- In our Realistic Expectations Scenario Europe will install 116 GW of new wind power capacity over the next five years, an average of 23.1 GW a year. The EU-27 will install 88 GW of this, 17.6 GW per year. The EU needs to install 32 GW pa to deliver its 40% renewable energy target.
- We expect onshore wind to make up 76% of the new installations in Europe with 88 GW. This translates into an average installation rate of 17.5 GW a year.
- We expect 27.9 GW of new offshore wind over the next five years. That entails almost a doubling of the annual installation rate from 3 GW to 5.6 GW.
- We expect Germany to install the most wind capacity over the next five years, 25.1 GW. Most of this will be onshore wind (19.7 GW).
- We expect the UK to install 15.2 GW, most of it offshore (10.8 GW). We expect France (12.2 GW), Spain (10.3 GW), and Sweden (7.5 GW) to provide the next highest contributions.
- About 11.4 GW could be decommissioned over the next five years. We expect only 2.9 GW of this to be repowered (leading to 5.7 GW of repowered¹ capacity). The remaining 8.6 GW will be fully decommissioned and removed from the system.
- If Governments don't deliver the (so far fairly modest) commitments they have made to improve permitting and they continue to restrict spatial and planning requirements for wind farms, then Europe will install just 89 GW over the period 2022-2026.

1. Referred to as capacity under repowering.

New installations in 2021:

17.4 GW
TOTAL EUROPE

11 GW
IN THE EU-27

Cumulative installed capacity (GW)²

GW

GW

New installations in 2021 (GW)

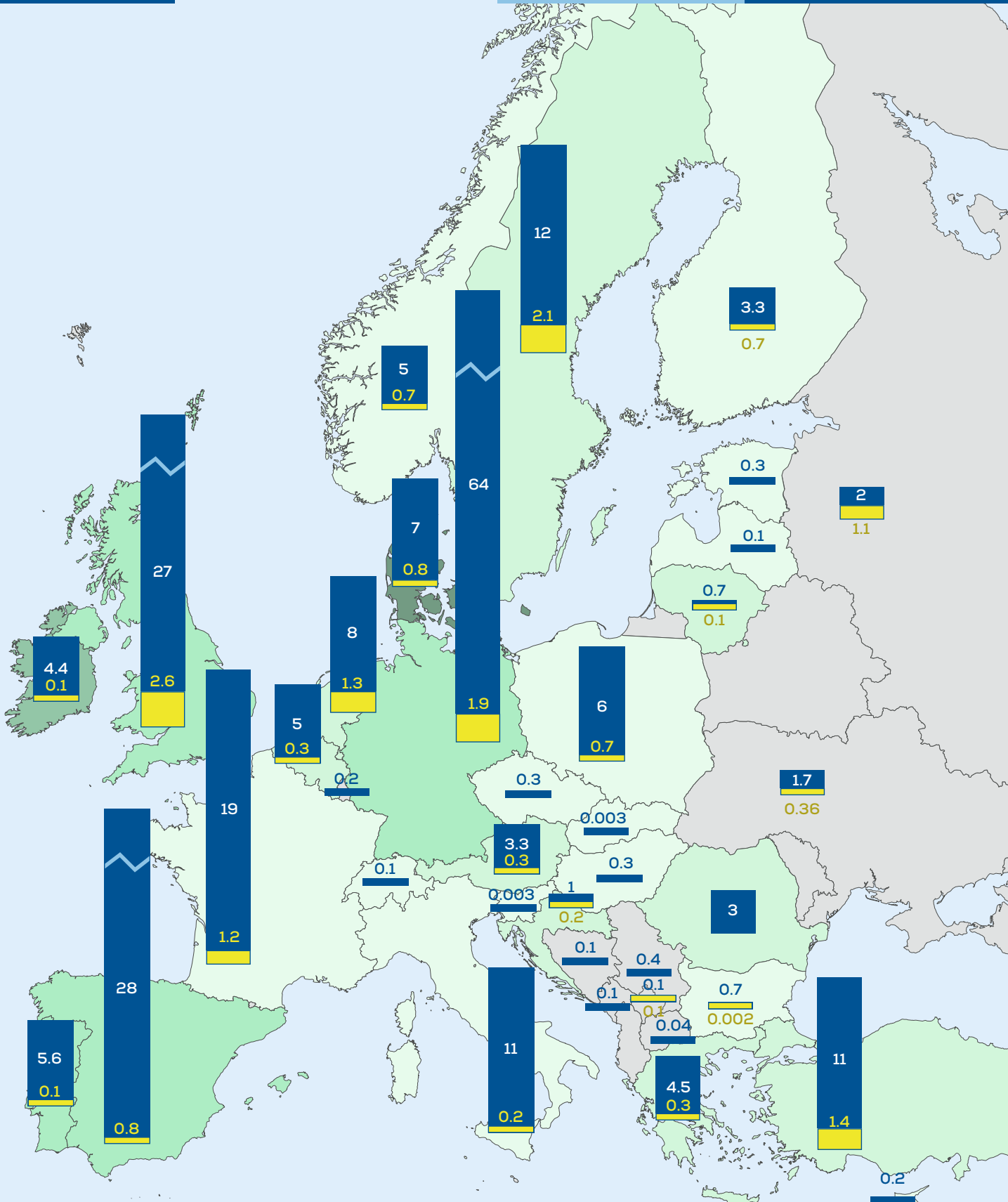
Share of wind in power demand^{3,4}

40-50%
30-40%
20-30%
10-20%
0-10%

WIND ENERGY COVERED

15%

OF EUROPE'S ELECTRICITY DEMAND IN 2021



2. Cumulative in each country reflects decommissioning in 2021: Germany (233 MW), Austria (103 MW), Denmark (26 MW), Belgium (23 MW), France (8 MW), the UK (3 MW), and Switzerland (0.2 MW).
3. Grey colored countries did not provide data for electricity generation and consumption to ENTSO-E transparency platform.
4. Data for Turkey's electricity generation and consumption was provided by the Turkish Wind Energy Association.

TABLE 1
New installations and cumulative capacity in 2021⁵

EU-27 (MW)	NEW INSTALLATIONS 2021			CUMULATIVE CAPACITY			SHARE OF WIND IN 2021		
	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL
Austria	298	-	298	3,300	-	3,300	11%	-	11%
Belgium	305	-	305	2,741	2,261	5,002	5%	8%	13%
Bulgaria	2	-	2	707	-	707	4%	0%	4%
Croatia	187	-	187	990	-	990	11%	0%	11%
Cyprus	-	-	-	158	-	158	6%	0%	6%
Czechia	-	-	-	337	-	337	1%	-	1%
Denmark	149	605	754	4,870	2,308	7,178	24%	19%	44%
Estonia	-	-	-	320	-	320	9%	0%	9%
Finland	671	-	671	3,257	71	3,328	9%	0%	9%
France	1,192	-	1,192	19,079	2	19,081	8%	0%	8%
Germany	1,925	-	1,925	56,130	7,713	63,843	18%	5%	23%
Greece	338	-	338	4,452	-	4,452	18%	0%	18%
Hungary	-	-	-	329	-	329	1%	-	1%
Ireland ⁶	54	-	54	4,380	25	4,405	31%	0%	31%
Italy ⁷	201	-	201	11,108	-	11,108	7%	0%	7%
Latvia	-	-	-	66	-	66	2%	0%	2%
Lithuania	120	-	120	668	-	668	10%	0%	10%
Luxembourg	4	-	4	168	-	168	-	-	-
Malta	-	-	-	-	-	-	0%	0%	0%
Netherlands	952	392	1,344	5,179	2,986	8,165	8%	7%	15%
Poland	660	-	660	6,347	-	6,347	9%	0%	9%
Portugal	126	-	126	5,587	25	5,612	26%	0%	26%
Romania	-	-	-	3,029	-	3,029	11%	0%	11%
Slovakia	-	-	-	3	-	3	0%	-	0%
Slovenia	-	-	-	3	-	3	0%	0%	0%
Spain ⁸	759	-	759	28,191	5	28,196	24%	0%	24%
Sweden	2,104	-	2,104	11,905	192	12,097	19%	0%	19%
Total EU-27	10,047	997	11,044	173,304	15,588	188,892	12%	2%	14%

OTHERS (MW)	NEW INSTALLATIONS 2021			CUMULATIVE CAPACITY			SHARE OF WIND IN 2021		
	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL
Bosnia & Herzegovina	-	-	-	135	-	135	-	-	-
Kosovo	105	-	105	137	-	137	-	-	-
Montenegro	-	-	-	118	-	118	-	-	-
North Macedonia	-	-	-	37	-	37	-	-	-
Norway	672	4	676	4,649	6	4,655	8%	0%	8%
Russia	1,139	-	1,139	2,043	-	2,043	-	-	-
Serbia	-	-	-	374	-	374	-	-	-
Switzerland	-	-	-	87	-	87	-	-	-
Turkey	1,400	-	1,400	10,750	-	10,750	10%	-	10%
Ukraine	359	-	359	1,673	-	1,673	-	-	-
UK	328	2,317	2,645	14,073	12,739	26,812	10%	12%	22%
Total others	4,003	2,321	6,324	34,076	12,745	46,821	-	-	-
Total Europe	14,050	3,318	17,368	207,380	28,333	235,712	12%	3%	15%

5. All numbers are rounded and therefore may not add up.

6. Irish figures are an estimate.

7. Italian figures are up to 31 October 2021.

8. Spanish figures are an estimate from Red Eléctrica de España.

1.

WIND POWER INSTALLATIONS

1.1 OVERVIEW

In 2021 new wind installations in Europe amounted to just 17.4 GW (14 GW onshore and 3.4 GW offshore) as permitting bottlenecks and global supply chain issues continue to delay the commissioning of new wind farms. While 2021 stands as a record year for installations (surpassing the 17.1 GW figure for 2017), they were 11% lower than our previous forecast from February 2021 and they are well below the level that Europe needs to reach its 2030 energy and climate goals. In order to reach the 40% renewables target the EU-27 need to install 32 GW of new wind capacity each year.

The UK installed the most wind capacity in 2021 driven by its strong offshore sector. Sweden followed with a record year for its vibrant onshore market and pushed Germany to third spot. But Germany's onshore installations showed further recovery, though they're still well below the levels of 2012-17 and the volumes its new Government has now committed to for the rest of this decade.

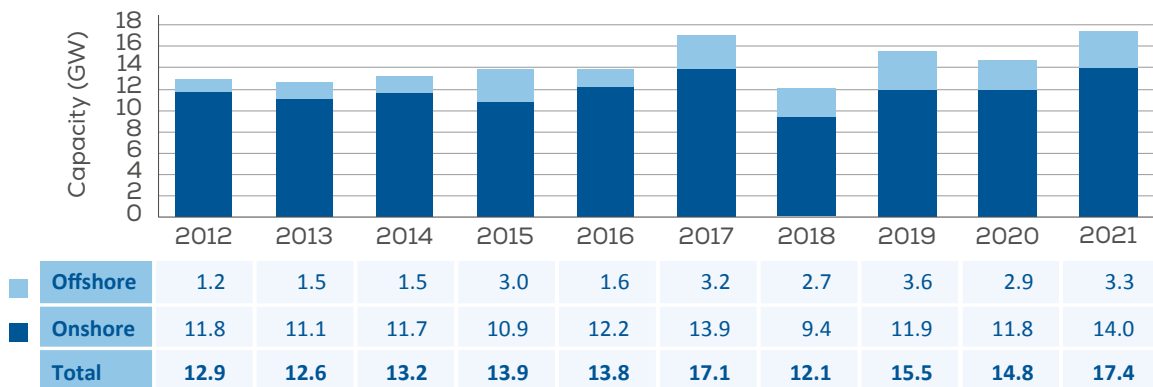
Turkey, Russia, Denmark, Finland and Croatia all installed what were for them record amounts of new wind capacity in 2021.

Offshore wind made up 19% of new installations in Europe, following the same pattern as in previous years. A total of 3.3 GW were connected to the grid in 2021. Most of the capacity was connected in the UK, followed by Denmark which had a record year (605 MW) as well as the Netherlands and Norway.

In 2021 new wind installations in the EU-27 totalled 11 GW, representing 63% of all installations in Europe. Outside of the EU, installations rose significantly in Turkey and Russia while the UK continues to be the main contributor.

There were 0.4 GW of decommissioned wind capacity in Europe during the year. Thus, overall net installations amounted to 17 GW.

FIGURE 1
Annual new wind installations in Europe, 2012-21



Source: WindEurope

1.2 2021 INSTALLATIONS BY COUNTRY

The UK had 2.6 GW of installations, with offshore making up 88% of this figure. Offshore installations were driven by the completion of the Moray East and Triton Knoll wind farms. Although onshore installations in the UK grew year-on-year they are still the second lowest figure since 2005.

Sweden saw a record year for installations as onshore installations more than doubled year-on-year. With 2.1 GW of new onshore installations Sweden connected the most onshore wind capacity in Europe.

Germany was the third largest country for wind installations. Onshore installations rose to 1.9 GW (from 1.4 GW in 2020) reflecting a slight improvement in the permitting situation. Decommissioning of onshore wind farms remained rather low at 0.2 GW as high wholesale electricity prices compensated for increased operational costs of

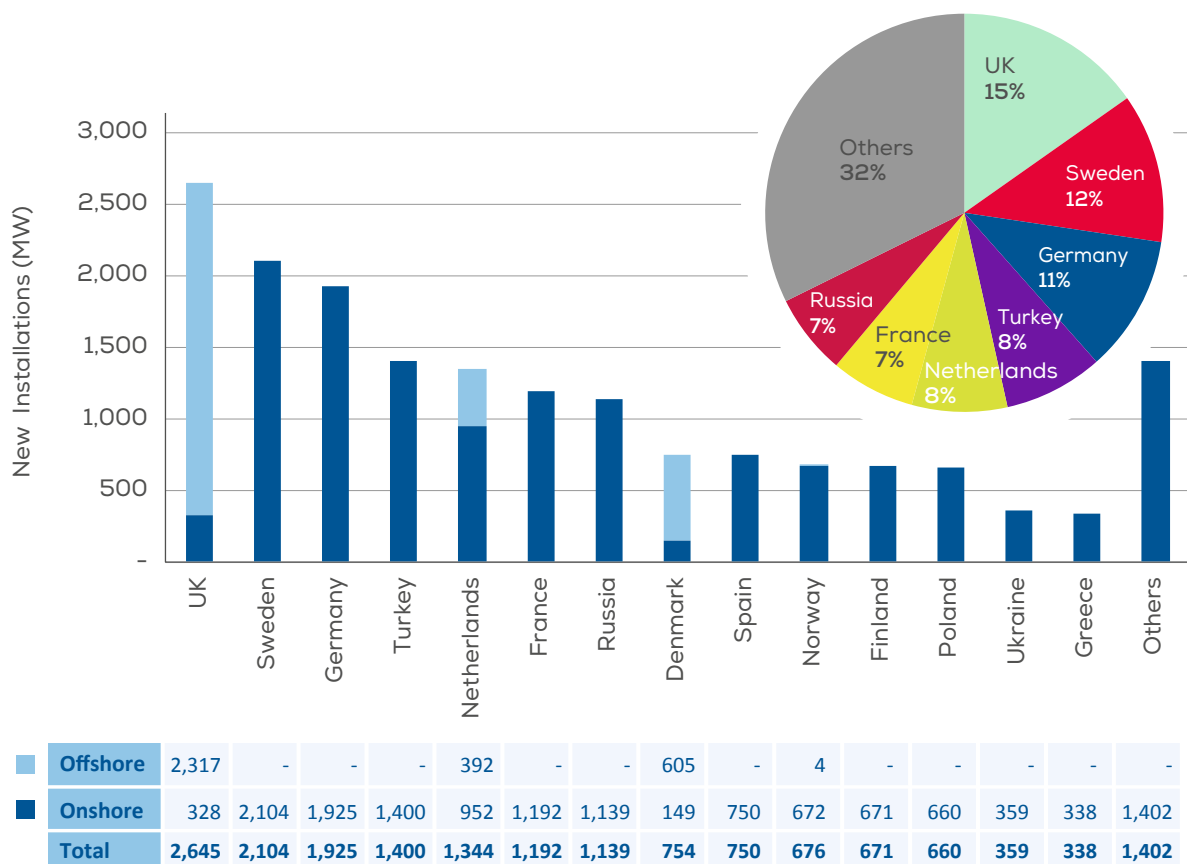
old wind turbines. There weren't any offshore wind installations in Germany as the wind farms that were awarded in the first auctions back in 2018 are waiting for the grid infrastructure to be developed by the Transmission System Operator and are only expected to be commissioned in 2022/23.

Turkey installed a record 1.4 GW of wind capacity, slightly overtaking a previous record in 2016.

The Netherlands installed 1.3 GW of wind capacity driven by onshore wind installations (952 MW).

France installed 1.2 GW of onshore capacity, 10% lower than in 2020 (1.3 GW) and continuing a worrying trend of decreasing installations since their peak back in 2017 when 1.7 GW were installed.

FIGURE 2
New wind installations in Europe per country



Source: WindEurope

Russia was the seventh-largest market and the third-largest non-EU market in Europe. With 1.1 GW of installations Russia saw a 60% increase on 2020 installation figures.

Spain is estimated to have installed 750 MW in 2021⁹, a 56% drop compared with 2020. This was primarily due to of a lack of auctions held between 2018 and 2020.

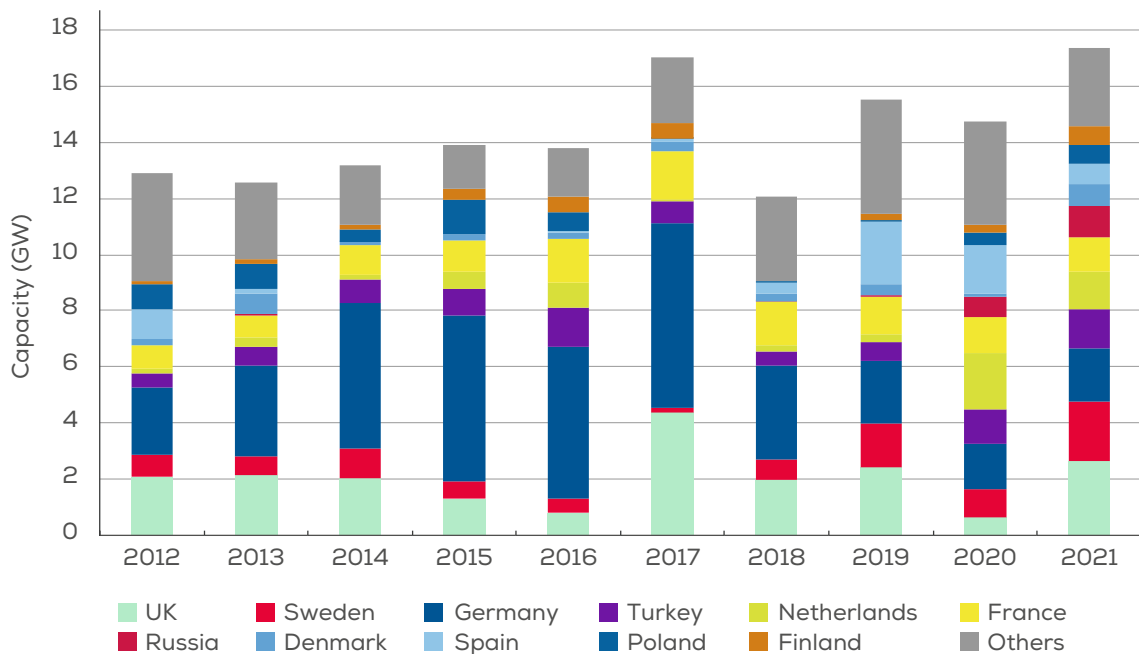
81%
OF WIND INSTALLATIONS IN 2021
CAME FROM ONSHORE WIND

Installations in **Norway** (0.7 GW) were driven by the phased-out green certificate scheme and some corporate Power Purchase Agreements (PPA). **Finland** (0.7 GW) saw a record year for new installations due to the strong uptake of PPAs and merchant projects. **Poland** (0.7 GW) also saw a strong year as the capacity auctioned in 2018 and 2019 is finally coming online.

Denmark installed 754 MW in 2021 with most of it coming from offshore wind. Kriegers Flak, the world’s first hybrid offshore wind project (connected to both Denmark and Germany) contributed 0.6 GW to installations in Denmark.

14 countries saw no wind installations in 2021. Nine of these are EU-27 Member States.

FIGURE 3
Distribution of new wind installations by country, 2012-21



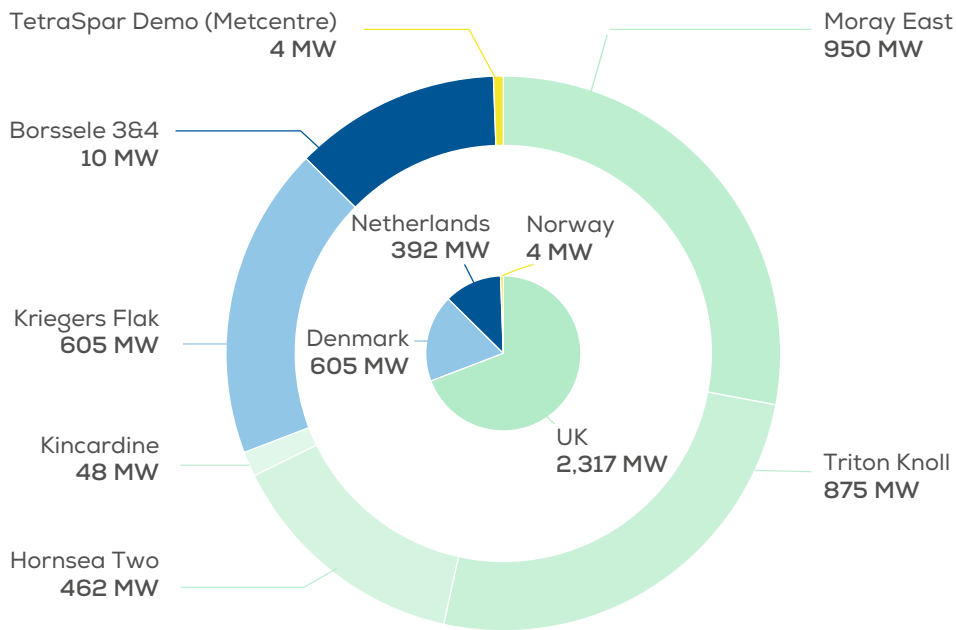
Source: WindEurope

9. Provisional figures, based on latest data (extracted on February 9) from the Transmission System Operator Red Elctrica de Espana.

There were eight offshore wind farms across three countries connecting turbines to the grid in 2021. The UK installed three new projects while a fourth project, the Hornsea Two, is still under construction with full commissioning expected in 2022. Kincardine, the largest operational floating project globally was commissioned off the coast of Scotland. Denmark completed the installation of

Kriegers Flak and the Netherlands saw the installation of one commercial wind farm and one demonstration project in the Borssele zone. Finally Norway saw the installation of a demonstration project with a new floating concept.

FIGURE 4
Offshore wind farms partially or fully commissioned in 2021¹⁰



Source: WindEurope

10. The chart shows only the wind farm capacity that was connected in 2021. The actual capacity of the mentioned wind farms are larger as some were partially commissioned in 2020 and others will be commissioned in 2022.

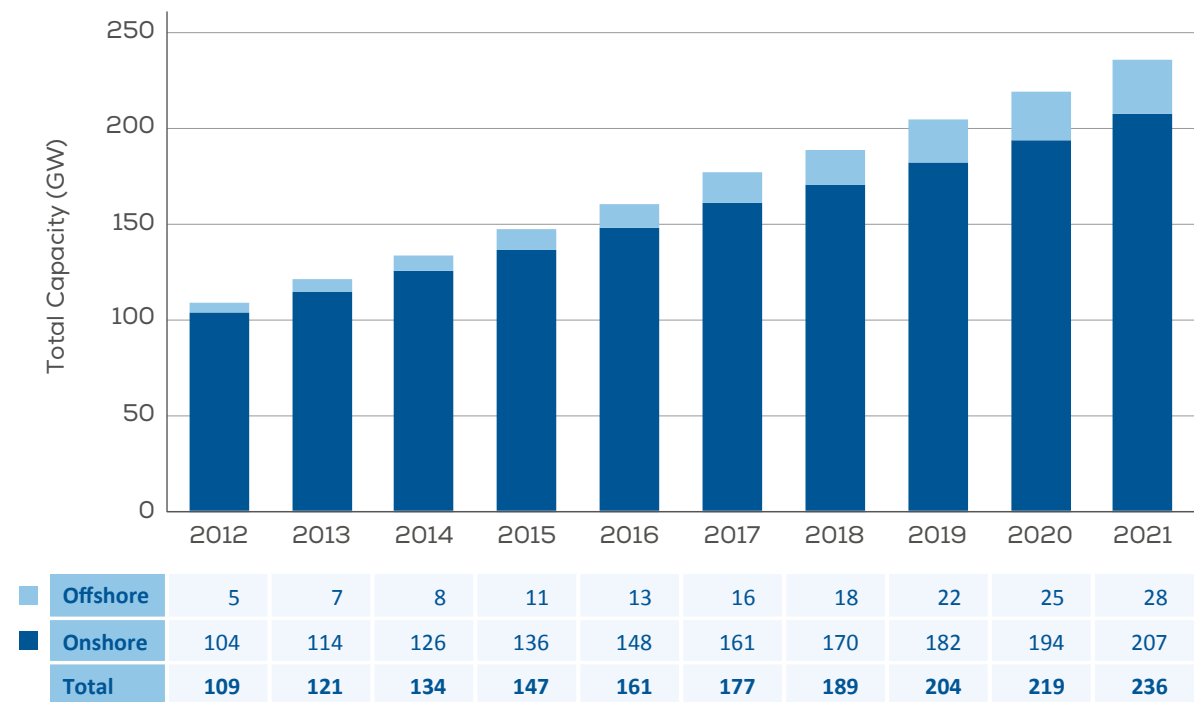
1.3 EUROPE’S TOTAL WIND POWER CAPACITY

236 GW of wind power capacity are now installed in Europe. 12% of this figure is offshore. Germany continues to have the largest installed capacity in Europe, followed by Spain, the UK, France, and Sweden. Seven other countries (Italy, Turkey, the Netherlands, Poland, Denmark, Portugal, and Belgium) have more than 5 GW installed each. Six additional countries have over 3 GW of installed capacity: Ireland, Greece, Norway, Finland, Austria, and Romania.

236 GW
OF WIND POWER CAPACITY IS NOW INSTALLED IN EUROPE

In the EU-27 the total capacity has reached 189 GW. The EU-27 has 55% of all the offshore wind capacity in Europe.

FIGURE 5
The growth of total wind energy capacity in Europe, 2012-21

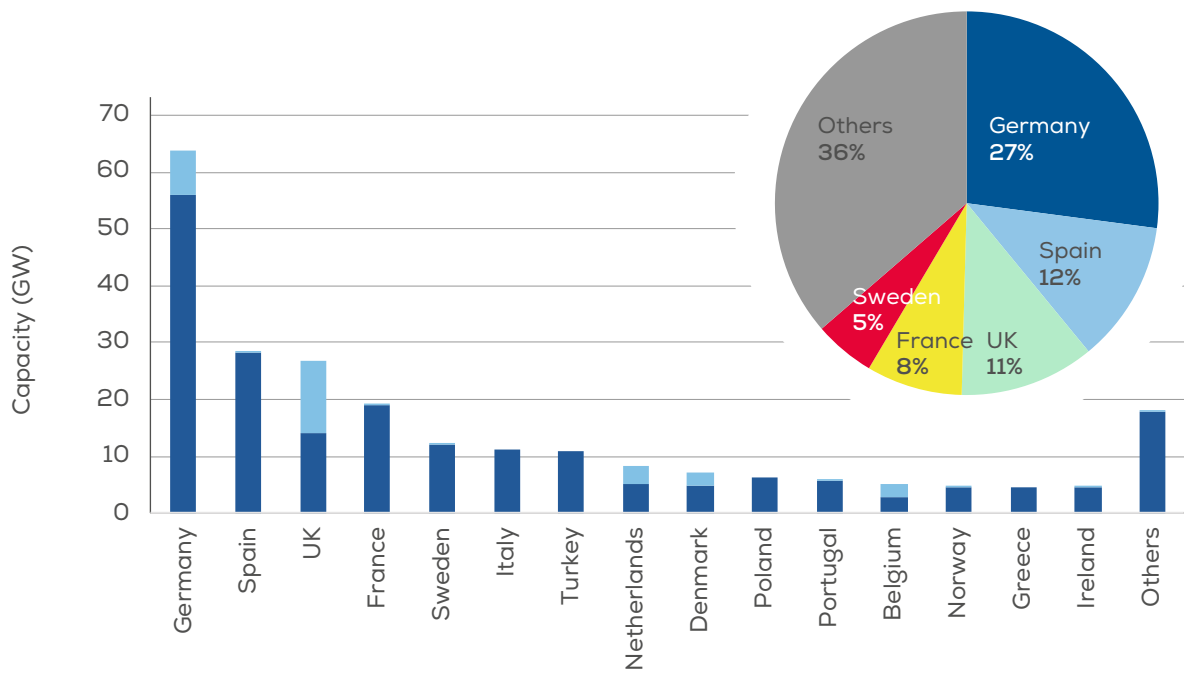


Source: WindEurope

64% of all wind power capacity in Europe is spread across five countries: Germany (64 GW), Spain (28 GW), the UK (27 GW), France (19 GW), and Sweden (12 GW). This is followed by Italy, Turkey, and the Netherlands with 11 GW, 11 GW and 8 GW respectively.

64%
OF EUROPE'S WIND POWER IS INSTALLED IN JUST FIVE COUNTRIES

FIGURE 6
Total wind installations by country



■ Offshore	8	0	12.7	0	0	-	-	3	2	-	0	2	0	-	0.03	0
■ Onshore	56	28	14	19	12	11	11	5	5	6	6	3	5	4	4	18
Total	64	28	26.7	19	12	11	11	8	7	6	6	5	5	4	4	18

Source: WindEurope

1.4 DECOMMISSIONING AND REPOWERING OF WIND FARMS

396 MW of wind power was decommissioned in 2021. This decommissioning took place in Germany (233 MW), Austria (103 MW), Denmark (26 MW), Belgium (23 MW), France (8 MW), the UK (3 MW), and Switzerland (0.2 MW). All decommissioned capacity came from onshore wind farms.

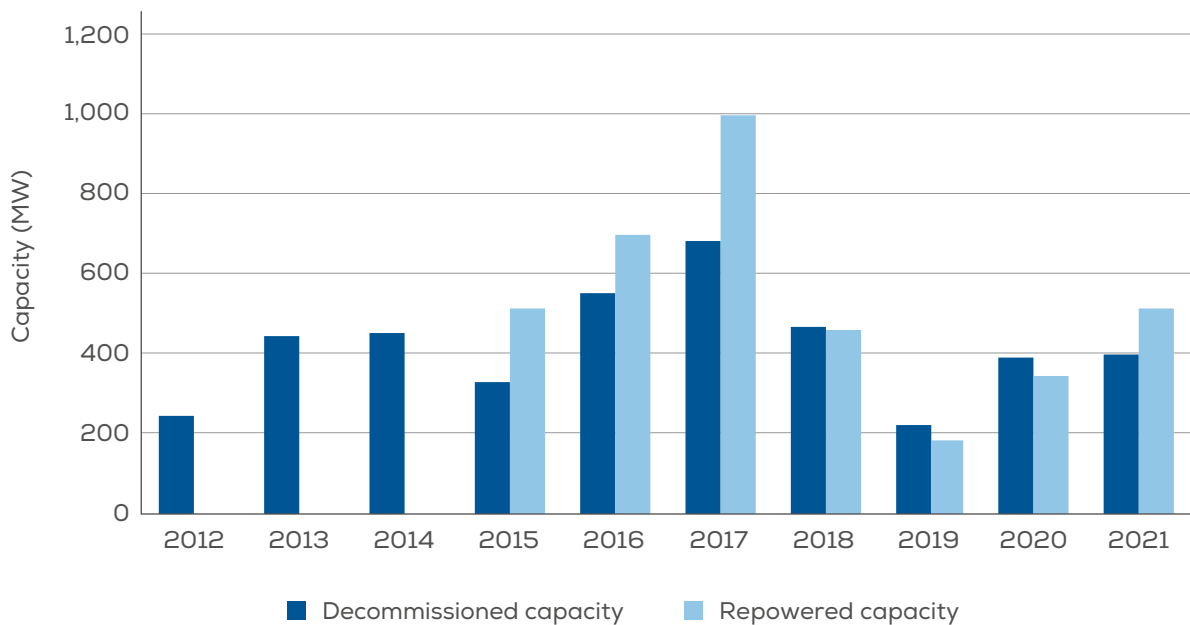
Out of the 14 GW of onshore wind installed in 2021, only 515 MW came from repowering projects. Most repowering took place in Germany and Austria, but there was also activity in Belgium, Greece and the UK. Complex per-

mitting rules are the key factor behind the slow uptake of repowering projects in Europe but the recent increase in wholesale power prices has also played a part.

396 MW

OF WIND POWER WAS DECOMMISSIONED IN 2021

FIGURE 7
Decommissioned and repowered¹¹ capacity



Repowering terminology Example			
Old project		New project	
Number of turbines	13	Number of turbines	9
Turbine power rating	2	Turbine power rating	4
Capacity under repowering	26	Repowered capacity	36

Decommissioned capacity = Capacity under repowering + Fully decommissioned capacity
Repowered capacity = the final capacity in the new project

Source: WindEurope

11. Data available as of 2015

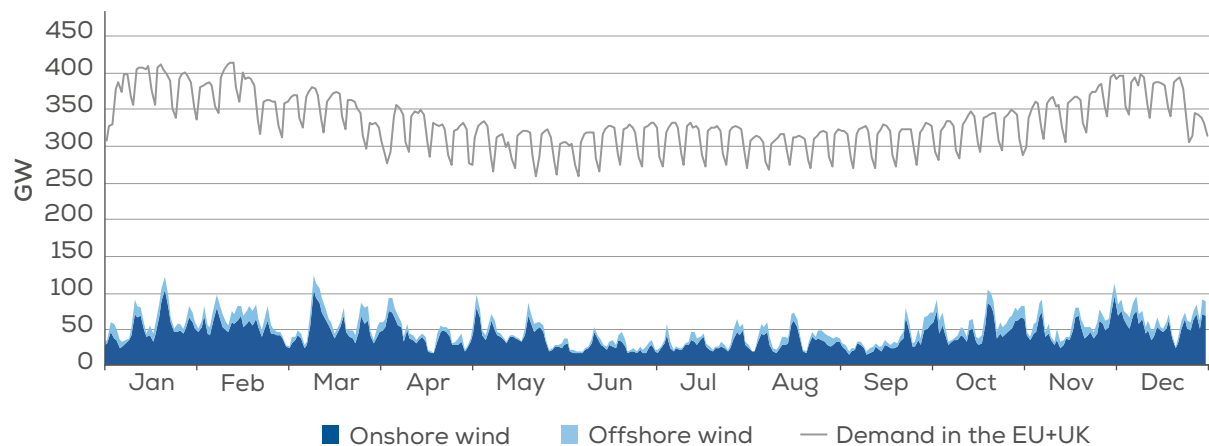
1.5 WIND ENERGY GENERATION

Wind energy met 15% of demand across the EU-27 + UK¹². This is 1.4% lower than levels seen in 2020 and similar to the share of demand wind energy met in 2019. Power demand in 2021 returned to levels seen before the pandemic's economic slowdown. Along with the increased demand, wind energy generation was lower in many regions across Europe, particularly in Northern Europe where there tend to be larger wind energy markets, including Germany, the UK and France. Only Spain and Italy out of the largest wind-producing countries generated more wind power than in previous years – even

though new capacity additions were very modest. Wind energy is by definition variable. It is normal to see annual fluctuations in wind capacity factors that will impact the share of demand.

The period of low wind generation was mostly recorded from January to March. While this was comparable with previous years, it was still down slightly throughout the year up until October. The final months of 2021 saw stronger wind generation.

FIGURE 8
Power demand and wind energy generation in the EU-27 and the UK in 2021 (GW)



Source: WindEurope

Wind power plants in Europe¹³ produced 437 TWh of electricity in 2021 and covered 15% of electricity demand (12.2% from onshore and 2.8% from offshore wind). Despite March having lower wind generation on the whole, wind power achieved record daily production on 11 March (2,936 GWh) corresponding to an average output of 103 GW or about 61% of the fleet producing at maximum output for the entire day. And later in the

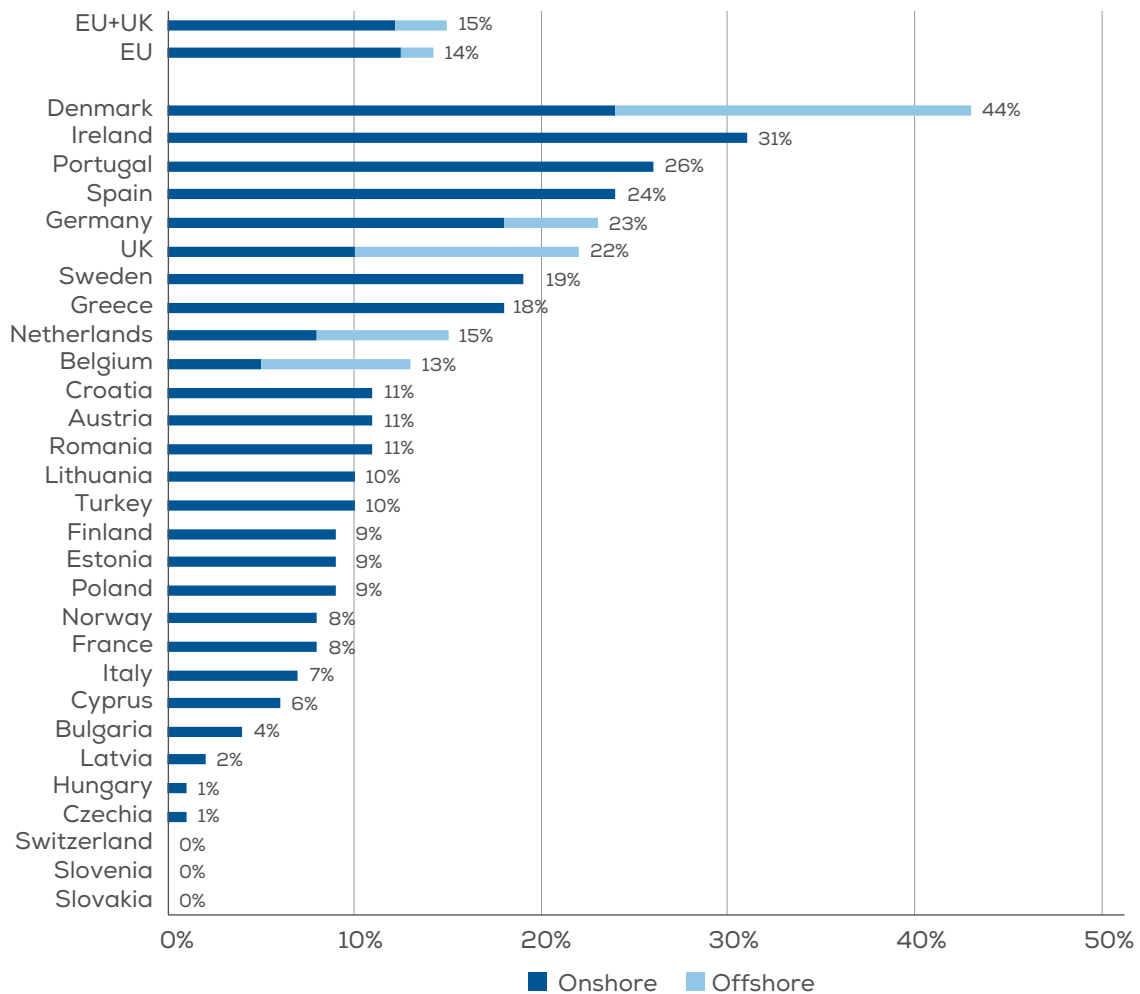
year, wind met 18% of the electricity demand in Europe for the whole of Q4 (October to December). The strongest month for generation in 2021 was October with wind meeting 19% of demand for the entire month. This goes against baseless claims that low wind energy levels were responsible for the spike in electricity prices in the second half of the year.

12. At time of publication, generation data for Luxemburg and Malta was not available (their combined demand represents less than 1% of EU demand). Figure excludes the UK.

13. Includes the EU-27 + the UK.

FIGURE 9

Percentage of the average annual electricity demand covered by wind in 2021¹⁴



Source: WindEurope

Denmark had the highest share of wind (44%), followed by Ireland (31%) and Portugal (26%). Spain, Germany and the UK followed with 26%, 24% and 23% respectively. With the exception of Spain and Portugal, all of these countries saw lower shares than in 2021, due in large part to the increase in demand, coupled with lower total wind generation over the year. 15 Member States had a wind energy share above 10%.

In the Netherlands offshore wind capacity additions in 2020 led to the share of offshore wind in the electricity mix doubling in just one year (from 3.4% in 2020 to 7% in 2021), and the total share of wind energy going from 12% to 15% in the same period.

Greece also saw a big increase in the share of wind energy in the electricity mix, from 15% in 2020 to 18% in 2021. This was largely driven by a vibrant market and by more favourable wind resource conditions in Southern Europe.

14. The figures represent the average of the share of wind in final electricity demand, captured hourly from ENTSO-E and corrected thanks to national TSOs and government data. Data is not available from all European countries.

TABLE 2

Electricity production from wind power in the EU+UK (TWh)

EU's+UK electricity consumption (TWh)	Onshore wind energy production (TWh)	Offshore wind energy production (TWh)	Total wind energy production (TWh)	Share of consumption met by wind energy
2,921	357	80	437	15%

Capacity factors of the entire wind fleet in the EU and UK were 24% on average, a 3% decrease on 2020. Capacity factors for onshore were 23% (down from 25% in 2020), while for offshore they fell significantly from 42% to 35% over 2021. Offshore fleet capacity factors are more variable than onshore since it is concentrated in a smaller region (albeit generally larger farms with more consistent and stronger wind resources). This highlights the benefits of diversifying resources - the wind is always blowing somewhere in Europe.

The capacity factor numbers are relatively low compared to new wind farms as they represent the performance of the entire wind fleet, including very old installations. Older installations feature turbines with large generators and relatively small rotors (short blades). These are best suited for very windy locations. Modern turbines are built in locations with a lower high-speed wind resource. As a result they need to optimise low-speed winds. They use larger blades and relatively lower generators, increasing their capacity factors. Capacity factors for new onshore wind farms are estimated at between 30-35%. For new offshore wind farms, this figure ranges between 42 and 55%¹⁵.

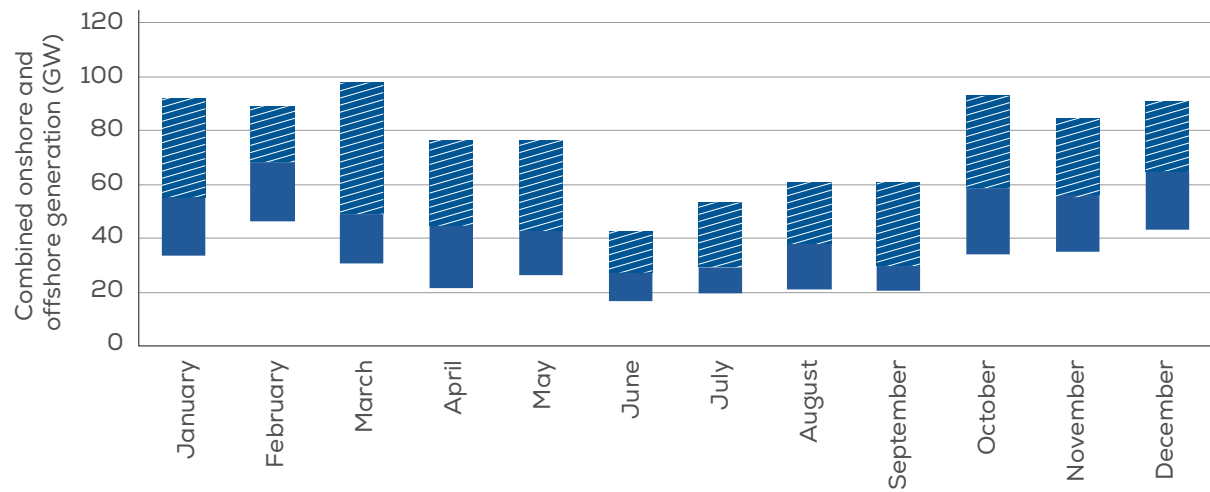
Wind energy production is variable, and the hourly variability generally follows a yearly pattern of more wind generation variability in the winter months. Over the summer, high-pressure systems are more common in Europe, and wind energy generation tends to be lower and less variable.


Figure 10 shows the range of hourly electricity generation from wind energy in each month of 2021. In January for instance, the average power output of the wind fleet was 55 GW, with a minimum of at least 34 GW for most of the time (90% of the time). There were a few instances (10% of the time) where the output surpassed 92 GW. As with 2020, February 2021 saw the highest average output with 68 GW. And for 90% of the time the EU and the UK's wind output was greater than 46 GW, equivalent to the combined average demand of the Scandinavian region (Denmark, Norway, Sweden and Finland).

However as mentioned above, the highest hourly generation was recorded in March.

15. See Analysis of individual offshore wind farms by energynumbers.info (February 2020).

FIGURE 10
Spread of hourly wind energy generation in 2021




 ← 90% of the time, wind generation is less than this ("P10")
 ← Most frequent hourly wind energy generation - there is an equal probability of more or less generation in an hour ("P50")
 ← 90% of the time, wind generation is more than this ("P90")

Source: WindEurope

Over the summer period from June to September, the variation in electricity produced by wind per hour fell (shown by the size of the boxes) and the average was also lower (shown by the lower position of the boxes).

output exceeded 20 GW, and for 10% of the time, it was more than 60 GW. This coincided with the steep increase in power prices which led some to claim that low wind in Europe was to blame for the crisis. The evidence now suggests this was mostly driven by high gas prices.

September had the lowest average generation, but the range of generation outputs over the month was similar to September 2020. For 90% of the hours in September

EUROPEAN WIND ENERGY GENERATION | 2021

15%

of Europe's electricity demand

44% 31% 26% 24% 23% 22% 19%



Highest wind energy shares

ONSHORE

207 GW

onshore wind capacity

OFFSHORE

28 GW

offshore wind capacity

12%

onshore wind in Europe's electricity demand

3%

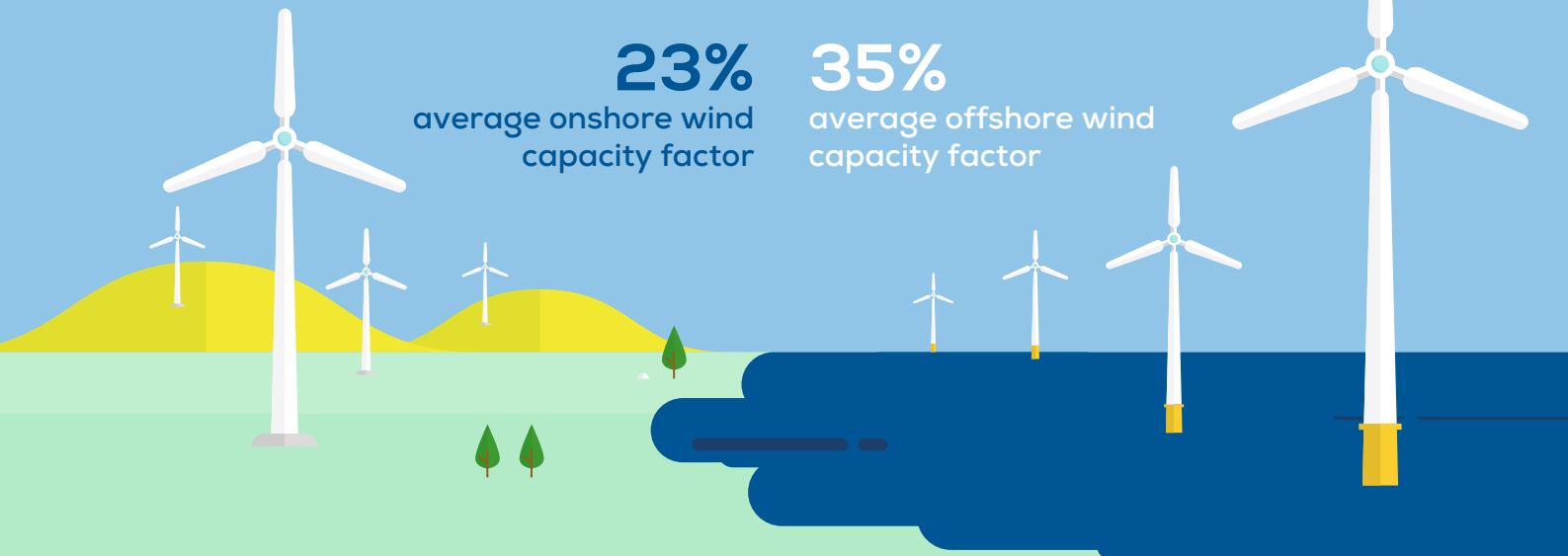
offshore wind in Europe's electricity demand

23%

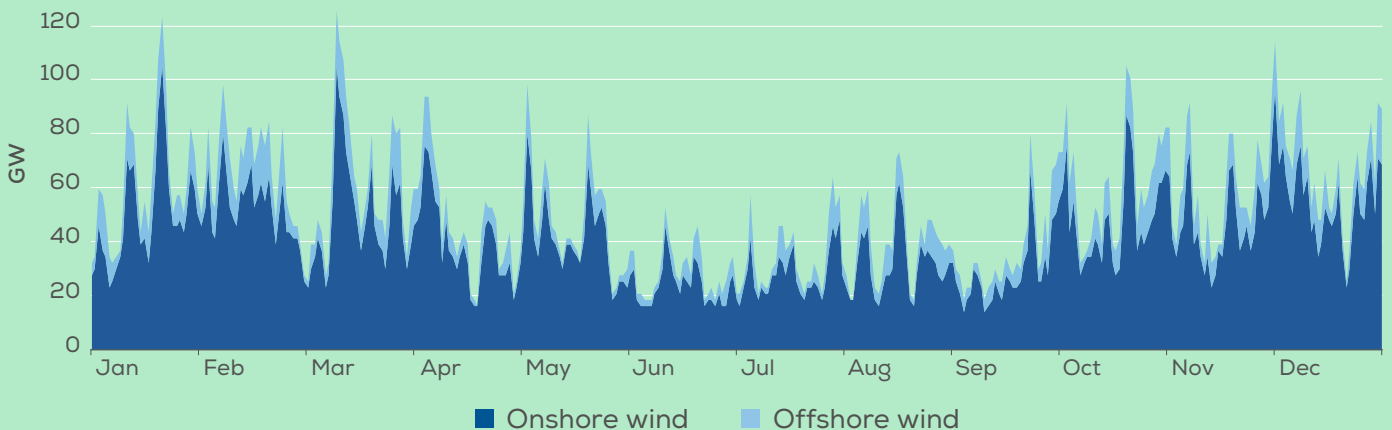
average onshore wind capacity factor

35%

average offshore wind capacity factor



European wind energy generation in 2021



Data refers to EU Member States and the UK.

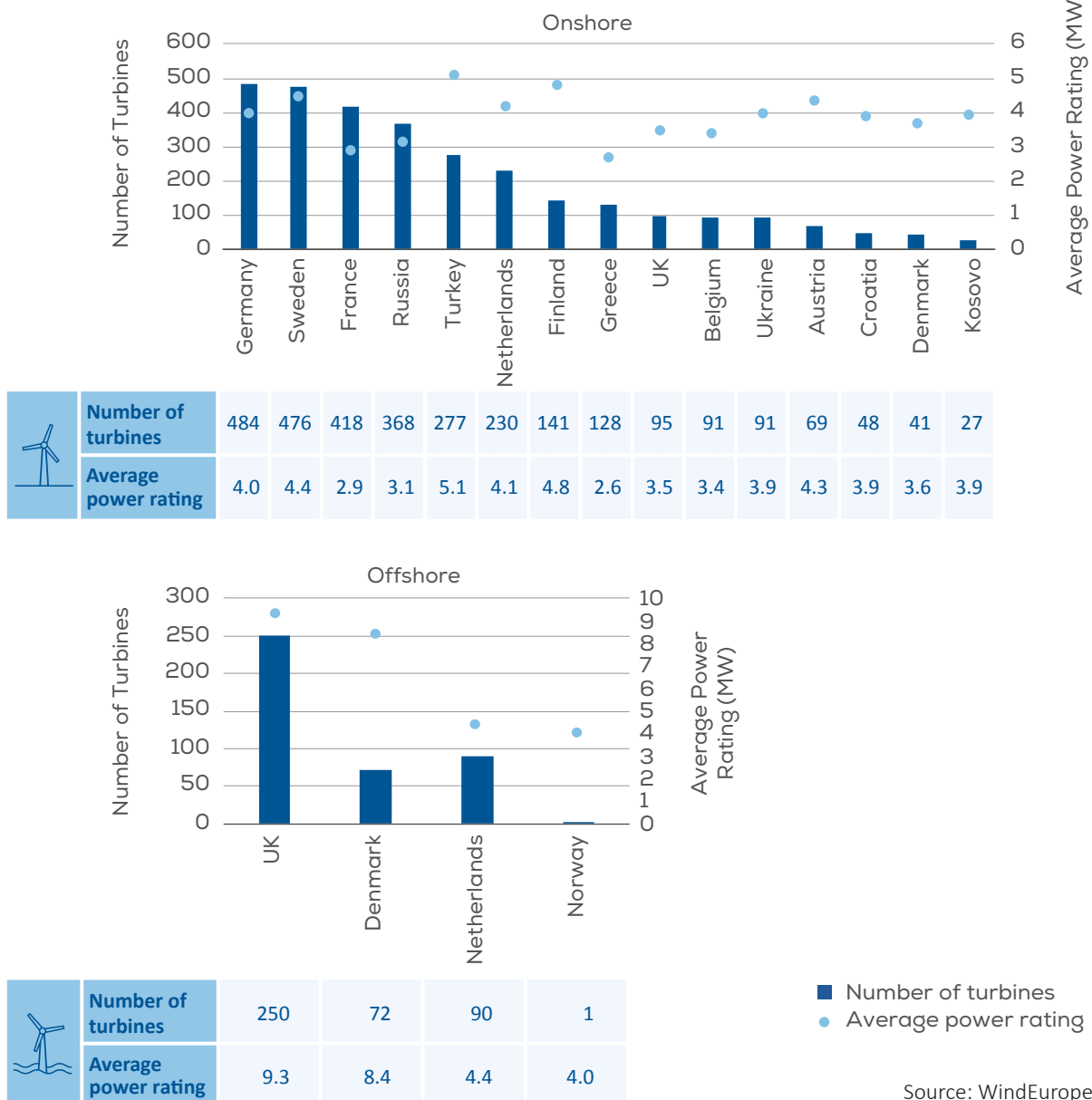
1.6 WIND TURBINE SIZE

The size and type of turbines installed in Europe varied significantly between countries. The most powerful onshore wind turbines were installed in Turkey, with an average power rating of 5.1 MW. Greece had the lowest average power rating of 2.6 MW. Based on the available data from 14 countries, the weighted average power rating of onshore turbines was 4 MWW.

In 2021, the average rated capacity of newly installed offshore turbines was 8.5 MW, up from 8.3 MW in 2020. The UK had the highest average power rating of 9.3 MW.

Based on the latest data from ordered capacity in 2021¹⁶ the average power rating of ordered onshore turbines in 2021 reached 4.9 MW. In offshore, the average reached 11.2 MW.

FIGURE 11
Number of turbines installed in 2021 and their average power rating



Source: WindEurope

16. Wind Turbine Orders Monitoring report – available for WindEurope’s members only (<https://windeurope.org/intelligence-platform/product/wind-turbine-orders-monitoring-2021/>).

1.7 AUCTIONS AND TENDERS IN 2020

In 2021 wind energy secured volumes of 12.4 GW through renewable energy auctions across seven countries. This is significantly higher than the 8 GW awarded in 2020 but below the 15 GW allocated in 2019. Onshore wind secured 10.4 GW, while offshore got 2 GW. Two auctions in France and the Netherlands have not yet announced winners.

It is hard to compare auction results between countries due to differences between support mechanisms and auction lengths, indexation of bids, conditions surrounding the auctions such as cost of capital (WACC), permitting and other sources of revenue or risks for developers.

In Germany and France energy regulators have cut the volume auctioned per round (after the undersubscription of

some auctions) to ensure competition, with the negative side effect of reducing long-term visibility for the industry.


12.4 GW

WAS AWARDED TO WIND THROUGH AUCTIONS AND TENDERS IN 2020

There were also three technology-neutral auctions where the entire capacity was allocated to solar PV projects. And in Denmark the onshore auction didn't receive any bids due to the very low ceiling price set in the auction.

TABLE 3

Auctions and tenders for wind energy support schemes in 2021^{17, 18}

	Country	MW AWARDED	TYPE OF AUCTION	SUPPORT MECHANISM	PRICE IN €/MWH
	France	540	Technology-specific	Feed-in-premium (floating)	61 €/MWh
	Germany	691	Technology-specific	Feed-in-premium (floating)	52 - 60 €/MWh
		1,110	Technology-specific	Feed-in-premium (floating)	57 - 60 €/MWh
		1,494	Technology-specific	Feed-in-premium (floating)	52 - 59 €/MWh
	Italy	41	Technology-neutral	Contract for difference	69 €/MWh
		296	Technology-neutral	Contract for difference	69 €/MWh
		393	Technology-neutral	Contract for difference	68 - 69 €/MWh
	Poland	300	Technology-neutral	Contract for difference	40 - 54 €/MWh
		460	Technology-neutral	Contract for difference	31 - 58 €/MWh
	Russia	1,851	Technology-neutral	Contract for difference	20 - 59 €/MWh
	Spain	1,000	Technology-neutral	Contract for difference	20 - 29 €/MWh
		98	Technology-specific	Investment subsidy	Not Available
2,200		Technology-neutral	Contract for difference	28 - 37 €/MWh	

	Country	MW AWARDED	TYPE OF AUCTION	SUPPORT MECHANISM	PRICE IN €/MWH
	Germany	958	Technology-specific	Zero-subsidy bid	0
	Denmark	1,000	Technology-specific	Contract for difference	0 €/MWh

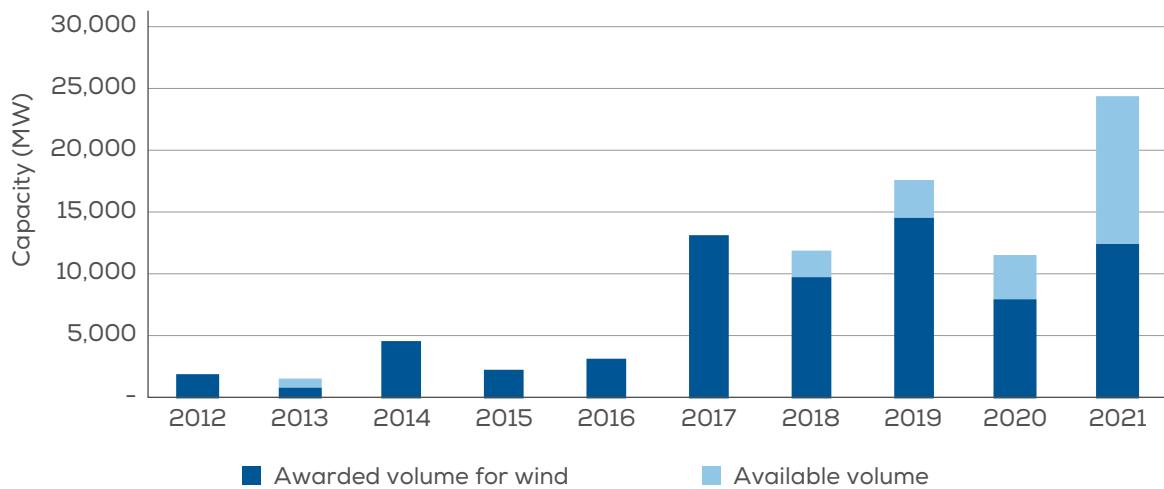
17. For an explanation between the different types of auctions see Annex 1.

18. Excludes seabed leasing tenders.

In Italy, all three auctions for wind and solar PV were under-subscribed due to the slow permitting process, following a similar trend from 2020. The capacity not awarded in the under-subscribed auctions is transferred to the following one, which gradually increases the total volume in the auction without addressing the root cause of the under-subscription – slow and cumbersome permitting.

Undersubscription in technology-specific auctions paired with a strong competition against solar PV in technology-neutral auctions means that wind only secured half of available volumes in 2021.

FIGURE 12
Auctions and tenders for wind energy support schemes in Europe¹⁹



19. Does not include the Dutch onshore auctions due to the planned volume in budget only.

2.

MARKET OUTLOOK 2022-2026

2.1 INTRODUCTION

The five-year Market Outlook for wind installations looks at the likely development of wind power capacity in Europe. It features two scenarios:

- Our **Realistic Expectations Scenario** providing the best estimate of installed capacity in Europe over the next five years. It assumes that Governments deliver on the firm (and still fairly modest) commitments they have already made to improve their permitting of new wind farms such as the new German policy to secure more land for wind. Under this scenario, Europe will install 116 GW, with an average installation rate of 23.1 GW. In the Realistic Expectations Scenario the EU-27 will install 17.6 GW a year, which is well short of the 32 GW a year needed to reach the 40% renewable energy target.
- Our **Low Scenario**, where Governments fail to address permitting issues and continue to restrict spatial and planning requirements for wind farms. It also assumes global supply chain disruption and high raw material prices will continue, leading to 89 GW of new wind

capacity with an average installation rate of 17.8 GW. The EU-27 would install 13.3 GW a year in the Low Scenario.

WE EXPECT THE EU TO BUILD
17.6 GW PER YEAR,
BUT IT NEEDS TO BE BUILDING
32 GW PER YEAR

Both scenarios reflect the latest developments in EU regulation, national policies, announcements of signed power purchase agreements (PPAs), project development timelines and the ability of wind to secure further capacity in upcoming auctions and tenders.

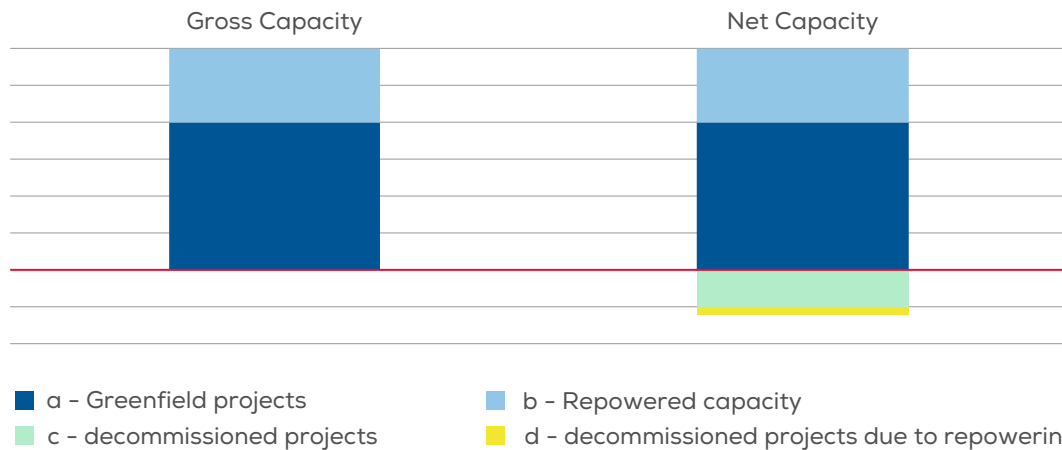
We use the term **gross annual installations** to refer to new installations, including greenfield projects and new capacity from repowered projects.

We also include predicted decommissioning volumes, by country and per year. We use the term **net additional**

capacity to refer to the gross annual installations minus decommissioned capacity.

This net additional capacity is used to calculate the **total** (or cumulative) capacity. See Figure 13 for more details.

FIGURE 13
Gross vs. net added capacity accounting for decommissioning and repowering



Gross added capacity = a + b
Net added capacity = (a + b) + (- c - d)

Source: WindEurope

HEADING TOWARDS 20 GW IN 2022

2022 is likely to be a record year in installations driven by a record year for onshore wind. 2021 installation figures were down partially due to delays in the wake of the COVID-19 pandemic and the limited movement of people and goods in 2020. However, 2021 also saw delays due to supply chain issues and rising material costs, with a number of important volumes being postponed to 2022.

This combined with a more positive outlook in Germany – driven by new government policies – have led us to put forward a Realistic Expectations Scenario where up to 21.9 GW will be installed in 2022, up 26% on 2021. We expect Germany to be the largest market in 2022 with 3 GW, followed by Sweden with 2.2 GW, and the UK with 2.1 GW.

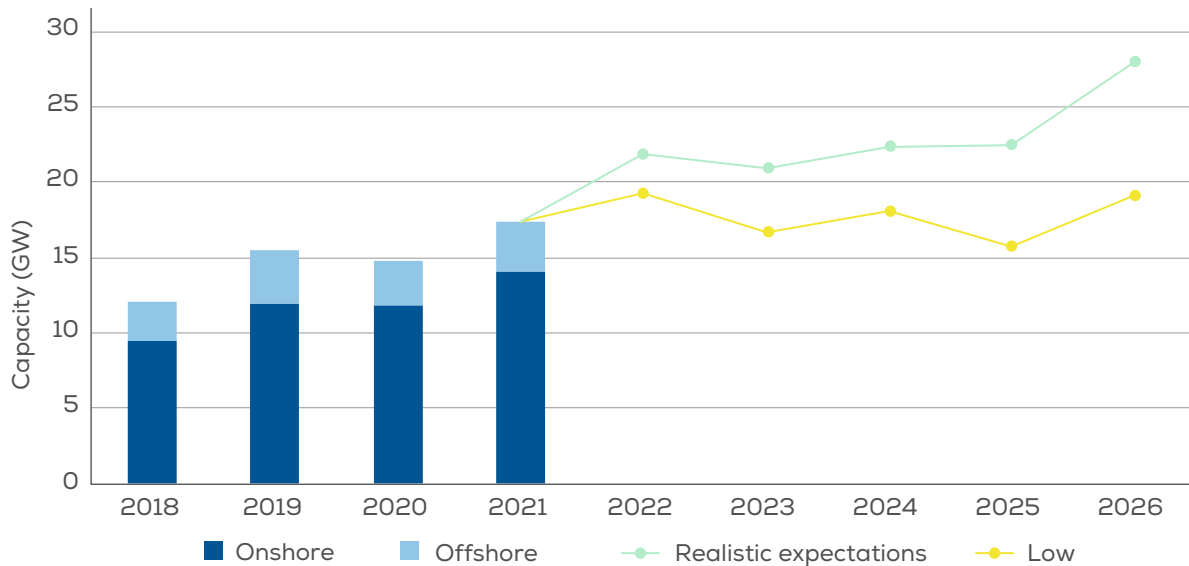
2022 WILL SEE
21.9 GW
OF NEW WIND INSTALLATIONS

We expect offshore installations to grow by 3.5 GW in 2022, up from 3.3 GW in 2021. The UK will install the most (1.5 GW), followed by the Netherlands (1.1 GW), France (480 MW), Germany (342 MW), Norway (98 MW), Italy (30 MW), and Spain (5 MW). France, Norway, and Italy will see their first-ever commercial offshore wind farm installations.

10 countries in total will install at least 1 GW of wind capacity over the next five years. In addition to Germany, Sweden and the UK, the largest markets will be France (2 GW), Finland and the Netherlands (1.9 GW each), Turkey and Spain (1.5 GW each), and Poland and Ukraine (1 GW each).

If 2022 ends up being affected by a prolonged pandemic and supply chain disruption, we could see 2.6 GW fewer installations as highlighted in our Low Scenario.

FIGURE 14
New installations in Europe – WindEurope’s scenarios



Source: WindEurope

2.2 REALISTIC EXPECTATIONS SCENARIO

WindEurope’s Realistic Expectations Scenario provides the best estimate for installed capacity in Europe over the next five years. This is based on the current policy context and ongoing permitting bottlenecks. The scenario factors in the pipeline of wind energy projects, auctions and tender results, and legislative changes in European countries. For offshore wind, the Realistic Expectations Scenario assumes that all the awarded wind farms are built on time.

Overall installations are expected to grow year-on-year. Onshore installations, which will make up 76% of all new installations over the next five years, will peak in 2022 with 18.3 GW. They will then decrease slightly to an average rate of 17.3 GW over the following years until 2026.

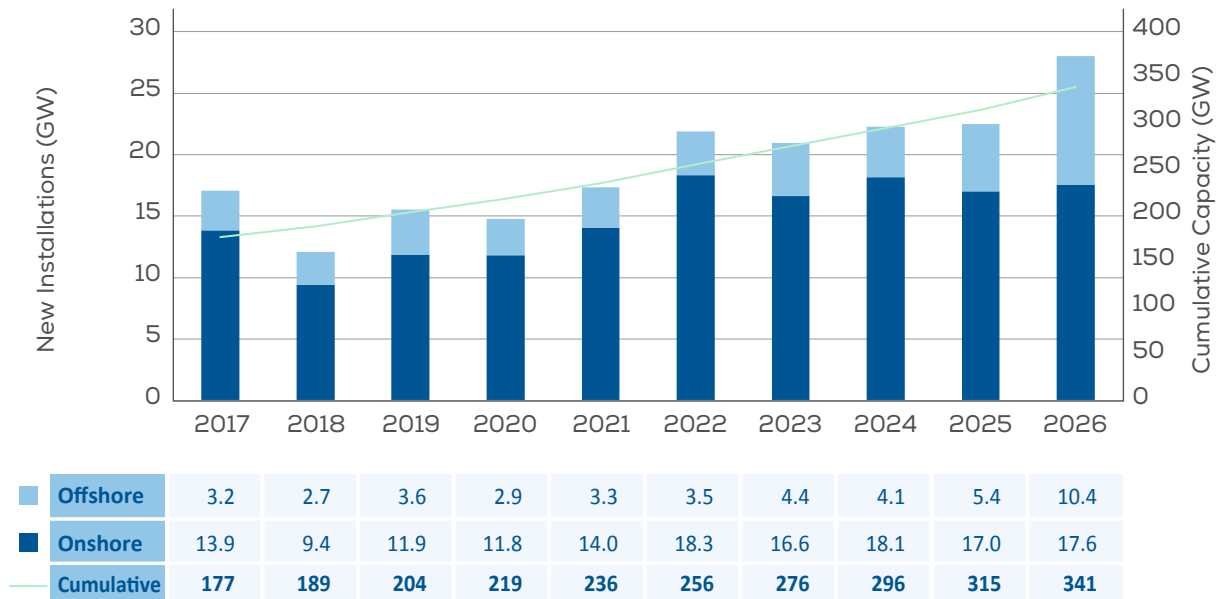
Onshore installations will grow strongly in Germany, Spain and the UK but their growth will be counterbalanced by

the decrease of installations in Sweden and Finland - flattening the onshore installations curve from 2023 to 2026.

ONSHORE WILL REPRESENT
76%
OF INSTALLATIONS IN THE NEXT
5 YEARS

For the first time offshore installations will surpass the 4 GW mark in 2023, staying above this annual rate in the years to follow and reaching 10 GW in 2026. About 39% of European offshore installations will come from the UK thanks in large part to their excellent Contracts for Difference (CfD) support scheme.

FIGURE 15
Expected new installations 2022-26 - Realistic Expectations Scenario



Source: WindEurope

Germany will be Europe’s largest wind market thanks to the strong expected performance of its onshore market over the next five year (19.7 GW) and rising offshore installations (5.4 GW). The permitting regime is improving in Germany and is expected to improve further as the new German Government introduces spatial planning reforms aimed at boosting onshore installation rates.

tion being undersubscribed (which has been the case in the last few years). This has caused a lot of uncertainty regarding future auction volumes.

The UK will be Europe’s second largest wind market thanks to strong offshore installation rates over the next five years (10.8 GW). After only allowing remote onshore wind farms to participate, the fourth Contracts-for-Difference (CfD) auction round once again allows both onshore wind and solar PV to take part. Several onshore wind projects will also benefit from a thriving Power Purchase Agreements (PPA) market. We expect about 4.4 GW of onshore wind installations in total across the UK over the period 2022-2026.

116 GW
OF NEW INSTALLATIONS
WILL BE INSTALLED BY 2025

About 4.1 GW of onshore wind capacity was permitted in 2021 alone, up from 3.3 GW in 2020. About 56% of the permitted capacity in 2021 has already been won at auction. We expect the remaining non-awarded capacity to be just as successful in auctions during 2022. We also expect all successful projects from recent auctions to be built. However, the German Network Agency (BNetzA) can reduce auction volumes when they see the risk of an auc-

In **France**, the outlook for onshore remains similar to our previous predictions, with about 8.9 GW to be built, meaning an installation rate of 1.8 GW a year. Although France saw slight improvements in its permitting process last year, onshore installation rates have been falling for a few years now. Offshore installations are finally set to take off as of 2022, and we expect 3.3 GW of offshore wind installations from now until 2026.

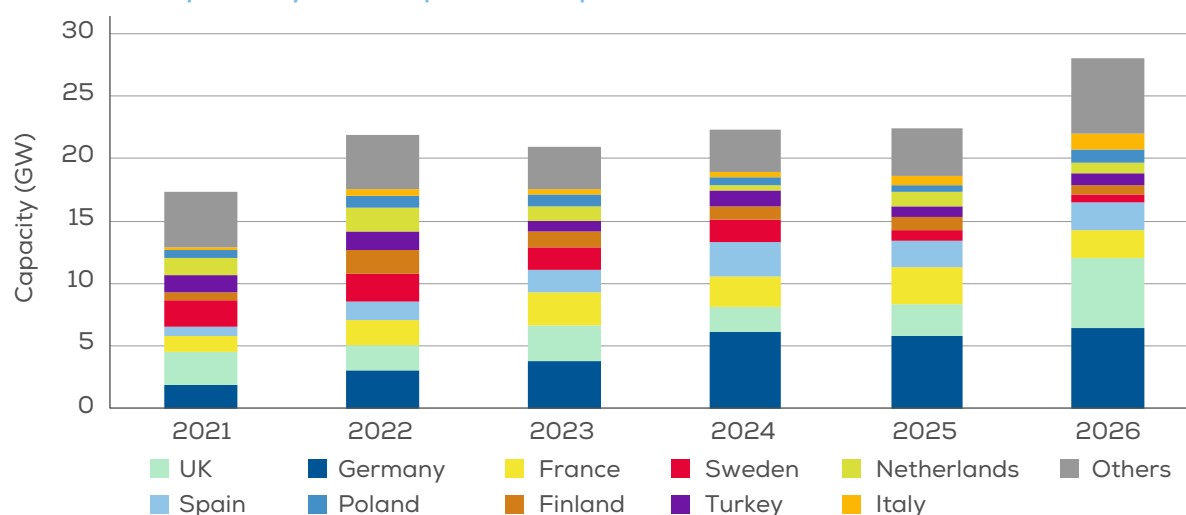
Spain is expected to be one of Europe's largest markets for wind installations. After a slow year in 2021, installations are expected to pick up due to the CfD auction scheme, which is running annually. Furthermore the PPA market and the merchant market is booming in Spain, allowing annual volumes to exceed the yearly auctioned capacity of 1.5 GW. Overall, we expect 10.3 GW to be installed in

the five-year period, giving an average installation rate of 2.1 GW a year.

In total the Realistic Expectations Scenario we expect to see about 116 GW of new capacity added over the next five years in Europe. In the EU-27 the installations over the next five years will total 88 GW, or 17.6 GW a year.

FIGURE 16

New installations per country – WindEurope's Realistic Expectations Scenario



Source: WindEurope

TABLE 4

Expected new installations per country, 2022-26 - WindEurope's Realistic Expectations Scenario

Country	ONSHORE INSTALLATIONS 2022-2026	OFFSHORE INSTALLATIONS 2022-2026	CUMULATIVE ONSHORE 2026	CUMULATIVE OFFSHORE 2026
Germany	19.7 GW	5.4 GW	71.5 GW	13.1 GW
UK	4.4 GW	10.8 GW	18.3 GW	23.5 GW
France	8.9 GW	3.3 GW	27.6 GW	3.3 GW
Spain	10 GW	0.3 GW	35.7 GW	0.3 GW
Sweden	7.5 GW	0 GW	19.2 GW	0.2 GW
Finland	5.8 GW	0 GW	9 GW	0.1 GW
Turkey	5.6 GW	0 GW	16.3 GW	0 GW
Netherlands	1.2 GW	4.3 GW	6 GW	7.3 GW
Poland	3.5 GW	0.7 GW	9.8 GW	0.7 GW
Italy	2.8 GW	0.5 GW	13.5 GW	0.5 GW
Russia	2.7 GW	0 GW	4.7 GW	0 GW
Ireland	2 GW	0.6 GW	6.2 GW	0.6 GW
Ukraine	2.2 GW	0 GW	3.9 GW	0 GW
Austria	2.1 GW	0 GW	5.2 GW	0 GW
Greece	1.9 GW	0 GW	6.2 GW	0 GW
Denmark	0.6 GW	1.3 GW	4.9 GW	3.5 GW
Belgium	1.1 GW	0.5 GW	3.7 GW	2.8 GW
Others	6.1 GW	0.1 GW	23.6 GW	0.1 GW

ONSHORE

Between 2022 and 2026 onshore installations could reach 88 GW, averaging about 17.5 GW a year. The EU-27 will see 71 GW in new installations over the next five years for an average of 14.2 GW a year.

Germany will continue to lead in new onshore installations with 19.7 GW over the five years (22% of the total onshore market), followed by Spain (10 GW), France (8.9 GW), Sweden (7.5 GW), and Finland (5.8 GW). 13 other countries will install more than 1 GW over the next five years.

We expect strong onshore installations to continue in 2023 and 2024 due to the mature PPA market (low electricity prices overall are very attractive to large corporates) but we expect installations to fall in 2025 and 2026 to less than 1 GW a year.

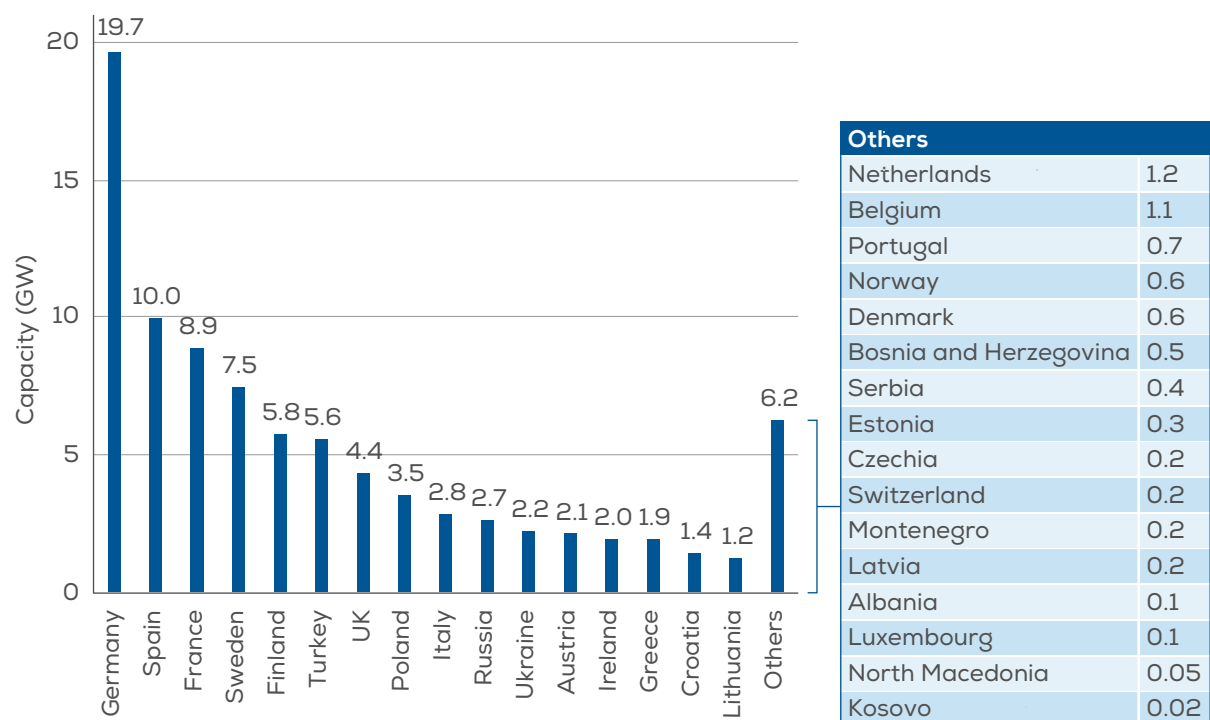
Finland will follow a similar trend to Sweden, with 2022 expected to be a record year with 1.9 GW of installations, after which installations will slowly decrease to below 1 GW a year in 2026.

Turkey will be the largest non-EU onshore market over the next five years with 5.6 GW of installations. Polish installations (3.5 GW) are mostly driven by capacity awarded in previous auctions, mostly dominated by wind farms featuring smaller wind turbines. Only projects permitted before the introduction of the 10H distance rule could participate in the auctions. Italian installations are forecasted at 2.8 GW due to the slow permitting process, which has led to severe undersubscription in recent auctions.

GERMANY WILL REMAIN THE LARGEST MARKET FOR ONSHORE WIND

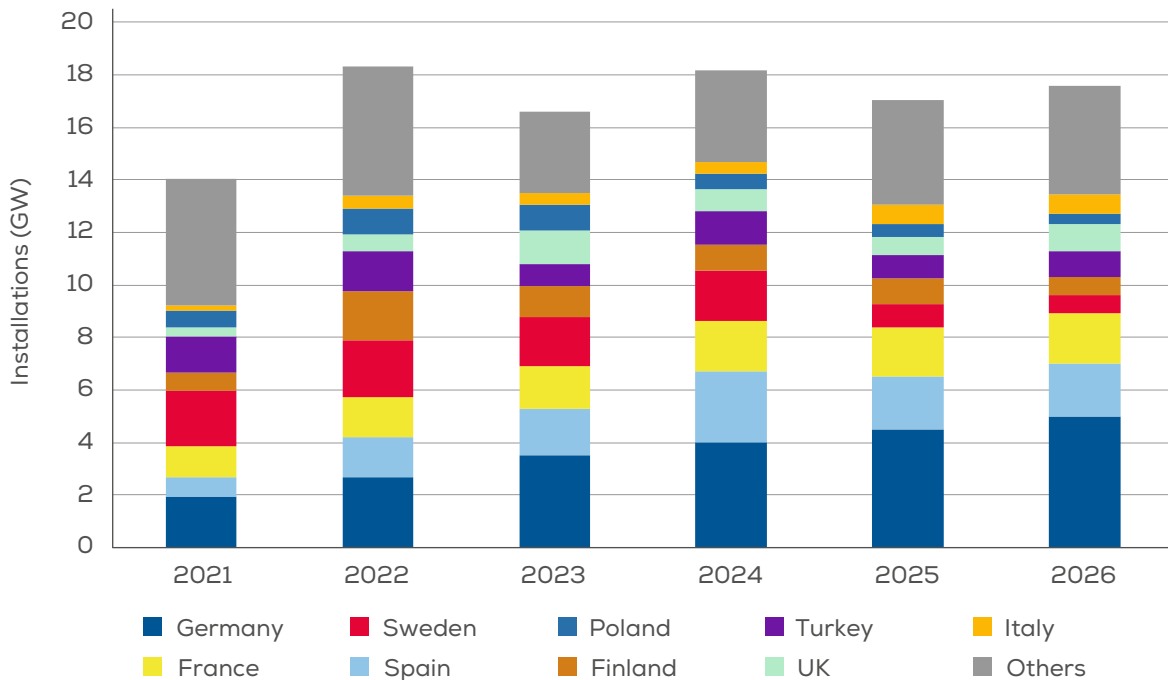
Sweden was the largest onshore market in 2021 and installations are expected to slightly increase in 2022 to 2.2 GW.

FIGURE 17
2022-2026 new installations of onshore wind per country



Source: WindEurope

FIGURE 18
New onshore installations per country, 2022-26 - Realistic Expectations Scenario



Source: WindEurope

OFFSHORE

According to our Realistic Expectations Scenario, between 2022 and 2026 Europe will install 27.9 GW of offshore wind capacity. With an average of 5.6 GW a year, offshore wind will make up about 24% of the total market across the five-year period.

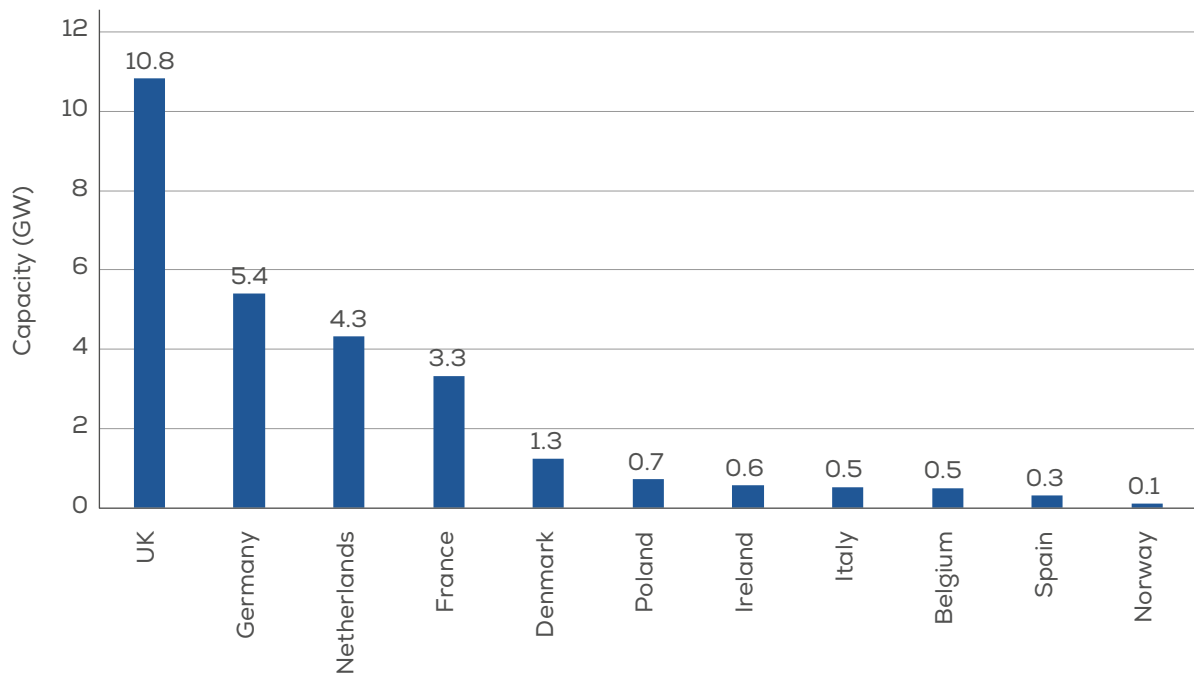
A majority of offshore installations will be built in UK waters (39%). Eight more countries will also see large offshore installations, such as Germany (5.4 GW), the Netherlands (4.3 GW), France (3.3 GW), Denmark (1.3 GW), Poland (0.7 GW), Ireland (0.6 GW), Italy (0.5 GW) and Belgium (0.5 GW). Spain and Norway will also have offshore wind installations. We expect 2026 to be the tipping point for the offshore market in Europe. Not only will the UK ramp up the rate of installation, but new markets such as Poland and Ireland will also contribute. They are expected to see high installation rates in the coming years alongside the more established markets. Belgium is also expected to jump back into the offshore race around 2026, in time for their second phase of expansion. And countries like

Spain and Italy will also chip in, albeit with more modest volumes.

**THE UK WILL REMAIN
THE LARGEST OFFSHORE
MARKET**

FIGURE 19

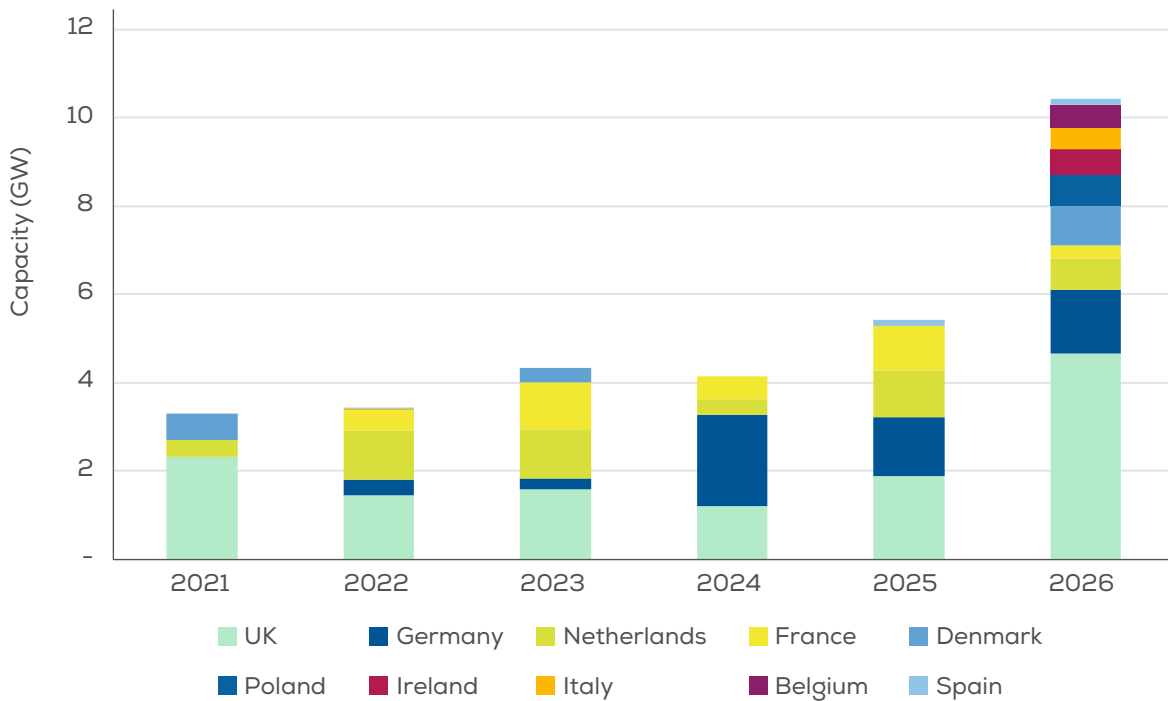
New offshore installations per country, 2022-26 - Realistic Expectations Scenario



Source: WindEurope

FIGURE 20

New offshore installations per country, 2022-26 - Realistic Expectations Scenario



Source: WindEurope

REPOWERING

Repowering decisions are driven by many factors and are done on a case-by-case basis. The most relevant factors when making a decision to repower include:

- current and future wholesale electricity prices;
- existing incentives for repowering or lifetime extension; and
- regulation around the Environmental Impact Assessment and other environmental restrictions that have changed over recent year.

Over the next five years we expect Europe to see 5.7 GW of repowering projects (repowered capacity). That means that about 2.9 GW will be decommissioned only to be repowered. On average, the output capacity is increased by a factor of two in repowered wind farms.

We expect Germany to continue being the largest repowering market, followed closely by the Netherlands, Italy, Denmark, and Spain.

DECOMMISSIONING AND LIFETIME EXTENSION

We expect 29 GW of projects to become older than 20 years over the next five years. Combined with 14 GW

of projects becoming 25 years old and 2.2 GW of projects becoming 30 years old, we reach 45 GW of projects that will require a decision on whether to repower, extend the life of the asset or decommission it. If Governments don't adopt the right policies to ease bottlenecks in new installations, we might see a decrease of total installations in certain countries.

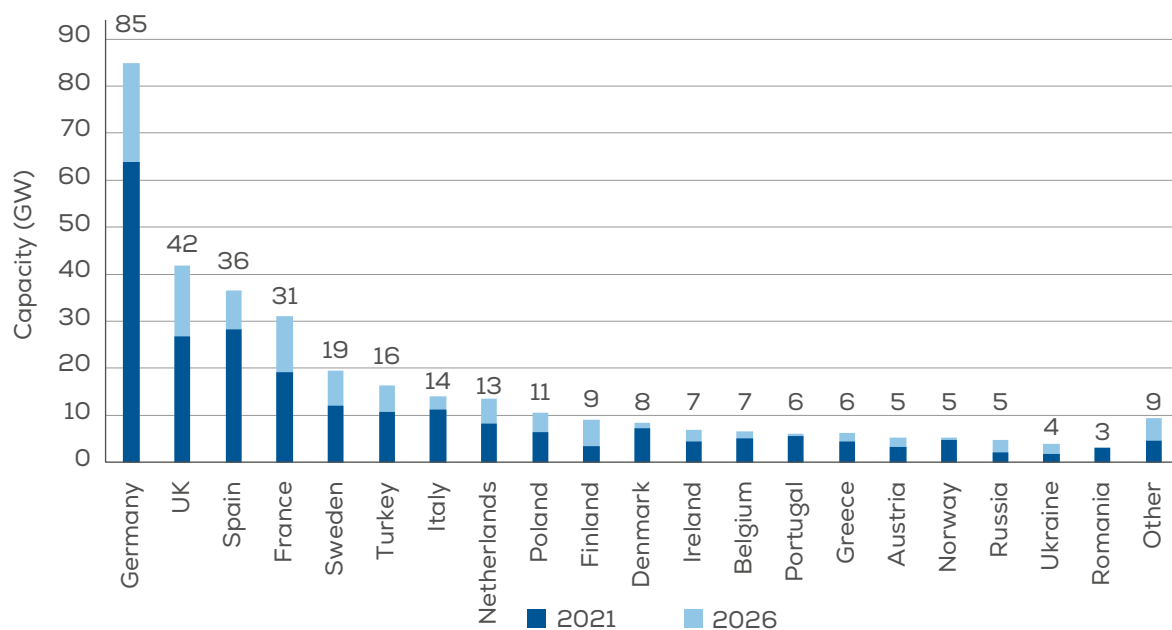
Based on current trends and the policy context, we estimate that about 2.9 GW will be decommissioned for repowering and 8.6 GW will be fully decommissioned. In total around 11.4 GW will be decommissioned over the next five years.

The remaining 34 GW will continue to operate and will probably be assessed for life-time extension services (perhaps with partial replacement of certain elements such as gearboxes or blades).

TOTAL CAPACITY

Cumulatively Europe would reach 341 GW of total installed capacity by the end of 2026. Germany will remain in the lead with 85 GW, followed by the UK (42 GW), Spain (36 GW), and France (31 GW). Five other countries will be above the 10 GW threshold (Sweden, Turkey, Italy, the Netherlands, and Poland).

FIGURE 21
Total (cumulative) capacity in 2025 per country - WindEurope's Realistic Expectations Scenario



Source: WindEurope

2.3 LOW SCENARIO

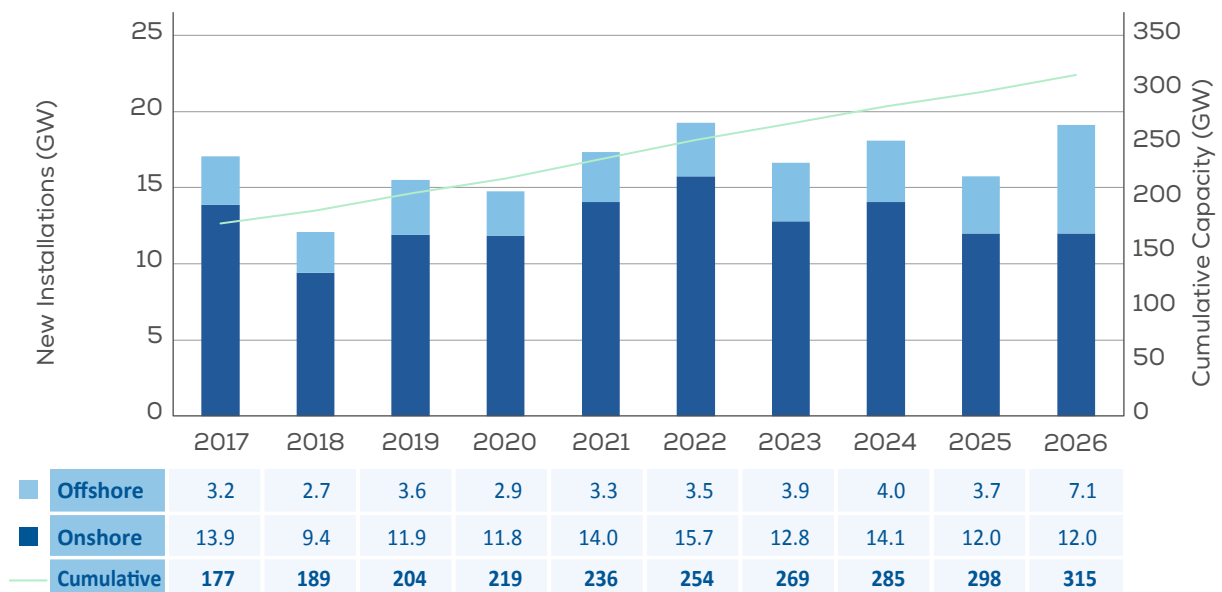
In our Low Scenario we assume that European Governments fail to address permitting issues and, in some cases, implement even stricter requirements for wind farms. This will lead to 89 GW of new wind capacity being built with an average installation rate of 17.8 GW a year. Total installations could be 27 GW lower than the Realistic Expectations Scenario. Under the Low Scenario the EU-27 would install 13.3 GW a year.

The Low Scenario assumes that the existing permitted pipeline is built as planned, but unhelpful national policies for permitting and planning remain in place or become even less favourable. The lack of permitted projects would lead to more undersubscribed auctions and fewer installations after 2024. The Low Scenario also assumes global supply chain disruptions and high raw material prices will persist.

While 2022 would still be a record year in terms of installations, a similar rate would not be sustained over the next five years. The biggest differences between the two scenarios are in the onshore market (22 GW lower), particularly for the last two years 2025 and 2026. In terms of offshore, the Low Scenario foresees a slower installation rate mainly due to delays in commissioning planned projects. This would result in a 5.6 GW drop over the next five years compared with the Realistic Expectations Scenario.

For more information on the implications of the Low Scenario for each country, visit WindEurope’s Wind Intelligence Platform²⁰.

FIGURE 22
New and total (cumulative) installations by country, 2022-26 - Low Scenario



Source: WindEurope

20. For members only – <https://windeurope.org/intelligence-platform/product/wind-energy-in-europe-2021-statistics-and-the-outlook-for-2022-2026/>

2.4 REACHING 2030 ENERGY AND CLIMATE TARGETS

The EU is committed to a 55% greenhouse gas emissions reduction target by 2030 (compared with 1990 levels). Based on the European Commission’s Impact Assessment for reaching the 40% renewable energy target, the EU would need 453 GW of wind energy capacity by 2030 (374 GW onshore and 79 GW offshore). Today, there are 189 GW installed in the EU-27.

The EU-27 installed 11 GW in 2021 and we believe that 17.6 GW a year will be installed over the next five years. This is well short of the 32 GW that we need a year between 2022 and 2030 to meet the 40% renewable energy target.

In order to reach 374 GW of onshore wind the EU-27 need to install an average of 24.8 GW annually from 2022 to 2030. But over the next five years we expect these countries to install an average of 14.2 GW in onshore wind capacity.

The European Commission modelling shows that we need at least 79 GW offshore wind but National Government have pledged to build at least 92 GW of offshore wind capacity by 2030. The EU-27 needs to install 8.5 GW a year on average from 2022 to 2030 to reach it this, which is significantly higher than the expected 3.4 GW a year.

If Governments want to reach the renewables target, they need to ramp up the build-out of both onshore and offshore wind by doing the following:

1. Addressing permitting - it is the biggest bottleneck and it needs to be streamlined.
2. Governments should conduct regular auctions for Contracts-for-Difference, which are the most cost-effective instrument for developing wind energy.
3. Accelerate grid buildout.
4. Sort out the rules on Guarantees of Origin to enable the right framework for electrification and to help sectors who want to decarbonise through renewable electricity.

FIGURE 23
EU-27 Expected and required onshore wind installations - WindEurope’s Realistic Expectations Scenario

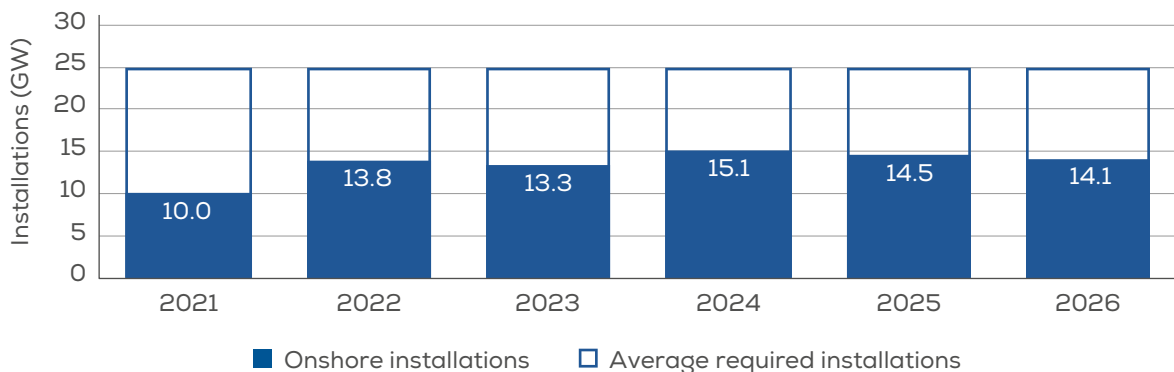
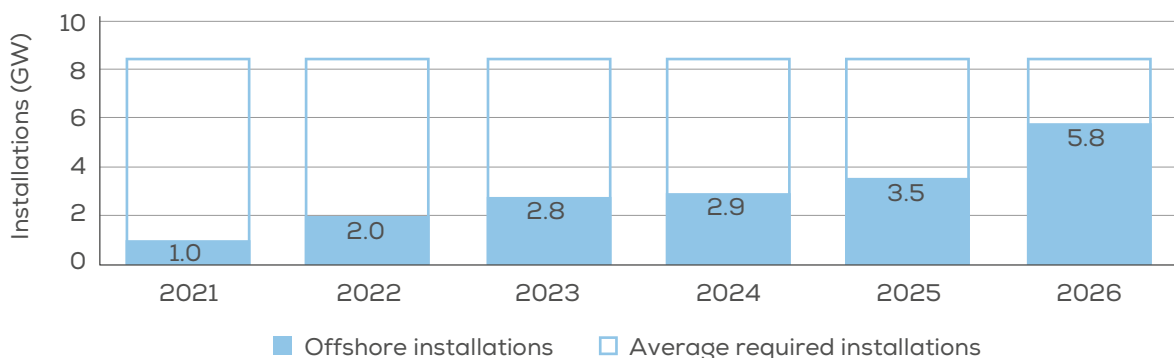


FIGURE 24
EU-27 Expected and required offshore wind installations - WindEurope’s Realistic Expectations Scenario



Source: WindEurope

ANNEX 1

SUPPORT MECHANISM	DESCRIPTION
Feed-in-Tariffs	A type of price-based policy instrument whereby eligible renewable energy generators are paid a fixed price at a guaranteed level (irrespective of the wholesale price) for the RES electricity produced and fed into the grid.
Feed-in-premium (fixed)	A type of price-based policy instrument whereby eligible renewable energy generators are paid a premium price which is a payment (x€/MWh) in addition to the wholesale price.
Feed-in-premium (floating)	A type of price-based policy instrument whereby eligible renewable energy generators are paid a premium price which is a payment in addition to the wholesale price. The floating premium would be calculated as the difference between an average wholesale price and a previously defined guaranteed price. Effectively it works as a floor price, guarantees always a minimum revenue.
Contracts for differences	Similar to the floating premium. However, under contracts for difference, if the wholesale price rises above the guaranteed price, generators are required to pay back the difference between the guaranteed price and the wholesale price.
Zero-subsidy bids (Dutch model)	Developers compete for the right to build a wind farm in a tender in which the selection criteria is not based on the price. The selection is made according to the experience of the bidders, the quality of the project design, the capacity of the project and the social costs, with added weight given to the quality of the survey, risk analysis and mitigation measures. While the winner doesn't receive any price premium, the transmission costs for the project are covered by the government.
Green Certificates	A tradable commodity proving that certain electricity is generated using renewable energy sources. May have guaranteed minimum prices. The certificates can be traded separately from the energy produced.

WindEurope is the voice of the wind industry, actively promoting wind power in Europe and worldwide. It has over 400 members with headquarters in more than 35 countries, including the leading wind turbine manufacturers, component suppliers, research institutes, national wind energy associations, developers, contractors, electricity providers, financial institutions, insurance companies and consultants. This combined strength makes WindEurope Europe's largest and most powerful wind energy network.

Wind[•]
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