Wind energy in Europe

2020 Statistics and the outlook for 2021-2025

WindEurope

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This report summarises new installations and financing activity in Europe's wind farms from 1 January to 31 December 2020. It also analyses how European markets will develop in the next five years (2021 to 2025). The outlook is based on WindEurope 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.

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EXECUTIVE SUMMARY

Europe installed 14.7 GW of new wind capacity in 2020. This was 6% less than in 2019 and 19% less than what we expected pre-COVID. EU27 installed 10.5 GW.

80% of the new wind installations were onshore.

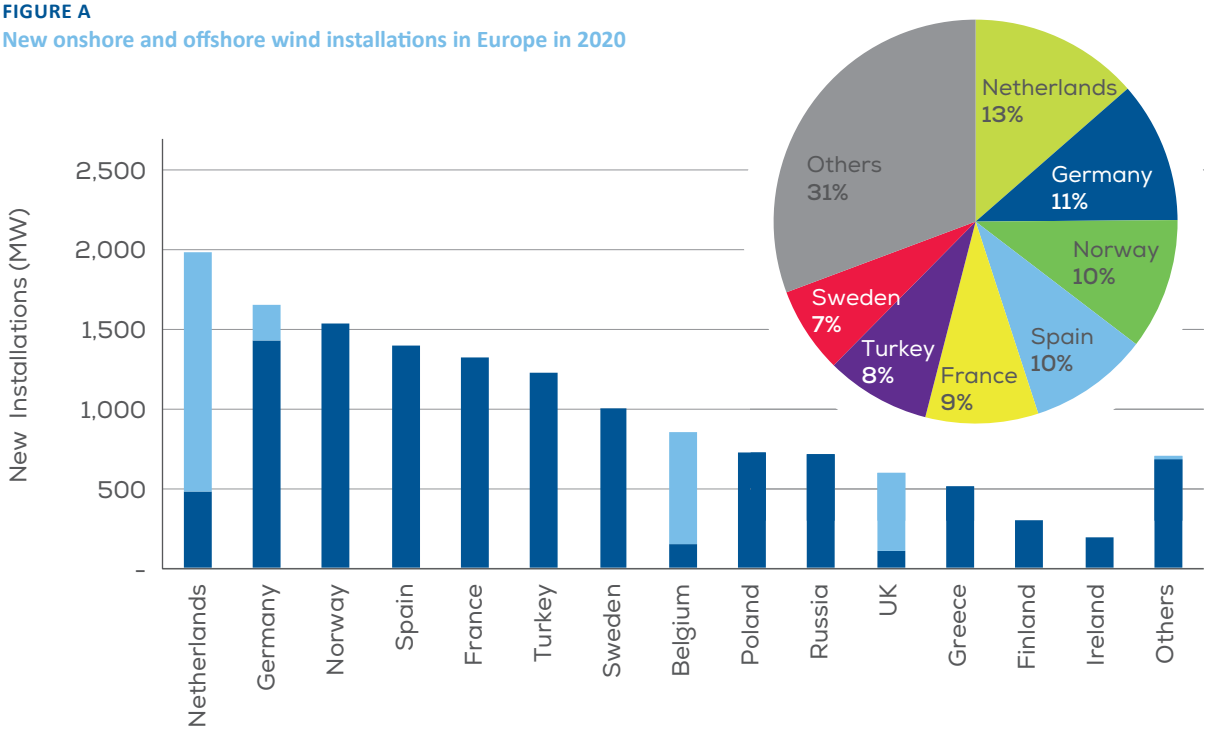
Wind accounted for 16% of the electricity consumed in 2020 (in EU27+UK).

Europe now has 220 GW of wind capacity.

The Netherlands installed the most wind capacity in 2020, most of it offshore wind. Norway built the most onshore wind, with Spain and France not far behind. Germany's new installations were its lowest since 2010.

FIGURE A

New onshore and offshore wind installations in Europe in 2020



	Netherlands	Germany	Norway	Spain	France	Turkey	Sweden	Belgium	Poland	Russia	UK	Greece	Finland	Ireland	Others
Offshore	1,493	219	-	-	-	-	-	706	-	-	483	-	-	-	17
Onshore	486	1,431	1,532	1,400	1,318	1,224	1,007	152	731	713	115	517	302	196	688
Total	**1,979**	**1,650**	**1,532**	**1,400**	**1,318**	**1,224**	**1,007**	**858**	**731**	**713**	**598**	**517**	**302**	**196**	**705**

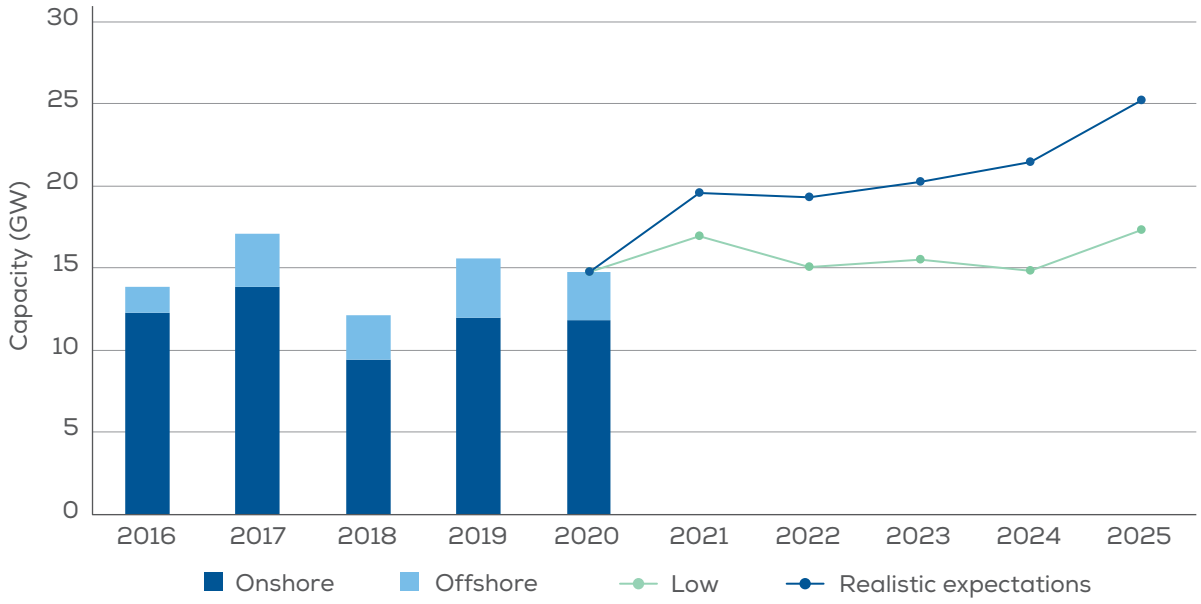
Source: WindEurope

We expect Europe to install 105 GW of new wind farms over 2021-25 provided Governments deliver on the promises they've made. Over 70% of this will be onshore wind.

But if Governments don't address permitting issues, fail to put in place effectives strategies for repowering and implement new restrictions on the free movement of goods and people due to the pandemic, then Europe will install less than 80 GW over 2021-25.

We expect the UK to install the most new wind over 2021-25: 18 GW, most of it offshore. Germany will install a similar amount, most of it onshore. France, Sweden and the Netherlands will provide the next largest contributions.

FIGURE B
2021-2025 new onshore and offshore wind installations in Europe – WindEurope's scenarios



Source: WindEurope

2020 annual figures

- Europe installed 14.7 GW of new wind power capacity in 2020 (gross installations). This was 6% less than in 2019. 10.5 GW of the new installations were in the EU-27.
- Onshore wind made up 80% of the new installations with 11.8 GW. This was 22% lower than our pre-COVID forecast.
- Offshore wind installations were 2.9 GW, in line with our pre-COVID forecast.
- Europe's wind farms generated 458 TWh of electricity in 2020. They covered 16% of the electricity demand in Europe (EU27+UK).

Trends and cumulative installations

- Europe now has 220 GW of installed wind power capacity: 194 GW onshore and 25 GW offshore.
- Europe decommissioned 388 MW of wind capacity in 2020. At the same time, it commissioned 345 MW of repowered capacity. The net new capacity additions were 14.3 GW.
- The average power rating of new onshore turbines was 3.3 MW. For offshore wind it was 8.2 MW.

Country highlights

- The Netherlands installed the most wind power capacity in 2020 (1.98 GW). 75% of that was offshore wind.
- Norway (1.5 GW), Germany (1.4 GW), Spain (1.4 GW) and France (1.3 GW) led the installation of onshore wind farms.
- Wind was 27% of the electricity consumed in both Germany and the UK. It was 22% in Spain and 25% in Portugal.
- Denmark and Ireland remain the countries with the highest share of wind in their electricity mix with 48% and 38% respectively.
- Finland installed the most powerful onshore wind turbines with an average rating of 4.5 MW. The Netherlands and Belgium had the most powerful new offshore turbines with an average rating of 8.7 MW.

2021-2025 outlook

- In our Realistic Expectations Scenario Europe will install 105 GW of new wind power capacity over the next five years. The EU27 will install 75 GW of this, 15 GW per year. The EU needs to install 18 GW pa to deliver its existing wind targets from the National Energy and Climate Plans.
- We expect onshore wind to make up 72% of the new installations with 76 GW.
- We expect 29 GW of new offshore wind over the next five years. That's almost a doubling of the annual installation rate from 3 GW to 5.8 GW.
- If Governments don't address permitting issues, fail to put in place effectives strategies for repowering and implement new restrictions on the free movement of goods and people due to the pandemic then Europe will install much less: only 79 GW.
- We expect the UK to install the most new wind capacity over the next 5 years, 18 GW. Most of this will be offshore wind (15 GW).
- We expect Germany to install 16 GW, most of it onshore (13 GW). France (12 GW), Sweden (7 GW), and the Netherlands (6 GW) will provide the next highest contributions respectively.
- About 9.4 GW could be decommissioned over the next five years. We expect only 2.4 GW of this to be repowered[1] (leading to 4.4 GW of repowered capacity). The remaining 7 GW will be fully decommissioned and removed from the system.

1. Referred to as capacity under repowering.

New installations in 2020:

14.7 GW
TOTAL EUROPE

10.5 GW
IN THE EU-27

Cumulative installed capacity (GW)[2]

GW

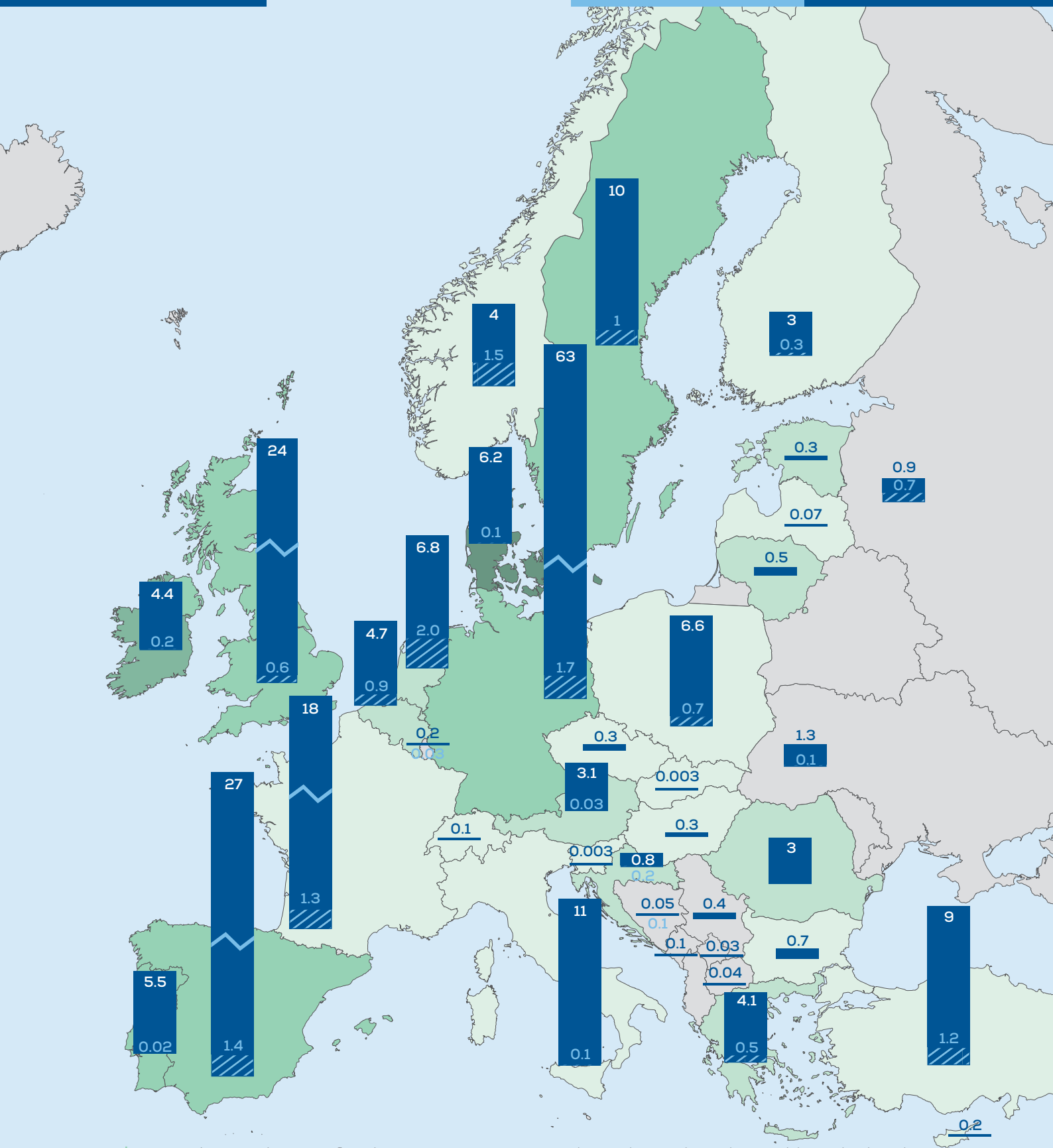
GW

New installations in 2020 (GW)

Share of wind in power demand[3-5]

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

WIND ENERGY COVERED
16%
OF EU ELECTRICITY DEMAND IN 2020



2. Cumulative in each country reflects decommissioning in 2020: Germany (222 MW), Austria (64 MW), Denmark (61 MW), Belgium (25 MW), France (15 MW), Luxembourg (2 MW), the UK (0.3 MW).
3. Grey coloured countries did not provide data for electricity generation and consumption to ENTSO-E transparency platform.
4. Data for Croatia's electricity generation and consumption was provided by the Croatian Energy Market Operator (HROTE).
5. Data for Turkey's electricity generation and consumption was provided by the Turkish Wind Energy Association.

TABLE 1

New installations and cumulative capacity in 2020[6]

EU-27 (MW)	NEW INSTALLATIONS 2020			CUMULATIVE CAPACITY			SHARE OF WIND IN 2020		
	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL
Austria	25	-	25	3,120	-	3,120	12%	N/A	12%
Belgium	152	706	858	2,459	2,261	4,719	5%	9%	14%
Bulgaria	-	-	-	691	-	691	4%	0%	4%
Croatia	152	-	152	803	-	803	10%	0%	10%
Cyprus	-	-	-	158	-	158	6%	0%	6%
Czechia	-	-	-	337	-	337	1%	N/A	1%
Denmark	136	-	136	4,478	1,703	6,180	30%	19%	48%
Estonia	-	-	-	320	-	320	11%	0%	11%
Finland	302	-	302	2,515	71	2,586	9%	0%	9%
France	1,318	-	1,318	17,947	2	17,949	9%	0%	9%
Germany	1,431	219	1,650	54,938	7,689	62,627	22%	6%	27%
Greece	517	-	517	4,113	-	4,113	15%	0%	15%
Hungary	-	-	-	329	-	329	2%	N/A	2%
Ireland[7]	196	-	196	4,326	25	4,351	38%	0%	38%
Italy[8]	137	-	137	10,852	-	10,852	7%	0%	7%
Latvia	-	-	-	66	-	66	2%	0%	2%
Lithuania	-	-	-	548	-	548	13%	0%	13%
Luxembourg	30	-	30	166	-	166	N/A	N/A	N/A
Malta	-	-	-	-	-	-	0%	0%	0%
Netherlands	486	1,493	1,979	4,174	2,611	6,784	9%	3%	12%
Poland	731	-	731	6,614	-	6,614	9%	0%	9%
Portugal	4	17	21	5,461	25	5,486	25%	0%	25%
Romania	-	-	-	3,029	-	3,029	12%	0%	12%
Slovakia	-	-	-	3	-	3	0%	N/A	0%
Slovenia	-	-	-	3	-	3	0%	0%	0%
Spain[9]	1,400	-	1,400	27,259	5	27,264	22%	0%	22%
Sweden	1,007	-	1,007	9,801	192	9,992	20%	0%	20%
Total EU-27	8,024	2,435	10,459	164,510	14,583	179,093	13%	2%	15%

OTHERS (MW)	NEW INSTALLATIONS 2020			CUMULATIVE CAPACITY			SHARE OF WIND IN 2020		
	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL	ONSHORE	OFFSHORE	TOTAL
Bosnia & Herzegovina	48	-	48	135	-	135	N/A	N/A	N/A
Kosovo	-	-	-	32	-	32	N/A	N/A	N/A
Montenegro	-	-	-	118	-	118	N/A	N/A	N/A
North Macedonia	-	-	-	37	-	37	N/A	N/A	N/A
Norway	1,532	-	1,532	3,977	2	3,980	7%	0%	7%
Russia	713	-	713	905	-	905	N/A	N/A	N/A
Serbia	-	-	-	374	-	374	N/A	N/A	N/A
Switzerland	12	-	12	87	-	87	N/A	N/A	0.2%
Turkey	1,224	-	1,224	9,305	-	9,305	8%	0%	8%
Ukraine	144	-	144	1,314	-	1,314	N/A	N/A	N/A
UK	115	483	598	13,740	10,428	24,167	N/A	N/A	27%
Total others	3,788	483	4,271	30,023	10,430	40,453	N/A	N/A	N/A
Total Europe	11,813	2,918	14,731	194,533	25,013	219,546	13%	3%	16%

6. All numbers are rounded and therefore may not add up.
7. Irish figures are an estimate.
8. Italian figures are up to 31 October 2020.
9. Spanish figures are an estimate from Red Eléctrica de España.

1. WIND POWER INSTALLATIONS

1.1 OVERVIEW

In 2020 new wind installations in Europe amounted to just 14.7 GW because of delays in commissioning new wind farms due to COVID-19-related supply chain disruptions and restrictions to the movement of people and goods. Onshore wind installations were 22% lower than our pre-COVID forecast while offshore installations were in line with these predictions. 2020 was the third largest year in terms of overall installations, following on from a record year in 2017 and a strong performance in 2019.

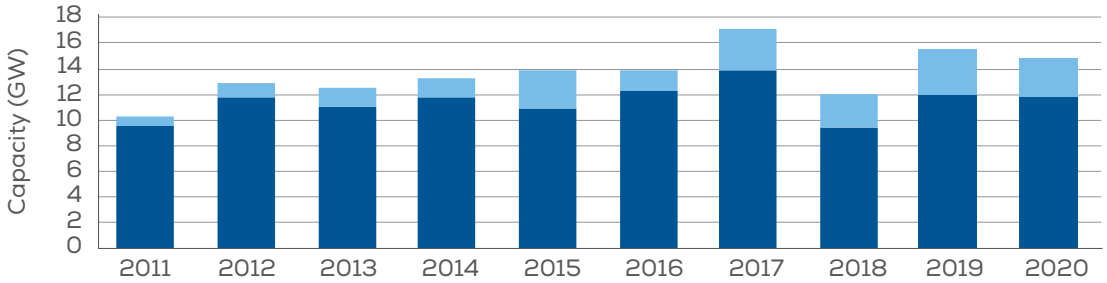
Germany saw the lowest number of installations since 2010, although the rate of onshore installations rose slightly from the previous year. The Netherlands installed the most wind capacity due to strong offshore additions. 2020 was also a record year for wind installations in Norway.

Offshore wind made up 20% of new installations in Europe with 2.9 GW of new capacity connected to the grid in 2020. The Netherlands installed half of that capacity, followed by Belgium which had a record year for offshore installations. Other installations were completed in the UK, Germany, and Portugal.

In 2020 new wind installations in the EU-27 were 10.5 GW. This represents 71% of all installations in Europe. Outside of the EU, installations rose significantly in Norway, Turkey and Russia.

There were 0.4 GW of decommissioned wind capacity in Europe during the year. Thus, overall net installations amounted to 14.3 GW.

FIGURE 1
New onshore and offshore wind installations in Europe



	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Offshore	0.8	1.2	1.5	1.5	3.0	1.6	3.2	2.7	3.6	2.9
Onshore	9.5	11.7	11.0	11.7	10.9	12.3	13.9	9.4	12.0	11.8
Total	**10.3**	**12.9**	**12.6**	**13.2**	**13.9**	**13.8**	**17.1**	**12.1**	**15.6**	**14.7**

Source: WindEurope

Source: WindEurope

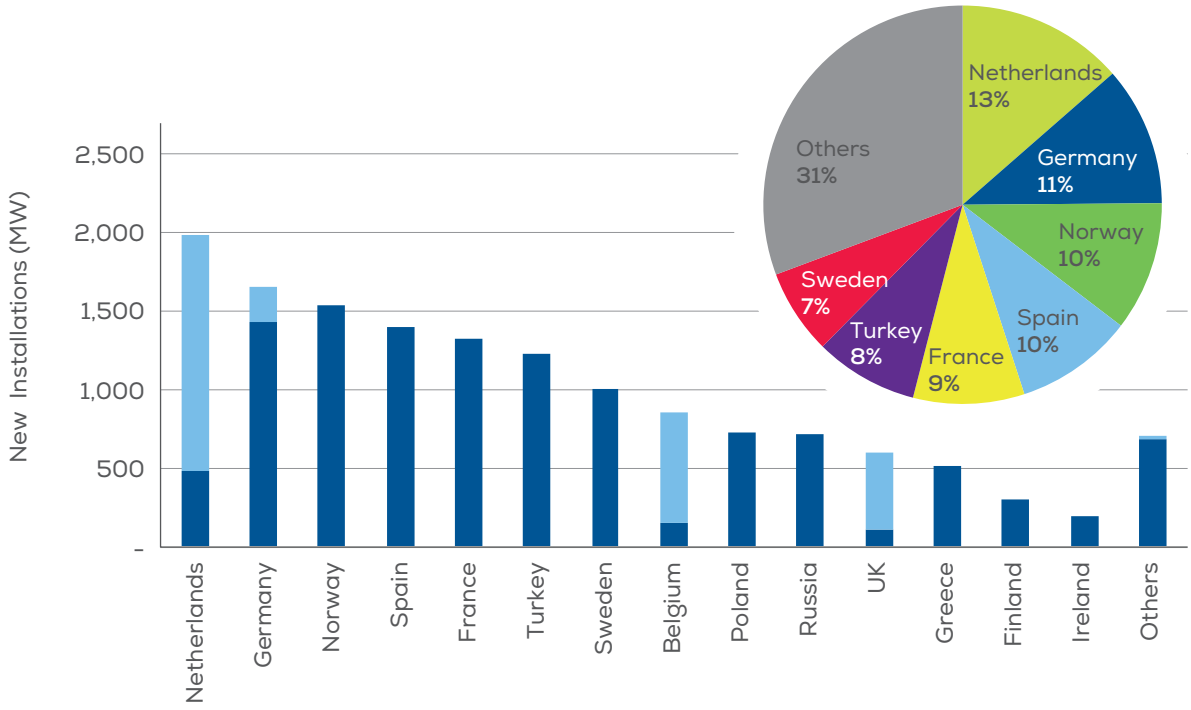
1.2 NATIONAL BREAKDOWN OF 2020 INSTALLATIONS

The Netherlands had 2 GW of installations, the most of any country in Europe. Offshore installations represent 75% of this, and helped the Netherlands achieve a record year in wind installations. Offshore installations were driven by the completion of the Borssele Wind Farm zones. The three wind farms were awarded to different consortia in 2016 and 2017.

Germany saw the lowest rate of installations since 2010. Onshore installations rose slightly to 1.4 GW due to small improvements in permitting rules. Offshore wind installations made up only 0.2 GW – representing the Albatros and the Trianel Windpark Borkum 2.

Norway installed a record 1.5 GW of wind capacity, all of it onshore. Norway's wind sector was strongly affected by the closed borders (installing only a few turbines in the first half of the year) but it managed to recover in the second half of the year.

FIGURE 2
New wind installations in Europe per country



	Netherlands	Germany	Norway	Spain	France	Turkey	Sweden	Belgium	Poland	Russia	UK	Greece	Finland	Ireland	Others
Offshore	1,493	219	-	-	-	-	-	706	-	-	483	-	-	-	17
Onshore	486	1,431	1,532	1,400	1,318	1,224	1,007	152	731	713	115	517	302	196	688
Total	**1,979**	**1,650**	**1,532**	**1,400**	**1,318**	**1,224**	**1,007**	**858**	**731**	**713**	**598**	**517**	**302**	**196**	**705**

Source: WindEurope

Spain is estimated to have installed 1.4 GW in 2020[10], a 40% drop compared to its strong performance in 2019. This rounds up the capacity awarded in the 2016 and 2017 auctions.

80%
OF WIND INSTALLATIONS IN 2020 CAME FROM ONSHORE WIND

France was the fifth-largest market. The installation figure of 1.3 GW was similar to 2019 but still lower than the expected 1.9 GW from their energy multi-annual programme (PPE).

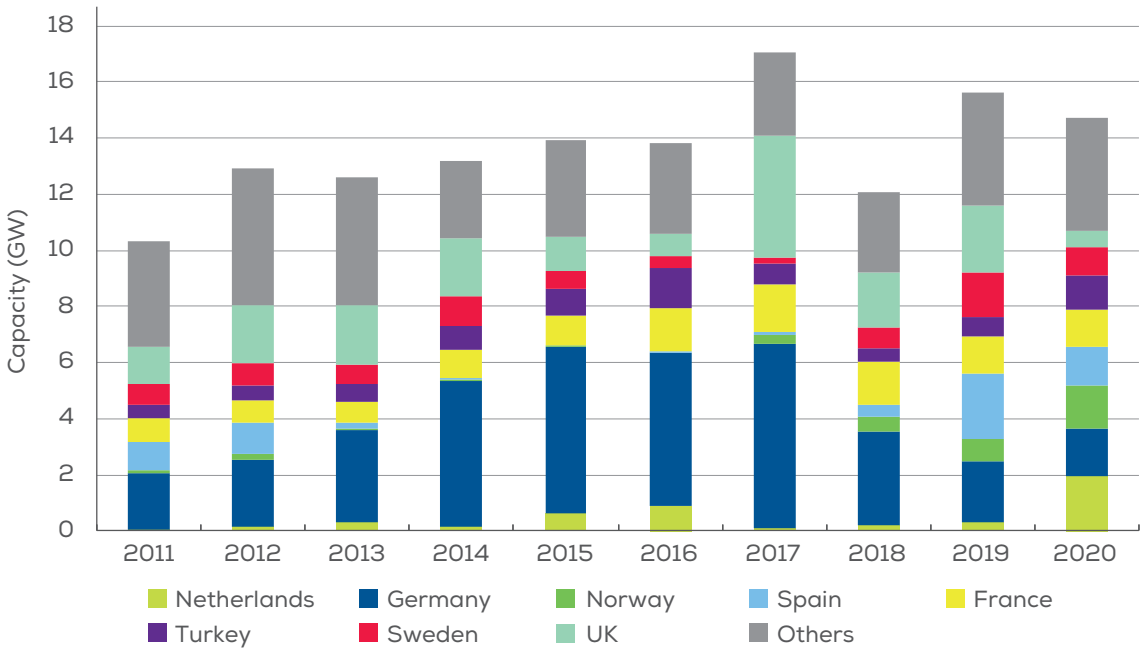
Turkey installed 1.2 GW, equal to 8% of installations in Europe. Wind installations in the first half of the year were severely impacted by the weekend curfew and the international travel ban. However, developers in Turkey managed to obtain a six-month extension on the commissioning deadlines of the wind farms with support awarded in 2017 and 2018.

Sweden installed 1 GW of new wind capacity. Delays due to windy conditions and COVID restrictions affecting the supply chain caused delays to some 0.6 GW of planned capacity. These projects will be installed in 2021 instead.

Installations in **Belgium** (0.9 GW) were driven by a record-year in offshore installations. **Poland** (0.7 GW) saw a significant increase from 53 MW in 2019 as a large part of the 1 GW auctioned in 2018 was connected to the grid. **Russia** (0.7 GW) also saw a significant increase in installations from 50 MW in 2019 as the capacity awarded in the 2018 auction (0.8 GW) began to be commissioned.

15 countries did not have any wind installations in 2018. 11 of these are EU-27 Member States.

FIGURE 3
Distribution of the new wind installations in Europe



Source: WindEurope

10. Provisional figure based on the Spanish TSO REE.

1.3 TOTAL WIND POWER INSTALLATIONS

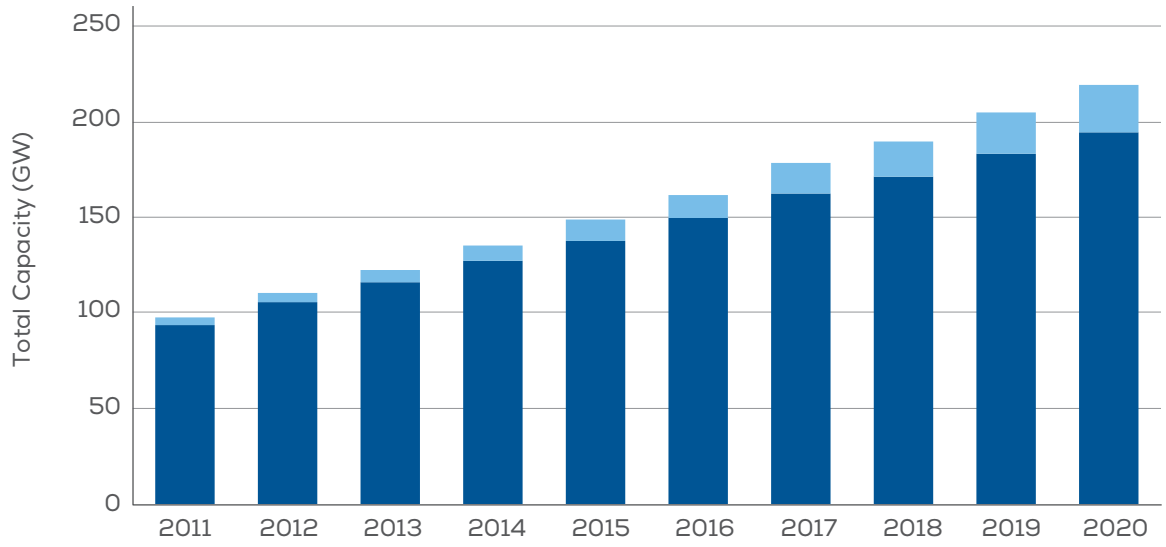
220 GW of wind power capacity are now installed in Europe. 11% of this figure is offshore. Germany continues to have the largest installed capacity in Europe, followed by Spain, the UK, France and Italy. Six other countries (Sweden, Turkey, the Netherlands, Poland, Denmark, and Portugal) have more than 5 GW installed each. Five additional countries have over 3 GW of installed capacity: Belgium, Ireland, Greece, Austria and Romania.

In the EU-27 the total capacity has reached 179 GW. The EU-27 has 58% of all installed offshore wind capacity in Europe.

220 GW

OF WIND POWER CAPACITY IS NOW INSTALLED IN EUROPE

FIGURE 4
Total wind installations in Europe

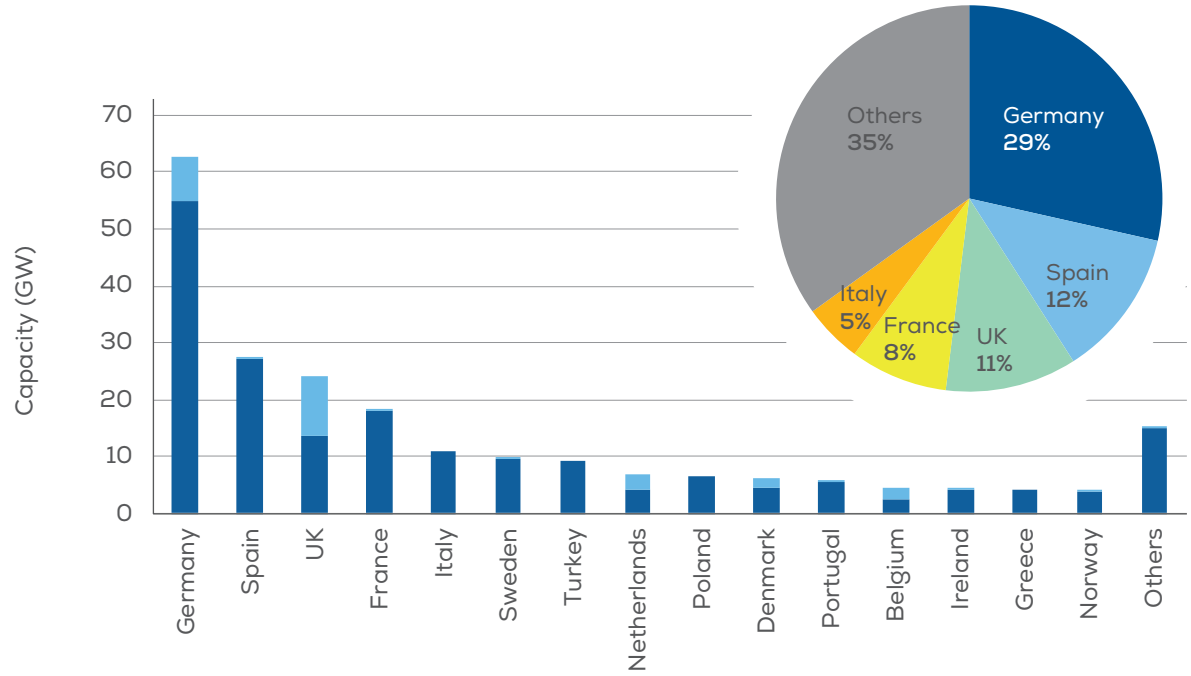


	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Offshore	4	5	7	8	11	13	16	18	22	25
Onshore	94	105	116	127	137	149	162	171	183	195
Total	**98**	**110**	**123**	**135**	**148**	**162**	**178**	**189**	**205**	**220**

Source: WindEurope

65% of all wind power installations in Europe are spread across five countries: Germany (63 GW), Spain (27 GW), the UK (24 GW), France (18 GW), and Italy (11 GW). This is followed by Sweden, Turkey and the Netherlands with 10 GW, 9 GW and 7 GW respectively.

FIGURE 5
Total wind installations by country



	Germany	Spain	UK	France	Italy	Sweden	Turkey	Netherlands	Poland	Denmark	Portugal	Belgium	Ireland	Greece	Norway	Others
Offshore	8	0	10	0	-	0	-	3	-	2	0	2	0	-	0	0
Onshore	55	27	14	18	11	10	9	4	7	4	5	2	4	4	4	15
Total	**63**	**27**	**24**	**18**	**11**	**10**	**9**	**7**	**7**	**6**	**5**	**4**	**4**	**4**	**4**	**15**

Source: WindEurope

1.4 DECOMMISSIONING AND REPOWERING OF WIND INSTALLATIONS

388 MW of wind power were decommissioned in 2020. This decommissioning took place in Germany (222 MW), Austria (64 MW), Denmark (61 MW), Belgium (25 MW), France (15 MW), Luxembourg (2 MW) and the UK (0.3 MW). All decommissioned capacity came from onshore wind.

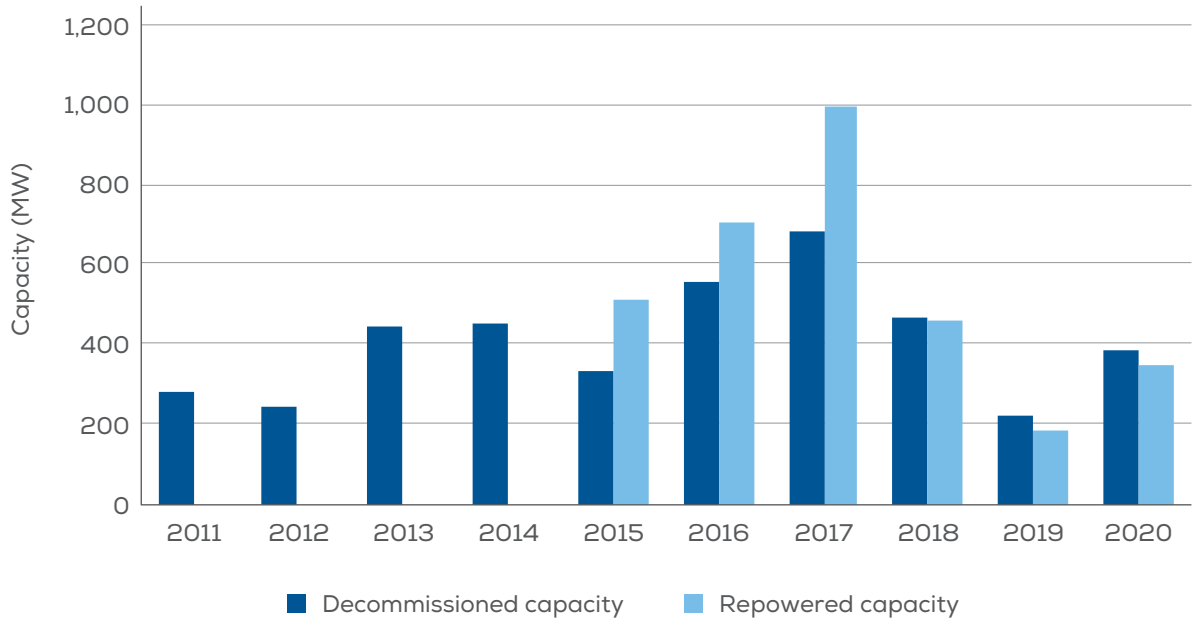
Out of the 14.7 GW of onshore wind installed in 2020, only 345 MW were through repowering projects. The majority came from Germany, but there was also repowering activity in Greece, Luxembourg and the UK. Complex permitting rules have been the main reason for the slow uptake of repowering projects in Europe.

388 MW

OF WIND POWER WERE DECOMMISSIONED IN 2020

FIGURE 6

Decommissioned and repowered 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

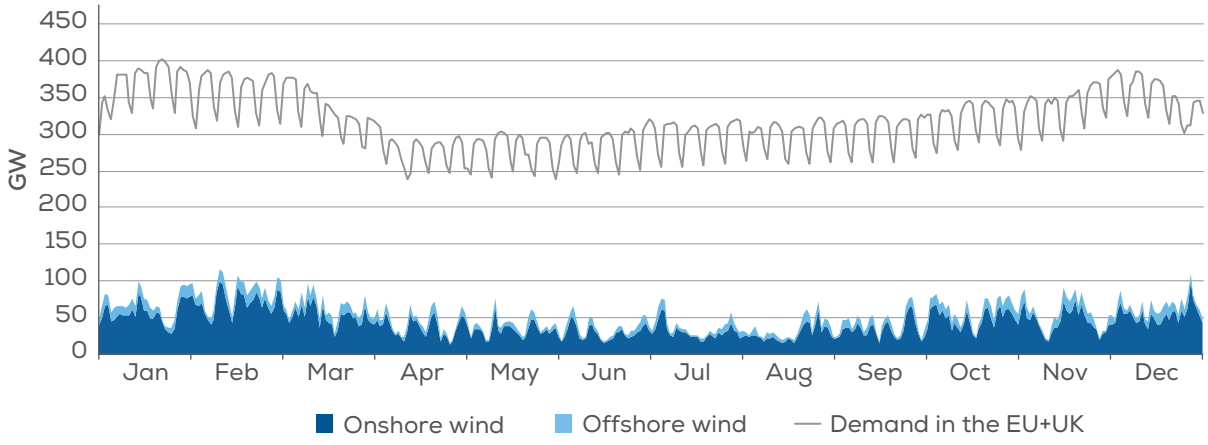
Source: WindEurope

1.5 WIND ENERGY GENERATION

Wind energy met 16.4% of demand across the EU+UK[11]. This is 1.4% higher than EU levels in 2019 (which included the UK), and came about from a combination of strong installations, windy conditions (particularly in February and March) and a significant drop in demand coinciding with the Europe-wide lockdowns as the first wave of COVID took hold.

The strong wind generation conditions in March and April, combined with lower supply from nuclear and gas, had a significant influence on spot market prices and system operation strategies. In cases of very low demand (bank holidays and weekends), some system operators curtailed wind energy in order to increase their upward balancing reserves in case of large system imbalances. This highlights the flexibility that wind energy offers to system operators in keeping the system secure.

FIGURE 7
Power demand and wind energy generation in EU-27 and the UK (GW)

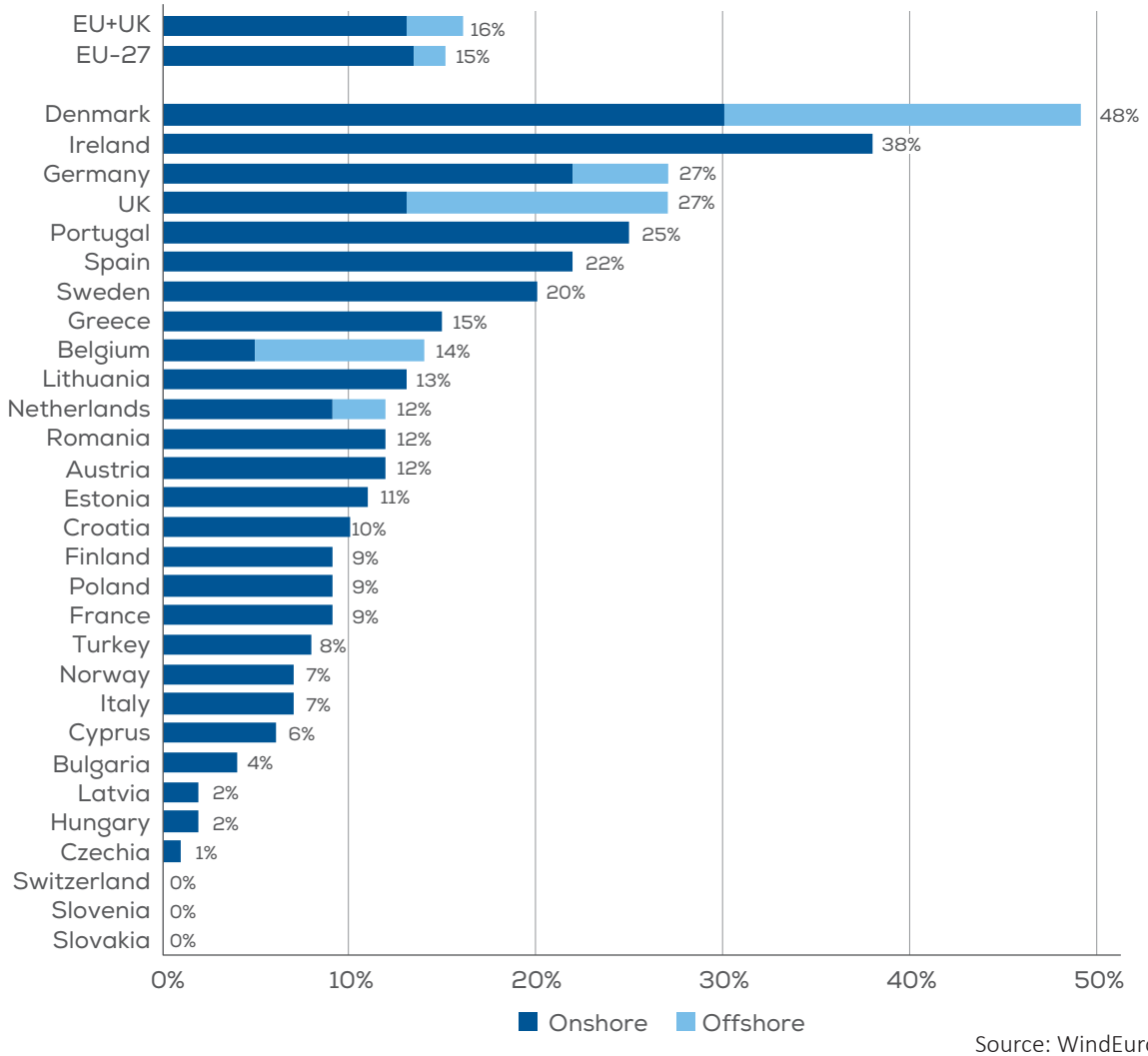


Source: WindEurope

Wind power plants in Europe[12] produced 458 TWh of electricity in 2020 and covered 16.4% of the electricity demand (13.4% from onshore and 3% from offshore wind). Wind power achieved record production in February, both in absolute terms as well as a share of demand. 10 February saw the largest production of wind energy in a single day (2,760 GWh), corresponding to about 60% of the fleet producing at maximum output for the entire day. And wind met 24% of the electricity demand for the entire month of February, before the COVID-19 impact had taken its toll on the countries' demand. The lower demand between March and June also coincided with much milder weather conditions and less wind than usual across Europe.

11. Data from ENTSO-E transparency platform. It excludes data for Luxemburg and Malta. Data for the UK comes from BEIS quarterly reports (estimated for Q4 2019). Data for Croatia comes from the Croatian Energy Market Operator (HROTE).
12. Includes the EU-27 + the UK.

FIGURE 8
Percentage of the average annual electricity demand covered by wind[13]



Source: WindEurope

Denmark had the highest share of wind (48%), followed by Ireland (38%) and Germany (27%). The UK, Portugal and Spain followed with 27%, 25% and 22% respectively. 14 Member States had a wind energy share above 10%.

In the Netherlands, installed offshore wind capacity more than doubled but most of the new capacity came online at the end of the year and so did not impact the annual figures. We expect to see an increased share of wind energy generation in the Dutch energy mix in 2021.

TABLE 2
Electricity production from wind power (TWh)

EU electricity consumption (TWh)[14]	Onshore wind energy production (TWh)	Offshore wind energy production (TWh)	Total wind energy production (TWh)	Share of EU consumption met by wind energy
2,797	375	83	458	16%

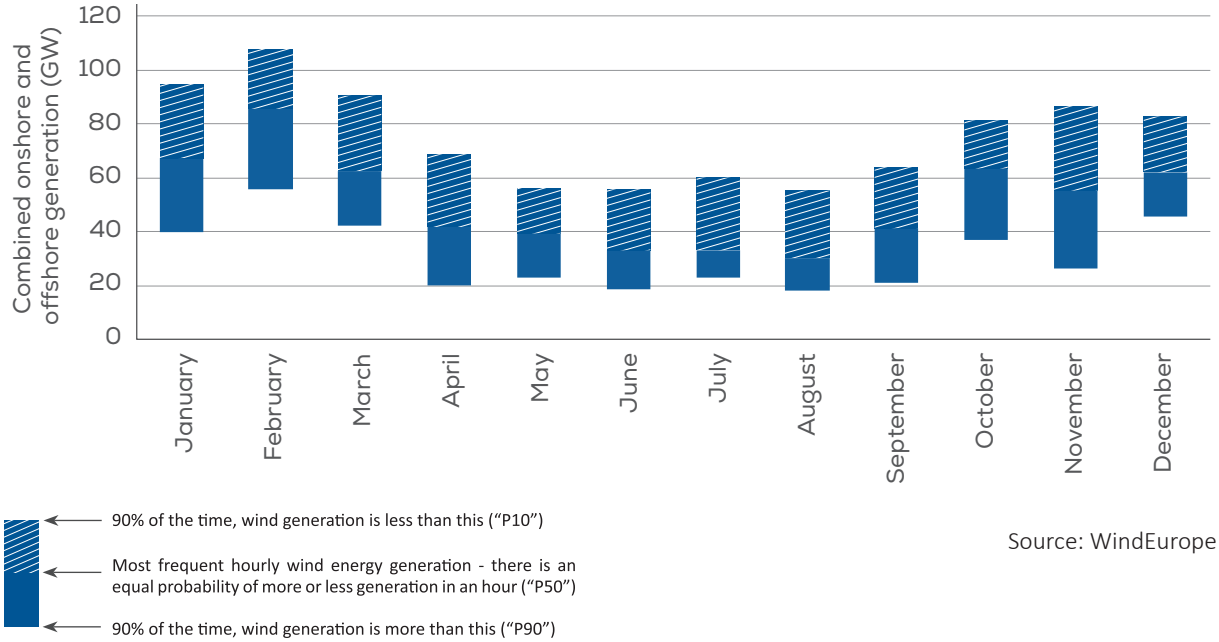
13. The figures represent the average of the share of wind in final electricity demand, captured hourly from ENTSO-E and corrected thanks to national TSOs and government data. Data is not available from all European countries.
14. Data from ENTSO-E transparency platform. It excludes data for Luxemburg and Malta. Data for the UK comes from BEIS quarterly reports (estimated for Q4 2019). Data for Croatia comes from the Croatian Energy Market Operator (HROTE).

In 2020 wind power plants produced at a stable rate throughout the year with a daily peak production[15] of 116 GW registered on 10 February.

Capacity factors of the entire wind fleet in the EU and UK were on average 27%, a 2% increase on 2019. Capacity factors for onshore were 25%, while for offshore they increased significantly from 38% to 42% over 2020. These numbers are relatively low compared to new wind farms as they represent the performance of the entire wind fleet, including very old installations. New onshore wind farms now operate at up to 40% and new offshore wind farms up to 60%.

Old installations are characterised by 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, and thus 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 30-35%. For new offshore wind farms, this figure ranges between 35 and 55%[16].

FIGURE 9
Spread of hourly wind energy generation in Europe



Source: WindEurope

Wind energy production is variable, and the hourly variability followed a clear pattern throughout the year. Figure 9 shows the range of hourly electricity generation from wind energy during each month of 2020. February saw the highest average hourly rate of generation. Across 90% of the entire month, wind energy generated more than 55 GW of electricity an hour in the EU and UK. This is roughly equivalent to the average hourly electricity demand of Germany.

Over the period from May to August, the variation in electricity produced per hour by wind dropped (shown by the size of the boxes above) and the average amount was also lower (shown by the lower position of the boxes). This was expected since the wind energy resource decreases during periods of high pressure, associated with the settled weather often seen in summer months.

Wind energy generation peaked in the winter months, particularly January to March, although in winter the variation in hourly generation is also higher than during summer.

15. Average hourly power output during one full day.
16. See Analysis of individual offshore wind farms by energynumbers.info (February 2020).

EUROPEAN WIND ENERGY GENERATION | 2020

16%
of Europe's electricity demand

48% 38% 27% 27% 25% 22% 20%
Highest wind energy shares

ONSHORE

195 GW
onshore wind capacity

13%
onshore wind in Europe's electricity demand

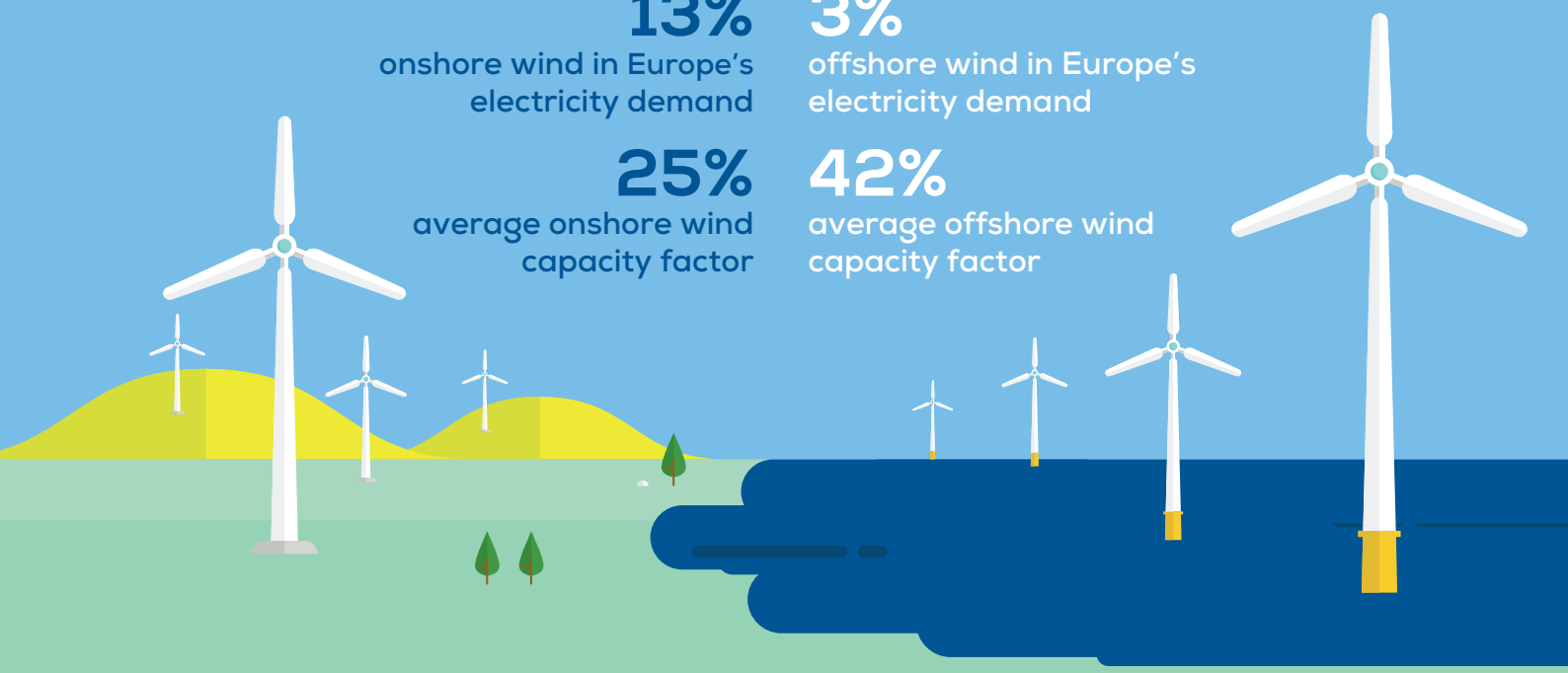
25%
average onshore wind capacity factor

OFFSHORE

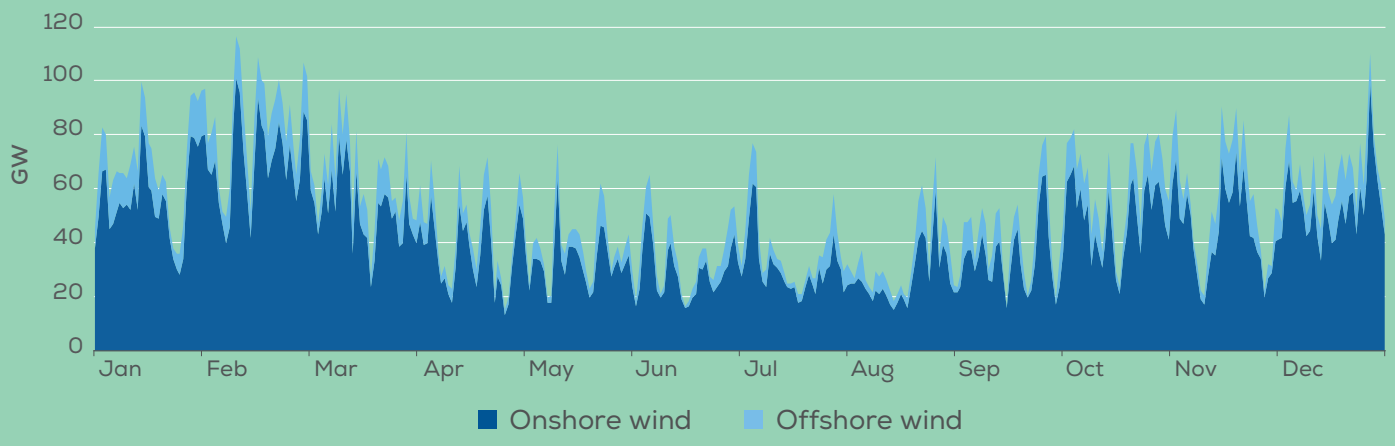
25 GW
offshore wind capacity

3%
offshore wind in Europe's electricity demand

42%
average offshore wind capacity factor



European wind energy generation in 2020



Data refers to EU Member States and the UK.

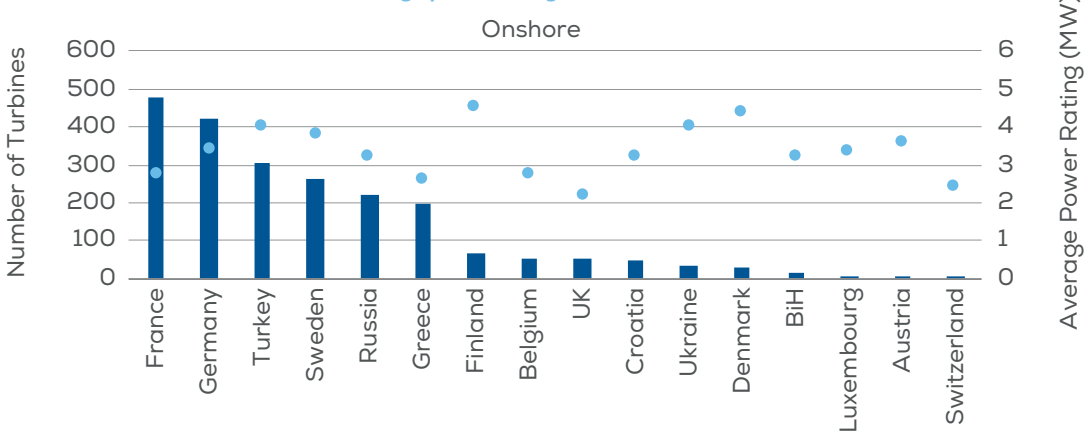
1.6 WIND TURBINE SIZE

The size and type of wind turbines installed in Europe varied significantly between countries. Once again, the most powerful onshore wind turbines were installed in Finland, with an average power rating of 4.5 MW. The UK had the lowest average power rating of 2.2 MW. Based on the available data from 16 countries, the weighted average power rating of onshore turbines was 3.3 MW.

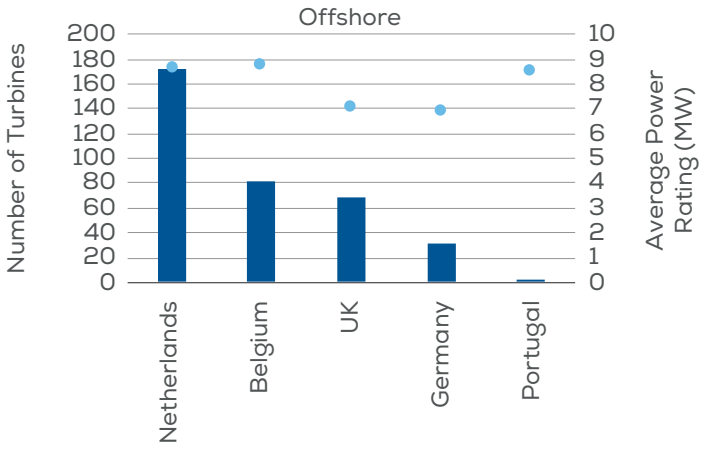
In 2020, the average rated capacity of newly installed offshore turbines was 8.2 MW, up from 7.2 MW in 2019. The Netherlands and Belgium had the highest average power rating of 8.7 MW.

Based on the latest data from ordered capacity in 2020[17] the average power rating of ordered onshore turbines reached 4.2 MW. In offshore, the average reached 10.4 MW in 2020.

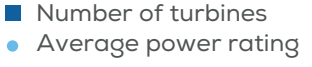
FIGURE 10
Number of turbines installed in 2020 and their average power rating



	France	Germany	Turkey	Sweden	Russia	Greece	Finland	Belgium	UK	Croatia	Ukraine	Denmark	BiH	Luxembourg	Austria	Switzerland
Number of turbines	477	420	306	264	223	200	67	55	52	47	36	31	15	9	7	5
Average power rating	2.8	3.4	4.0	3.8	3.2	2.6	4.5	2.8	2.2	2.0	4.0	4.4	3.2	3.3	3.6	2.4



	Netherlands	Belgium	UK	Germany	Portugal
Number of turbines	172	81	69	32	2
Average power rating	8.7	8.7	7.0	6.8	8.5



Source: WindEurope

17. Wind Turbine Orders Monitoring report (https://windeurope.org/data-and-analysis/product/wind-turbine-orders-monitoring-2020/) – available for WindEurope's members only.

1.7 AUCTIONS AND TENDERS IN 2020

In 2020 wind energy secured volumes of 8 GW through renewable energy auctions across seven countries. Onshore wind secured 7.4 GW, while offshore got only 759 MW. All of the planned auctions were carried out aside from Lithuania and Slovakia. The Spanish auction, postponed from December 2020 to January 2021, saw wind farms secure 1 GW with bids below €30/MWh.

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

In Germany six out of the seven onshore wind auctions held in 2020 were undersubscribed. Only 2.7 GW out of the 3.9 GW on offer were awarded because there weren't enough projects permitted.

There were also two technology-neutral auctions where the entire capacity was allocated to solar PV projects.

8 GW

WERE AWARDED TO WIND THROUGH AUCTIONS AND TENDERS IN 2020

In Italy, all three auctions for wind and solar PV were undersubscribed due to the slow permitting process. This inefficiency meant that project developers had to wait many years to receive responses from planning authorities. This will undoubtedly lead to undersubscribed auctions in 2021 as well.

TABLE 3

Successful auctions and tenders for wind energy in 2020[18]

Country	MW AWARDED	TYPE OF AUCTION	SUPPORT MECHANISM	PRICE IN €/MWH
France	749	Technology-specific	Feed-in-premium (floating)	62.9
	258	Technology-specific	Feed-in-premium (floating)	59.7
	520	Technology-specific	Feed-in-premium (floating)	59.5
Germany	523	Technology-specific	Feed-in-premium (floating)	57.6-62
	151	Technology-specific	Feed-in-premium (floating)	57.4-62
	464	Technology-specific	Feed-in-premium (floating)	59-62
	192	Technology-specific	Feed-in-premium (floating)	60-62
	285	Technology-specific	Feed-in-premium (floating)	61.7-62
	659	Technology-specific	Feed-in-premium (floating)	56-62
	400	Technology-specific	Feed-in-premium (floating)	55.9-60.7
	7	Technology-neutral	Feed-in-premium (fixed)	19.4-55.2
Greece	153	Technology-specific	Feed-in-premium (floating)	59.1-69.2
	472	Technology-neutral	Feed-in-premium (floating)	60
Italy	406	Technology-neutral	Contract for difference	56-68.4
	281	Technology-neutral	Contract for difference	66.9-68.5
	259	Technology-neutral	Contract for difference	68.4-68.6
Ireland	479	Technology-neutral	Contract for difference	74
Netherlands	116	Technology-neutral	Feed-in-premium (floating)	Not Available
	107	Technology-neutral	Feed-in-premium (floating)	Not Available
Poland	930	Technology-neutral	Contract for difference	42.4-55.7

Country	MW AWARDED	TYPE OF AUCTION	SUPPORT MECHANISM	PRICE IN €/MWH
Netherlands	759	Technology-specific	Zero-subsidy bid	0

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

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2. MARKET OUTLOOK 2021-2025

2.1 INTRODUCTION

The five-year Market Outlook for wind installations analyses the likely development of wind power capacity in Europe. It lays out two scenarios:

- Our **Realistic Expectations Scenario**, which provides the best estimate of the installed capacity in Europe over the next 5 years. According to this scenario, there will be 318 GW of total installed capacity in Europe, with an average installation rate of 21 GW. In the Realistic Expectations Scenario the EU-27 will install 15 GW p.a. This is well short of the 18 GW p.a. the EU-27 must install to deliver on the NECPs and the existing 2030 renewable energy target of 32%[19].

- Our **Low Scenario**, in which European governments don't address permitting issues, fail to put in place effectives strategies for repowering and implement new restrictions on the free movement of goods and people due to the pandemic, leading to 292 GW of cumulative installed capacity with an average installation rate of 16 GW.

Both scenarios reflect potential developments in European regulatory frameworks, national policies, project development timelines and the ability of wind to secure further capacity through upcoming auctions and tenders.

WE EXPECT EUROPE TO BUILD
105 GW
OF NEW WIND CAPACITY BY
2025

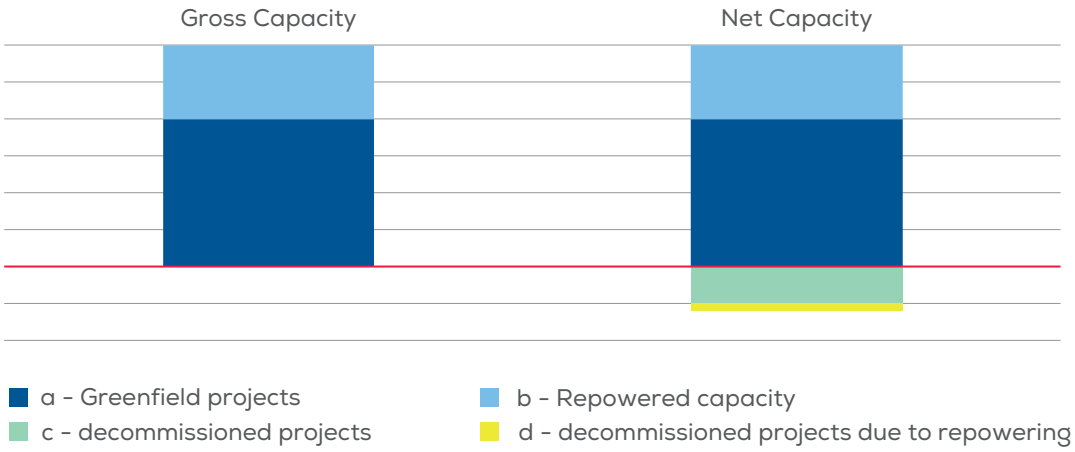
19. The wind capacity targets set in the National Energy and Climate Plans can be found here: https://windeurope.org/data-and-analysis/product/wind-energy-and-economic-recovery-in-europe/

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

We also account for expected decommissioning volumes, per 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 eventual **total** (or cumulative) capacity. See Figure 11 for more details.

FIGURE 11
Gross vs. net added capacity accounting for decommissioning and repowering



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

Source: WindEurope

2021 A RECORD YEAR?

2021 is likely to be a record year in installations, both for onshore and offshore wind. Some of the projects affected by COVID-related delays in 2020, particularly in onshore, will be delivered in 2021. This is why, under our Realistic Expectations Scenario, Sweden will be the largest market for new installations in 2021 with 2.9 GW.

Offshore is expected to see a record year in 2021, in line with our pre-COVID outlook. More than half of the 3.7 GW offshore installations in 2021 will take place in the UK (2 GW). The rest will be completed in the Netherlands, Denmark, and France.

Germany will be the third largest market in 2021 with 2 GW of installations, all of it coming from onshore wind. This rate is expected due to the roughly 4.5 GW of projects permitted and secured in auctions between 2018 and 2020.

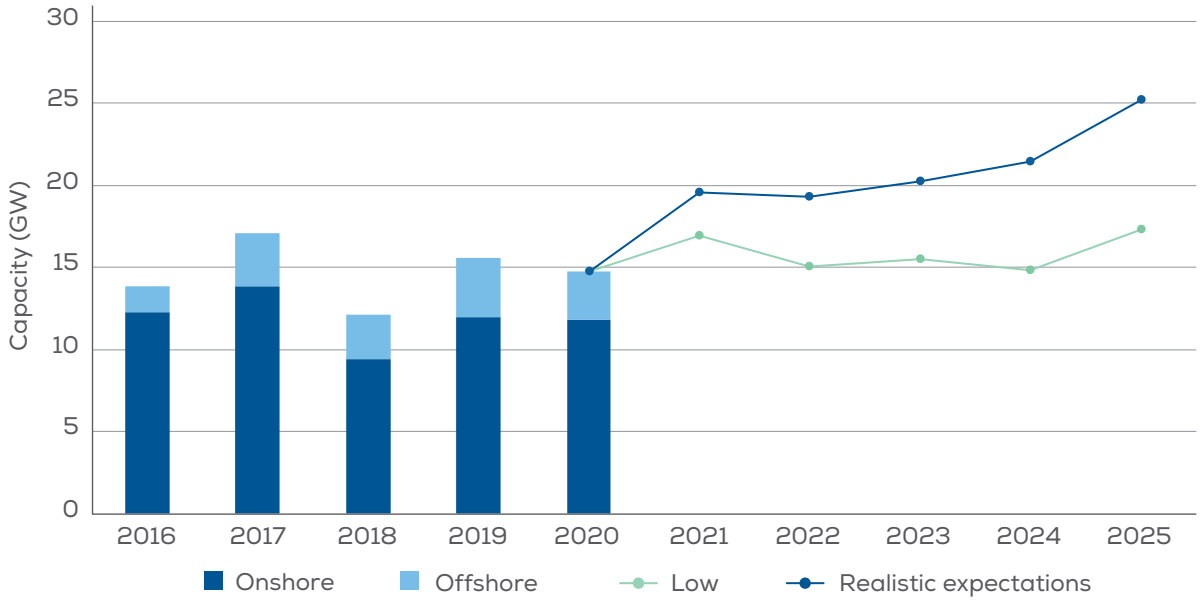
France will be the fourth largest market with 1.7 GW of installations. The majority will come from onshore wind (1.5 GW), but 2021 will be a milestone for offshore wind installations as well (about 240 MW, with the first commercial offshore projects kicking in). The offshore capacity comes from projects awarded in the 2012 tender, which experienced long delays.

2021
WILL BE A RECORD YEAR, WITH
19.5 GW
OF NEW WIND INSTALLATIONS

A couple of other countries will install more than 1 GW of capacity in 2021: the Netherlands (1.6 GW), Turkey (1.1 GW), Norway (1.1 GW), Spain (1 GW), Poland (1 GW) and Finland (1 GW).

If 2021 ends up being heavily affected by COVID-19 and the supply chain is disrupted, we could see 2.6 GW fewer installations, as highlighted in our Low Scenario.

FIGURE 12
New installations in Europe – WindEurope's scenarios



Source: WindEurope

2.2 REALISTIC EXPECTATIONS SCENARIO

WindEurope's Realistic Expectations Scenario provides the best estimate of the installed capacity in Europe over the next five years. This scenario considers the pipeline of wind energy projects, auctions and tenders results, and ongoing legislative changes in European countries that could enable the deployment of additional capacity. In addition, it builds on proposed regulatory changes in national documents, including proposed targets that are part of the National Energy and Climate Plans, longer-term national targets and calendars for auctions. For offshore wind, the Realistic Expectations Scenario assumes that all of the awarded wind farms are built on schedule.

ONSHORE WILL REPRESENT

72%

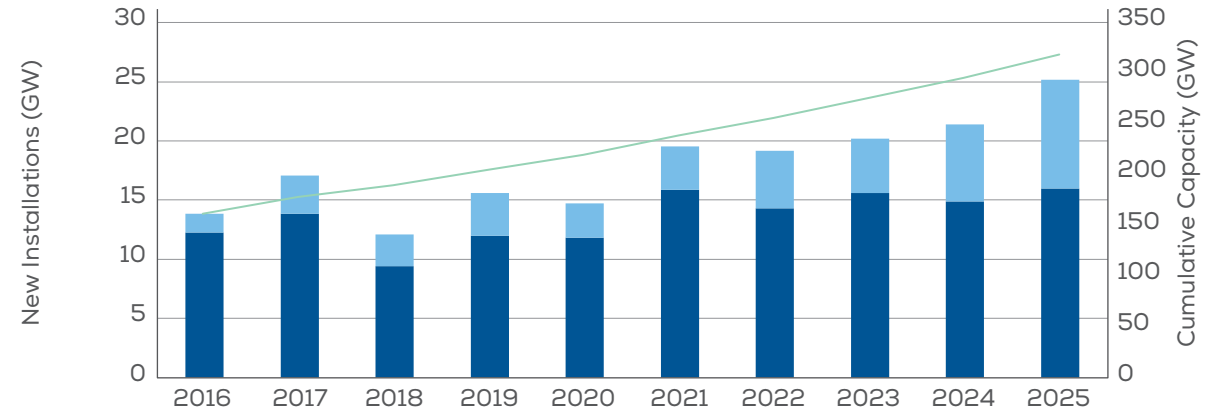
OF INSTALLATIONS IN THE NEXT 5 YEARS

Although new installations are forecasted to grow year on year (except for the forecasted 19.5 GW in 2022), the rate of onshore installations will begin to stall. Onshore installations represent 72% of new installations over the next five year. 2021 will see the peak for onshore installations, just below the 16 GW mark. And although countries such as Spain and the UK will see an increase in onshore installations, the simultaneous decrease in Swedish and Norwegian installations will flatten the onshore growth curve.

Offshore installations will also see new records beaten each year (except for the expected 4.6 GW in 2023) due to the number of projects reaching financial closure. Half of the installations will take place in the UK thanks in large part to their excellent Contracts for Difference (CfD) support scheme.

FIGURE 13

New and total (cumulative) installations in Europe - WindEurope's Realistic Expectations Scenario



	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Offshore	1.6	3.2	2.7	3.6	2.9	3.7	5.1	4.6	6.5	9.2
Onshore	12.3	13.9	9.4	12.0	11.8	15.9	14.1	15.6	14.9	16.0
Cumulative	162	178	190	205	220	238	256	275	295	318

Source: WindEurope

The UK will be Europe's largest wind market due to strong offshore figures over the next five year with 15 GW of new installations. However, the latest changes to the CfD auction system will allow onshore wind to participate as well. Several onshore wind projects will also benefit from Power Purchase Agreements (PPA) or from merchant financing. After installing about 450 MW per year in 2021 and 2022 we expect the onshore figures to double the years after.

In Germany we see the permitting situation improving slightly, as 3.3 GW of onshore wind projects were awarded with permits in 2020, up from 1.9 GW in 2019. There are about 4.5 GW of onshore wind projects that have permits and were awarded in auctions in 2018-2020 – we expect all of these to be built. There are also 2.6 GW of projects awarded in auctions in 2017 (without permits) that haven't yet been built and most likely won't be built at all. And while Germany plans to tender up to 17 GW over the next five years, we have also considered recent changes to the Renewable Energy Act (EEG). These allow the German Network Agency (BNetzA) to reduce auction volumes where there is a risk of the auction being undersubscribed (which has been the case in the last few years).

France also saw slight improvements in its permitting process, but there is still a lot of room for improvement. Onshore installations are set to grow to 1.9 GW per year by 2023, while offshore installations will grow from 0.2 GW in 2021 to 1 GW in 2025.

After a strong 2021 we are forecasting a decrease in installations in Sweden as new installations rely mostly on merchant financing or corporate renewable PPAs. A similar trend is taking place in Norway due to a deadlock in attempts to change the licencing process, and so we expect very few Norwegian installations in 2022.

105 GW

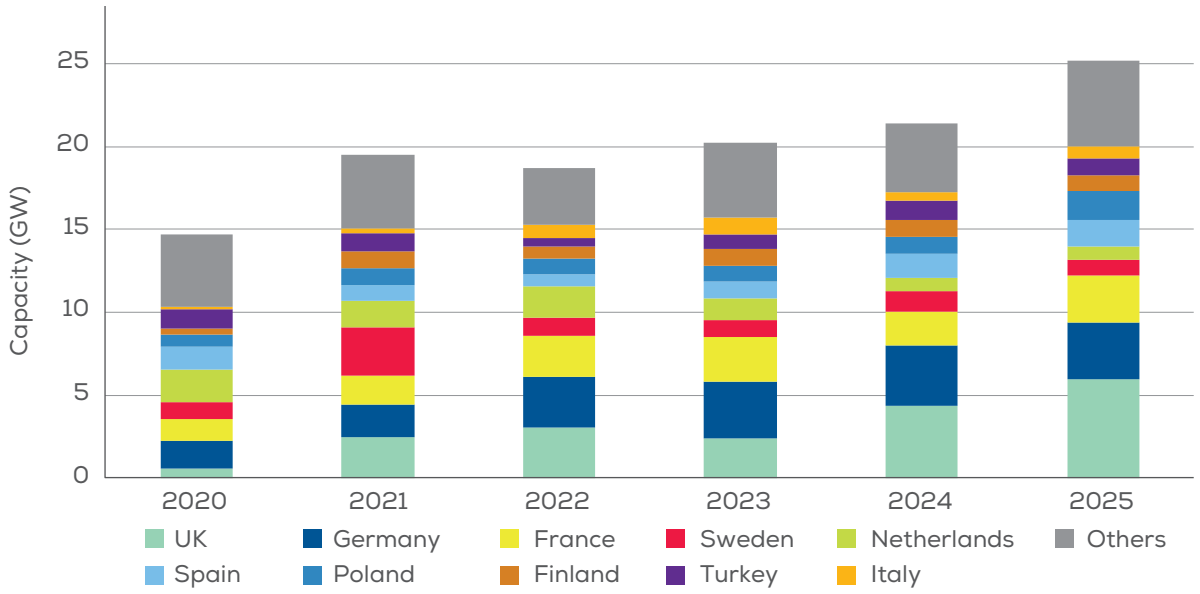
OF NEW INSTALLATIONS WILL BE INSTALLED BY 2025

In total, the Realistic Expectations Scenario would see about 105 GW of new capacity registered over the next five years in Europe. In the EU-27 the installations over the next five years are 76 GW, or 15 GW per year. That's lower than the 18 GW per year needed to deliver the volumes from the National Energy and Climate Plans due to bad permitting and a lack of strategy on repowering.

Although the 2021-2025 onshore wind installations (12.4 GW per year) are almost in line with the needed installation rate (12.8 GW per year), we are still concerned about the onshore installations after 2025. In offshore we expect an increase in installations in the 2025-2030 period due to the strong number of projects in the pipeline.

FIGURE 14

New installations per country – WindEurope's Realistic Expectations Scenario



Source: WindEurope

ONSHORE

Between 2021 and 2025 European onshore installations could reach 76 GW, averaging about 15 GW/year.

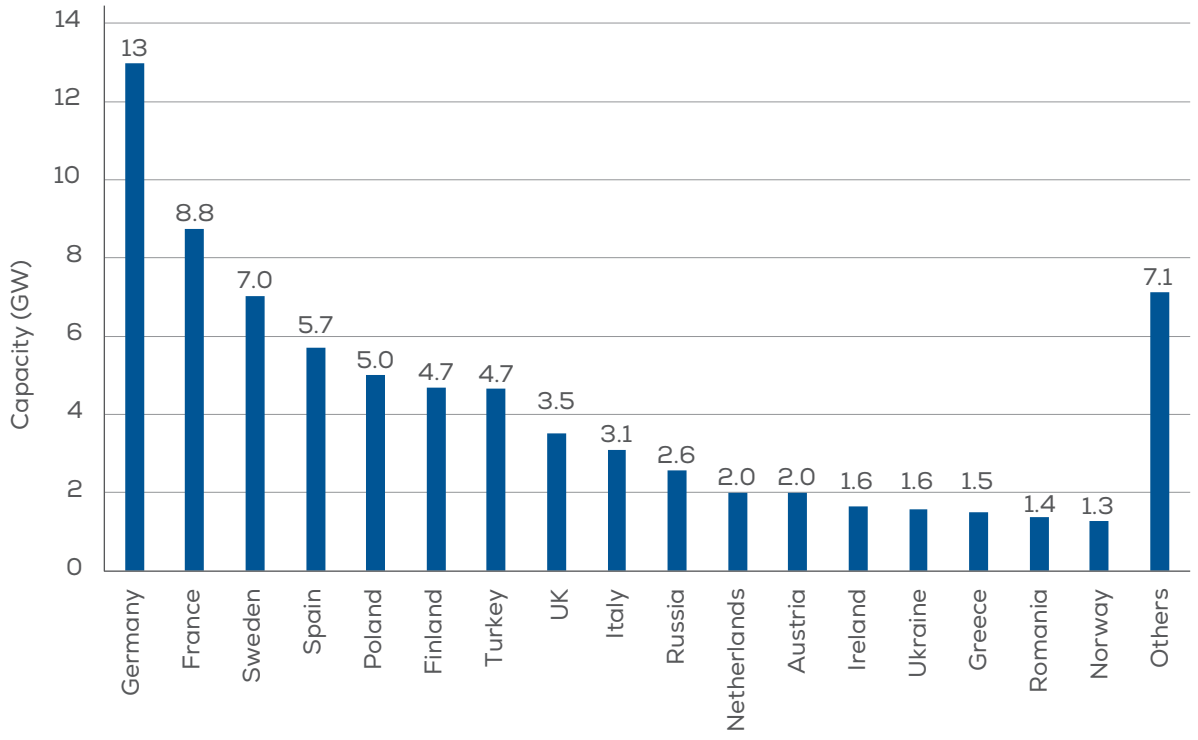
The EU-27 will have 65 GW of new installations over the next five years for an average of 12.4 GW/year. This is in line with the 12.8 GW/year needed to reach the volumes set in the National Energy and Climate Plans.

GERMANY WILL REMAIN THE LARGEST MARKET FOR ONSHORE WIND

Germany will continue to lead in new onshore installations with 13 GW over the five years (17% of the total onshore market), followed by France (8.8 GW), Sweden (7 GW), Spain (5.7 GW) and Poland (5 GW). 13 other countries will install more than 1 GW over the next five years.

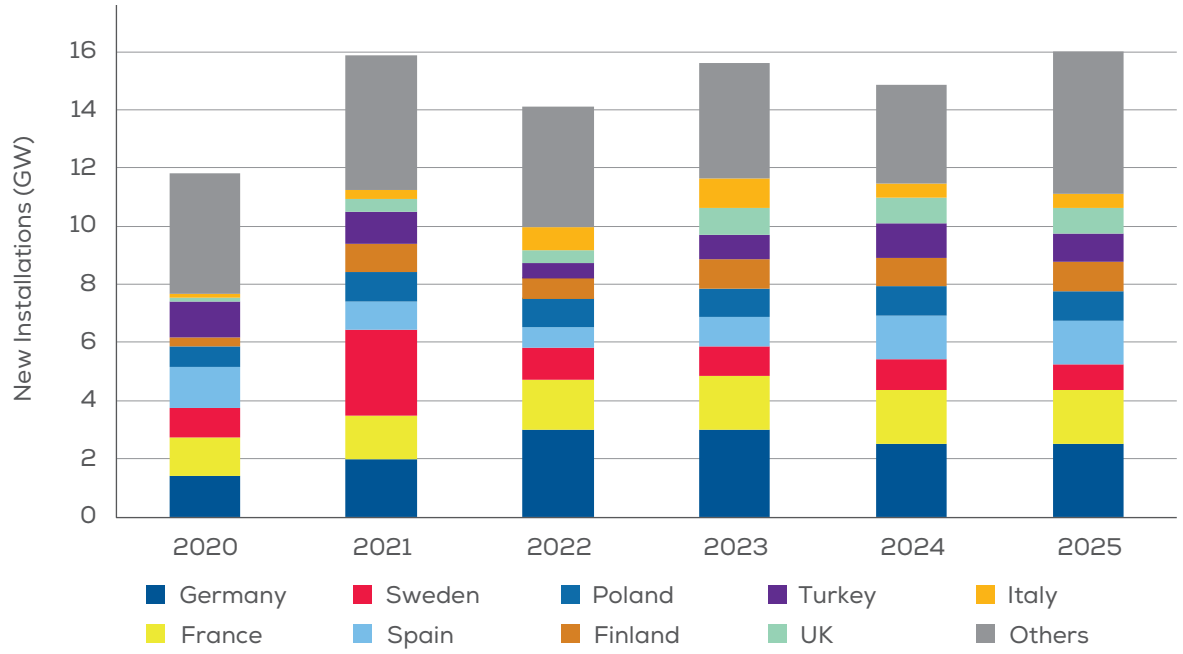
The Spanish Government recently announced their five-year auction calendar for renewables, where wind is eligible for at least 8.5 GW. Although initially planned in December 2020, the first auction under the new CfD support scheme took place in January, in which1 GW of wind projects won. With a deadline of April 2024, most of these projects are expected to come online in 2023 and 2024. The next 1.5 GW auction will take place in December 2021 – most of this capacity should come online by 2024 and 2025.

FIGURE 15
2021-2025 new installations of onshore wind per country



Source: WindEurope

FIGURE 16
New onshore installations per country - WindEurope's Realistic Expectations Scenario



Source: WindEurope

OFFSHORE

According to our Realistic Expectations Scenario, between 2021 and 2025, Europe will install 29 GW of offshore wind. With an average of 6 GW/year, offshore wind will represent about 28% of the total market across the five-year period (compared to a 20% share in the 2019-2023 period).

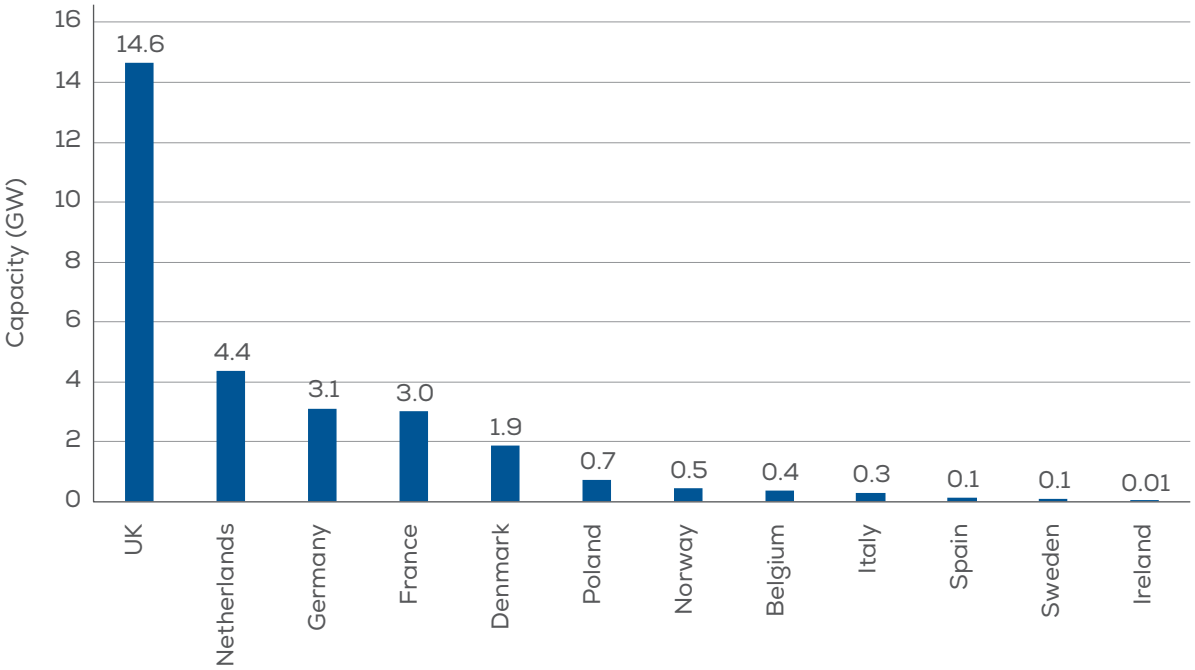
Installations will be mainly concentrated in the UK, with 15 GW or 50% of all new grid-connected capacity. Five other countries will also see large offshore installations, namely the Netherlands (4.4 GW), Germany (3 GW), France (3 GW), Denmark (1.9 GW) and Poland (0.7 GW). Norway, Belgium, Italy, Spain, and Sweden will see more than 100 MW of offshore installations completed over the next five years. Ireland will have a small project coming online in 2023.

The outlook for offshore is very positive in the long-term. The recently published Offshore Renewable Energy Strategy proposes legislative and non-legislative recommendations for the deployment of 300 GW of offshore wind in the EU-27 by 2050. Together with the UK and Norway's targets, Europe would have over 400 GW by 2050.

THE UK WILL REMAIN THE LARGEST OFFSHORE MARKET

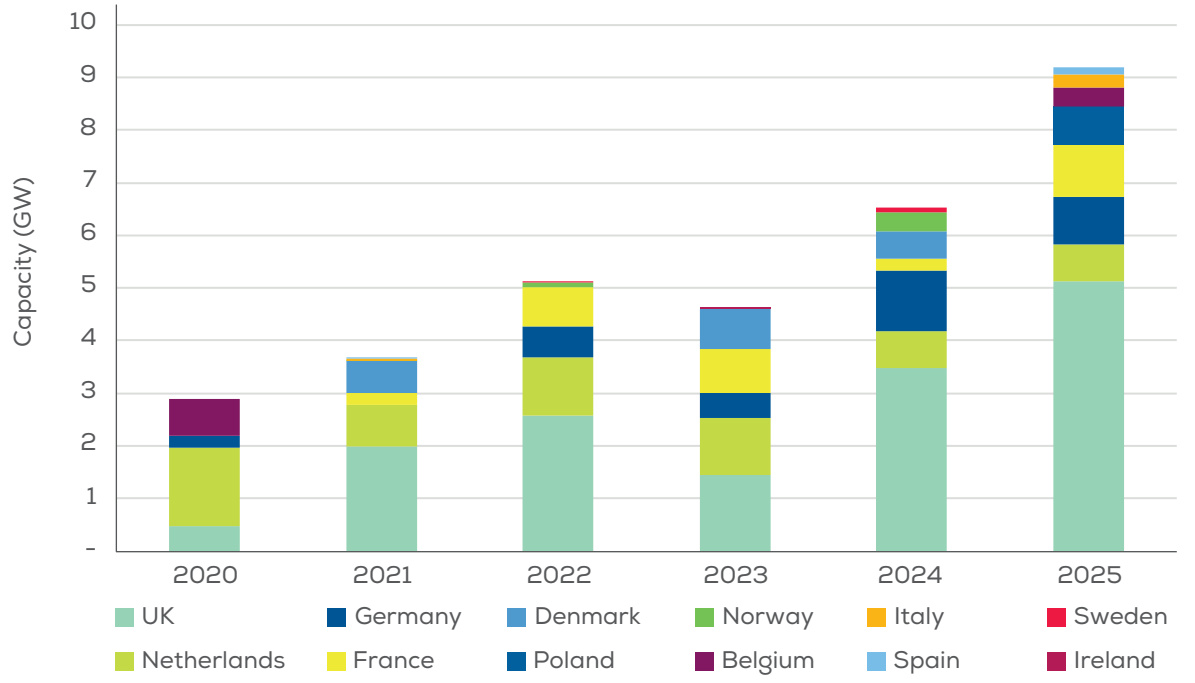
However, looking towards 2030 there is a lot of work still to be addressed by European policymakers. If Governments want to reach their commitments of 111 GW of offshore wind by 2030, they need to ramp up build-out from the current 3 GW/year to 11 GW/year by 2026 and maintain this installation pace. And they should provide a clear pipeline of auctions for contracts for difference, which are the most cost-effective instrument for developing offshore wind.

FIGURE 17
New offshore installations per country - WindEurope's Realistic Expectations Scenario



Source: WindEurope

FIGURE 18
New offshore installations per country - WindEurope's 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:

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

Over the next 5 years we expect Europe to see 4.4 GW of repowering projects (repowered capacity). That means that about 2.4 GW will be decommissioned only to be repowered later (capacity under repowering), as on average, the output capacity is increased by a factor of 1.8 in repowered wind farms.

We expect Germany to be the largest repowering market even though the market continues to face permitting constraints. We also see similar developments taking place in Spain, Denmark, Italy, and the Netherlands.

DECOMMISSIONING AND LIFETIME EXTENSION

We expect 26 GW of projects to become older than 20 years over the next five years. Combined with 10 GW of projects becoming 25 years old and 1.5 GW of projects becoming 30 years old, we reach 38 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 step up we might see negative additions of wind capacity. In 2020 Austria had a net negative installation of -39 MW, because Austria decommissioned 64 MW and commissioned only 25 MW.

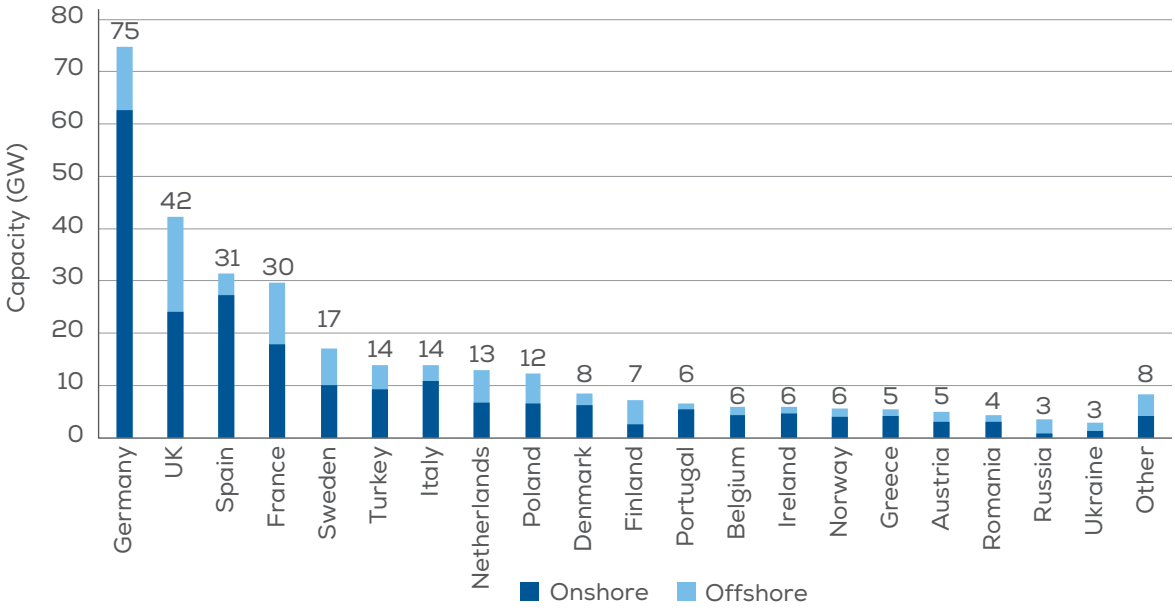
Based on current trends and the policy context, we estimate that about 2.4 GW will be decommissioned for repowering and 7 GW will be fully decommissioned. In total around 9.4 GW will be decommissioned over the next five years.

The remaining 29 GW will continue to operate and will probably be considered for life-time extension services (perhaps with partial replacement of certain elements such as gearbox or blades).

TOTAL CAPACITY

In cumulative terms, Europe would reach 318 GW of installed capacity by the end of 2025. Germany will have the largest wind fleet (75 GW), followed by the UK (42 GW), Spain (31 GW), and France (30 GW). Five other countries will be above the 10 GW threshold (Sweden, Turkey, Italy, the Netherlands and Poland).

FIGURE 19
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 don't address permitting issues, fail to put in place effectives strategies for repowering and implement new restrictions on the free movement of goods and people due to the pandemic.

In the low scenario we assume that the countries that do not have incentives for wind energy do not build any new installations.

The permitted and currently supported pipeline is built as planned, but unfavourable national policies for permitting and planning persist. The lack of permitted projects would translate into more undersubscribed auctions and fewer installations after 2023.

The Low scenario has an annual installation rate of 16 GW/year leading to a total capacity of 292 GW by 2025.

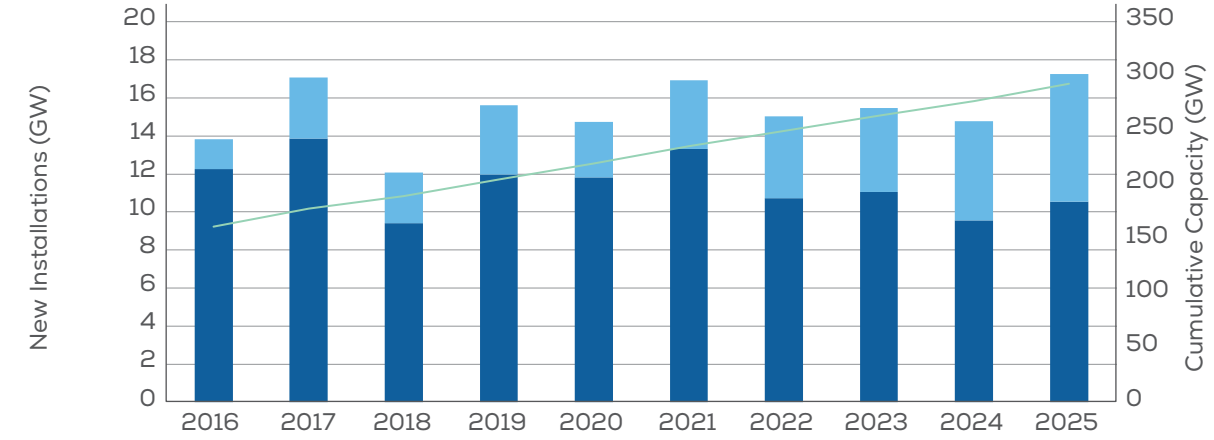
This is 26 GW lower compared with the Realistic Expectations Scenario.

Most of the risk in the short-term concerns onshore wind. After growth in 2021, installations would fall below 10 GW in 2024, similar to the very poor installation rate in 2018.

In terms of offshore, the Low Scenario foresees a slower installation rate mainly due to delays in the commissioning of previously planned projects. This would result in a 5 GW drop over the next five years compared to the Realistic Expectations Scenario.

For more info on the implications of the Low Scenario for each country, visit WindEurope's Wind Intelligence Platform[20].

FIGURE 20
New onshore installations per country - WindEurope's Low Scenario



	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025
Offshore	1.6	3.2	2.7	3.6	2.9	3.6	4.3	4.4	5.2	6.7
Onshore	12.3	13.9	9.4	12.0	11.8	13.3	10.7	11.1	9.6	10.6
Cumulative	**162**	**178**	**190**	**205**	**220**	**236**	**250**	**264**	**277**	**293**

Source: WindEurope

20. For members only – https://windeurope.org/data-and-analysis/product/wind-energy-in-europe-in-2020-trends-and-statistics/

ANNEX 1

TABLE 5

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.

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