Wind EUROPE

Wind energy in Europe

2022 Statistics and the outlook for 2023-2027

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DISCLAIMER

This report summarises new installations and financing activity in Europe's wind farms from 1 January to 31 December 2022. It also analyses how European markets will develop in the next five years (2023 to 2024). 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.

This publication contains information collected on a regular basis throughout the year and then verified with relevant members of the industry ahead of publication. Neither WindEurope, nor its members, nor their related entities are, by means of this publication, rendering professional advice or services. Neither WindEurope nor its members shall be responsible for any loss whatsoever sustained by any person who relies on this publication.

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Executive summary

EUROPE NOW HAS

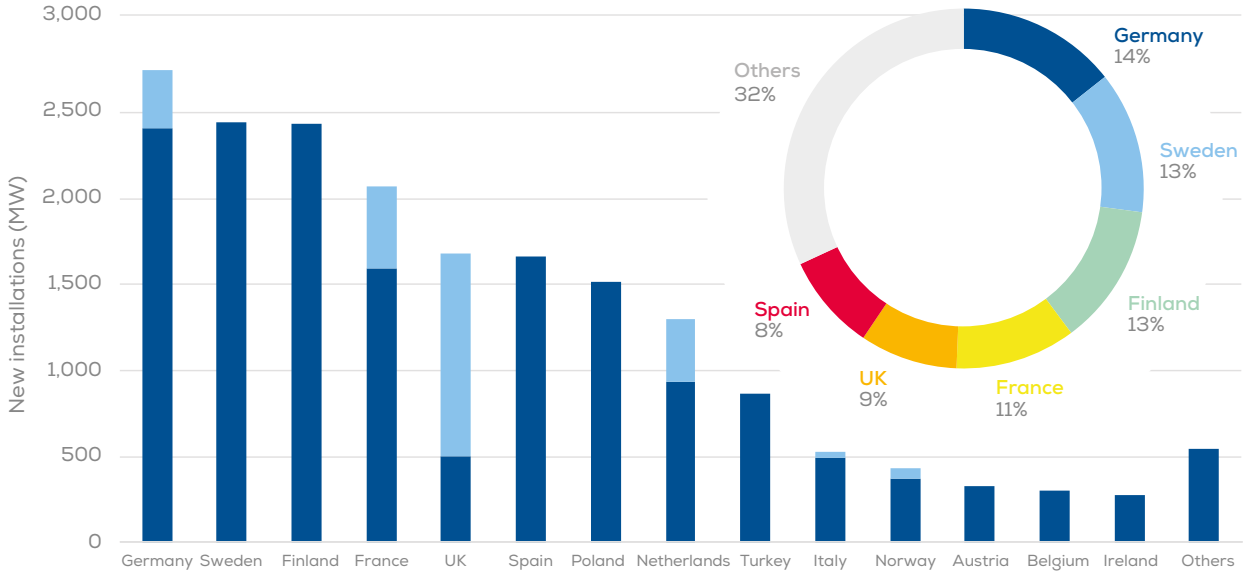
255 GW

OF WIND CAPACITY

Europe installed 19 GW of new wind power capacity in 2022. This was 4% more than in 2021. The EU-27 installed 16 GW, up 40% on 2021 but still below what the EU should be building to meet its 2030 Climate and Energy goals.

87% of the new wind installations in Europe were onshore, with Germany, Sweden, and Finland building the most. Almost half the offshore installations were in the UK, and France installed its first large offshore wind farm.

FIGURE A. New onshore and offshore wind installations in Europe in 2022



	Germany	Sweden	Finland	France	UK	Spain	Poland	Netherlands	Turkey	Italy	Norway	Austria	Belgium	Ireland	Others
Onshore	2,403	2,441	2,430	1,590	502	1,659	1,517	933	867	496	372	328	303	280	546
Offshore	342	0	0	480	1,179	0	0	369	0	30	60	0	0	0	0

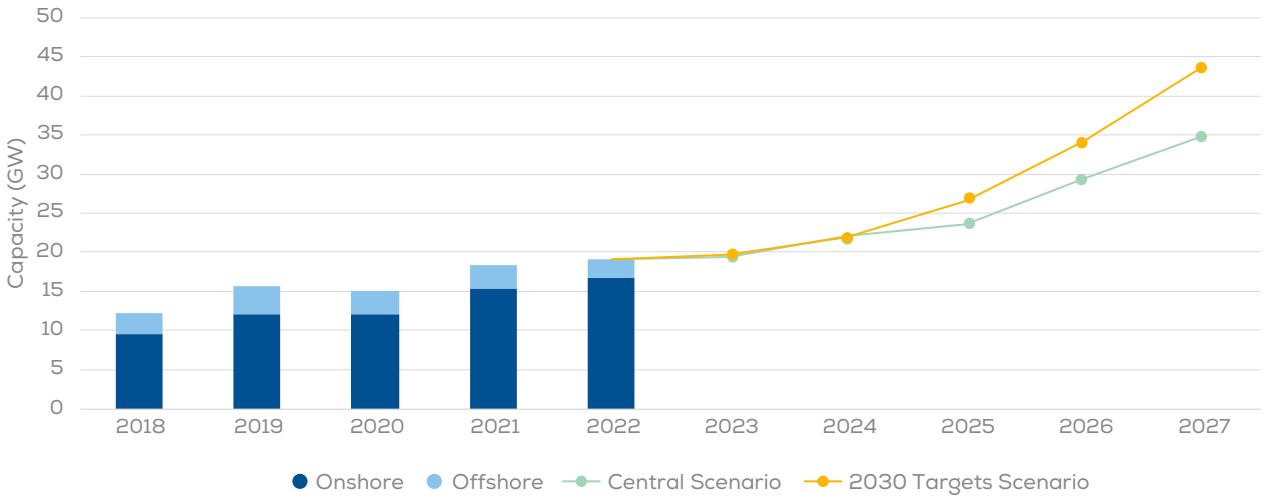
Source: WindEurope

We expect Europe to install 129 GW of new wind farms over the period 2023-2027, and the EU-27 to install 98 GW of that. Three quarters of the new capacity additions over 2023-27 will be onshore. We expect the EU to build 20 GW of new wind farms a year on average over 2023-2027. The EU should be building over 30 GW a year of new wind on average to meet its 2030 targets.

Permitting bottlenecks remain the biggest barrier to the expansion of wind energy. But Governments are now working actively to tackle these, and the new REPowerEU rules will help.

Investments in new wind farms fell in 2022. Europe announced €17bn of new investments which covers 12 GW of new capacity that will be built this year and beyond. This was less than half the amount invested in 2021. Not a single large-scale offshore wind farm reached a final investment decision. Two factors caused this: (a) high inflation in input costs which is insufficiently reflected in developers' revenues; and (b) unhelpful market interventions by National Governments which undermined investor confidence.

FIGURE B. 2023-2027 new onshore and offshore wind installations in Europe – WindEurope's scenarios



Source: WindEurope

2022 Annual figures

- Europe installed 19.1 GW of new wind power capacity in 2022 (gross installations). This was 4% up on 2021. 16.1 GW of the new installations were in the EU-27.
- Onshore wind made up 87% of the new installations with 16.7 GW. In the EU-27 onshore represented 92%.
- New offshore wind installations in Europe were 2.5 GW.
- Europe's wind farms generated 487 TWh of electricity in 2022. This covered 17% of the electricity demand in the EU-27+UK.
- Investment in new wind farms fell in 2022. Europe announced €17bn of new investments which covers 12 GW of new capacity that will be built this year and beyond. This was less than half the amount invested in 2021.

Total installed capacity

- Europe now has 255 GW of installed wind power capacity: 225 GW onshore and 30 GW offshore. The EU-27 has 204 GW installed. 188 GW onshore and 16 GW offshore.

Performance of new wind farms

- The anticipated capacity factors of the new onshore wind farms built in Europe in 2022 is 30-45%. And around 50% for offshore wind.
- The average power rating of new onshore turbines was 4.1 MW. For offshore wind it was 8.0 MW.

Country highlights

- Germany installed the most wind power capacity in 2022 (2.7 GW). 88% of that was onshore wind.
- Sweden (2.4 GW), Finland (2.4 GW), France (2.1 GW), the UK and Spain (each with 1.7 GW) came next.
- Denmark and Ireland had the highest share of wind in their electricity mix with 55% and 34% respectively.
- Wind met more than 20% of the electricity demand in another five countries: the UK (28%), Germany (26%), Portugal (26%), Spain and Sweden (both 25%).
- Despite the war Ukraine installed 83 MW of new capacity. 75% of its total installed capacity of 1.8 GW is currently out of operation.

2023-2027 Outlook

- We expect Europe to install 129 GW of new wind power capacity over the next five years. We expect the EU to install 98 GW of this, 19.6 GW a year on average.
- We expect 74% of the new installations in Europe over 2023-27 to be onshore.
- The EU needs to build on average 31 GW a year to 2030 to meet the REPowerEU renewable energy goals.
- Governments are working to address the permitting issues that have caused construction bottlenecks over the past few years and policies are being introduced that could help streamline the process of approving spatial and planning requirements for wind farms. This effort needs to be accelerated if Europe is to meet its energy and climate targets.
- The EU's upcoming Electricity Market Design revision has to restore investor confidence. It must make clear that EU emergence measures are temporary. Contracts-for-Difference (CfDs) will be crucial for new investments. But investors must be allowed to finance their projects with Power Purchase Agreements (PPAs) and on a purely merchant basis if they prefer.

Old wind farms and repowering

- Europe decommissioned 454 MW of wind capacity in 2022. At the same time, it commissioned 591 MW of repowered capacity. The net new capacity additions were 18.7 GW.
- About 5.6 GW is expected to be decommissioned over the next five years. We expect 3.2 GW of this to be repowered (leading to 5.2 GW of repowered capacity). The remaining 2.4 GW will be fully decommissioned and removed from the system.
- Repowering wind farms on average trebles the output whilst reducing the number of turbines by 25%.

1. Referred to as capacity under repowering.

TABLE 1. New additions, total wind capacity and the share of wind in the electricity demand in 2022 [2] [3]

	New installations in 2022 (MW)			Cumulative capacity (MW)			Share of wind in power mix in 2022		
EU-27	**Onshore**	**Offshore**	**Total**	**Onshore**	**Offshore**	**Total**	**Onshore**	**Offshore**	**Total**
Austria	328	-	**328**	3,586	-	**3,586**	12%	-	**12%**
Belgium	303	-	**303**	3,045	2,261	**5,306**	5%	8%	**13%**
Bulgaria	-	-	**-**	707	-	**707**	4%	-	**4%**
Croatia	-	-	**-**	1,100	-	**1,100**	13%	-	**13%**
Cyprus	-	-	**-**	158	-	**158**	6%	-	**6%**
Czechia	-	-	**-**	337	-	**337**	1%	-	**1%**
Denmark	131	-	**131**	4,974	2,308	**7,282**	31%	25%	**55%**
Estonia	-	-	**-**	320	-	**320**	8%	-	**8%**
Finland	2,430	-	**2,430**	5,607	71	**5,678**	14%	-	**14%**
France	1,590	480	**2,070**	20,653	482	**21,135**	8%	-	**8%**
Germany	2,403	342	**2,745**	58,267	8,055	**66,322**	21%	5%	**26%**
Greece	230	-	**230**	4,682	-	**4,682**	19%	-	**19%**
Hungary	-	-	**-**	329	-	**329**	1%	-	**1%**
Ireland	280	-	**280**	4,612	25	**4,637**	34%	-	**34%**
Italy	496	30	**526**	11,818	30	**11,848**	7%	0%	**7%**
Latvia	59	-	**59**	137	-	**137**	3%	-	**3%**
Lithuania	69	-	**69**	740	-	**740**	12%	-	**12%**
Luxembourg	29	-	**29**	166	-	**166**	-	-	**-**
Malta	-	-	**-**	-	-	**-**	-	-	**-**
Netherlands	933	369	**1,302**	6,223	2,829	**9,052**	12%	7%	**19%**
Poland	1,517	-	**1,517**	7,864	-	**7,864**	11%	-	**11%**
Portugal	28	-	**28**	5,671	25	**5,696**	26%	0%	**26%**
Romania	-	-	**-**	3,029	-	**3,029**	12%	-	**12%**
Slovakia	-	-	**-**	3	-	**3**	0%	-	**0%**
Slovenia	-	-	**-**	3	-	**3**	0%	-	**0%**
Spain	1,659	-	**1,659**	29,793	5	**29,798**	25%	-	**25%**
Sweden	2,441	-	**2,441**	14,393	192	**14,585**	25%	-	**25%**
Total EU-27	**14,927**	**1,221**	**16,148**	**188,216**	**16,283**	**204,499**	**14%**	**2%**	**16%**

2. All numbers are rounded and therefore may not sum to totals.
3. The impact of the war in Ukraine is unknown.

	New installations in 2022 (MW)			Cumulative capacity (MW)			Share of wind in power mix in 2022		
Others	**Onshore**	**Offshore**	**Total**	**Onshore**	**Offshore**	**Total**	**Onshore**	**Offshore**	**Total**
Albania	-	-	**-**	-	-	**-**	-	-	**-**
Belarus	-	-	**-**	3	-	**3**	-	-	**-**
Bosnia & Herzegovina	-	-	**-**	135	-	**135**	-	-	**-**
Faroe Islands	-	-	**-**	68	-	**68**	-	-	**-**
Iceland	-	-	**-**	3	-	**3**	-	-	**-**
Kosovo	-	-	**-**	137	-	**137**	-	-	**-**
Liechtenstein	-	-	**-**	-	-	**-**	-	-	**-**
Montenegro	-	-	**-**	118	-	**118**	-	-	**-**
North Macedonia	-	-	**-**	37	-	**37**	-	-	**-**
Norway	372	60	**432**	5,083	66	**5,149**	11%	-	**11%**
Russia	-	-	**-**	2,043	-	**2,043**	-	-	**-**
Serbia	-	-	**-**	374	-	**374**	-	-	**-**
Switzerland	-	-	**-**	87	-	**87**	0%	-	**0%**
Turkey	867	-	**867**	11,969	-	**11,969**	11%	-	**11%**
UK	502	1,179	**1,681**	14,575	13,918	**28,493**	12%	15%	**28%**
Ukraine	-	-	**-**	1,673	-	**1,673**	-	-	**-**
Total others	**1,741**	**1,239**	**2,980**	**36,305**	**13,984**	**50,289**	**-**	**-**	**-**
Total Europe	**16,668**	**2,460**	**19,128**	**224,521**	**30,267**	**254,788**	**14%**	**3%**	**17%**

1.

"We connected 19 GW of new wind farms to the electricity grid in 2022. In many ways this is good news – especially given the challenges we face as an industry. But the reality is that we need to be installing much more for Europe to meet its climate and energy goals for 2030"

Giles Dickson

Chief Executive Officer,
WindEurope

Wind power in 2022

1.1 Overview

New wind installations in Europe totalled 19.1 GW in 2022, with 16.7 GW of wind capacity installed onshore and 2.5 GW offshore. Despite the challenging economic environment and supply chain difficulties, this was a record year for installations in Europe with an increase of 4% compared with the previous year. However, installations fell short of our realistic expectations scenario from 2021 by 12% and were well below the rates requited to meet Europe's climate and energy goals.

For the EU to reach a 45% renewable energy target by 2030, wind energy installations need to average 31 GW per year between 2023 and 2030. This is based on an installed wind power capacity target of 440 GW (see section 4.1).

Wind farm installations in Germany were the highest in Europe in 2022 with almost 90% of the installed capacity onshore, continuing the trend of recovering installation rates. The offshore wind farm Kaskasi (342 MW) was connected to the grid giving Germany a total installations figure of 2.7 GW. Sweden and Finland (2.4 GW each) and France (2.1 GW), including its first large-scale offshore wind farm Saint Nazaire (480 MW), all saw record capacity installations.

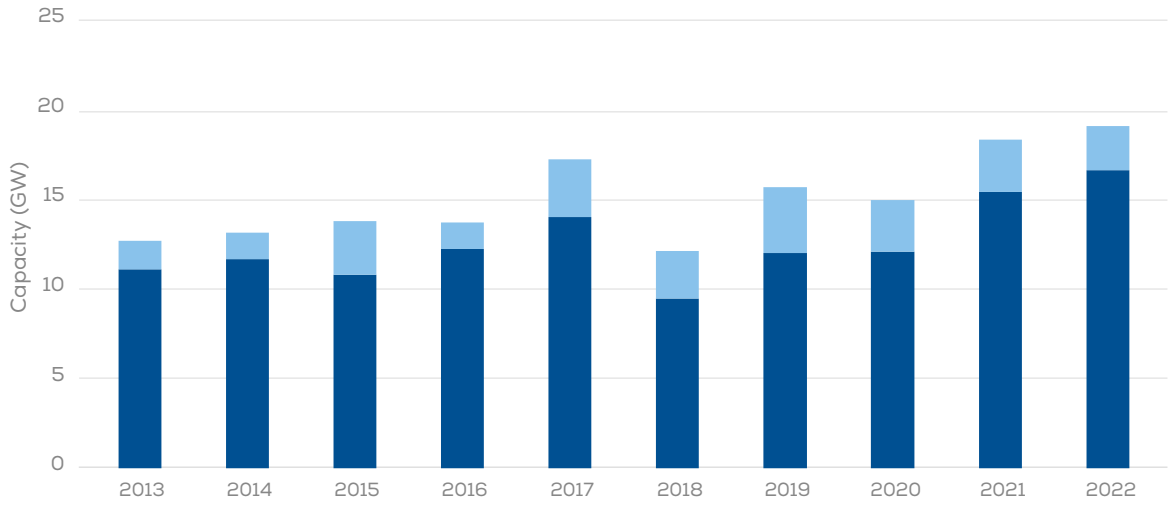
There were also record installations in Poland (1.5 GW). These installations represent some of the last projects permitted before the introduction of the 10H rule (which restricts the building of onshore wind farms) in 2016. Future installations will grind to a halt if the law is not abolished. The Polish Government should reform the 10H rule and introduce a 500m setback distance in line with European standards.

Offshore wind accounted for 13% of installations in Europe with 2.5 GW of wind farm capacity connecting to the grid.

Nearly half of the newly connected capacity was in the UK (1.2 GW) with the remainder coming from France (0.5 GW), the Netherlands (0.4 GW), Germany (0.3 GW) and Italy with its first offshore wind farm Beleolico (30 MW).

In 2022 new wind installations in the EU-27 totalled 16.1 GW, representing 84% of all installations in Europe.

FIGURE 1. New onshore and offshore wind installations in Europe



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Onshore	11.1	11.7	10.8	12.3	14.1	9.5	12.0	12.1	15.4	16.7
Offshore	1.6	1.5	3.0	1.5	3.2	2.7	3.7	2.9	2.9	2.5

Source: WindEurope

Outside the EU, the 3 GW installed were attributable to the UK (1.7 GW), Turkey (0.9 GW) and Norway (0.4 GW).

There were 0.5 GW of decommissioned wind capacity in 2022, so net installations in Europe (installed minus decommissioned capacity) totalled 18.6 GW.

Astonishingly there were 83 MW of new wind energy installations in Ukraine. The tragic war there has led to some destruction of several wind turbines and approximately 1.3 GW or 75% of its installed capacity was out of operation at the end of 2022, but not destroyed. Given the uncertainty of the situation, data from the region has not been included in the 2022 annual statistics for Europe.

1.2 Installations

Germany installed the most new wind power capacity in 2022 with 2.7 GW. 2.4 GW was onshore, up from 1.9 GW in 2021. Additionally, Germany connected 342 MW of offshore wind capacity in the North Seas, all from the Kaskasi offshore wind farm. 0.3 GW of old wind farm capacity was decommissioned.

Sweden set a new national record for installations in a single year with 2.4 GW, up from 2.1 GW in 2021. This was the most onshore wind capacity installed in Europe, equal with Finland.

Finland also saw a record year for installations, with them also installing 2.4 GW onshore in 2022, almost four times the installation figure in 2021 (0.7 GW).

France installed a record 2.1 GW of wind power capacity, of which 1.6 GW was onshore. The remaining 480 MW were installed at France's first commercial-scale offshore wind farm, Saint Nazaire

The UK installed 1.7 GW of wind power capacity, significantly less than the year before when it installed 2.7 GW. Offshore installations totalled 1.2 GW making the UK the European country with the most offshore wind capacity installed in 2022. Onshore installations were 0.5 GW.

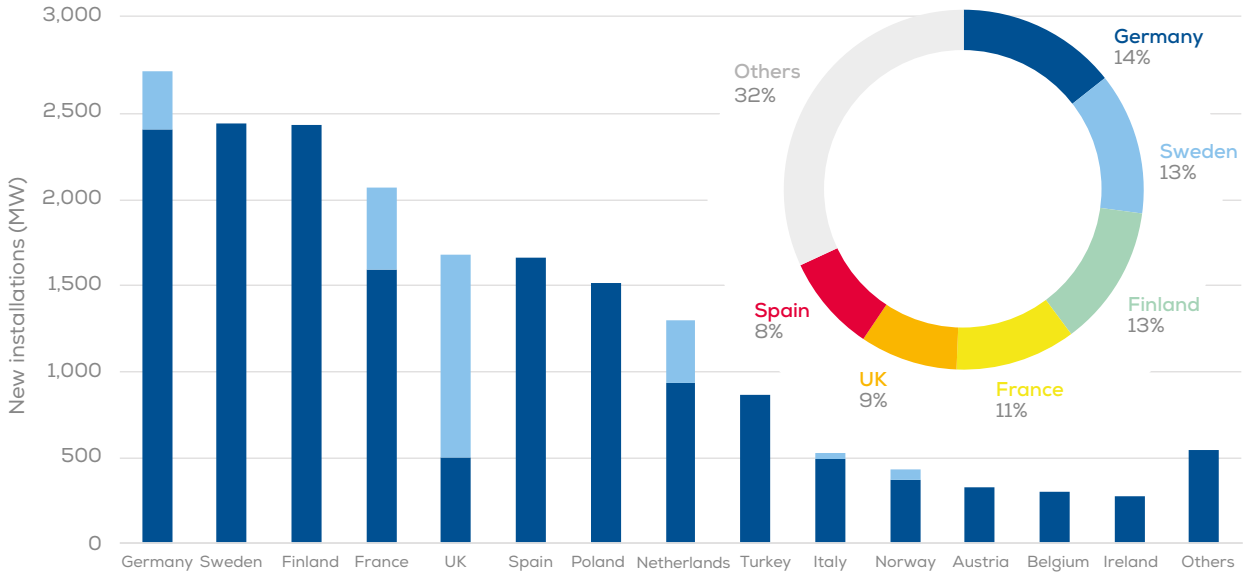
Spain installed 1.7 GW of onshore capacity. This was around twice the capacity installed in 2021 and in line with expectations.

Poland hit an all-time record, installing 1.5 GW of onshore wind. This was despite the infamous 10H rule which bans the construction of onshore wind farms within a distance of ten times the height of a turbine from residential buildings. The installations represent some of the last projects permitted before the introduction of the law in 2016. Future installations will grind to a halt if the 10H rule is not abolished.

87%

OF WIND INSTALLATIONS IN 2022 CAME FROM ONSHORE WIND

FIGURE 2. New wind installations in Europe per country in 2022



	Germany	Sweden	Finland	France	UK	Spain	Poland	Netherlands	Turkey	Italy	Norway	Austria	Belgium	Ireland	Others
Onshore	2,403	2,441	2,430	1,590	502	1,659	1,517	933	867	496	372	328	303	280	546
Offshore	342	0	0	480	1,179	0	0	369	0	30	60	0	0	0	0

Source: WindEurope

The Netherlands installed a total of 1.3 GW, of which 0.9 GW were onshore and 369 MW were turbines connected at the Hollandse Kust Zuid 1&2 offshore wind farm.

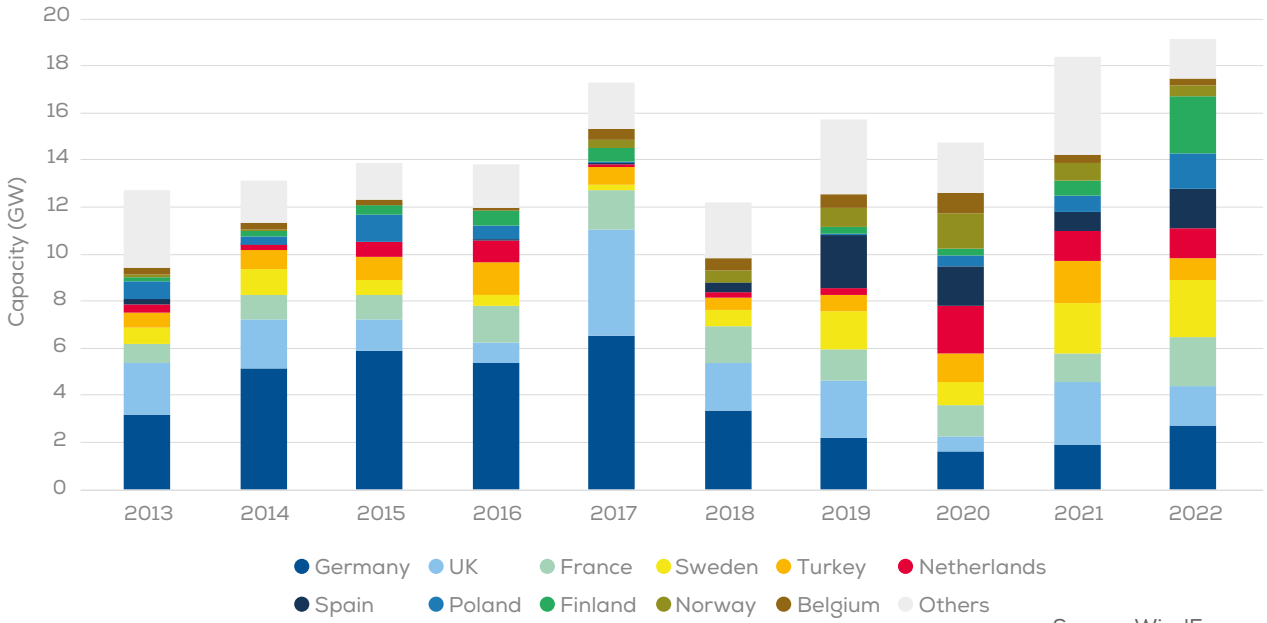
Turkey installed 867 MW of onshore wind capacity in 2022, less than half of the record 1.8 GW installed in 2021[4].

Italy installed 0.5 GW, including its first offshore wind farm in the waters of Taranto, in the Apulia region. The Beleolico wind farm has 10 turbines and a total capacity of 30 MW.

Norway installed 0.5 GW, 372 MW of which were installed onshore. The floating offshore wind farm Hywind Tampen connected seven turbines to the grid with a combined 60 MW.

23 countries did not have any wind installations in 2022[5]. 10 of these are EU Member States.

FIGURE 3. Distribution of new wind installations by country in 2013-22



Source: WindEurope

4. Turkey's 2021 installations have been revised upward from the 1.4 GW previously communicated.

5. Including 83 MW installed in Ukraine.

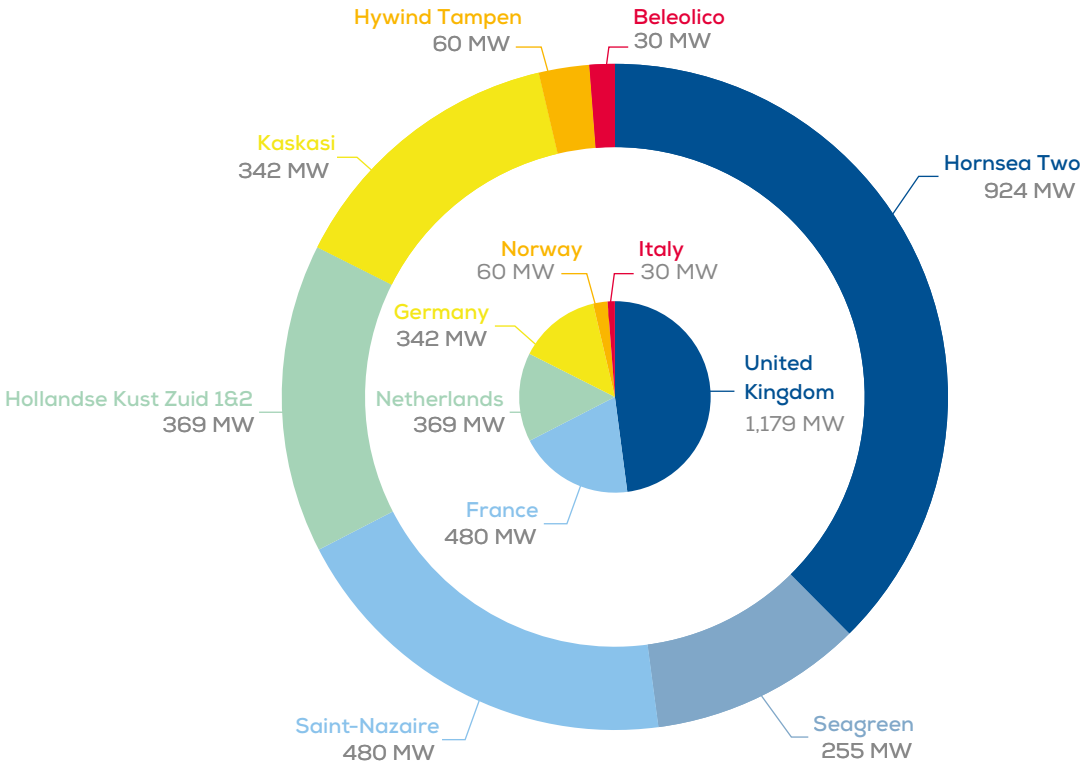
A total of 2.5 GW of offshore capacity was connected to the grid in Europe. There were seven wind farms across six countries connecting turbines to the grid in 2022.

The UK commissioned the world's largest wind farm Hornsea Two (1,386 MW). In 2022 the last 110 turbines (924 MW) were connected to the grid. In addition, the first turbines at Seagreen were connected (27 turbines 255 MW). The total capacity of the project will be 1,075 MW.

In France the 480 MW Saint Nazaire wind farm became the country's first operational commercial-scale offshore wind farm.

In the Netherlands and Germany there were 369 MW and 342 MW of capacity connected to the grids respectively. At Hollandse Kust Zuid 1&2, which will have a total capacity of 760 MW, 34 turbines were connected and all 38 turbines were connected at the Kaskasi offshore wind farm. Finally, after 14 years of delays, Italy installed its first offshore wind farm, the 30 MW Beleolico.

FIGURE 4. New offshore wind farms in Europe in 2022



Source: WindEurope

Decommissioning, capacity under repowering and repowered capacity

Wind farms have a finite operational lifetime. For the oldest wind farms this is typically in the region of 15 – 25 years. Newer wind farms, constructed with more modern turbines will likely have longer lifetimes.

When the wind farm reaches the end of its operational lifetime, assuming its lifetime is not extended by replacing components or blades, the turbines will be shut off, taken down and removed. This is known as decommissioning.

Often it will make sense to repower the wind farm since this involves replacing all the turbines, cables and grid connections with modern turbines and accessories which are more powerful and efficient. The original capacity that is being replaced is known as capacity under repowering.

Wind farm capacity that is decommissioned but not repowered is fully decommissioned.

Finally, because of the enormous technological advances since the early turbines were installed, the new repowered wind farms often have increased capacity even with fewer new turbines. This increased capacity is known as repowered capacity.

Decommissioned capacity = Capacity under repowering + Fully decommissioned capacity

Repowered capacity = Capacity of new wind farm

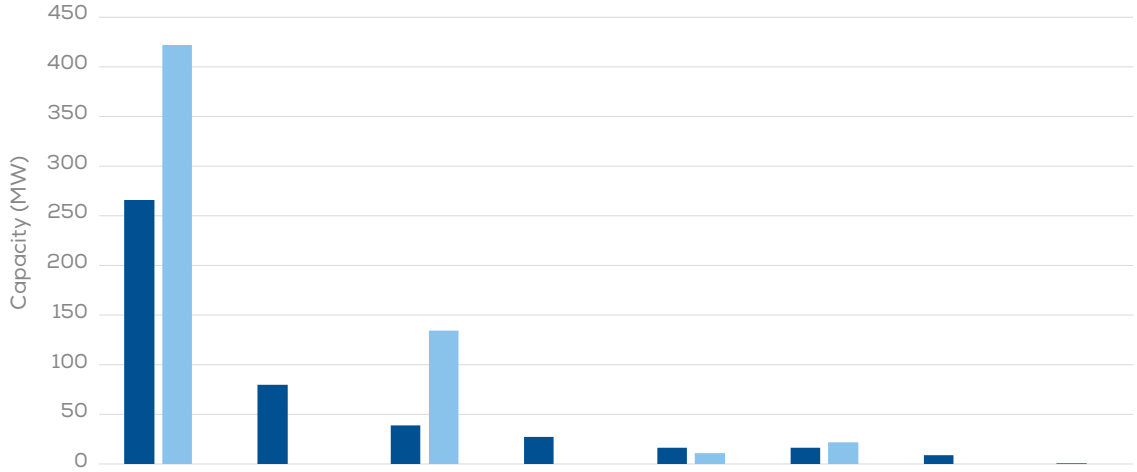
1.3 Decommissioning and repowering

454 MW of wind power was decommissioned in 2022. The decommissioning took place in Germany (266 MW), the Netherlands (80 MW[6]), Austria (39 MW), Denmark (27 MW), Belgium (16 MW), France (16 MW), Finland (9 MW) and the UK (0.5 MW).

Out of the 19.1 GW of wind power capacity added in Europe in 2022 only 591 MW were from repowering projects[7]. Most repowering took place in Germany and Austria with some also taking place in the Netherlands, Belgium and France.

Repowering represents a major opportunity to quickly boost wind energy installations in Europe. Not only do older projects tend to be located in the best wind locations, but asset owners should be very familiar with the site conditions, with many years of operational data. Much of the infrastructure is already in place (roads, substations) and there is generally less opposition from local communities (although it is still important to engage local communities given the likely increase in the size of the turbines).

FIGURE 5. Decommissioned and repowered capacity in 2022



	Germany	Netherlands	Austria	Denmark	France	Belgium	Finland	UK
Decommissioned	266	80	39	27	16	16	9	1
Repowered	423	0	135	0	11	22	0	0

Source: WindEurope

6. Provisional information.
7. Based on information provided by National Associations. Modelling suggests repowering capacity should be greater.

454 MW

DECOMMISSIONED IN 2022

Obtaining new permits should therefore be quicker and more efficient than greenfield projects.

The EU has recognised the potential for repowering projects and has introduced emergency legislation (under Article 122 of the EU Treaty) to accelerate the deployment of renewable energy. The legislation calls on Member States to ensure that all permitting procedures for renewable projects should be completed within two years, and for repowering projects six months.

However, high electricity prices and regulatory and investment uncertainty, following on from the various revenue caps and the upcoming EU Electricity Market Design Review, will likely increase the attractiveness for developers and asset owners to extend project lifetimes rather than repower their wind farms.

1.4 Power generation

Wind energy met a record 17% of demand across the EU-27+ UK, an increase of 2% from 2021.

Wind conditions, especially in northern Europe, were significantly better and coupled with strong installations in Sweden and Finland particularly, generation in the EU-27 + UK was up more than 9% compared with 2021.

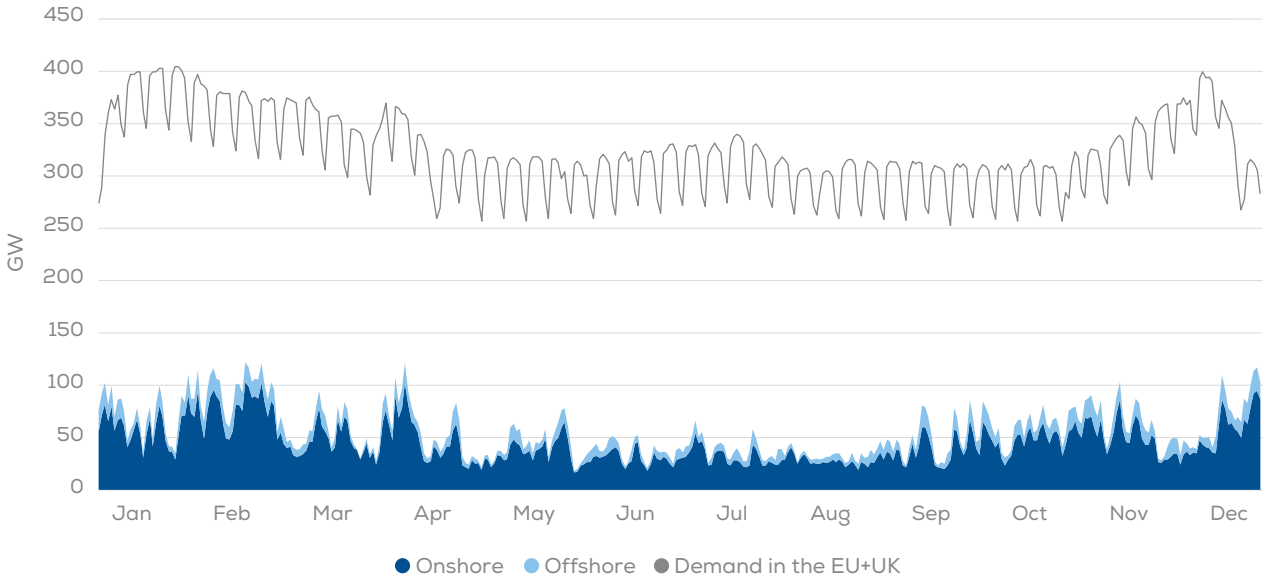
Conversely electricity demand was down in 2022 because of particularly high prices and measures introduced by Governments to reduce demand in the wake of the Russian invasion of Ukraine.

In 2021 Spain and Italy were alone amongst the major markets in increasing power output from the previous year. In 2022 they were alone amongst the major markets in not increasing power output. All other countries in Europe with the exception of Estonia, Slovakia, Hungary and Slovenia, produced more wind power than in 2021.

Wind power plants in Europe produced 489 TWh of electricity in 2022 and covered 17% of the electricity demand (14.1% from onshore and 3.2% from offshore wind). Wind power achieved record daily production on 16 February (2,927 GWh) corresponding to 122 GW average output or about 56% of the fleet producing at maximum output for the entire day. And wind met 26% of the electricity demand in Europe for the whole of the month of February.

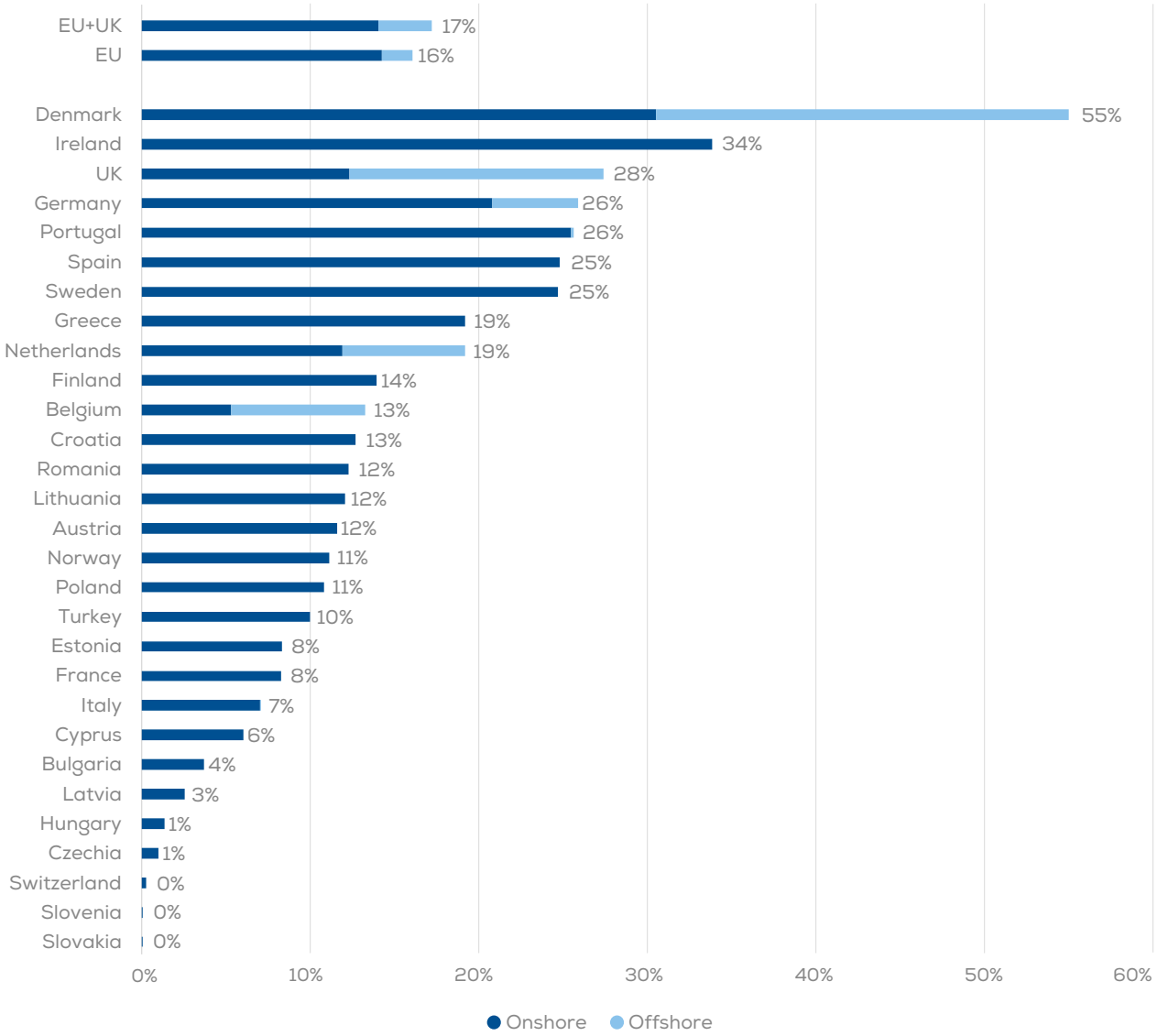
The day of the year in which wind power plants generated the lowest output of electricity was on 30 May when total generation was 449 GWh, covering 6% of demand in Europe on that day.

FIGURE 6. Power demand and wind energy generation in the EU-27 and the UK in 2022 (GW)



Source: WindEurope

FIGURE 7. Percentage of electricity demand covered by wind[8]



Source: WindEurope

WIND ENERGY MET

17%

OF THE ELECTRICITY DEMAND IN THE EU AND UK IN 2022

Denmark had the highest share of wind with an impressive 55%, followed by Ireland with 34%. The UK became the country with the third highest share of wind with 28%.

Germany (26%), Portugal (26%), Spain (25%), and Sweden (25%) followed. Across the board the share of wind was higher in 2022 than 2021. 17 countries had wind energy shares above 10%.

In Sweden and Finland, good wind conditions and strong installations led to an increase in the share of wind of 6% and 5% respectively compared with 2021.

The Netherlands also saw a significant increase in the share of wind energy in the electricity mix, from 12% in 2020 to 15% in 2021 and 19% in 2022. This was driven by the installed onshore and offshore capacity doubling since the start of 2020 (2.6 GW onshore and 1.8 GW offshore) and favourable wind conditions in the North Sea in 2022.

8. 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-27 and in the EU+UK (TWh)

	Electricity consumption in EU+UK (TWh)	Onshore wind energy production (TWh)	Offshore wind energy production (TWh)	Total wind energy production (TWh)	Share of consumption met by wind energy
EU-27	2,549	364	48	412	16%
EU+UK	2,828	399	90	489	17%

Wind energy generation in Europe (EU+UK) in 2022 reached new records in terms of absolute production (489 TWh), and for share of consumption met by onshore (14.1%) and offshore wind energy (3.2%). It is not surprising that the general trend is of increased generation and share of demand given the new installations of ever more powerful turbines. But wind conditions also play a role and this was highlighted in 2021 when generation was lower than in 2020.

The electricity demand in Europe was also lower in 2022 than in 2021, driven down by very high electricity prices across the year and measures taken by Governments to reduce demand in the wake of the Russian invasion of Ukraine.

In the EU, the share of wind energy covering electricity demand reached 16%. The lack of the UK's large offshore fleet (which produced 42 TWh in 2022) in the EU figures is the main reason for this lower share. The REPowerEU Action Plan envisages an increase in the targeted renewable share in the energy mix from the current goal of 32% by 2030 to 45% (the final target is likely to be a compromise between the two). This amounts to a 36-50% share of wind in the EU's electricity mix by 2030.

Capacity factors for the entire wind fleet in the EU and UK were 25% on average. Capacity factors for onshore were 24% (up from 22% in 2021), while for offshore they were 36%, up from 32% in 2021.

The fleet-wide capacity factor numbers are relatively low compared with new wind farms as they represent the performance of the entire wind fleet, including very old installations. Old installations typically feature turbines with large generators and relatively small rotors (short blades). These are best suited for very windy locations. Modern turbines can be built in locations with a lower high-speed wind resource, and thus need to take advantage of lower-wind speeds. They use larger blades and relatively smaller 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 42% and 55%.

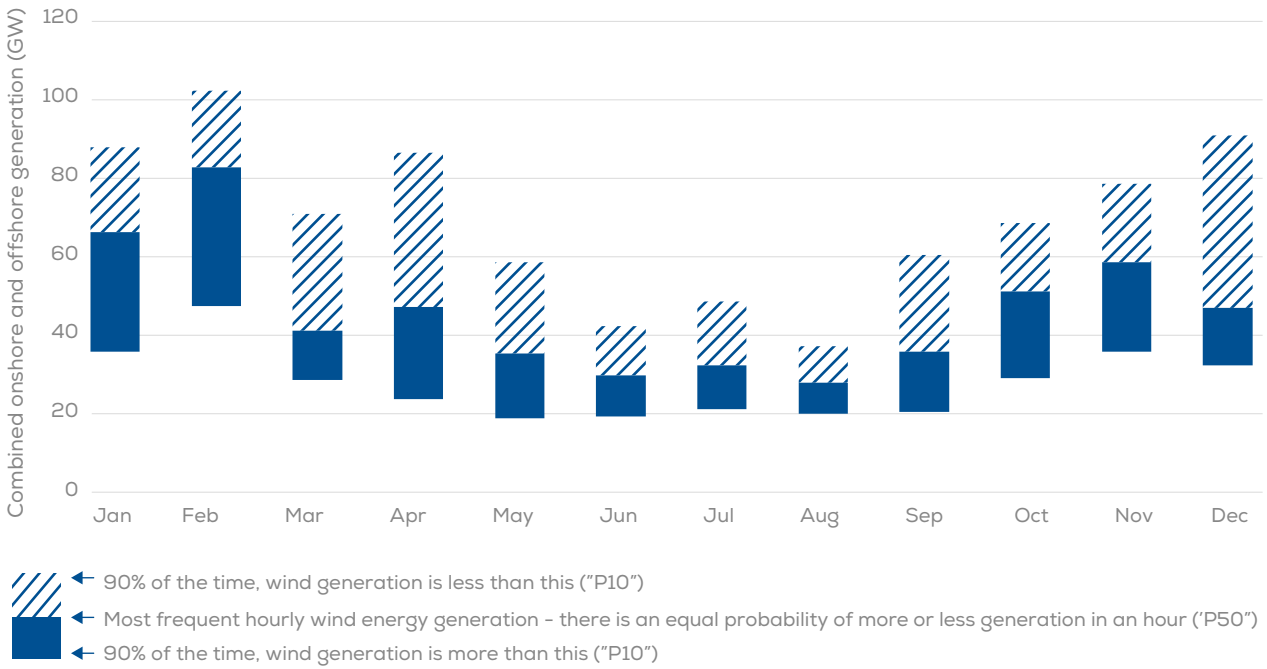
Figure 8 shows the range of hourly electricity generation from wind energy during each month of 2022. In January for instance, the average (median) power output of the wind fleet was 66 GW, while we could rely on at least 36 GW most of the time (90% of the hours). There were a few instances (10% of all hours) where output exceeded 88 GW. Similarly to 2020 and 2021, February saw the highest average output with 83 GW. And for 90% of the time the EU and UK's wind output was more than 47 GW, equivalent to over 90% of the average demand of France.

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

August had the lowest average generation. Output for 90% of the hours exceeded 20 GW, and for 10% of the hours, it was more than 37 GW.

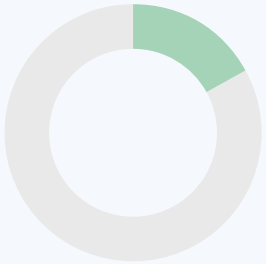
Wind energy production is variable, and the hourly variability generally follows a set pattern of more wind generation and greater variability of generation in the winter months. Over the summer when stable, high-pressure systems are more common in Europe, wind energy generation tends to be lower and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

FIGURE 8. Spread of hourly wind energy generation in the EU+UK in 2022



Source: WindEurope

European wind energy generation 2022



17%
of EU + UK electricity demand

489 TW/h
EU + UK wind energy generation

Highest wind energy shares

- 55%
- 34%
- 28%
- 26%
- 26%
- 25%
- 25%

225 GW
onshore wind capacity

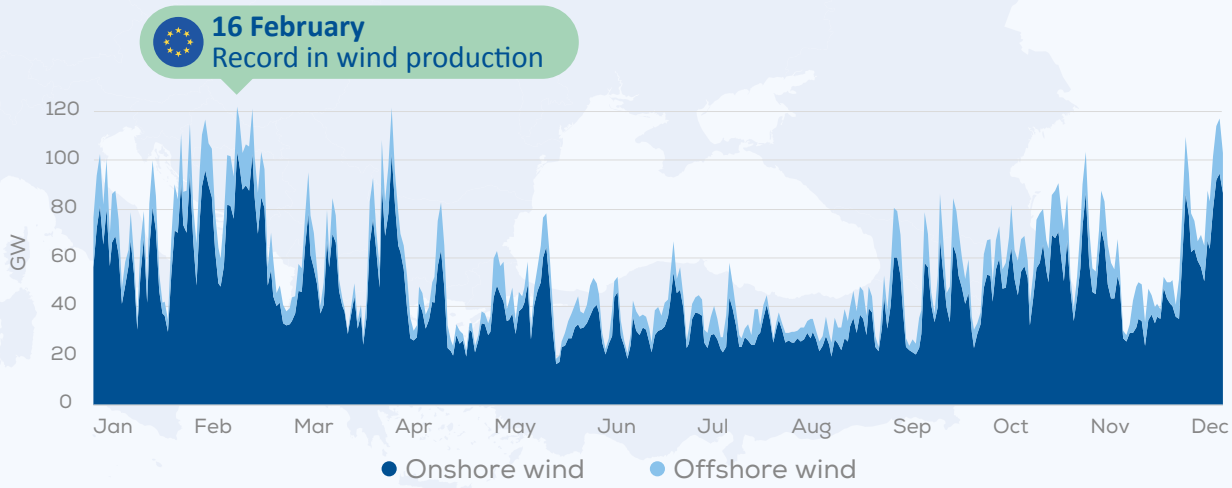
14%
onshore wind of EU + UK electricity demand

24%
average onshore wind capacity factor*

30 GW
offshore wind capacity

3%
offshore wind of EU + UK electricity demand

36%
average offshore wind capacity factor*



*Capacity factors of entire fleet including old turbines

1.5 Turbine sizes

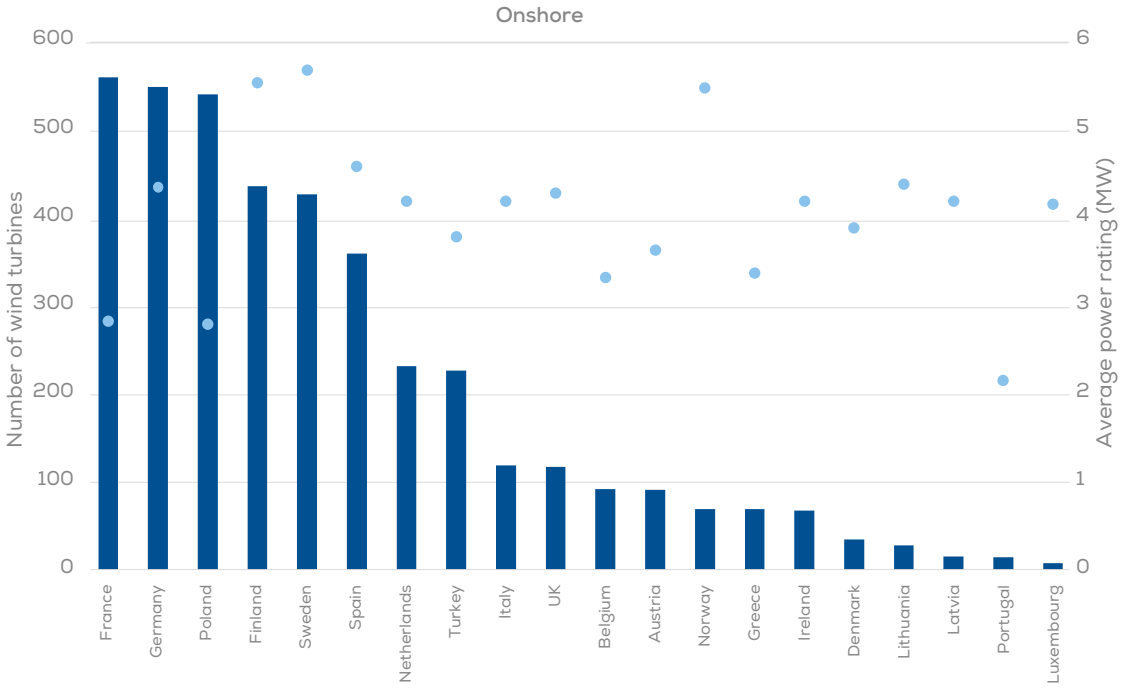
The size and type of wind turbines installed in Europe varies between countries. The most powerful onshore wind turbines were installed in Sweden, with an average power rating of 5.7 MW, closely followed by Finland, with an average power rating of 5.6 MW.

Portugal had the lowest average power rating with 2.2 MW, albeit based on only 13 installed turbines. Poland installed the second lowest average turbine rating of 2.8 MW. Power ratings are closely correlated to the size of the turbines and in Poland the sizes are largely constrained by the so-called 10H rule which limits the minimum distance between a wind turbine and nearby housing to ten times the tip height of a turbine.

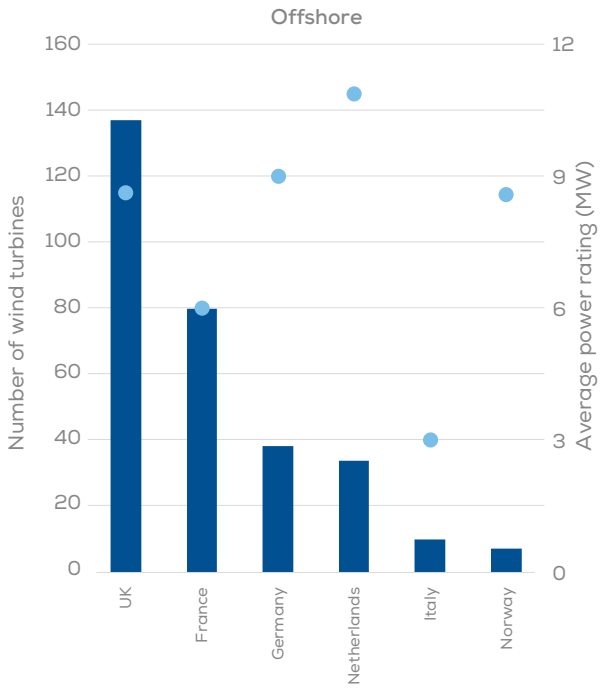
The average power rating of onshore turbines installed in 2022 across Europe was 4.1 MW, equal to the value recorded in 2021.

In 2022 the average rated capacity of newly installed off- shore turbines was 8 MW, also equal to the figures for 2021. The Netherlands had the highest average power rating with 10.9 MW. In Italy, the Beleolico wind farm which went through many years of project delays, had the lowest average power rating with 3 MW.

FIGURE 9. Number of turbines installed in 2022 and their average power rating



	France	Germany	Poland	Finland	Sweden	Spain	Netherlands	Turkey	Italy	UK	Belgium	Austria	Norway	Greece	Ireland	Denmark	Lithuania	Latvia	Portugal	Luxembourg
Average power rating	2.8	4.4	2.8	5.6	5.7	4.6	4.2	3.8	4.2	4.3	3.3	3.6	5.5	3.4	4.2	3.9	4.4	4.2	2.2	4.2
Number of wind turbines	562	551	542	437	428	361	232	227	118	117	91	90	68	68	67	34	27	14	13	7



	UK	France	Germany	Netherlands	Italy	Norway
	8.6	6.0	9.0	10.9	3.0	8.6
	137	80	38	34	10	7

Source: WindEurope

Based on disclosed wind turbine orders, the average power rating of onshore turbines ordered in 2022 was 5.1 MW. For offshore turbines, this figure reached 12.2 MW. These turbines should be installed over the next few years and this will likely continue the trend of increasing power ratings for installed turbines.

1.6 Auction and tenders

In 2022 wind energy secured 16.9 GW in 15 countries, surpassing the figure of 12.4 GW that was allocated in 2021. 9.5 GW was awarded to offshore wind in the UK, Germany and the Netherlands and 7.4 GW of onshore wind was awarded in 15 countries. The results of four auctions in the Czech Republic, France, the Netherlands and Romania are not yet available.

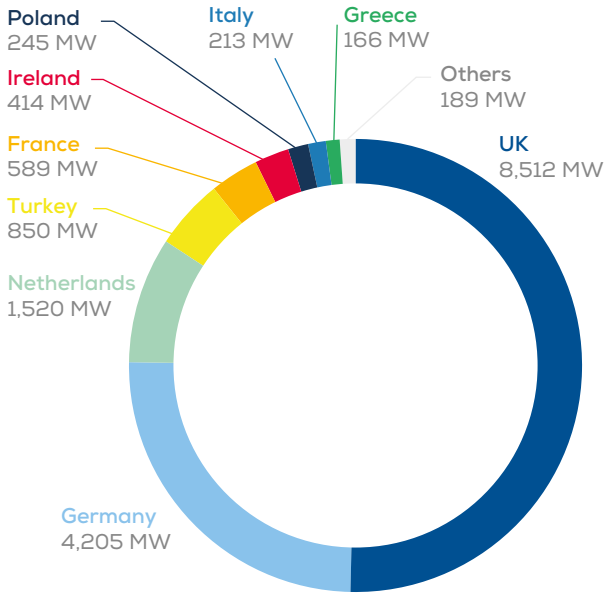
Onshore

Germany awarded the most capacity via auctions. 3.2 GW was secured from a total available capacity of 4.6 GW through technology-specific auctions. The average capacity-weighted award value was €58.1/MWh, just below the maximum permissible value of €58.8/MWh. In 2023 Germany will auction a staggering 12.8 GW of onshore wind capacity; however it is unlikely that there will be such a volume of permitted projects which could compete. The Federal Network Agency (BNetzA) has been permitted to increase the maximum allowed bid price by up to 25% (€73.5/MWh), recognising the impact of inflation and more expensive raw materials on project development costs.

The UK awarded almost 1.5 GW of support for onshore wind as part of the Contract-for-Difference (CfD) Allocation Round 4 (AR 4), all in Scotland. This figure included around 900 MW from a maximum 3.5 GW in Pot 1 for established technologies and just under 600 MW from Pot 2, where onshore remote island wind competed against other less established technologies. Onshore wind under Pot 1 cleared at £42.47/MWh (€49.8/MWh), while onshore remote island wind cleared at £46.39/MWh (€54.4/MWh). For CfD AR 5 which will launch in 2023, the administrative strike price of onshore wind has been kept at £53/MWh (€62.2/MWh), while for remote island wind it has been reduced to £53/MWh from £62/MWh (€72.7/MWh).

France's partial results for 2022 indicate that 589 MW of onshore wind capacity was awarded through two rounds: one part of the AO PPE2 technology neutral auction scheme (321 MW) and the other part of the AO PPE2 technology specific auction scheme (268 MW). The weighted average price for onshore wind in the technology neutral round was €78.8/MWh, while the technology specific auction round reported a weighted average price of €67.3/MWh. A second technology specific auction round was run at the end of 2022.

FIGURE 10. Share of auctions and tenders for wind energy support schemes by country in 2022



Source: WindEurope

Turkey awarded support for 850 MW of wind power capacity spread over 20 projects as part of the country's Renewable Energy Resources Zone YEKA tender programme. The lowest bid offer was TRY40.8c/kWh (€23.6/MWh), while the highest bid offer was TRY77.8c/kWh (€45.0/MWh).

Ireland awarded 414 MW of onshore wind capacity via the second edition of its technology neutral Renewable Electricity Support Scheme, RESS 2. The weighted average Price of successful bids – including both onshore wind and solar PV, as well utility-scale and community projects – was €97.9/MWh.

Poland allocated 245 MW of onshore wind support in its technology neutral auction, out of 11.25 TWh offered. This was below the 460 MW awarded to onshore wind in the equivalent auction in 2021. The minimum price achieved for onshore wind was PLN150/MWh (€32.3/MWh).

Italy saw only 213 MW awarded, despite more than 5.7 GW being offered over three rounds in the unsubscribed FER1 technology neutral scheme. The average weighted strike price of the successful bids was €64.2/MWh. The FER 1 CfD scheme which was launched in 2019 originally featured only seven rounds. However, unallocated capacity each round is rolled over to subsequent rounds with the option to create additional rounds if capacity is not fully allocated. Nearly 1.3 GW remains to be tendered under the FER 1 auction scheme.

Greece awarded 166 MW of onshore wind in its technology neutral auction. The average bidding price of the awarded onshore wind volumes was €57.7/MWh.

Croatia awarded 78 MW of onshore wind in its first utility-scale technology neutral auction, which made 300 MW available for onshore wind. The successful projects were awarded premiums of HRK 453.60/MWh (€60.2/ MWh). The maximum strike price was set at HRK 460.91 (€61.4/ MWh).

Austria awarded 45 MW to onshore wind as part of its new renewable energy auction scheme under the recently adopted Renewable Expansion Act. The volume available was capped at 190 MW for 2022 instead of 390 MW which will be tendered annually from 2023 onwards. The average price recorded as part of the auction was €82.2/MWh.

Spain awarded just 45 MW out of 1.5 GW offered to onshore wind. The Spanish Government set a maximum bidding price but did not disclose the cap to bidders. It was later revealed to be at around €45/MWh, but most participants priced their projects at around €60/MWh on average, making their bids unsuccessful.

Estonia tendered support for 540 GWh of renewable electricity as part of its first technology neutral auction. The volume offered was increased from the original 450 GWh due to strong demand. A total of 1,201 GWh of bids were submitted of which 220 GWh was successful from a hybrid onshore wind-solar PV facility. The auction model is based on a one-sided sliding premium (capped at €20/MWh) equal to the difference between the winning bid price (strike price) and the market price of electricity.

The results of some auctions that took place in 2022 are not yet available. They include the Netherlands' scheme on Sustainable Energy Production and Climate Transition Incentive SDE++, the Czech Republic's first renewable energy auction, which featured 30 MW available for onshore wind, and Romania's investment subsidy auction for around 950 MW of eligible technologies including onshore wind. In the second half of 2022 Albania completed the initial phase of its first wind power auction for 200 MW. Bids are expected to be submitted in 2023.

Offshore

The UK auctioned the most offshore wind capacity with 7 GW awarded as part of the CfD AR 4 (Pot 3), exclusively to bottom-fixed offshore. This included the Scottish wind farms Inch Cape Phase 1 (1,080 MW) and the Moray West Offshore Wind Farm which secured support for 294 MW out of its total 882 MW capacity. Other winners were EA3 Phase 1 (1,372 MW), Norfolk Boreas Phase 1 (1,396 MW) and Hornsea 3 (2,852 MW), all in England. The strike price was a record low of £37.35/MWh (€43.8/MWh).

The TwinHub Floating Offshore Wind Project (32 MW) was also successful in securing support from Pot 2 for emerging technologies with a strike price of £87.30/MWh (€102.4/ MWh).

The Netherlands awarded the rights to develop just over 1.5 GW of capacity to Hollandse Kust West VI and VII, with 760 MW each. Both auctions were almost exclusively evaluated against non-price criteria. Site VI was evaluated on biodiversity protection criteria and Site VII on system integration.

Germany awarded 980 MW for the N-7.2 area in the North Sea via a zero-subsidy tender, but the original developer exercised their step-in rights to develop the site.

TABLE 3. Auctions and tenders for wind energy support schemes in 2022

Onshore	Auction	MW awarded	Type of auction	Support mechanism	Price in €/MWh
Austria	EAG- 2022	45	Technology specific	Feed-in-premium (floating)	82
Croatia	OIE br. 1/2022	78	Technology specific	Contract for Difference	60
Estonia	Technology neutral 2022	21	Technology neutral	Feed-in-premium (floating)	19-35
France	AO PPE2 Neutre	321	Technology neutral	Feed-in-premium (floating)	79
	AO PPE2 Eolien terrestre	268	Technology specific	Feed-in-premium (floating)	67
Germany	EEG- February bidding round	1,328	Technology specific	Feed-in-premium (floating)	58
	EEG- May bidding round	931	Technology specific	Feed-in-premium (floating)	59
	EEG- September bidding round	773	Technology specific	Feed-in-premium (floating)	58
	EEG- December bidding round	189	Technology specific	Feed-in-premium (floating)	59
Greece	Joint Competitive Tendering Process	166	Technology neutral	Contract for Difference	58
Ireland	RESS 2	414	Technology neutral	Contract for Difference	98
Italy	FER 1 bidding round 8	40	Technology neutral	Contract for Difference	65
	FER 1 bidding round 9	151	Technology neutral	Contract for Difference	65
	FER 1 bidding round 10	22	Technology neutral	Contract for Difference	65
Poland	AZ/2/2022 (systems > 1 MW)	245	Technology neutral	Contract for Difference	32
Spain	Onshore wind 2022	45	Technology specific	Contract for Difference	43
Turkey	YEKA RES-3 wind	850	Technology specific	Feed-in-tariff	24-45
UK	CfD AR 4- Onshore wind	888	Technology specific	Contract for Difference	50
	CfD AR 4- Remote island wind	598	Technology specific	Contract for Difference	54

Offshore	Auction	MW awarded	Type of auction	Support mechanism	Price in €/MWh
Germany	N-7.2	980	Technology specific	Zero-subsidy bid	n.a.
Netherlands	Hollandse Kust West VI & VII	1,520	Technology specific	Zero-subsidy bid	n.a.
UK	CfD AR 4- Offshore wind	6,994	Technology specific	Contract for Difference	44
	CfD AR 4- Floating offshore	32	Technology specific	Contract for Difference	102

Photo: Jason Bickley

2.

"Wind energy is delivering more clean power to Europe than ever before – meeting 17% of its electricity demand in 2022, up from 13% five years ago. And the further build-out of wind will be key to reducing our dependence on imported fossil fuels and transitioning to climate neutrality"

Sven Utermöhlen

CEO, RWE Offshore Wind
WindEurope Chairman

Wind power in Europe: The full picture

2.1 Europe's total wind power capacity

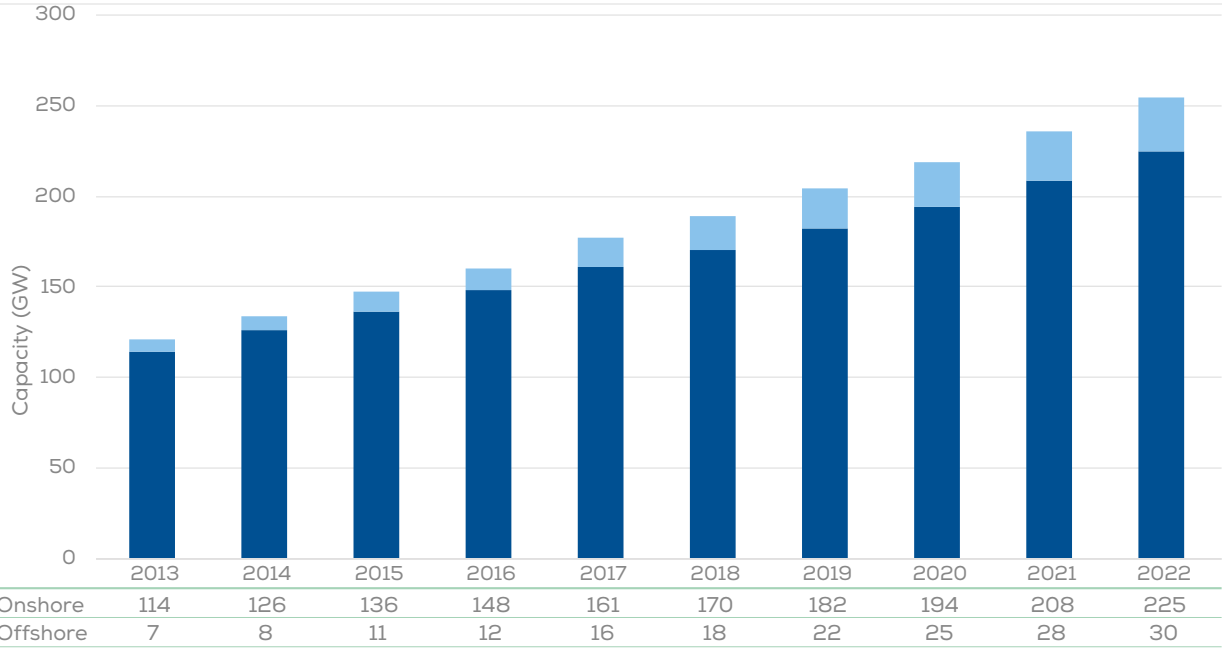
A total of 255 GW of wind power capacity is now installed in Europe. 88% of this (225 GW) is onshore and 12% (30 GW) is installed offshore.

In the EU-27 the total installed wind power capacity has reached 204 GW with 188 GW (92%) onshore and 16 GW (8%) offshore.

255 GW

OF WIND POWER CAPACITY IS NOW INSTALLED IN EUROPE

FIGURE 11. Installed wind power capacity in Europe, 2013-2022



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Onshore	114	126	136	148	161	170	182	194	208	225
Offshore	7	8	11	12	16	18	22	25	28	30

Source: WindEurope

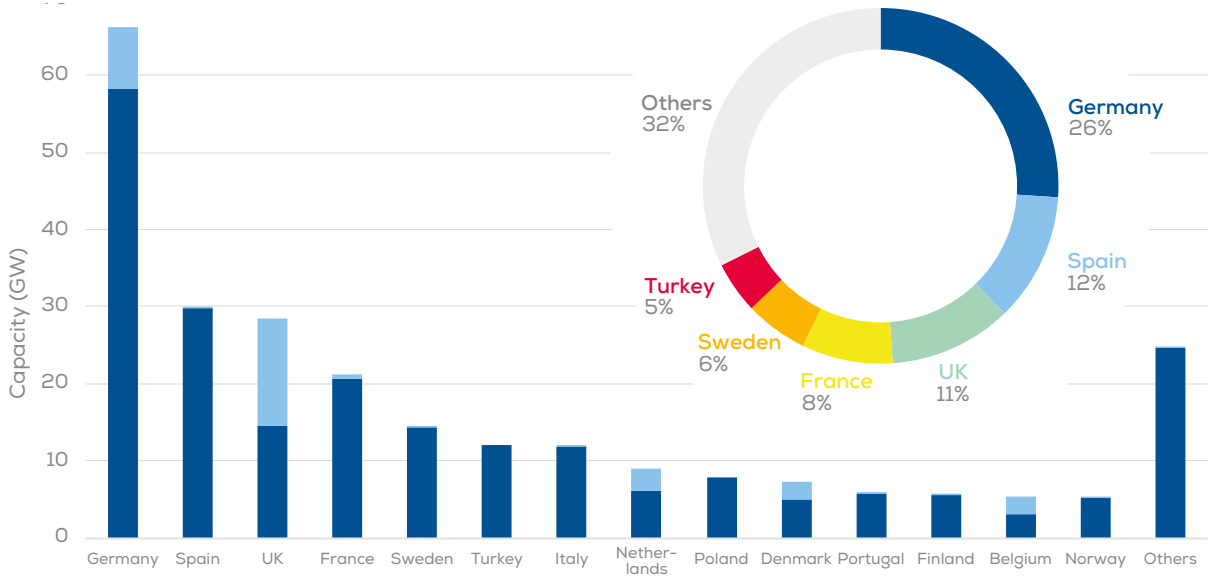
2/3 OF EUROPE'S WIND POWER IS INSTALLED IN JUST SIX COUNTRIES

Germany continues to have the largest installed wind power fleet in Europe with over 66 GW of installed capacity. With Spain (30 GW), the UK (29 GW), France (21 GW), Sweden (15 GW) and Turkey (12 GW), the top six countries account for two-thirds of the total installed capacity in Europe. Italy now sits seventh in Europe with just under 12 GW of installed capacity.

The Netherlands, Poland, Denmark, Portugal, Finland, Belgium, and Norway (ranked here in descending order) all have installed wind power capacity in excess of 5 GW. Among these, Finland jumped five places after record installations in 2022.

The next four countries each have over 3 GW of installed capacity. They are Greece, Ireland, Austria, and Romania.

FIGURE 12. Total wind power installed capacity in by country, 2022



	Germany	Spain	UK	France	Sweden	Turkey	Italy	Nether-lands	Poland	Denmark	Portugal	Finland	Belgium	Norway	Others
Onshore	58	30	15	21	14	12	12	6	8	5	6	6	3	5	25
Offshore	8	0	14	0	0	0	0	3	0	2	0	0	2	0	0

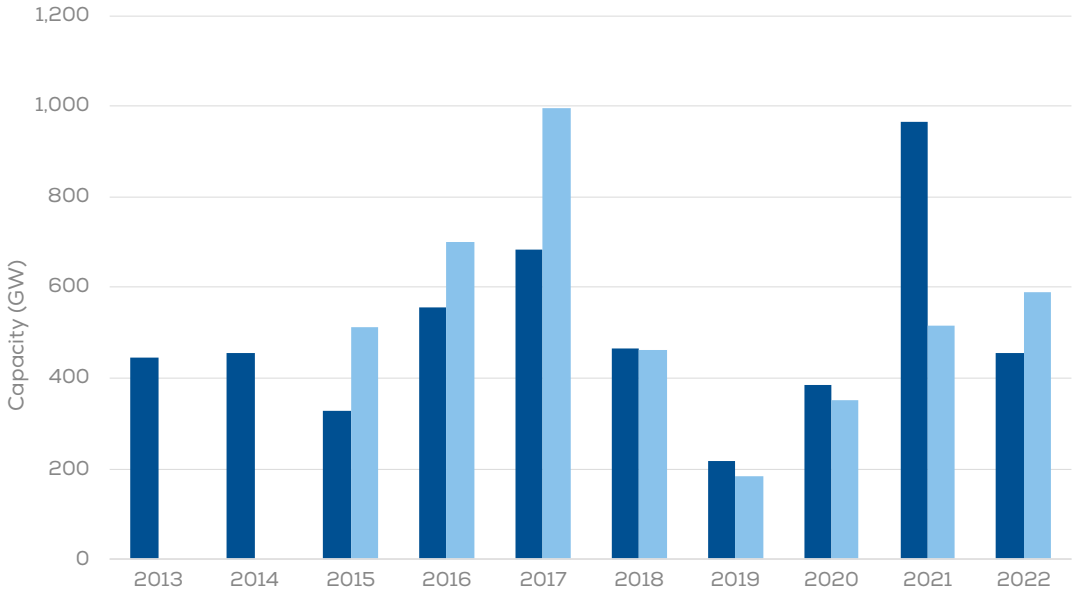
Source: WindEurope

2.2 Decommissioning and repowering trends

454 MW of wind power capacity was decommissioned in Europe in 2022. 1.5 GW was expected to be decommissioned but very high electricity prices throughout the year likely enabled Europe's oldest turbines to continue operating.

Of the 19.1 GW installed in 2022, 591 MW were repowered projects[9]. The total repowered capacity increased for the fourth year running and was the highest since 2017.

FIGURE 13. Decommissioned and repowered capacity in Europe, 2013-22



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Decommissioned capacity	444	455	329	555	684	466	217	383	964	454
Repowered capacity	0	0	513	700	996	461	185	351	515	591

Source: WindEurope

9. Based on information provided by National Associations. Modelling suggests repowering capacity should be greater.

As the European wind turbine fleet ages, it is expected that repowering volumes will increase. Some Governments are setting out new rules to facilitate repowering. But as long as power prices remain higher than expected, the economic situation will continue to favour the lifetime extension of turbines.

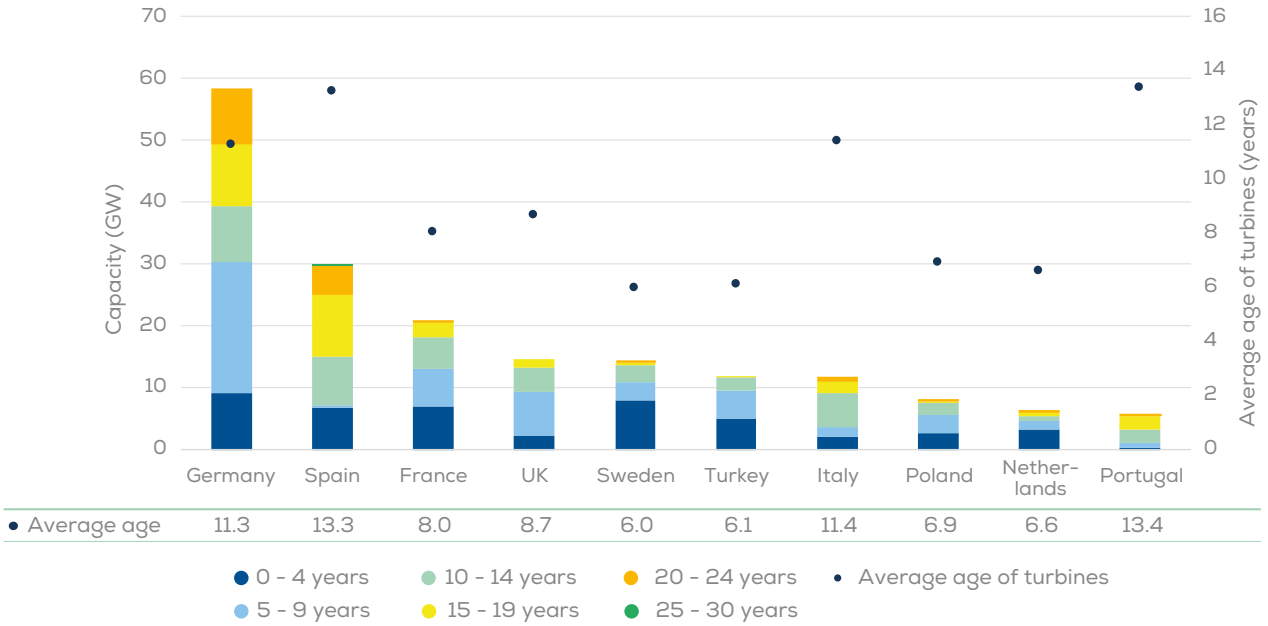
Many of Europe's onshore wind farms are approaching the end of their planned operational lifetime. Currently, 14 GW of Europe's existing wind farms have already been running for more than 20 years. By 2030, 78 GW of capacity will be more than 20 years old. On average, Denmark, Spain and Portugal have the oldest wind fleets. Germany has the largest installed capacity which could potentially be repowered with 17 GW older than 15 years.

Most wind farms reaching the end-of-life stage currently opt for some form of lifetime extension, not only because of the current economic situation, but often because legislative frameworks for repowering are not yet in place.

Wind farm repowering boosts output three times over on average, while also cutting down the number of turbines. It therefore represents a great opportunity to quickly ramp up the wind energy production in Europe.

Almost all repowered capacity by 2030 will be from onshore wind.

FIGURE 14. Age of onshore wind farms in Europe



Source: WindEurope

2.3 Turbine trends

Onshore

The average power rating of turbines installed onshore in 2022 was 4.1 MW, equal to the figure for 2021. Before this, the average power rating grew from a value of 2.4 GW in 2013, an increase of more than 70% over the last decade.

In addition to new, more powerful machines, turbines with relatively larger rotor diameters and lower power ratings were unveiled in 2022. These are designed for sites characterised by lower wind speeds. The average power rating of onshore turbines ordered over the year reached a record 5.1 MW. Their deployment on the ground in the following years is likely to lead to further increases to the average power rating of installed onshore wind turbines.

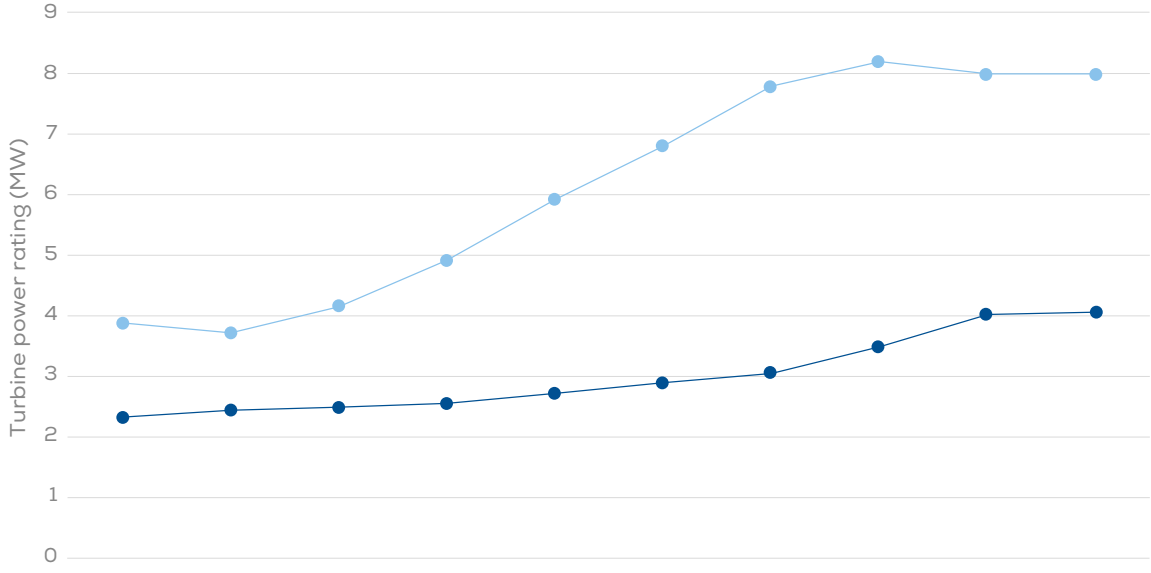
Offshore

After a period of continuous growth between 2014 and 2020 when installed turbine power ratings more than doubled, the average power rating of offshore wind turbines has remained steady at around 8 MW since.

The 2022 value was impacted by the commissioning of Italy's first offshore wind farm featuring ten relatively small offshore wind turbines of 3 MW each. The wind farm was first proposed in 2008 but suffered significant permitting delays during which time offshore wind turbines have greatly increased in size and power.

Orders of offshore turbines in 2022 also reached a record high, averaging 12.2 MW. With new, more powerful turbines about to enter the market, average installed offshore wind turbines are expected to see their power ratings increase from 2023 on.

FIGURE 15. Average power rating of installed turbines in Europe, 2013-22



	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
Onshore	2.4	2.5	2.5	2.6	2.8	2.9	3.1	3.5	4.1	4.1
Offshore	3.9	3.8	4.2	5.0	6.0	6.8	7.8	8.2	8.0	8.0

Source: WindEurope

2.4 Power generation trends

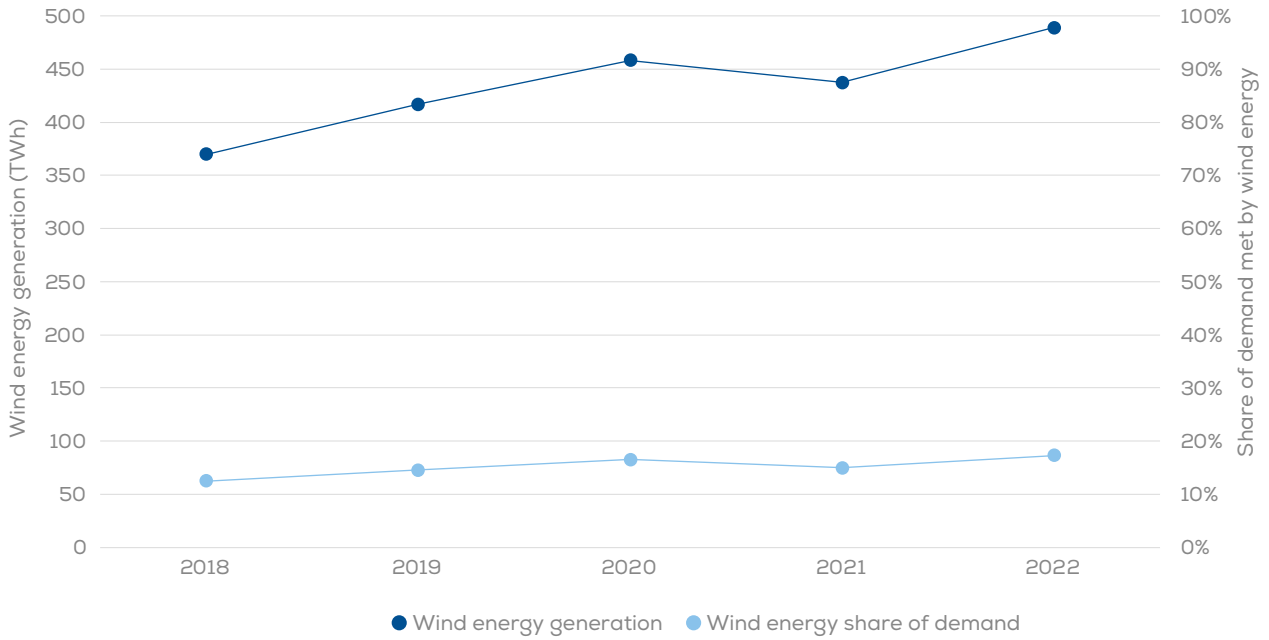
Wind energy generation in Europe has been growing steadily from 370 TWh in 2018 to 489 TWh in 2022, with one anomalous year in 2021 when generation was lower than in 2020. Over the same period, electricity demand has fallen from 2,960 TWh in 2018 to 2,830 TWh in 2022. In part this was the result of lockdowns from the COVID-19 pandemic in 2020 and the war in Ukraine in 2022.

Wind energy met 13% of the demand in the EU and UK in 2018, and in 2022 it covered 17%. In the EU, wind energy's share of demand was 12% in 2018, increasing to 16% in 2022.

In general, capacity factors for wind turbines increase over time as turbine technology improves and many countries have seen rising fleet-wide capacity factors over the years as they install more modern turbines.

For example, Finland's onshore wind capacity factor showed particularly strong growth over the last five years, growing from 21% in 2018 to 32% in 2022. Norway saw a similar increase (27% - 37%). Both of these countries had strong installation figures between 2018-22 and typically install relatively large onshore turbines, leading to a significant increase in generating capacity.

FIGURE 16. Wind energy generation and share of demand in EU+UK, 2018-22



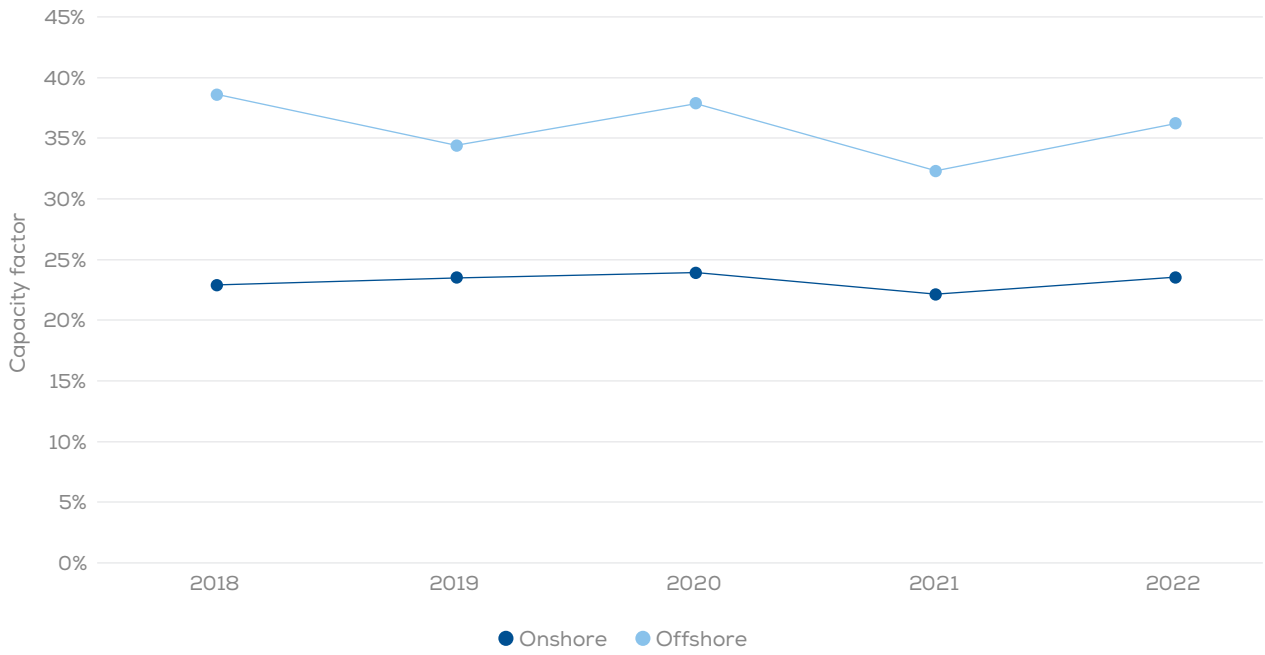
Source: WindEurope

When looking at Europe as a whole, other factors become important. The size of turbines being installed in each country has a major impact. If there are more turbines installed in countries which typically install smaller turbines (for example because they have more restrictive rules), this would boost the proportion of turbines with lower capacity factors in Europe. The European fleet's capacity factors could fall as a result.

Wind conditions across the continent also impact fleet-wide capacity factor trends. In 2021, wind conditions were lower than average in northern Europe. Even though they were higher than usual in southern Europe, the larger part of installed wind capacity is located in the north. The impact is visible in the capacity factor statistics for that year.

Offshore fleet capacity factors are more variable than onshore wind since it is concentrated in a smaller region (albeit over generally larger farms stronger and steadier wind resources). This points to the advantages of diversifying resources; the wind is always blowing somewhere in Europe.

FIGURE 17. Average capacity factor of installed wind turbines in EU+UK, 2018-22



Source: WindEurope

3.

"Governments across Europe see the value of wind in decarbonising their economies, and crucially, boosting energy security. The pledges are there. But over the next five years we expect installations in Europe to fall short. To stay the course Governments must now deliver on the simplification and acceleration of permitting"

Pierre Tardieu

Chief Policy Officer,
WindEurope

Market outlook 2023-2027

3.1 WindEurope's Outlook Scenarios

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

- **Our Central Scenario.** This scenario lays out the best estimate for installed capacity in Europe over the next five years, including any likely political or economic developments which could affect installations. We consider 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. Under this scenario, Europe will install 129 GW, with an average installation rate of 25.8 GW per year. In the EU, we expect installations of 98 GW between 2023 and 2027 at an average rate of 19.6 GW a year. This is significantly less than the average installation rate of 31 GW per year between 2023 and 2030, which is required to meet our energy and climate targets.

- **Our 2030 Targets Scenario.** This scenario represents a theoretical installation rate required to meet the REPowerEU target (440 GW[10]) and the 2030 targets of non-EU countries, namely the UK (50 GW), Turkey (18 GW), Norway (12 GW) and Switzerland (0.2 GW). The installation rate begins at the level of installations from 2022 and increases to a peak growth rate between 2026 and 2027, showing the expected ramp-up in installations over the next few years. Annual installations continue to increase after 2027, albeit at a slower rate (including an allowance for expected decommissioning), leading to the 2030 targets being met. Under this scenario, Europe needs to install 145 GW over the next five years to stay on target. In the EU, 117 GW would need to be installed from 2023-27 to stay on track to meet the REPowerEU targets for 2030.

In Europe, we expect there to be 19.4 GW of new capacity installations in 2023. The small increase in installations compared with 2022 will be mainly driven by offshore installations. But in the EU installations are expected to be just 15.8 GW, falling from 16.1 GW in 2022.

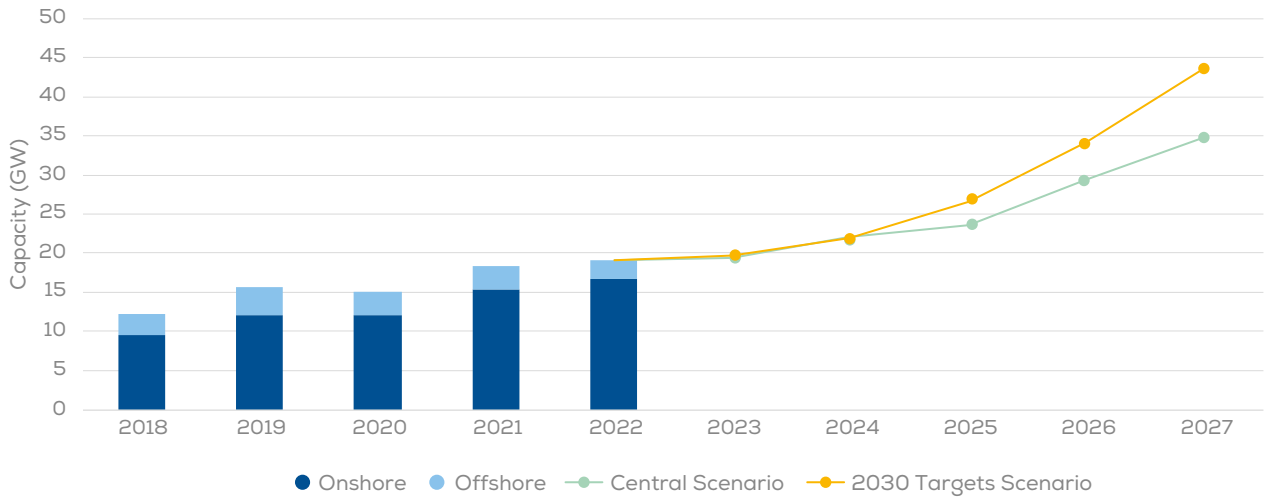
High inflation from energy and raw material price increases, together with global supply chain bottlenecks have made developing projects much more challenging. But there is also a lot of uncertainty for developers and investors. This follows on from the patchwork of measures introduced by National Governments across Europe to protect consumers from the effects of the energy crisis.

Investments in 2022 were down from previous years and orders of wind turbines were 47% lower than in 2021. The EU must make Europe an attractive place for renewables again and ensure that proposed changes to the electricity market design do not reverse 20 years of European energy market integration.

Over the five years to 2027, installations in Europe are expected to fall short 16 GW short of the required ramp-up rates set out in the 2030 Targets Scenario.

10. See section 4.1 for an explanation of the REPowerEU targets.

FIGURE 18. New installations in Europe – WindEurope's scenarios



Source: WindEurope

Germany will continue to be Europe's largest wind market with the build out of wind power capacity over the next five years expected to be 21 GW onshore and 6.4 GW offshore. In 2022 the German Parliament adopted a new Onshore Wind Law (WindLandG) which sets an installation target of 10 GW a year from 2025. It also enshrines the principle that the expansion of renewables is a matter of "overriding public interest" and includes improvements to onshore wind permitting. The onshore wind auction schedules have been revised as well. In 2023 alone 12.8 GW of onshore wind will be auctioned followed by 10 GW per year in the period 2024-2028. It is unlikely that there will be sufficient permitted projects to fill the schedule in the early years, particularly in 2023 when there may be up to 6 GW of permitted projects available. Germany will also auction 8.8 GW of offshore wind in 2023, followed by 8-9 GW in 2024, 3-5 GW a year in 2025-2026, and 4 GW in 2027.

In **Spain** onshore wind power capacity is expected to increase by 12 GW over the next five years, making it one of the largest markets in Europe. The PPA and merchant markets remain strong, allowing annual volumes to exceed the 1.5 GW of onshore wind scheduled to be auctioned each year until 2025. While there is currently no dedicated offshore wind energy auction schedule, Spain might, in 2023, launch an auction tender for a floating wind farm in the Canary Islands, with an indicative volume of approximately 300 MW.

In **France** the National Assembly and Senate approved its first law on renewable energy in February 2023. The so-called Renewable Acceleration Law makes local elected officials jointly responsible for the implementation of the energy transition. There are 6.5 GW of onshore wind capacity auctions scheduled (with an additional 2 GW available in technology neutral auctions) over the next five years and the build out is expected to reach 7.5 GW. There is also positive language in the new law for offshore wind, where a framework for development is set to be established. France is set to auction 2.75 GW of offshore wind capacity in 2023 and 1.5 GW in 2024. Overall it is expected to install 3.6 GW of new offshore wind power capacity between 2023 and 2027.

Sweden is expected to install 6.5 GW of new onshore capacity over the period from 2023 to 2027. The new Government has put less emphasis on renewables, but wind energy is still likely to play an important role in the decarbonisation of industry. Sweden does not currently run auctions to grant support for the development of wind energy, but the country has a strong PPA market which will continue to support wind energy development.

The Netherlands' wind capacity growth over the 2023-2027 period is expected to come predominantly from the offshore sector, with 4.3 GW of new capacity expected to be installed. In 2023 the Ministry of Economic Affairs and Climate Policy will auction 4 GW of offshore wind capacity for the IJmuiden Ver sites I, II, III, and IV, originally scheduled to be tendered over the 2023-26 period. There is some uncertainty surrounding the expected onshore wind build-out in the Netherlands. The scale of future installations depends on the outcome of the unresolved Nevele judgment case. This centres around the standards which are currently used to licence onshore wind farms. We have forecasted 1.5 GW of new onshore capacity by 2027.

Poland is expected to commission 4.2 GW over the period from 2023-27. While a significant portion (2 GW) is expected to come from offshore facilities, the onshore sector is still expected to contribute 2.2 GW. The 10H rule, which forbids the construction of wind turbines if located at a distance from buildings equal to ten times their tip height, has excluded onshore wind from 98% of Polish territory since 2016. The lower chamber of the Parliament voted for a new law in February 2023 which theoretically makes it easier to build new onshore wind, but the original proposal (a 500 m

setback distance) was watered down resulting in a 700 m setback distance. This will continue to restrict onshore wind development if adopted.

Finland will continue to expand its onshore wind installed capacity, albeit at a slower pace than in 2022. In total, it is expected to add 4.8 GW during the period from2023-2027, all onshore. However the Government is working on its first offshore wind auction, which could take place in 2023 or 2024, the details of which have not yet been finalised. Finland does not currently run onshore wind auctions but has strong merchant and PPA markets.

Italy is expected to add limited volumes of wind power capacity over the next five years. Most of this will be onshore wind (3.6 GW). Just under 0.8 GW are expected to come from offshore installations. In 2023 Italy will allocate the remaining 1.3 GW volume for the technology neutral FER 1 auction scheme which went unawarded in 2022. Similarly it should launch the long-awaited FER 2 auction scheme in Spring 2023, dedicated to less established technologies including floating wind (and possibly also bottom-fixed). This scheme should feature an overall volume of 3.5 GW spread over the period 2023-26.

Denmark's build out of wind power capacity from 2023-2027 is expected to be around 2 GW of onshore wind and 2.4 GW offshore. Around one quarter of the forecasted offshore wind capacity was expected to be developed under Denmark's open scheme. It is unclear how the recent decision to pause the scheme by the Danish Government will affect the projects involved. In Spring 2023 Denmark will launch the tender procedure for its North Sea energy island and in Q4 it should publish the contract notice for the Energy Island Bornholm. The award of the concession is expected to take place in Q4 of the following year. Finally, following the change to the Hesselø Offshore Wind Farm location, the awarding of the concession is now expected sometime in 2025-26.

Ireland is expected to install 3.2 GW over the next five years, most of which will be onshore wind (2.6 GW). The country is set to unveil the details of its third onshore wind auction scheme, the RESS 3, later in 2023. It will also be running its first offshore wind auction scheme, the ORESS 1, in the first half of 2023, which is expected to tender 2.5 GW of offshore capacity.

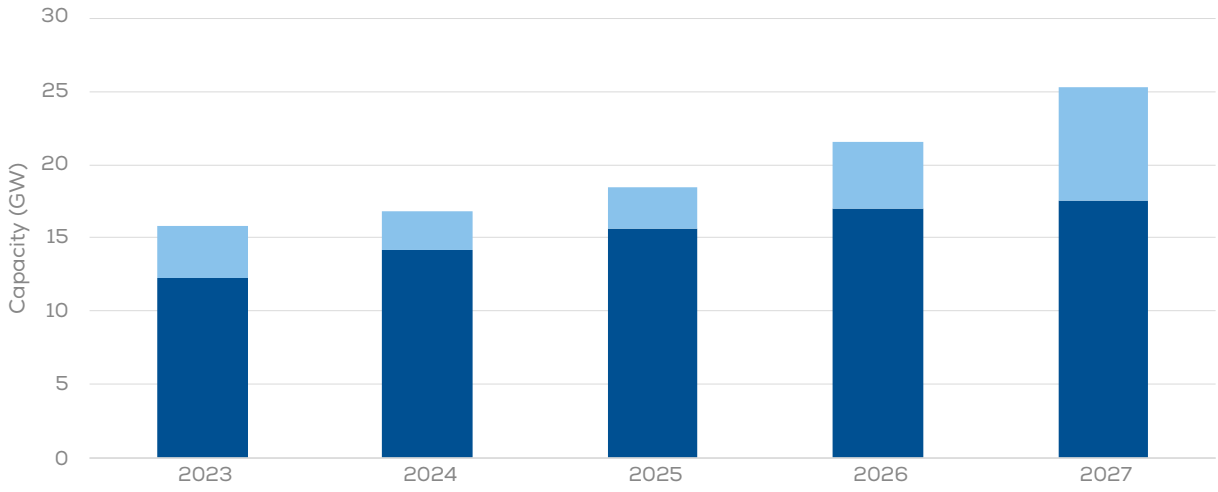
Belgium is expected to install annual onshore wind volumes similar to those recorded for 2022, totalling 1.6 GW by 2027. New offshore wind capacity is expected to reach 1 GW by the same date. While Belgium does not run onshore auctions, it is expected that 3.5 GW of offshore wind will be auctioned between 2024-26 as part of the Princess Elisabeth Island project.

In **Greece**, wind power additions over the 2023-27 period are expected to come exclusively from onshore wind, totalling 2 GW. In 2023, it will hold two 600 MW multi-technology tenders featuring wind power, and two 100 MW tenders for small PV and wind power systems. In 2024, there will be tenders for at least 500 MW of eligible technologies including wind power, but further details about this auction are not yet known.

Austria's wind energy outlook for 2027 is 2 GW of capacity additions. The country's latest renewable energy law aims to auction 390 MW of wind per year.

For the EU overall, 98 GW of capacity additions are expected over the next five years, with onshore wind accounting for 78%. Offshore wind capacity additions should total 21 GW.

FIGURE 19. New installations in the EU – Central scenario



	2023	2024	2025	2026	2027
Onshore	12.3	14.1	15.7	17.0	17.5
Offshore	3.5	2.7	2.8	4.5	7.7

Source: WindEurope

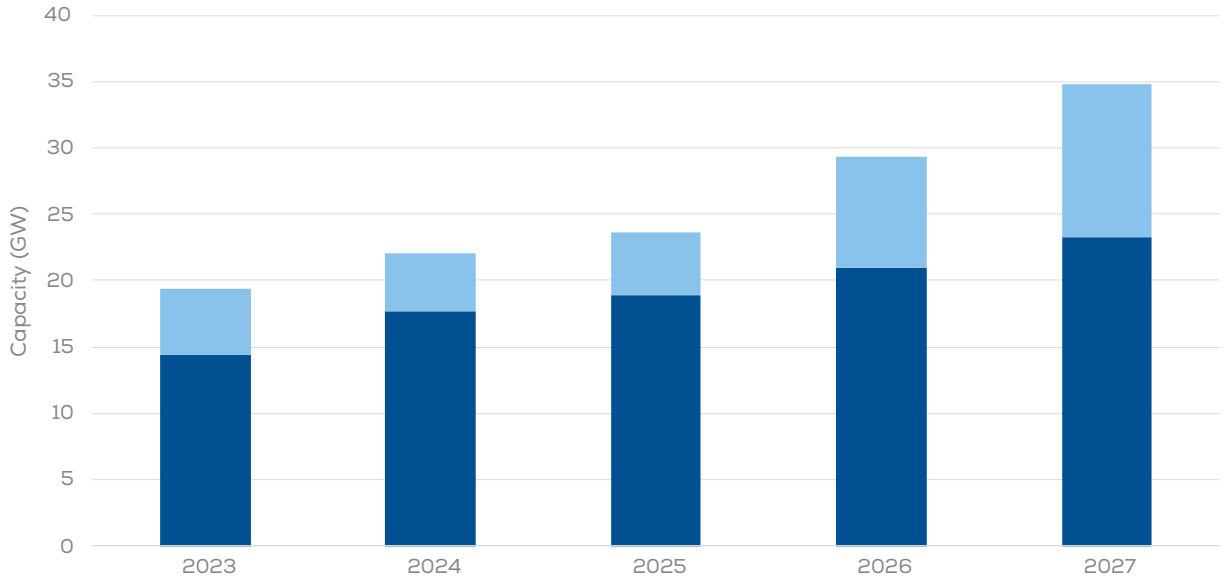
Outside of the EU-27, **the UK** is expected to install the most new wind power capacity over the next five years, second only to Germany in Europe. Most will be offshore installations (12.7 GW). Onshore wind build-out is expected to be 7.3 GW, with most of this likely to be built in Scotland due to the lasting effects of the de facto ban of onshore wind in England. The UK will launch its fifth CfD Allocation Round in 2023. Bottom-fixed offshore will compete against onshore wind and floating offshore wind will compete in a separate pot for less mature technologies.

In **Norway**, strong local opposition and laws enabling local communities to block any project have led to a bleak outlook for onshore wind. The Government is developing its framework for offshore wind, both for bottom fixed and floating, but there are unlikely to be any installations before 2027 (besides small demonstrators and the final turbines being connected to the grid at Hywind Tampen).

Turkey is expected to install 8.2 GW between 2023 and 2027, all of which will be onshore.

Total capacity additions across Europe over the next five years are expected to come to 129 GW, 95 GW (74%) from onshore wind and 34 GW of new capacity installed offshore. Up to 500 MW of this will be floating offshore wind, including Hywind Tampen and the first projects in France and the UK.

FIGURE 20. New installations in Europe – Central scenario



	2023	2024	2025	2026	2027
Onshore	14.5	17.7	18.9	21.0	23.3
Offshore	5.0	4.4	4.7	8.4	11.6

Source: WindEurope

Photo: Jason Bickley

TABLE 4. Expected new installations per country 2023-27 – WindEurope's Central Scenario

	2023		2024		2025		2026		2027	
EU-27 (MW)	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore
Austria	400	-	400	-	400	-	400	-	400	-
Belgium	290	-	300	-	340	-	340	500	340	500
Croatia	50	-	150	-	250	-	300	-	300	-
Czechia	40	-	40	-	80	-	80	-	70	-
Denmark	40	350	510	190	450	210	580	800	410	900
Estonia	60	-	240	-	100	-	150	-	200	-
Finland	1,000	-	1,200	-	1,000	-	780	-	800	-
France	1,200	990	1,500	530	1,500	990	1,500	300	1,800	800
Germany	3,000	250	3,500	1,630	4,500	900	5,000	1,420	5,000	2,210
Greece	590	-	330	-	410	-	350	-	350	-
Ireland	290	-	520	-	490	-	700	-	630	560
Italy	450	-	450	-	730	-	870	250	1,140	520
Latvia	-	-	50	-	150	-	300	-	300	-
Lithuania	150	-	290	-	290	-	360	-	380	-
Luxembourg	10	-	10	-	10	-	10	-	10	-
Netherlands	400	1,910	400	350	220	700	230	350	250	1,000
Poland	450	-	250	-	500	-	500	920	500	1,090
Portugal	90	-	120	-	200	-	200	-	380	-
Romania	60	-	300	-	450	-	550	-	320	-
Slovakia	-	-	-	-	-	-	-	-	10	-
Spain	2,200	-	2,500	-	2,500	-	2,500	-	2,500	160
Sweden	1,540	-	1,100	-	1,090	-	1,330	-	1,420	-
Total EU-27	**12,310**	**3,500**	**14,160**	**2,700**	**15,660**	**2,800**	**17,030**	**4,540**	**17,510**	**7,740**

	2023		2024		2025		2026		2027	
Others (MW)	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore
Albania	-	-	-	-	20	-	50	-	50	-
Bosnia & Herzegovina	100	-	130	-	130	-	100	-	-	-
Montenegro	60	-	-	-	-	-	-	-	100	-
North Macedonia	50	-	20	-	100	-	100	-	100	-
Norway	10	40	-	-	-	10	-	-	-	-
Serbia	110	-	280	-	780	-	70	-	300	-
Switzerland	50	-	50	-	50	-	50	-	-	-
Turkey	1,000	-	1,350	-	1,600	-	1,900	-	2,300	-
UK	810	1,420	1,760	1,670	580	1,900	1,500	3,890	2,630	3,820
Ukraine	-	-	-	-	-	-	150	-	300	-
Total others	**2,190**	**1,460**	**3,590**	**1,670**	**3,260**	**1,910**	**3,920**	**3,890**	**5,780**	**3,820**
Total Europe	**14,500**	**4,960**	**17,750**	**4,370**	**18,920**	**4,710**	**20,950**	**8,430**	**23,290**	**11,560**

Permitting prospects in Europe

The REPowerEU Action Plan recognises that renewables-based decarbonisation is key for climate neutrality and energy security. And the EU understands that the simplification and acceleration of permitting is a top priority.

In December 2022 the EU formally agreed emergency measures on permitting. Under the new rules Member States:

1. Have signed up to the principle that renewables are of **overriding public interest**: This means the EU Member States can speed up renewables permitting while ensuring a good working balance with other societal interests such as the protection of biodiversity.

2. Must now permit new repowering projects within 6 months, including the Environmental Impact Assessment (EIA) and the grid permits.

These new rules apply to all new permitting applications. Member States can apply them to permits already in the pipeline.

The EU is revising its 2018 Renewables Directive in parallel which we expect to incorporate these proposals.

Permitting status

Approximately 80 GW of wind power capacity is currently stuck in permitting procedures across Europe, of which at least 59 GW are onshore. Of these, 12 GW are in the final stages and should receive their final approvals shortly.

A further 14 GW have received all their permits and are ready for construction.

This means that at least 47 GW of onshore wind capacity are stuck in administrative procedures with no clear timeline on their progress.

TABLE A. Onshore wind energy capacity under permitting in Europe

Country	Permitting pipeline* (GW)	Permitting final stages (GW)	Permitted (GW)
Croatia	1.8	n/a	0.1
Denmark	0.2	n/a	n/a
Finland	12.8	2.2	1.0
France	11.0	4.8	n/a
Germany	4.7	n/a	4.0
Greece	3.0	1.0	0.8
Italy	2.7	n/a	n/a
Latvia	0.3	n/a	n/a
Netherlands	0.8	0.5	0.8
Norway	2.5	n/a	n/a
Poland	0.6	n/a	n/a
Spain	9.7	3.3	1.3
Sweden	8.8	n/a	6.1
Total	**58.8**	**11.8**	**14.2**

*Pipeline of projects likely to receive permits.

In Poland it is unclear how much of the 0.6 GW is affected by uncertainty surrounding the changing legislation on setback distances.

There are also significant volumes of wind energy projects in the process of applying for permitting. Hundreds of GW of onshore and offshore wind in Europe are at some stage in the permitting process, with varying probabilities of being built. This makes it difficult to decipher a single value which represents a true potential build-out. The volumes listed in the table above are all likely to receive a permit and therefore could potentially be released by improving the permitting process.

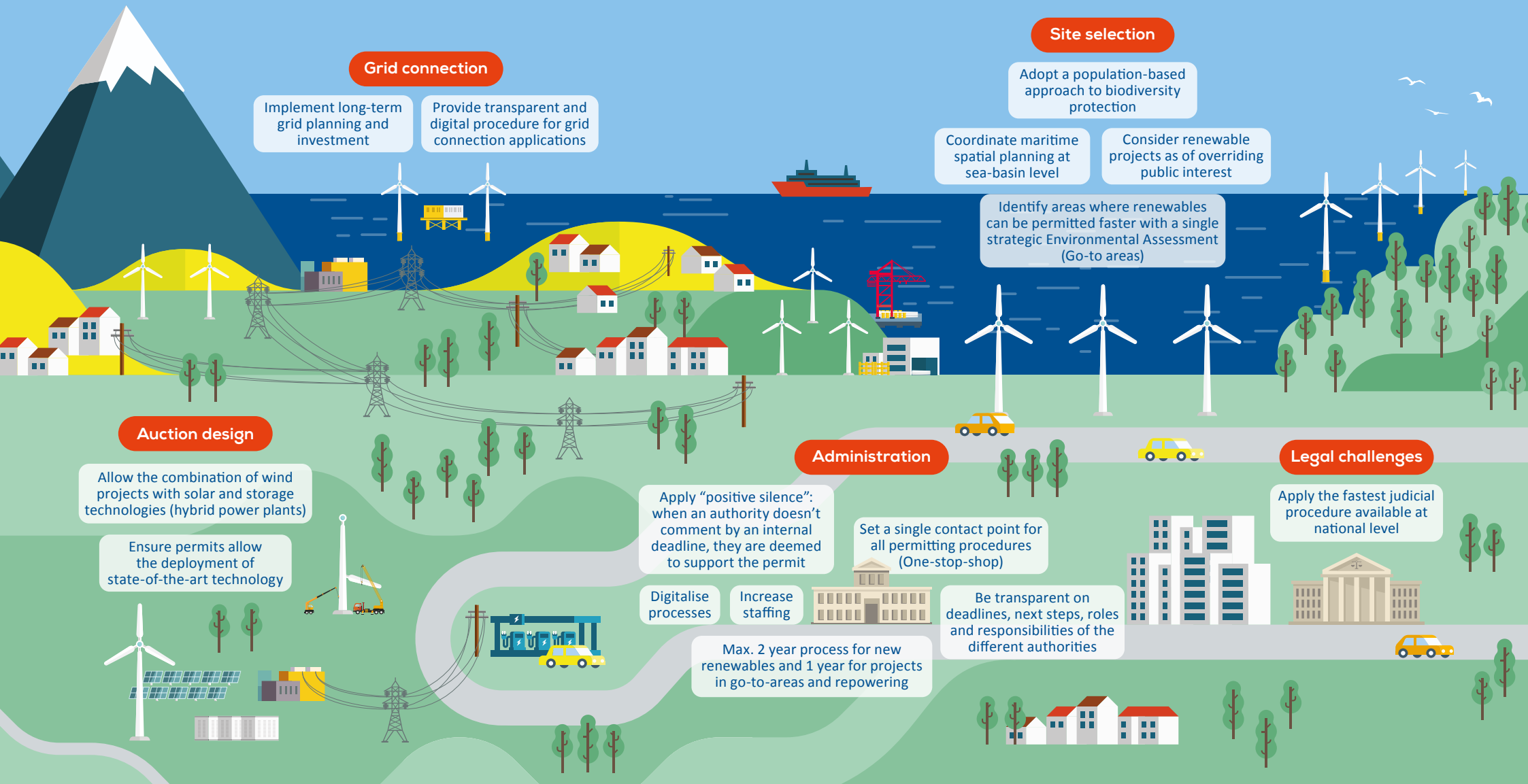
With at least 26 GW of onshore wind permitted or in the final stages, things are starting to look better - but there is more to do and it needs to be done faster.

Alongside the new rules, the REPowerEU Action Plan contains detailed recommendations to national Governments on how exactly they can and should simplify their permitting procedures.

See WindEurope's summary of the European Commission's new laws and guidance to simplify the permitting of wind energy projects below.

How to simplify permitting

The European Commission has issued new laws and guidance to simplify the permitting of wind energy projects



3.2 Repowering

Repowering decisions are driven by many factors and are carried out 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 versus lifetime extension; and
- regulation around the Environmental Impact Assessment and other environmental restrictions that have changed over recent years.

Over the next five years we expect Europe to install 5.2 GW of repowered wind energy projects[11] (repowered capacity). The new repowered capacity is expected to come from 3.2 GW of wind farms which will be decommissioned for repowering. We assume that the new repowered capacity is 2.7 times the original capacity, in line with our analysis of past repowering projects. We also assume that there is a timing delay so that there is not a direct annual relationship between the capacity under repowering and the final installed repowered capacity.

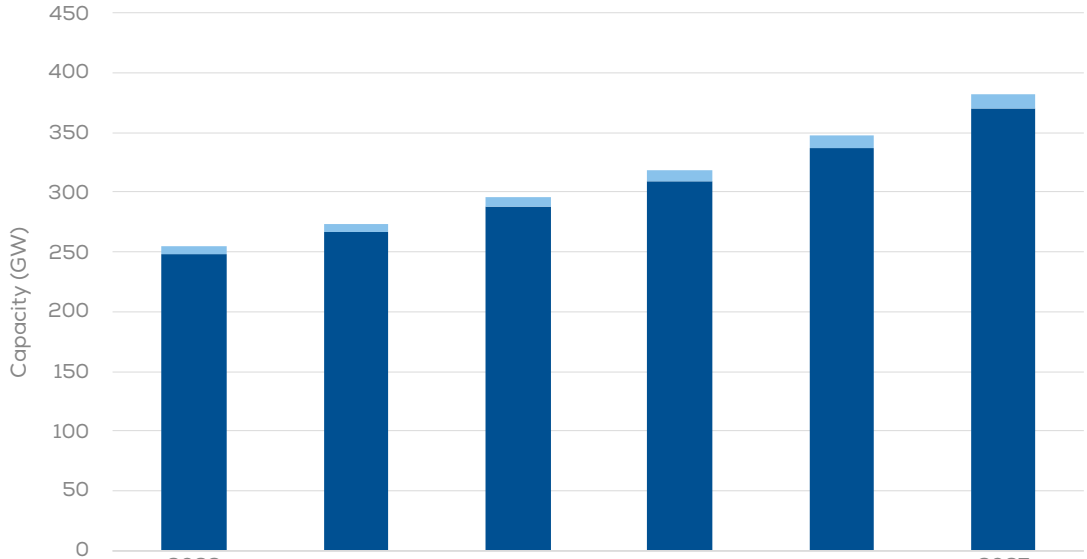
Germany will remain the largest repowering market, followed closely by the Netherlands, Italy, Denmark, and Spain.

We expect 33 GW of projects to reach 20 years of age or more over the next five years, and with 16 GW of projects becoming 25 years old and 1 GW of projects becoming more than 30 years old, we will have 51 GW of projects that will require a decision on whether to repower, extend the life of the asset or decommission them.

If Governments do not adopt the right policies to ease bottlenecks in new installations, we might see a fall in total installations in some countries.

The repowering of wind farms is crucial if Europe is to meet its energy and climate targets but the current barriers to repowering prevent us from taking full advantage of it. We estimate that if repowering rates are doubled for wind farms between 20 and 30 years of age (resulting in up to just 8% of wind farms being repowered a year), an additional 3.5 GW of repowered capacity could be installed. The potential is much higher.

FIGURE 21. New and repowered wind energy installations in Europe - WindEurope's Central Scenario

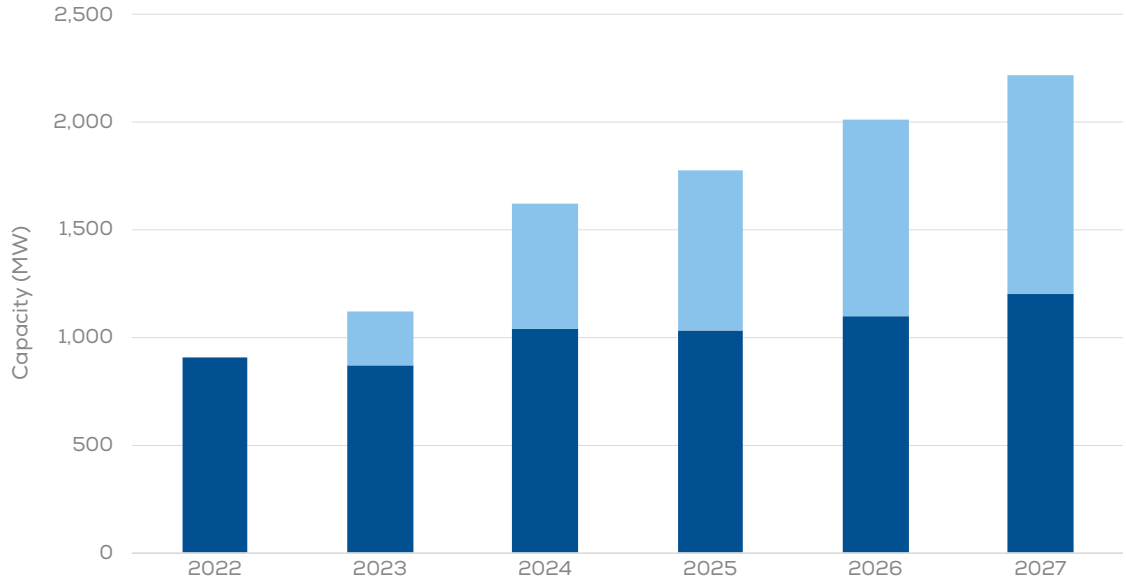


	2022	2023	2024	2025	2026	2027
Repowered wind farms	6	7	8	9	10	11
New wind farms	249	267	287	309	337	370

Source: WindEurope

11. See Annex 2 for details of repowering and decommissioning assumptions.

FIGURE 22. Additional repowering potential in Europe, 2022-27



	2022	2023	2024	2025	2026	2027
Additional repowering	0	250	580	750	910	1,020
Expected repowering	910	870	1,040	1,030	1,100	1,200

Source: WindEurope

Based on current trends and the policy context, we estimate that about 3.2 GW will be decommissioned for repowering and 2.4 GW will be fully decommissioned. This is lower than our previous assumptions, as high electricity prices have boosted the economic prospects of older wind farms. In total around 5.6 GW will be decommissioned over the next five years.

The remaining 45 GW will continue to operate and will probably be assessed for life-time extension services (perhaps with partial replacement of certain components such as gearboxes or blades).

4.

"The wind industry is ready to deliver, but attracting investment remains crucial. Electricity grids, both onshore and offshore, will need major development in the next decade to ensure they can maximise Europe's plentiful clean energy resources to deliver a cleaner, fairer and more secure energy system for its citizens"

Cordi O'Hara

President,
National Grid Ventures

Reaching 2030 energy and climate targets

4.1 REPowerEU scenario

The EU is committed to a 55% greenhouse gas emissions reduction target by 2030 (compared to 1990 levels). Based on the European Commission's Impact Assessment for reaching the 40% renewable energy target, it was estimated that the EU would need 453 GW of wind energy capacity by 2030 (374 GW onshore and 79 GW offshore).

The Russian invasion of Ukraine shifted the narrative on energy policy. The war has underlined the critical importance of energy independence and the value that renewable technologies can deliver in addition to their primary benefit of reducing greenhouse gas emissions.

In response, the European Commission put forward the REPowerEU Action Plan which aims to cut the EU's reliance on fossil fuel imports from Russia and reduce fossil fuel imports in general by accelerating the build out of renewables and renewable hydrogen. Under the plan the EU binding renewables target would be increased to 45% of total energy demand, up from 40% in the Fit-for-55 proposal. According to the Commission's assessments, this would mean a revised target of 510 GW of wind energy by 2030, an additional 57 GW. But this target has been calculated using capacity factors that do not reflect current technology.

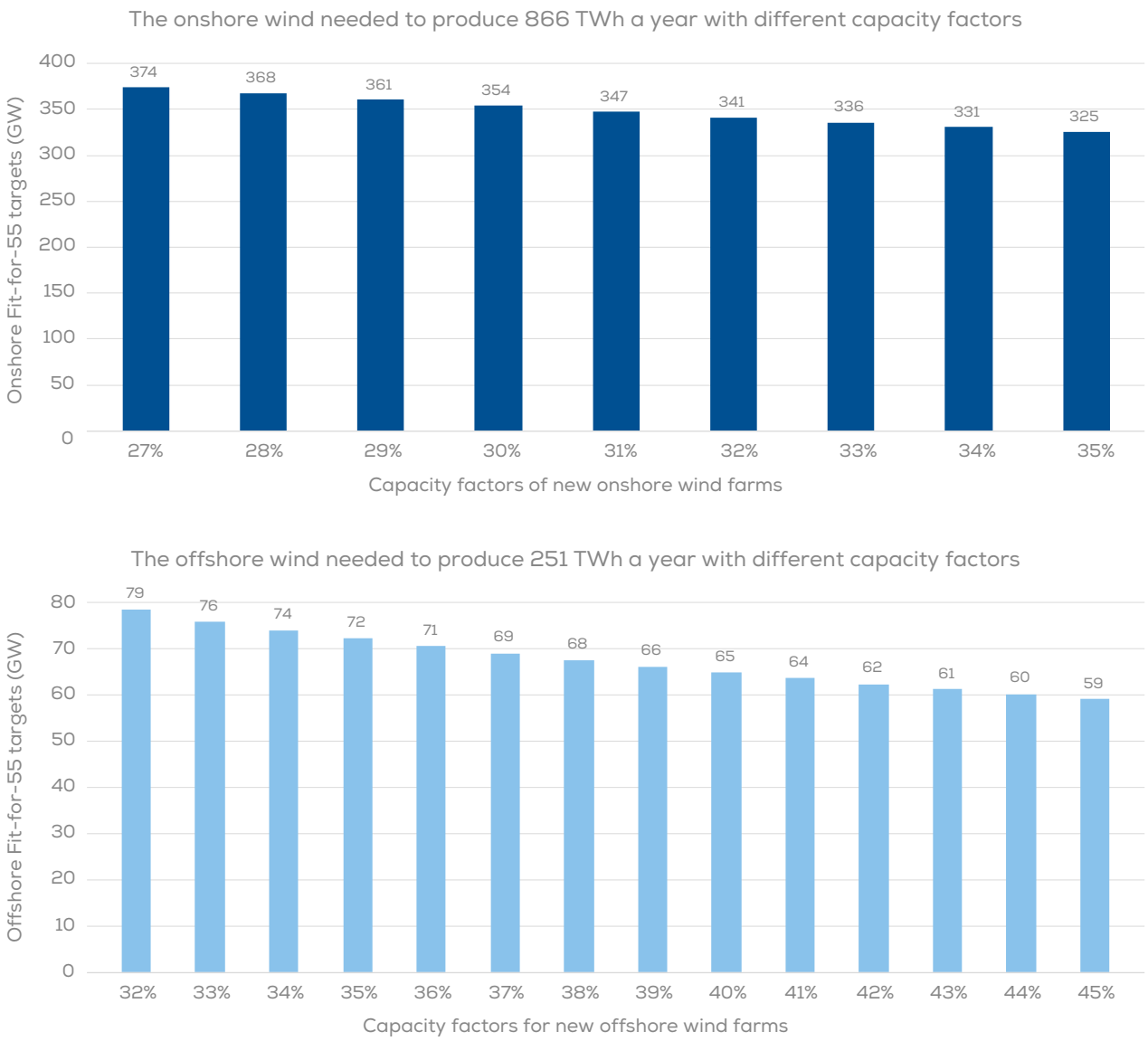
440 GW: enough to deliver the REPowerEU wind energy target

The original REPowerEU Action Plan and Fit-for-55 targets of 510 GW are based on a production of wind energy required to meet 45% of energy demand. The installed capacity required to meet this figure largely depends on the electricity output from these expected installations. In the Impact Assessment carried out by the European Commission in 2020, it was assumed that onshore and offshore wind would have capacity factors of 27% and 32% respectively.

Capacity factors give an indication of the energy that a power plant can produce. A 100% capacity factor would indicate that the energy produced throughout the year is equal to the maximum nameplate capacity of the plant. Capacity factors of 27% and 32% of onshore and offshore wind are reasonable for all of the wind farms in Europe combined but these include a significant proportion of older wind farms with smaller, less powerful turbines.

But today's turbines are much more efficient. We expect that onshore wind farms installed today will have capacity factors of around 35%. For offshore wind, new wind farms are already achieving capacity factors of 50%. Using a conservative offshore capacity factor of 45% and 35% for onshore reduces the total wind farm capacity that needs to be installed by 2030 to meet the energy production targets.

FIGURE 23. Onshore and offshore 2030 wind targets



Source: WindEurope

Meeting the Fit-for-55's 40% renewable energy target would require 325 GW of onshore and 59 GW of offshore wind by 2030 allowing for the superior capacity factors of new turbines installed between 2023 and 2030.

The REPowerEU Action Plan sets out an additional target of 57 GW of wind power capacity to boost the renewables share of energy in the EU to 45% by 2030. We do not reduce the additional REPowerEU target because the assumptions behind the calculations are unclear (for example there is no breakdown between onshore and offshore wind). The resulting wind power capacity needed to meet a 45% renewable energy target by 2030 – when accounting for the superior capacity factors – is 440 GW.

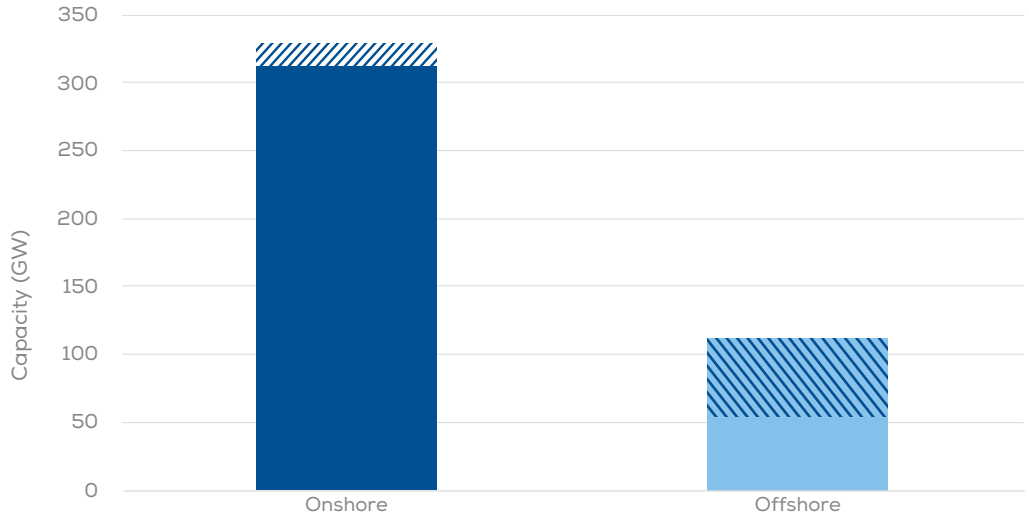
Current 2030 wind energy pledges

Pledges made by EU Member States for wind energy targets in 2030 have grown in light of the new political context. There have been more ambitious commitments, particularly for offshore wind where current pledges stand at 111 GW by 2030. This is almost double the revised Fit-for-55 target and surpasses the additional REPowerEU target by 9 GW.

There is still a 17 GW gap between Member State pledges and the 440 GW target. We assume that this is more likely to be met by new onshore wind given the optimistic offshore wind pledges.

The 45% renewables target has not been agreed at the time of writing and a compromise might be found at 42.5% or 43%. This would reduce the 2030 target approximately to the current value of Member State pledges – 423 GW.

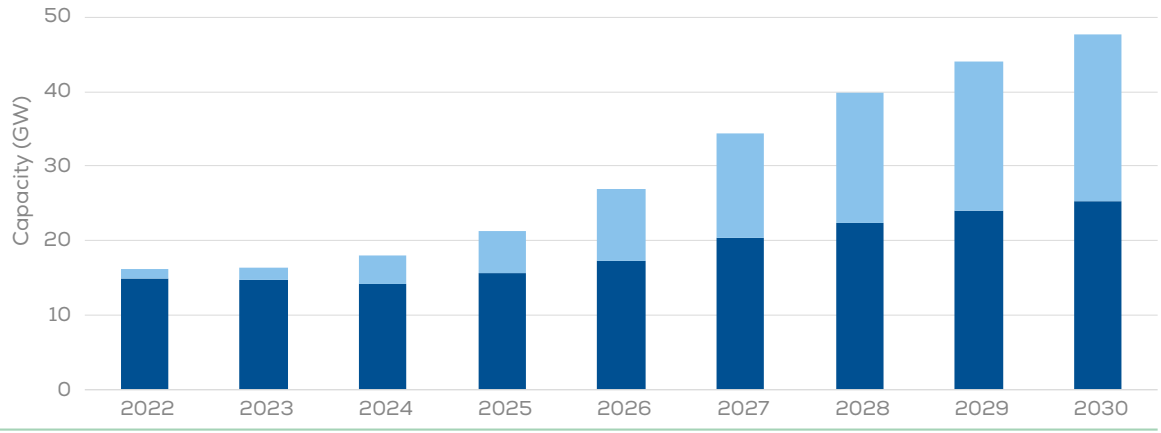
FIGURE 24. REPowerEU targets and current 2030 wind energy pledges



	Onshore	Offshore
Pledges shortfall for 45%	17	0
Pledges covering REPowerEU	0	57
Member State pledges	311	54
Total	329	111

Source: WindEurope

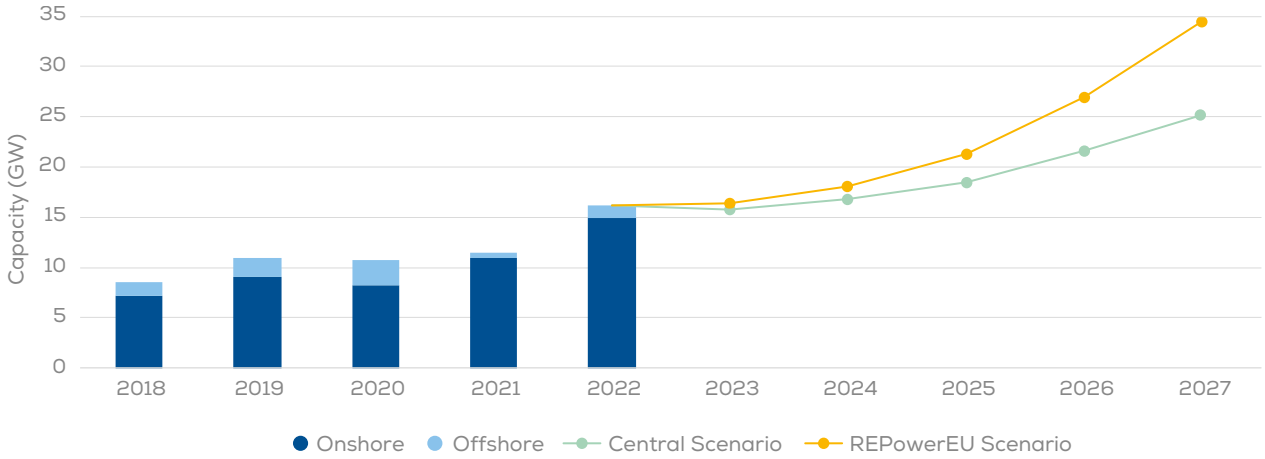
FIGURE 25. Build out of wind energy in the EU under the REPowerEU Scenario



	2022	2023	2024	2025	2026	2027	2028	2029	2030
Onshore wind	14.9	14.7	14.2	15.7	17.2	20.3	22.3	23.9	25.2
Offshore wind	1.2	1.8	3.8	5.7	9.8	14.1	17.5	20.1	22.4

Source: WindEurope

FIGURE 26. New installations in EU - WindEurope's scenarios



Source: WindEurope

WE EXPECT TO BUILD

20 GW

PER YEAR IN THE EU, BUT WE NEED TO BE BUILDING 31 GW PER YEAR

At the end of 2022, there was 205 GW of wind power capacity installed in the EU. To meet the 440 GW REPowerEU renewable energy target the EU needs to install on average 31 GW a year to 2030.

In our REPowerEU Scenario we consider a theoretical installation rate which rises each year with a maximum increase between 2026 and 2027. This represents the need for the supply chain to develop capacity to increase production over the next few years – and the expected ramp-up in installations rates.

The rate of increase of installations slows each year after 2027, with maximum installations of 25 GW of onshore wind and 22 GW of offshore wind in 2030. If achieved, this build-out would result in cumulative installations of 440 GW in the EU in 2030 after making an allowance for the expected decommissioning of older wind farms.

The EU-27 installed 16 GW in 2022 and we believe that 20 GW per year on average will be installed over the next five years. This is less than the 23 GW that would need to be installed each year between 2023 and 2027 to stay on track to meet a 45% renewable energy target.

Given the ramp-up in required installation rates, the EU will need to install around 44 GW per year between 2028 and 2030. It is therefore vital that installations over the next few years are as close as possible to the required rates if the targets are to be met.

4.2 European country targets

Outside of the EU, other European countries have made significant 2030 commitments for wind energy.

The UK has set a target of 50 GW of offshore wind alone. With a 2030 target for onshore wind of 22 GW, the UK's total wind energy target is 72 GW making it the second highest in Europe after Germany (145 GW).

Turkey has set a wind energy target of 18.1 GW by 2030 and 29.6 GW by 2035. There is no breakdown between onshore and offshore, but we expect that all the wind farm capacity installed by 2030 will be onshore. The 18.1 GW target puts Turkey in the top 10 countries in Europe for 2030 wind energy ambitions.

Norway has over 5 GW of wind energy installed (mostly onshore) and does not have 2030 bidding targets for wind. Onshore wind currently faces strong opposition from local communities which will hold up installations in the short and medium term. The Government is now looking to offshore wind and will run its first offshore wind auctions (3 GW total) in 2023. The winning projects should be commissioned by 2030. Beyond this the Government announced last year that it will allocate 30 GW of offshore wind capacity by 2040, mostly for exporting electricity to mainland Europe.

Serbia's Government has set a target to increase installed wind power capacity tenfold by 2030 which would suggest a target of 3.5 GW.

Switzerland want to increase wind energy output to 0.3 TWh by 2025 and 1.2 TWh by 2035. This would need approximately 240 MW of capacity to be installed by 2030 to be on track.

In total, including pledges set by EU Member States of approximately 423 GW, European countries have set targets of 520 GW of wind power capacity by 2030. Today there are 255 GW of wind power capacity installed in Europe.

4.3 How to deliver

WindEurope's outlook shows that installation rates over the next five years are likely to be insufficient to remain on track to delivering on the 2030 energy and climate targets. And the 2030 Targets Scenario requires annual installation rates in Europe of over 50 GW at the end of the decade.

Permitting

As shown above (see Permitting prospects in Europe Box) there is a huge amount of capacity stuck in administrative permitting procedures across Europe: at least 80 GW. If Governments act now to accelerate the permitting of these projects, 47 GW of capacity could be made available for development earlier than expected. This would increase manufacturing pipelines, improve investments signals for developing the supply chain and allow Europe to increase installation rates over the next few years.

In the EU, Governments have agreed emergency measures to improve permitting procedures including introducing new deadlines for securing all permits. Permitting authorities will have two years from the moment the documents are submitted, including the evaluation of the Environmental Impact Assessment, to provide a definitive outcome. For repowered projects the deadline will be six months.

Furthermore, renewables are to be considered in the "overriding public interest". This should help to prevent projects being bogged down in lengthy permitting processes or litigation.

These EU Emergency Measures under Article 122 of the EU Treaty apply to new projects, but Member States can apply them to projects already in the pipeline. These measures will be replaced by the upcoming Renewable Energy Directive which will apply to both new and existing projects.

Supply chain

Today the wind industry in Europe employs 300,000 people and manufactures components in over 250 factories. But the wind energy supply chain is struggling. Inflation, challenging access to raw materials, the lack of a clear project pipelines and increasing competition from non-European manufacturers and markets are all putting pressure on the industry.

This is all compounded by the 80 GW of wind energy projects that are currently stuck at various stages of permitting across Europe. Together, these issues create an environment that leads to companies holding back investment decisions for new manufacturing facilities. With the large-scale roll-out of wind turbine installations that are needed and expected as we head towards 2030, Europe could run into significant bottlenecks across the supply chain if the right investment environment is not created.

Today we already see waiting periods of up to three years for offshore foundations and the availability of cable and installation vessels will also become an issue in the short-term if more are not produced. As new markets in Asia and North America open up to offshore wind expected competition for vessels is only going to increase.

Onshore wind, which will make up the lion's share of installations between now and 2030, is being hit by historically low turbine prices (which were agreed 2-3 years previously) that, combined with the pressures of raw material price increases and wider inflation, create a commercial environment that is not sustainable long-term.

To meet these challenges, the EU and European countries need to provide a more predictable and supportive environment to sustain and grow its wind energy manufacturing base – through the right policy and regulatory frameworks. This includes:

- simplifying permitting processes for wind farms;
- expanding and investing in the grid;
- reforming auction designs to take indexation into consideration, and to include non-price criteria such as system integration, biodiversity and benefits to local communities as a significant decision-making factor;
- speeding up access to funding for infrastructure investments; and
- creating a level-playing field for European manufacturers competing against unfairly subsidised competitors from around the world.

A quick adoption of new measures that are manufacturer-friendly is vital for a healthy European wind energy supply chain, capable of delivering the continent's renewable energy targets.

Market design and investment signals

Investors need stable regulatory conditions to make informed decisions regarding long-term investments. Unfortunately, despite Governments attempting to act in the best interest of consumers in the short-term by applying measures to protect them from high energy prices, the resulting patchwork of measures across Europe has created an uncertain regulatory environment. This has negatively impacted investment security and threatens Europe's longer-term renewable development goals.

Investments in wind energy in 2022 were down compared with previous years and particularly with respect to required investment for new projects. Turbine orders were down 47% on 2021 orders.

With the introduction of the Net-Zero Industry Act and the review of the Electricity Market Design to take place in the EU, there is an opportunity to reverse these negative trends.

The **Net-Zero Industry Act** should focus on delivering key technologies for climate neutrality, namely wind energy, solar, storage, heat pumps and electrolysers. As mentioned above, support for the supply chain is vital and the EU should dedicate financial resources to support immediate investments in wind energy manufacturing in Europe.

Given the timeframes required to increase the rate of build-out across the EU, investments in renewables and renewables manufacturing are needed now. So it is crucial that accessing support for these investments is made as simple and efficient as possible.

The EU is also looking at reforming the **Electricity Market Design**. It is important that the patchwork of different revenue caps seen across Member States are not embedded and remain a temporary measure.

Renewables need long-term price visibility to be developed with the greatest cost efficiency. Developers and investors should be allowed to achieve that price visibility in a variety of ways. In many situations this will be through a Government-backed 2-sided Contract-for-Difference (CfD) but other long-term contracts are also important. Other examples include Power Purchase Agreements (PPAs) or hedging power prices where available, as well as merchant investments. Relying exclusively on one form could lead to unwanted market distortions.

Grids

For years Europe has been under-investing in the electricity grid. To deliver a grid compatible with a climate neutral energy system, Europe needs to double the rate of investment. It is estimated that grid investments in the region of €460bn[12] are needed over the next decade to support the electrification of the EU's energy system.

The development of offshore grids needs to be coordinated across borders, and it is a welcome step that the UK will once again take part in the North Seas Energy Cooperation given the size and importance of British offshore wind to Europe.

Europe should take the opportunity to lead the development in offshore grids by fully leveraging the potential of offshore hybrids and energy islands rather than rely only on point-to-point connections.

The Electricity Market Design reform is a key opportunity to develop the right investment framework for optimising the electricity grid build-out.

Summary

To meet renewable energy and climate targets, Governments in Europe need to ramp up the build-out of both onshore and offshore wind by:

1. Continuing to improve permitting procedures by make them faster and easier.

2. Supporting the wind energy supply chain by unlocking permitting projects and making financial support accessible for immediate investment in manufacturing facilities.

3. Supporting a market design that allows renewables to take advantage of all forms of long-term contracts and merchant investments.

4. Investing in developing the electricity grid and working across borders to develop offshore hybrid structures and energy islands.

12. Based on REPowerEU estimate of €584bn of grid investments needed between 2020 and 2030.

Annex 1

Glossary

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 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, always guarantees a minimum revenue.
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.

Annex 2

Assumptions for decommissioning and repowering[13]

	Decommissioning rate		Repowering rate		Repowered wind farms	
Projection year	Onshore	Offshore	Onshore	Offshore	Onshore	Offshore
0	-	-	-	-	-	-
1	-	-	-	-	-	-
2	-	-	-	-	-	-
3	-	-	-	-	-	-
4	-	-	-	-	-	-
5	-	-	-	-	-	-
6	-	-	-	-	-	-
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-
12	-	-	-	-	-	-
13	-	-	-	-	-	-
14	-	-	-	-	-	-
15	0%	-	-	-	-	-
16	1%	-	90%	-	0%	-
17	1%	-	90%	-	0%	-
18	1%	-	90%	-	0%	-
19	1%	-	90%	-	0%	-
20	1%	-	90%	-	1%	-
21	1%	-	75%	-	1%	-
22	1%	-	75%	-	1%	-
23	2%	15%	75%	100%	1%	15%
24	4%	15%	75%	100%	3%	15%
25	5%	15%	60%	100%	3%	15%
26	8%	25%	50%	75%	4%	19%
27	8%	50%	40%	50%	3%	25%
28	8%	50%	25%	10%	2%	5%
29	15%	50%	10%	-	2%	-
30	50%	50%	-	-	-	-
31	50%	50%	-	-	-	-
32	50%	50%	-	-	-	-
33	50%	50%	-	-	-	-
34	50%	50%	-	-	-	-
35	100%	100%	-	-	-	-

13. Repowered wind farms assumption represents proportion of original fleet which is repowered each year, i.e. out of all the wind farms installed in year 0, 21% will be repowered..

WindEurope is the voice of the wind industry, actively promoting wind power in Europe and worldwide. It has over 500+ 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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