WindEurope

# Wind energy in Europe

## 2024 Statistics and the outlook for 2025-2030

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## DISCLAIMER

This report summarises new installations and financing activity in Europe's wind farms from 1 January to 31 December 2024.

It also analyses how European markets will develop in the next six years (2025 to 2030). The outlook is based on WindEurope internal analysis and consultation with its members.

The data represents gross installations per country unless stated otherwise. 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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# Contents

# Executive summary

EUROPE NOW HAS

**285 GW**

OF WIND CAPACITY

Europe installed 16.4 GW of new wind power capacity in 2024. The EU-27 installed 12.9 GW of this.

84% of new wind capacity built in Europe last year was onshore. And 75% of new wind installations up to 2030 will continue to be onshore.

Germany built the most new wind capacity last year, thanks to its ongoing expansion of onshore wind. After Germany, the UK and France built the most new capacity. All three countries installed new capacity onshore and offshore.

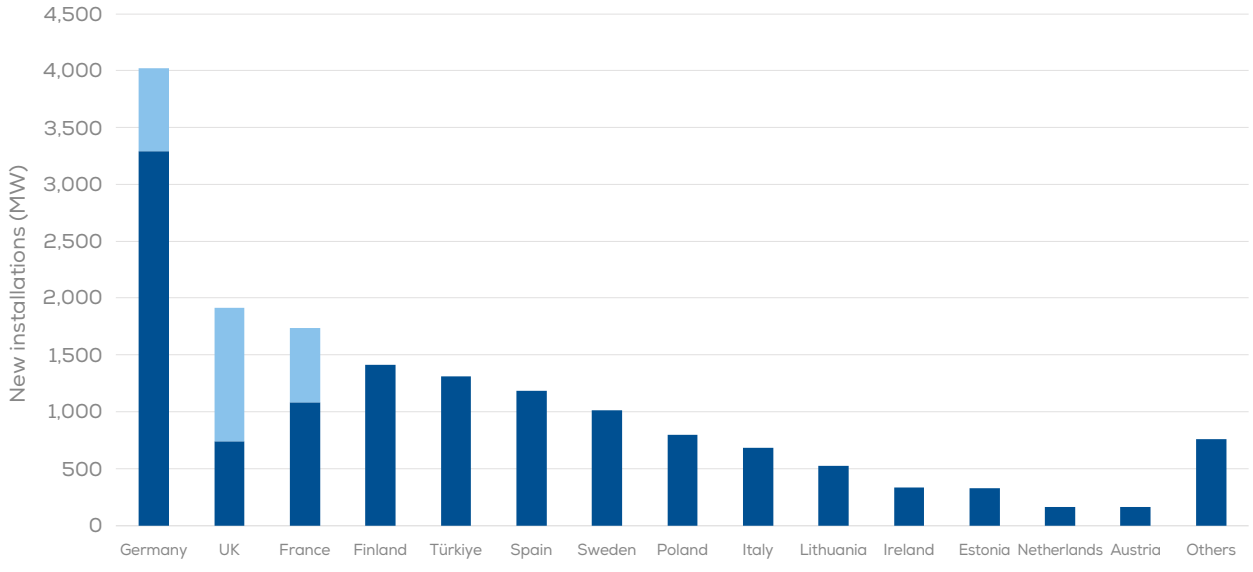
Wind energy made up 19% of all the electricity consumed across the EU-27 in 2024. It was 56% in Denmark, 33% in Ireland, 31% in Sweden and 30% in Germany.

Europe's Governments awarded 36.8 GW of new wind power capacity across 12 countries in 2024: 17 GW onshore and 19.9 GW offshore. This was a record amount and 1/3 more than the volume awarded in 2023.

New installations in 2024 were lower than expected. Grid bottlenecks, ongoing issues with permits in many countries and challenging financial conditions all mean that wind energy is not expanding as quickly as Governments would like.

Restrictions in grid capacity, port capacity and vessel availability are also hindering the expansion of offshore wind.

**FIGURE A.** New onshore and offshore wind installations in Europe in 2024




| | Germany | UK | France | Finland | Türkiye | Spain | Sweden | Poland | Italy | Lithuania | Ireland | Estonia | Netherlands | Austria | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onshore | 3,292 | 739 | 1,081 | 1,414 | 1,310 | 1,183 | 1,015 | 805 | 685 | 522 | 333 | 330 | 161 | 160 | 758 |
| Offshore | 730 | 1,178 | 658 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: WindEurope

We now expect Europe to build on average 31 GW of new wind farms a year over the period 2025-2030.

In the EU we expect to build on average 23 GW of new wind farms a year over the same period, taking total wind energy capacity to 351 GW by 2030: 304 GW onshore; 48 GW offshore. The EU's designated target is 425 GW[1].

2024 saw more onshore wind farm investments than in previous years. Total onshore "Final Investment Decisions" (FIDs) came to €24.7bn, and with an extra €7.9bn of offshore investments, this means almost 20 GW of new wind farms were financed and will now be built over the next few years.

Sustained wind deployment in the EU in the 2030s would allow wind to almost quadruple its output by 2040 compared with today.

But Governments now need to continue expanding and modernising their electricity grids, investing in port infrastructure and implementing the EU's new permitting rules in full.

Energy is at the core of Europe's competitiveness challenge. Electrification will help drive the resilience and competitiveness of our economy while staying the course on decarbonisation.

Investing in our electricity grids will help unleash the massive potential of renewables, meet rising energy demand while displacing expensive fossil fuels, and create a self-sustaining investment climate for decarbonised energy.

1. 2030 REPowerEU target reduced from 440 GW after the compromise of a 42.5% renewable energy target for 2030 was reached in 2023

**FIGURE B.** 2025-30 annual onshore and offshore wind power installations in the EU - WindEurope's Outlook

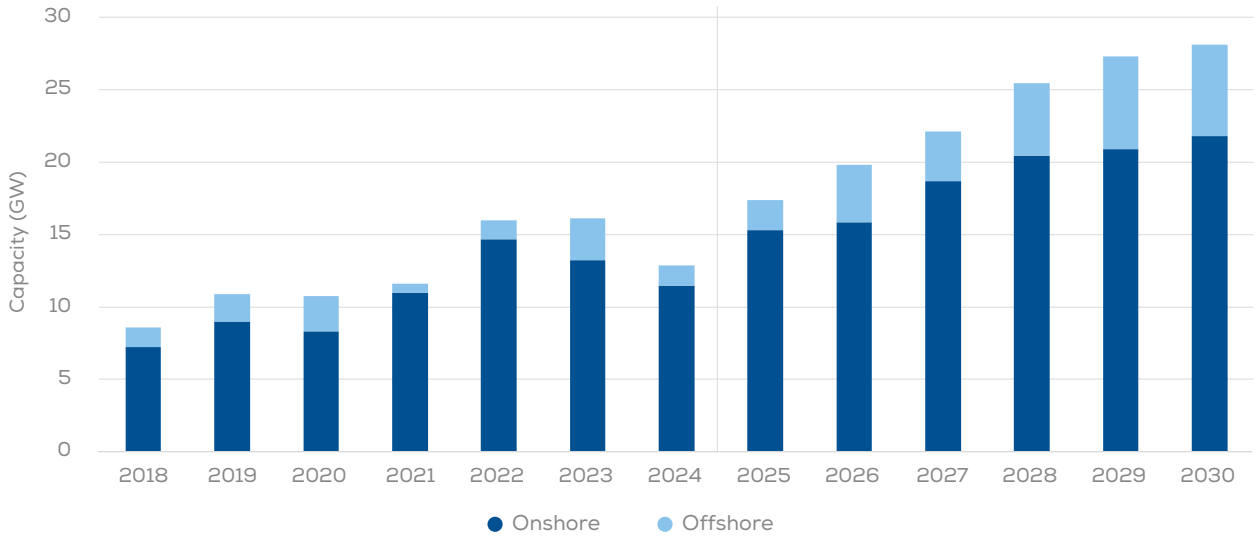
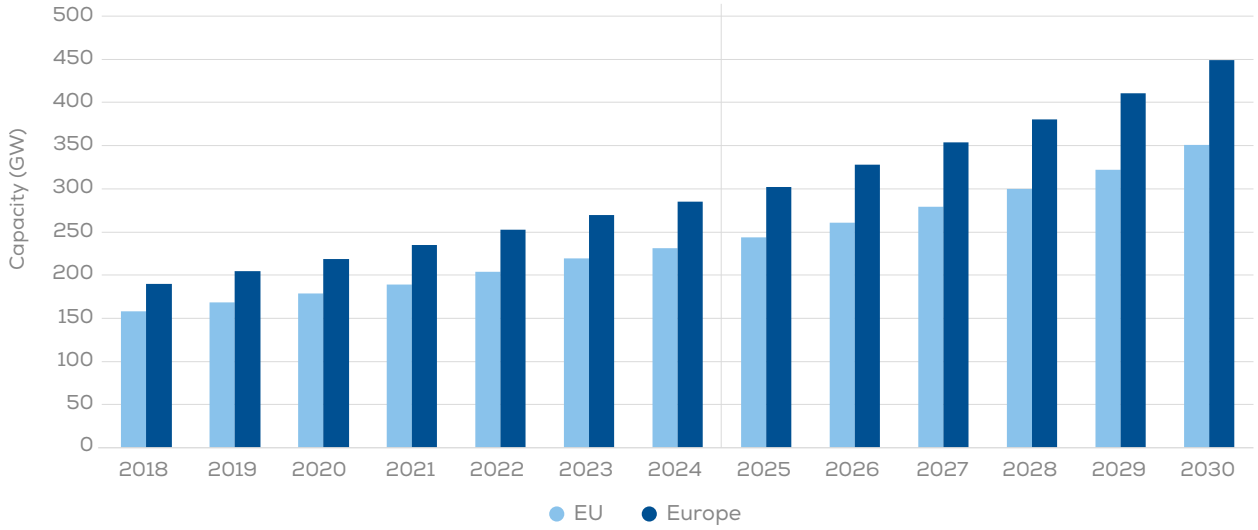



**FIGURE C.** 2025-30 new wind power capacity in Europe and the EU - WindEurope's Outlook




Source: WindEurope

## 2024 Annual figures

- Europe installed 16.4 GW of new wind power capacity in 2024 (gross installations). Onshore wind made up 84% of the new installations with 13.8 GW.
- 12.9 GW of the new wind power capacity was installed in the EU-27, 89% of which was onshore (11.5 GW).
- New offshore wind installations in Europe were 2.6 GW. 1.4 GW were in the EU-27.
- Wind farms in the EU generated 475 TWh of electricity in 2024. This covered 19% of total electricity demand in the EU.
- Total "Final Investment Decisions" (FIDs) were €33bn, financing 19.9 GW of new projects.

## Total installed capacity

- Europe now has 285 GW of installed wind power capacity: 248 GW onshore and 37 GW offshore.
- The EU-27 has 231 GW installed. 210 GW of this is onshore and 21 GW offshore.

## Performance of new wind farms

- The anticipated capacity factors of new onshore wind farms built in Europe in 2024 is 30-45%. And around 50% for offshore wind.
- The average power rating for new onshore turbines installed in 2024 was 4.6 MW. For offshore turbines it was 10.1 MW.

## Country highlights

- Germany installed the most wind power capacity in 2024 (4.0 GW). 82% of this was onshore.
- The UK (1.9 GW), France (1.7 GW), Finland (1.4 GW), Türkiye (1.3 GW), Spain (1.2 GW) and Sweden (1.0 GW) came next.
- Denmark and Ireland had the highest share of wind in their electricity mix with 56% and 33% respectively.
- Wind met more than a quarter of electricity demand in another seven countries: Sweden (31%), Germany (30%), the UK (30%), the Netherlands (29%), Portugal (28%), Lithuania (27%) and Spain (25%).
- Despite the ongoing war, Ukraine installed 45 MW of new capacity. 69% of its total installed capacity of 1.9 GW is currently in occupied territory.

## 2025-2030 Outlook

- We expect Europe to install 187 GW of new wind power capacity in the 2025-2030 period. We expect the EU-27 to install 140 GW of this, 23 GW a year on average.
- For the period 2025-2030, we expect 75% of new installations in Europe and 81% of installations in the EU to be onshore.
- The new EU rules on permitting are already boosting permitting volumes for new wind farms. In Germany, where the principle of Overriding Public Interest is being implemented, a record 13.8 GW was permitted in 2024. Other Member States should follow this example and implement the good EU rules.
- Grids are now the biggest bottleneck to deploying wind energy at scale. National Authorities should invest in expanding, reinforcing or optimising their transmission and distribution networks as soon as possible and urgently move away from the first come, first served approach to managing connection queues.
- Sustained wind deployment in the EU in the 2030s would allow wind to almost quadruple its output compared with today, delivering 1,830 TWh by 2040.

## Old wind farms and repowering

- Europe decommissioned 1.3 GW of wind capacity in 2024. At the same time, it commissioned 1.6 GW of repowered capacity. The net new capacity additions were 15 GW.
- We expect about 22 GW to be decommissioned over the 2025-2030 period. 12 GW should be repowered (eventually leading to 26 GW of repowered capacity), with the remaining 10 GW to be fully decommissioned and removed from the system.
- Repowering wind farms on average trebles the output whilst reducing the number of turbines by 25%.

**TABLE 1.** New additions, total wind capacity and the share of wind in electricity demand in 2024 [2]

| | New installations in 2024 (MW) | | | Cumulative capacity (MW) | | | Share of wind in power mix in 2024 | | |
|---|---|---|---|---|---|---|---|---|---|
| EU-27 | Onshore | Offshore | Total | Onshore | Offshore | Total | Onshore | Offshore | Total |
| Austria | 160 | - | **160** | 4,028 | - | **4,028** | 16% | - | **16%** |
| Belgium | 151 | - | **151** | 3,386 | 2,261 | **5,648** | 7% | 9% | **16%** |
| Bulgaria | - | - | **-** | 706 | - | **706** | 4% | - | **4%** |
| Croatia | 47 | - | **47** | 1,303 | - | **1,303** | 14% | - | **14%** |
| Cyprus | - | - | **-** | 158 | - | **158** | - | - | **-** |
| Czechia | 16 | - | **16** | 371 | - | **371** | 1% | - | **1%** |
| Denmark | 50 | - | **50** | 4,960 | 2,652 | **7,612** | 29% | 26% | **56%** |
| Estonia | 330 | - | **330** | 711 | - | **711** | 14% | - | **14%** |
| Finland | 1,414 | - | **1,414** | 8,286 | 71 | **8,357** | 24% | - | **24%** |
| France | 1,081 | 658 | **1,739** | 22,883 | 1,500 | **24,383** | 10% | 1% | **11%** |
| Germany | 3,292 | 730 | **4,022** | 63,551 | 9,121 | **72,672** | 24% | 6% | **30%** |
| Greece | 128 | - | **128** | 5,354 | - | **5,354** | 22% | - | **22%** |
| Hungary | - | - | **-** | 329 | - | **329** | 1% | - | **1%** |
| Ireland | 333 | - | **333** | 4,836 | 25 | **4,861** | 33% | - | **33%** |
| Italy | 685 | - | **685** | 12,915 | 30 | **12,945** | 8% | 0% | **8%** |
| Latvia | - | - | **-** | 137 | - | **137** | 4% | - | **4%** |
| Lithuania | 522 | - | **522** | 1,750 | - | **1,750** | 27% | - | **27%** |
| Luxembourg | 7 | - | **7** | 214 | - | **214** | - | - | **-** |
| Malta | - | - | **-** | - | - | **-** | - | - | **-** |
| Netherlands | 161 | - | **161** | 6,968 | 4,738 | **11,706** | 15% | 14% | **29%** |
| Poland | 805 | - | **805** | 10,233 | - | **10,233** | 14% | - | **14%** |
| Portugal | 45 | - | **45** | 5,938 | 25 | **5,963** | 27% | 0% | **28%** |
| Romania | 50 | - | **50** | 3,150 | - | **3,150** | 12% | - | **12%** |
| Slovakia | - | - | **-** | 4 | - | **4** | 0% | - | **0%** |
| Slovenia | - | - | **-** | 3 | - | **3** | 0% | - | **0%** |
| Spain | 1,183 | - | **1,183** | 31,173 | 7 | **31,180** | 25% | - | **25%** |
| Sweden | 1,015 | - | **1,015** | 17,008 | 192 | **17,200** | 31% | - | **31%** |
| **Total EU-27** | **11,474** | **1,387** | **12,861** | **210,356** | **20,623** | **230,979** | **17%** | **2%** | **19%** |

2. All numbers are rounded and therefore may not sum to totals.

| | New installations in 2024 (MW) | | | Cumulative capacity (MW) | | | Share of wind in power mix in 2024 | | |
|---|---|---|---|---|---|---|---|---|---|
| Others | Onshore | Offshore | Total | Onshore | Offshore | Total | Onshore | Offshore | Total |
| Albania | - | - | - | - | - | - | - | - | - |
| Belarus | - | - | - | 3 | - | 3 | - | - | - |
| Bosnia & Herzegovina | 109 | - | 109 | 244 | - | 244 | - | - | - |
| Faroe Islands | - | - | - | 71 | - | 71 | - | - | - |
| Iceland | - | - | - | 3 | - | 3 | - | - | - |
| Kosovo | - | - | - | 137 | - | 137 | - | - | - |
| Liechtenstein | - | - | - | - | - | - | - | - | - |
| Moldova | - | - | - | - | - | - | - | - | - |
| Montenegro | - | - | - | 118 | - | 118 | - | - | - |
| North Macedonia | - | - | - | 73 | - | 73 | - | - | - |
| Norway | - | - | - | 5,087 | 101 | 5,188 | 11% | - | 11% |
| Serbia | 111 | - | 111 | 623 | - | 623 | - | - | - |
| Switzerland | - | - | - | 100 | - | 100 | 0% | - | 0% |
| Türkiye | 1,310 | - | 1,310 | 13,793 | - | 13,793 | 11% | - | 11% |
| UK | 739 | 1.178 | 1,916 | 15,703 | 15.933 | 31,636 | 13% | 17% | 30% |
| Ukraine | 45 | - | 45 | 1.947 | - | 1,947 | - | - | - |
| Total others | 2,313 | 1.178 | 3,491 | 37,902 | 16.034 | 53.936 | - | - | - |
| Total Europe | 13,787 | 2,565 | 16,352 | 248,257 | 36,657 | 284,914 | 16% | 4% | 20% |

# 1.

# Wind power in 2024

## 1.1 Overview

Europe installed 16.4 GW of new wind farms in 2024, with 13.8 GW of new capacity installed onshore and 2.6 GW offshore. Total installations in Europe fell short of our Central Scenario from 2023 by 23%.

Onshore installations were lower than expected as projects were delayed for a variety of reasons, including the partial closure of a major freeway in Germany and several wind projects being blocked in Galicia, Spain. Offshore as well there were construction delays at Dogger Bank A (1.2 GW) in the UK and Calvados (488 MW) in France, and connection delays with Borkum Riffgrund in Germany (980 MW).

The EU-27 added 12.9 GW of new wind power capacity in 2024, representing 79% of all installations in Europe. Installations in the EU were less than in 2023 when 16.1 GW of capacity was added. For the EU to reach its 42.5% renewable energy target by 2030, wind energy installations need to average 36 GW a year between 2025 and 2030. This is based on an installed wind power capacity target of 425 GW[3].

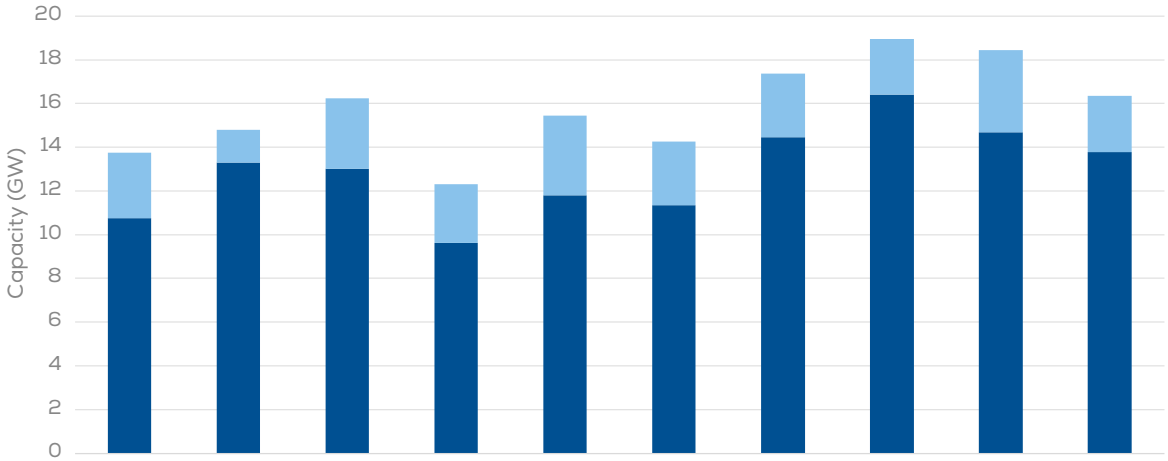
Wind turbine installations in Germany were the highest in Europe in 2024, making up 25% of the total installed capacity. They installed 4 GW, including 730 MW offshore, up from 3.8 GW in 2023. Seven countries installed more than 1 GW of new wind power capacity in 2024, the same number as in 2023.

Offshore wind accounted for 16% of installations in Europe with 2.6 GW of wind farm capacity connecting to the grid, down from 3.7 GW in 2023. The newly connected offshore capacity was in the UK (1,178 MW), Germany (730 MW), and France (658 MW).

Outside the EU, 3.5 GW of new wind farms were installed (up from 2.3 GW in 2023). Out of this the UK installed the most (1.9 GW), followed by Türkiye (1.3 GW), Serbia (111 MW), Bosnia & Herzegovina (109 MW) and Ukraine (45 MW).

1.3 GW of wind capacity was decommissioned in 2024, so net installations in Europe (installed minus decommissioned capacity) came to 15 GW.

**FIGURE 1.** Annual onshore and offshore wind power capacity installed in Europe




| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|
| Onshore | 10,8 | 13,3 | 13,0 | 9,6 | 11,8 | 11,3 | 14,4 | 16,4 | 14,7 | 13,8 |
| Offshore | 3,0 | 1,5 | 3,2 | 2,7 | 3,7 | 2,9 | 2,9 | 2,5 | 3,7 | 2,6 |

Source: WindEurope

3. 2030 REPowerEU target reduced from 440 GW after the compromise of a 42.5% renewable energy target for 2030 was reached in 2023.

For the third year running Ukraine built new wind farm capacity despite the ongoing war. 21 MW were added to the grid, while 24 MW were installed by industrial players for self-consumption. However, 69% of the country's total capacity of 1.9 GW was located in occupied territory as of the end of 2024. Given the uncertainty of the situation, estimates for future build-out in the region have only been included up to 2026 in the 2025-2030 outlook for Europe.

## 1.2 Onshore installations

**Germany** installed the most onshore wind energy capacity in 2024 with 3.3 GW. The newly installed capacity came from 644 wind turbines with an average power rating of 5.1 MW, up from 4.8 MW in 2023. 712 MW of onshore capacity was decommissioned bringing net additions to 2.6 GW. Onshore installations in 2024 fell by 8% compared with 2023, when Germany installed 3.6 GW. One third of the newly installed capacity (1.1 GW) came from repowered wind farms.

Installations were delayed significantly by the partial shutdown of the A27 freeway in northwest Germany, which is a crucial link for rotor blades entering through the port of Cuxhaven. Supply chain constraints (e.g. substations) and a cumbersome permitting system for transport have all led to a shortfall in installations.

**Finland** installed the second largest new onshore wind capacity in 2024, with 1.4 GW. They installed 235 turbines, with an average power rating of 6 MW, the same as in 2023. Onshore installations were up from 2023, when they installed 1.3 GW. No wind farms were decommissioned in 2024.

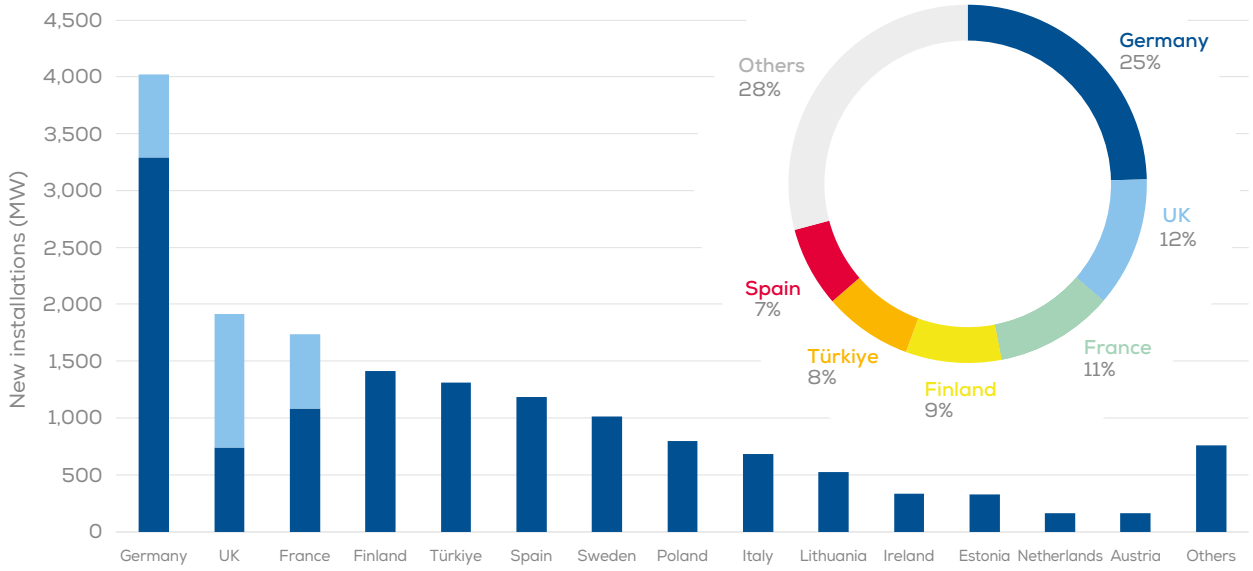
**Türkiye** added 1.3 GW in 2024, more than twice the volume installed in 2023. The reasons for this are the capacity extension projects for current wind farms now coming online, as well as additions from YEKA-2 (EnerjiSA and Enercon projects with a total capacity of 1 GW), due to be fully commissioned by the end of 2025. With 272 onshore wind turbines installed during the year, the average power rating for new turbines was 4.8 MW.

**Spain** installed 1.2 GW of onshore wind in 2024, nearly double the volume installed the year before. 435 MW of existing capacity was decommissioned, bringing net additions to 748 MW. The newly installed capacity was spread across 227 turbines, for an average power rating of 5.2 MW.

**84%**

**OF WIND INSTALLATIONS IN 2024 CAME FROM ONSHORE WIND**

**FIGURE 2.** New onshore and offshore wind installations in Europe in 2024




| | Germany | UK | France | Finland | Türkiye | Spain | Sweden | Poland | Italy | Lithuania | Ireland | Estonia | Netherlands | Austria | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onshore | 3,292 | 739 | 1,081 | 1,414 | 1,310 | 1,183 | 1,015 | 805 | 685 | 522 | 333 | 330 | 161 | 160 | 758 |
| Offshore | 730 | 1,178 | 658 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

Source: WindEurope

**France** installed 1.1 GW, down on the figure for 2023 (1.3 GW). The country also decommissioned 13 MW of capacity, bringing net additions to 1,068 MW. A total of 387 onshore wind turbines were installed in 2024, resulting in an average power rating of 2.8 MW, one of the lowest in Europe in 2024.

**Sweden** was the only other country that installed more than 1 GW of onshore wind energy in 2024, with 1,015 MW. This capacity included 165 turbines, giving an average power rating for newly installed turbines of 6.2 MW, the third highest after Lithuania and Romania.

Poland, the UK, Italy, and Lithuania rounded out the top 10 countries for newly installed onshore wind capacity. They were also the only other countries that added more than 500 MW in 2024.

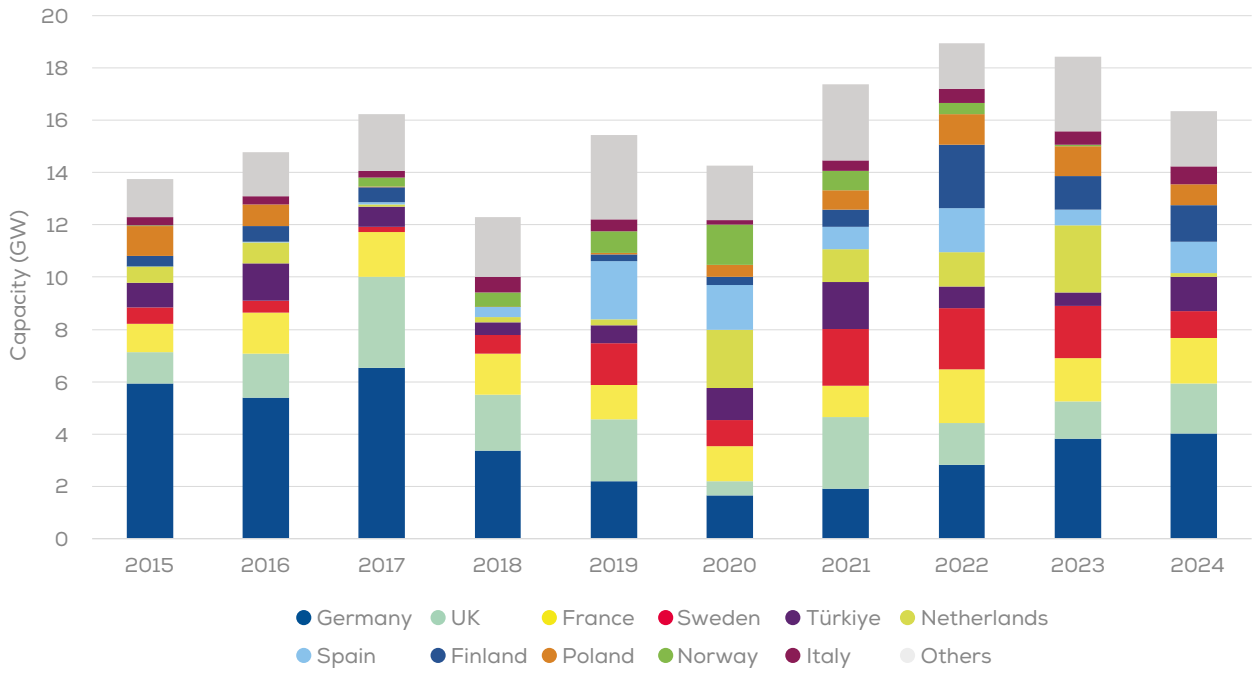
**Poland** installed 805 MW, down from 2023 when it installed 1.2 GW. The 10H currently being repealed severely restricted turbine heights, leading to relatively small turbine models being installed. This meant that the average power rating of onshore turbines installed in 2024 was 3.3 MW.

**Italy** installed 685 MW of onshore wind capacity in 2024, 32% more than in 2023. The average power rating of turbines installed in 2024 was 4.1 MW.

**The UK** installed 739 MW with an average power rating of 3.7 MW.

**Lithuania** had its best year so far, with 522 MW of onshore wind capacity connected to the grid. The average power rating of wind turbines installed last year was 6.3 MW, the highest in Europe together with Romania.

**FIGURE 3.** Distribution of new wind installations by country, 2015-24




Source: WindEurope

## 1.3 Offshore installations

WindEurope reports new offshore wind energy capacity connected to the grid, rather than newly installed capacity on its own. On the whole, offshore wind farms are significantly larger than onshore wind farms, and construction times tend to be longer. There can be periods when turbines have been installed at the wind farm but are not yet connected to the grid, and not feeding renewable electricity into the energy system at that point.

2.6 GW of offshore wind capacity was connected to the grid in Europe last year – across 8 wind farms in three different countries.

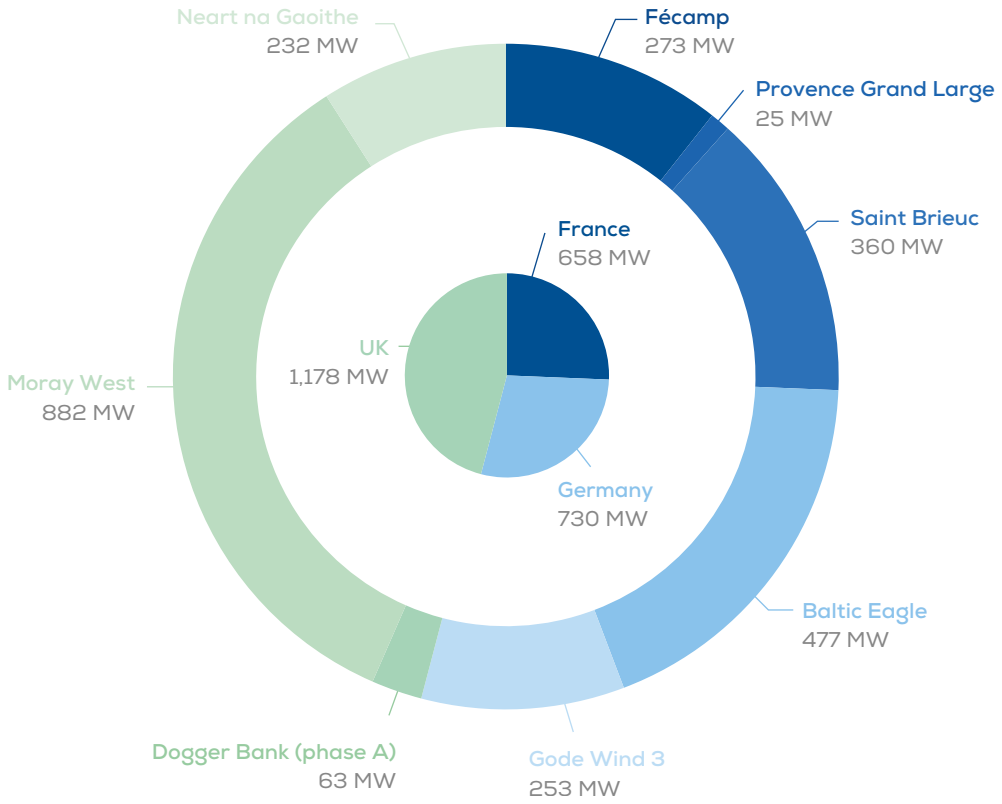
**The UK** connected the most offshore wind energy capacity, 1,178 MW across three wind farms. All 60 turbines at Moray West offshore wind farm were connected, adding 882 MW. A further 296 MW were connected across Neart na Gaoithe (448 MW) and Dogger Bank Phase A (1.2 GW). 93 turbines were connected in total, resulting in an average power rating of 12.7 MW.

In **Germany** 730 MW of offshore wind capacity was connected with the commissioning of Baltic Eagle (477 MW) and Gode Wind 3 (253 MW). A total of 73 turbines were connected, with an average power rating of 10 MW.

Finally, **France** connected 658 MW of offshore wind in 2024. This includes turbines from Saint Brieuc (496 MW), Fécamp (497 MW) and the pilot Provence Grand Large floating project (25 MW). A total of 87 turbines were connected, with an average power rating of 7.6 MW.

Works were carried out at a further six wind farms in the UK, France and Germany without any turbines being connected to the grid.

**FIGURE 4.** New offshore wind capacity connected in Europe in 2024




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 it is not extended by replacing components or blades, the turbines will be shut off, taken down and removed. This is known as decommissioning.

It often makes sense to repower the wind farm as 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 made since the days of early turbines, newly 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

## 1.4 Decommissioning and repowering

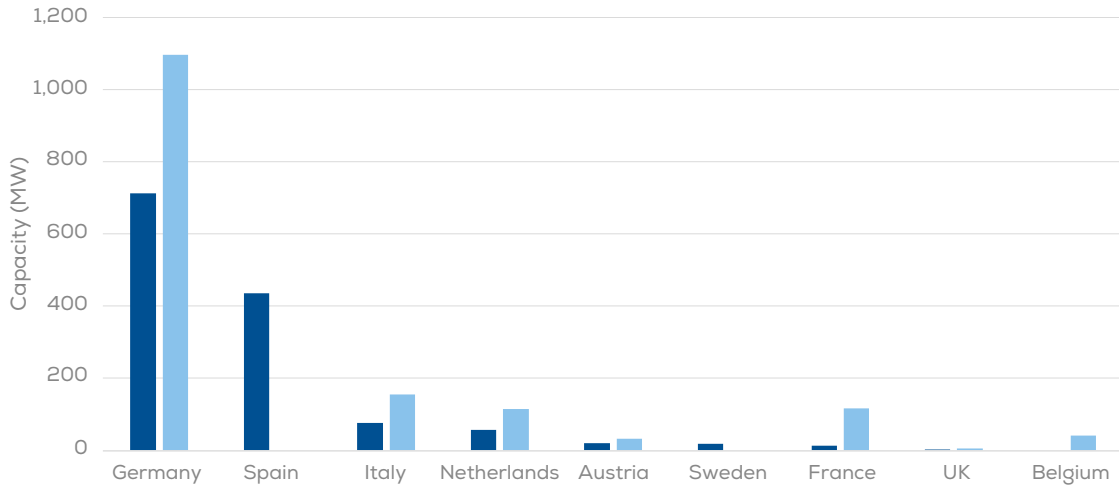
1.3 GW across eight countries was decommissioned in 2024. This includes Germany (712 MW), Spain (435 MW), Italy (76 MW), the Netherlands (57 MW), Austria (20 MW), Sweden (18 MW), France (13 MW), and the UK (1 MW).

Out of the 16.4 GW of wind power capacity installed in Europe in 2024, 1.6 GW was from repowering projects. Most repowering took place in Germany (1.1 GW) with some also taking place in Italy (155 MW), France (116 MW), the Netherlands (114 MW), Belgium (41 MW), Austria (31 MW), and the UK (2 MW).

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 resource 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 communities given the likely increase in the size of the turbines).

Obtaining new permits should therefore take less time and be more efficient than for greenfield projects.

**FIGURE 5.** Decommissioned and repowered capacity in 2024




| | Germany | Spain | Italy | Netherlands | Austria | Sweden | France | UK | Belgium |
|---|---|---|---|---|---|---|---|---|---|
| Decommissioned | 712 | 435 | 76 | 57 | 20 | 18 | 13 | 1 | 0 |
| Repowered | 1,096 | 0 | 155 | 114 | 31 | 0 | 116 | 2 | 41 |

Source: WindEurope

# 1.6 GW

## REPOWERING IN 2024

The EU recognises the potential of repowering projects with dedicated measures in the Renewable Energy Directive, revised in 2023. 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 within one year (except in Renewables Acceleration Areas where the deadline is six months for new and repowered projects).

There are still hurdles at the national level which hinder the possibility of repowering. For example, in Italy repowering projects can take part in auctions, but they need to discount their bids because the legislator considers the development costs of repowered projects to be less than greenfield projects. In fact, this is not always the case – for example, unlike greenfield projects, repowering projects often entail decommissioning costs. For now, permitting timescales for repowering projects are similar to those for new projects.

## 1.5 Power generation

Wind energy met 19% of demand across the EU-27 in 2024, unchanged from 2023 despite increased generation. EU electricity demand has recovered somewhat from the global energy crisis, and electricity demand was 1.4% higher in 2024 than it was in 2023.

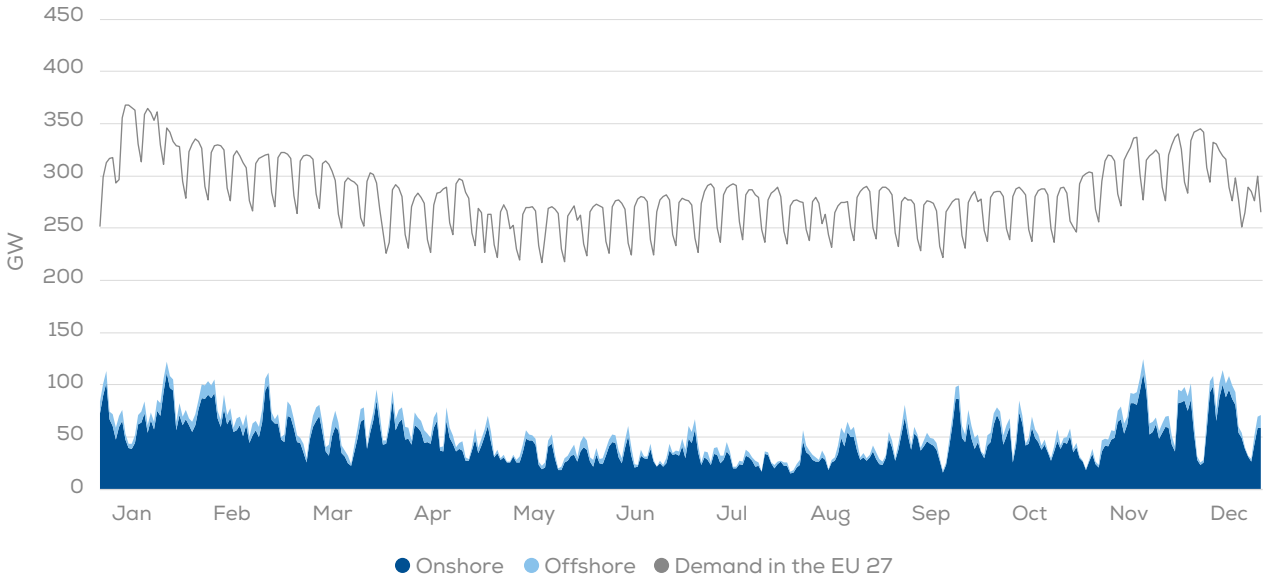
The share of demand that was met by wind power was bolstered by record levels of generation in the EU, driven in large parts by new capacity additions. Onshore wind conditions in Europe were mixed, with good conditions in the north but less favourable conditions in the west and south. Offshore conditions were similar to previous years.

Across Europe, wind energy was partially curtailed, as capacity additions have outpaced the expansion and modernisation of the grid. This led to a loss of potential generation.

Wind power plants in the EU produced 475 TWh of electricity and covered 19% of the electricity demand (16.6% from onshore and 2.5% from offshore wind). Wind power achieved record daily production on 24 November (2,995 GWh) corresponding to an average output of 125 GW or about 60% of the fleet running at maximum output for the entire day.

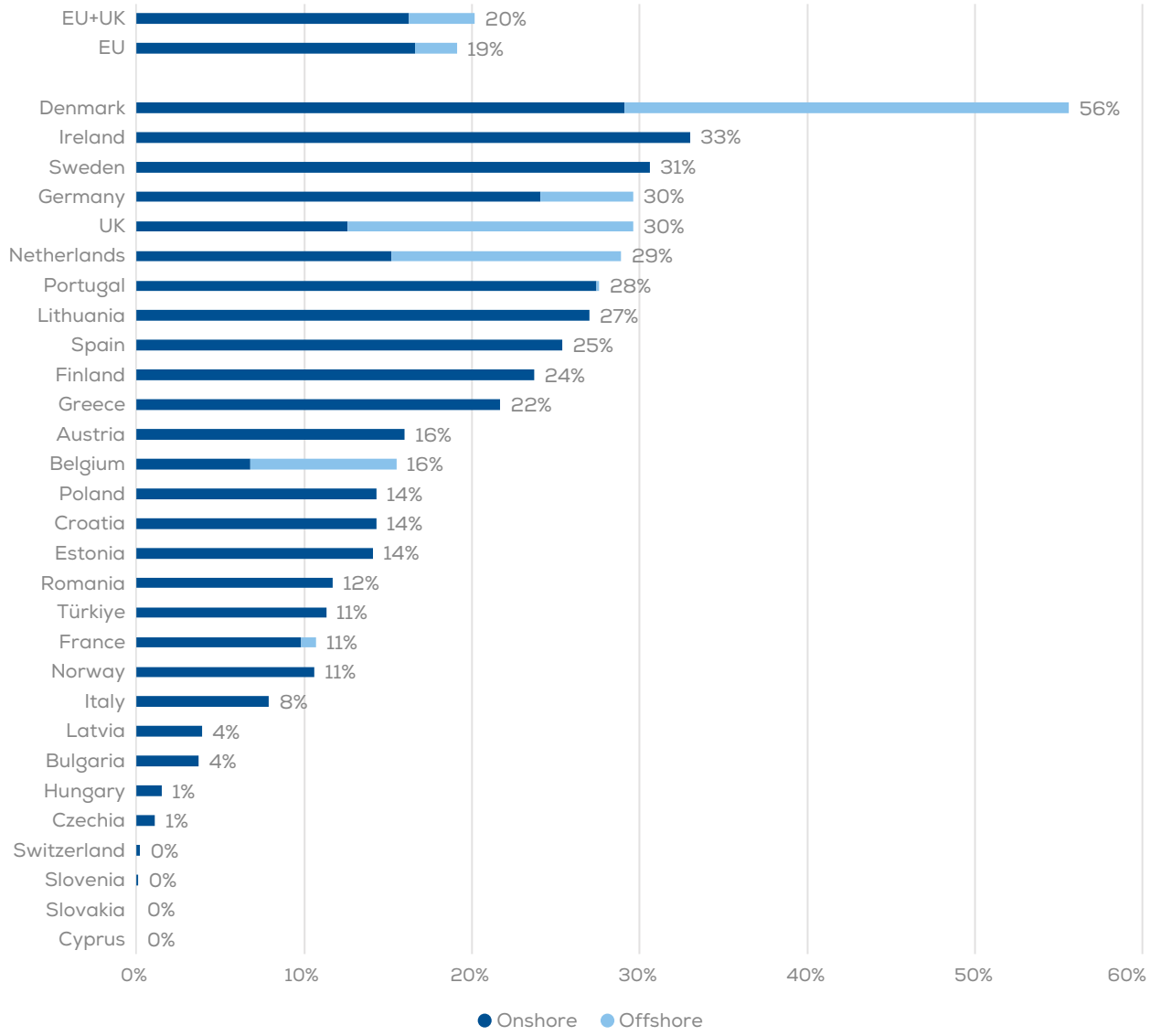
5 August saw the lowest daily electricity output from wind power plants, with a total generation just 401 GWh, covering 6% of demand in the EU on that day.

**FIGURE 6.** Power demand and wind energy generation in the EU-27 in 2024 (GW)




Source: WindEurope

**FIGURE 7.** Percentage of electricity demand covererd by wind in 2024




Source: WindEurope

**WIND ENERGY MET**

# 19%

**OF THE ELECTRICITY DEMAND IN THE EU IN 2024**

Denmark had the highest share of wind with 56%, followed by Ireland with 33%. A combination of a 6% increase in Sweden's installed capacity and a 6% increase in the fleet's capacity factor saw its share of demand jump from 26% in 2023 to 31% in 2024, overtaking Spain, the Netherlands, the UK and Germany to have the third highest share in Europe.

Estonia, Finland and Lithuania all saw large increases in generation on the back of strong build-out and favourable wind conditions. Lithuania's share of demand increased from 21% in 2023 to 27% in 2024. Finland's share grew from 18% to 24% and Estonia's from 10% to 14% respectively.

The UK was the non-EU country with the highest share of wind at 30%, putting it fifth in Europe. The Netherlands (29%), Portugal (28%) and Lithuania (27%) followed, all registering increases in their generation that offset higher loads.

Half of all countries in Europe met a greater share of demand with wind power in 2024. 20 countries had wind energy shares above 10%, 17 in the EU plus the UK, Türkiye and Norway.

**TABLE 2.** Electricity production in 2024 from wind power in the EU-27 and in the EU+UK

| | Electricity consumption (TWh) | Onshore wind energy production (TWh) | Offshore wind energy production (TWh) | Total wind energy production (TWh) | Share of consumption met by wind energy |
|---|---|---|---|---|---|
| EU-27 | 2,483 | 413 | 62 | 475 | 19% |
| EU+UK | 2,761 | 448 | 109 | 557 | 20% |

Wind power generation in the EU achieved another record year in 2024 in terms of absolute production (475 TWh). Wind energy's share of consumption remained steady at 19% overall, as electricity demand in the EU grew by just over 1%. Onshore wind met 16.6% of demand and offshore wind covered 2.5% of the EU's electricity consumption.

Wind energy generation in the EU+UK also reached record levels (557 TWh) and met 20% of the electricity demand between the two. The UK's offshore fleet generated 47 TWh, exceeding the entire electricity demand of Hungary (43 TWh).

It is not surprising that the general trend is for increased generation given the ever more powerful turbines installed in recent years. But electricity demand and weather conditions also factor into the share of consumption covered by wind.

In Ireland and the UK, generation relative to installed capacity was down from 2023, a result of less favourable weather conditions and record levels of reported wind energy curtailment.

Favourable wind conditions in the north and the Baltics led to higher levels of generation in Sweden, Norway, Finland, Latvia, Lithuania and Estonia. In Lithuania, Estonia and Finland, significant new capacity was added over the course of 2024. This led to a jump in total generation over the year compared with 2023 of 39% in Estonia and Finland and 37% in Lithuania respectively.

Capacity factors for the entire EU wind fleet were 24% on average. For onshore they were 23% (down from 24% in 2023), while for offshore they were 35%, up from 34% in 2023 and equal to 2022.

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. These 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 wind resource, and thus need to take advantage of lower wind speeds.

They use larger blades and relatively lower generators, increasing their capacity factors.

Capacity factors for new onshore wind farms are estimated to be between 30-35%. For new offshore wind farms, this figure ranges between 42% and 55%.

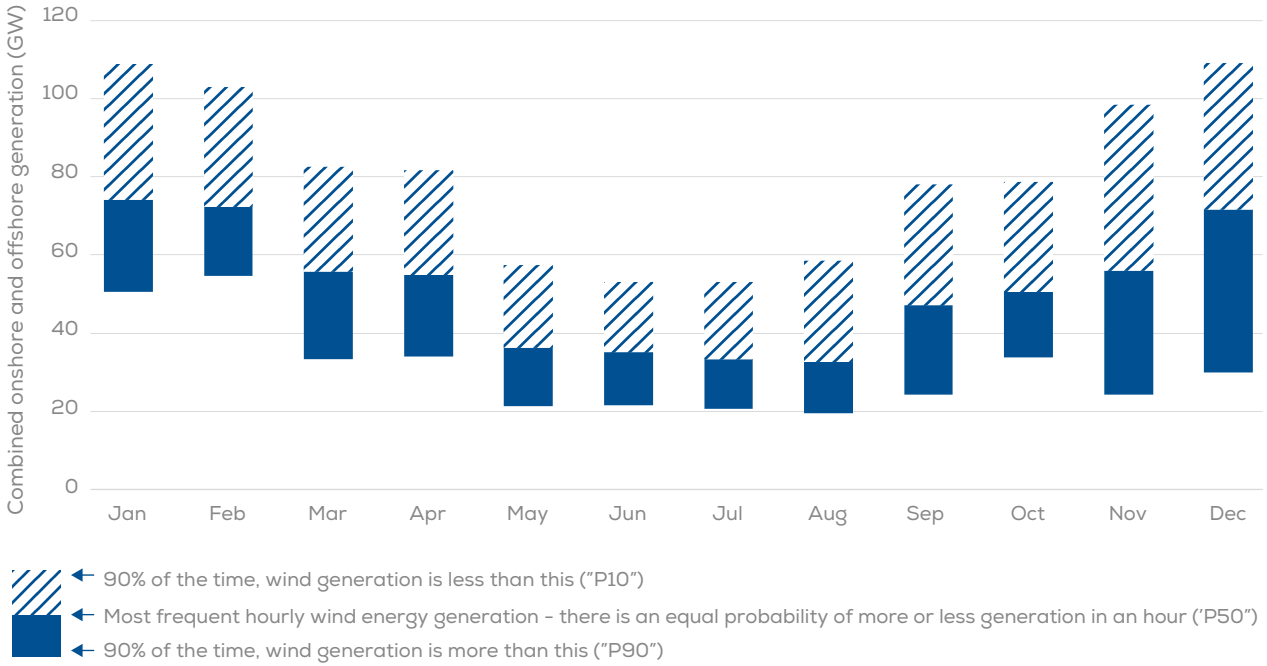
Figure 8 shows the range of hourly electricity generation from wind energy during each month of 2024. In January for instance, the average (median) power output of the wind fleet was 74 GW, while we could rely on at least 51 GW most of the time (90% of all hours). There were a few instances (10% of all hours) where output exceeded 109 GW. In 2024 February was the month with the highest average (mean) output with 77 GW. And for 90% of the time the EU's wind output was more than 25 GW, nearly enough to cover the average national demand of Spain.

Over the summer period from May 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).

July and August had the lowest average generation (mean and median respectively). Output for 90% of the hours exceeded 20 GW, and for 10% of the hours, it was 57 GW or more.

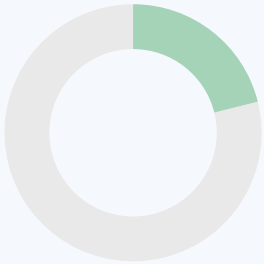
Wind energy production is variable, and the hourly variability generally follows a set pattern of more wind generation and greater variability of generation in the winter months. Over the summer when stable, high-pressure weather systems are more common in Europe, wind energy generation tends to be lower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

**FIGURE 8.** Spread of hourly wind energy generation across the EU in 2024




Source: WindEurope

# The EU's wind energy generation in 2024



**19%**
of the EU's electricity demand

**475 TWh**
EU wind energy generation

## Highest wind energy shares

- 56%
- 33%
- 31%
- 30%
- 29%
- 28%
- 27%
- 25%

**210 GW**
onshore wind capacity

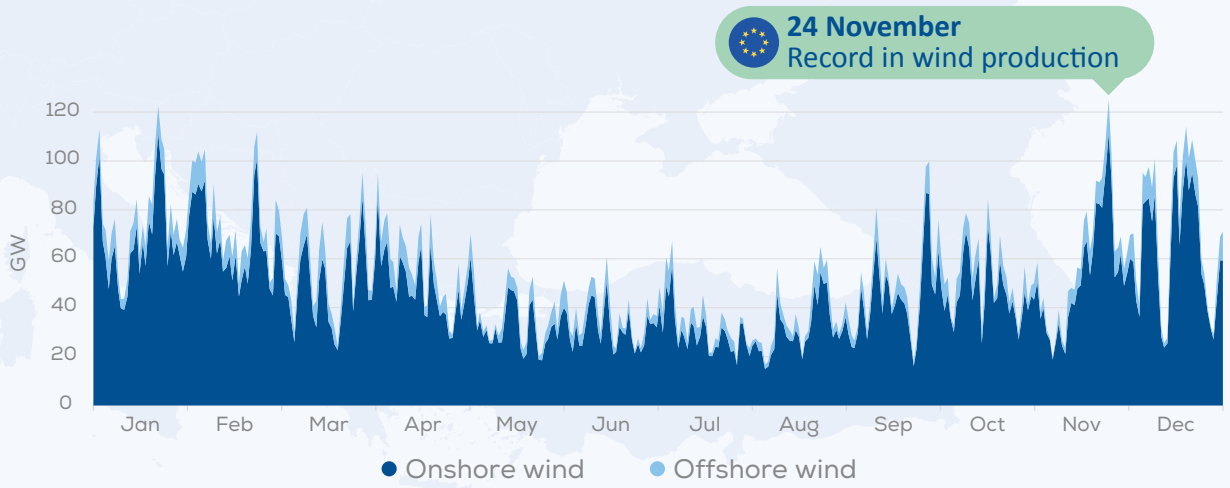
**17%**
of EU electricity demand met by onshore wind

**23%**
average onshore wind capacity factor*

**21 GW**
offshore wind capacity

**2%**
of EU electricity demand met by offshore wind

**35%**
average offshore wind capacity factor*




*Capacity factors of entire fleet including old turbines

## 1.6 Turbine sizes

### Onshore

The size and type of wind turbines installed in Europe varies between countries. The average power rating of onshore turbines installed in 2024 across Europe was 4.6 MW, up from 4.5 MW in 2023.

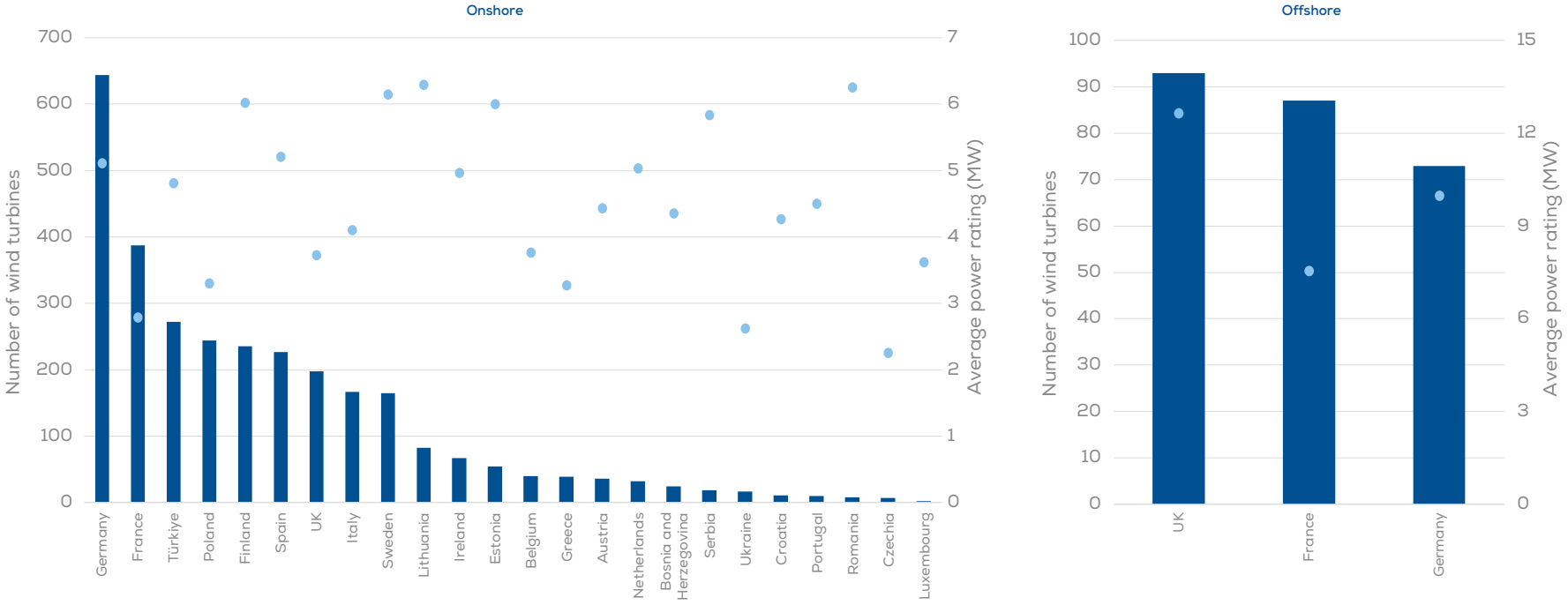
The most powerful onshore wind turbines were installed in Lithuania and Romania, with an average power rating of 6.3 MW, followed by Sweden (6.2 MW), Estonia and Finland (6.0 MW).

Czechia had the lowest average power rating with 2.3 MW, albeit based on just seven installed turbines. Ukraine and France installed turbines with the second and third lowest average power ratings in Europe, with 2.6 MW and 2.8 MW respectively.

The low average in Ukraine was a result of industrial consumers installing 13 used wind turbines for self-consumption, totalling 24 MW (1.8 MW each). Excluding these turbines, the average power rating of the turbines connected to the grid was 5.5 MW.

As for France, stringent height restrictions limit the power ratings of installed turbines, leading to one of the lowest averages in Europe for newly installed turbine power ratings, and limiting the potential benefits of onshore wind as a result.

**FIGURE 9.** Number of turbines installed in 2024 and their average power rating




| | Germany | France | Türkiye | Poland | Finland | Spain | UK | Italy | Sweden | Lithuania | Ireland | Estonia | Belgium | Greece | Austria | Netherlands | Bosnia and Herzegovina | Serbia | Ukraine | Croatia | Portugal | Romania | Czechia | Luxembourg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Average power rating | 5.1 | 2.8 | 4.8 | 3.3 | 6.0 | 5.2 | 3.7 | 4.1 | 6.2 | 6.3 | 5.0 | 6.0 | 3.8 | 3.3 | 4.4 | 5.0 | 4.4 | 5.8 | 2.6 | 4.3 | 4.5 | 6.3 | 2.3 | 3.6 |
| Number of wind turbines | 644 | 387 | 272 | 244 | 235 | 227 | 198 | 167 | 165 | 83 | 67 | 55 | 40 | 39 | 36 | 32 | 25 | 19 | 17 | 11 | 10 | 8 | 7 | 2 |

| | UK | France | Germany |
|---|---|---|---|
| | 12.7 | 7.6 | 10.0 |
| | 93 | 87 | 73 |

Source: WindEurope

Based on disclosed wind turbine orders, the average power rating of onshore turbines ordered in 2024 was 5.7 MW, up from 5.5 MW in 2023.

### Offshore

In 2024 the average power rating of offshore wind turbines connected to the grid was 10.1 MW, up from 9.7 MW in 2023. The UK connected the largest turbines, both on average (12.7 MW) and overall, at the Moray West offshore wind farm (14.7 MW). France connected turbines with the smallest power rating, both on average (7.6 MW) and overall with 7 MW turbines installed at the Fécamp wind farm.

The power rating for offshore turbine orders in 2024 rose to an average of 14.8 MW (up from 14.7 MW in 2023). These turbines will be installed over the next few years, and will likely continue the trend of rising power ratings for newly installed turbines.

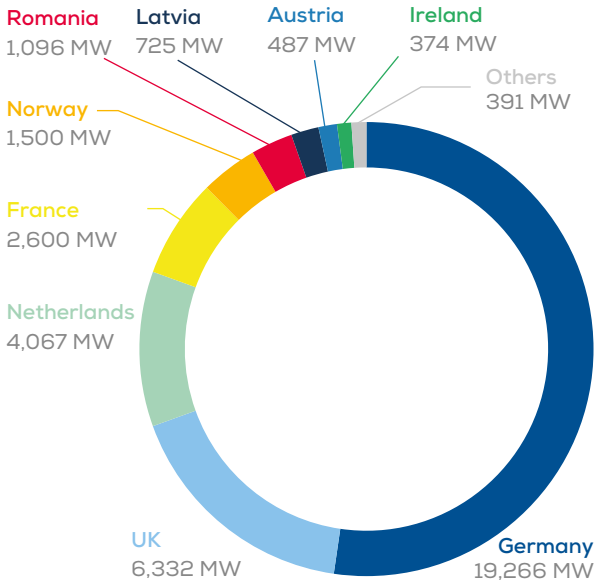
## 1.7 Auction and tenders

In 2024, 36.8 GW of new wind power capacity was awarded across 12 countries in Europe – 17 GW for onshore wind and 19.9 GW for offshore wind. This was 35% more than the volume awarded in 2023 (27.3 GW) and a record figure for a single year. Germany awarded the most capacity (19 GW), followed by the UK (6.3 GW), and the Netherlands (4.1 GW).

### Onshore

European countries offered more than 20.6 GW of onshore wind in 2024 through auctions and tenders, awarding 17 GW in total (83% of the capacity on offer).

**FIGURE 10.** Share of awarded support in wind energy auctions in 2024




Source: WindEurope

Floating feed-in-premiums were awarded to 11.5 GW of onshore wind capacity, 96% of this in Germany. The average strike price for the 20-year support was €73.6/MWh across awarded projects, down slightly on 2023 when 6.7 GW of onshore wind was awarded in auctions in Germany and Austria.

Two-sided contracts-for-difference (2-sided CfDs) were awarded to a total of 4.7 GW in Czechia, France, Ireland, Italy, Poland, Romania, and the UK. The average strike price was €81.8/MWh.

Under 2-sided CfDs, projects receive a minimum price for the electricity they sell – as they do under the floating feed-in premium model – but revenues from electricity sold in excess of this minimum price are returned to the state. The projects therefore receive a fixed price for the power they sell. Since projects do not receive an "up-side" (when prices are high), strike prices tend to be higher than feed-in premiums.

Finally, the land needed to develop at least 725 MW of onshore wind was awarded through auctions in 2024 in Latvia. In these auctions, developers bid to pay for the right to develop onshore wind farms, but not to receive support for the generation of electricity.

See Appendix 1 for more details by country.

## Offshore

In 2024 seven countries offered support to at least 23.3 GW of offshore wind, awarding 85% - or 19.9 GW.

The new capacity of bottom-fixed offshore wind energy projects that were awarded in Germany, the Netherlands, Denmark, Estonia, Norway and the UK totalled 18.4 GW. The remaining 1.2 GW was awarded for floating offshore wind energy projects in France (750 MW) and the UK (400 MW).

Negative bidding was used to award 12.3 GW of new capacity across Germany (8.3 GW) and the Netherlands (4 GW). Developers will pay a combined €4.14bn to National Governments for the right to develop 10.5 GW - the sum that will be paid to develop one of the awarded German offshore sites was not disclosed.

The remaining 7.6 GW was awarded 2-sided CfDs. Newly awarded bottom-fixed capacity in the UK (3.4 GW) and Norway (1.5 GW) secured support for 15 years with an average strike price of €99.4/MWh. 1.6 GW of UK projects also rebid part of their capacities after the significant cost inflation since AR4 in 2022.

In France, the A05 Brittany South and AO6 Mediterranean floating projects were awarded with strike prices ranging from €85.5/MWh to €92.7/MWh.

This was a record low for floating offshore wind. But the French tenders were unique in many ways. Project developers did not have to pay for a grid connection for either the export cables or the offshore substation. Floating offshore wind is a relatively nascent industry and we expect prices to vary greatly across Europe depending on projects specifics and auction characteristics.

In the UK for example, the 400 MW Green Volt floating wind project secured a strike price of €236.3/MWh. While offshore wind energy projects in France are awarded 20-year 2-sided CfDs, projects in the UK are supported for 15 years. Additionally, offshore wind project developers in the UK must bid in negative seabed lease auctions, which is not the case in France.

Crucially, 3.7 GW of offshore capacity was not allocated, as Denmark (3 GW) and Lithuania (0.7 GW) did not award contracts in their respective 2024 offshore wind auctions.

Some offshore wind auction rounds that were expected to take place in the second half of 2024 are now scheduled for 2025. These include Ireland's ORESS 2.1 (900 MW), and Italy and Portugal's first-ever offshore wind auctions.

See Appendix 1 for more details by country.

**TABLE 3.** Auctions and tenders for wind energy support schemes in 2024

| Onshore | Auction | MW awarded | Type of auction | Support mechanism | Price in €/MWh |
|---|---|---|---|---|---|
| Austria | EAG - 2024 April-May round | 162 | Technology specific | Feed-in-premium (floating) | 96 |
| | EAG - 2024 July-August round | 35 | Technology specific | Feed-in-premium (floating) | 95 |
| | EAG - 2024 September-October round | 30 | Technology specific | Feed-in-premium (floating) | 96 |
| | EAG - 2024 November-December round | 231 | Technology specific | Feed-in-premium (floating) | 96 |
| | EAG - 2024 May round | 29 | Technology neutral | Feed-in-premium (floating) | 101 |
| Croatia | 2024 auction round | - | Technology specific | Contract for Difference | - |
| Czechia | 4th call | 25 | Technology neutral | Contract for Difference | 125 |
| | 5th call | 89 | Technology neutral | Contract for Difference | 124 |
| France | AO PPE2 Neutre | 37 | Technology neutral | Contract for Difference | 84 |
| | AO PPE2 Eolien terrestre 7th round | 1.058 | Technology specific | Contract for Difference | 88 |
| | AO PPE2 Eolien terrestre 8th round | 755 | Technology specific | Contract for Difference | 88 |
| Germany | EEG - 2024 February round | 1.795 | Technology specific | Feed-in-premium (floating) | 73 |
| | EEG - 2024 May round | 2.379 | Technology specific | Feed-in-premium (floating) | 73 |
| | EEG - 2024 August round | 2.724 | Technology specific | Feed-in-premium (floating) | 73 |
| | EEG - 2024 November round | 4.098 | Technology specific | Feed-in-premium (floating) | 72 |
| Ireland | RESS 4 | 374 | Technology neutral | Contract for Difference | 90 |
| Italy | FER 1 - 14th round | 98 | Technology neutral | Contract for Difference | 76 |
| | FER 1 - 15th round | 88 | Technology neutral | Contract for Difference | 76 |
| Latvia | 2023 land lease | 725 | Technology neutral | Zero-subsidy bid | - |
| Poland | 2024 round for systems above 1 MW | 91 | Technology neutral | Contract for Difference | 35-41 |
| Romania | 2024 round | 1.096 | Technology specific | Contract for Difference | 65 |
| Netherlands | SDE++ 2024 | 67 | Technology specific | Feed-in-premium (floating) | |
| Ukraine | 2024 round | - | Technology specific | Feed-in-premium (floating) | - |
| UK | Allocation Round 6 Onshore wind | 990 | Technology specific | Contract for Difference | 86 |

| Offshore | Auction | MW awarded | Type of auction | Support mechanism | Price in €/MWh |
|---|---|---|---|---|---|
| Denmark | North Sea I - Area 1 | - | Bottom-fixed | Zero-subsidy bid | - |
| | North Sea I - Area 2 | - | Bottom-fixed | Zero-subsidy bid | - |
| | North Sea I - Area 3 | - | Bottom-fixed | Zero-subsidy bid | - |
| France | AO5 - Brittany South 1 | 250 | Floating | Contract for Difference | 86 |
| | AO6 - Narbonnaise 1 | 250 | Floating | Contract for Difference | 93 |
| | AO6 - Golfe de Fos 1 | 250 | Floating | Contract for Difference | 86 |
| Germany | N-11.2 (site not pre-surveyed) | 1.500 | Bottom-fixed | Zero-subsidy bid | n.a. |
| | N-12.3 (site not pre-surveyed) | 1.000 | Bottom-fixed | Zero-subsidy bid | n.a. |
| | N-9.1 (pre-surveyed site) | 2.000 | Bottom-fixed | Zero-subsidy bid | n.a. |
| | N-9.2 (pre-surveyed site) | 2.000 | Bottom-fixed | Zero-subsidy bid | n.a. |
| | N-9.3 (pre-surveyed site) | 1.500 | Bottom-fixed | Zero-subsidy bid | n.a. |
| | N-6.7 (pre-surveyed site) | 270 | Bottom-fixed | Zero-subsidy bid | n.a. |
| Lithuania | 2nd offshore auction | - | Bottom-fixed | Contract for Difference | - |
| Netherlands | IJmuiden Ver Alpha | 2.000 | Bottom-fixed | Zero-subsidy bid | n.a. |
| | IJmuiden Ver Beta | 2.000 | Bottom-fixed | Zero-subsidy bid | n.a. |
| Norway | Soerlige Nordsjoe II | 1.500 | Bottom-fixed | Contract for Difference | 99 |
| UK | CfD Allocation Round 6 - Hornsea 4 | 2.400 | Bottom-fixed | Contract for Difference | 99 |
| | CfD Allocation Round 6 - East Anglia 2 | 963 | Bottom-fixed | Contract for Difference | 99 |
| | CfD Allocation Round 6 - Inch Cape (Permitted reduction) | 266 | Bottom-fixed | Contract for Difference | 92 |
| | CfD Allocation Round 6 - Moray West (Permitted reduction) | 74 | Bottom-fixed | Contract for Difference | 92 |
| | CfD Allocation Round 6 - East Anglia 3 (Permitted reduction) | 159 | Bottom-fixed | Contract for Difference | 92 |
| | CfD Allocation Round 6 - Hornsea 3 (Permitted reduction) | 1.080 | Bottom-fixed | Contract for Difference | 92 |
| | CfD Allocation Round 6 - Green Volt | 400 | Floating | Contract for Difference | 236 |

2.

# Wind power in Europe: The full picture

## 2.1 Europe's total wind power capacity

285 GW of wind power capacity is now installed in Europe. 87% of this (248 GW) is located onshore and 13% (37 GW) offshore.

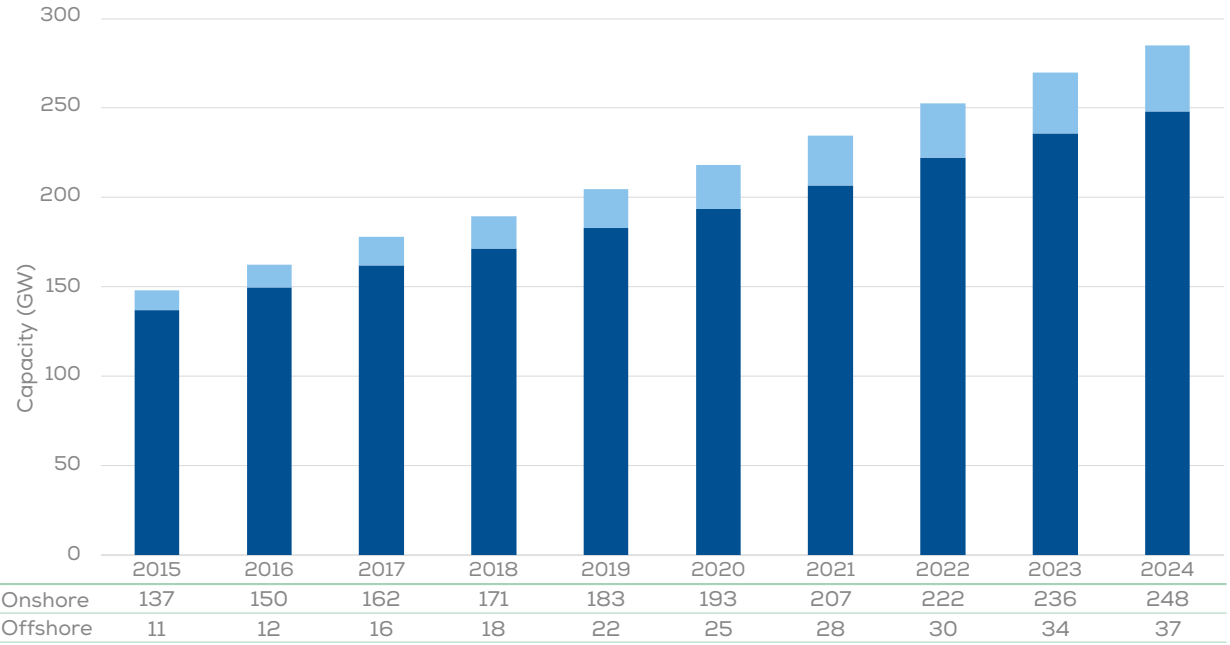
In the EU-27 the total installed wind power capacity has reached 231 GW, with 210 GW (91%) onshore and 21 GW (9%) offshore.

EUROPE NOW HAS

**285 GW**

OF WIND POWER CAPACITY

**FIGURE 11.** The growth of wind power capacity in Europe, 2015-24




| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|
| Onshore | 137 | 150 | 162 | 171 | 183 | 193 | 207 | 222 | 236 | 248 |
| Offshore | 11 | 12 | 16 | 18 | 22 | 25 | 28 | 30 | 34 | 37 |

Source: WindEurope

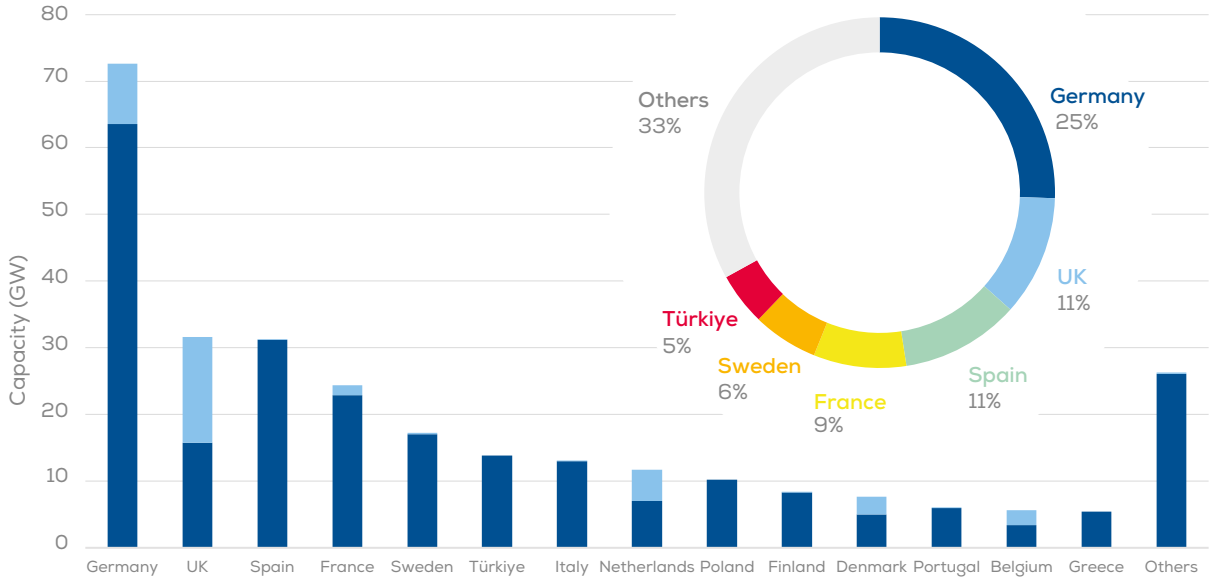
# 2/3 OF EUROPE'S WIND POWER IS INSTALLED IN JUST SIX COUNTRIES

Germany continues to have the largest installed wind power fleet in Europe with 72.7 GW. The UK has overtaken Spain to have the second largest installed fleet with 31.6 GW. With Spain (31.2 GW), France (24.4 GW), Sweden (17.2 GW), and Türkiye (13.8 GW), the top six countries account for two-thirds of the total installed capacity in Europe. Italy (12.9 GW), the Netherlands (11.7 GW) and for the first time, Poland (10.2 GW), round out the countries in Europe with an installed wind power capacity greater than 10 GW.

Finland (8.4 GW), Denmark (7.6 GW), Portugal (6 GW), Belgium (5.6 GW), Greece (5.4 GW) and Norway (5.2 GW) all have an installed wind power capacity in excess of 5 GW.

Three further countries have more than 3 GW of installed capacity – Ireland (4.9 GW), Austria (4 GW), and Romania (3.2 GW).

**FIGURE 12.** Total wind power installations by country




| | Germany | UK | Spain | France | Sweden | Türkiye | Italy | Netherlands | Poland | Finland | Denmark | Portugal | Belgium | Greece | Others |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Onshore | 64 | 16 | 31 | 23 | 17 | 14 | 13 | 7 | 10 | 8 | 5 | 6 | 3 | 5 | 26 |
| Offshore | 9 | 16 | 0 | 2 | 0 | 0 | 0 | 5 | 0 | 0 | 3 | 0 | 2 | 0 | 0 |

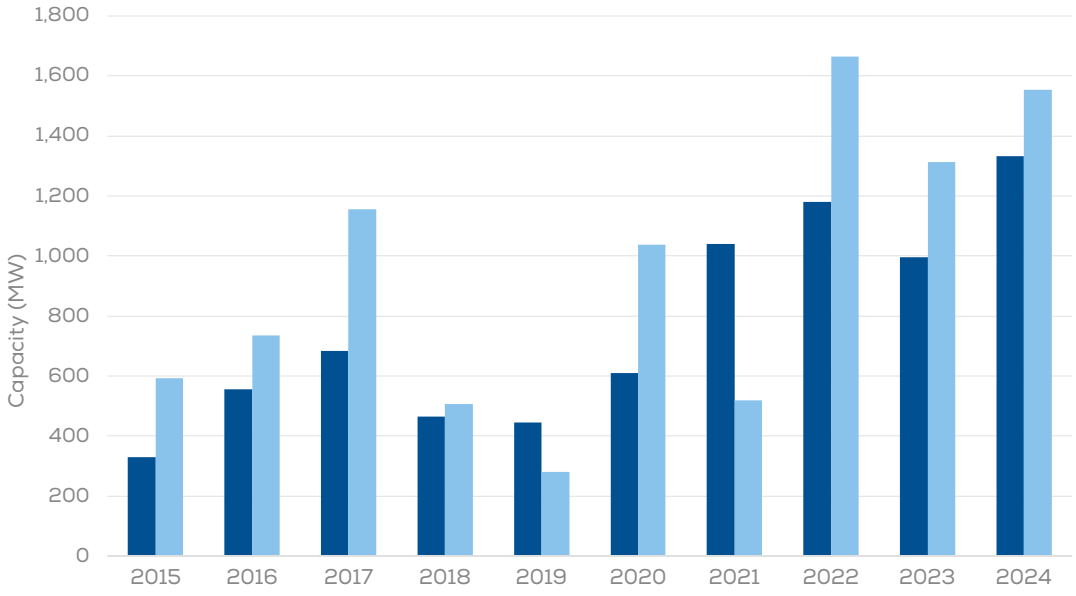
Source: WindEurope

## 2.2 Decommissioning and repowering trends

1.3 GW of wind power capacity was decommissioned in Europe in 2024. Germany made up more than half of this figure, taking 712 MW offline. Together with Spain (435 MW) and Italy (76 MW), these countries accounted for more than 90% of decommissioned capacity last year, all of which was onshore.

Of the 16.4 GW installed in 2024, 1.6 GW came from repowered projects. Germany installed the most repowered capacity (1.1 GW) and Italy came second with 155 MW, a net increase for both countries. Spain meanwhile did not install any repowered capacity.

**FIGURE 13.** Decommissioned and repowered capacity in Europe, 2015-24




| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|
| Decommissioned capacity | 329 | 555 | 684 | 466 | 444 | 610 | 1,041 | 1,180 | 997 | 1.332 |
| Repowered capacity | 593 | 735 | 1,155 | 508 | 281 | 1,037 | 519 | 1,666 | 1,314 | 1,555 |

Source: WindEurope

As Europe's wind turbine fleet ages, repowering volumes are expected to 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 lifetime extension for turbines.

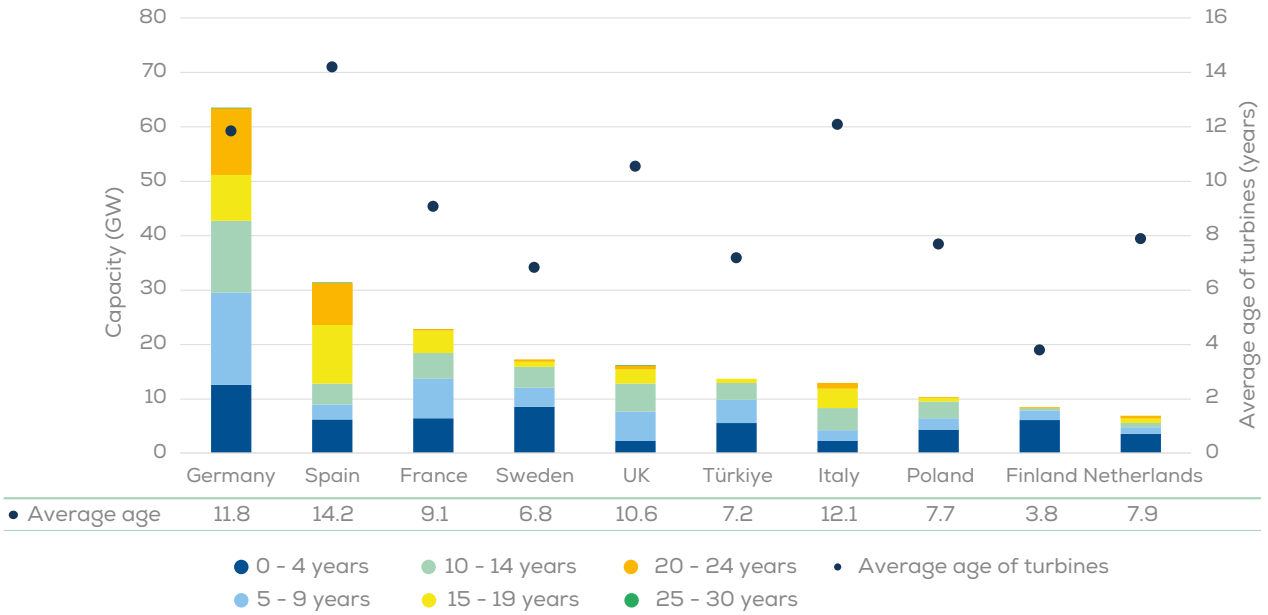
Many of Europe's onshore wind farms are approaching the end of contracts supporting their electricity generation (usually in the region of 20 years for onshore and 15 years for offshore under past support regimes). 26 GW of Europe's existing wind farms have already been running for more than 20 years. By 2030, 57 GW of capacity will be more than 20 years old. On average, Denmark, Spain and Portugal have the oldest wind fleets. Germany and Spain have the largest installed capacity which could potentially be repowered, with 21 GW and 19 GW older than 15 years, respectively.

But most wind farms reaching the end of their generation support mechanism currently opt for some form of lifetime extension, not least because in many cases legislative frameworks for repowering fail to recognise the added value of repowering. This is especially the case in Spain, where hurdles relating to obtaining new grid connections, coupled with the absence of onshore wind support mechanisms and cumbersome permitting, all combine to create an unattractive environment for repowering.

Wind farm repowering trebles output on average, while also reducing the number of turbines. For that reason it is a great way to quickly ramp up wind energy production in Europe.

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

**FIGURE 14.** Average age of onshore wind farms in Europe




Source: WindEurope

## 2.3 Turbine trends

### Onshore

The average power rating for turbines installed onshore in 2024 was 4.6 MW, up from 4.5 MW in 2023. Before this, the average power rating grew from a value of 2.5 MW in 2015, an increase of 84% over the last decade.

In addition to new, more powerful machines, turbines with larger rotor diameters and lower power ratings have been unveiled in recent years, designed for sites with lower wind speeds. This boosts the number of potential sites for economically viable projects.

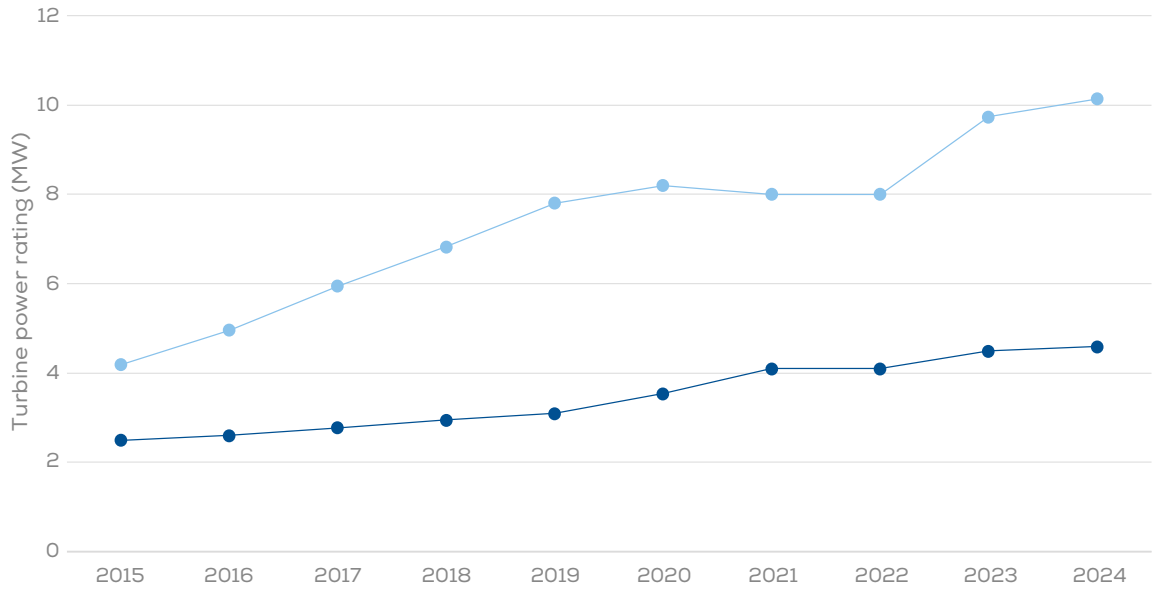
The average power rating for onshore turbines ordered over the year reached a record 5.7 MW (up from 5.5 MW in 2023). Their deployment on the ground in the years ahead is likely to further boost the average power rating of installed onshore turbines.

### Offshore

The average power rating for offshore wind turbines installed in Europe grew by 2.4 times over the last decade, and by more than a quarter since 2022.

Ratings for ordered offshore turbines also reached record highs last year, averaging 14.8 MW, slightly up from 14.7 MW in 2023. With new, more powerful turbines about to enter the market, the average power rating of installed offshore wind turbines should continue to increase in the years ahead.

**FIGURE 15.** Average power rating of installed turbines in Europe, 2015-24




| | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | 2021 | 2022 | 2023 | 2024 |
|---|---|---|---|---|---|---|---|---|---|---|
| Onshore | 2.5 | 2.6 | 2.8 | 2.9 | 3.1 | 3.5 | 4.1 | 4.1 | 4.5 | 4.6 |
| Offshore | 4.2 | 5.0 | 6.0 | 6.8 | 7.8 | 8.2 | 8.0 | 8.0 | 9.7 | 10.1 |

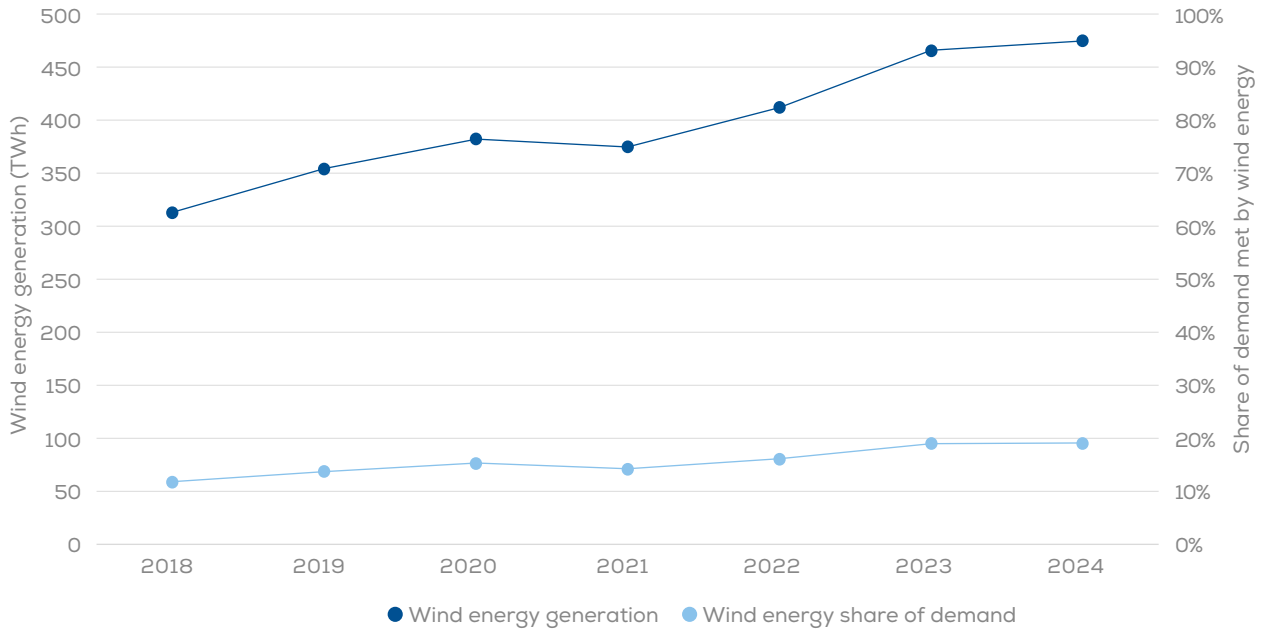
Source: WindEurope

## 2.4 Power generation trends

Wind energy generation in the EU has grown steadily from 313 TWh in 2018 to 475 TWh in 2024, with one anomalous year in 2021 when generation was lower than in 2020. Over the same period, electricity demand has fallen from 2,652 TWh in 2018 to 2,483 TWh in 2024. This is partly the result of the COVID-19 pandemic in 2020 and the energy crisis following Russia's invasion of Ukraine in 2022.

Wind energy met 12% of total demand in the EU in 2018, and in 2024 it covered 19%, the same as in 2023. On the whole capacity factors for wind turbines have grown over time as turbine technology improves. Many countries have seen rising capacity factors across their turbine fleets over the past few years as they install more modern models.

**FIGURE 16.** Wind energy generation and share of demand in the EU, 2018-24



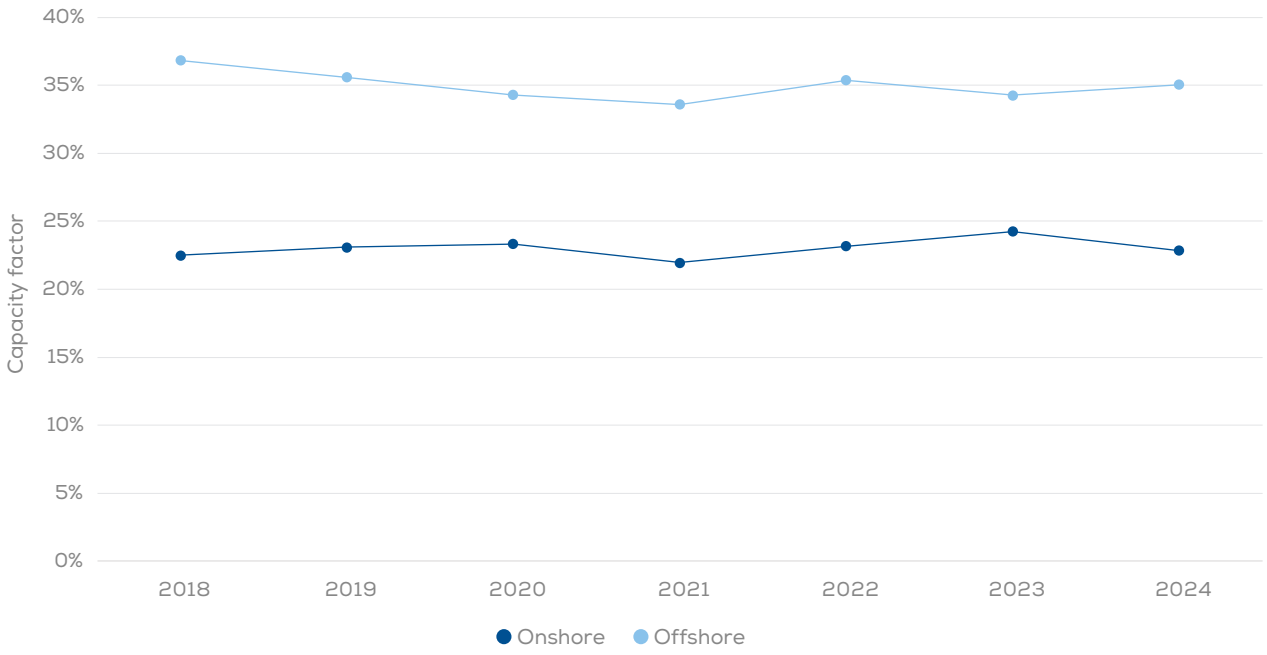

Source: WindEurope

When looking at Europe as a whole, other factors become apparent. The size of turbines installed in each country has a major impact. If there are more turbines installed in countries which typically install smaller turbines (because of more restrictive rules, for example), this would boost the proportion of turbines with lower capacity factors.

In this scenario, the European fleet's capacity factors could fall as a result. Wind conditions across the continent also affect fleet-wide capacity factor trends. 2021 was less windy than average across northern Europe. Even though the reverse was true in southern Europe, the larger part of installed wind capacity is located in the north. The impact of this can be seen in the capacity factor statistics for that year. In 2023, despite less favourable conditions in northern Europe leading to lower offshore capacity factors, record build-out of onshore wind in the EU counteracted this, and it was a record year for generation.

Offshore wind capacity factors across the entire EU fleet tend to be more variable than for onshore wind, as the fleet is concentrated in a smaller region (albeit over generally larger farms with a stronger and steadier wind resource). Onshore wind capacity factors rose across the EU in 2024. This points to the benefits of diversifying resources; the wind is always blowing somewhere in Europe.

**FIGURE 17.** Average capacity factor of installed wind turbines in the EU, 2018-24




Source: WindEurope

## 2.5 Investments

In 2024, there were €33bn worth of investments in wind farms, financing 19.9 GW of new wind energy capacity – set to be commissioned over the next few years.

Onshore wind investments in Europe totalled €24.7bn, financing approximately 17.3 GW of new onshore capacity. This was the largest annual investment figure in new onshore wind since 2016 when onshore wind investments financed 19.5 GW of new capacity.

In the EU, onshore investments totalled approximately €19bn, financing 13.1 GW of new projects. Germany and Spain alone invested almost half of this amount.

Offshore wind investments in Europe totalled €7.9bn, financing approximately 2.6 GW of new offshore wind capacity—all of which was in the EU. Three out of the four wind farms financed are in Germany (Nordseecluster A&B and Windanker) with the remaining one, Oranjewind, in the Netherlands.

The offshore investment figure is down almost 80% from 2023, which was a record year. This is a normal variation in annual investments for offshore wind, however. Since offshore wind farms tend to be very large (often measured in GW), only a few Final Investment Decisions (FIDs) are made each year. This leads to wide-ranging annual investment figures, which are highly dependent on the timing of these transactions.

Baltica 2 and Inch Cape for example initially hoped to be financed in 2024, but instead took FID in January 2025, raising €10.7bn for 2.6 GW of capacity. These amounts will be included in the 2025 statistics.

The wind energy sector still faces a number of challenges: rising costs, slow permitting processes, inefficient auction designs, and global supply chain competition – all of which impact financing.

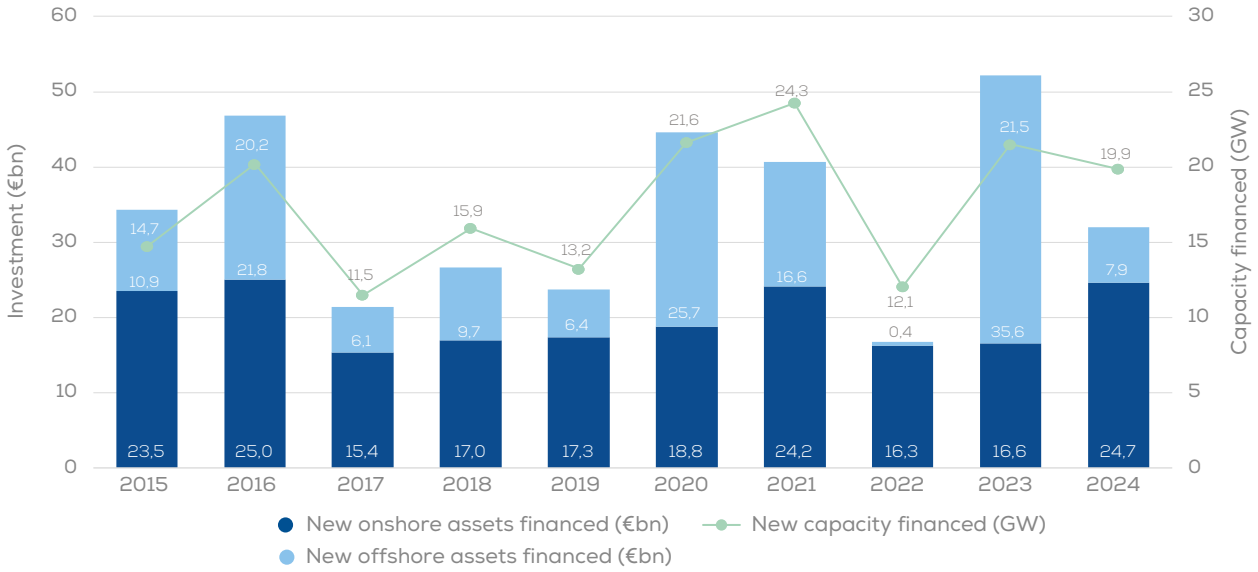
Initially, the supply chain was identified as the main bottleneck. But since 2022, manufacturers and suppliers have reaffirmed plans to invest at least €11bn to significantly expand manufacturing facilities for nacelles, blades, towers, foundations, cables, substations, and other grid components, along with port infrastructure and vessels for offshore wind.

Cables and grid technologies are the key sectors driving the expansion and construction of new factories. For turbines, foundations have seen the largest investment, with manufacturing capacity expected to nearly double over the next three years. These investments should be enough for Europe to meet its installation pipeline for the next 3-4 years. But planning needs to continue for the next scale-up in installations – expected towards the end of the decade, primarily offshore.

The European Investment Bank's (EIB) counter-guarantee scheme supports intermediaries (commercial banks) in issuing advance and performance bonds for wind turbine manufacturers and the related value chain. They have already offered at least €3bn in six tranches to commercial banks in Germany, France, Italy and Spain.

Unlocking more investments will require a combination of private capital, triggered by pipeline consolidation, and different mechanisms aimed at scaling up technologies and manufacturing.

**FIGURE 18.** Investment in new wind farms 2015 - 2024 (GW and €bn)




Source: WindEurope

Photo: Jason Bickley

3.

# Outlook 2025-2030

## 3.1 WindEurope's Outlook

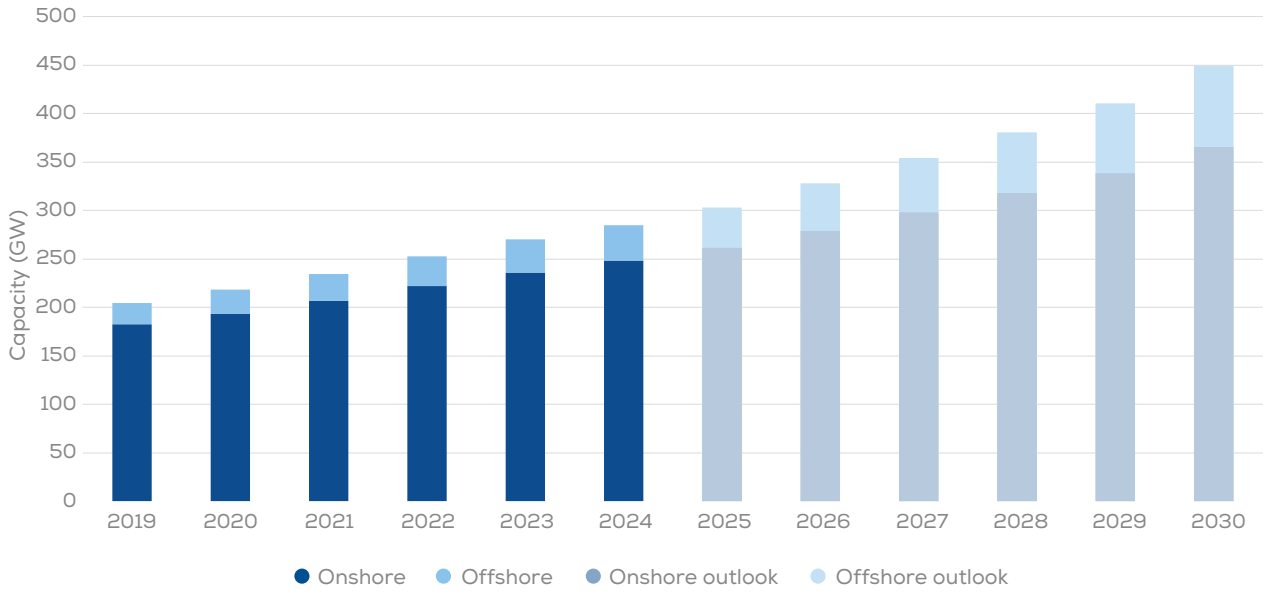
WindEurope's **Outlook** for wind installations looks at the likely development of wind power capacity in Europe up to 2030.

The **Outlook** sets out the best estimate for installed capacity in Europe over the next six 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 187 GW, with an average installation rate of 31 GW per year.

In the EU, we expect 140 GW to be installed between 2025 and 2030, at an average rate of 23 GW a year.

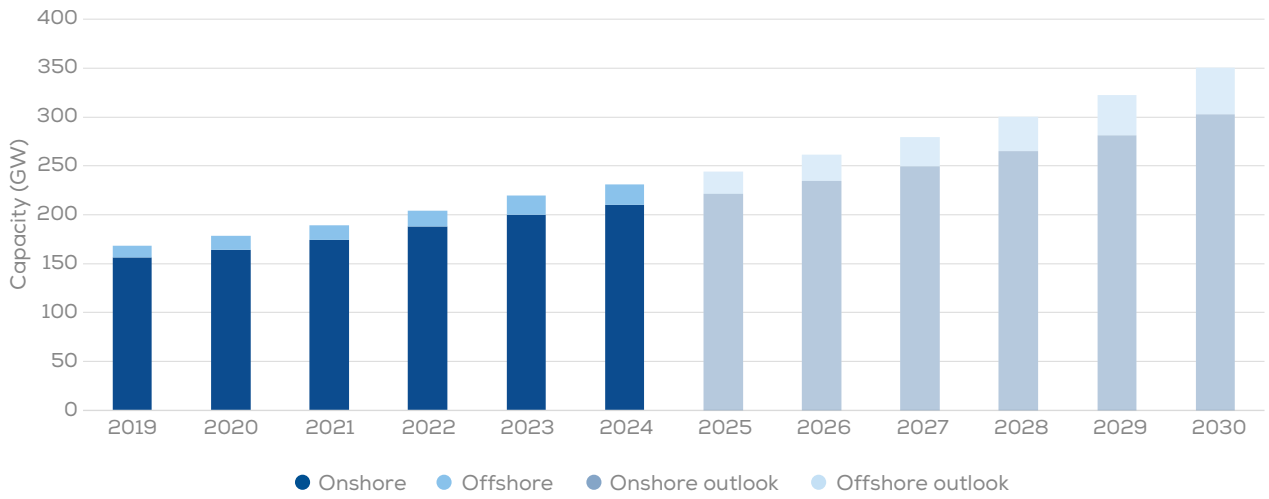
Onshore wind additions are expected to make up almost 75% of the new build-out in Europe, and 81% of new capacity in the EU. By 2030, we expect Europe's installed wind power capacity to reach 450 GW.

**FIGURE 19.** New wind power capacity in Europe - WindEurope's Outlook




Source: WindEurope

**FIGURE 20.** New wind power capacity in the EU - WindEurope's Outlook




Source: WindEurope

The expected rise in annual build-out from 2025-2030 will take the EU to 351 GW. The EU's 2030 target is 425 GW.

Installations in the EU are expected to come to 17.4 GW in 2025. This is 4.5 GW more that the capacity installed in 2024 and includes capacity originally due to be installed in 2024 and delayed to 2025, as well as the first offshore wind capacity connected in Poland.

Europe-wide we expect both more onshore (18 GW) and offshore (4.5 GW) wind installations in 2025 compared with 2024. For onshore, this includes capacity that was delayed from 2024 and projects that were successful in the record volumes of onshore wind awarded in 2023 and 2024. And offshore, we expect several large wind farms to be commissioned, including Iles of Yeu / Noirmoutier (496 MW) in France, Neart na Gaoithe (448 MW) in the UK, and He Dreiht (960 MW) in Germany.

42% of new onshore capacity built in the EU over the next six years will come from projects awarded in future auctions. Offshore, 10% of new installations over the next six years will be from projects awarded in future auctions.

Any auction delays would also postpone the construction of new projects and lead to lower installed capacity in the EU than originally forecasted.

## 3.2 Onshore wind outlook

Onshore wind is expected to make up the overwhelming majority of installations over the period up to 2030. We expect a total of 140 GW of onshore wind capacity additions over the period 2025-2030, 75% of all forecasted additions in Europe of 187 GW.

Taking account of expected decommissioning over this period, we expect total onshore installations in Europe to come to 366 GW by 2030.

In the EU, we expect 113 GW of additional onshore capacity, 81% of the total of 140 GW to be installed by 2030. Total installed onshore wind capacity in the EU is expected to reach 304 GW.

Figure 21 sets out the expected totals for annual onshore installations in the EU by support type. Capacity labelled as "Already awarded in auctions" indicates those projects which have already been successful in auctions and which have revenue support in place. These projects therefore are very likely to be developed and represent approximately 26 GW over the period 2025-2027.

The light blue category labelled "Scheduled to be auctioned" includes capacity that we expect to be awarded in auctions which have already been scheduled and which will take place over the next few years. We do not assume that all capacity offered will be awarded, and we expect varying levels of success in terms of the proportion of offered capacity being awarded across different markets. The allocation rate assumption is between 65% and 100% for each country.

We expect 35 GW of total wind capacity to be awarded in auctions over the period 2025-2030.

The patterned light blue labelled "Expected to be auctioned" is the capacity likely to be awarded in auctions that have not yet been finalised. In many cases the auctions have been announced but the details have not been settled or there is no schedule in place yet. Over the rest of the decade up to 2030, the total capacity in this category is 13 GW.

Total onshore installations in the EU over the period 2025-2030 are expected to come to 113 GW.

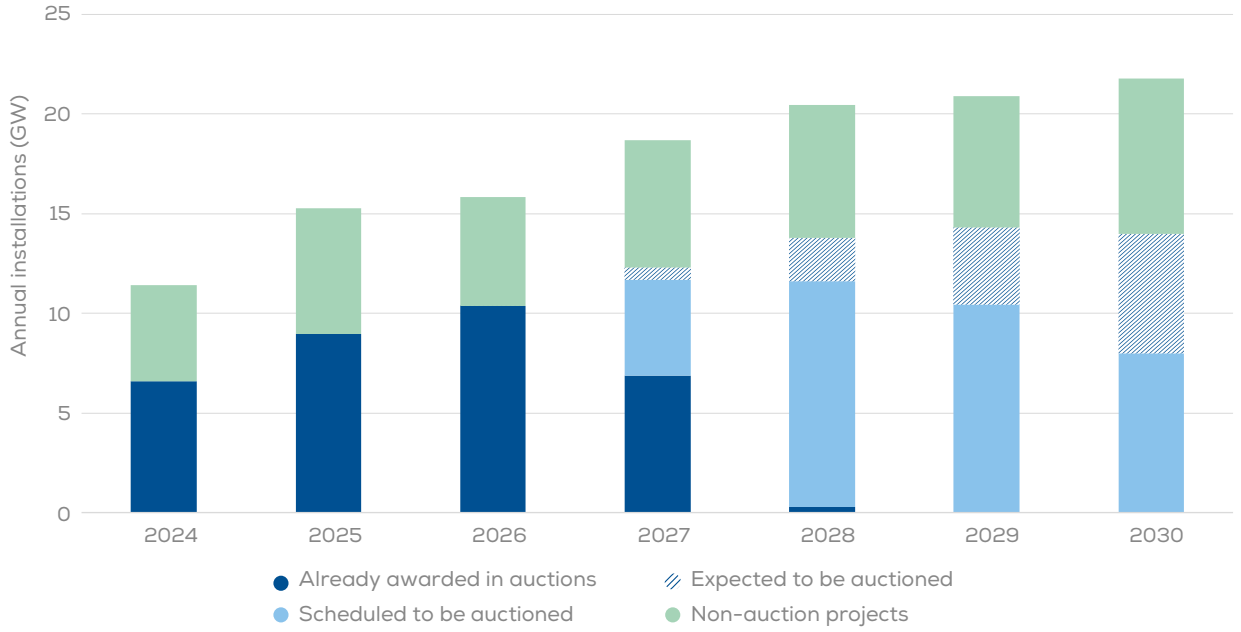
We therefore presume that at least 74 GW or 65% will come from wind farms awarded in auctions.

The light green area labelled "Non-auction projects" represents wind power capacity that is developed without going through central auctioning systems, i.e. projects which will either be supported through Power Purchase Agreements (PPAs) or developed on an entirely merchant basis.

In some markets like Sweden and Finland there is no support provided by the Government, so all projects are developed in this way. The capacity due to be developed on a merchant or PPA basis encompasses those markets plus a proportion of project capacity in other markets including those with centralised auction systems. We expect a total capacity of 39 GW to be developed on a merchant/PPA basis from 2025-2030.

See Appendix 2 for a breakdown by country.

**FIGURE 21.** Breakdown of auctioned and non-auctioned new build onshore projects in the EU




Source: WindEurope

## 3.3 Offshore wind outlook

Europe has bold ambitions for offshore wind. In many ways, it is ideally suited— there is an abundance of shallow sea available with very good wind resource, particularly in the North and Baltic Seas. And Europe has been the global leader in offshore wind development with a strong supply chain and long track record.

Governments across Europe have recognised the benefits of offshore wind. Initially setting a combined 2030 target of 114 GW at the start of 2021, they later revised this upward, raising the maximum target to 158 GW by September 2022.

Since this peak, many National Governments have scaled back their 2030 targets as they realise that the time needed to establish a political framework for offshore wind, upgrade electricity grids to connect projects, and develop local supply chains makes delivering projects by 2030 a significant challenge.

But despite the fact that we are unlikely to develop offshore wind as quickly as hoped to meet the 2030 targets, markets are still being developed nonetheless. Many will see new projects entering the electricity system shortly after the turn of the decade.

On a Europe-wide scale, there are also major barriers to the rapid expansion of offshore wind envisaged by 2030. The implementation of offshore auctions has been slower than expected, with some planned auctions delayed due to the drafting of rules or the absence of a regulatory framework. This has created uncertainty about the commissioning dates of wind farms, complicating supply chain expansion.

While most of the supply chain has grown in line with projects awarded in auctions or reaching negotiation phases before the Final Investment Decision, certain aspects require more planning and longer lead times. This presents challenges for scaling up installations.

The most acute hurdle is likely to be port capacity. As things stand, we believe there is sufficient port capacity in Europe to service build-out up to 2028. But by 2029 we expect the planned rate of installations to outstrip port capacity, even when new expansions are taken into account.

We therefore expect offshore project delays to become a major bottleneck across Europe from 2029.

Port capacity is also our main priority for offshore wind build-out, as it has the longest development lead times within the value chain. Expanding ports typically takes 6–10 years from permitting to commissioning. This makes it essential for investments to be made as soon as possible to minimise potential delays.

Other key factors likely to constrain offshore wind build-out in Europe up to 2030 include **the pace of electrical grid development and the ineffective management of grid connection requests.** On- and offshore grid expansion and reinforcement are running into major delays across Europe, and very little if any capacity is available for new connections on time. At the same time, many national authorities continue to apply a 'first come, first served' approach to grid permitting rather than adopting dynamic methods to filter viable projects and prioritise mature and strategic ones.

Finally, there is uncertainty over **vessel availability**. Right now around 80 vessels have been active in wind farm construction and installation across Europe. However, only five of these can handle the largest 14–15 MW turbines being used in the latest projects. Most turbines installed towards the end of the decade will be this magnitude or larger. There is also a limited number of vessels capable of installing large substructures, such as substations and converter platforms, at offshore wind farms.

Vessel supply is also affected by global demand. During Europe's winter months, when rough sea conditions make turbine installation nearly impossible, vessels are often contracted to markets in the southern hemisphere. The growth of other markets, such as the USA, could further impact vessel availability for Europe in the future.

New vessels have a lead time of 2–3 years, making it crucial to assess global capacity needs in the coming years. Delivering sufficient investment in new vessels capable of installing the largest turbines and grid infrastructure will be essential if we want to avoid project delays.

Other recent setbacks and delays have affected auction planning in Belgium and Denmark, while grid deployment delays continue to impact markets including Germany, the Netherlands and Ireland.

While we have shown that the build-out of offshore wind up to 2030 is unlikely to match Government ambitions, we do not foresee a fall in installations—only a delay of 1–2 years in many cases. Governments across Europe are still committed to offshore wind development, and the industry's outlook remains positive.

Figure 22 sets out expected annual offshore wind installations in the EU by their current status. The total amount, including the 1.4 GW installed in 2024, is 29 GW which would take the **EU's installed capacity to 48 GW in 2030**.

The dark blue segment labelled "Already awarded in auctions" is all the capacity that has been awarded in auctions across the EU (including countries where no revenue support is awarded). This capacity is likely to be installed on time as the projects have already taken Final Investment Decisions (FIDs) – or are expected to do so shortly. They should therefore have all the right supply and construction contracts in place. The total capacity of projects in this category over the period 2025-2030 is 24 GW.

Capacity in the light blue category labelled "Scheduled to be auctioned" is from projects which are due to take part in auctions over the next few years. These projects are likely to be developed, but there is some uncertainty on the timing given that they have not yet secured the rights to develop.

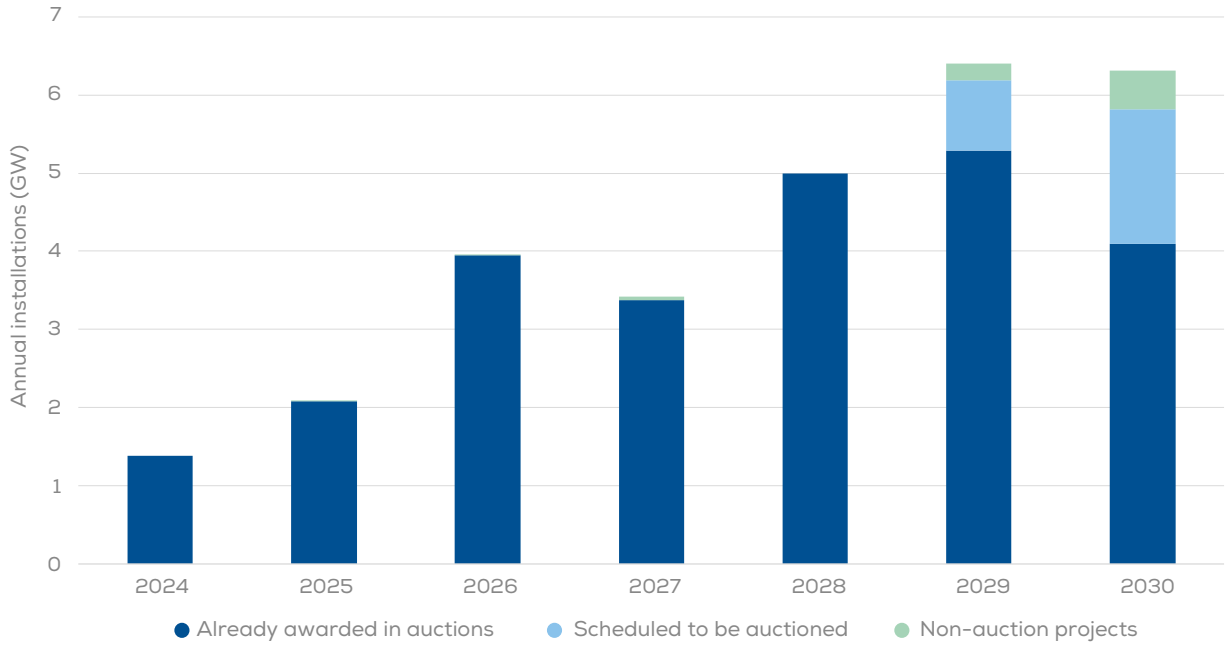
These projects represent an additional 3 GW which can be installed in the EU by 2030.

The light green area labelled "Non-auction projects" represents a small number of projects which will be managed in open development systems, as is the case in Sweden and Finland. Projects in this capacity have the largest uncertainty when it comes to their timescales but we believe they have a realistic chance of being installed by 2030. The total capacity represented by these types of projects over 2025-2030 is approximately 1 GW.

In Europe, 39 GW of total expected installations of 48 GW have already been awarded in auctions with a further 8 GW expected to be auctioned over the next few years. Projects developed outside of auction systems are also expected to total less than 1 GW by 2030. This would take **Europe's total installed offshore capacity to 84 GW in 2030**.

See Appendix 2 for a breakdown by country.

**FIGURE 22.** Breakdown of auctioned and non-auctioned new build offshore projects in the EU




Source: WindEurope

**TABLE 4.** Expected new installations per country, 2025-30 - WindEurope's Outlook

| | 2025 | | 2026 | | 2027 | | 2028 | | 2029 | | 2030 | | Total installations by 2030 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| EU-27 | Onshore | Offshore | Onshore | Offshore | Onshore | Offshore | Onshore | Offshore | Onshore | Offshore | Onshore | Offshore | Onshore | Offshore |
| Austria | 340 | - | 250 | - | 620 | - | 720 | - | 350 | - | 350 | - | 6,230 | - |
| Belgium | 180 | - | 180 | - | 250 | - | 250 | - | 250 | - | 250 | - | 4,230 | 2,260 |
| Bulgaria | 30 | 10 | 90 | - | 100 | - | 130 | - | 140 | - | 150 | - | 1,080 | 10 |
| Croatia | 120 | - | 50 | - | 50 | - | 170 | - | 120 | - | 260 | - | 2,070 | - |
| Cyprus | - | - | - | - | - | - | - | - | - | - | 10 | - | 170 | - |
| Czechia | 20 | - | 30 | - | 50 | - | 90 | - | 110 | - | 130 | - | 770 | - |
| Denmark | 120 | - | 230 | 500 | 260 | 550 | 270 | - | 280 | 220 | 280 | 210 | 5,600 | 4,080 |
| Estonia | - | - | - | - | 150 | - | 240 | - | 430 | - | 460 | - | 1,900 | - |
| Finland | 1,130 | - | 970 | - | 1,210 | - | 1,470 | - | 1,490 | - | 1,500 | 180 | 15,530 | 250 |
| France | 1,850 | 560 | 1,850 | 950 | 2,000 | - | 2,000 | - | 2,000 | 180 | 1,630 | 630 | 31,790 | 3,820 |
| Germany | 5,130 | 960 | 5,590 | 1,560 | 6,230 | 770 | 6,740 | 1,470 | 6,740 | 2,220 | 7,380 | 2,190 | 96,290 | 18,290 |
| Greece | 450 | - | 470 | - | 400 | - | 400 | - | 350 | - | 350 | - | 7,580 | - |
| Hungary | - | - | 20 | - | 50 | - | 100 | - | 150 | - | 180 | - | 810 | - |
| Ireland | 450 | - | 550 | - | 480 | - | 380 | 150 | 480 | 400 | 500 | 480 | 7,080 | 1,050 |
| Italy | 740 | - | 770 | - | 1,200 | - | 1,500 | - | 1,800 | - | 1,800 | 10 | 20,050 | 40 |
| Latvia | - | - | 290 | - | 280 | - | 320 | - | 360 | - | 390 | - | 1,760 | - |
| Lithuania | 350 | - | 450 | - | 350 | - | 300 | - | 300 | 320 | 300 | 320 | 3,780 | 630 |
| Luxembourg | 10 | - | 70 | - | 50 | - | 80 | - | 40 | - | 50 | - | 500 | - |
| Malta | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Netherlands | 300 | - | 280 | 380 | 190 | 780 | 210 | 1,900 | 230 | 1,840 | 250 | 780 | 7,440 | 10,410 |
| Poland | 450 | 570 | 380 | 570 | 570 | 1,320 | 680 | 1,470 | 860 | 1,230 | 1,130 | 870 | 13,400 | 6,040 |
| Portugal | 230 | - | 230 | - | 380 | - | 500 | - | 500 | - | 500 | - | 6,640 | 20 |
| Romania | 380 | - | 490 | - | 600 | - | 550 | - | 500 | - | 500 | - | 6,100 | - |
| Slovakia | 60 | - | 50 | - | 80 | - | 100 | - | 120 | - | 120 | - | 530 | - |
| Slovenia | - | - | - | - | - | - | 30 | - | 40 | - | 40 | - | 120 | - |
| Spain | 1,500 | - | 1,500 | - | 2,450 | - | 2,470 | - | 2,500 | - | 2,500 | 290 | 39,970 | 300 |
| Sweden | 1,440 | - | 1,060 | - | 700 | - | 740 | - | 760 | - | 790 | 350 | 22,200 | 540 |
| **Total EU-27** | **15,280** | **2,100** | **15,850** | **3,960** | **18,700** | **3,420** | **20,440** | **4,990** | **20,900** | **6,410** | **21,800** | **6,310** | **303,620** | **47,740** |

| | 2025 | | 2026 | | 2027 | | 2028 | | 2029 | | 2030 | | Total installations by 2030 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Others (MW) | Onshore | Offshore | Onshore | Offshore | Onshore | Offshore | Onshore | Offshore | Onshore | Offshore | Onshore | Offshore | Onshore | Offshore |
| Albania | - | - | - | - | - | - | 150 | - | 150 | - | 150 | - | 460 | - |
| Belarus | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Bosnia & Herzegovina | - | - | 130 | - | 140 | - | 130 | - | 100 | - | 80 | - | 830 | - |
| Faroe Islands | - | - | - | - | - | - | - | - | - | - | - | - | 70 | - |
| Iceland | - | - | 60 | - | 60 | - | - | - | - | - | - | - | 120 | - |
| Kosovo | - | - | - | - | - | - | 20 | - | 50 | - | 80 | - | 290 | - |
| Liechtenstein | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Moldova | - | - | - | - | 50 | - | 50 | - | - | - | - | - | 110 | - |
| Montenegro | - | - | 120 | - | 160 | - | - | - | - | - | - | - | 390 | - |
| North Macedonia | 30 | - | 200 | - | 200 | - | - | - | - | - | - | - | 500 | - |
| Norway | - | - | - | - | - | - | 150 | - | 180 | - | 190 | 780 | 5,380 | 880 |
| Serbia | 70 | - | 300 | - | 300 | - | 300 | - | 130 | - | 160 | - | 1,880 | - |
| Switzerland | - | - | 40 | - | 30 | - | 110 | - | 50 | - | 40 | - | 360 | - |
| Türkiye | 1,600 | - | 1,900 | - | 2,300 | - | 2,240 | - | 2,240 | - | 2,240 | - | 26,150 | - |
| UK | 720 | 2,420 | 1,060 | 4,430 | 2,090 | 3,070 | 1,510 | 1,720 | 1,950 | 3,290 | 1,840 | 4,680 | 23,510 | 35,500 |
| Ukraine | 300 | - | 500 | - | - | - | - | - | - | - | - | - | 2,060 | - |
| **Total others** | **2,720** | **2,420** | **4,310** | **4,430** | **5,330** | **3,070** | **4,660** | **1,720** | **4,850** | **3,290** | **4,780** | **5,460** | **62,110** | **36,380** |
| **Total Europe** | **18,000** | **4,520** | **20,160** | **8,390** | **24,030** | **6,490** | **25,100** | **6,710** | **25,750** | **9,700** | **26,580** | **11,770** | **365,730** | **84,120** |

## 3.4 Repowering

Repowering decisions are influenced 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.

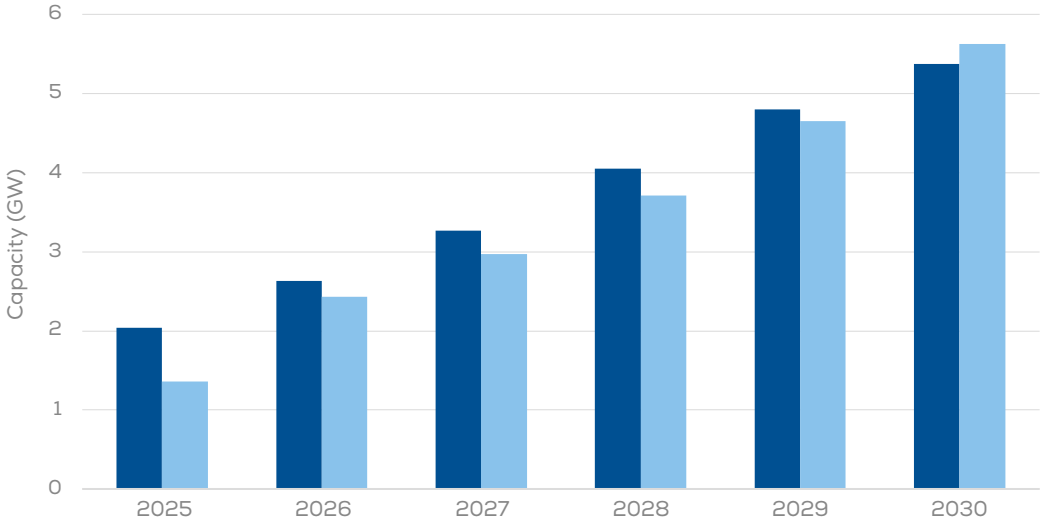
Over the next six years we expect the annual installations of repowered projects to rise from 1.4 GW to well over 5 GW in 2030, with the total build-out from repowered wind farms nearing 21 GW.

Over the same period, we expect just over 22 GW of old wind farms to be decommissioned. It is tempting to consider repowering as having little impact on the total annual build-out each year since in the projection the annual decommissioned and repowering volumes are similar. On average however, we assume that the capacity of repowered projects is more than double that of the original wind farm.

The annual repowered project capacity does not tend to exceed the decommissioned amount in a given year for two main reasons. First, not all existing projects are repowered. The proportion of projects which are repowered varies considerably by region and the policies which govern repowering. Second, the capacity repowered each year arises from the repowering of projects in previous years.

Germany, the UK, the Netherlands and Spain are expected to install almost 2/3 of the repowered capacity in Europe by 2030.

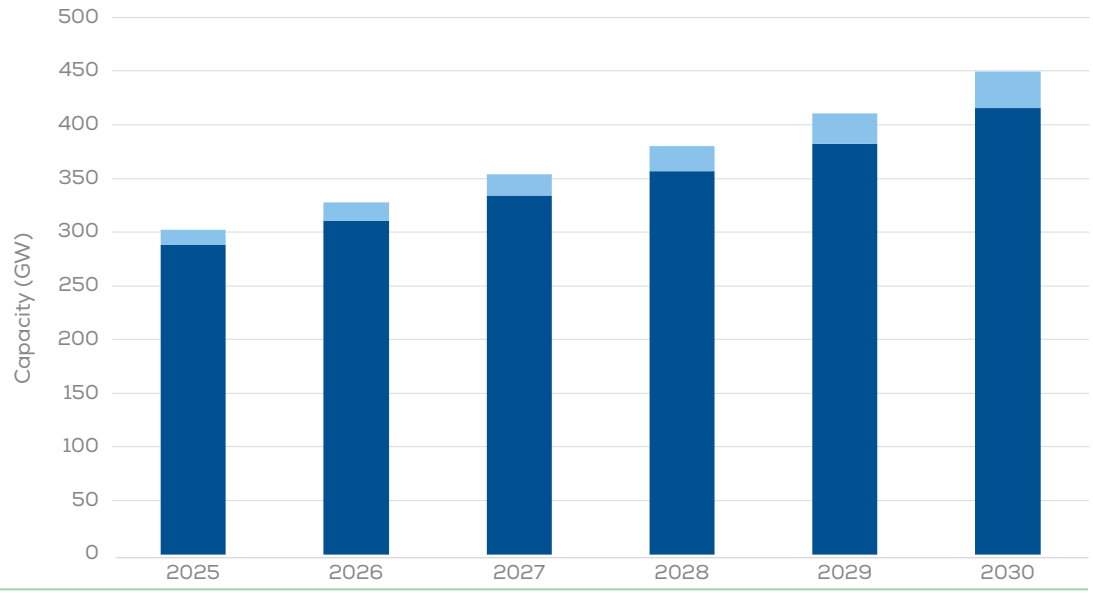
**FIGURE 23.** Decommissioned and repowered wind power capacity in Europe - WindEurope's Outlook




| | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|
| Decommissioned capacity | 2.0 | 2.6 | 3.3 | 4.1 | 4.8 | 5.4 |
| Repowered capacity | 1.4 | 2.4 | 3.0 | 3.7 | 4.6 | 5.6 |

Source: WindEurope

**FIGURE 24.** New and repowered wind energy installations in Europe - WindEurope's Outlook




| | 2025 | 2026 | 2027 | 2028 | 2029 | 2030 |
|---|---|---|---|---|---|---|
| Repowered wind farms | 14 | 17 | 20 | 24 | 28 | 34 |
| New wind farms | 288 | 311 | 335 | 358 | 383 | 416 |

Source: WindEurope

Repowered wind farms will represent just 8% of all installed power capacity in Europe by 2030 but we expect 49 GW of projects to reach 20 years of age or more over the next six years. And with 21 GW of projects reaching 25 years of age and 5 GW of projects reaching 30 years, we will have 75 GW of projects that need a decision on whether to repower, extend the life of the asset or decommission it.

Of the 49 GW set to become 20 years old by 2030, we expect 3 GW to be repowered or to undergo repowering and 1.4 GW to be completely retired. We use repowering rates that are higher for wind farms which are decommissioned earlier as we expect the economic benefits of repowering to be the main driver for earlier decommissioning. The older the wind farm, the less likely that it will be repowered since on average, we expect that if it could have been repowered, it would have been. We therefore assume the oldest wind farms are operated until they are eventually decommissioned.

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

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.

# 4.

# Delivering on electrification

## 4.1 Delivering on electrification

Electrification is the most cost-effective and energy-efficient way to boost resilience and decarbonise Europe's economy.

In its January 2025 "Compass for Competitiveness" document, the European Commission stresses: 'Europe relies on fossil fuel imports for almost two thirds of its energy. Russia's manipulation of this dependency in the context of its war of aggression against Ukraine is the major driver of the most recent price spikes. This dependence can only be reduced over time, as a greater share of energy is produced from decarbonised generation in Europe. The EU must thus accelerate the clean energy transition and promote electrification.'

Electrification will help drive the resilience and competitiveness of our economy while staying the course on decarbonisation. The rate of electrification in the EU economy has remained stubbornly flat over the last 10 years.

But a new focus on supporting demand, including by providing Opex and Capex support to decarbonise industrial processes, mainly through renewables-based electrification, as set out by the European Commission in its Clean Industrial Deal, can change that.

Sectors such as cement, chemicals and aluminium which are at the core of the European economy all expect their electricity demand to grow significantly up to 2040. And are already working with the wind sector to help meet their demand.

According to the European Commission's impact assessment underpinning a 90% cut in greenhouse gas emissions by 2040, the share of electricity in final energy consumption will double from under 25% today to 50% in 2040. Electricity generation would increase from 3,360 TWh in 2030 to 4,560 TWh in 2040.

**TABLE 5.** Expected demand of chemicals, cement and aluminium sectors in Europe, 2030 and 2040

| | Electricity demand in TWh | |
|---|---|---|
| | 2030 | 2040 |
| Chemicals[4] | 195 | 290 |
| Cement[5] | 32 | 76 |
| Aluminium[6] | 70 | 100 |

### Electrification of the Medgidia Cement Plant

Building materials producer CRH has successfully completed the construction of a wind farm to power its cement plant in Medgidia, Romania.

This 30 MW wind farm, which became operational in November 2024, consists of five Nordex turbines, each with a capacity of 6 MW.

The wind farm is expected to produce around 80 GWh of electricity annually, meeting about 50% of the Medgidia Cement Plant's energy needs.

4. https://cefic.org/app/uploads/2024/12/The-Carbon-Managers-iC2050.pdf
5. https://cembureau.eu/media/ulxj5lyh/cembureau-net-zero-roadmap.pdf
6. https://european-aluminium.eu/wp-content/uploads/2023/11/23-11-14-Net-Zero-by-2050-Science-based-Decarbonisation-Pathways-for-the-European-Aluminium-Industry_FULL-REPORT.pdf

Meeting this demand with decarbonised and competitive electricity is indispensable to the success of the EU's competitiveness strategy.

Wind can be deployed at scale in a relatively short time span and will be a major contributor to meeting that additional demand. Sustained wind deployment in the EU of 30 GW a year in the 2030s would allow wind to almost quadruple its output compared to today, delivering 1,830 TWh.

This sustained deployment in the 2030s would require continuing to streamline permitting which is currently holding back deployment rates. The recipe is clear. By applying the binding EU rules on permitting, notably the principle of overriding public interest, Germany has managed to increase the rate of permitting 7-fold in the last four years. And digitalisation can accelerate this trend.

The main bottleneck is grids.

The EU has been underinvesting in its electricity grids leading to massive grid connection queues, curtailment and undermining the business case for new build.

National Governments must take urgent action to manage long grid connection queues. Currently more than 500 GW of total wind capacity in Croatia, France, Germany, Ireland, Italy, Norway, Poland, Romania, Spain and the UK are waiting for grid connection assessments. In order to deal with this massive backlog, National authorities, TSOs and DSOs need to urgently move away from the 'first come, first served' principle in handling grid connection requests. They need to apply smart and dynamic management of grid connection queues with adequate entry criteria, filtering and prioritisation. They also need to put in place strategies that guarantee balanced grid access for all strategic net-zero technologies and electrified demand. The UK Connections Reform[7] is a very promising example.

TSOs and DSOs must plan grid investments in line with Europe's climate neutrality commitment. According to the EU Action Plan for Grids, Europe needs to invest more than €584bn this decade. The biggest share of this will be for national grid build-out. To reach national targets, System Operators must anticipate grid investments with 10-to-12-year time horizon. National Governments must support TSOs and DSOs with risk mitigation tools for investment recovery via network tariffs. They also need to enable private third parties to finance and develop grid projects while following the respective unbundling rules.

Energy is at the core of Europe's competitiveness challenge. Investing in our electricity grids will help unleash the massive potential of renewables, meet rising energy demand while displacing expensive fossil fuels, and create a self-sustaining investment climate for decarbonised energy.

**TABLE 6.** Wind energy generation in the EU, 2024, 2030 and 2040

| | | 2024 | 2030 | 2040 |
|---|---|---|---|---|
| Total installed capacity (GW) | Onshore | 210 | 303 | 440 |
| | Offshore | 21 | 48 | 150 |
| | Total | **231** | **351** | **590** |

| | | 2024 | 2030 | 2040 |
|---|---|---|---|---|
| Generation (TWh) | 413 | 413 | 720 | 1,210 |
| | 62 | 62 | 180 | 620 |
| | 475 | **475** | **900** | **1,830** |

7. https://www.neso.energy/industry-information/connections/connections-reform

Photo: Jason Bickley

# Appendices

# Appendix 1
# Auctions & Tenders by country

## Onshore capacity awarded in auctions in 2024

**Germany** held four technology-specific auction rounds in 2024, offering support to 12.1 GW of onshore wind and awarding 11 GW (91% allocation rate). The awarded volume is 72% more than that awarded in 2023, when Germany awarded support to 6.4 GW of onshore wind projects. The support offered is a 20-year Feed-in-Premium. Awarded strike prices are not indexed to inflation.

**France** held two technology-specific auction rounds in 2024 in which it offered support to 1,850 MW of onshore wind, which was almost completely awarded (1,813 MW). The awarded volume in 2024 is significantly lower than that awarded in 2023 (3,097 MW) because one fewer round was offered.

France also held a technology-neutral round where support was offered to 500 MW of onshore wind and solar PV. While this volume was fully awarded, support was awarded to only 37 MW of onshore wind. The support offered under both schemes is a 20-year 2-sided CfD, with strike prices fully indexed to inflation indices relevant for onshore wind.

**Romania** awarded 1,096 MW in its first-ever onshore wind energy auction. The call was oversubscribed, as it originally sought to allocate support to just 1 GW of onshore wind. The support offered is a 20-year 2-sided CfD.

**The UK** awarded almost 1 GW of onshore wind under Pot 1 (established renewable energy technologies, including onshore wind energy) of the Allocation Round (AR) 6, under which a 15-year 2-sided CfD is offered. While there is no fixed MW capacity quota for the support offered to onshore wind, the budget for Pot 1 was set at £185 million. Most capacity was awarded in Scotland, with only three projects in Wales (73 MW) and one in England (8 MW). In 2023, the UK awarded support to 1,705 MW of onshore wind. The support offered is a 15-year 2-sided CfD and strike prices are indexed to the Consumer Price Index.

**Austria** awarded support to 458 MW of onshore wind in 2024 across four technology-specific auction rounds. That is 79% of the support it sought to originally allocate (582 MW). Ultimately, support was offered to 1,142 MW of onshore wind as unallocated volumes in any give round are carried forward to the following rounds. Austria also awarded support to an additional 29 MW of onshore wind under a technology-neutral auction round where hydropower also competes. The support offered under both schemes is a 20-year Feed-in-Premium. Awarded strike prices are not indexed to inflation.

**Ireland**'s sole 2024 renewable energy auction round awarded support to 374 MW of onshore wind. That 2.5 times the volume supported in 2023. The support offered is a 16.5-year 2-sided CfD. Awarded strike prices are partially indexed to inflation.

**Italy** held two auction rounds in 2024 under its FER 1 renewable energy auction scheme, allocating support to 186 MW of onshore wind. In 2023, Italy held three technology-neutral auction rounds where it awarded support to 897 MW of onshore wind. The support offered is a 20-year 2-sided CfD.

**Czechia** awarded 114 MW of onshore wind in 2024, while it sought to allocate support to 125 MW (91% allocation rate). The country offers 20-year 2-sided CfDs.

**Poland**'s yearly technology-neutral renewable energy auction scheme awarded support to 91 MW of onshore wind. The country offers 20-year 2-sided CfDs with strike prices indexed to the Consumer Price Indexed.

**Latvia** did not auction support to onshore wind energy projects. However, Latvia's State Forests company, which manages state-owned forest property, allocated land across 2024 to develop at least 725 MW of onshore wind.

Both **Croatia** and **Ukraine** failed to award support to any onshore wind energy project in their respective onshore wind energy auctions held in 2024.

## Offshore capacity awarded in auctions in 2024

**Germany** awarded 8 GW of offshore wind in 2024 spread across five sites. For the N-11.2 site (1.5 GW) and the N-12.3 (1 GW) concessions were secured through the dynamic bidding procedure, where if more than one zero-cent bid is received for a site, bidders enter a multi-round negative bidding process.

The N-9.1 (2 GW), N-9.2 (2 GW), and N-9.3 (1.5 GW) sites were awarded through negative bidding and non-price criteria – including their contribution to decarbonisation, PPAs, noise levels, and contribution to workforce development.

**The UK** allocated support to 5.3 GW of offshore wind energy projects under Pot 3 (bottom-fixed offshore wind energy) and Pot 2 (emerging technologies, which includes floating offshore wind energy) of the CfD AR 6. In particular, 4,942 MW of bottom-fixed offshore wind energy projects were awarded. But 1,579 MW of this capacity was from projects that were awarded under the UK CfD AR4 but that were allowed to re-bid part of their awarded capacity to secure a higher strike price. A 400 MW floating project was also awarded.

While there is no fixed MW capacity quota for the support offered to offshore wind, the budget for Pot 3 was set at £1.1bn while Pot 2 was set at £280 million. The award was based on price only. The support offered is a 15-year 2-sided CfD. Awarded strike prices are indexed to the Consumer Price Index.

**The Netherlands** awarded 4 GW of offshore wind in the first half of 2024, evenly spread across the IJmuiden Ver Alpha and Beta sites. Bids were ranked using both negative bidding and non-price criteria, focusing on ecology for the Alpha site and system integration for the Beta site.

**Norway** awarded support to 1.5 GW of offshore wind through its first ever offshore wind auction in 2024 for the Sørlige Nordsjø II site. The evaluation of the bids was based on both the bid price (a 15-year 2-sided CfD was offered with the strike price indexed to the CPI) and pre-qualification criteria. The latter included execution capability, sustainability, and positive ripple effects.

**France** awarded support to 750 MW of offshore wind energy across three floating projects, each worth 250 MW. The bids ranking included both price and non-price criteria focused on social and territorial development issues as well as environmental issues. The support offered is in the form of a 20-year 2-sided CfD with a maximum strike price of €130/MWh for the two sites in the Mediterranean and €140/MWh for the site in the Atlantic. Strike prices are indexed to industry-relevant inflation indices.

**Denmark** failed to attract bids for three offshore sites it auctioned in the North Sea I area in 2024, totalling 3 GW. Bids were to be evaluated based on the financial offer (negative bidding) and non-price criteria focusing on sustainability and social responsibility.

**Lithuania** held its second offshore wind energy auction in the first half of 2024. The country sought to allocate support with a 15-year 2-sided CfD for a 700 MW wind farm. However, only one bid was received rendering the auction unsuccessful. The auction is expected to be held again in early 2026.

# Appendix 2
# Outlooks by country

## Onshore

### Germany

Germany will continue to be Europe's largest market with a total build-out of onshore wind power capacity of 38 GW over the next six years.

In 2022 the German Parliament adopted the Onshore Wind Law (WindLandG), setting an installation target of 10 GW a year from 2025. It also enshrined the principle that the expansion of renewables is a matter of "overriding public interest", and this is being systematically implemented - the exception rather than the rule across most EU Member States. The benefits of improved onshore wind permitting for both greenfield and repowering projects are already being seen, with 13.8 GW of projects permitted in 2024, up from 7.6 GW in 2023 and 4.3 GW in 2022.

But at the same time permits for transportation have turned into a separate bottleneck. Transportation companies require 150 permits on average to transport just one wind turbine, and there is a backlog of 15,000 applications which could stall installations[8].

Germany's onshore wind auction schedules have been revised as well. In 2024, support was awarded to 11 GW of onshore wind. Originally, support was only due to be offered to 10 GW of onshore wind. However, the Federal Network Agency BNetzA increased this to 12.1 GW. For 2025 the Agency already revised the volume of the first auction round up from 2.5 GW to 4.1 GW.

These onshore capacity additions would bring Germany's total installed onshore wind power to approximately 96 GW by 2030. This would make it by some margin the largest onshore wind market in Europe, with more than twice the installed capacity of the next largest onshore market, Spain.

But the expected total installed onshore capacity of 96 GW by 2030 would fall 19 GW short of the Government's ambitious target of 115 GW.

Following the collapse of Germany's Federal Government in November 2024, the country held a general election at the end of February 2025. The opposition centre-right CDU won most votes, but it needs to form a coalition with other parties. Its leader has ruled out forming a coalition with the second largest party, the far-right AfD, leaving the centre-left SPD as most likely coalition partner, currently in Government. This could mean that the excellent onshore wind energy measures enacted by the outgoing Government will be maintained.

### Spain

In Spain new onshore wind power capacity is expected to total nearly 13 GW over the six years to 2030. This would make it the second largest wind energy market in the EU after Germany. The PPA and merchant markets have remained strong, despite an unsuccessful auction in 2022 and lack of auctions in either 2023 or 2024. We expect a new auction scheme to be finalised in 2025 or 2026.

But the Government still needs to improve the country's permitting processes. As it stands, there are sharp regional differences. For example, it has become impossible to develop wind farms in Galicia, where local judges have put all construction on hold. 2 GW of projects are ready to be built in the autonomous community but are currently blocked.

At the national level, permitting processes are relatively inefficient and can be delayed by long appeal procedures. Another challenge for Spain is the grid where there is a high risk of congestion and a lack of new access points and connections.

Spain has set an ambitious target of 59 GW of onshore wind by 2030. But given the current challenges, we see just 40 GW of onshore capacity being installed by then. The final years of the decade would need to see much higher rates of build-out if the installed capacity is to come close to the Government's target.

8. https://www.reuters.com/business/energy/germanys-wind-power-expansion-stalls-roads-2023-09-07/

## Türkiye

In Türkiye energy independence is high on the agenda and wind energy has strong political and social support. In October 2024 the country announced that it will conduct YEKA tenders of at least 2 GW annually up to 2035, and in early 2025 the country held an auction for 1.2 GW of onshore wind, which was heavily oversubscribed. It also announced changes in permitting rules for power plants, with the goal to at least halve request processing times from the current standard of four years. They also announced significant investment in the transmission system, allowing it to integrate 29.6 GW of wind energy in the grid. We expect Türkiye to add an extra 12.5 GW of onshore wind, for a total of more than 26 GW of onshore wind energy capacity by 2030.

## France

In France the country's first national law on renewable energy came into force in 2023. The Renewable Acceleration Law improved auctioned conditions for wind and solar and makes local elected officials jointly responsible for the implementation of the energy transition. 2024 on the other hand was characterised by political instability, featuring a general election, four Prime Ministers, and public debt high on the agenda. This led to general legislative paralysis, affecting future onshore wind legislation.

France's technology-specific auction scheme will end in 2025, while the technology-neutral auction scheme (where onshore wind competes with solar PV) will end in 2026. Despite the ongoing political challenges, a new onshore wind energy auction scheme should be operative as soon as 2026.

France has also seen regional differences in the build-out of wind energy which may limit future expansion in some areas. For example some regions in the north of the country have become resistant to new developments after more wind farms were built there than in other parts of the country. And there are some regions which face a total blockage as a result of physical grid constraints.

Separately, the deployment of onshore wind energy is affected by stringent wind turbines tip height rules, due to military and radar restrictions. Developers are often only able to install turbines with significantly lower power ratings than average and even smaller than those commercially available today.

Despite these challenges, we expect onshore build-out to exceed 11 GW over the next six years. With a total onshore wind power capacity of 32 GW this would bring France close to meeting its 2030 onshore target of 35 GW. Further auctions scheduled for 2026 and beyond would support the extra build-out needed to meet the 2030 target.

## UK

As was widely expected, the Labour Party won the UK's general election in 2024, bringing 14 years of Conservative Government to an end. The new Government swiftly adopted new rules for onshore wind, notably lifting the de-facto ban on onshore wind in England, in place since 2015.

The Onshore Wind Industry Taskforce was launched, bringing together key organisations from Government, industry, regulatory and other relevant bodies. It aims to accelerate onshore wind build-out.

The new Government has also reclassified English onshore projects exceeding 100 MW as nationally significant infrastructure projects (NSIP). This change means that permitting approval will now be handled at the national level through an expedited permitting process.

And CfD auction rules were changed to allow onshore repowering projects to take part in Allocation Round 7 in 2025.

We expect the UK to build 9 GW of onshore wind over the next six years, taking the total installed capacity to 24 GW, short of the Government's goal of 27-29 GW by 2030.

## Finland

Finland will continue to expand its installed onshore capacity, albeit falling short of the record volume of over 2.4 GW installed in 2022. Overall, we expect total onshore build-out during the period from 2025-2030 to be 7.8 GW, when there would be 15.5 GW installed onshore nationwide.

A real estate tax applied to wind turbines and paid to municipalities has helped foster a supportive local Government environment. While the country does not have a Government-backed support mechanism for onshore wind generation, it has strong merchant and PPA markets.

In general, Finland's low population is favourable for onshore wind development. But some developers may be holding back as rising electrification of final energy consumption and demand for renewable hydrogen might not grow as quickly as originally hoped.

## Italy

Italy has an ambitious onshore wind capacity target of 26 GW by 2030. Project permitting comes with many challenges, with project developers needing to secure support from the regions and from the Soprintendenze, the regional representatives of the national Ministry of Culture and Heritage.

Penalising tariffs for repowered wind farms and speculative grid connections also hinder the redevelopment of Italy's oldest wind projects, and since Italy's wind fleet is amongst the oldest in Europe, this is a serious missed opportunity to quickly increase wind energy build-out.

Fortunately the Government is now finalising a new auction scheme with more favourable conditions than before. It features a strike price indexed to inflation and auction rounds dedicated to onshore wind which would offer support to a total of 16.5 GW over the 2025-2028 period. In 2024 the Government drew up new laws that would group permitting rules under one legal text.

We expect Italy to add 7.8 GW of onshore wind capacity from 2025-2030, taking its total onshore capacity to 20 GW by 2030, 6 GW short of their prescribed target.

## Sweden

New onshore capacity additions in Sweden are expected to come to 5.5 GW over the period from 2025 to 2030. While the current Government has prioritised the development of nuclear energy, it also intends to provide support to municipalities that allow onshore wind farms in their jurisdiction.

There is no central support for wind energy, but Sweden has one of the most established and well-functioning PPA markets in Europe. While there is strong demand from industry, e.g. for green steel, battery factories and wider renewable hydrogen, several industrial consumers have recently postponed their investments, leading to a slow-down in the forecast for electricity demand.

Industrial project delays include the Hybrit project for fossil-free steel production which was supposed to start in 2026 but has been pushed back to 2027-2028, and the Fertiberia renewable ammonia and fertiliser plant that should have been operational by 2026 but has now been postponed to 2028. Further delays to the ramp-up in electricity demand could lead to a slower wind power build-out as well.

## Other EU Markets

**Poland** is expected to install just over 4 GW of onshore wind over 2025-2030. The country auctions have not yet gathered significant interest from wind farm developers. However, this is compensated at least in part by relatively high electricity wholesale prices and a promising PPA market. The 10H rule, currently being repealed and replaced by a rule with a 500m setback distance from buildings, is expected to favour the development of onshore wind in Poland in the latter part of the decade.

**Romania** held its first auction for onshore wind in 2024, awarding more than 1 GW of CfD support. They now plan to hold a 1.5 GW onshore auction in 2025. We now expect the country to add 3 GW over the next six years taking their total installed capacity to 6.1 GW, 1.2 GW short of their target.

**Ireland** is expected to install 2.8 GW over the period 2025-2030. The onshore auction in 2024 awarded support to 374 MW of onshore wind, up from 148 MW in 2023. Additional technology neutral onshore auctions are currently scheduled for 2025.

There is broad support for onshore wind in Ireland across the political spectrum. Planning rules are also being improved and significant funds are being allocated to reinforce the grid. Merchant and PPA backed projects are likely to play a part. Demand from data centres has led to onshore wind PPAs being signed by Amazon, Meta and Microsoft in recent years. Ireland has a 2030 onshore wind target of 9 GW and we expect their total onshore wind power capacity to climb to almost 7 GW by 2030.

In **Greece**, onshore wind power additions over the period from 2025-2030 are expected to reach 2.4 GW. The country currently offers no support mechanisms for electricity generation from onshore wind, meaning that future wind farms will have to rely on either merchant or PPA revenue routes. The country has a revised 2030 onshore wind power capacity target of 8.9 GW, and with 5.4 GW already installed it would need to add 3.5 GW to reach this goal.

**Portugal** is expected to add 2.3 GW of onshore wind energy capacity over the next six years, bringing their cumulative installed capacity in 2030 to 6.6 GW. This is nearly 4 GW short of the country's designated onshore target (10.4 GW).

**Lithuania** is expected to add 2.1 GW of onshore wind energy capacity in the next six years. This would allow the country to reach 3.8 GW of total installed onshore capacity by 2030, within reach of its 4.5 GW 2030 target.

**Denmark**'s build-out of wind power capacity from 2025-2030 is expected to include around 1.4 GW of onshore wind. Repowering will play an important role given the age of the fleet and the limited space for further development. Build-out is expected to be on a merchant or PPA basis since there is no central support scheme envisaged. The revised National Energy and Climate Plan sets a goal of 5.9 GW of onshore wind by 2030, and we expect it to get close to, or to even beat this target by then.

**Belgium** has had a stable level of onshore wind capacity build-out over the last 10 years, installing 220 MW a year on average. We expect the trend to continue with a total onshore build-out of 1.4 GW over the next six years, giving it an installed onshore wind capacity figure of 4.2 GW. The 2030 onshore wind targets are set at a regional level, but we expect the combined targets for Wallonia and Flanders to come to 5.1 GW.

# Offshore

## United Kingdom

The United Kingdom is due to remain the largest market for offshore wind in Europe. The newly elected Labour Government has continued the clean technology strategy of the previous administration. Following the failure of the Allocation Round 5 (AR5) in 2023, 5.4 GW of capacity was awarded in the latest Allocation Round 6 (AR6), ensuring the United Kingdom has a solid project pipeline extending up to 2030 and beyond.

We expect around 20 GW of additional offshore installations between 2025 and 2030, bringing total expected offshore wind power capacity to nearly 36 GW. This would be a significant achievement but would still fall short of the UK's ambitious 2030 offshore wind power target of 50 GW.

## Germany

Germany is expected to lead offshore installations in the EU up to 2030. The country awarded 8 GW in 2024, and it is planning to tender an additional 12 GW over the next four years. But it is unlikely that much, if any, of the capacity to be awarded could be installed by 2030.

We expect around 9 GW of offshore wind capacity additions between 2025 and 2030, bringing the total projected offshore wind power capacity to over 18 GW. Germany's offshore wind target is 30 GW by 2030.

## Poland

Poland is one of the emerging offshore wind markets that has made huge strides in recent years. With construction starting on its first offshore wind farm in late 2024 and another round of CfD auctions due for 2025, the country is already positioning itself as a leading market in the Baltic Sea.

The country is expected to install around 6 GW of offshore wind capacity between 2025 and 2030, which would meet the 2030 target set by the 2020 Offshore Wind Act.

## Netherlands

In 2023, the Netherlands achieved a record in offshore installations with around 2 GW of new capacity. Although no installations took place in 2024, the country has awarded 4 GW of projects, for the Ijmuiden Ver Alpha and Ijmuiden Ver Beta, and plans to award an additional 11 GW between 2025 and 2027, building up to its 2030 target of 15.8 GW.

But due mainly to grid connection delays which are expected to hold up project commissioning dates by 1-2 years, we expect that just 6 GW will be added between 2025 and 2030, reaching a total of 10.4 GW.

## France

France has made major progress in 2024, awarding its first commercial-scale floating projects, totalling 750 MW. The Government plans to award an extra 15 GW over the next two years, including in the AO10 round which has not yet been officially announced. France is aiming for 3.6 GW of offshore installed capacity by 2030, with medium- and long-term goals of 18 GW by 2035 and 45 GW by 2050.

We expect France to add an extra 2.3 GW of offshore wind capacity between 2025 and 2030, bringing total installed capacity to 3.8 GW.

Photo: T.W. van Urk / Shutterstock

# Annex 1

## Glossary

| Support mechanism | Description |
|---|---|
| Feed-in-Tariffs | A type of price-based policy instrument where 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 where eligible renewable energy generators are paid a premium price which is a payment (€x/MWh) in addition to the wholesale price. |
| Feed-in-premium (floating) | A type of price-based policy instrument where 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 guaranteeing a minimum revenue. |
| Contracts-for-Difference | 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 are 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[9]

| | 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 | 1% | - | 75% | - | 1% | - |
| 14 | 1% | - | 74% | - | 1% | - |
| 15 | 2% | - | 72% | - | 1% | - |
| 16 | 4% | - | 70% | - | 3% | - |
| 17 | 6% | - | 66% | - | 4% | - |
| 18 | 10% | - | 63% | - | 6% | - |
| 19 | 13% | - | 59% | - | 8% | - |
| 20 | 16% | - | 54% | - | 9% | - |
| 21 | 18% | 1% | 50% | 13% | 9% | 0% |
| 22 | 19% | 1% | 45% | 18% | 9% | 0% |
| 23 | 22% | 2% | 41% | 23% | 9% | 0% |
| 24 | 24% | 3% | 37% | 29% | 9% | 1% |
| 25 | 27% | 4% | 32% | 35% | 9% | 1% |
| 26 | 31% | 6% | 28% | 41% | 9% | 2% |
| 27 | 36% | 9% | 25% | 45% | 9% | 4% |
| 28 | 42% | 12% | 21% | 48% | 9% | 6% |
| 29 | 48% | 16% | 18% | 50% | 9% | 8% |
| 30 | 55% | 22% | 16% | 50% | 9% | 11% |
| 31 | 62% | 29% | 13% | 48% | 8% | 14% |
| 32 | 69% | 38% | 11% | 45% | 8% | 17% |
| 33 | 76% | 48% | 9% | 41% | 7% | 20% |
| 34 | 82% | 58% | 8% | 36% | 7% | 21% |
| 35 | 88% | 68% | 6% | 31% | 5% | 21% |
| 36 | 92% | 78% | 5% | 26% | 5% | 20% |
| 37 | 95% | 86% | 4% | 21% | 4% | 18% |
| 38 | 97% | 93% | 3% | 17% | 3% | 16% |
| 39 | 99% | 97% | 3% | 13% | 3% | 13% |
| 40 | 99% | 99% | 2% | 10% | 2% | 10% |
| 41 | 100% | 100% | 2% | 7% | 2% | 7% |
| 42 | 100% | 100% | 1% | 5% | 1% | 5% |
| 43 | 100% | 100% | 1% | 3% | 1% | 3% |
| 44 | 100% | 100% | 1% | 2% | 1% | 2% |
| 45 | 100% | 100% | 1% | 2% | 1% | 2% |
| 46 | 100% | 100% | - | 1% | - | 1% |
| 47 | 100% | 100% | - | 1% | - | 1% |
| 48 | 100% | 100% | - | - | - | - |
| 49 | 100% | 100% | - | - | - | - |
| 50 | 100% | 100% | - | - | - | - |

9. Repowered wind farms assumption represents proportion of remaining fleet which is repowered in a given year. Assumptions differ per country - assumptions above are for Germany.

WindEurope is the voice of the wind industry, actively promoting wind power in Europe and worldwide. It has over 600+ 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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