



Report 2023

European Commission and WindEurope

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Wind energy installations in the EU reached 16.2 GW in 2023, with a record of 2.9 GW in offshore wind, whereof 37 MW was floating offshore wind. This is on par with 2022 installations, however, it is only half of what the EU should be building to meet its 2030 climate and energy targets.

Installations in 2024 will likely be similar to 2023 but are expected to increase thereafter, with the average installations over the 2024-2030 period reaching 29 GW per year. However, depending on the scenario, between 33 and 37 GW per year is needed over the same period to reach the EU's 2030 energy and climate goals.

In general, progress is improving after some challenging years for the wind industry in Europe. Permitting

volumes are up, investments are up and build-out expectations are more optimistic. Despite this, a new important challenge has emerged – without prompt action, grids are going to become a major bottleneck if they are not already in many Member States. Governments must urgently accelerate the grid expansion via anticipatory investments, optimising the use of the existing grid and proactively managing grid connection queues.

Table 1. Key National Statistics 2023: EU-27

Total (net) installed wind power capacity	220.3 GW
Total offshore capacity <i>of which floating</i>	19.4 GW 0.2 GW
New wind power capacity installed	16.2 GW
Decommissioned capacity (in 2023)	0.7 GW
Total electrical energy output from wind	466 TWh
Wind-generated electricity as percent of national electricity demand	19%
Average national capacity factor	24% onshore / 34% offshore
Target	At least 42.5% RES in final energy demand by 2030
National wind energy R&D budget	

Highlight(s)

- Installations totalled 16 GW in the EU in 2023, on a par with 2022.
- EU-27 Installed wind power capacity is now 220 GW. 201 GW are onshore and 19 GW are offshore.
- There are now 108,000 turbines installed in the EU-27, of which 4,000 are offshore.
- 82% of new installations were onshore. Germany connected 3.9 GW, the most in the EU.
- 2023 was a record year for offshore in the EU. 2.9 GW was connected to the grid, including 37 MW floating offshore wind.

Market Development

Targets and Policy

After a difficult period, the European wind industry has now turned a corner. EU policy changes in 2023 are helping this recovery.

The revised **Renewable Energy**

Directive has enshrined in EU law a 2030 renewable energy target of at least 42.5%. Furthermore, it includes temporary rules on permitting to allow shorter deadlines, the overriding of public interest principle, and the digitalisation of procedures permanent.

In October 2023, the European Commission (EC) unveiled the **Wind Power Action Plan**. The Plan entails 15 immediately implementable actions to be taken by the Commission, Member States, and industry across six main areas, including permitting, auction design, and access to finance. 26 EU Member States committed to take action by signing a **European Wind Charter**.

Together with the Wind Power Action Plan, the EC presented its plan to deliver on the EU offshore renewable energy ambitions.

In November 2023, the Commission adopted the **EU Action Plan for Grids**. The Plan defines 14 actions to make the EU's electricity grids stronger, more interconnected, more digitalised and cyber-resilient.

A **Net-Zero Industry Act** will strengthen Europe's clean energy

supply chains. The act mandates the inclusion of non-price criteria in wind energy auctions and refers to an indicative target of 36 GW a year of wind turbines to be produced in the EU by 2030. The Critical Raw Materials Act provides a new regulatory framework to diversify the EU's supply of critical raw materials, including provisions to strengthen the domestic raw material value chains.

EU Member States have drafted new **National Energy and Climate Plans**. Several countries have increased their 2030 wind energy targets. A preliminary analysis shows that EU Member States have ambitions to collectively install at least 437 GW of wind energy by 2030.

The EC revised the **Strategic Energy Technology Plan** to align it with the abovementioned policies and build a sustainable and resilient energy future.

Progress and Operational Details

In 2023, the EU installed 16.3 GW (13.4 GW onshore and 2.9 GW offshore) of new wind capacity. It now has 220 GW of cumulative installed

wind capacity (201 GW onshore and 19 GW offshore). 720 MW of old wind capacity was also decommissioned in the EU, exclusively onshore.

Wind energy generated 466 TWh in 2023, 54 TWh more than in 2022, despite worse conditions in northern Europe, where the bulk of Europe’s wind power capacity is located. Wind met a record 19% of demand across the EU, up from 16% in 2022. The increased share was largely thanks to new installations and coupled with lower electricity demand.

Capacity factors for the entire wind fleet in the EU were 25% on average. Capacity factors for onshore were 24% (up from 23% in 2022), while for offshore they were 34% (down from 35%). The capacity factors of new installations are significantly higher than those of fleet-wide installations, which include very old installations.

The average power rating of onshore turbines installed in 2023 was 4.5 MW, up from 4.1 MW in 2022. The average rated capacity of offshore turbines was 9.7 MW, up from 8 MW in 2022. The average power rating of turbines ordered in 2023 was 5.5 MW for onshore and 14.9 MW for offshore.

Investment in new EU wind farms was a record EUR 30 billion. The EUR 30 billion investment covers 14.7 GW of new onshore and offshore wind capacity that will be built in 2024 and beyond. Almost half the capital raised (EUR 14 billion) was in respect to five offshore wind farms in France, Germany, the Netherlands and Poland.

Matters Affecting Growth and Work to Remove Barriers

Over the 2024-2030 period, the build-out rate of wind energy is expected to increase. Wind energy installations could average up to 29 GW a year, putting us within reach of the EU’s 2030 targets.

While permitting bottlenecks begin to ease (Germany and Spain each permitted 70% more onshore wind than in 2022), grid bottlenecks are emerging as a new key barrier. Member States struggle to build out the grid needed to integrate new wind capacity and filter out speculative grid connection requests.

Some countries have increased wind energy auction bidding ceilings and indexed strike prices to inflation to counter rising project costs. However, others continue to use the

“negative bidding” model, increasing the development costs, likely to be passed on to the supply chain.

RD&D Activities

In 2023, the European wind industry invested almost EUR 1.3 billion in R&D, equal to 3.73% of the industry’s contribution to the EU GDP. Through the European Technology and Innovation Platform on wind (ETIPWind), the European wind industry adopted a new short-term [Strategic Research & Innovation Agenda](#). ETIPWind is established as part of the SET Plan to facilitate R&I cooperation among wind energy stakeholders. ETIPWind estimates the industry needs EU 1.8 billion in funding to address the 23 most pressing R&I needs in the period 2025-2027.

The European Energy Research Alliance’s Joint Programme on Wind energy supports the development of a long-term research agenda (NeWindEERA), which will spell out the sector’s research needs by 2050. The NeWindEERA publication is due later in 2024.

2023 was the best year since 2009 for EU wind research funding through the framework programmes FP7,

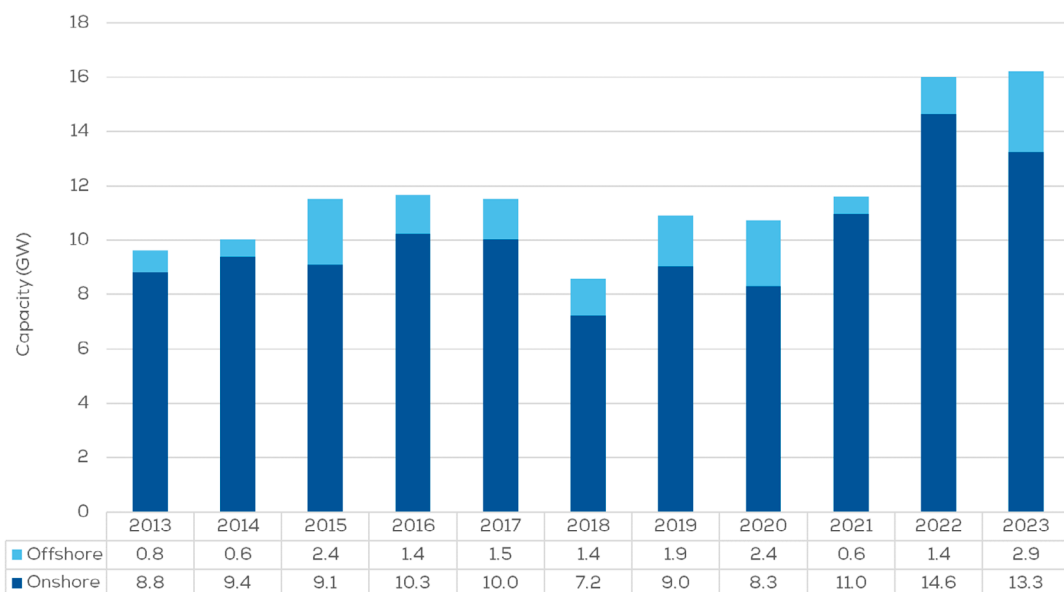


Figure 1: New onshore and offshore wind power installations in the EU-27.

H2020, Horizon Europe. New wind energy research projects funded increased to 38 and the cumulated R&I investment more than doubled (EUR 169.1 million) compared to 2022 (EUR 67.7 million).

Table 2. Wind energy-specific funding under Horizon Europe is granted to projects starting in 2023.
Source: JRC based in CORDIS, 2024.

Horizon Europe funded projects	Total project cost Million EUR(Million USD)	EU contribution Million EUR(Million USD)	Number of projects
Wind-specific projects	168 (199)	149(175)	31
Non-wind specific projects	27(29)	20 (21)	7
Total funding for wind energy	195(228)	169(196)	38

Figure 2 shows the development of wind R&I funding in the period 2009 – 2023 under the EU framework programmes. Wind energy projects starting in 2023 focused on floating offshore research, which represented 19% of EC funding (EUR 32.6 million), followed by grid integration (14%) and new materials & components (13%).

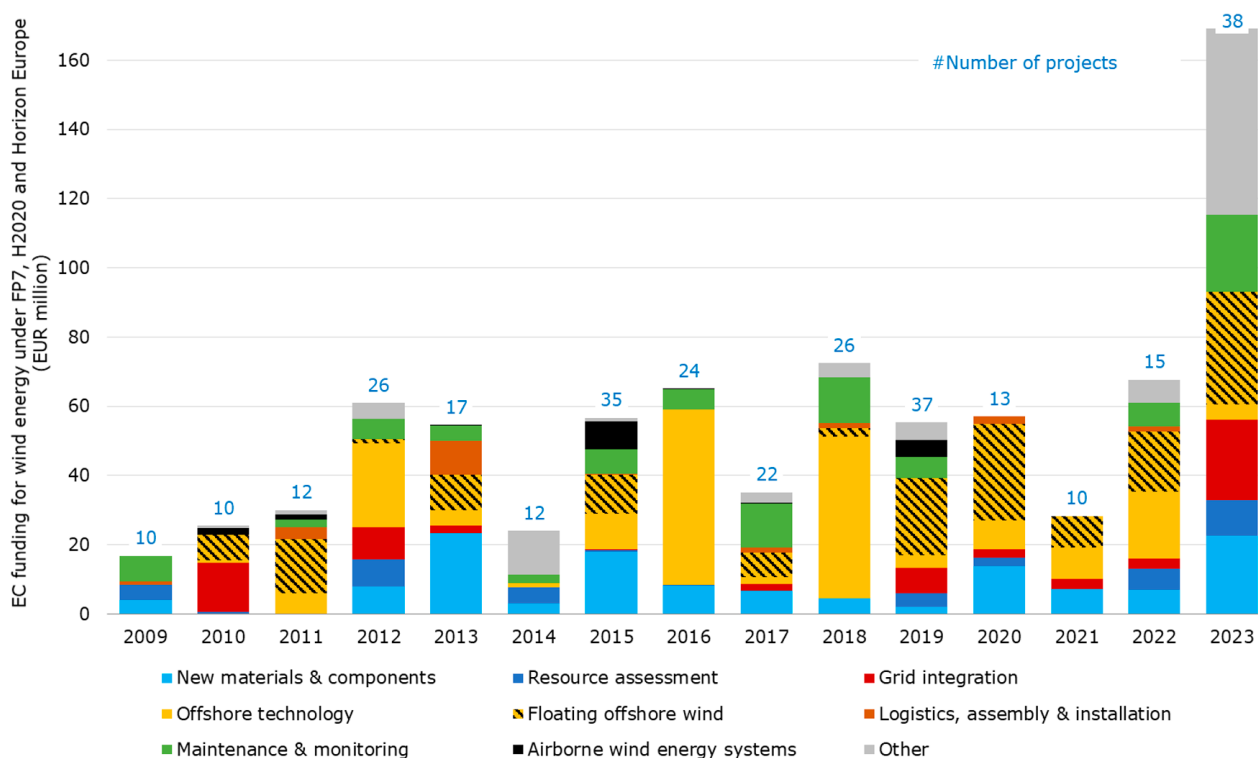


Figure 2: Evolution of EU R&I funding categorised by R&I priorities for wind energy under the FP7 (2009-2013), H2020 (2014-2021) and Horizon Europe (2022-2023) programmes and the number of projects funded in the period 2009-2023. Projects in wind energy and those with a significant wind energy component are accounted for (Table 2). Note: The other item includes some projects exploring emerging technologies, such as social acceptance and critical rare earth elements, among others. Funds granted refer to the start year of the project.
Source: JRC based in CORDIS, 2024.

Since 2009, EU framework programmes allocated substantial funding across all wind research R&I priorities. Projects on offshore wind technology (EUR 191 million), floating offshore wind (EUR 165 million) and new materials & components (EUR 128 million) comprise the majority of the funds.

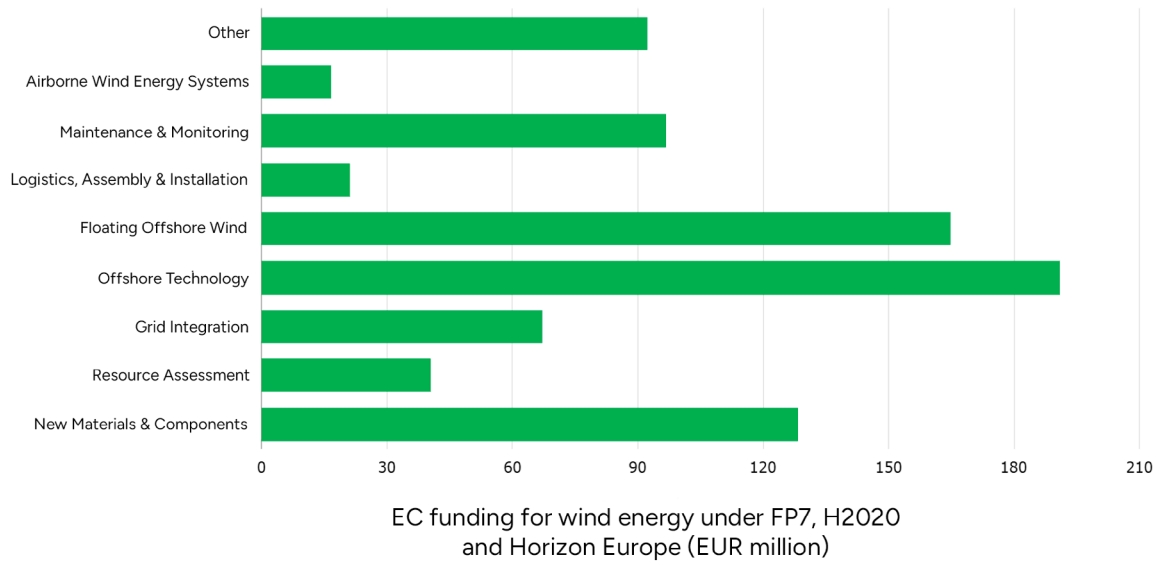


Figure 3: EC funding on wind energy R&I priorities in the period 2009 -2023 under FP7, H2020 and Horizon Europe. Source: JRC based in CORDIS, 2024.

In addition to the Framework programmes, the EC has other funding instruments available, such as the ETS Innovation Fund and Life programme. In 2023, one wind energy project secured EUR 30 million in funding through the ETS Innovation Fund. This is down from 2022, when two projects secured a combined funding of almost EUR 100 million.

Research Initiatives and Results

Fourteen wind research projects worth EUR 63.9 million in EU Funding ended in 2023. 31% of the funding addressed offshore technology, followed by new turbine materials & components (28%) and floating technology (24%).

The following selected projects exemplify the research progress made:

- Neodymium-containing magnets are key components in various products driving the green transition, including wind turbines with permanent magnet generators. However, the current supply chain cannot cope with the anticipated demand for these magnets. The **SUS-MAGPRO project** (EU support: EUR 13.0 million) developed

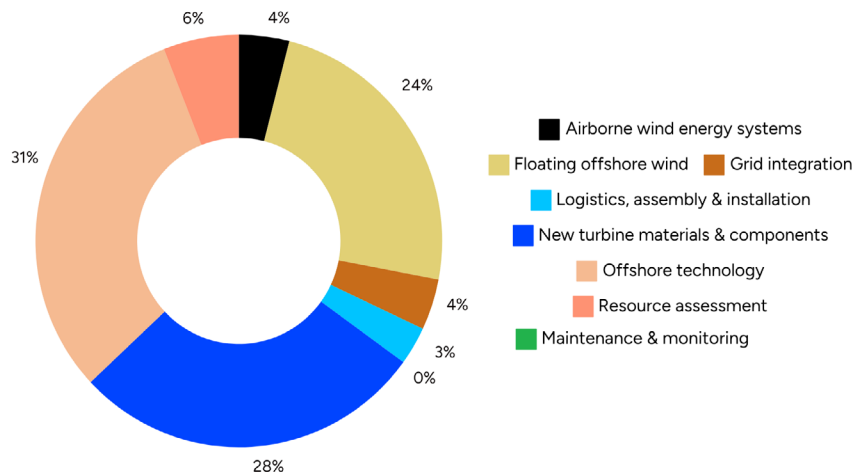


Figure 4: Share of wind energy funding under H2020 is granted to projects completed in 2023 and categorised by research area for wind energy. Source: JRC based in CORDIS, 2024.

new ways to recycle and reuse magnets directly from waste, creating a shorter recycling loop with a higher recovery rate and increased yield (25%) compared to traditional methods. After evaluation and disassembly of the magnet-containing items, the magnet scrap can be processed to produce powders, which can then be transformed into new alloys or magnets. An innovative technique based on metal injection moulding was developed for this last step, which allows creating complexly shaped magnets with minimal waste from production [1].

- Floating Offshore Wind (FOW) presents a large potential due to the amount of wind resources existing in deep waters (<60m). This potential has not been exploited yet since traditional bottom-fixed offshore wind is not economically attractive for such locations, and floating technology is still in its development and demonstration phase. The **COREWIND project** (EU support: EUR 5 million) enabled compelling reductions in costs and environmental footprint, thanks to digital tools and optimisation of offshore wind energy systems. The novel digital tools focussed on the optimal design of both the station-keeping system and the dynamic cables, allowing reductions in costs arising largely due to oversizing. In terms of offshore wind energy systems, two floating substructures were optimised: a concrete spar (a single large-diameter vertical buoyant cylinder ballasted at the bottom end) and a semi-submersible (multiple smaller columns and pontoons) [2].

Selected examples of new R&I projects

- The overall objective of the **WHEEL project** (EU support: EUR 16.7 million) is to fully demonstrate and achieve a

pre-commercial Technology Readiness Level (TRL) for an innovative floating wind technology excellently suited for deep water locations, effective industrialisation strategies, breakthrough cost reduction and minimised carbon footprint. This shall enable a radical step forward for LCoE reduction while also addressing scalability, harbour infrastructure suitability and availability, and the sustainability & circularity of floating offshore wind. The development and demonstration needed to reach the pursued TRL will be achieved through the design, installation, certification and testing of a fully operative 6 MW Pilot unit [3].

- The rapid growth in wind power generation will eventually result in tens of thousands of tonnes of blade debris. This is why recycling wind turbine blades is important. In this context, the EU-funded **REFRESH project** (EU support: EUR 11.5 million), will develop and demonstrate a circular, smart system for improved recycling (at least 90%) of glass fibre-reinforced composites derived from wind turbine dismantling or reblading. While focusing on the mechanical and thermal treatment of waste, it will involve the entire reverse circular value chain: from end-of-life blades to a wide range of remanufactured products. Overall, the project will increase awareness among European stakeholder communities [4].

Impact of Wind Energy

Environmental Impact

- In 2023, wind energy helped to avoid 202,145 tonnes of CO₂ emissions with an estimated value of EUR 16.9 billion based on the average yearly price of the EU emission allowances. Wind energy also helped avoid 654 tonnes of NO_x and 3.8 tonnes of

SO₂ emissions [5].

Economic Benefits and Industry Development

- In 2022, the European wind energy industry contributed EUR 52 billion to the gross domestic product of the EU. EUR 31.9 billion was a direct contribution, and EUR 20.3 billion was an indirect contribution [5].
- For every EUR 10,000 revenue generated by wind activities, an additional EUR 2,442 was generated in other sectors [5].
- The wind industry provides direct employment for almost 177,000 people in the EU. Indirect employment in the EU linked to wind energy activity was almost 183,000 [5].
- The EU wind industry contributed almost EUR 10 billion in taxes. Corporate taxes amounted to EUR 3.9 billion, income taxes to EUR 3.7 billion and all other taxes, including community taxes, amounted to EUR 2.3 billion [5].

Next Term

- In 2024, new installations in the EU are expected to total 15.8 GW, slightly less than the 16.2 GW installed in 2023. Onshore wind installations will increase, but offshore installations will be lower [6].
- We expect the EU-27 to install 200 GW of new wind power capacity by 2030. This would be, on average, 29 GW a year. Two-thirds will be onshore [6].
- 50% of new installations over the next seven years should come from projects already awarded in auctions. The other 50% will depend on timely executed auctions by Member States [6].

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