

Status of Offshore Wind Energy Development in Germany

First Half of 2024



On behalf of

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Notes

The data was obtained through surveys with industry representatives as well as through additional research. Retroactive adjustments to the data are done based on corrected notifications if required.

The installed capacity of offshore wind energy projects is not always equal to the assigned grid connection capacity.

Future offshore wind energy projects are assigned with their total capacity to the respective expected year of commissioning.

The information provided within the text and figures partially includes rounded values. Thus, when added, there is a possibility of deviations from the overall values.

Photo on Title Page

Start of construction OWP EnBW He Dreiht

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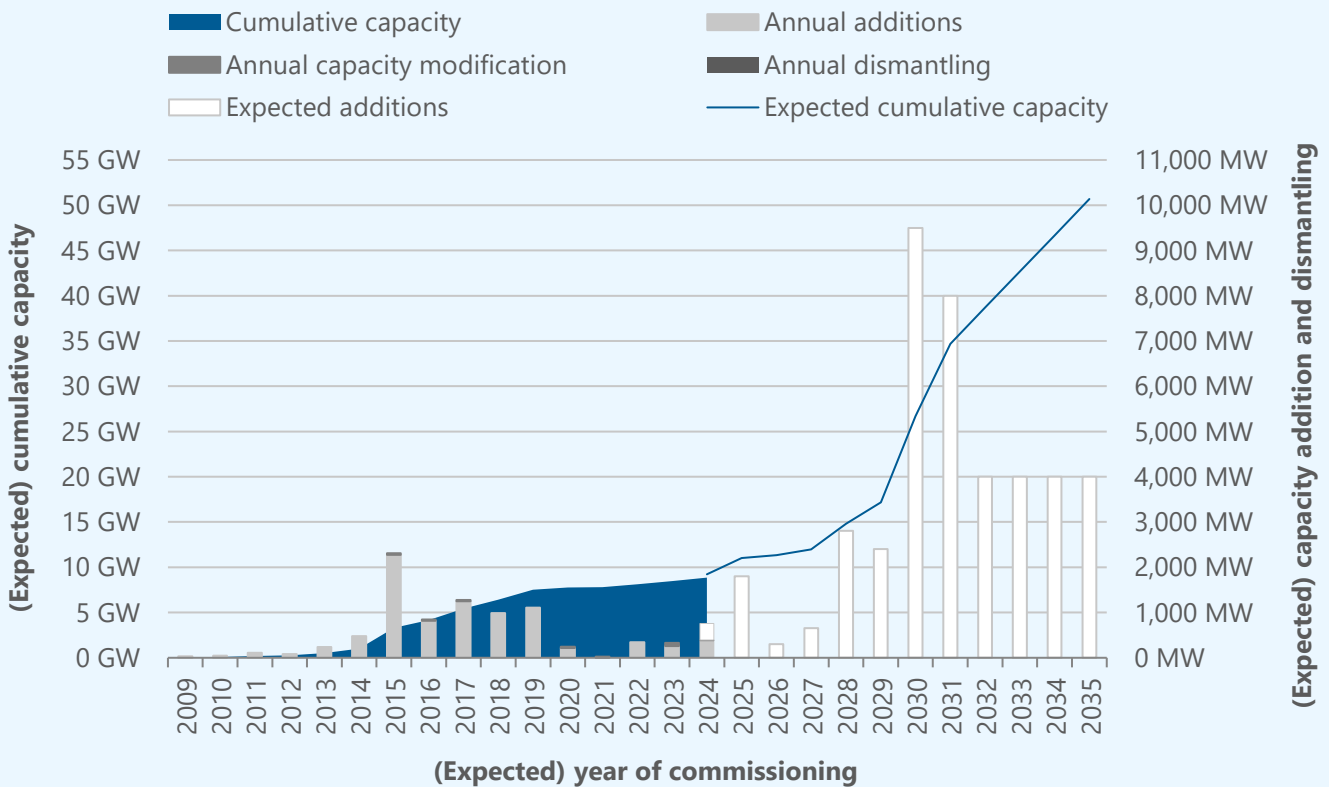
Offshore Wind Energy Development

As of June 30, 2024, 1,602 offshore wind turbines (OWT) with a total capacity of just under 8.9 GW were in operation in Germany. Of these, 36 turbines with a total capacity of 377 MW fed into the electricity grid for the first time in the first half of 2024. In addition, capacity modifications were performed on 78 existing turbines over the course of the half-year. New foundations were also installed and some of the associated wind turbines had already been erected by mid-2024.

With the offshore wind turbines commissioned in the first half of 2024, the implementation of the projects awarded in the transitional system (tender rounds in 2017 and 2018) is progressing. The full commissioning of all turbines of the transitional system projects is planned by the end of 2025, so that the cumulative capacity of offshore wind energy in Germany is expected to increase to approximately 11 GW by 2025.

Status of the offshore wind energy development

| | Capacity | Number |
|------------------------------|----------------------------------------|----------------------|
| Additions H1 2024 | OWT (feeding in) | 377 MW / 36 OWT |
| | Capacity modifications of existing OWT | 16 MW / 78 OWT |
| | Installed OWT (no feed-in) | 271 MW / 25 OWT |
| | Foundations w/o OWT | 73 Foundations |
| Cumulative 2024-06-30 | OWT (feeding in) | 8,858 MW / 1,602 OWT |
| | Installed OWT (no feed-in) | 271 MW / 25 OWT |
| | Foundations w/o OWT | 95 Foundations |

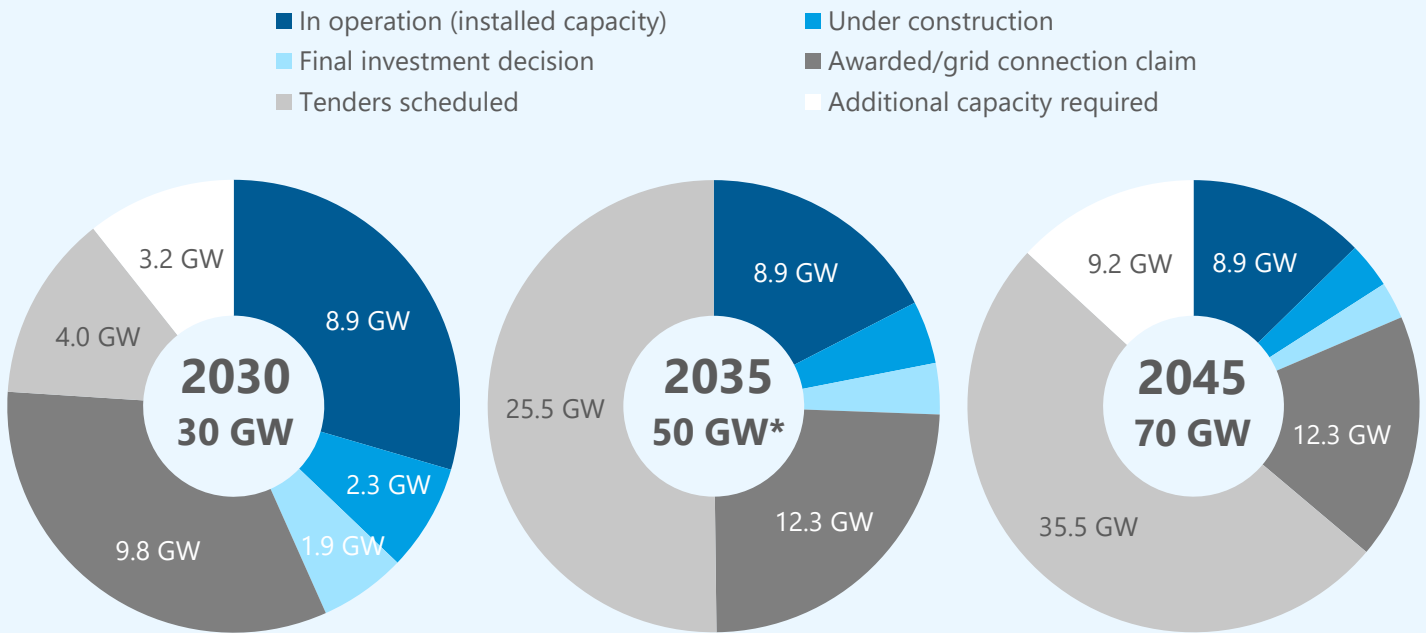


(Expected) development of the offshore wind energy capacity in Germany (Database: own surveys, MaStR, Draft FEP 2024)

Expansion Targets Offshore Wind Energy

The political expansion targets for offshore wind energy are defined in the German Offshore Wind Energy Act (German: Windenergie-auf-See-Gesetz or WindSeeG). It specifies that the installed capacity of offshore wind turbines connected to the grid is to be increased to at least 30 GW by 2030, to at least 40 GW by 2035 and to at least 70 GW by 2045. According to the current plans of the Federal Maritime and Hydrographic Agency (German: Bundesamt für Seeschifffahrt und Hydrographie or BSH), the legally specified minimum target of 40 GW by 2035 is set to be exceeded, with 50 GW to be installed by 2035. In order to achieve the expansion targets for offshore wind energy, the BSH is constantly designating new areas for future expansion in the Site Development Plan (German: Flächenentwicklungsplan or FEP). The FEP 2023 was published at

the beginning of 2023. Its update was initiated in September 2023 with the publication of the preliminary draft and continued with the publication of the draft in June 2024. The latest draft specifies timeframes for wind energy sites and grid connection systems up to 2037. As of mid-2024, it is expected that offshore wind energy projects totalling just under 27 GW will be able to feed into the grid by the end of 2030. The legally defined expansion target of 30 GW by 2030 is therefore not expected to be reached. The expansion target of 50 GW by 2035 could be achieved with the new plans included in the draft FEP 2024, if all sites are awarded and the projects are commissioned in the planned commissioning year. In order to achieve the long-term expansion target of 70 GW by 2045, further specifications of around 9 GW are required in the FEP.



* According to the WindSeeG, the installed capacity is to be increased to at least 40 GW by 2035. The current plan is to exceed the legally defined expansion target and to install 50 GW by 2035.

Development status of offshore wind energy capacity with expansion targets by 2030, 2035 and 2045 (Database: own surveys, MaStR, WindSeeG 2023, Draft FEP 2024)

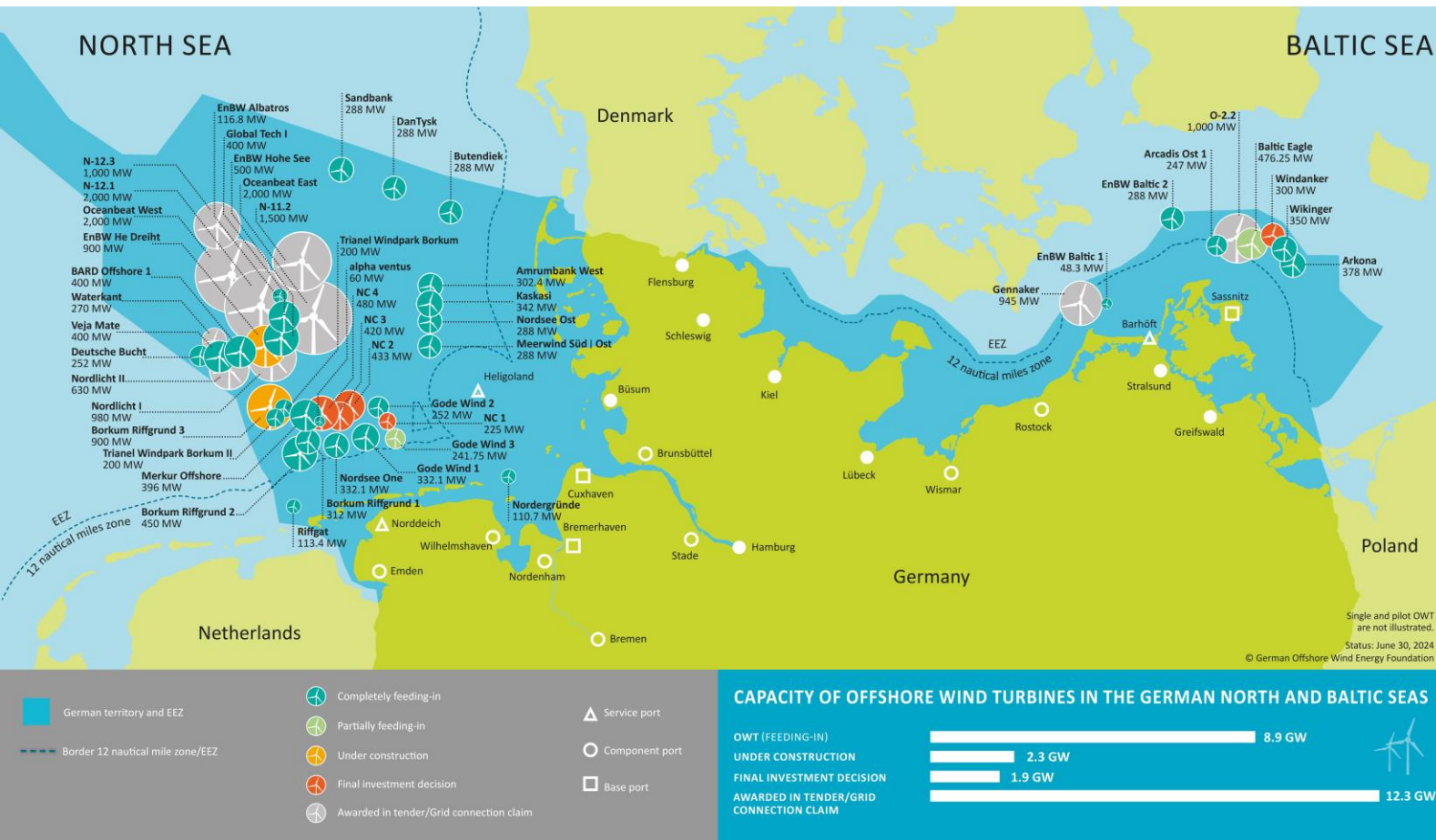
Activities in Offshore Wind Energy Projects

By mid-2024, 29 offshore wind energy projects (OWP) were fully operational in Germany. Two further projects, Gode Wind 3 and Baltic Eagle, are expected to be commissioned by the end of 2024. The foundation installations for both projects were already completed in 2023. Installation of the turbines started at the beginning of 2024 and many of these turbines have already been commissioned. The installation of the foundations for the Borkum Riffgrund 3 project began at the end of 2023, it continued in the first half of 2024 and the first turbines were installed. Installation of the first foundations for the OWP EnBW He Dreiht began in May 2024. In addition to these construction activities, in the Windanker and NC 1-4 projects the final investment decision was made in spring 2024. Further offshore wind energy projects had an award/claim for grid connection at the end of June 2024.

Overview of future offshore wind energy projects

| OWP | Status | Expected commissioning | Expected capacity* |
|-------------------------|-----------------------|------------------------|--------------------|
| Gode Wind 3 | Partially feeding-in | 2024 | 242 MW |
| Baltic Eagle | Partially feeding-in | 2024 | 476 MW |
| Borkum Riffgrund 3 | Under construction | 2025 | 900 MW |
| EnBW He Dreiht | Under construction | 2025 | 900 MW |
| Windanker | FID | 2026 | 300 MW |
| NC 1 (N-3.7) | FID | 2027 | 225 MW |
| NC 2 (N-3.8) | FID | 2027 | 433 MW |
| Nordlicht I | Awarded | 2028 | 980 MW |
| Nordlicht II | Awarded | 2028 | 630 MW |
| Gennaker | Grid connection claim | 2028 | 945 MW |
| Waterkant | Awarded | 2028 | 270 MW |
| NC 3 (N-3.5) | FID | 2029 | 420 MW |
| NC 4 (N-3.6) | FID | 2029 | 480 MW |
| Oceanbeat East (N-11.1) | Awarded | 2030 | 2,000 MW |
| N-12.1 | Awarded | 2030 | 2,000 MW |
| Oceanbeat West (N-12.2) | Awarded | 2030 | 2,000 MW |
| O-2.2 | Awarded | 2030 | 1,000 MW |
| N-11.2 | Awarded | 2031 | 1,500 MW |
| N-12.3 | Awarded | 2031 | 1,000 MW |

* grid connection capacity



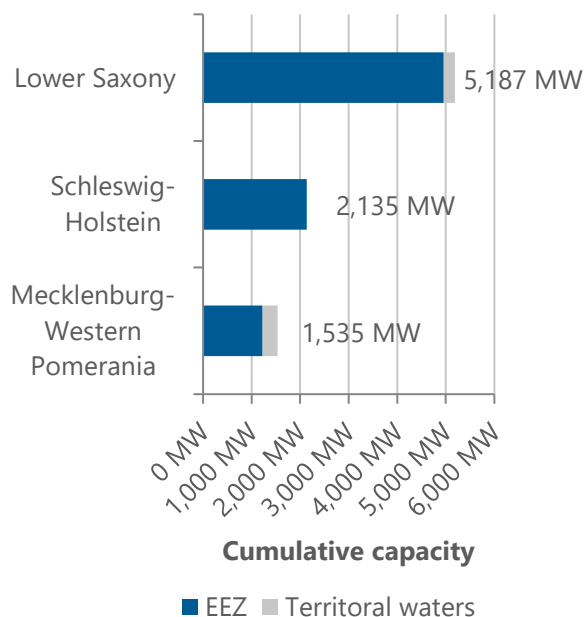
Overview map of offshore wind energy in Germany (© German Offshore Wind Energy Foundation)

Distribution across Federal States and North and Baltic Sea

As of 30 June 2024, the installed capacity of German offshore wind turbines feeding into the grid is largely located in the North Sea (7.3 GW). The Baltic Sea accounts for significantly less capacity (1.5 GW). Commissioning activities in the course of the first half of 2024 took place in both the North Sea and the Baltic Sea, but the future expansion of offshore wind energy in Germany will focus much more on the North Sea, especially the North Sea Exclusive Economic Zone (EEZ). The offshore wind turbines in the North Sea and Baltic Sea are predominantly installed in the EEZ (8.3 GW), with significantly fewer turbines installed in the territorial sea (0.5 GW).

The capacity installed at sea can be allocated to the German federal states based on the location of the respective grid connection point. Around 5.2 GW of the capacity installed in the North Sea can be allocated to Lower Saxony and 2.1 GW to Schleswig-Holstein. The installed capacity of

1.5 GW in the Baltic Sea is fully connected in Mecklenburg-Western Pomerania.



Distribution of cumulative capacity of OWT (feeding in) across the federal states and maritime areas

Distribution across the North and Baltic Sea

| | | North Sea | | Baltic Sea | |
|--------------------------|----------------------------------------|-----------|----------------|------------|----------------|
| | | Capacity | Number | Capacity | Number |
| Additions H1 2024 | OWT (feeding in) | 196 MW | 17 OWT | 181 MW | 19 OWT |
| | Capacity modifications of existing OWT | 16 MW | 78 OWT | 0 MW | 0 OWT |
| | Installed OWT (no feed-in) | 185 MW | 16 OWT | 86 MW | 9 OWT |
| | Foundations w/o OWT | | 73 Foundations | | 0 Foundations |
| Cumulative 2024-06-30 | OWT (feeding in) | 7,322 MW | 1,324 OWT | 1,535 MW | 278 OWT |
| | Installed OWT (no feed-in) | 185 MW | 16 OWT | 86 MW | 9 OWT |
| | Foundations w/o OWT | | 73 Foundations | | 22 Foundations |

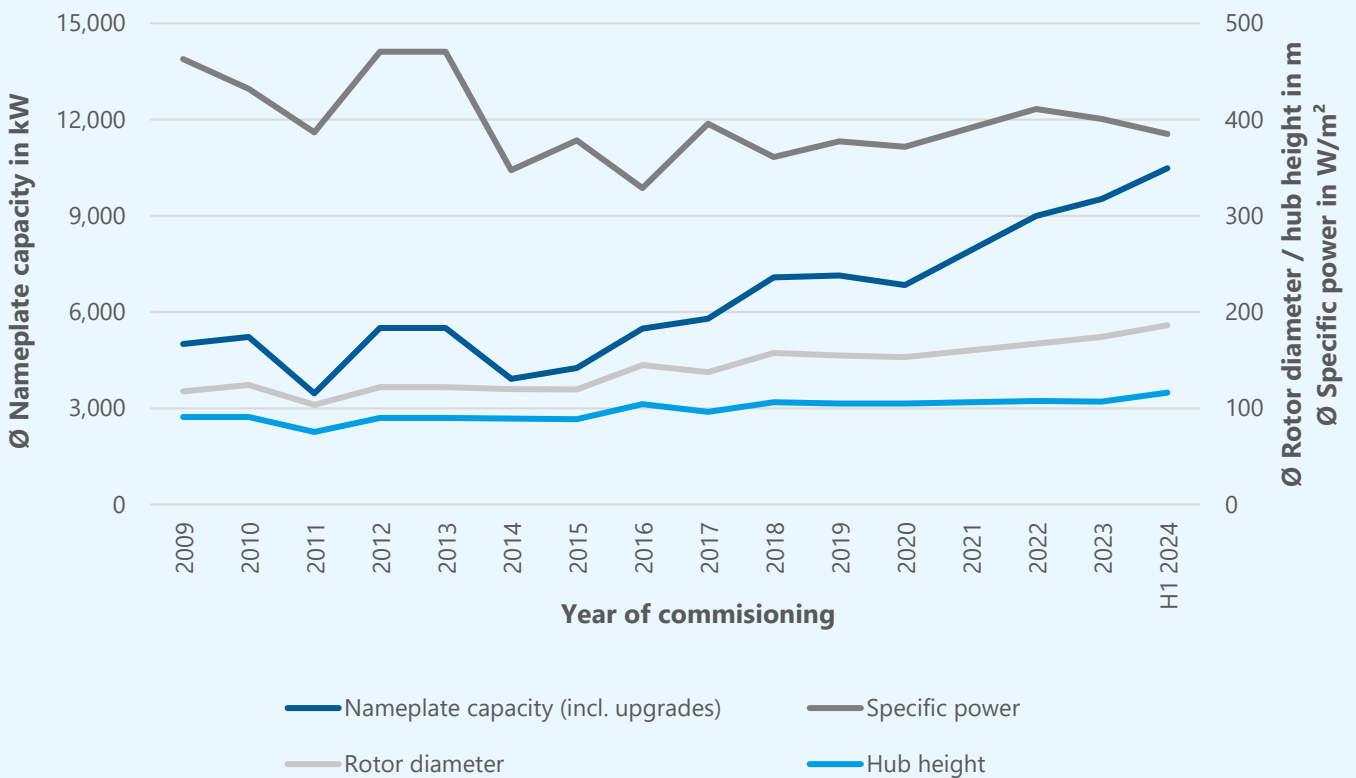
Turbine Configuration

In the first half of 2024, offshore wind turbines with an average nameplate capacity of 10.5 MW were commissioned. The average values for rotor diameter and hub height are 186 m and 116 m respectively. The turbines currently being added in the first half of 2024 are therefore significantly more powerful and larger than the existing turbines. For the entire portfolio of all turbines in operation in mid-2024, the average turbine capacity is approximately 5.5 MW, the rotor diameter is 135 m, and the hub height is 96 m. After a turbine with a capacity of 11 MW was commissioned for the first time in Germany at the beginning of 2024, the 15 MW mark is expected to be reached in 2025. The 15 MW turbines will also contribute to further significant increases compared to existing turbines in terms of rotor diameter and hub height. For future offshore wind

energy projects after 2025 offshore wind turbines with a capacity of at least 15 MW are also planned.

Average offshore wind turbine configuration

| Average Configuration | Cumulative 2024-06-30 | Additions H1 2024 |
|-------------------------------------|-----------------------|----------------------|
| Nameplate capacity (incl. upgrades) | 5,529 kW | 10,481 kW |
| Rotor diameter | 135 m | 186 m |
| Hub height | 96 m | 116 m |
| Specific power | 378 W/m ² | 385 W/m ² |



Turbine configuration over course of time

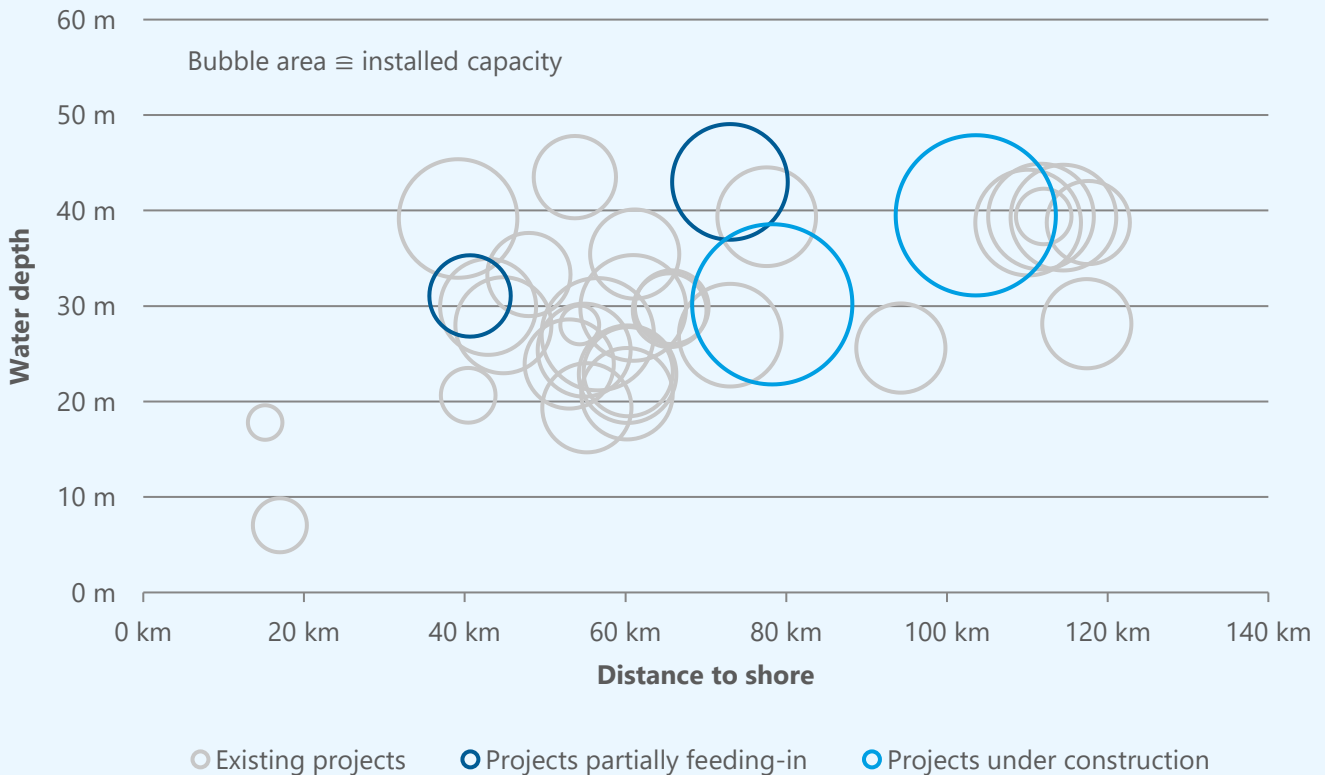
Water Depth and Distance to Shore

The majority of offshore wind energy projects off the German coast are located at least 40 km from the shore in water depths of 20 m or more; only a few projects are located in shallow waters close to the coast. Some of the projects are installed at locations in the German Exclusive Economic Zone (EEZ) with a coastal distance of over 120 km and water depths of up to 44 m. On average, the existing projects have a water depth of approximately 31 m and a distance from the coast of approximately 70 km. The two projects that achieved their first feed-ins into the grid in the first half of 2024 have a greater average water depth, but are located somewhat closer to the coast than the existing projects. The two projects that were under construction in the middle of the year are on average located significantly further out in the German EEZ with a comparable water depth to the existing projects.

In terms of foundation type, the monopile foundation has established as the most commonly used type in Germany. No other foundation type has been installed since 2019. All foundations installed in the first half of 2024 were monopiles. In parallel with the growing dimensions of the offshore wind turbines, the dimensions of monopile foundations are also continuing to increase.

Average water depth and distance to shore

| Average location | Existing projects | Projects partially feeding-in in H1 2024 | Projects under construction in H1 2024 |
|-------------------|-------------------|------------------------------------------|----------------------------------------|
| Water depth | 31 m | 39 m | 35 m |
| Distance to shore | 70 km | 62 km | 91 km |



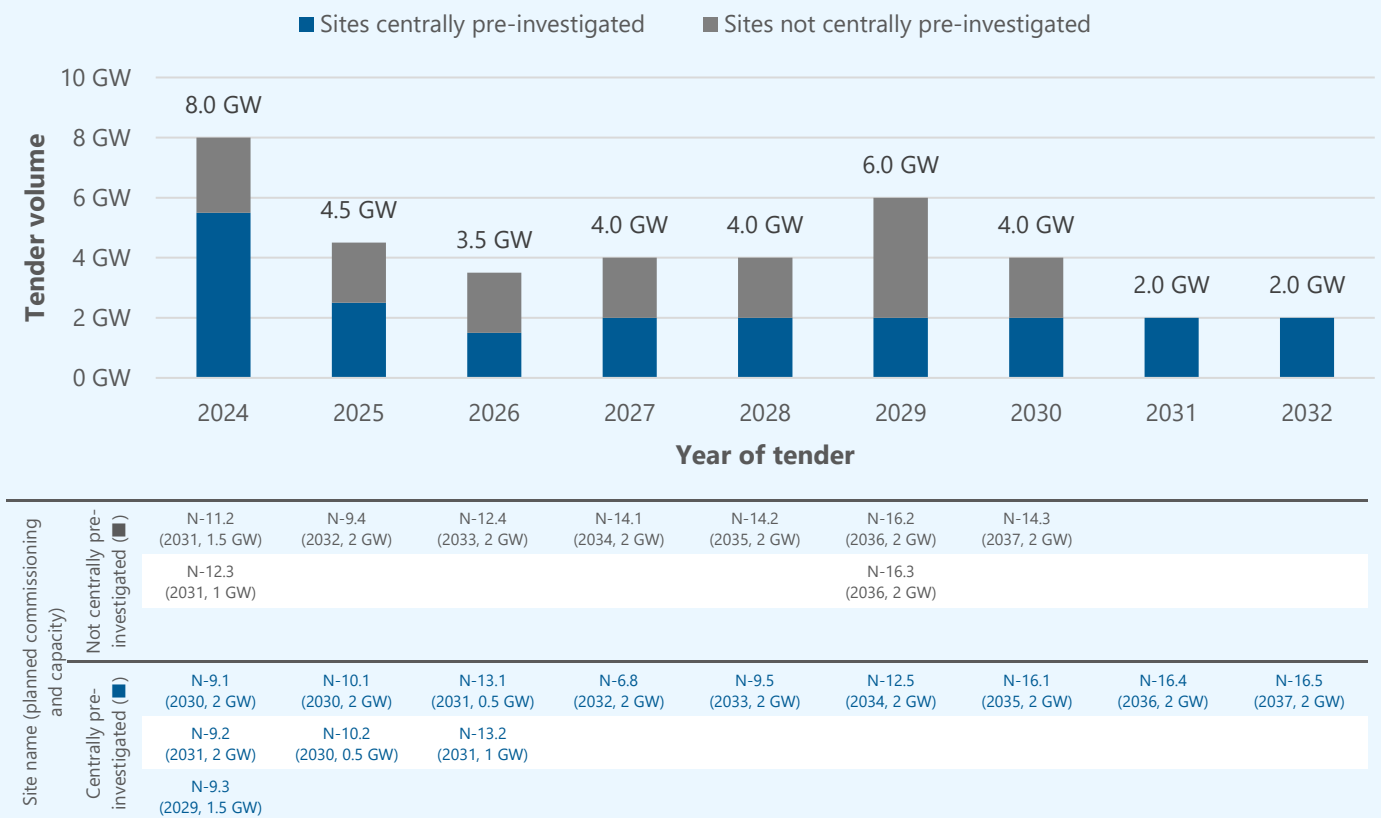
Water depth and distance to shore of existing projects, projects partially feeding-in in H1 2024 and projects under construction in H1 2024

Tenders for Offshore Wind Energy

Since 2023, in addition to the tenders for sites centrally pre-investigated by the Federal Maritime and Hydrographic Agency (German: Bundesamt für Seeschifffahrt und Hydrographie or BSH), tendering rounds have also been held for sites not centrally pre-investigated. Sites that are not centrally pre-investigated are put out to tender annually on 1st of June, while the tenders for centrally pre-investigated sites are scheduled for 1st of August each year. In the case of not centrally pre-investigated sites, the awarded bidder must subsequently organise the pre-investigation under its own responsibility. The tendering procedure differs depending on the type of site. In June 2024, the tender round for not centrally pre-investigated sites took place for the second time. Two sites in the North Sea (N-11.2 and N-12.3) with a planned capacity of 2.5 GW in total

were put out to tender. For both sites several bidders submitted 0-cent-bids, meaning that the dynamic bidding process had to be carried out as in the previous year. The bidders with the highest willingness to pay were awarded. Total Energies was awarded the right to develop site N-11.2 for €1.305 million/MW. EnBW won the award for area N-12.3 at a bid value of €1.065 million/MW. The total payments offered by the two winning bidders amount to around €3 billion.

In August 2024, the tendering round for three centrally pre-investigated sites (N-9.1, N-9.2 and N-9.3) with a total volume of 5.5 GW will take place. The centrally pre-investigated sites will be awarded on the basis of various criteria. These include financial (bid for a payment) and non-financial criteria (e.g. contribution to decarbonisation and securing skilled labour).



Offshore sites for tenders 2024 to 2032 (Database: Draft FEP 2024)

Overview of Grid Connection Capacities

In Germany, a total of 21 grid connection systems with a total capacity of approximately 9.8 GW were operational in mid-2024. Of these, 13 grid connection systems with approximately 8 GW are located in the North Sea and eight grid connection systems with approx. 1.8 GW in the Baltic Sea. Further grid connection systems in the North Sea

and Baltic Sea, which are scheduled to be commissioned by 2028, were under construction in mid-2024. Implementation of the grid connection systems in accordance with the new 2 GW standard is planned from 2029. By 2037, a total connection capacity of over 60 GW is to be available for offshore wind energy.

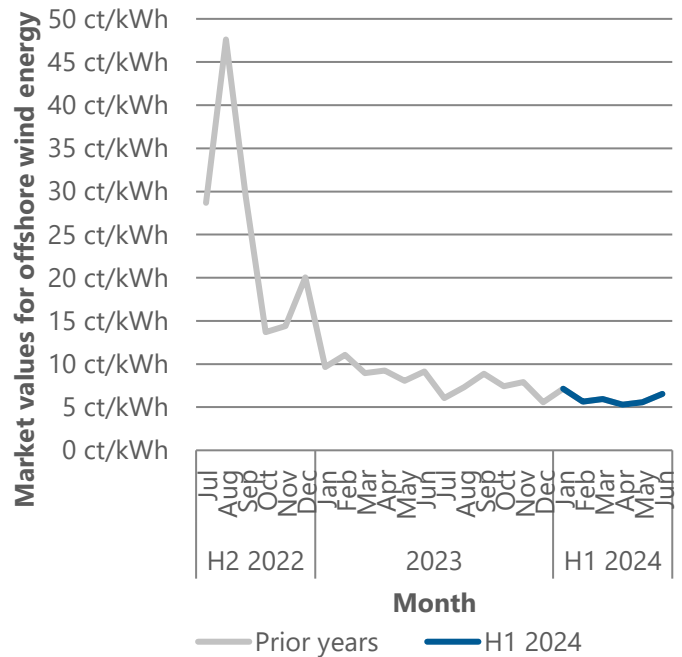
Installed and planned grid connections (to converter station or bundling point) in the North and Baltic Seas
(Database: Confirmation of Grid Development Plan Electricity 2037/2045, Draft FEP 2024, TSOs, additional research)

| Grid Connection System | Status | (Expected) Commissioning | (Expected) Capacity | (Preliminary) assigned offshore wind energy projects and sites |
|------------------------|--------------------|--------------------------|---------------------|-------------------------------------------------------------------------|
| Nordsee | | | | |
| NOR-2-1 (alpha ventus) | In Operation | 2009 | 62 MW | alpha ventus |
| NOR-6-1 (BorWin1) | In Operation | 2010 | 400 MW | BARD Offshore 1 |
| NOR-0-1 (Riffgat) | In Operation | 2014 | 113 MW | Riffgat |
| NOR-2-2 (DolWin1) | In Operation | 2015 | 800 MW | Borkum Riffgrund 1, Trianel Windpark Borkum, Trianel Windpark Borkum II |
| NOR-4-1 (HelWin1) | In Operation | 2015 | 576 MW | Meerwind Süd Ost, Nordsee Ost |
| NOR-4-2 (HelWin2) | In Operation | 2015 | 690 MW | Amrumbank West, Kaskasi |
| NOR-5-1 (SylWin1) | In Operation | 2015 | 864 MW | Butendiek, DanTysk, Sandbank |
| NOR-6-2 (BorWin2) | In Operation | 2015 | 800 MW | Deutsche Bucht, EnBW Albatros, Veja Mate |
| NOR-3-1 (DolWin2) | In Operation | 2016 | 916 MW | Gode Wind 1, Gode Wind 2, Nordsee One |
| NOR-0-2 (Nordergründe) | In Operation | 2017 | 111 MW | Nordergründe |
| NOR-2-3 (DolWin3) | In Operation | 2018 | 900 MW | Borkum Riffgrund 2, Merkur Offshore |
| NOR-8-1 (BorWin3) | In Operation | 2019 | 900 MW | EnBW Hohe See, Global Tech I |
| NOR-3-3 (DolWin6) | In Operation | 2023 | 900 MW | Gode Wind 3, NC 1, NC 2 |
| NOR-1-1 (DolWin5) | Under Construction | 2025 | 900 MW | Borkum Riffgrund 3 |
| NOR-7-1 (BorWin5) | Under Construction | 2025 | 900 MW | EnBW He Dreih |
| NOR-7-2 (BorWin6) | Under Construction | 2027 | 980 MW | Nordlicht I |
| NOR-3-2 (DolWin4) | Under Construction | 2028 | 900 MW | NC 3, NC 4 |
| NOR-6-3 (BorWin4) | Under Construction | 2028 | 900 MW | Nordlicht II, Waterkant |
| NOR-9-3 (BalWin4) | Planned | 2029 | 2,000 MW | N-9.3, N-10.2 |
| NOR-9-1 (BalWin1) | Planned | 2030 | 2,000 MW | N-9.1 |
| NOR-11-1 (LanWin3) | Planned | 2030 | 2,000 MW | Oceanbeat East |
| NOR-12-1 (LanWin1) | Planned | 2030 | 2,000 MW | N-12.1 |
| NOR-12-2 (LanWin2) | Planned | 2030 | 2,000 MW | Oceanbeat West |
| NOR-9-2 (BalWin3) | Planned | 2031 | 2,000 MW | N-9.2 |
| NOR-10-1 (BalWin2) | Planned | 2031 | 2,000 MW | N-10.1 |
| NOR-11-2 (LanWin4) | Planned | 2031 | 2,000 MW | N-11.2, N-13-1 |
| NOR-13-1 (LanWin5) | Planned | 2031 | 2,000 MW | N-12.3, N-13.2 |
| NOR-6-4 (BorWin7) | Planned | 2032 | 2,000 MW | N-6.8 |
| NOR-9-4 | Planned | 2032 | 2,000 MW | N-9.4 |
| NOR-9-5 | Planned | 2033 | 2,000 MW | N-9.5 |
| NOR-12-3 | Planned | 2033 | 2,000 MW | N-12.4 |
| NOR-12-4 | Planned | 2034 | 2,000 MW | N-12.5 |
| NOR-14-1 | Planned | 2034 | 2,000 MW | N-14.1 |
| NOR-14-2 | Planned | 2035 | 2,000 MW | N-14.2 |
| NOR-16-1 | Planned | 2035 | 2,000 MW | N-16.1 |
| NOR-16-2 | Planned | 2036 | 2,000 MW | N-16.2 |
| NOR-16-3 | Planned | 2036 | 2,000 MW | N-16.3 |
| NOR-16-4 | Planned | 2036 | 2,000 MW | N-16.4 |
| NOR-14-3 | Planned | 2037 | 2,000 MW | N-14.3 |
| NOR-16-5 | Planned | 2037 | 2,000 MW | N-16.5 |
| Ostsee | | | | |
| OST-3-1 (Baltic 1) | In Operation | 2011 | 51 MW | EnBW Baltic 1 |
| OST-3-2 (Baltic 2) | In Operation | 2015 | 288 MW | EnBW Baltic 2 |
| OST-1-1 (Ostwind 1) | In Operation | 2018 | 250 MW | Wikinger |
| OST-1-2 (Ostwind 1) | In Operation | 2019 | 250 MW | Arkona |
| OST-1-3 (Ostwind 1) | In Operation | 2019 | 250 MW | Arkona, Wikinger |
| OST-2-1 (Ostwind 2) | In Operation | 2023 | 250 MW | Arcadis Ost 1 |
| OST-2-2 (Ostwind 2) | In Operation | 2024 | 250 MW | Baltic Eagle |
| OST-2-3 (Ostwind 2) | In Operation | 2024 | 250 MW | Baltic Eagle |
| OST-1-4 (Ostwind 3) | Under Construction | 2026 | 300 MW | Windanker |
| OST-6-1 (Gennaker) | Planned | | ca. 900 MW | Gennaker |
| OST-2-4 (Ostwind 4) | Planned | 2030 | 2,000 MW | O-2.2 |
| OST-T-1 (Test field) | | | 300 MW | Test field |

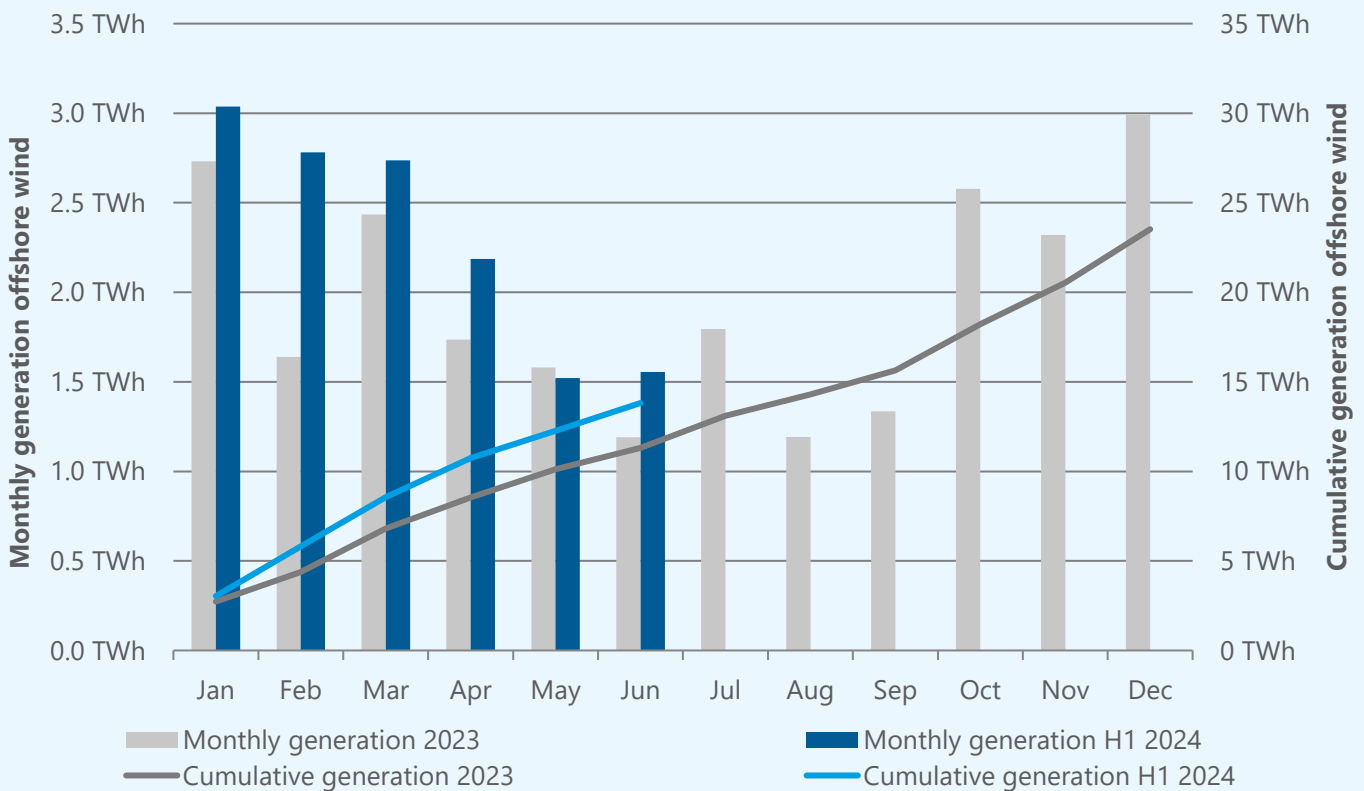
Power Generation and Market Values

The monthly market values for electricity from offshore wind energy remained at a stable level over the course of the first half of 2024, ranging from a maximum of 7.14 ct/kWh (January 2024) to a minimum of 5.29 ct/kWh (April 2024). The volume-weighted average monthly market value was 6.07 ct/kWh. Overall, the monthly market values in the first half of 2024 were at a lower level than in the previous year.

Offshore wind energy generated a total of 13.8 TWh of electricity in the first six months of 2024. The highest generation of just over 3 TWh was achieved in January and the lowest generation of 1.5 TWh was recorded in May. Overall, electricity generation was at a higher level than in the same period of the previous year. Offshore wind energy accounted for 6.3% of German electricity generation in the first half of 2024.



Monthly market values for offshore wind energy (Database: Netztransparenz)



Power generation offshore wind (Database: Bundesnetzagentur | SMARD.de)

About Deutsche WindGuard

In the complex energy market, Deutsche WindGuard is committed to providing unbiased, manufacturer-independent consulting and comprehensive scientific, technical and operational services.

About the German Windenergy Association (BWE)

The German Wind Energy Association (BWE) is a partner to more than 3.000 companies in the wind industry sector and represents the interests of its approximately 17.000 members. BWE pools the combined know-how of a diverse industry sector.

About the German Offshore Wind Energy Association (BWO)

The aim of the BWO is to represent the political interests of the offshore wind industry in Germany. The BWO acts as central point of contact for politicians and authorities at federal and state level for all questions relating to offshore wind energy.

About the German Offshore Wind Energy Foundation

The non-profit organization's overall purpose is to consolidate the role of offshore wind energy in the energy mix of the future in Germany and Europe and to promote its expansion in the interests of environmental and climate protection. Since 2005, it has been established as a non-partisan, supra-regional and cross-sector think tank as well as an independent communication platform for the entire offshore wind energy industry.

About VDMA Power Systems

VDMA Power Systems is the association for the power plant engineering. It represents the interests of manufacturers and suppliers of electricity and heat generation systems in Germany and abroad. These include wind energy, photovoltaic and hydropower plants, engines and thermal power plants as well as storage and sector coupling technologies.

About WAB e.V.

The WAB is the nationwide contact for the offshore wind industry, the onshore network in the Northwest and promotes the production of green hydrogen from wind power. Wind Industry and Hydrogen Association WAB e.V. includes around 250 smaller and larger companies as well as institutes from all areas of the wind industry, the maritime industry, the emerging hydrogen economy and science.

About WindEnergy Network e.V. (WEN)

The WEN is the leading company network for wind energy in the northeast region with currently 106 member companies. The aim is to promote the expansion of companies and supply chains in order to enhance regional value creation in the future sector renewable energies. The key topics are windenergy on- and offshore, maritime technologies in connection with offshore wind as well as the development of green hydrogen.