

# Status of Offshore Wind Energy Development in Germany

## First Half of 2022



On behalf of



## Contents

Offshore Wind Energy Development.....	3
Expansion Targets Offshore Wind Energy .....	4
Activities in Offshore Wind Energy Projects.....	5
Distribution across Federal States and North and Baltic Seas .....	6
Turbine Configuration .....	7
Water Depth and Distance to Shore .....	8
Tenders for Offshore Wind Energy .....	9
Overview of Grid Connection Capacities.....	10
Power Generation and Market Values.....	11

## Notes

The data was obtained through surveys with industry representatives as well as through additional research (sources e.g. BNetzA and BSH). 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 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

Installation of foundations at RWE's OWP Kaskasi

© RWE AG | Matthias Ibeler

## Contact

Deutsche WindGuard GmbH

Oldenburger Straße 65

26316 Varel, Germany

Phone +49-4451 9515 0

Fax +49-4451 9515 29

Email [info@windguard.de](mailto:info@windguard.de)

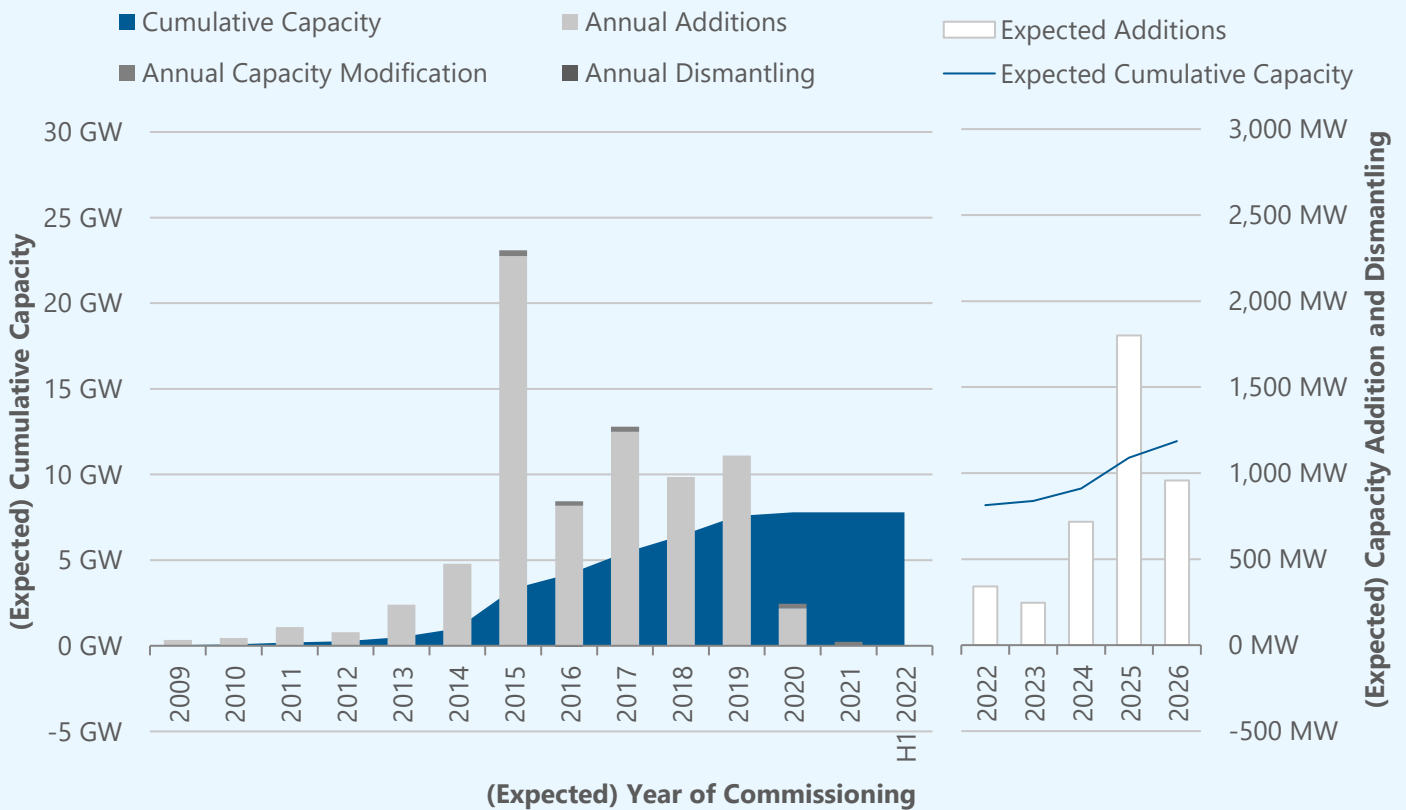
URL <http://www.windguard.com/>

# Offshore Wind Energy Development

As of June 30, 2022, 1,501 offshore wind turbines (OWT) with a capacity of 7.8 GW were in operation in Germany. During the first half of 2022, construction activities started in two offshore wind energy projects (OWP) in the German North Sea and Baltic Sea, and foundations for new turbines were installed for the first time since 2019. The latest works offshore mark the start of the implementation phase of the projects, which were awarded in the tender rounds of the transitional system in 2017/2018 and are scheduled to be commissioned by the end of 2025. In addition, in the first tender round in the central model in 2021, further projects were awarded to be commissioned in 2026, so that if these projects are fully implemented, the total installed capacity can be increased to almost 12 GW by the end of 2026.

Status of the Offshore Wind Energy Development

		Capacity	Number
Additions H1 2022	OWT (feeding in)	0 MW	0 OWT
	Installed OWT (no feed-in)	0 MW	0 OWT
	Foundations w/o OWT		24 Foundations
Cumulative 2022-06-30	OWT (feeding in)	7,794 MW	1,501 OWT
	Installed OWT (no feed-in)	0 MW	0 OWT
	Foundations w/o OWT		24 Foundations



(Expected) Development of the Offshore Wind Energy in Germany  
(Database: own surveys, MaStR, BNetzA)

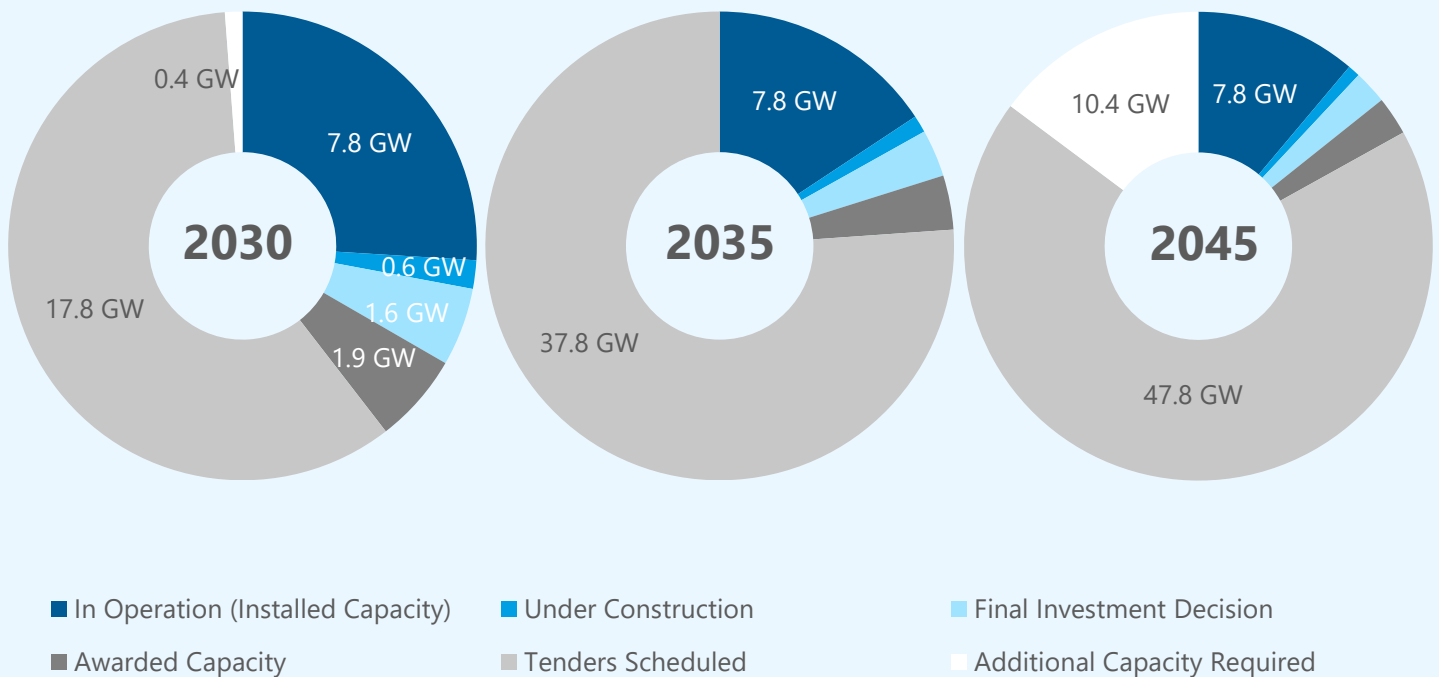
## Expansion Targets Offshore Wind Energy

The increase in the expansion targets for offshore wind energy in accordance with the coalition agreement of December 2021 was legally anchored in the amendment to the Offshore Wind Energy Act (German: Windenergie-auf-See-Gesetz or WindSeeG) in mid-2022. The new targets provide for the installed capacity of offshore wind turbines connected to the grid to be raised to a total of at least 30 GW by 2030, 40 GW by 2035 and 70 GW by 2045.

As of 30 June, 2022, the installed capacity of offshore wind energy projects in operation was 7.8 GW. Projects with a total capacity of 0.6 GW were under construction. In addition, a final investment decision had already been made for several projects with a total capacity of 1.6 GW by the end of the first half of 2022. Further projects with a total capacity of 1.9 GW had been awarded in the tenders for offshore wind energy, but they have not yet reached a final investment decision.

In mid-2022, the Federal Maritime and Hydrographic Agency (German: Bundesamt für Seeschifffahrt und Hydrographie or BSH) published further areas in the draft of the updated Site Development Plan (German: Flächenentwicklungsplan or FEP), on which a total capacity of 17.8 GW can be realised by 2030. According to these plans, the expansion target of 30 GW by 2030 could just be reached. Additional capacity could also result from the realisation of the OWP Gennaker with almost 1 GW in the territorial waters of the Baltic Sea.

The draft of the updated Site Development Plan further provides for the development of areas with a total capacity of 30 GW, which are scheduled to be commissioned between the years 2031 and 2038. Thus, the 40 GW target could already be reached before 2035. For the long-term target of 70 GW by 2045, further areas would have to be defined.



Development Status of Offshore Capacity with Expansion Targets by 2030, 2035 and 2045  
(Database: own surveys, MaStR, BNetzA, Draft FEP)

# Activities in Offshore Wind Energy Projects

At mid-year 2022, 27 offshore wind energy projects were fully operational in Germany. Two further projects were under construction: Construction activities at sea began in the first half of 2022 for the projects Kaskasi and Arcadis Ost 1. At the OWP Kaskasi, the substation and a major share of the foundations have already been installed. The erection and commissioning of all turbines is planned for the second half of the year. The substation at the OWP Arcadis Ost 1 has also been installed, and full commissioning of the project is scheduled for the first half of 2023. In the OWP Baltic Eagle, construction is expected to start in the second half of 2022, in the Gode Wind 3 and Borkum Riffgrund 3 projects in 2023 and in the EnBW He Dreih project in 2024. The projects awarded in the 2021 tender round (N-3.7, Nordsee Two and Windanker) are still in the early stages of project development.

In addition to the projects of the tender system, two further projects are planned in the coastal waters of the Baltic Sea: the OWP Gennaker (927 MW) and a test field near Warnemünde.

## Overview of awarded projects

OWP	Status	Expected Commissioning	Capacity**
Kaskasi*	Under Construction	2022	342 MW
Arcadis Ost 1	Under Construction	2023	247 MW
Baltic Eagle	FID	2024	476.25 MW
Gode Wind 3	FID	2024	241.75 MW
Borkum Riffgrund 3	FID	2025	900 MW
EnBW He Dreih	Awarded	2025	900 MW
N-3.7	Awarded	2026	225 MW
Nordsee Two	Awarded	2026	433 MW
Windanker	Awarded	2026	300 MW

\* incl. pilot OWT

\*\* grid connection capacity

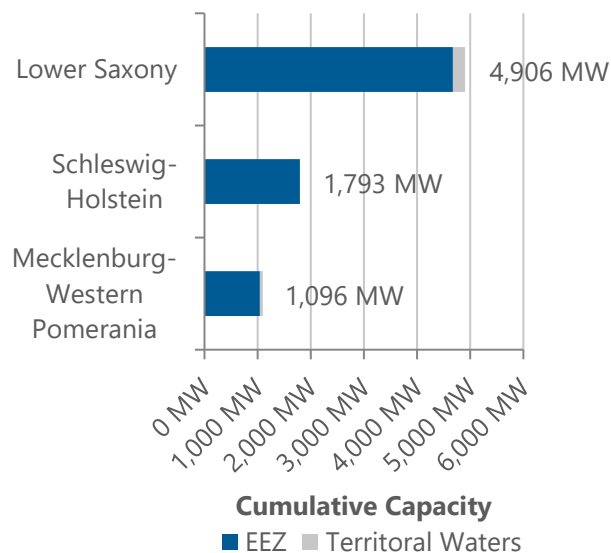


Overview Map of Offshore Wind Energy in Germany (© German Offshore Wind Energy Foundation)

## Distribution across Federal States and North and Baltic Seas

The majority of the installed capacity of offshore wind turbines feeding into the grid in Germany, 6.7 GW, is located in the North Sea, with only 1.1 GW in the Baltic Sea. Based on the location of the respective grid connection point, the offshore installed capacity can be allocated to the federal states. The installed capacity in the North Sea is distributed among Lower Saxony (4.9 GW) and among Schleswig-Holstein (1.8 GW). The 1.1 GW of installed capacity in the Baltic Sea is entirely assigned to Mecklenburg-Western Pomerania. With regard to the distribution of installed capacity between the Exclusive Economic Zone (EEZ; German: Ausschließliche Wirtschaftszone or AWZ) and the territorial waters, the share installed in the EEZ (7.5 GW) clearly exceeds that in the territorial waters (0.3 GW). The projects tendered in the previous tender rounds, which are scheduled to be commissioned by 2026, account for approx. 3 GW in the North

Sea and 1 GW in the Baltic Sea. Most of the areas to be tendered in the future and commissioned by 2030 are also located in the North Sea.



Distribution of Cumulative Capacity of OWT (feeding in) across the Federal States and Maritime Areas

### Distribution across the North and Baltic Seas

		North Sea		Baltic Sea	
		Capacity	Number	Capacity	Number
Additions H1 2022	OWT (feeding in)	0 MW	0 OWT	0 MW	0 OWT
	Installed OWT (no feed-in)	0 MW	0 OWT	0 MW	0 OWT
	Foundations w/o OWT		24 Foundations		No Foundations
Cumulative 2022-06-30	OWT (feeding in)	6,698 MW	1,269 OWT	1,096 MW	232 OWT
	Installed OWT (no feed-in)	0 MW	0 OWT	0 MW	0 OWT
	Foundations w/o OWT		24 Foundations		No Foundations
Future Additions	Already awarded capacity* (Commissioning by 2026)	3,042 MW		1,023 MW	
	Capacity to be tendered until 2025 (Commissioning by 2030)**	16,780 MW		1,000 MW	

\* incl. pilot OWT  
\*\* according to Draft FEP

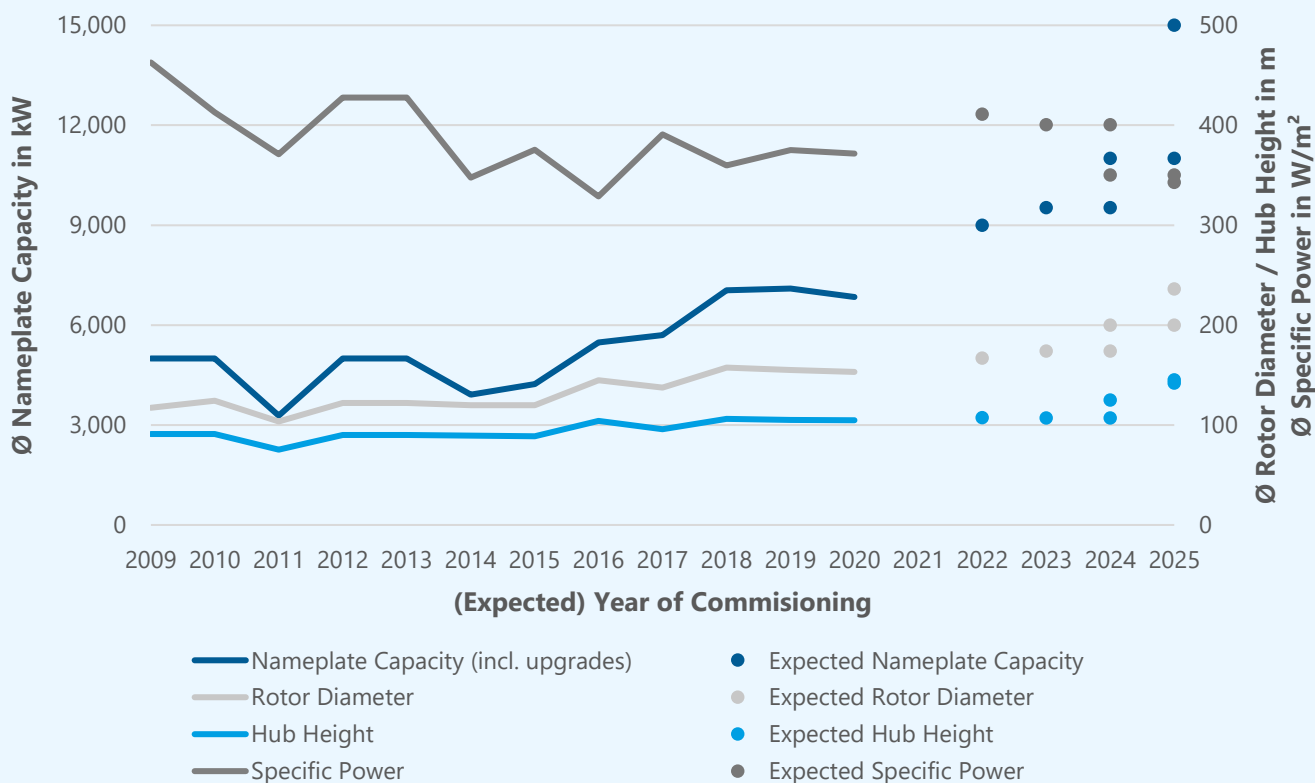
## Turbine Configuration

The configuration of offshore wind turbines in Germany has developed steadily over the past two decades. On average, the offshore wind turbines in operation by mid-2022 have a nameplate capacity of just under 5.2 MW. In recent years, increasingly powerful turbines have been installed. In the projects that will be commissioned between the end of 2022 and 2025, turbine types with significantly higher nominal capacities are planned. The expected capacity range from 9 MW to 15 MW. This results in an average nameplate capacity of more than 11 MW for the new turbines until 2025. The current plans for future projects by 2025 also provide for significant increases in rotor diameter and hub height compared to the existing turbines. According to the plans, rotor diameter and hub height will be between 167 m and 236 m (rotor diameter) and between 107 m and 145 m

(hub height), depending on the project. The specific power (ratio of turbine capacity to rotor area) remains at a level comparable to previous years and will range between 340 W/m<sup>2</sup> and 410 W/m<sup>2</sup> in the future projects until 2025.

### Average Turbine Configuration

Average Configuration	Cumulative 2022-06-30	Expected additions until 2025
Nameplate Capacity (incl. upgrades)	5,192 kW	11,233 kW
Rotor Diameter	133 m	197 m
Hub Height	95 m	127 m
Specific Power	372 W/m <sup>2</sup>	370 W/m <sup>2</sup>



(Expected\*) Turbine Configuration over Course of Time

\* Illustration of expected turbine configuration by project and year of commissioning

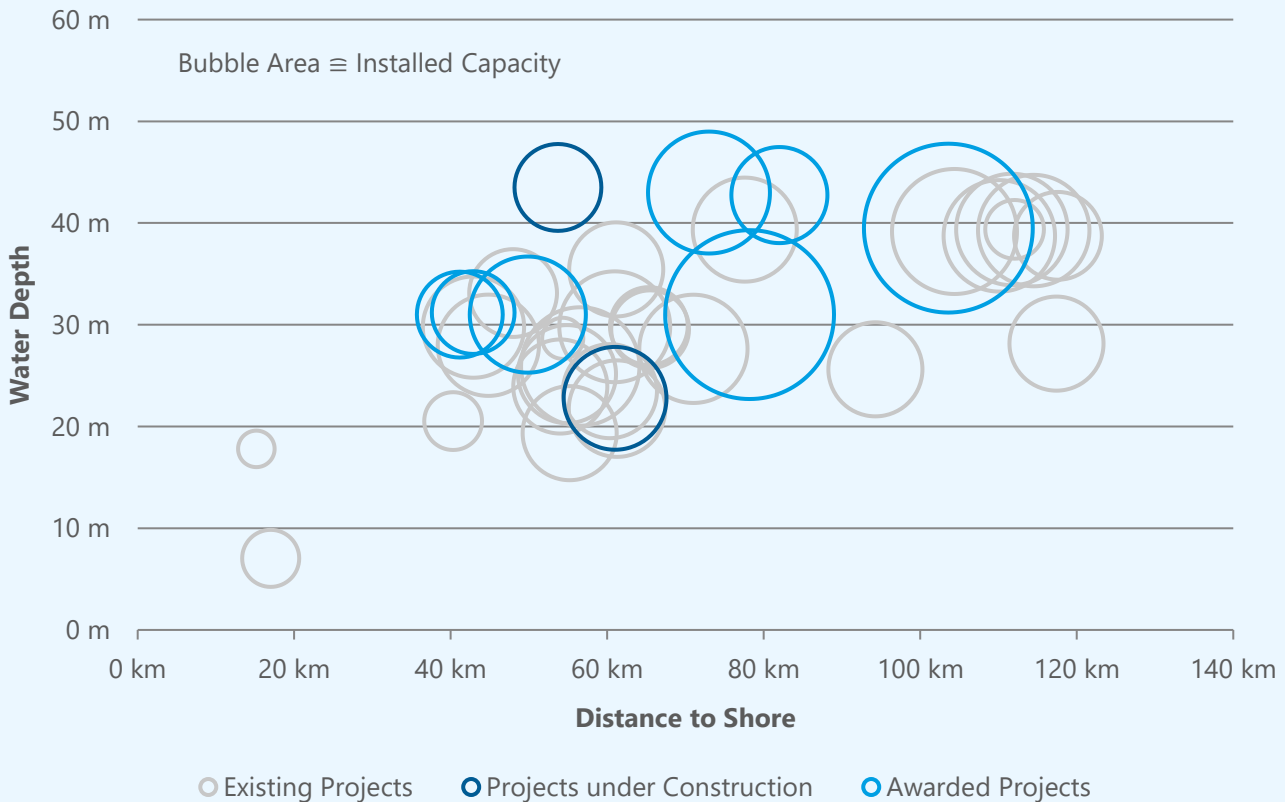
## Water Depth and Distance to Shore

German waters provide different conditions in terms of water depths and distances to the shore for the development of offshore wind energy. Only a few of the offshore wind turbines installed in Germany are located in shallow waters close to the coast; the majority of turbines are located at least 40 km off the coast in water depths of 20 m and more. Some of the turbines are installed at locations with a distance to the shore of more than 120 km and water depths of up to 44 m. On average, the installed turbines have a water depth of 30 m and a distance to the shore of 74 km. The two projects under construction have a similar average water depth but are located slightly closer to the shore. The awarded projects that are to be realised in the years up to 2026 are also distributed at locations with different conditions. On average, however, their water depth and distance to shore do not differ much from those of the existing turbines.

With regard to the type of foundation, the monopile foundation has become the most commonly used type in Germany. All of the foundations installed during the first half of 2022 were monopiles, and only monopile foundations and no other foundation types have been announced for the future projects that are to be commissioned by 2025.

Average Water Depth and Distance to Shore

Average Location	Water Depth	Distance to Shore
Existing Projects	30 m	74 km
Projects under Construction	31 m	58 km
Awarded Projects	36 m	76 km



Water Depth and Distance to Shore of Existing Projects, Projects under Construction and Awarded Projects



## Tenders for Offshore Wind Energy

After the first tender round in the central model for the areas N-3.7, N-3.8 and O-1.3 in September 2021, the Federal Network Agency (German: Bundesnetzagentur or BNetzA) launched the second round in the central model at the end of February 2022. The pre-investigated area N-7.2 in the North Sea with 980 MW was put out to tender. A maximum bid value of 6.4 ct/kWh applies and bids must be submitted by September 1, 2022. The bidder with the lowest bid value will be awarded, but there is a right of entry for a company that had already planned a project on this area before the introduction of the tender system.

The preliminary investigations and the determination of suitability for areas N-3.5 and N-3.6 have already been completed, and they are due to be put out to tender in 2023. N-6.6 and N-6.7 are still being investigated and a draft of the suitability determination has already been published.

The amendment to the WindSeeG provides for changes to the tender system in the future. In order to achieve the increased expansion targets, areas that have not been centrally pre-investigated will also be tendered in addition to the areas that have been centrally pre-investigated by the BSH. The award procedure differs depending on the area. The centrally pre-investigated areas are to 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 qualified employees). For areas that have not been centrally pre-investigated, the current award procedure will be supplemented by a dynamic regulation in the case of several 0-cent bids; the lottery procedure will be cancelled.

In addition, an award procedure for an area for other offshore energy production is to be carried out for the first time in 2022.

### Envisioned Offshore Areas for Tenders until 2026 (Database: Draft FEP)

Area	Tender Round	Expected Commissioning	Expected Capacity	Size of Area	Preliminary Investigation	Status
N-7.2	2022	2027	980 MW	ca. 58 km <sup>2</sup>	central	Currently being tendered Deadline 01.09.2022
N-3.5	2023	2028	420 MW	ca. 29 km <sup>2</sup>	central	Suitability determined (2. WindSeeV)
N-3.6	2023	2028	480 MW	ca. 33 km <sup>2</sup>	central	Suitability determined (2. WindSeeV)
N-6.6	2023	2028	630 MW	ca. 44 km <sup>2</sup>	central	Ongoing (Draft 3. WindSeeV)
N-6.7	2023	2028	270 MW	ca. 16 km <sup>2</sup>	central	Ongoing (Draft 3. WindSeeV)
N-11.1	2023	2030	2,000 MW	ca. 192 km <sup>2</sup>	not central	
N-12.1	2023	2030	2,000 MW	ca. 193 km <sup>2</sup>	not central	
N-12.2	2023	2030	2,000 MW	ca. 187 km <sup>2</sup>	not central	
O-2.2	2023	2030	1,000 MW	ca. 92 km <sup>2</sup>	not central	
N-9.1	2024	2029	2,000 MW	ca. 158 km <sup>2</sup>	central	
N-9.2	2024	2029	2,000 MW	ca. 157 km <sup>2</sup>	central	
N-9.3	2024	2029	1,500 MW	ca. 106 km <sup>2</sup>	central	
N-11.2	2024	2031	1,500 MW	ca. 148 km <sup>2</sup>	not central	
N-12.3	2024	2031	1,000 MW	ca. 80 km <sup>2</sup>	not central	
N-10.1	2025	2030	2,000 MW	ca. 148 km <sup>2</sup>	central	
N-10.2	2025	2030	500 MW	ca. 31 km <sup>2</sup>	central	
N-13.1	2026	2031	500 MW	ca. 50 km <sup>2</sup>	central	
N-13.2	2026	2031	1,000 MW	ca. 92 km <sup>2</sup>	central	
SEN-1	2022			ca. 28 km <sup>2</sup>		

## Overview of Grid Connection Capacities

In Germany, grid connections for offshore wind energy with a capacity of 8.2 GW were in operation at the end of the first half of 2022. The majority of the connection capacity is already being used by the projects feeding into the grid. Further capacities are under construction or in

planning. Furthermore, additional connections with planned commissioning from 2032 onwards are listed in the draft of the Site Development Plan; these must be identified in the next Grid Development Plan and confirmed by the Federal Network Agency.

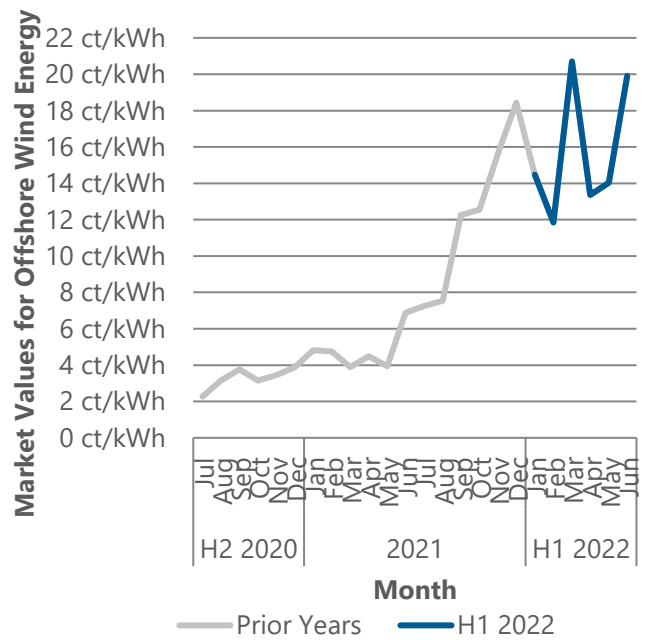
### Installed and Planned Grid Connections (to Converter Station or Bundling Point) in the North and Baltic Seas (Database: Draft FEP, TSOs, additional research)

Grid Connection System	Status	(Expected) Commissioning	(Expected) Capacity	(Preliminary) Assigned Offshore Wind Energy Projects and Areas
<b>North Sea</b>				
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 incl. Pilotanlagen
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)	Under Construction	2023	900 MW	Gode Wind 3, N-3.7, Nordsee Two
NOR-1-1 (DolWin5)	Under Construction	2025	900 MW	Borkum Riffgrund 3
NOR-7-1 (BorWin5)	Under Construction	2025	900 MW	EnBW He Dreiht
NOR-7-2 (BorWin6)	Under Construction	2027	980 MW	N-7.2
NOR-3-2 (DolWin4)	Approval Procedure	2028	900 MW	N-3.5, N-3.6
NOR-6-3 (BorWin4)	Approval Procedure	2028	900 MW	N-6.6, N-6.7
NOR-9-1	Planned	2029	2,000 MW	N-9.1
NOR-9-2	Planned	2029	2,000 MW	N-9.2
NOR-9-3	Planned	2029	2,000 MW	N-9.3, N-10.2
NOR-10-1	Planned	2030	2,000 MW	N-10.1
NOR-11-1	Planned	2030	2,000 MW	N-11.1
NOR-12-2	Planned	2030	2,000 MW	N-12.2
NOR-12-1	Planned	2030	2,000 MW	N-12.1
NOR-11-2	Planned	2031	2,000 MW	N-11.2, N-13-1
NOR-13-1	Planned	2031	2,000 MW	N-12.3, N-13.2
<b>Baltic Sea</b>				
OST-3-1 (Kriegers Flak)	In Operation	2011	51 MW	EnBW Baltic1, GICON-SOF
OST-3-2 (Kriegers Flak)	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)	Under Construction	2023	250 MW	Arcadis Ost 1
OST-2-2 (Ostwind 2)	Under Construction	2023	250 MW	Baltic Eagle
OST-2-3 (Ostwind 2)	Under Construction	2024	250 MW	Baltic Eagle
OST-1-4 (Ostwind 3)	Approval Procedure	2026	300 MW	Windanker
OST-2-4	Planned	2030	1,000 MW	O-2.2
OST-T-1 (Testfeld)	Planned			
OST-6-1 ("Gennaker")	Realisation in accordance with § 17d EnWG			Gennaker

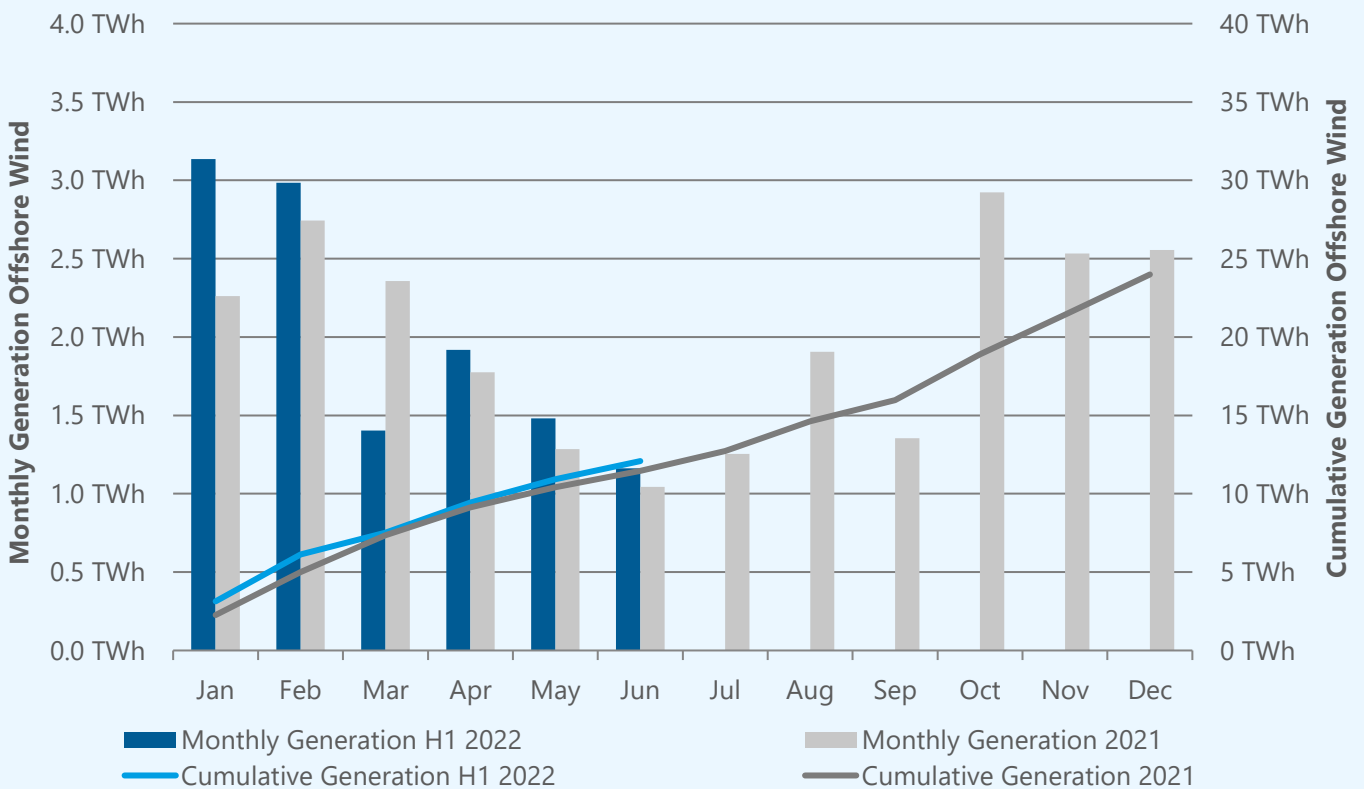
## Power Generation and Market Values

In the first half of 2022, energy prices were particularly influenced by the war in Ukraine. The market values for electricity from offshore wind energy again reached record levels in the course of the first half of 2022. In March 2022, the highest value to date was achieved at 20.7 ct/kWh - this is many times higher than the values achieved in the period between July 2020 and June 2021. On average, the volume-weighted monthly market value of the first half of 2022, at 14.74 ct/kWh, is 63% higher than the average value for 2021.

Power generation by offshore wind turbines in the first half of 2022 slightly exceeded that of the first half of 2021. 12.1 TWh were generated, approx. 5% more than in the first half of the previous year. During the first half of 2022, power generation was higher than in 2021 in all months except from March 2022.



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 Windenergy Association (BWE) is partner to over 3,000 companies in the wind energy industry and represents the interests of about 20,000 members. The entire know-how of a multifaceted industry is pooled through BWE.

### **About Bundesverband der Windparkbetreiber Offshore e.V. (BWO)**

The association of German offshore wind farm operators (BWO) represents all companies that plan, construct and operate offshore wind farms in Germany. The BWO is the central contact on all questions concerning offshore wind energy.

### **About the German Foundation OFFSHORE WIND ENERGY**

The foundation'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. It has established itself as a non-partisan, supra-regional and independent communication platform for the entire offshore wind energy sector.

### **About VDMA Power Systems**

The trade association VDMA Power Systems and its working groups represent the interests of manufacturers and suppliers of power and heat generation plants.

### **About WAB e.V.**

Bremerhaven-based WAB is the nationwide contact partner for the offshore wind industry in Germany and the leading business network for onshore wind energy in the north-west region. The association fosters the production of "green" hydrogen from wind energy. It comprises some 250 SMEs as well as institutes from all sectors of the wind and maritime industry as well as research.