DEUTSCHE WINDGUARD

Status of Offshore Wind Energy Development in Germany

First Half of 2020

On behalf of

BWE Bundesverband WindEnergie

BWO Bundesverband der Windparkbetreiber Offshore e.V.

STIFTUNG OFFSHORE WINDENERGIE

VDMA Power Systems

wab

Contents

Notes

The data was obtained through surveys with industry representatives, as well as additional research (e.g. BNetzA and BSH). Retroactive adjustments to the data are done based on data corrections by the project developer.

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.

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

Photo on Title Page

Trianel Windpark Borkum II

Kontakt

Deutsche WindGuard GmbH
Oldenburger Straße 65
26316 Varel, Germany
Phone +49-4451 9515 0
Fax +49-4451 9515 29
Email info@windguard.de
URL http://www.windguard.com/

Offshore Wind Energy Development

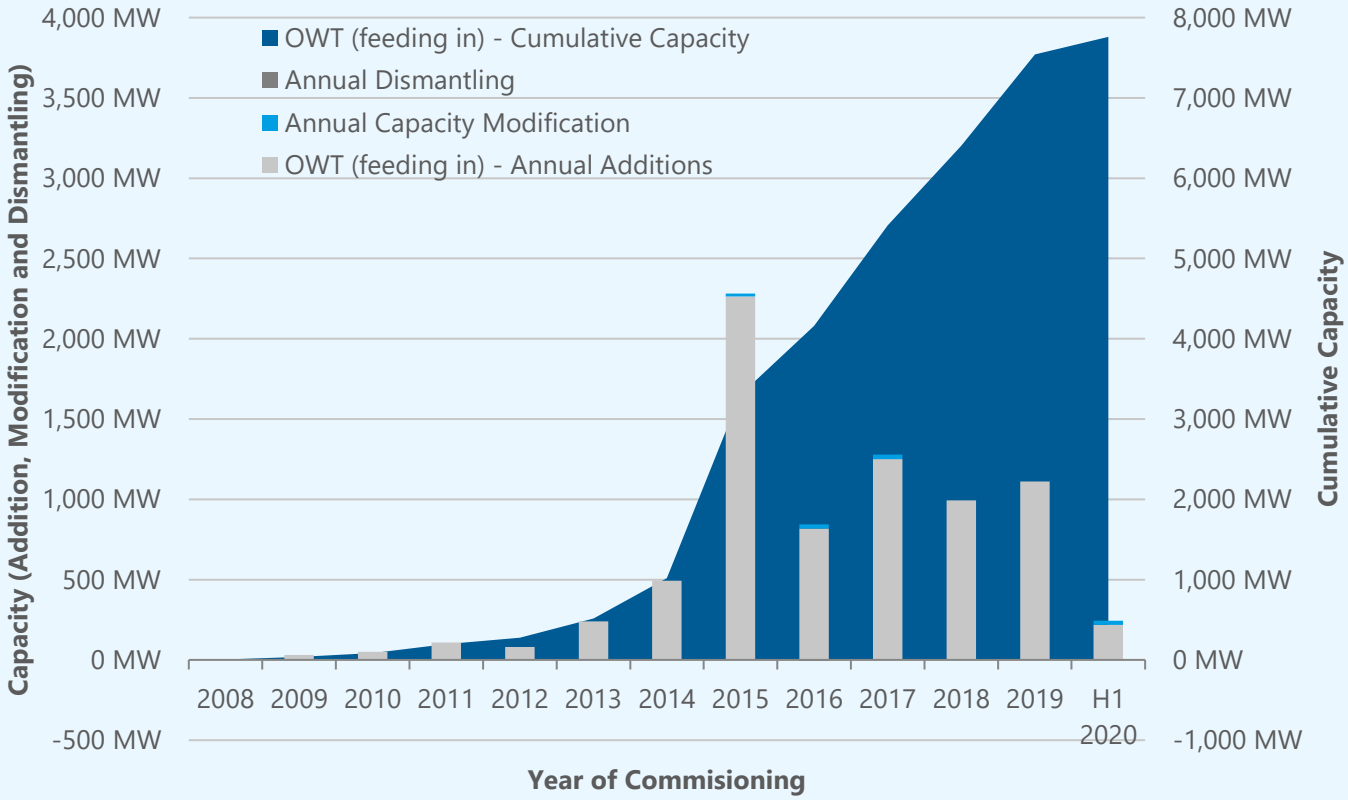
In the first half of 2020, 32 offshore wind turbines (OWT) in the German Exclusive Economic Zone (EEZ; German: Ausschließliche Wirtschaftszone or AWZ) with an installed capacity of 219 MW fed into the grid for the first time[1]. Of these 32 turbines, 15, with a total installed capacity of 101 MW, were erected in the first half of 2020 whilst the remaining turbines had been set up the previous year. No foundations were installed in the first half of 2020. Capacity upgrades totaling 25 MW were carried out on 71 turbines over the course of the first half of the year.

As of June 30, 2020, 1,501 OWT with a cumulative installed capacity of 7,760 MW were in operation. As expected, the number of new installations has fallen significantly compared to previous years. The cumulative installed capacity has increased by only 3% since the end of 2019.

Status of the Offshore Wind Energy Development

		Capacity	Number
Additions H1 2020	OWT (feeding in)[1]	219 MW	32 OWT
	Capacity Modifications of existing OWT	25 MW	71 OWT
	Installed OWT (no feed-in)	0 MW	0 OWT
	Foundations w/o OWT		No Foundations
Cumulative 2020-06-30	OWT (feeding in)	7,760 MW	1,501 OWT
	Installed OWT (no feed-in)	0 MW	0 OWT
	Foundations w/o OWT		No Foundations

[1]The MaStR reported a divergent commissioning date for one of the newly installed OWT (July 1st, 2020).

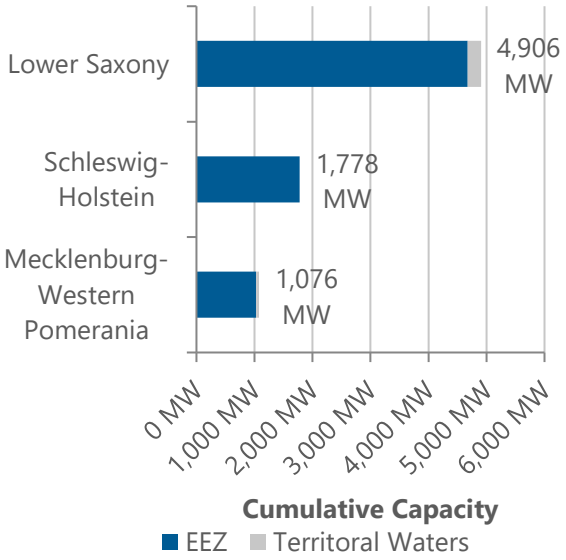


Development of the Offshore Wind Energy in Germany (Capacity of OWT Feeding into the Grid)

Distribution across Federal States and North and Baltic Seas

The distribution of capacity across the federal states is allocated on the basis of the location of grid connection point for each installed OWT. The majority of the installed capacity (4,906 MW) is attributed to Lower Saxony. In Schleswig-Holstein 1,778 MW of offshore wind capacity is connected to the grid. Together, this results in an installed capacity of 6,684 MW in the North Sea. In Mecklenburg-Western Pomerania, the turbines installed in the Baltic Sea feed into the grid with a total capacity of 1,076 MW. The share of turbines erected in territorial waters is comparatively low by contrast with those in the EEZ.

Changes compared to the previous year were limited to turbine installation, commissioning and capacity upgrades in the North Sea.



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

Distribution across the North and Baltic Seas

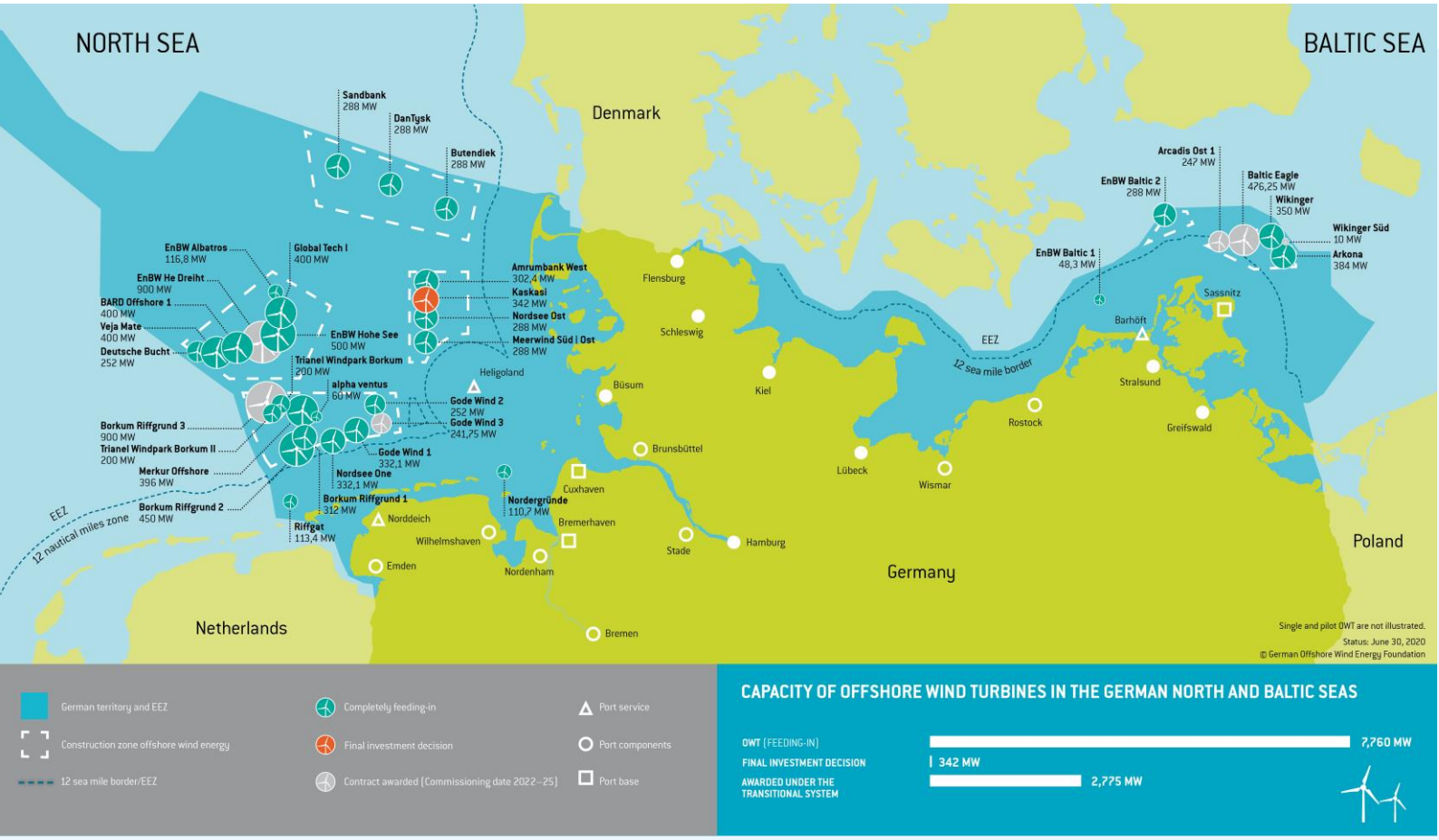
		North Sea		Baltic Sea	
		Capacity	**Number**	**Capacity**	**Number**
Additions H1 2020	OWT (feeding in)	219 MW	32 OWT	0 MW	0 OWT
	Capacity Modifications of existing OWT	25 MW	71 OWT	0 MW	0 OWT
	Installed OWT (no feed-in)	0 MW	0 OWT	0 MW	0 OWT
	Foundations w/o OWT		No Foundations		No Foundations
Cumulative 2020-06-30	OWT (feeding in)	6,684 MW	1,269 OWT	1,076 MW	232 OWT
	Installed OWT (no feed-in)	0 MW	0 OWT	0 MW	0 OWT
	Foundations w/o OWT		No Foundations		No Foundations

Activities in Offshore Wind Energy Projects

In the first half of 2020, turbines from two projects in Germany were commissioned. In the EnBW Albatros OWP, all plants went into operation. In the Trianel Windpark Borkum II project commissioning work[1], that had started the previous year, was completed. The turbines in the EnBW Hohe See project were upgraded. The pilot project at the Deutsche Bucht OWP was discontinued over the course of the first six months due to technical difficulties. As of June 30, 2020, 27 projects in the North Sea and Baltic Sea are in operation. The expansion phase of the projects implemented prior to the introduction of tenders, is now complete.

The next OWP to be implemented in Germany will be the projects awarded in the transitional tenders of 2017 and 2018. Seven projects are to be commissioned by 2025. An investment decision has already been made for the Kaskasi OWP, which is scheduled to go online in 2022, including the associated pilot plants. The Baltic Sea projects Arcadis Ost 1 and Wikinger Süd are to be realised in 2023, with the final investment decision still to be made. The completion of the OWP Baltic Eagle is expected to follow in 2024. Furthermore, the North Sea project Gode Wind 3 (including the Gode Wind 3 and Gode Wind 4 awards) is scheduled for grid connection in 2024. The completion of Borkum Riffgrund 3 (including the awards for Borkum Riffgrund West 1, Borkum Riffgrund West 2 and OWP West) and EnBW He Dreiht is expected in 2025.

No grid connection commitments have yet been made for the approved Gennaker project and the planned test field in the Baltic Sea, which can be defined in the Site Development Plan (German: Flächenentwicklungsplan or FEP) from 2021.



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

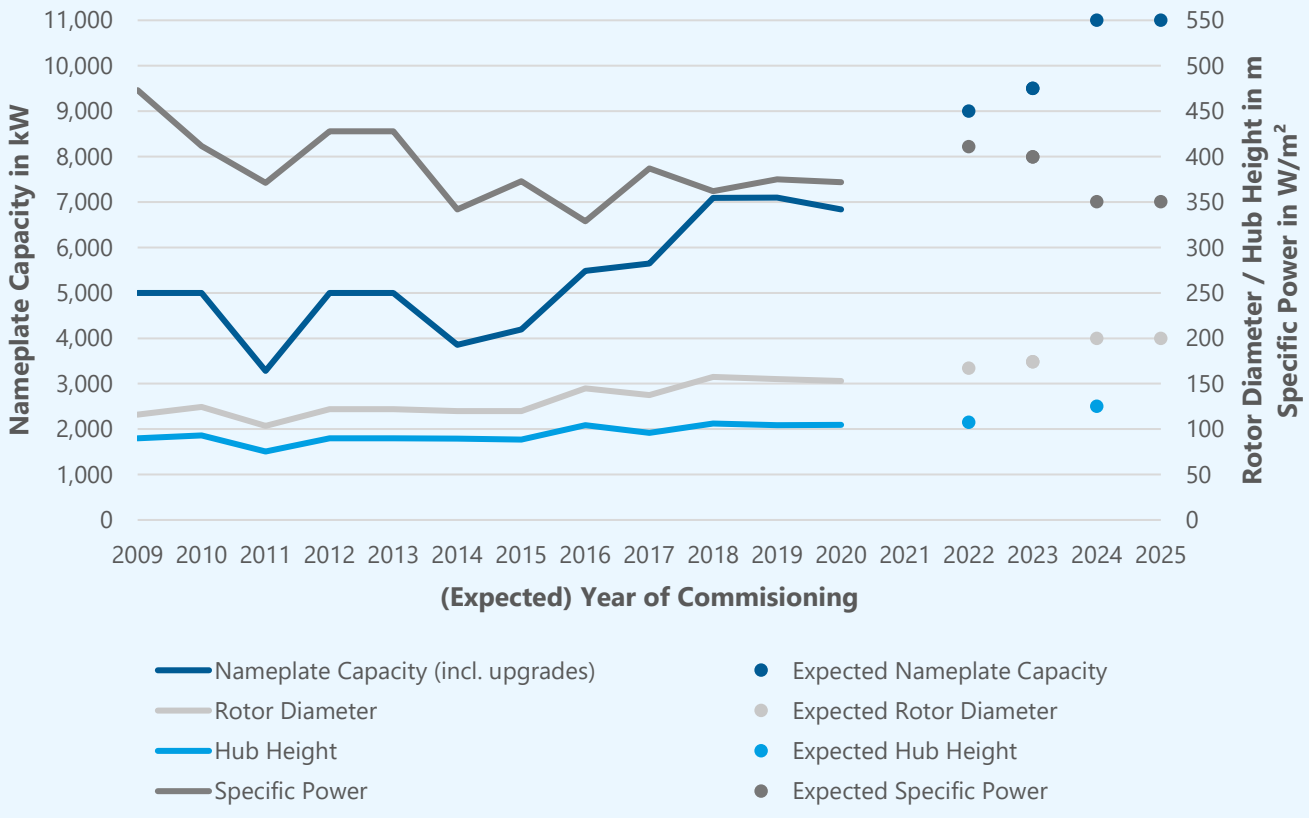
Turbine Configuration

In the first half of 2020, two different types of turbines were commissioned. The 16 turbines with 7.35 MW and the 16 turbines with 6.33 MW result in an average turbine capacity of 6.84 MW. So far in 2020, the average installed rotor diameter has been 153 m and the average hub height was 105 m. In the first half of the year, the ratio of nominal capacity to rotor area, the so-called specific power, averaged 372 W/m² for newly commissioned turbines. Compared to the previous year, the average configuration of the turbines has deviated only slightly.

Despite the project-related leaps in the development of turbine configuration over time, a trend towards ever larger turbines can be observed, particularly with regard to nominal capacity. Even higher nominal capacity (up to 11 MW) is planned for the coming projects in the next expansion phase (up to 2025). Rotor diameter and hub height will increase further – according to current plans, turbines with a rotor diameter of up to 200 m and a hub height of 125 m are to be commissioned by 2025. Due to the expected increases in nominal capacity, however, the specific power will remain relatively constant.

Average Turbine Configuration of OWT Feeding into the Grid

Average Configuration	Additions H1 2020	Cumulative 2020-06-30
Nameplate Capacity (incl. upgrades)	6,840 kW	5,170 kW
Rotor Diameter	153 m	133 m
Hub Height	105 m	95 m
Specific Power	372 W/m²	370 W/m²



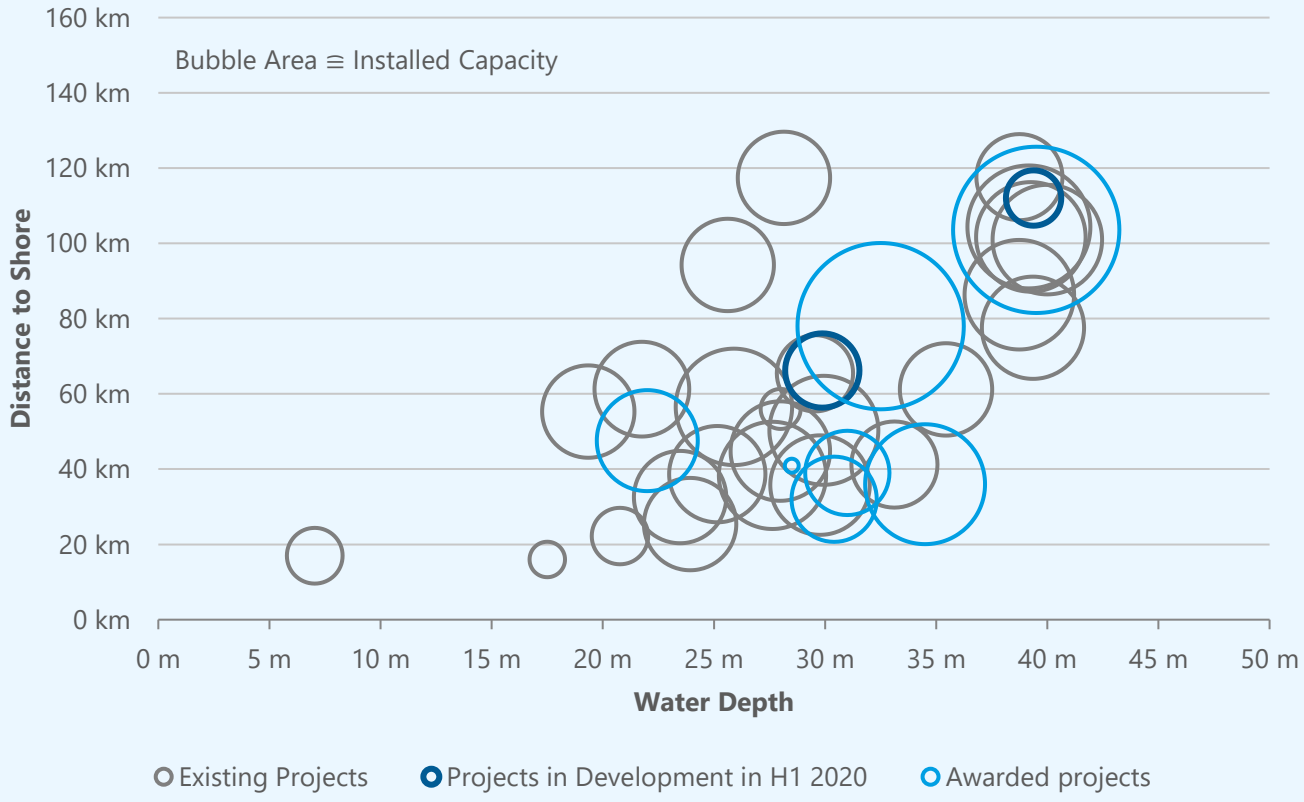
Turbine Configuration over Course of Time

Water Depth and Distance to Shore

The turbines in the two offshore wind energy projects (OWP) which fed into the grid for the first time in the first half of 2020, are located at an average water depth of 34 m and an average distance of 91 km from the coast. Some of the turbines are located at greater water depths and distances from the coast (Cluster 8), while the turbines in Cluster 2 are in the midfield of the overall portfolio in terms of distance and depth.
The turbines that will be realised in the coming years are also to be distributed over a wide range of water depths and distances from the coast. They will be located in different clusters in zones one and two. The more distant clusters in zone three will only be awarded in future tenders.

Average Location of OWT Feeding into the Grid

Average Location	Additions H1 2020	Cumulative 2020-06-30
Water Depth	34 m	30 m
Distance to Shore	89 km	66 km



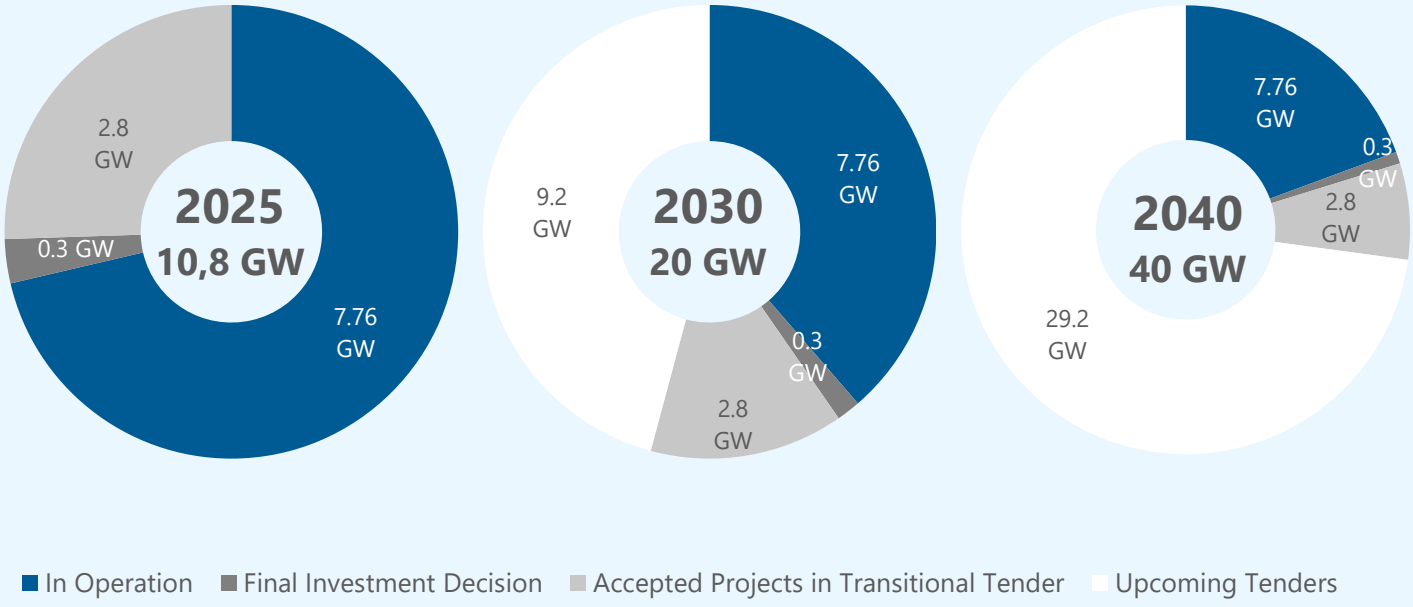
Water Depth and Distance to Shore of Existing Projects, Projects in Development and Awarded Projects

Expansion Targets Offshore Wind Energy

In the draft law to amend the Offshore Wind Energy Act (German: Windenergie-auf-See-Gesetz or WindSeeG) adopted by the Federal Cabinet on June 3, 2020, new targets for the further expansion of offshore wind energy up to 2040 were defined. Instead of the offshore target of 15 GW as previously defined in the EEG, a new target of 20 GW is to be achieved by 2030. By 2040, 40 GW offshore capacity is planned.

With the currently erected turbines in addition to the turbines awarded in the 2017/18 tender rounds which are now preparing for implementation, 10.8 GW of offshore capacity is to be implemented by 2025. A final investment decision has already been made for 325 MW of awarded capacity at the Kaskasi OWP with an additional 17 MW of pilot turbines. For the remaining 2.8 GW of awarded capacity the final investment decision is still pending.

To ensure that the new target of 20 GW by 2030 is achieved, a total capacity of 9.2 GW must be tendered, awarded and realised in tender rounds from 2021 onwards. Additionally, a further 20 GW would then be required to achieve the 40 GW target by 2040. Thus, a total of 29.2 GW still has to be added by 2040.



Development Status of Offshore Capacity with expected Commissioning by 2025, 2030 and 2040

Offshore Tenders from 2021 onwards

From 2021, regular tender calls for competitive awarding of funding entitlements will be held. In contrast to the 2017 and 2018 tender rounds, the so-called central model is advertised. The areas to be offered in the tender and the respective dates of the tenders are determined by the Federal Maritime and Hydrographic Agency (German: Bundesamt für Seeschifffahrt und Hydrographie or BSH) in the Site Development Plan (German: Flächenentwicklungsplan or FEP).

According to the cabinet decision to change the WindSeeG, the bids for the development of an OWP on a pre-examined area should be awarded in the first instance to the bidder with the lowest bid at the value applied for. For some of the areas, the owners of the originally planned projects have a right of entry, which they can claim in the tender procedure. The draft law allows for a dynamic bidding procedure with a second bid component for stalemate situations with several zero-cent bids. Projects with a zero-cent bid therefore not only waive funding for each kilowatt hour generated but should also offer a payment for the grid expansion. The winning bid will be awarded to the bidder with the highest bid. This is used to calculate the offshore grid expansion contribution, which is paid by the wind farm operator to the grid operator in annual instalments over 15 years.

In 2019 the BSH defined areas in the FEP for tenders from 2021 onwards. In order to meet the expansion of the offshore target to 20 GW in 2030 and 40 GW in 2040, the BSH has proposed some adjustments in the preliminary draft of the FEP 2020 and has identified additional areas for the offshore wind development until 2035. Furthermore, two areas for possible alternative energy generation at sea without a grid connection were put up for discussion in the preliminary draft of the FEP 2020.

Envisaged Offshore Areas for Tender from 2021 onwards (Database: FEP 2019, Preliminary Draft FEP 2020)

Area	Tender Round	Location	Expected Capacity	Expected Year of Commissioning	Expected Grid Connection	Amendments between FEP 2019 and Preliminary Draft FEP 2020
N-3.7	2021	North Sea	225 MW	2026	NOR-3-3	none
N-3.8	2021	North Sea	433 MW	2026	NOR-3-3	Capacity increased
O-1.3	2021	Baltic Sea	300 MW	2026	OST-1-4	none
N-7.2	2022	North Sea	930 MW	2027	NOR-7-2	Capacity increased
N-3.5	2023	North Sea	420 MW	2028	NOR-3-2	none
N-3.6	2023	North Sea	480 MW	2028	NOR-3-2	none
N-6.6	2024	North Sea	630 MW	2029	NOR-6-3	none
N-6.7	2024	North Sea	270 MW	2029	NOR-6-3	none
N-9.1	2024	North Sea	1,000 MW	2029	NOR-9-1	Area and Capacity increased, rescheduled
N-9.2	2024	North Sea	1,000 MW	2029	NOR-9 -1	new
N-10.1	2025	North Sea	1,000 MW	2030	NOR-10-1	new
N-10.2	2025	North Sea	1,000 MW	2030	NOR-10-1	new
N-9.3	2025	North Sea	1,000 MW	2030	NOR-9 -2	new
N-9.4	2025	North Sea	1,000 MW	2030	NOR-9 -2	new
N-12.1/N-12.2	after 2025	North Sea	2,000 MW	after 2030	NOR-12-1	new
N-12.3/N-12.4	after 2025	North Sea	2,000 MW	after 2030	NOR-12-2	new
N-11.1/N-11.2	after 2025	North Sea	2,000 MW	after 2030	NOR-11-1	new
N-11.3/N-12.5/N-13.1	after 2025	North Sea	2,000 MW	after 2030	NOR-11-2	new
N-13.2/N-13.3	after 2025	North Sea	2,000 MW	after 2030	NOR-13-1	new
SEN-1		North Sea			None	new
SEO-1		Baltic Sea			None	new

Overview of Grid Connection Capacities

As of June 30, 2020, a total offshore grid connection capacity of 8.2 GW was in operation in Germany. The majority of this capacity is already being used by existing OWP. As a result, additional capacity must be created to achieve the goals by 2030. This additional capacity has already been confirmed in the 2030 Grid Development Plan (German: Netzentwicklungs-plan or NEP) or identified in the preliminary draft of the 2020 Site Development Plan (FEP).

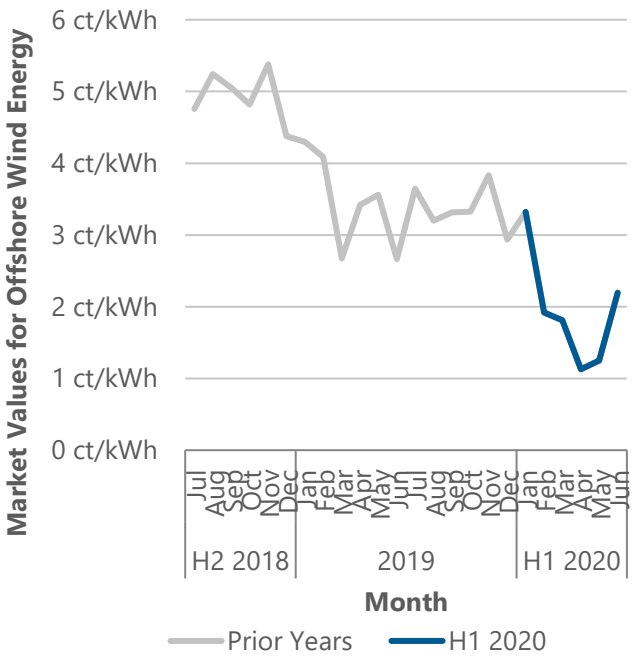
Installed and Planned Grid Connections (to Converter Station or Bundling Point) in the North and Baltic Seas (Database: NEP 2030 Version 2019 Second Draft and Confirmation, FEP 2019 und Preliminary Draft 2020, TSO, Additional Research)

Grid Connection System	Status	(Expect.) Commissioning	(Plan.) Capacity	(Preliminary) Assigned Offshore Wind Energy Projects and Areas
North Sea				
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-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. Pilot OWT
NOR-2-2 (DolWin1)	In Operation	2015	800 MW	Borkum Riffgrund 1, Trianel Windpark Borkum, Trianel Windpark Borkum II
NOR-6-2 (BorWin2)	In Operation	2015	800 MW	Deutsche Bucht, EnBW Albatros, Veja Mate
NOR-5-1 (SylWin1)	In Operation	2015	864 MW	Butendiek, DanTysk, Sandbank
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)	Unter Construction	2023	900 MW	Gode Wind 3, N-3.7, N-3.8
NOR-1-1 (DolWin5)	Unter Construction	2024	900 MW	Borkum Riffgrund 3
NOR-7-1 (BorWin5)	Procurement Procedure	2025	900 MW	EnBW He Dreiht
NOR-7-2 (BorWin6)	Preparation of the Permitting Procedures	2027	930 MW	N-7.2
NOR-3-2 (DolWin4)	Preparation of the Permitting Procedures	2028	900 MW	N-3.5, N-3.6
NOR-6-3 (BorWin4)	Preparation of the Permitting Procedures	2029	900 MW	N-6.6, N-6.7
NOR-9-1 (BalWin1)	Preparation of the Permitting Procedures	2029	2,000 MW	N-9.1, N-9.2
NOR-9-2	Identified in Preliminary FEP Draft	2030	2,000 MW	N-9.3, N-9.4
NOR-10-1 (BalWin2)	Confirmed in NEP, amended in Preliminary FEP Draft	2030	2,000 MW	N-10.1, N-10.2
NOR-12-1 (LanWin1)	Confirmed in NEP	after 2030	2,000 MW	N-12.1, N-12.2
NOR-12-2	Identified in Preliminary FEP Draft	after 2030	2,000 MW	N-12.3, N-12.4
NOR-11-1	Confirmed in NEP	after 2030	2,000 MW	N-11.1, N-11.2
NOR-11-2	Confirmed in NEP	after 2030	2,000 MW	N-11.3, N-12.5, N-13.1
NOR-13-1 (SylWin3)	Confirmed in NEP	after 2030	2,000 MW	N-13.2, N-13.3
Baltic Sea				
OST-3-1 (Baltic 1)	In Operation	2011	51 MW	EnBW Baltic1, GICON-SOF
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, Wikinger Süd
OST-2-1 (Ostwind 2)	Partially under Construction	2023	250 MW	Arcadis Ost 1
OST-2-2 (Ostwind 2)	Partially under Construction	2023	250 MW	Baltic Eagle
OST-2-3 (Ostwind 2)	Partially under Construction	2024	250 MW	Baltic Eagle
OST-1-4	Confirmed in NEP	2026	300 MW	O-1.3
OST-7-1	Conditionally confirmed in NEP, not sheduled yet			Offshore-Test Field (conditional: O-7)
OST-6-1 ("Gennaker")	No need identified in FEP, therefore not confirmed by the NEP			

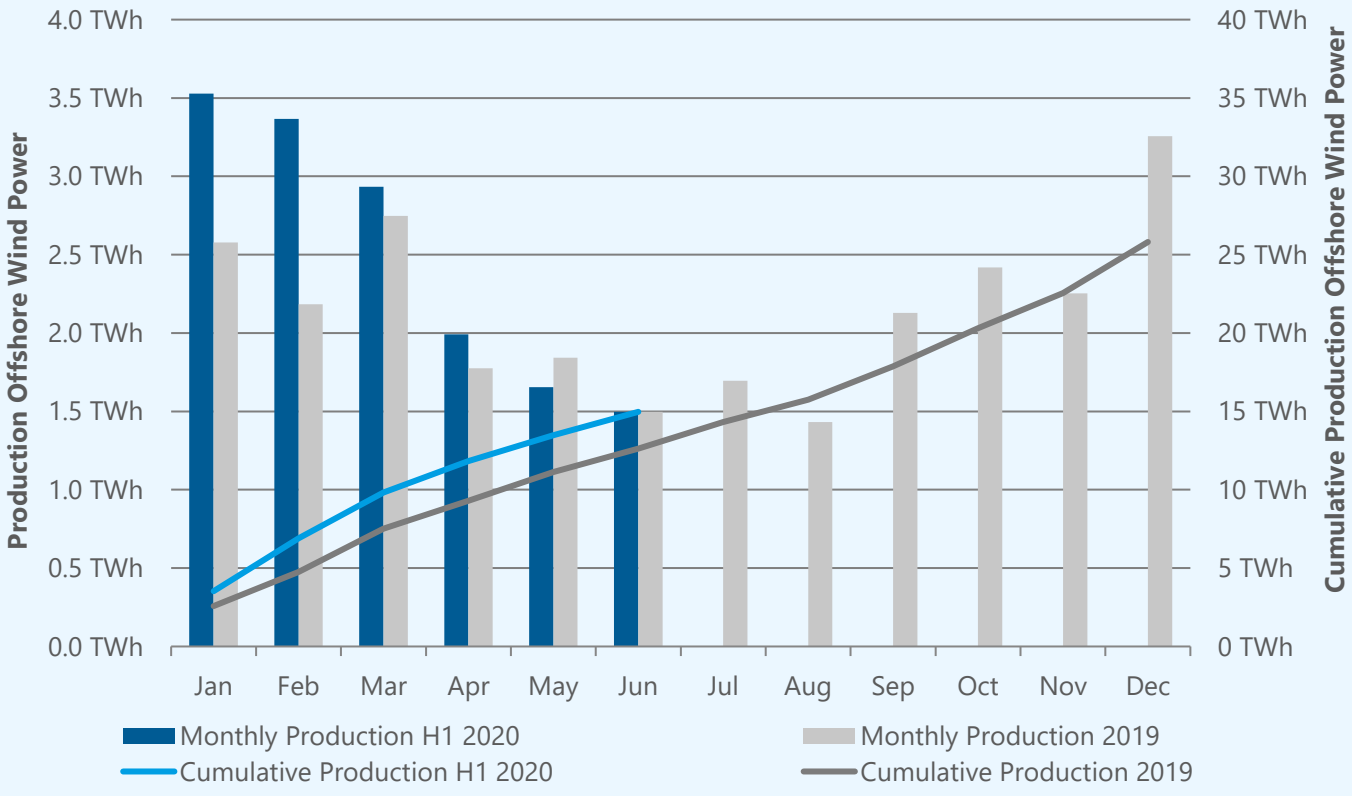
Monthly Power Production and Market Values

The monthly market values for offshore wind power collapsed in spring 2020 due to the COVID-19 pandemic and reached a low point of 1.2 ct/kWh in April 2020. The value on the electricity exchange recovered slightly in June 2020 but is still significantly lower than the level before the pandemic. In 2019, the market value stabilized around 3 ct/kWh after the high values in summer 2018. On average, the volume-weighted market value in the first half of 2020 was 2.1 ct/kWh, 38% below the previous year's average.

In the first half of 2020, the power generation of the German offshore wind energy projects was 15 TWh according to the extrapolation data of the transmission system operator (TSO). This corresponds to an increase of around 19% compared to the projection of the previous year and can be attributed to the higher feed-in in January and February compared to 2019.



Monthly Market Values for Offshore Wind Power (Database: Netztransparenz)



Power Production from Offshore Wind Turbine Generators (Database: Projection by TSO (Netztransparenz)

About Deutsche WindGuard
In a complex energy market WindGuard is committed to providing extensive scientific, technical, and operational services which are unbiased and manufacturer-independent. WindGuard has been publishing the semi-annual development statistics since 2012.

About Bundesverband WindEnergie e.V. (BWE)
The Bundesverband WindEnergie e.V. (BWE) is a partner of over 3,000 wind energy industry companies and represents 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 Stiftung OFFSHORE-WINDENERGIE
The aim of the foundation is to consolidate the role of offshore wind energy and promote its expansion in the interest 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 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.