DEUTSCHE WINDGUARD

Status of Onshore Wind Energy Development in Germany

First Half of 2020

On behalf of

BWE Bundesverband WindEnergie

VDMA Power Systems

Contents

Notes

The data from 2012 onward was obtained through surveys with manufacturers and other industry representatives, as well as additional research. The basis of the data for the years 1992 – 2011 are analyses of the DEWI. The MaStR and the publications of the awards by the BNetzA serve as a data basis for the analysis of the approval situation and the tendering results.

The information provided within the text and the figures partially includes rounded values. Thus, when added, there is a possibility of deviations from the overall values. The cumulative data may be overestimated due to the incomplete capture of dismantling.

Analyses that rely on deviating data bases (i.e. MaStR) exhibit a deviating data inventory.

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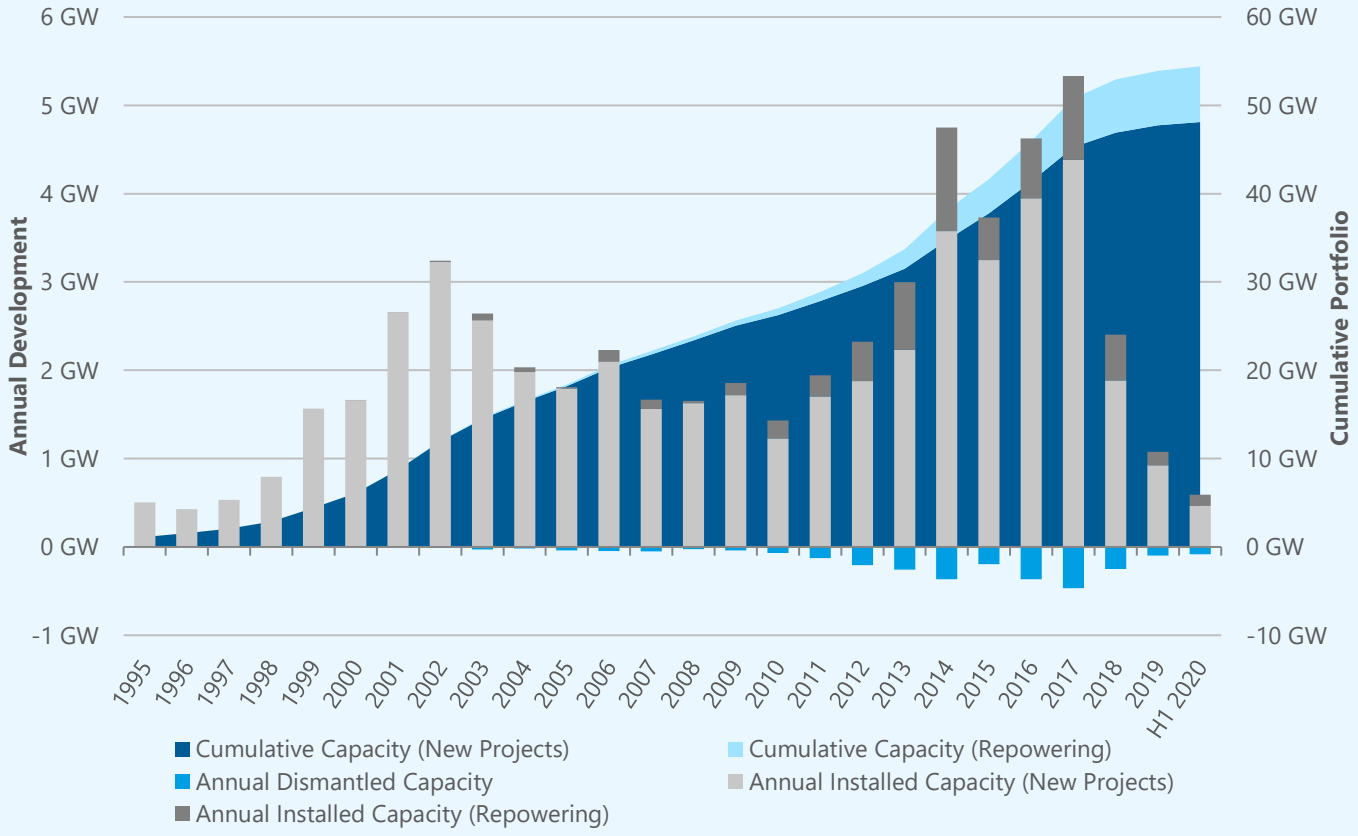
Net and Gross Wind Energy Additions

In the first half of 2020, the number of new wind turbine generators (WTG) installed in Germany remained at a low level of 178 WTG or 591 MW. Nevertheless, the gross addition was around twice as high as in the first six months of the previous year. Accounting for the dismantling of 88 WTG with a capacity of 84 MW, the net addition in the first half of 2020 was 90 WTG with a cumulative capacity of 507 MW.

The cumulative WTG portfolio as of June 30, 2020, increased by 1% to 29,546 WTG, with an overall capacity of 54,418 MW.

Status of Onshore Wind Energy Development

		Capacity	Number
Development H1 2020	Gross additions	591 MW	178 WTG
	Repowering share	124 MW	40 WTG
	Dismantling (incl. subsequent registration) (non-binding)	84 MW	88 WTG
	Net additions	507 MW	90 WTG
Cumulative 2020-06-30	Cumulative WTG portfolio (non-binding)	54,418 MW	29,546 WTG



Annual Development Onshore Wind Energy in Germany

Average Wind Turbine Generator Configuration

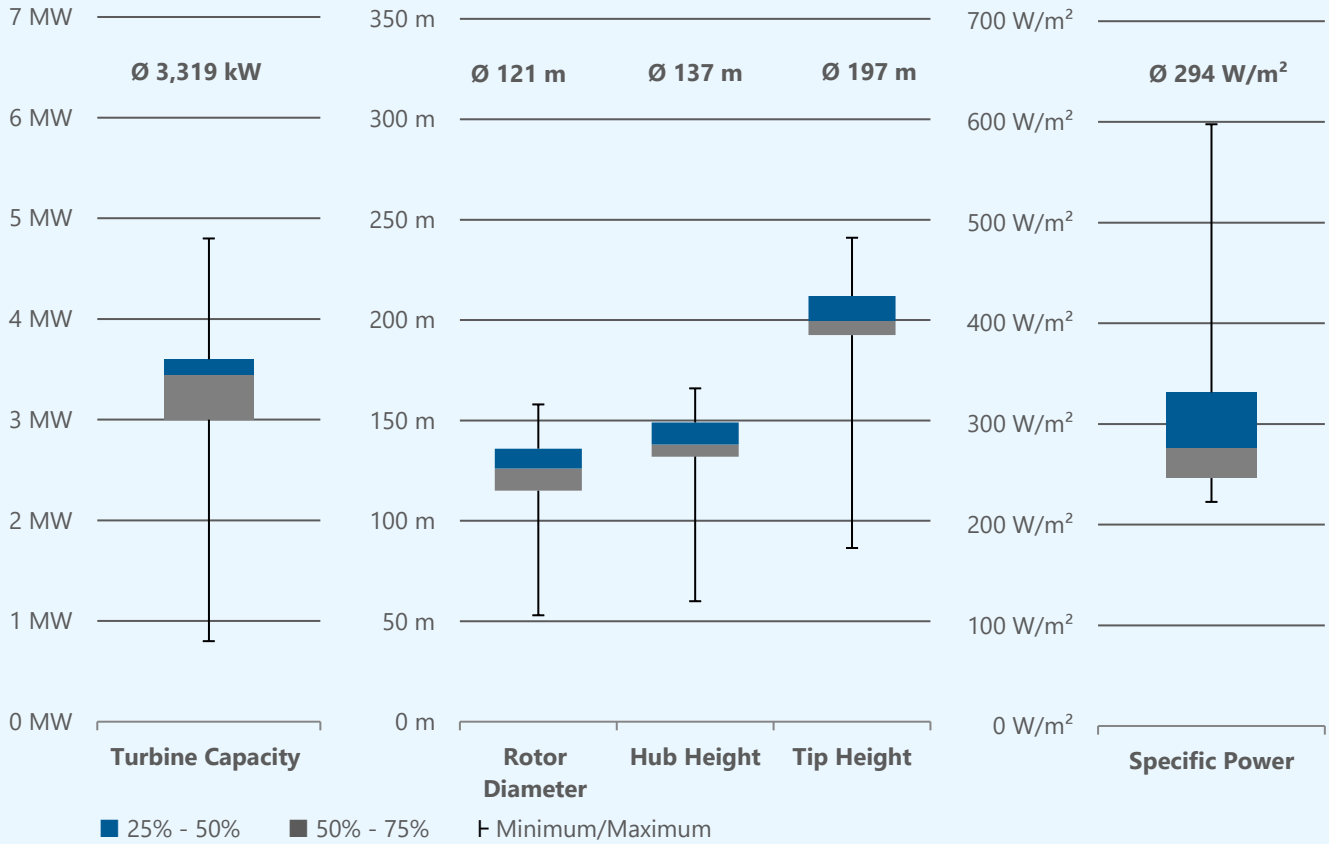
The average wind turbine configuration is described by the nominal turbine capacity, the rotor diameter, the hub height and the specific power. The latter results from the relation of the nominal turbine capacity to the area swept by the rotor.

The turbines installed in the first half of 2020 largely correspond to the technology used in the previous year. The average turbine capacity remains unchanged from 2019 at 3.3 MW. The average rotor diameter of 121 m and the average hub height of 137 m have increased by 1% and 3% respectively compared to the previous year. This results in an average total height of 197 m.

Due to the increased rotor diameter, the average specific power in the first half of 2020 was 3% lower than in the previous year and decreased to 294 W/m².

Average Wind Turbine Generator Configuration

Average Configuration	Addition H1 2020	Changes compared to prior year
Turbine Capacity	3,319 kW	0%
Rotor Diameter	121 m	+1%
Hub Height	137 m	+3%
Tip Height	197 m	+2%
Specific Power	294 W/m²	-3%



Range of Configuration Values of newly installed WTG

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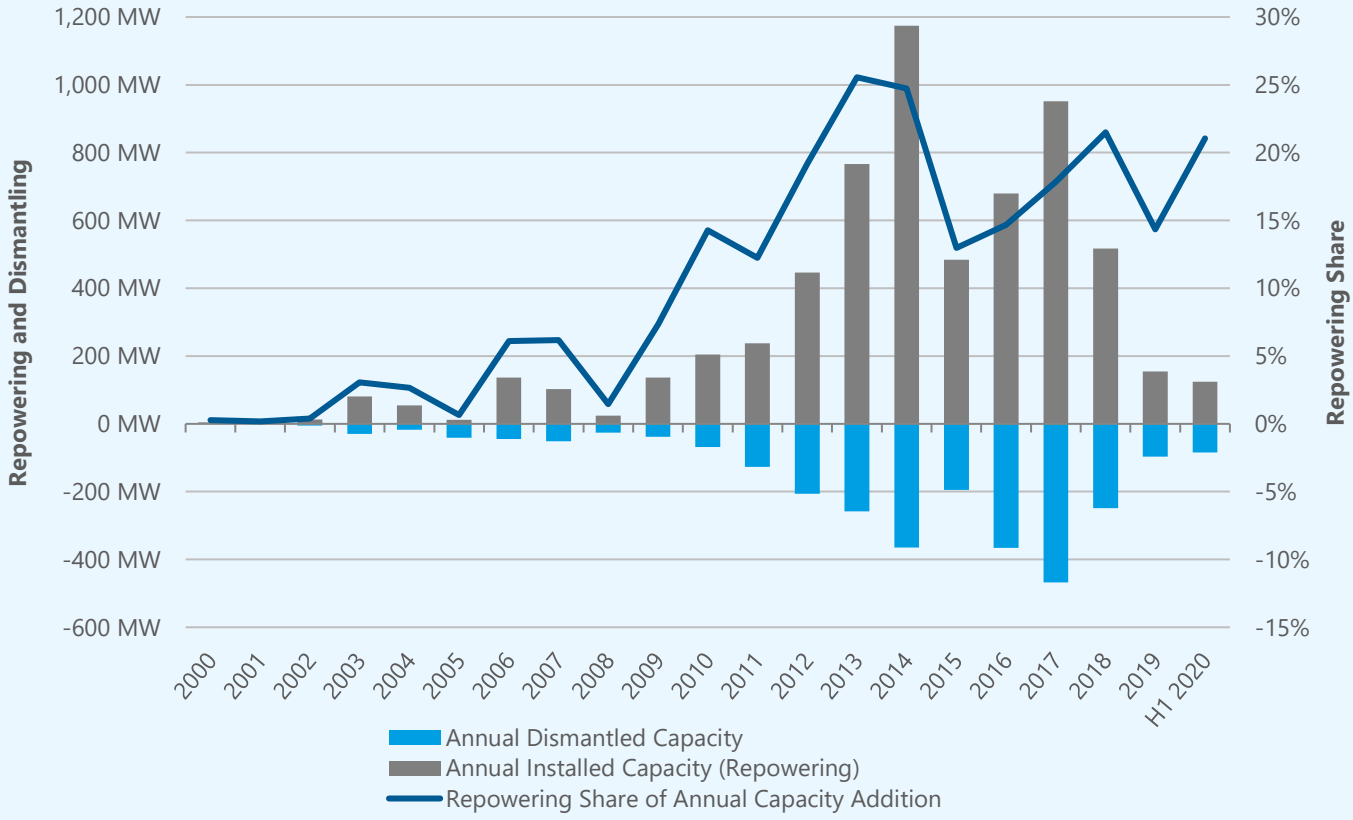
Dismantling and Repowering

The dismantling of 88 WTG with a cumulative capacity of 84 MW was captured during the first half of 2020. Not every dismantled WTG can be replaced by a new turbine in the context of repowering measures. If no new WTG can be approved on project sites, old WTG that have reached the end of their technical or economic life will be dismantled without replacement.

With the expiration of the remuneration by the Renewable Energy Sources Act (German: Erneuerbare-Energien-Gesetz or EEG) at the end of 2020 for WTG commissioned in or before 2000, the economic pressure on older WTG will increase significantly. Dismantling for economic reasons could therefore increase considerably in 2021.

In the first half of 2020, 40 WTG with 124 MW were identified as repowering WTG which were replacing old WTG. The share of repowering in the construction of new turbines is thus comparable to that of previous years, but the absolute figures - just like the total number of new WTG - have fallen significantly.

The space required for the new WTG, which are usually much larger and have larger rotor diameters, is greater than for the old WTG. As a result, in repowering projects a large number of small and low-power WTG are often replaced by a smaller number of modern WTG. Nevertheless, repowering WTG can usually achieve higher energy yields than the old, dismantled WTG.



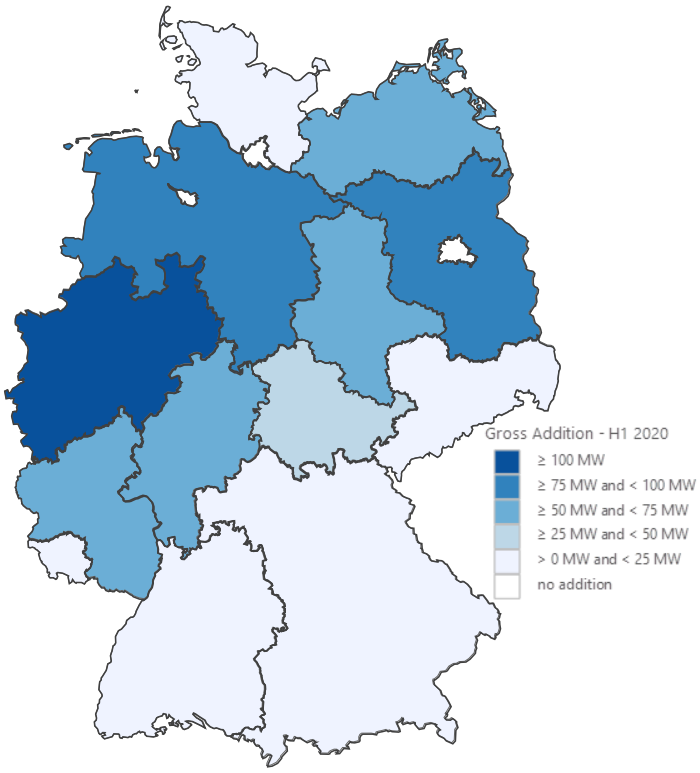
Repowering Share, Annual Installed Repowering Capacity and Dismantled Capacity

Regional Distribution of Wind Energy Additions

In Germany, site quality-dependent remuneration elements are intended to enable the installation of WTG even at locations with less wind. However, the development depends on various factors (e.g. decisions by the federal states, approval procedures), which influence the regional distribution among the federal states.

In the first half of the year, North Rhine-Westphalia accounted for the largest share of gross capacity additions, at around one fifth. Brandenburg and Lower Saxony follow in second and third place. Apart from the city states, WTG were also erected in all other federal states.

Due to the low level of new installations in some states, the average configuration is sometimes strongly influenced by individual projects. Turbines with the lowest height are still installed in Schleswig-Holstein; WTG in the southern states are on average 54 m to 84 m higher.



Regional Distribution of Gross Capacity Additions

Addition (gross) and Average Configuration of newly installed WTG in the German Federal States

Position	State	Gross Additions in H1 2020			Average Configuration of newly added WTG			
		Capacity Addition	Number of added WTG	Share in the Gross Capacity Addition	WTG Capacity	Rotor Diameter	Hub Height	Specific Power
1	North Rhine-Westphalia	115 MW	39 WTG	19.5%	2,949 kW	110 m	128 m	307 W/m²
2	Brandenburg	85 MW	24 WTG	14.4%	3,556 kW	126 m	136 m	292 W/m²
3	Lower Saxony	75 MW	23 WTG	12.8%	3,281 kW	116 m	137 m	320 W/m²
4	Saxony-Anhalt	63 MW	18 WTG	10.6%	3,494 kW	133 m	139 m	253 W/m²
5	Hesse	54 MW	16 WTG	9.1%	3,374 kW	130 m	150 m	253 W/m²
6	Mecklenburg-Western Pomerania	53 MW	16 WTG	9.0%	3,306 kW	115 m	136 m	323 W/m²
7	Rhineland-Palatinate	51 MW	15 WTG	8.7%	3,423 kW	123 m	148 m	292 W/m²
8	Thuringia	25 MW	7 WTG	4.3%	3,614 kW	131 m	150 m	271 W/m²
9	Bavaria	23 MW	5 WTG	4.0%	4,680 kW	154 m	152 m	250 W/m²
10	Schleswig-Holstein	14 MW	5 WTG	2.4%	2,840 kW	101 m	95 m	375 W/m²
11	Baden-Württemberg	14 MW	4 WTG	2.3%	3,450 kW	127 m	144 m	272 W/m²
12	Saarland	9 MW	3 WTG	1.5%	3,000 kW	131 m	134 m	223 W/m²
13	Saxony	8 MW	3 WTG	1.4%	2,700 kW	100 m	137 m	355 W/m²
	Berlin	0 MW	0 WTG	0.0%				
	Bremen	0 MW	0 WTG	0.0%				
	Hamburg	0 MW	0 WTG	0.0%				
	Germany	**591 MW**	**178 WTG**		**3,319 kW**	**121 m**	**137 m**	**294 W/m²**

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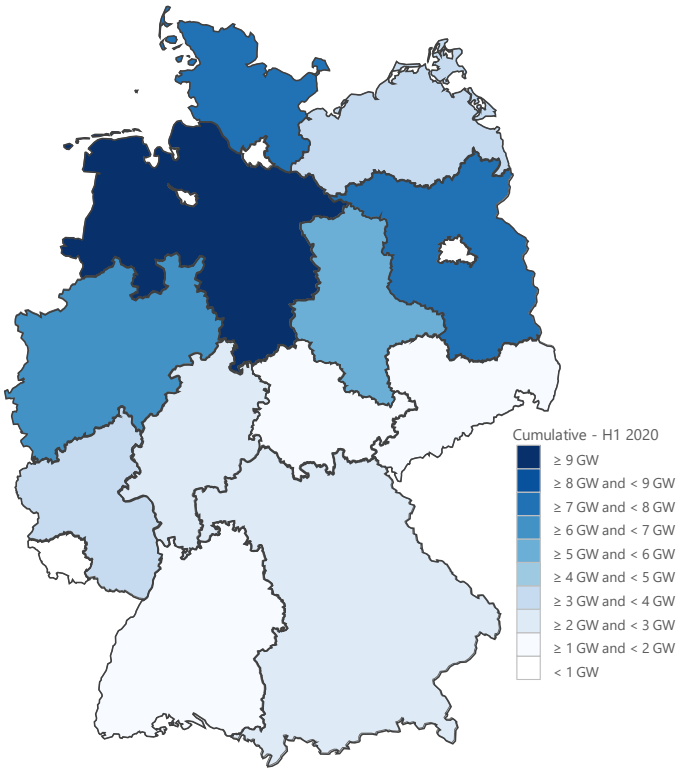
Regional Distribution of the Cumulative Portfolio

The regional distribution of the total number of WTG in Germany shows a clear north-south divide. Even though the subsidy system provides increased support for the locations with low wind levels, which are more common in the south, the share is lowest in the south, with only 15% of the cumulative capacity as of June 30, 2020. About 41% of the cumulative capacity was installed in the coastal states of Northern Germany. The central states contribute around 44% of the capacity.

Different data are available on the actual cumulative portfolio. Due to different definitions and counting systems, the sources differ from one another. The Core Energy Market Data Register (German: Marktstammdatenregister or MaStR), in which operators must register their WTG, is still under development and is to be filled with all existing WTG by the end of January 2021. Until then, the sources (DWG Statistics, MaStR and in some cases, state data) will be maintained in parallel.



Regional Distribution of the Cumulative Capacity

Cumulative Capacity and Number of WTG in the German Federal States

Cumulative Portfolio (2020-06-30)							
		Cumulative Capacity			Cumulative Number		
Region	State	DWG Statistics	MaStR*	State Data**	DWG Statistics	MaStR*	State Data**
North	Lower Saxony	11,386 MW	12,177 MW		6,354 WTG	6,345 WTG	
	Schleswig-Holstein	7,006 MW	6,822 MW	6,700 MW	3,671 WTG	3,325 WTG	2,998 WTG
	Mecklenburg-Western Pomerania	3,525 MW	3,471 MW		1,958 WTG	1,894 WTG	
	Bremen	198 MW	204 MW		91 WTG	93 WTG	
	Hamburg	128 MW	122 MW		65 WTG	71 WTG	
Central	Brandenburg	7,383 MW	7,394 MW		3,887 WTG	3,903 WTG	
	North Rhine-Westphalia	6,025 MW	5,968 MW		3,795 WTG	3,473 WTG	
	Saxony-Anhalt	5,240 MW	5,254 MW		2,870 WTG	2,901 WTG	
	Hesse	2,271 MW	2,213 MW		1,176 WTG	985 WTG	
	Thuringia	1,631 MW	1,724 MW		867 WTG	933 WTG	
	Saxony	1,272 MW	1,296 MW		907 WTG	968 WTG	
	Berlin	12 MW	12 MW		4 WTG	10 WTG	
South	Rheinland-Pfalz	3,735 MW	3,727 MW		1,786 WTG	1,724 WTG	
	Bavaria	2,554 MW	2,561 MW		1,171 WTG	1,235 WTG	
	Baden-Württemberg	1,560 MW	1,614 MW		732 WTG	765 WTG	
	Saarland	492 MW	515 MW		212 WTG	211 WTG	
	Germany	**54,418 MW**	**55,074 MW**		**29,546 WTG**	**28,836 WTG**	

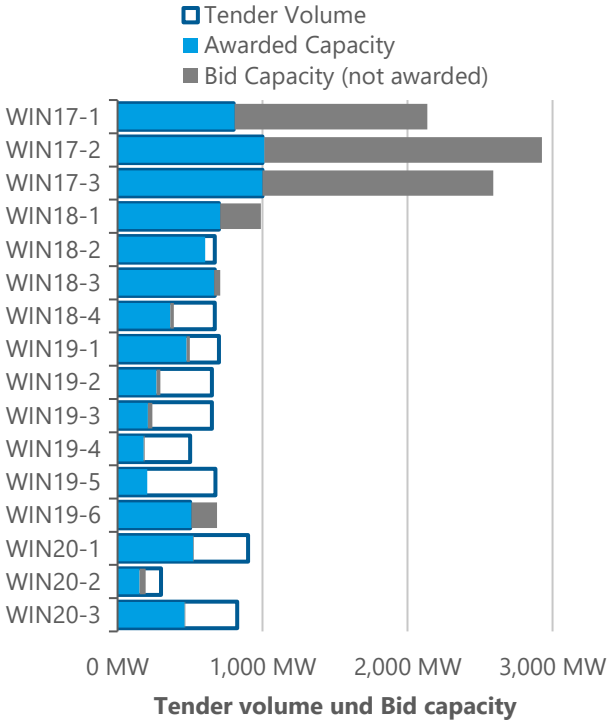
* Turbine Portfolio according to statistically relevant WTG in Operation as in the Core Energy Market Data Register (MaStR)

** Turbine Portfolio subject to approval according to LLUR Schleswig-Holstein as of June 10, 2020

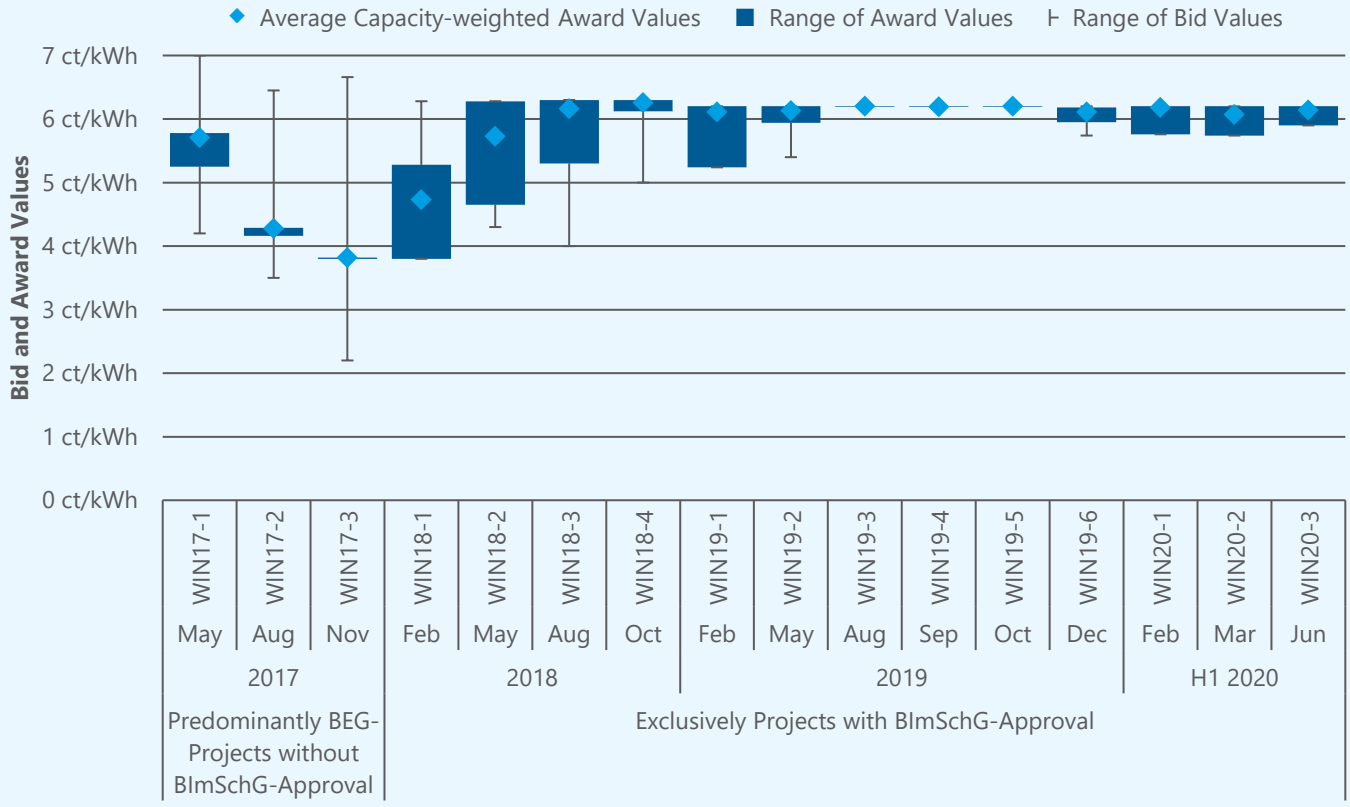
Results of Tender Rounds

The first three tender rounds in 2020, like almost all rounds since the suspension of the specific rules for non-approved projects, are characterized by the undersubscription of the tender volume - i.e. the submitted bids are below the tender volume. The volume of 2,026 MW tendered in the first half of the year was offset by the awarded wind energy projects with a capacity of 1,138 MW. It is noticeable that despite the general low participation in the second round of the year, the maximum permissible volume in the grid expansion area (German: Netzausbaugebiet) was reached. Some bids in the grid expansion area were therefore not awarded.

As in 2019, the maximum permissible value for the tenders in 2020 is 6.2 ct/kWh. Even though the range of bid values has increased compared to the rounds at the end of 2019, many of the bids are based on this value.



Competitive Situation in Tender System for Onshore Wind Energy (Database: BNetzA)



Development of Awarded Bids of Tender Rounds for Onshore Wind Energy (Database: BNetzA)

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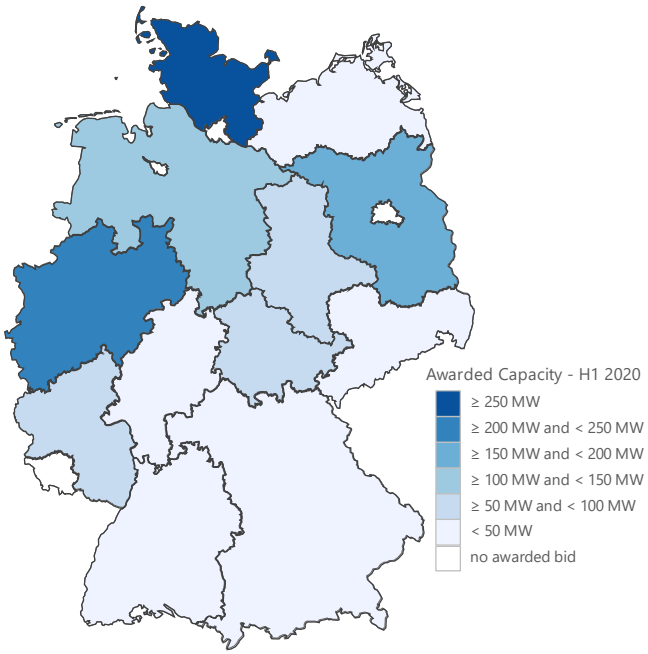
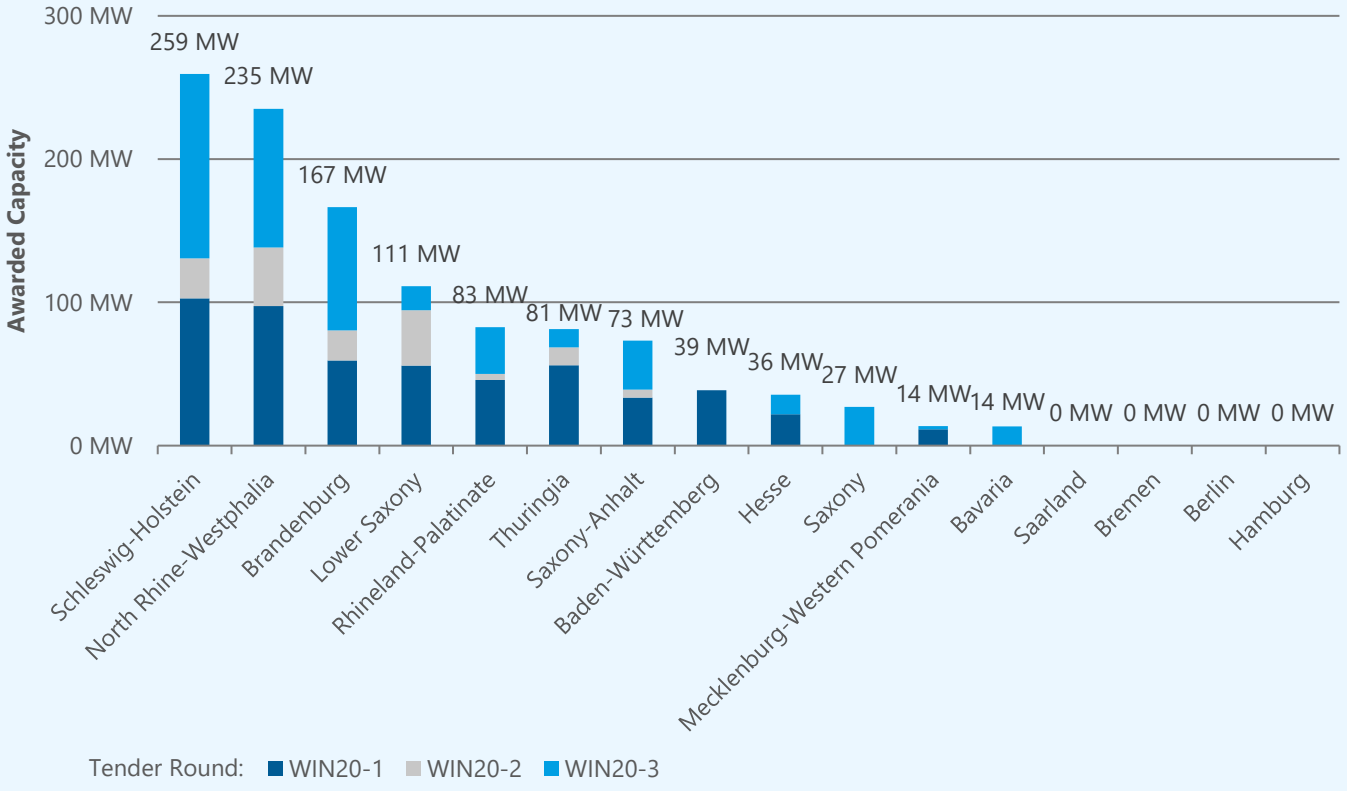
Regional Distribution of Awarded Bids

In the tender rounds of the first half of 2020, Schleswig-Holstein and North Rhine-Westphalia stood out with a share of more than 20% each of the total awarded volume of 1,138 MW. Projects in Brandenburg and Lower Saxony also accounted for an above-average share of 15% and 10% of the awarded volume respectively.

Rhineland-Palatinate, Thuringia and Saxony-Anhalt were in the middle range with 50 MW of the awarded capacity each (6-7% of the volume). Apart from Mecklenburg-Western Pomerania, the federal states with an awarded capacity of less than 50 MW are mainly located in the center of the country (Hesse, Saxony) and in the south (Baden-Württemberg, Bavaria). In the first half of 2020, no projects from Saarland and the city states took part in the tenders.



Regional Distribution of Awarded Capacity (Database: BNetzA)

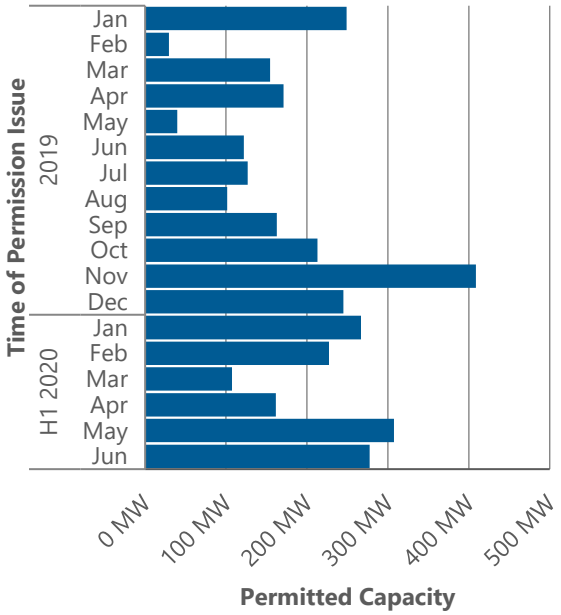


Regional Distribution of Awarded Capacity across the German Federal States (Database: BNetzA)

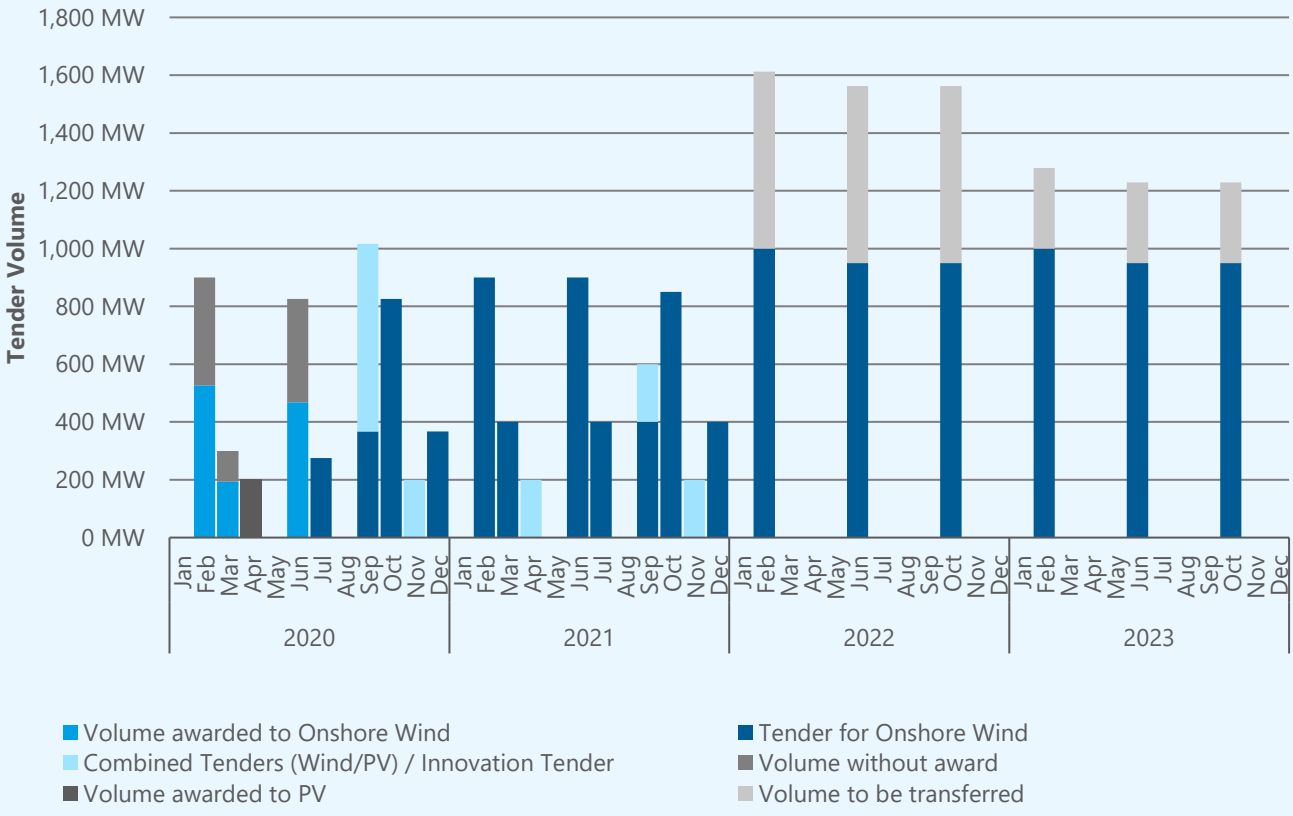
Permitted Capacity and Future Tender Rounds

The MaStR reported approximately 1.4 GW at the time of this analysis, for which approval was granted in the first half of 2020. This corresponds roughly to the approvals granted in the second half of 2019 and is more than 75% above the BImSchG approvals granted in the first half of 2019. The granted permit is a prerequisite for participation in future tender rounds. Some of the approved WTG have already been awarded, but allocation is not possible due to the suspension of the publication of awards as a result of the COVID 19 pandemic.

For the second half of 2020, technology-specific tenders of 1.8 GW are planned for onshore wind energy. The volumes of the technology-specific tenders that were not awarded in 2019 will be added to the tenders in 2022. Accordingly, volume that cannot be awarded in 2020 will be postponed until 2023.



Monthly Permitted Capacity

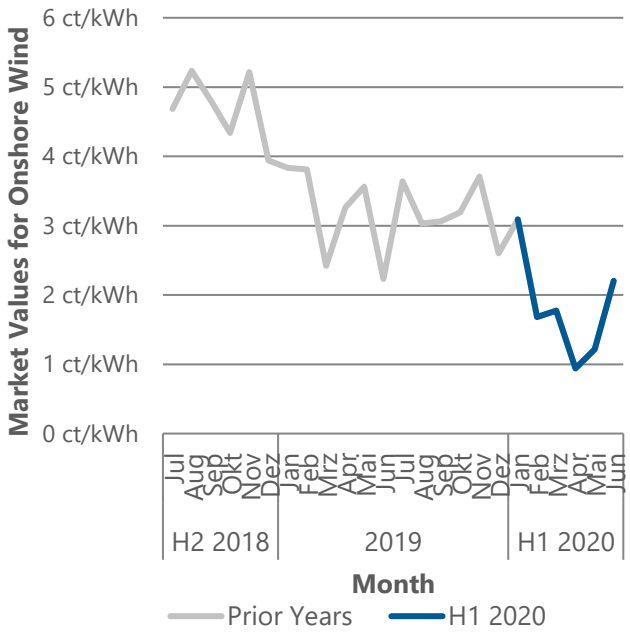


Tender Volume 2020 to 2023 (according to the EEG)

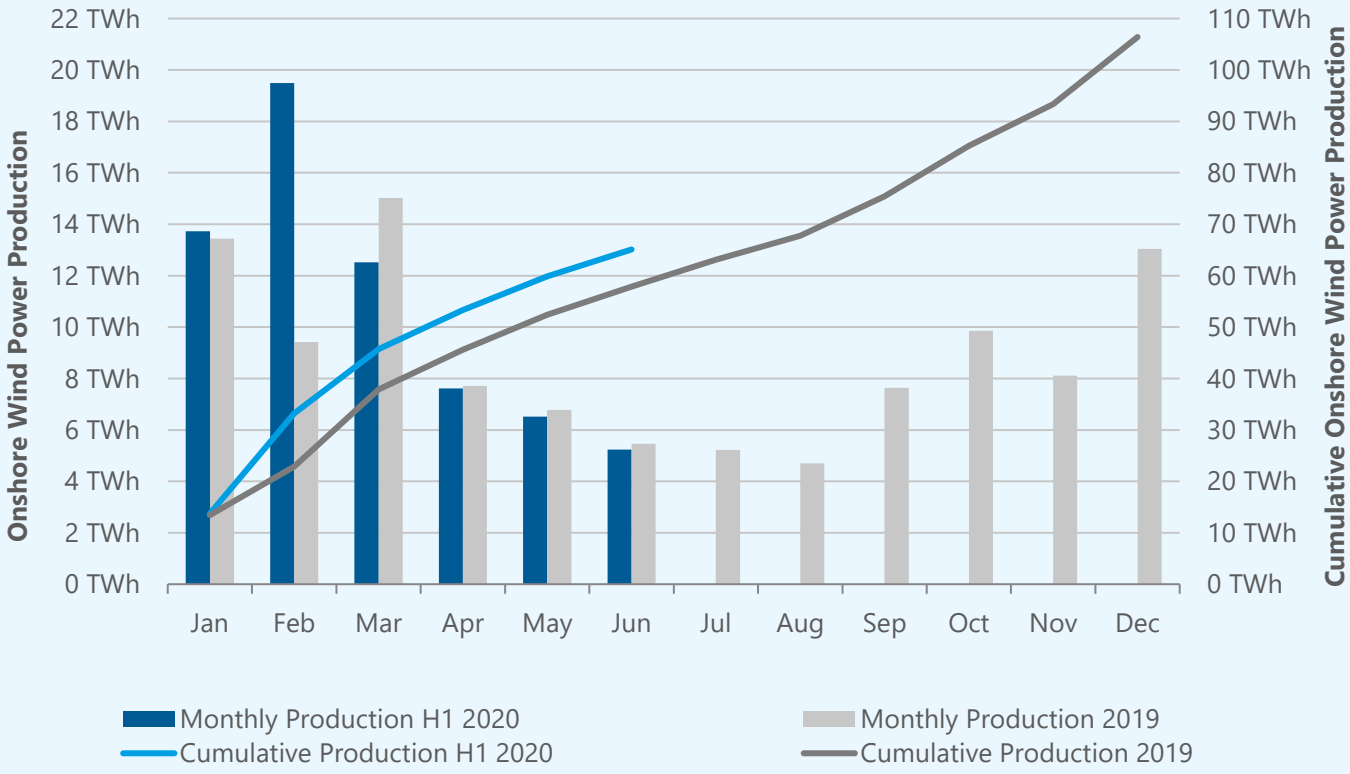
Monthly Power Production and Market Values

According to the projection data of Transmission System Operators (German: Übertragungs-netzbetreiber or ÜNB), onshore wind energy in Germany produced 65 TWh of power in the first half of 2020; 13% more than in the first six months of the previous year. Of the 65 TWh, about 30% was generated in February alone due to favorable wind conditions.

The average power market values per kilowatt hour for onshore wind energy dropped to below 1 ct/kW in connection with the COVID 19 pandemic in spring. In June, however, there were already signs of a recovery. Nevertheless, the volume-weighted average market value in the first half of the year was 1.9 ct/kWh. Compared to the annual average in 2019, this corresponds to a market value reduction of 40%.



Monthly Market Values for Onshore Wind Energy (Database: Netztransparenz)



Projection of Power Production by Onshore WTG (Database: Netztransparenz Projection Data)

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. Over 40 services lead to extraordinary synergistic effects between departments. Whether due diligence, market analysis, contract & tenders or feasibility studies: every single one of them contains the expertise and knowhow of the whole WindGuard Group. WindGuard has been publishing the semi-annual statistics on wind energy development since 2012.

About Bundesverband Windenergie e.V. (BWE)

BWE, a member of Bundesverband Erneuerbare Energie [German Renewable Energy Federation (BEE)] with more than 20,000 members, represents the entire industry. Members of BWE include the mechanical engineering industry's suppliers and manufacturers; project developers; specialist jurists; the financial sector; companies from the fields of logistics, construction, service/maintenance and storage technology; electricity traders; network operators; and energy suppliers. As a result, BWE is the primary contact for politics and business, science and the media.

About VDMA Power Systems

VDMA Power Systems is an association of the Mechanical Engineering Industry Association (VDMA). It represents the interests of manufacturers of wind energy and hydroelectric plants, fuel cells, gas/steam turbines and systems and engine systems in Germany and abroad. For all of these manufacturers, VDMA Power Systems serves as an information and communication platform for all topics within the industry, such as energy policy, legislation, market analyses, trade fairs, standardization, and press and public relations.