DEUTSCHE WINDGUARD

Status of Land-based Wind Energy Development in Germany

Year 2018

On behalf of

BWE Bundesverband WindEnergie

VDMA Power Systems

Contents

Notes

The data from 2012 onward was obtained through surveys with industry representatives, as well as additional research. The basis of the data for the years 1992 – 2011 are analyses of the DEWI.
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. BNetzA Installations Core Data) exhibit a deviating data inventory.

Photo on Title Page

Contact

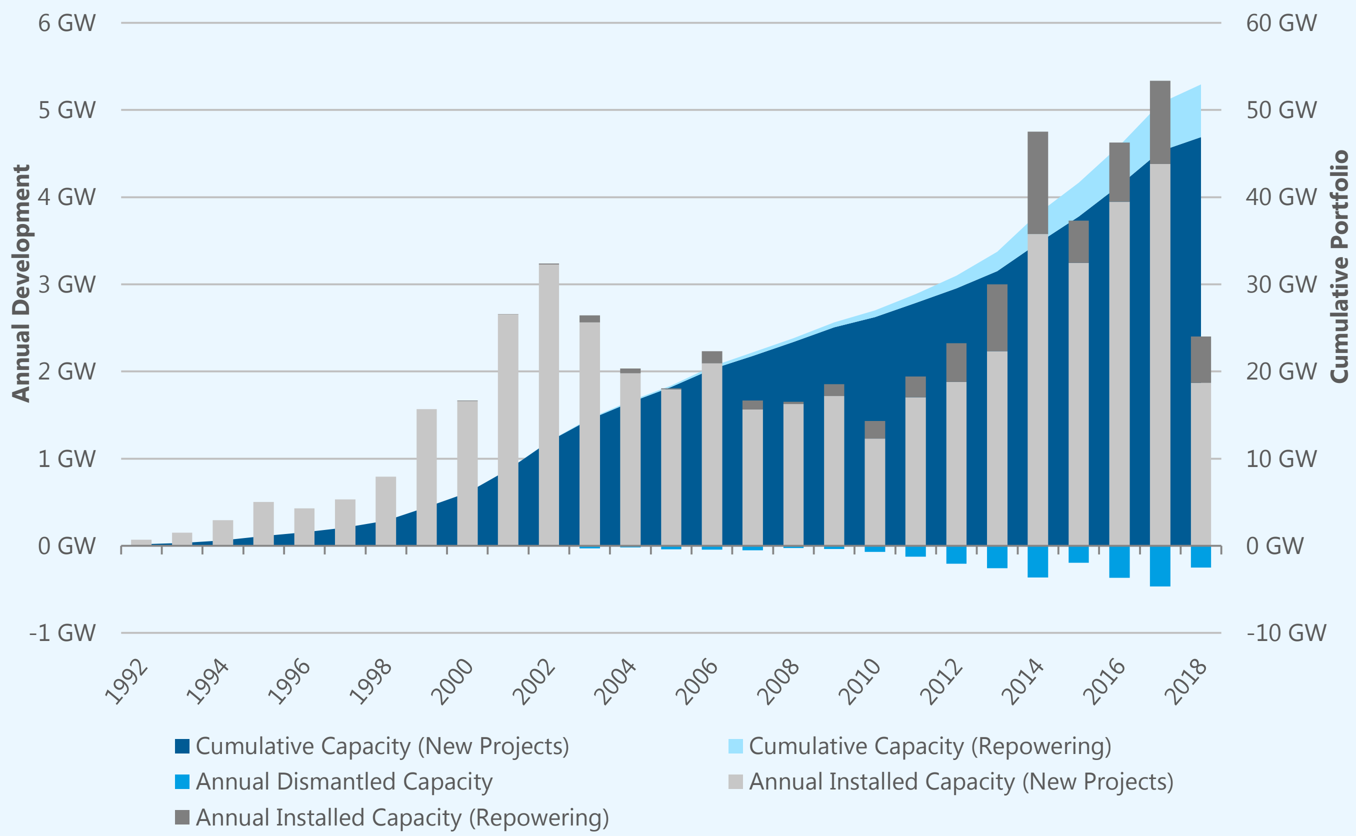
Deutsche WindGuard GmbH
Oldenburger Strasse 65
26316 Varel, Germany
Phone +49 (4451) 9515-0
Fax +49 (4451) 9515-29
Email info@windguard.de
URL http://www.windguard.com/

Net and Gross Wind Energy Additions

Over the course of 2018, 743 wind turbine generators (WTG) were erected in Germany. This is equivalent to a gross addition of 2,402 MW. Following several years marked with considerable additions, this is a sizeable decline. Compared to 2017, 55% less capacity was installed. Bearing in mind the dismantling of 205 WTG with a combined capacity of 249 MW, the resulting net additions for 2018 are 2,154 MW. The recorded cumulative turbine portfolio subsequently increased to 29,213 WTG with an overall capacity of 52,931 MW by December 31st, 2018.

Status of Land-based Wind Energy Development

		Capacity	Number
Development Year 2018	Gross additions	2,402 MW	743 WTG
	Repowering share (non-binding)	363 MW	111 WTG
	Dismantling (incl. subsequent registration) (non-binding)	249 MW	205 WTG
	Net additions	2,154 MW	538 WTG
Cumulative 2018-12-31	Cumulative WTG portfolio (non-binding)	52,931 MW	29,213 WTG



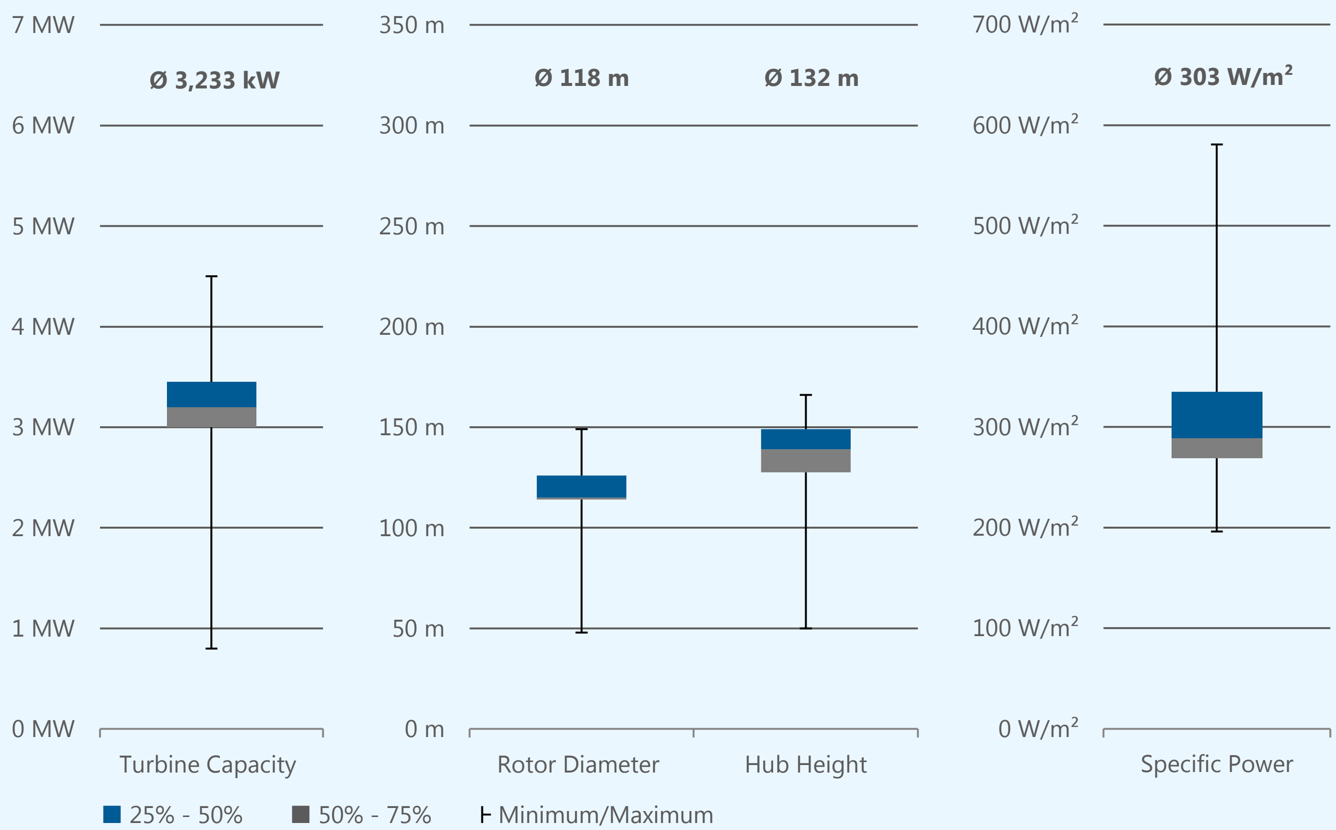
Annual Development Land-based Wind Energy in Germany

Average Wind Turbine Generator Configuration

The average turbine configuration of newly installed wind turbine generators is described by the parameters of nominal capacity, rotor diameter, hub height and specific capacity. The specific area capacity is the result of the nominal capacity in relation to the area swept across by the rotor.

In contrast to the previous year, in particular the nominal capacity of WTG developed an upward trend and increased by 9% to 3,233 MW. Rotor diameter and hub height also increased – each by 4% compared to the previous year – to 118 meters and 132 meters, respectively. The specific area capacity of 303 W/m^2 was 2% lower compared to the year before.

The range of turbine configurations used in Germany is very large. The box plot diagram below shows this clearly: of individual WTG the nominal capacity, for example, is between 0.8 and 4.5 MW. Most turbines (depicted by quartiles), however, have a capacity of 3 to 3.45 MW.

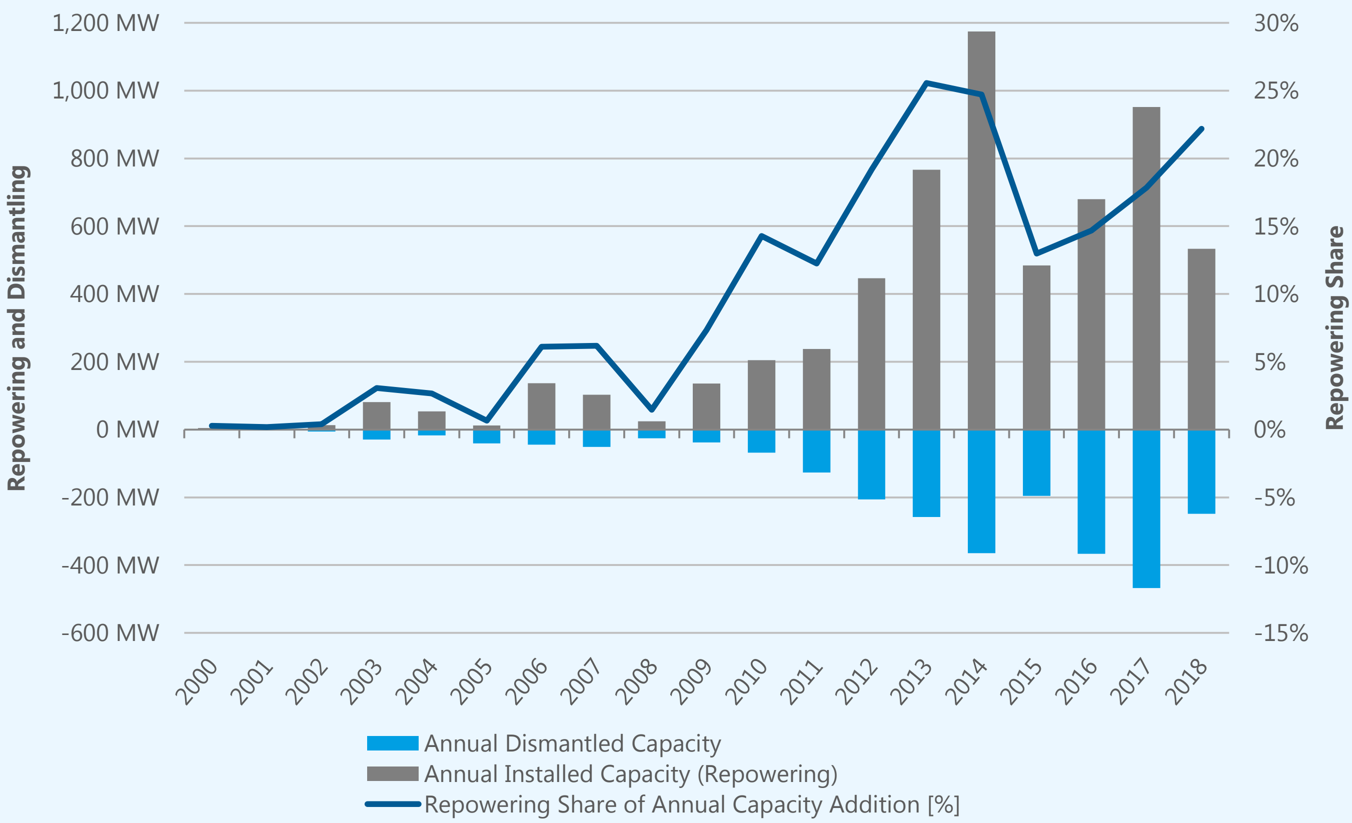


Range of Configuration Values of newly installed WTG

Dismantling and Repowering

Over the course of 2018, 205 dismantled WTG with an overall capacity of 249 MW were captured. A portion of these were replaced by 111 new WTG in the framework of repowering. These repowering WTG had an overall capacity of 363 MW. With that, the newly installed repowering capacity dropped in comparison to the previous year, but the repowering share of the gross additions of 2018 continued to increase succeeding the decrease after the elimination of the repowering bonus in 2014.

The dismantling capturing includes late registrations from the previous year, as well as decommissionings published in the installations core data of the German Federal Network Agency (German: Bundesnetzagentur or BNetzA). The identification of WTG dismantled in the past is subject to increased uncertainty and may assumedly remain incomplete despite the capturing of late registrations.



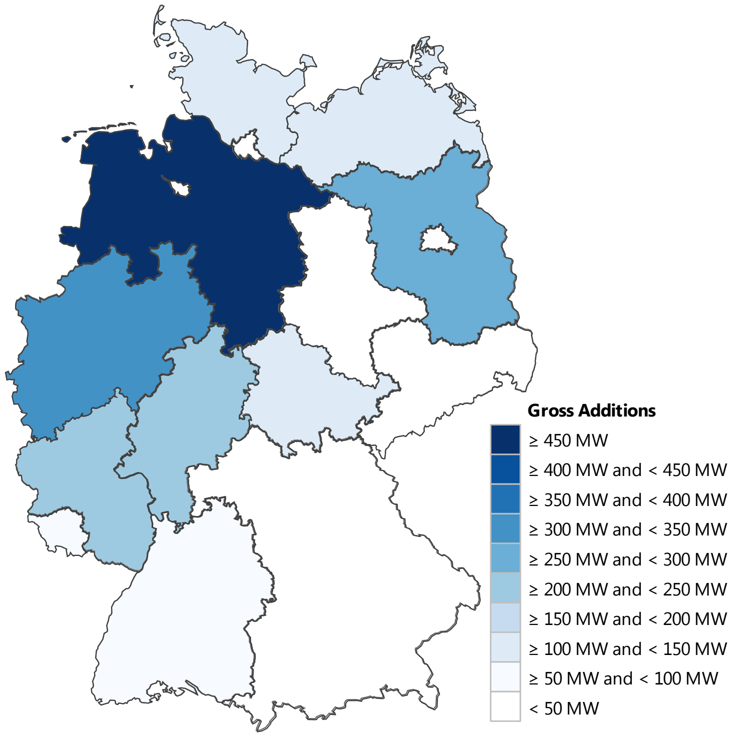
Repowering Share, annual installed Repowering Capacity and dismantled Capacity

Regional Distribution of Wind Energy Additions

Compensation elements differentiated by location allowed for wind energy development to reach far inland. Subject to a variety of factors (land availability, regional political decisions etc.) additions in the German Federal States took place inconsistently.

Although only about half of the turbines can be considered new installations, just as in the previous year Lower Saxony is the state with the largest gross additions for 2018. North Rhine-Westphalia and Brandenburg are trailing at a noticeable distance.

The average turbine configuration also displays distinct differences across the federal states. Schleswig-Holstein, Hamburg and Bremen, in particular, stand out with on average very low hub heights. In comparison, larger hub heights and a lower specific area capacity are common in the south.



Regional Distribution of Gross Capacity Additions

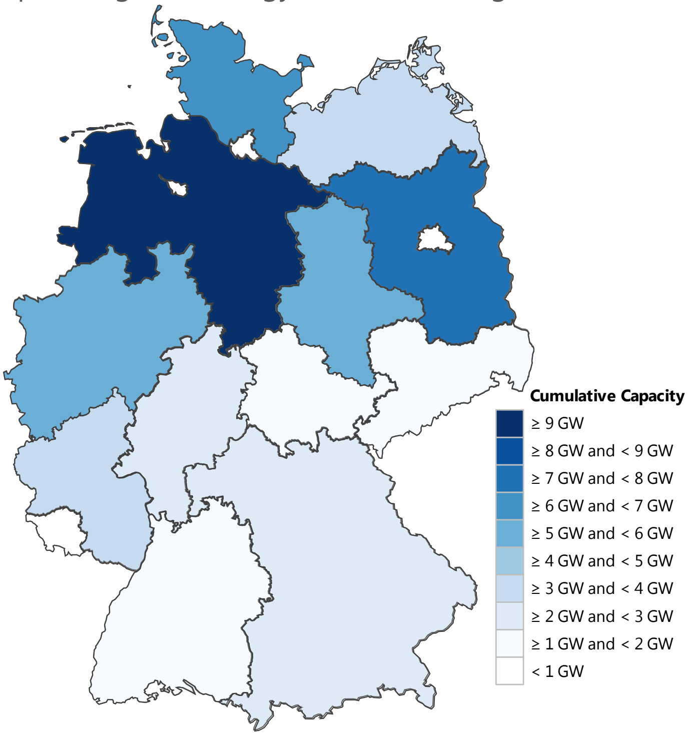
Addition (gross) and Average Configuration of newly installed WTG in the German Federal States

Position	State	Gross Additions in 2018			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	Lower Saxony	718 MW	206 WTG	29,9%	3,483 kW	120 m	132 m	317 W/m²
2	North Rhine-Westphalia	331 MW	106 WTG	13,8%	3,120 kW	116 m	140 m	302 W/m²
3	Brandenburg	289 MW	91 WTG	12,0%	3,181 kW	120 m	135 m	284 W/m²
4	Hesse	220 MW	70 WTG	9,1%	3,136 kW	118 m	145 m	288 W/m²
5	Rhineland-Palatinate	203 MW	66 WTG	8,4%	3,070 kW	117 m	143 m	289 W/m²
6	Schleswig-Holstein	147 MW	49 WTG	6,1%	2,992 kW	103 m	92 m	365 W/m²
7	Mecklenburg-Western Pomerania	127 MW	38 WTG	5,3%	3,330 kW	120 m	119 m	300 W/m²
8	Thuringia	112 MW	33 WTG	4,7%	3,405 kW	121 m	132 m	300 W/m²
9	Baden-Württemberg	87 MW	26 WTG	3,6%	3,362 kW	123 m	143 m	283 W/m²
10	Saarland	60 MW	21 WTG	2,5%	2,857 kW	116 m	140 m	269 W/m²
11	Saxony-Anhalt	33 MW	11 WTG	1,4%	2,991 kW	113 m	123 m	304 W/m²
12	Saxony	31 MW	10 WTG	1,3%	3,050 kW	112 m	117 m	305 W/m²
13	Bavaria	22 MW	8 WTG	0,9%	2,731 kW	116 m	133 m	261 W/m²
14	Bremen	13 MW	4 WTG	0,5%	3,200 kW	113 m	104 m	319 W/m²
15	Hamburg	11 MW	4 WTG	0,5%	2,850 kW	117 m	91 m	265 W/m²
16	Berlin	0 MW	0 WTG	0,0%				
	Germany	**2,402 MW**	**743 WTG**		**3,233 kW**	**118 m**	**132 m**	**303 W/m²**

Regional Distribution of the Cumulative Portfolio

The cumulative turbine portfolio is also distributed across the entire Federal Republic of Germany. In all federal states, WTG are being operated and contribute to the energy production transformation. While the undeniably largest number of WTG and largest installed capacity is found in Lower Saxony, the largest WTG portfolio in relation to the land area is found in Schleswig-Holstein. In the south, where development started later on, the portfolio is smaller. The northern federal states incorporate 41% of the overall capacity, the share of the federal states in the middle of the country is 43% and the remaining 15% of the cumulative capacity are found in the southern states.

The data presented here differ from other publications due to the presumably incomplete capture of dismantling and due to inconsistent definition and systematics. These deviations might be solved in the future by evaluation of the upcoming core energy market data register.



Regional Distribution of the Cumulative Capacity

Cumulative Capacity and Number of WTG in the German Federal States

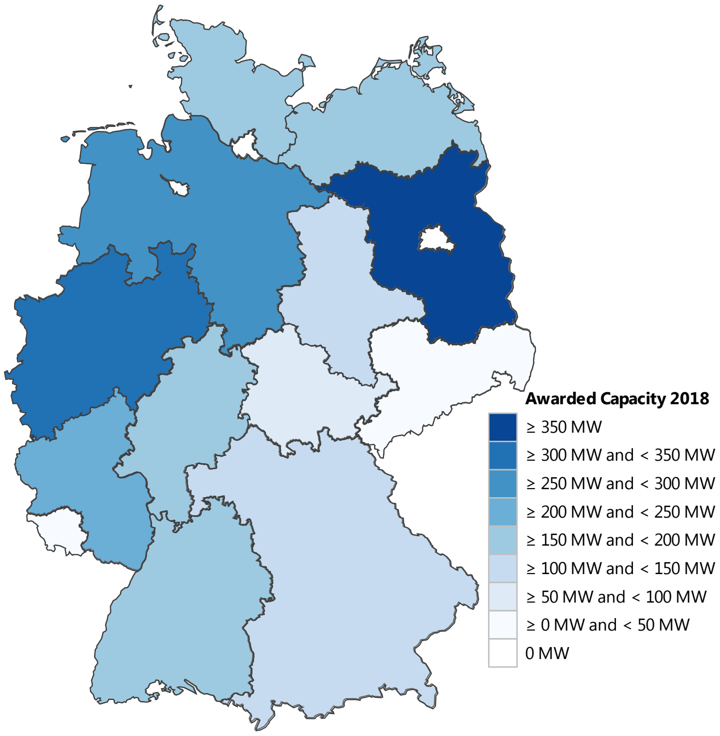
Region	State	Cumulative Portfolio (2018-12-31) Capacity		Number	
North	Lower Saxony	11,165 MW		6,305 WTG	
North	Schleswig-Holstein	6,964 MW	or 6,536 MW*	3,661 WTG	or 2,959 WTG*
North	Mecklenburg-Western Pomerania	3,366 MW		1,920 WTG	
North	Bremen	198 MW		91 WTG	
North	Hamburg	128 MW		65 WTG	
Central	Brandenburg	7,081 MW		3,821 WTG	
Central	North Rhine-Westphalia	5,773 MW		3,726 WTG	
Central	Saxony-Anhalt	5,139 MW		2,862 WTG	
Central	Hesse	2,201 MW		1,159 WTG	
Central	Thuringia	1,567 MW		859 WTG	
Central	Saxony	1,227 MW		899 WTG	
Central	Berlin	12 MW		4 WTG	
South	Rhineland-Palatinate	3,589 MW		1,748 WTG	
South	Bavaria	2,515 MW		1,161 WTG	
South	Baden-Wuerttemberg	1,529 MW		725 WTG	
South	Saarland	476 MW		207 WTG	
		52,931 MW		**29,213 WTG**	

*Turbine Portfolio subject to approval according to LLUR Schleswig-Holstein

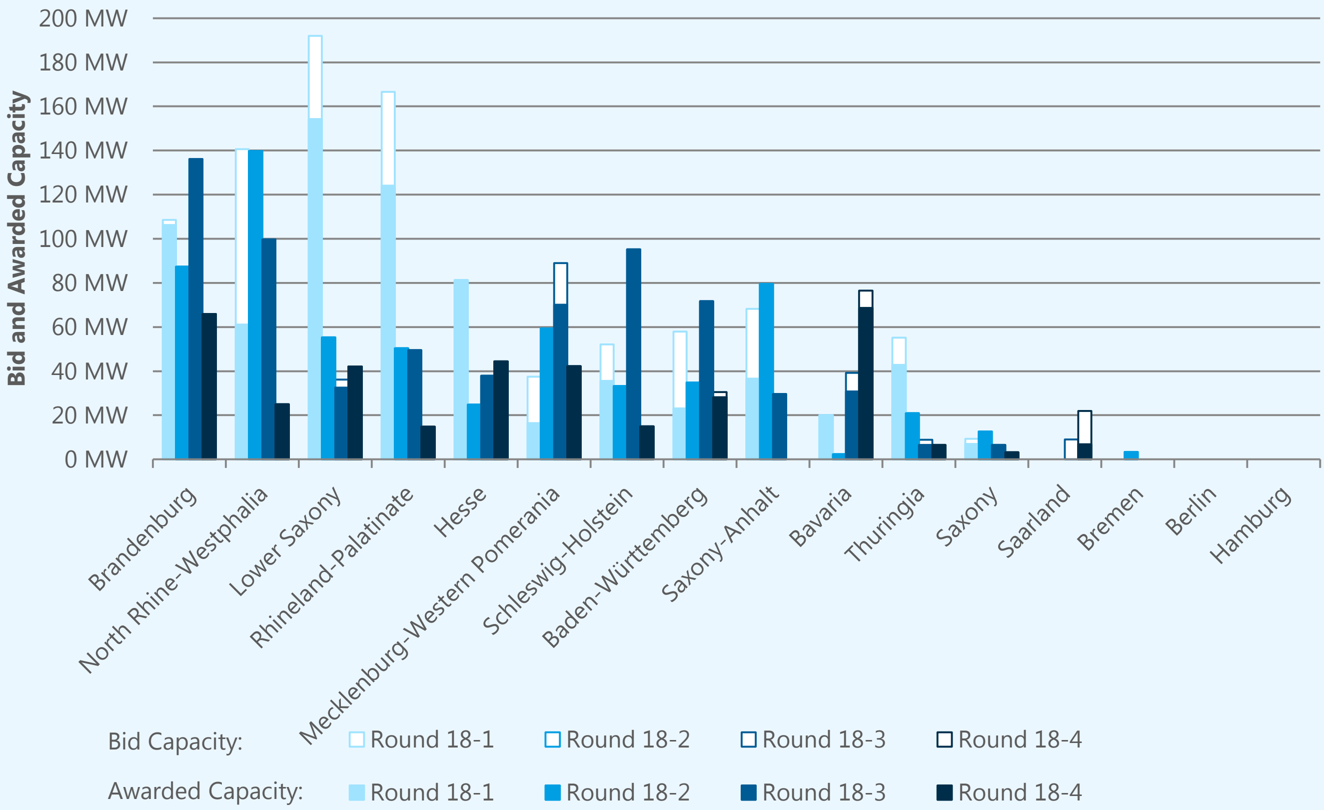
Regional Distribution of Awarded Bids

In Germany, a total capacity of 2,343 MW was awarded to land-based wind energy in 2018 in four technology-specific tendering rounds. The tendering volume of 2,710 MW, which was available in these rounds, was thus not exhausted. The low competition in the last three tendering rounds of 2018 led to all projects that were not excluded (e.g. due to formal reasons) receiving an award. Hence, there is a pronounced correlation between the regional distribution of the bids and awards.

Deviating from the three tendering rounds in 2017, the rounds of 2018 only allowed projects to participate that had received approval according to the Federal Immission Control Act (German: Bundes-Immissionsschutzgesetz or BImSchG). This put a considerable limit on the pool of projects admitted to the call for tenders compared to the previous year.



Regional Distribution of Awarded Capacity (Database: BNetzA)



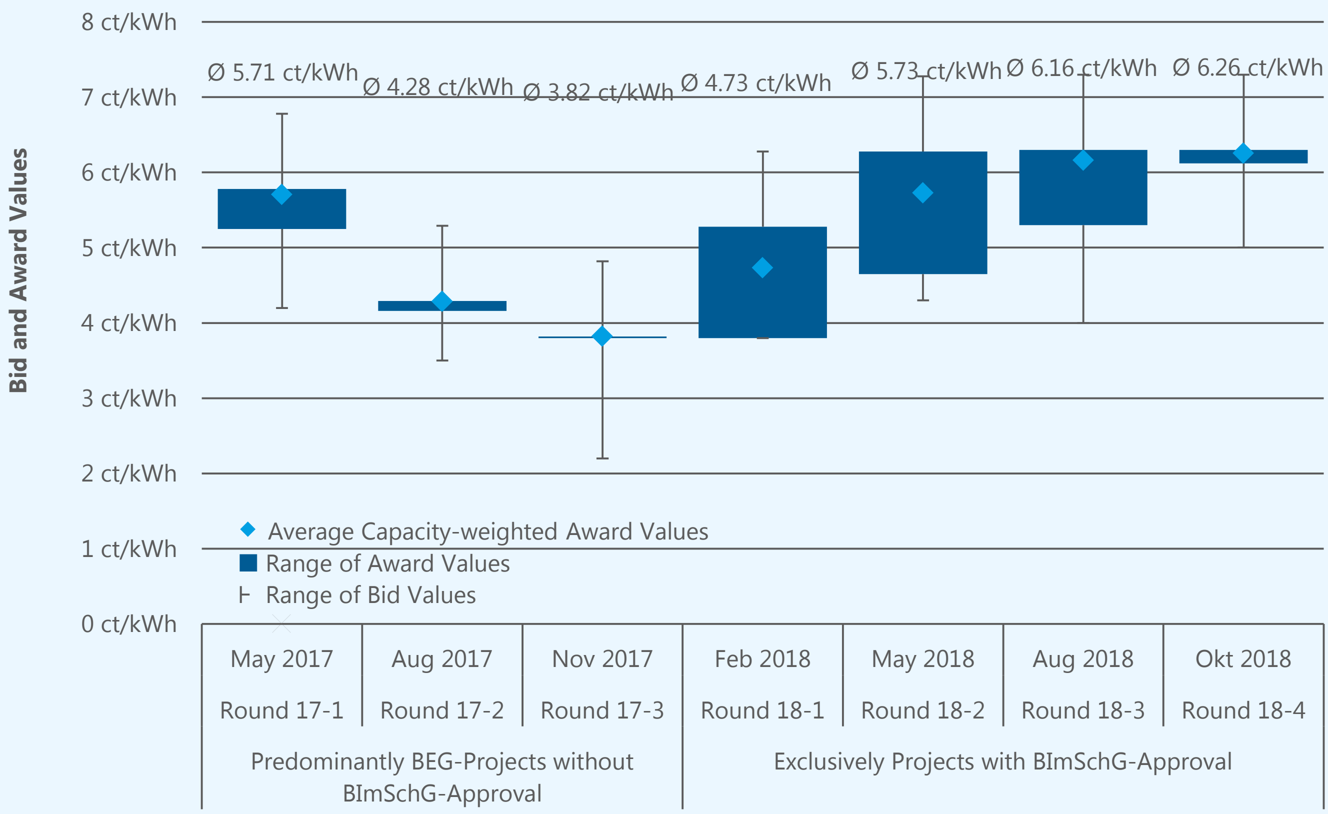
Regional Distribution of Awarded Capacity across the German Federal States (Database: BNetzA)

Bid and Award Values of the Tenders

In the tenders for land-based wind energy, award is given to bidders providing the lowest bid value for a project at the reference location. In case the bidders are citizens' energy cooperatives (German: Bürgerenergiegesellschaften or BEG), the bid value is corrected according to the unit-price process and the attributable award value is equivalent to the in each case highest awarded bid value. For regular projects without citizens' involvement according to the Renewable Energy Sources Act (German: Erneuerbare-Energien-Gesetz or EEG) the bid value is equivalent to the award value. Possible bid values are limited by a maximum value, which in 2018 was 6.3 € cents/kWh.

The bid, as well as the award values of the tendering rounds have increased notably compared to the previous year. However, the values cannot be compared directly, because in 2017 the exceptions for BEGs were further-reaching and provided for long implementation deadlines, whereby future turbine technologies could be used in the planning process and comparatively lower bids could be submitted. Since 2018, a BImSchG permit is required for participation, which in turn shortened the implementation deadlines. At the same time, due to the low participation in the tender process, only the first of the four rounds saw any competition. The volume-weighted average award value of the four tendering rounds of 2018 was 5.6 € cents/kWh.

The values to be applied that are decisive for the expected proceeds per kilowatt-hour of the awarded WTG result out of the adaptation of the award values with the help of location-specific correction factors. Thereby applicable: If the project has an energy yield higher than the reference yield, the award value will be corrected downward; is a lower energy yield achieved, the value to be applied will be above the award value.

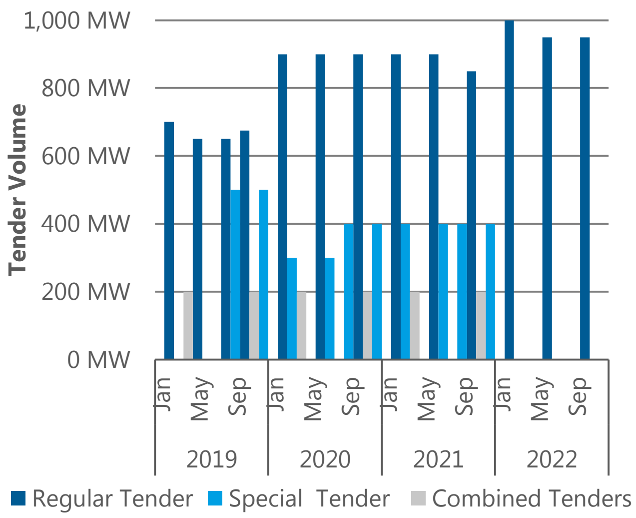


Development of Awarded Bids of Tender Rounds for Land-based Wind Energy (Database: BNetzA)

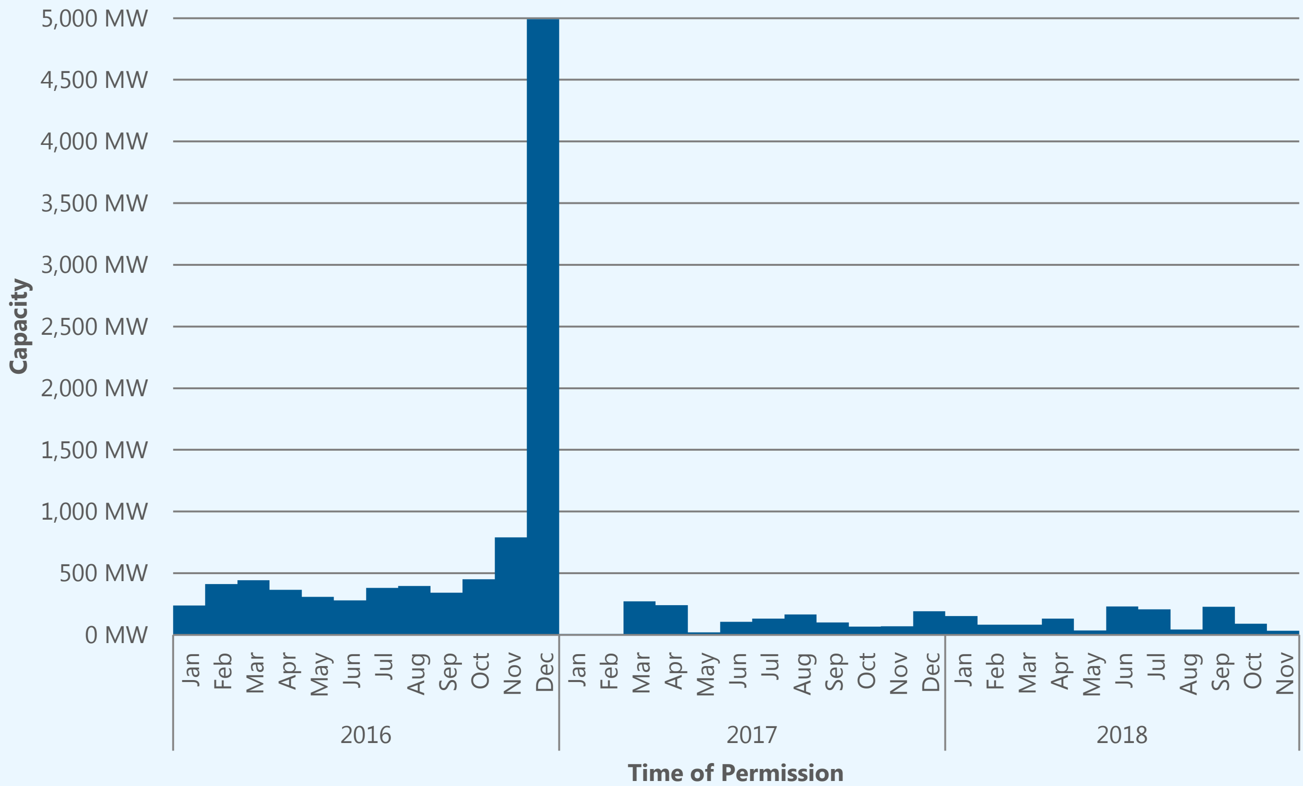
Permitted Capacity and Future Tender Rounds

With the Omnibus Energy Act (German: Energiesammelgesetz) the tender volumes of the next three years for land-based wind energy was significantly increased through the establishment of special calls for tenders. In 2019, a total capacity of 3,675 MW is to be awarded, 4,100 MW and 4,250 MW, respectively, are announced for 2020 and 2021. Projects have an additional possibility to persevere against PV in combined tenders.

To fill named tender volumes, a sufficient number of approved projects have to participate. Following BNetzA, by the 2019-01-11 deadline for the February 2019 round 1,840 MW were reported as approved and are therefore eligible for participation. About half of that (914 MW) falls on WTG for which the installation deadline to participate in the transitional system at the end of 2018 expired and which as a result can now participate in the tenders to secure funding for themselves. The other half is comprised of projects that were approved starting in 2017 but did not receive an award to date, as well as projects with older approvals that declined participation in the transitional system from the onset.



Tender Volume 2019 to 2022 (according to the EEG and EnSaG)

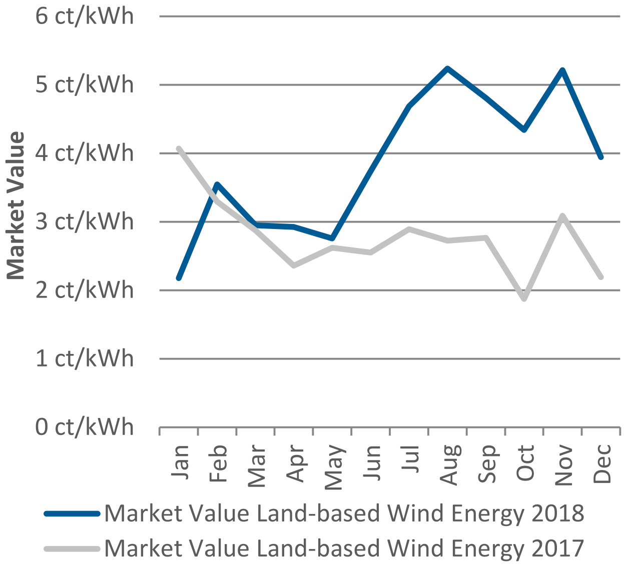


Monthly Permit Amount since 2016 (Database: BNetzA installations core data, Version 11/18)

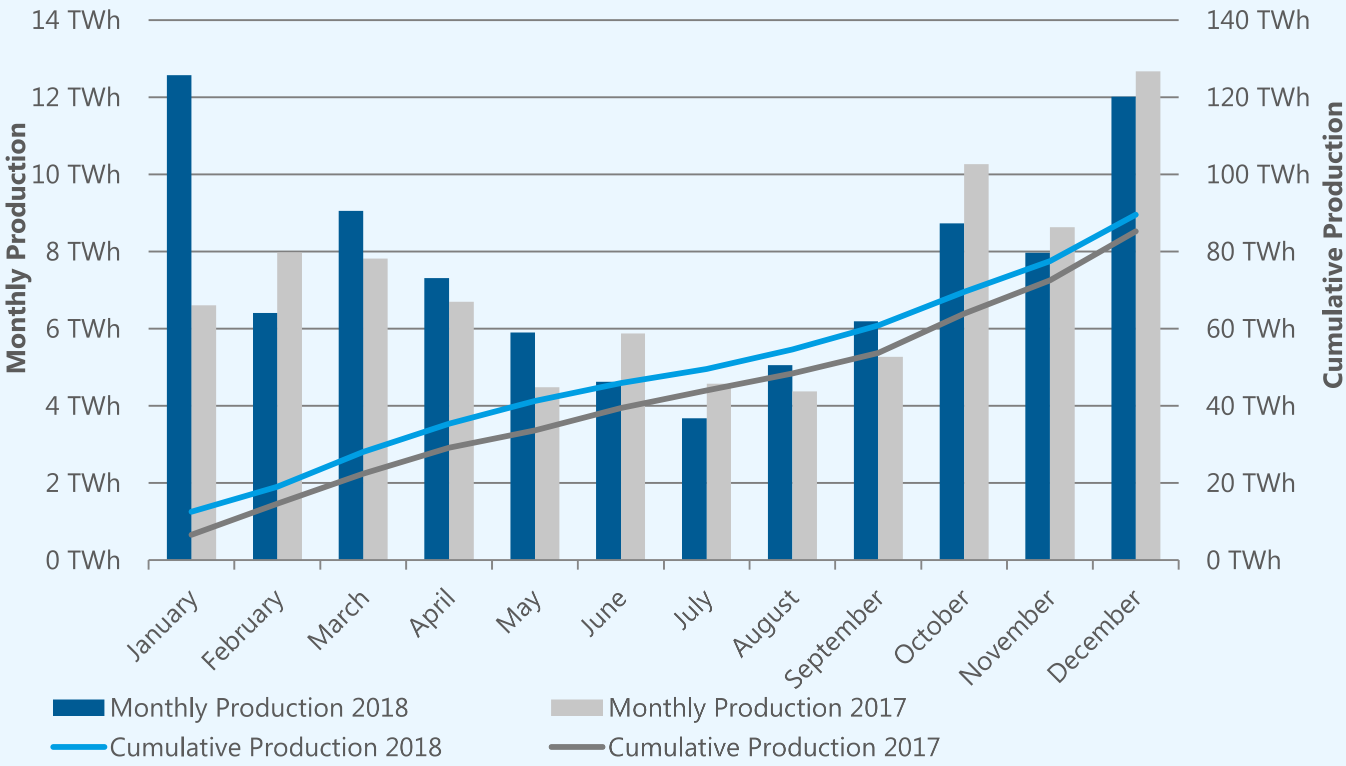
Monthly Power Production and Market Values

According to the data forecasted by transmission grid operators, land-based wind turbine generators in Germany produced 89.5 TWh of electricity over the course of 2018. Compared to the previous year this is equivalent to an increase of 4%.

The average volume-weighted power market proceeds per kilowatt-hour for land-based wind energy (monthly market values) increased from about 3 € cents/kWh to up to 5.2 € cents/kWh since May of 2018. Overall, the average volume-weighted power market value of 3.7 € cents/kWh for 2018 was 37% above the 2.7 € cents/kWh from the previous year.



Monthly Market Values for Land-based Wind Energy (Database: Netztransparenz)



Projection of Power Production by Land-based 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 a division of the non-profit German Engineering Federation (VDMA). The association represents the interests of manufacturers of wind turbines and hydroelectric plants, fuel cells, gas/steam turbines and plants and engine systems at home and abroad. VDMA Power Systems serves them all as an information and communication platform for all industry issues, such as energy policy, energy policy, legislation, market analyses, trade fairs, standardisation, and press and public relations.