

**Year
2015**

DEUTSCHE
WINDGUARD

STATUS OF LAND-BASED WIND ENERGY DEVELOPMENT IN GERMANY

On behalf of:



STATUS OF LAND-BASED WIND ENERGY DEVELOPMENT

This factsheet describes the status of land-based wind energy development in Germany. In addition to new construction in 2015 and cumulative turbine portfolio, turbine configuration and regional distribution are presented.

NET AND GROSS ADDITIONS

The net capacity additions during the year 2015 came to 3 536 MW, which equates to 1 115 wind turbine generators (WTG). The net additions result out of the gross additions of 1 368 WTG with a capacity of 3 731 MW and the dismantling of 253 WTG with a capacity of 195 MW. Contained in the gross additions are 176 repowering turbines with a cumulative capacity of 484 MW. The numbers pertaining to the wind energy additions status are depicted in Table 1.

Table 1: Status of land-based wind energy development (31 December 2015)

	Status of land-based wind energy development	Capacity [MW]	Number of WTG
Development year 2015	Net additions during 2015	3 535.77	1 115
	Gross additions during 2015	3 730.95	1 368
	Repowering share (non-binding)	484.10	176
	Dismantling in 2015 (incl. subsequent registration) (non-binding)	195.18	253
Cumulative 31.12.2015	Cumulative WTG portfolio Status: 31.12.2015 (non-binding)	41 651.50	25 982

The development of additions to wind energy in Germany over time is depicted in Figure 1. The year 2015 had the second largest gross additions since the beginning of wind energy development in Germany. However, the gross additions in 2015 are about 1 019 MW below those of the previous year and thus decreased by about 21%.

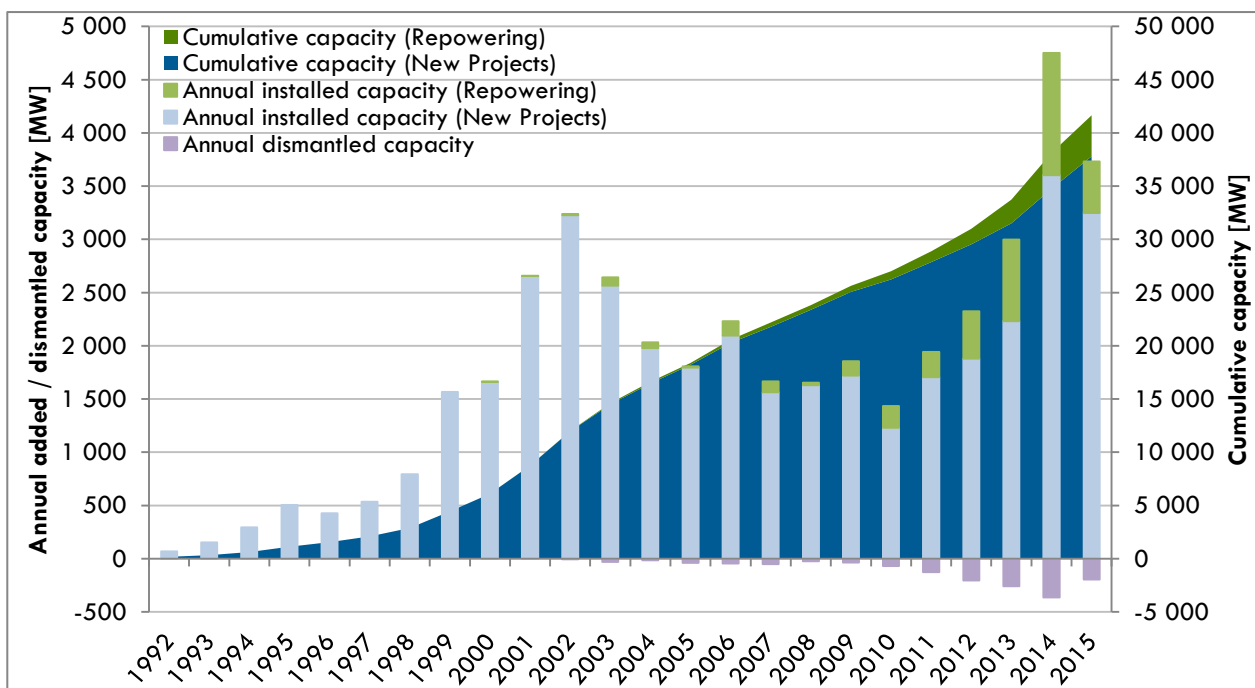


Figure 1: Development of the annual installed and cumulative capacity [MW] of land-based wind energy in Germany incl. repowering and dismantling, status: 31 December 2015

DISMANTLING

Without the financial incentive of a remuneration bonus for repowering projects, old WTG are dismantled if they can no longer be operated economically profitable, the state of their technology does not allow for continued operation or the pressure concerning land availability is very high. With the going-into-effect of the Renewable Energy Law (EEG) 2000, all WTG currently operating receive at least the base remuneration as WTG installed prior to 2000 were guaranteed to be eligible for this remuneration until 2020. An increase in dismantling of WTG can be expected from 2021 onwards.

253 WTG with a capacity of 195 MW were identified as dismantled in 2015. Included in that number is a reconciliation of WTG taken out of service as published in the central WTG register, as well as recognizing subsequent notifications from the previous year. The dismantling of WTG is 46% lower than in the previous year. The average capacity of dismantled WTG was 771 kW and is thus 15% higher than the average capacity of a WTG dismantled in 2014.

REPOWERING

Due to the discontinuation of the repowering bonus with the 2014 amendment to the EEG, the definition of repowering WTG is being narrowed. Prior to the amendment, each WTG that replaced at least one old WTG in the same or an adjacent county received the repowering bonus and was thus identified as a repowering WTG. Without this bonus, the term repowering is now used if a new WTG replaces an existing one. It can be assumed that this is taking place in spatial relation. WTG will no longer be classified as repowering turbines if old ones in adjacent counties are dismantled.

In the framework of the statistical data collection for 2015, 176 WTG of those 1 368 erected during this year could be identified as repowering WTG. With a total capacity of 484 MW, this is equivalent to a repowering share of about 13% of the gross additions for 2015. The repowered WTG possess an average capacity of 2 751 kW.

CUMULATIVE PORTFOLIO AND TURBINE REGISTER

Taking into consideration the net additions of 2015, by the end of that year a total of 25 982 WTG with a cumulative capacity of 41 652 MW were installed in Germany. It should be noted that the cumulative values in particular are non-binding and that they were most likely overestimated due to the underestimation of dismantling during previous years. With the last amendment to the Renewable Energy Law (EEG), which took effect 1 August 2014, a central WTG register was established. Through mandatory reporting by WTG operators, WTG addition, repowering and dismantling are captured by it. The register provides for reliable and comprehensive data about repowering and dismantling from August 2014 onward. WTG that were dismantled prior to the EEG 2014 going into effect are not captured retroactively. It must be noted that in the register the commissioning of WTG is used as the allocation criteria for a particular year. In comparison, the development statistic at hand captures the erection of WTG. Since a certain amount of time passes between the erection and the commissioning of WTG, the capture of part of the WTG into the WTG register ends up getting pushed into the following year.

AVERAGE WIND TURBINE GENERATOR CONFIGURATION

On average, a WTG erected in Germany in 2015 had a nominal capacity of 2 727 kW. In comparison to the average capacity of installations in the previous year, this equated to an increase of about 1%. The average rotor diameter increased by about 6% to 105 meters compared to 2014. The same increase of about 6% to 123 meters on average was determined for the hub height of WTG erected

Table 2: Average turbine configuration of WTG installed in 2015, status: 31 December 2015

Average Land-based WTG Configuration, installed in Year 2015		
Year 2015	Average Turbine Capacity	2 727 kW
	Average Rotor Diameter	105 m
	Average Hub Height	123 m
	Average Specific Area Capacity	326 W/m ²

in 2015. With an average specific area capacity of 326 W/m² it is clear that the trend to WTG with a large rotor area compared to their capacity is continuing. In comparison to the previous year, the specific area capacity decreased by 10%. The numbers pertaining to the average WTG configuration are shown in Table 2.

The increase of the average nominal capacity of WTG erected annually over time is depicted in Figure 2. Also shown is how the mean WTG capacity developed relative to the total number of WTG in Germany. At the end of 2015 the average capacity of WTG in the cumulative portfolio came to about 1 603 kW. In comparison to the previous year, this corresponds to a 4.6% increase in average capacity.

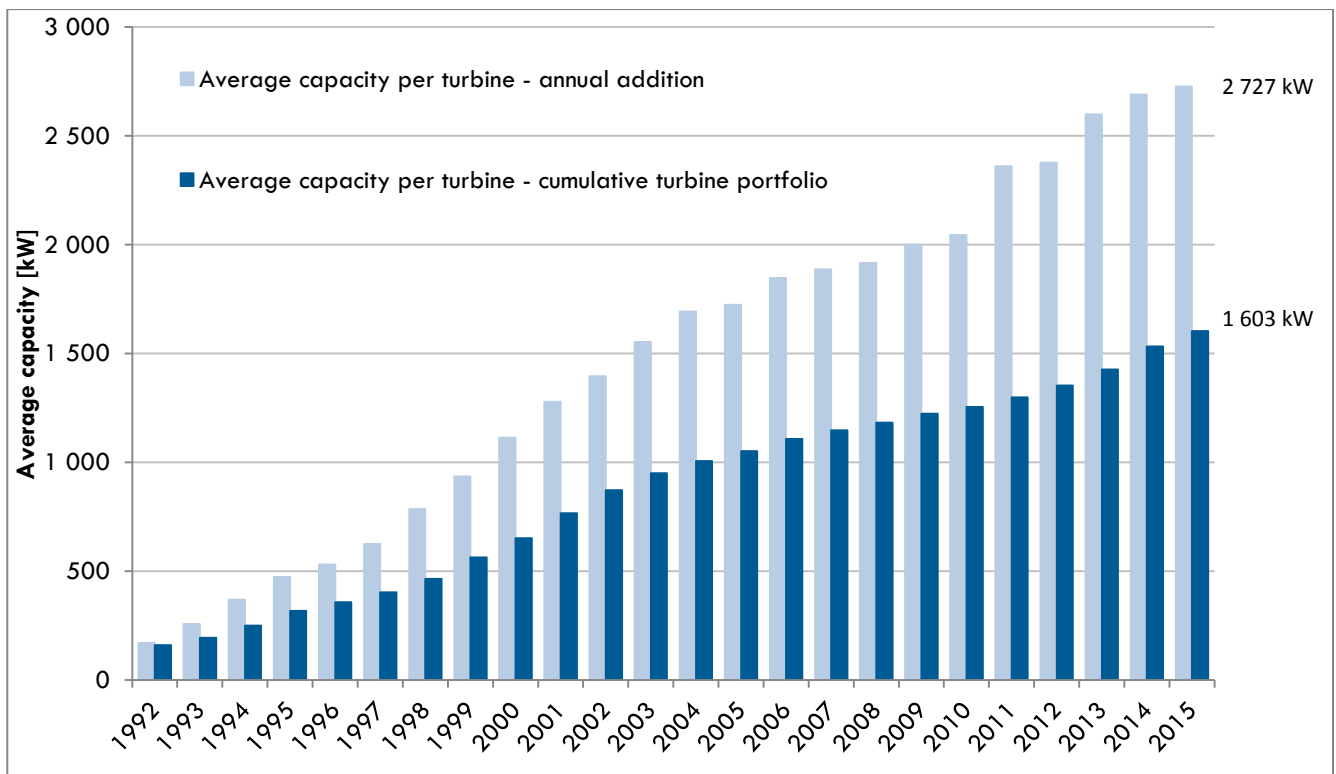


Figure 2: Development of the average capacity of land-based WTG newly installed and cumulatively present in the German turbine portfolio, status: 31 December 2015

REGIONAL DISTRIBUTION OF WIND ENERGY DISTRIBUTION

For the third year in a row, Schleswig-Holstein leads the comparison between German states with respect to the gross addition. With the erection of 888 MW, Schleswig-Holstein loses 3.6 percentage points from the portion of the total addition. With an installed capacity of 422 MW, North Rhine-Westphalia experienced a distinct increase of the nominal, as well as proportional addition compared to installations during the previous year and subsequently came in second place. Lower Saxony comes in third place with an installed capacity of 413 MW and an 11% portion of the federal addition. With 144 MW, by far the most distinct increase of additional capacity compared to 2014 was achieved in Baden-Württemberg. The regional distribution of the gross addition, as well as the average WTG configuration according to the German states are shown in Table 3.

Table 3: Gross additions to wind energy in the German states in the 2015, status: 31 December 2015

Rank	State	Gross additions – year 2015			Average turbine configuration			
		Gross capacity additions [MW]	Gross additions number WTG	Share of added capacity of gross addition	Average turbine capacity [kW]	Average rotor diameter [m]	Average hub height [m]	Average specific area capacity [W/m ²]
1	Schleswig-Holstein	888.35	307	23.8%	2 894	103	96	352
2	North Rhine-Westphalia	421.65	167	11.3%	2 525	97	122	346
3	Lower Saxony	413.30	152	11.1%	2 719	99	121	357
4	Brandenburg	398.05	148	10.7%	2 690	109	133	294
5	Bavaria	372.40	143	10.0%	2 604	114	141	260
6	Saxony-Anhalt	264.45	97	7.1%	2 726	99	126	362
7	Hesse	207.70	75	5.6%	2 769	115	141	271
8	Rhineland-Palatinate	201.20	72	5.4%	2 794	105	136	327
9	Mecklenburg-Western Pomerania	193.05	68	5.2%	2 839	102	131	357
10	Baden-Württemberg	144.05	52	3.9%	2 770	113	138	281
11	Thuringia	76.55	26	2.1%	2 944	109	133	316
12	Saxony	69.05	30	1.9%	2 302	90	108	362
13	Saarland	63.85	23	1.7%	2 776	116	142	265
14	Hamburg	8.00	4	0.2%	2 000	100	100	255
15	Berlin	4.70	2	0.1%	2 350	92	138	354
16	Bremen	4.60	2	0.1%	2 300	82	109	436
	Total	3 730.95	1 368	100%	2 727	105	123	326

In 2015, WTG with the highest average capacity (2 944 kW) were erected in Thuringia, those with the lowest (2 000 kW) in Hamburg. The average rotor diameters span between 82 meters in Bremen and up to 116 meters in the Saarland. With 142 meters, the WTG installed in the Saarland also have the highest hub heights. The on average lowest hub heights of 96 meters are found in Schleswig-Holstein. The highest, as well as the lowest average specific area capacity are installed in the city states. Trailing the city state of Hamburg with 255 W/m², Bavaria is the area state with the lowest specific area capacity averaging 260 W/m². Following Bremen with 436 W/m², Saxony and Saxony-Anhalt have the highest average specific area capacity of 362 W/m².

REGIONAL DISTRIBUTION OF WIND ENERGY DEVELOPMENT

The cumulative capacity and number of turbines according to the German states can be ascertained from Table 4. With 5 713 WTG and a total capacity of about 8 602.45 MW, Lower Saxony contributes the largest share of the installed capacity in Germany. Schleswig-Holstein follows with 5 896.57 MW in second place. With 5 849.56 MW in cumulatively installed capacity Brandenburg is in first place among the land-locked states and in third place federally. Combined at the end of 2015, the northern states comprise 42% of the cumulative installed capacity and central Germany 44 %.

Table 4: Cumulative capacity and number of turbines in the German states, status: 31 December 2015

Region / State		Cumulative Capacity [MW] Status: 30 th June 2015	Cumulative Number WTG Status: 30 th June 2015
North	Lower Saxony	8 602.45	5 713
	Schleswig-Holstein	5 896.57	3 435
	Mecklenburg Western Pomerania	2 884.32	1 788
	Bremen	170.81	84
	Hamburg	62.09	53
Central	Brandenburg	5 849.56	3 463
	Saxony-Anhalt	4 598.64	2 697
	North Rhine-Westphalia	4 080.32	3 174
	Hesse	1 386.52	886
	Thuringia	1 199.99	749
	Saxony	1 132.10	880
	Berlin	9.00	4
South	Rhineland-Palatinate	2 925.73	1 535
	Bavaria	1 892.77	937
	Baden-Württemberg	693.95	448
	Saarland	266.70	136
Total		41 651.50	25 982

Countrywide, 14% of the installed capacity is found in the southern states. Compared to the previous year, the share of the northern and central states decreased slightly. The share of installed capacity in the southern states increased slightly over the course of the year 2015. This also corresponds to the trend observed in the previous years.

Figure 3 shows the distribution of the cumulative capacity across the regions over time.

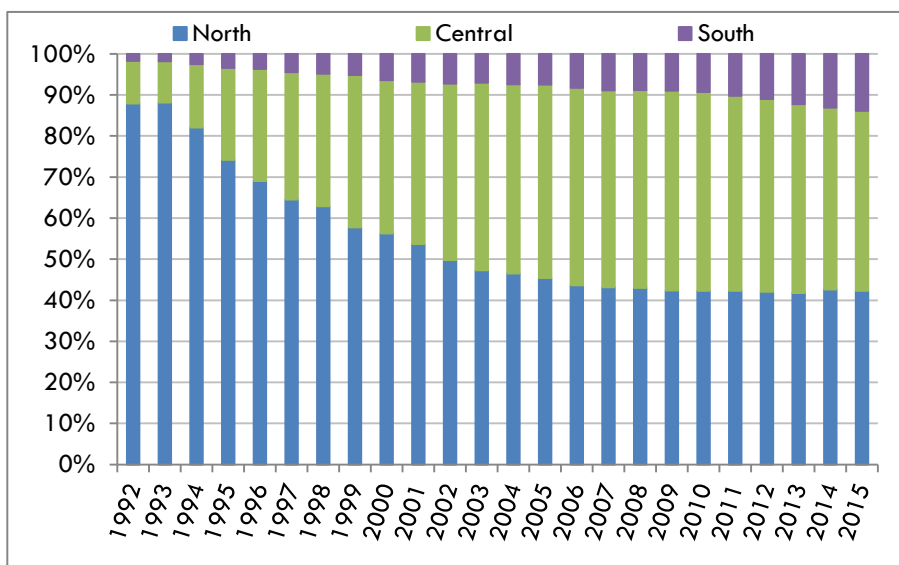


Figure 3: Distribution of the Germany-wide installed cumulative capacity across the regions, Status: 31 December 2015

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