

Year  
2014

DEUTSCHE  
**WINDGUARD**

## STATUS OF LAND-BASED WIND ENERGY DEVELOPMENT IN GERMANY

On behalf of:



Power Systems

**STATUS OF LAND-BASED WIND ENERGY DEVELOPMENT AS OF 31<sup>ST</sup> DECEMBER 2014**

This fact sheet presents the status of land-based wind energy development in Germany as of 31<sup>st</sup> December 2014 and analyses the development of additions during the year 2014. In the time period examined, 1 766 land-based wind turbine generators (WTG) with a total capacity of 4 750.26 MW were erected. At least 413 repowering turbines with a capacity of 1 147.88 MW are included in the gross addition. Furthermore, 544 dismantled WTG's with a capacity of 364.35 MW were identified.

An overview of the development in 2014 and the installed total capacity is presented in Table 1. As of 31<sup>st</sup> December 2014, a total of 24 867 WTG's with a total capacity of 38 115.74 MW

Table 1: Status of Land-Based Wind Energy Development in 2014

Status of Land-based Wind Energy Development		Capacity [MW]	Number [WTG]
Development 2014	Gross additions during first Half of 2014	4 750.26	1 766
	Repowering share (non-binding)	1 147.88	413
	Dismantling in first Half of 2014 (non-binding)	364.35	544
Cumulative 2014	Cumulative WTG portfolio Status: 30 June 2014	38 115.74	24 867

were installed. The data collected for repowering and dismantling are non-binding and most likely underestimated. As a result, the total portfolio runs the risk of being overestimated. The corresponding section deals with this topic in more detail.

The development of annual additions to wind energy capacity and the cumulative capacity over time is depicted in Figure 1. Compared to the previous record year of 2002 (with 3 240 MW), about 47 % more capacity was added in 2014. Regarding to the number of WTG's (2 321 WTG in 2002), the additions are about 24 % less in 2014.

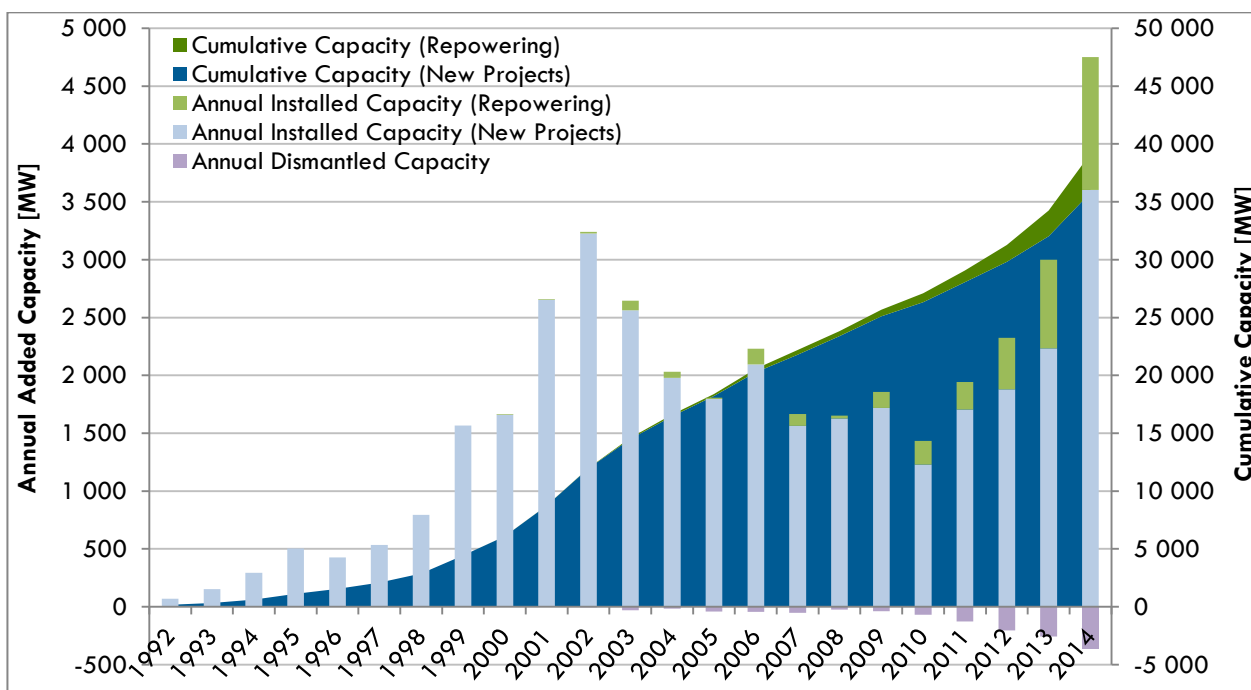


Figure 1: Development of the Annual Installed and Cumulative Capacity (MW) of Land-Based Wind Energy in Germany incl. Repowering and Dismantling, Status: 31<sup>st</sup> December 2014

## DISMANTLING AND REPOWERING

In accordance with the last REL (Renewable Energy Law or EEG) amendment that came into force on 1<sup>st</sup> August 2014, a central turbine register was established. The register is designed to capture additions to wind energy, as well as repowering and dismantling, in detail. Operators are obligated to provide relevant reports. Starting in August 2014, this resulted in the availability of reliable and comprehensive data for repowering and dismantling for the first time. The repowering turbines, as well as dismantled WTG's, captured by the turbine register between August and December 2014 were synchronized with this statistic and complemented by additional data collected specifically between January and July. In summary, for the entire year 2014 the data availability for repowering and dismantling has improved, however, the actual repowering and dismantling numbers assumedly are still higher than the collected data.

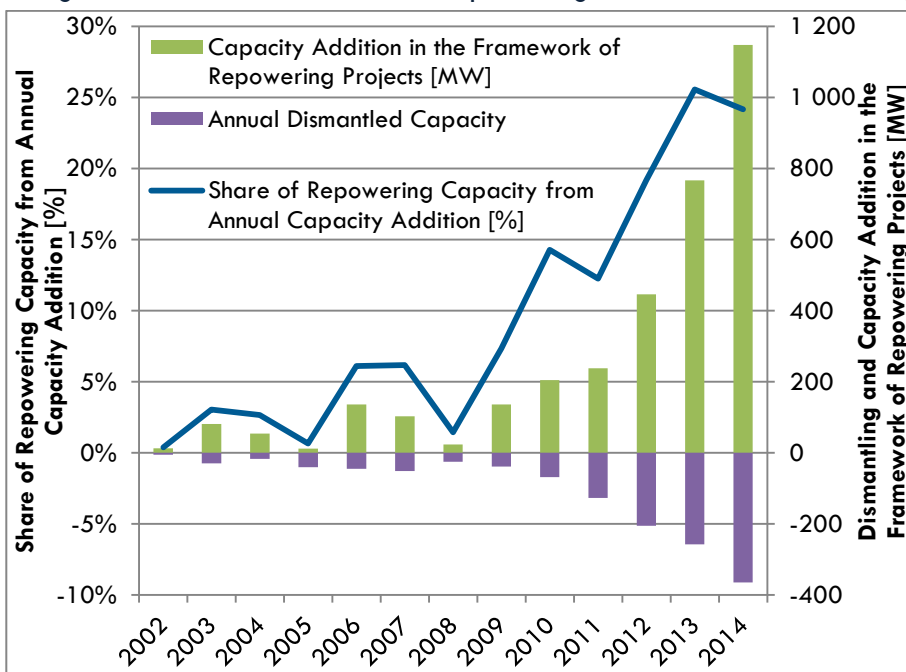
### Dismantling

Over the course of 2014, at least 544 WTG's with a capacity of 364.35 MW were dismantled. The average capacity of a dismantled WTG was about 670 kW.

It is possible to derive the net added capacity from the annual gross addition and the dismantling of WTG's. For 2014, the net capacity is 4 385.91 MW. It should be noted again that an underestimation of the dismantling numbers leads to an overestimation of the net capacity addition.

### Repowering

In the framework of the statistical data collection for the year 2014, 413 of the total 1 766 newly erected WTG's have been identified as repowering turbines (meaning those WTG's for which at least one old WTG located in the same or neighboring county/district had been dismantled). With an identified capacity of 1 147.88 MW, this equates to a repowering share of at least 24.2 % of the gross addition for 2014. The repowering turbines have an average output of 2 779 kW. This



results in an average repowering factor of about 4.1 (meaning that in the framework of repowering, the installed capacity quadrupled compared to the average dismantled WTG).

Figure 2 shows the annual installed and dismantled capacity in the framework of repowering projects, as well as the repowering share of the annual gross capacity addition in relation to elapsed time.

Figure 2: Development of Proportional and Absolute Installed Capacity in the Framework of Repowering Projects and Dismantling, Status 31<sup>st</sup> December 2014

### AVERAGE TURBINE CONFIGURATION

This section discusses the average turbine configuration of land-based WTG's. The results are shown in Table 2. In 2014 on average, the turbine capacity of newly erected WTG's in Germany was 2 690 kW (in 2013 the average was 2 598 kW). The average rotor diameter was 99 meters, four meter larger than the average in 2013 (95 meters). The average hub height was 116 meters, one meter below the average of 2013 (117 meters). Regional differences regarding the average turbine configuration are discussed in more detail in the following section ("Regional Distribution of Wind Energy Development").

Table 2: Average Turbine Configuration of WTGs installed in 2014

Average Land-Based WTG Configuration, Installed in 2014		
2014	Average Turbine Capacity	2 690 kW
	Average Rotor Diameter	99 meters
	Average Hub Height	116 meters

Figure 3 shows the development of the average land-based turbine capacity in reference to annual new installations and of the cumulative turbine portfolio. Compared to the average capacity determined for 2013, the average capacity of WTG erected annually (CY 2014) has increased by about 4 %. As of 31<sup>st</sup> December 2014, the average capacity per WTG within the overall portfolio was 1,533 kW and thus lies about 7 % higher than at the end of 2013.

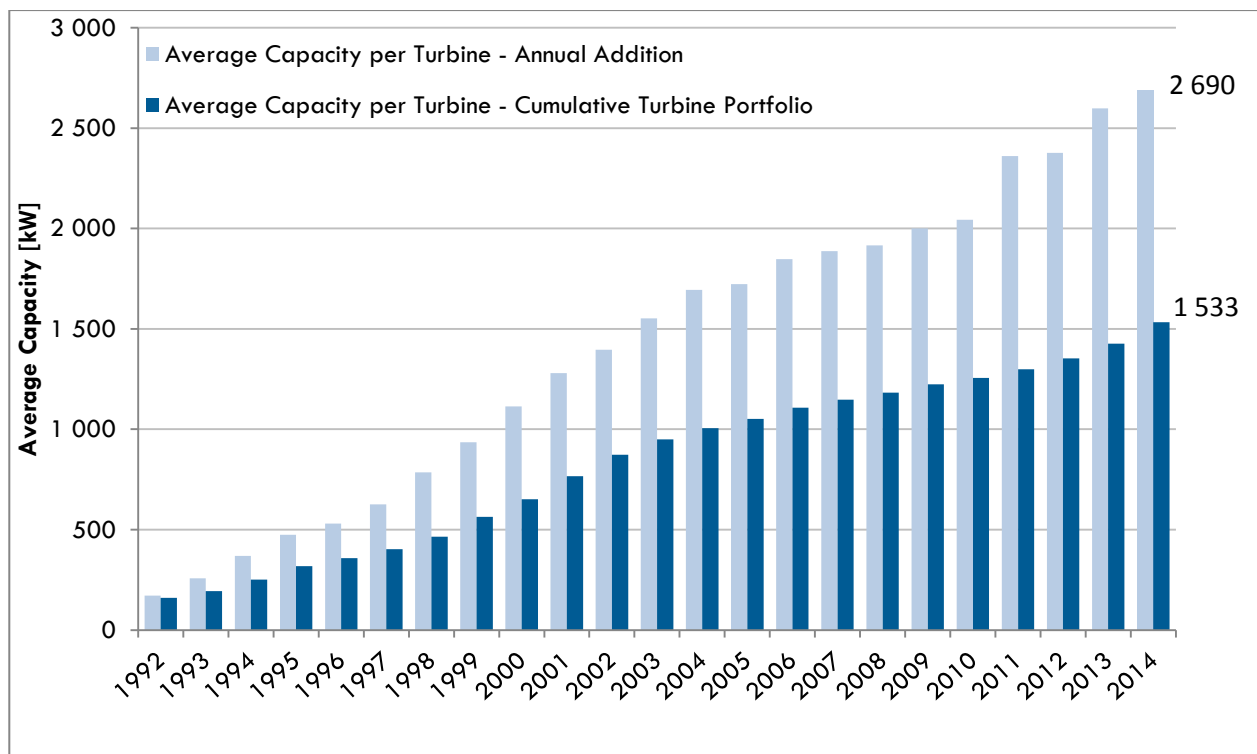


Figure 3: Development of the Average Capacity of Land-Based WTGs Newly Installed and Cumulatively Present in the German Turbine Portfolio, Status: 31<sup>st</sup> December 2014

## REGIONAL DISTRIBUTION OF WIND ENERGY DEVELOPMENT

The regional distribution of wind energy development in 2014 across the individual German states is examined below. The results are shown in Table 3. In 2014, WTG's were erected in all 16 states. Schleswig-Holstein received more than a quarter of the overall capacity of 4 750 MW installed in Germany. In the Germany-wide comparison, Lower Saxony came in second place with about 627 MW of newly installed capacity. With 498 MW, Brandenburg reached the third place. More than half (51 %) of the total new installations took place in the three states named above.

The southern German states of Rhineland-Palatinate and Bavaria came in fourth and fifth place with capacities of 463 and 410 MW of newly installed capacity. Another northern German territorial state, Mecklenburg-Western Pomerania, took sixth place with 373 MW. North Rhine-Westphalia, located in central Germany, took seventh place with 307 MW, followed by Saxony-Anhalt with 291 MW in eighth place. 215 MW were installed in Hesse (ninth place) and 148 MW in Thuringia (tenth place). In each of the remaining states less than 100 MW were installed.

Table 3: Addition to Wind Energy in the German States in 2014, Status 31<sup>st</sup> December 2014

Rank	State	Gross Addition in 2014			Average Turbine Configuration in 2014		
		Added Capacity [MW]	Added Number [WEA]	Share of Added Capacity of Total Addition	Average Turbine Capacity [kW]	Average Rotor Diameter [m]	Average Hub Height [m]
1	Schleswig-Holstein	1 303.15	455	27.6%	2 864	98	88
2	Lower Saxony	627.36	227	13.2%	2 764	96	111
3	Brandenburg	498.20	196	10.5%	2 542	99	123
4	Rhineland-Palatinate	462.70	168	9.7%	2 754	107	138
5	Bavaria	410.00	154	8.6%	2 662	110	136
6	Mecklenburg-Western Pomerania	373.25	144	7.9%	2 592	96	122
7	North Rhine-Westphalia	307.20	124	6.5%	2 477	94	119
8	Saxony-Anhalt	291.40	109	6.1%	2 673	97	124
9	Hesse	214.85	82	4.5%	2 620	107	136
10	Thuringia	148.20	62	3.1%	2 390	96	124
11	Saarland	37.30	15	0.8%	2 487	104	133
12	Saxony	32.70	13	0.7%	2 515	92	121
13	Baden-Wuerttemberg	18.65	8	0.4%	2 331	89	131
14	Bremen	18.60	6	0.4%	3 100	99	110
15	Hamburg	4.40	2	0.1%	2 200	104	123
16	Berlin	2.30	1	0.0%	2 300	82	138
	<b>Total</b>	<b>4 750.26</b>	<b>1 766</b>	<b>100%</b>	<b>2 690</b>	<b>99</b>	<b>116</b>

Also shown in Table 3 is the average turbine configuration of new additions across the German states. The lowest and highest average turbine capacities of 2 200 kW and 3 100 kW were installed in the city-states of Hamburg and Bremen. In reference to the territorial states, Baden-Wuerttemberg installed WTG's with the lowest overall capacity (2 331 kW) and Schleswig-Holstein installed those with the highest overall capacity (2 864 kW).

The average rotor diameters lie between 82 and 110 meters. As expected, the largest diameters can be found in the south. The average hub height in all German states, with the exception of Schleswig-Holstein (with 88 m), was at least 110 and up to 138 meters.

REGIONAL DISTRIBUTION OF THE CUMULATIVE PORTFOLIO OF WIND TURBINES

The cumulative capacity and number of turbines ascribed to the German states can be ascertained from Table 4. It should be noted again, that the cumulative values may deviate from the actual turbine portfolio.

Among all German states, Lower Saxony leads the list of cumulative wind energy installed with 8 233 MW of installed capacity. Again in second place was Brandenburg with 5 457 MW. Schleswig-Holstein came in third with a cumulative capacity of 5 090 MW.

43 % of the total capacity installed is merged in the northern states, which slightly increased their importance compared to the previous years. The share of the central

German states decreased to about 44 % of the cumulative capacity and thus lay below the status at the end of 2013. The southern German states combined 13 % of the installed capacity and

hence continued the progressive upward trend of the last several years. The cumulative capacity distribution development is depicted graphically in Figure 4.

Table 4: Cumulative Capacity and Number of Turbines in the German States, Status: 31<sup>st</sup> December 2014

Region / State		Cumulative Capacity Status: 31 <sup>st</sup> December 2014 [MW]	Cumulative Number Status: 31 <sup>st</sup> December 2014 [WEA]
North	Lower Saxony	8 233.05	5 616
	Schleswig-Holstein	5 089.57	3 228
	Mecklenburg Western Pomerania	2 706.12	1 742
	Bremen	169.61	84
	Hamburg	57.49	54
Central	Brandenburg	5 456.61	3 319
	Saxony-Anhalt	4 336.39	2 603
	North Rhine-Westphalia	3 681.12	3 037
	Thuringia	1 129.24	727
	Hesse	1 181.38	820
	Saxony	1 066.45	857
	Berlin	4.30	2
South	Rhineland-Palatinate	2 727.80	1 472
	Bavaria	1 523.87	797
	Baden-Württemberg	549.90	396
	Saarland	202.85	113
<b>Total</b>		<b>38 115.74</b>	<b>24 867</b>

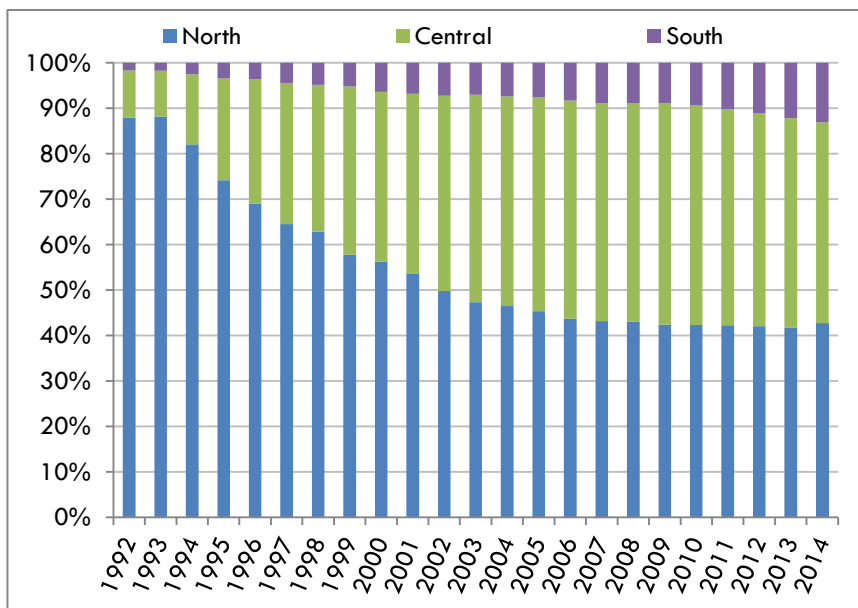


Figure 4: Distribution of the Germany-wide Installed Cumulative Capacity across the Regions, Status: 31<sup>st</sup> December 2014

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