

# Status of Onshore Wind Energy Development in Germany

## First Half of 2024



On behalf of



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## Notes

The analysis within the scope of the Status of Onshore Wind Energy Development is based on the data of the core energy market data register (German: Marktstammdatenregister or MaStR) of the Federal Network Agency (German: Bundesnetzagentur or BNetzA) as well as on the announcements of the BNetzA regarding the tenders for onshore wind energy. The data was partially validated and corrected with regard to various details and supplemented with unrecorded dismantling and repowering properties of projects. Only wind turbines with a installed capacity of over 100 kW are included in the analysis.

The publication of the Status of Onshore Wind Energy Development takes place before the reporting deadline for commissioning in the first half of 2024. Further reports increasing the quantity added and decommissioned as well as permits are possible. Furthermore, changes or subsequent reporting of existing turbines to the MaStR may result in deviations from the cumulative portfolio shown.

Some of the figures in the text and illustrations are rounded values. Their addition may therefore result in slight deviations from the total values.

## Photo on Title Page

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## Wind Energy Development and Status

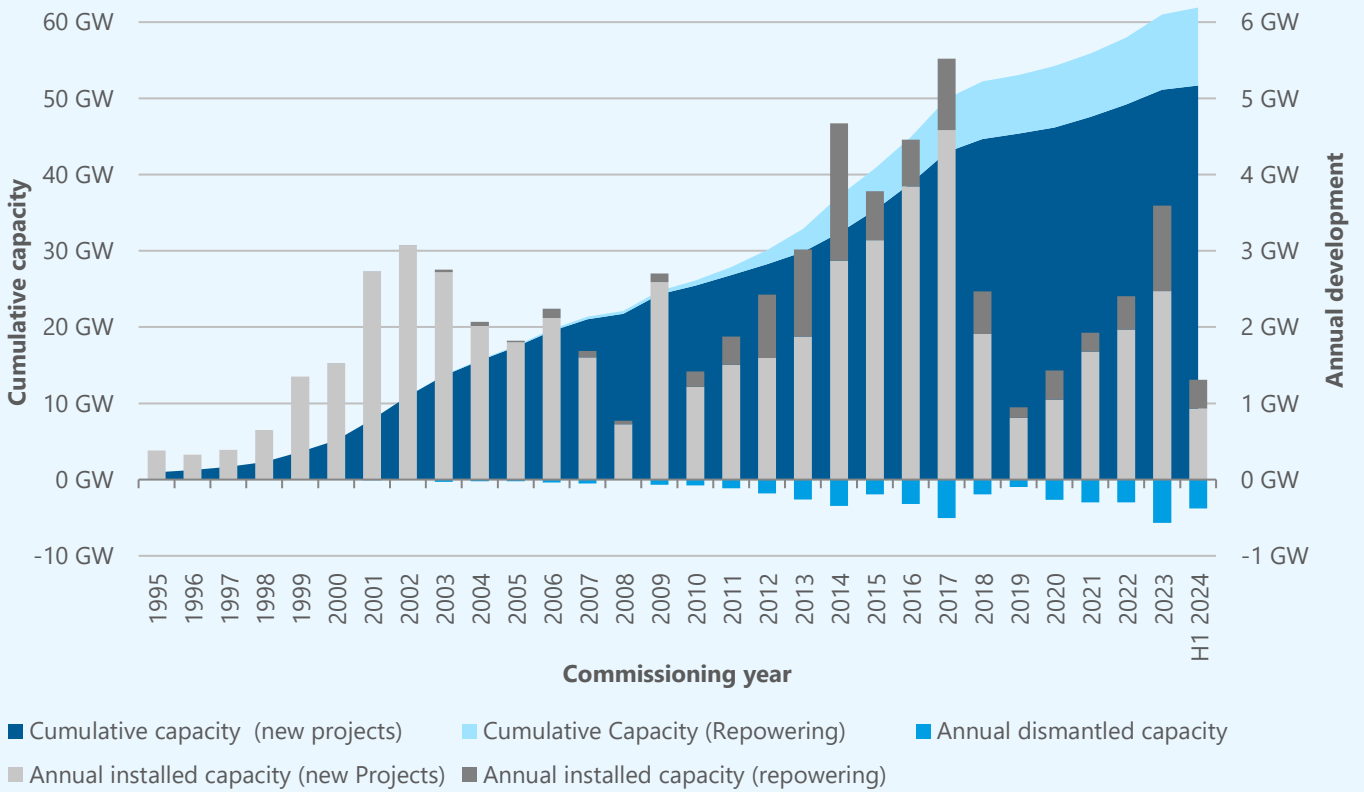
In the first half of 2024, 250 new wind turbines (WT) with a total capacity of 1,308 MW were installed in Germany. This is 19% less than in the first half of the previous year.

The additions of new wind turbines are offset by the decommissioning of 277 wind turbines with a total capacity of 379 MW. In terms of capacity, the net additions in the first half of 2024 therefore amount to 929 MW.

As of 30 June 2024, the cumulative total number of wind turbines in operation in Germany is 28,611 with a total capacity of 61,917 MW. The installed capacity has increased by 1.5% in the year to date, while the cumulative total number of wind turbines has fallen slightly.

Status of onshore wind energy development

		Capacity	Turbines
Cumulative	2023-12-31		
	Cumulative 2023	60,988 MW	28,638 WT
Development	H1 2024		
	Gross installations	1,308 MW	250 WT
	Repowering share	377 MW	68 WT
	Decommissioning	379 MW	277 WT
Net installations	929 MW	-27 WT	
Cumulative	2024-06-30		
	Cumulative H1 2024	61,917 MW	28,611 WT



Annual development onshore wind energy capacity in Germany

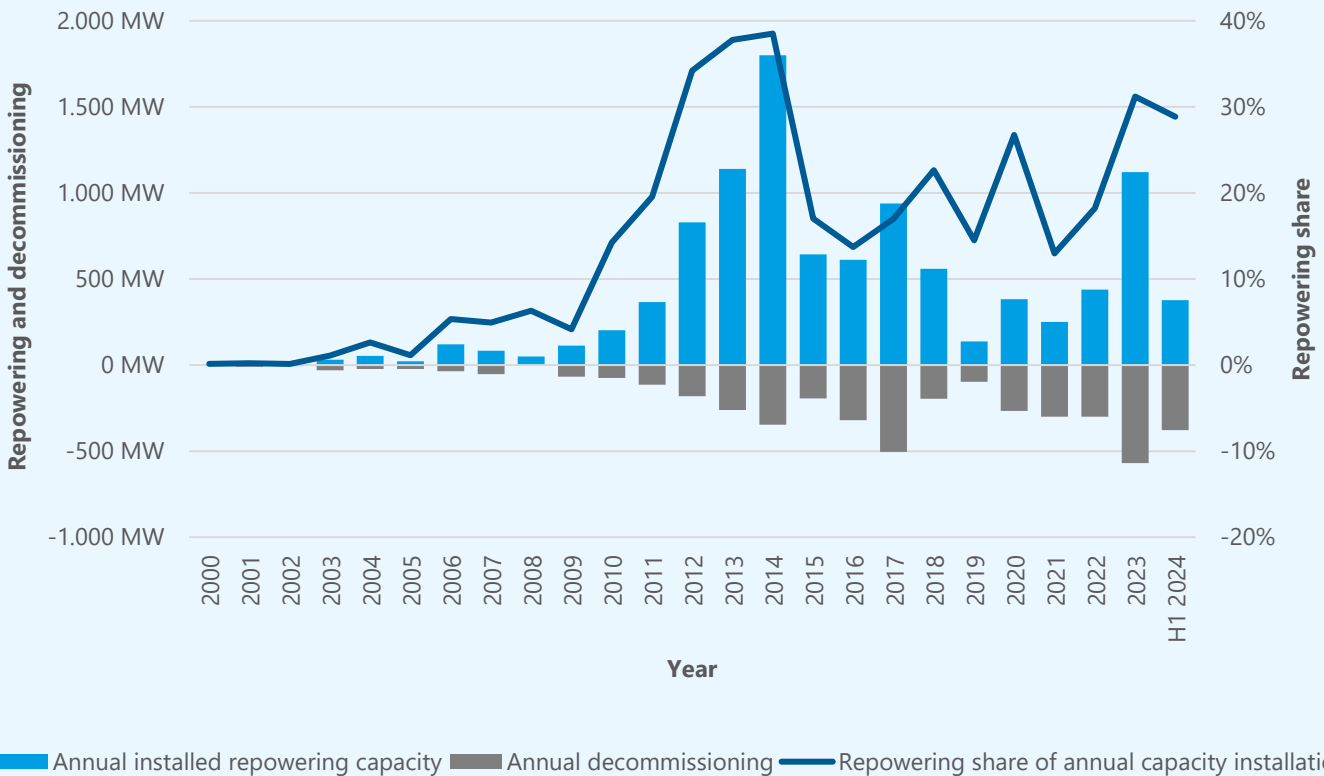
## Decommissioning, Continued Operation and Repowering

In the first half of 2024, 277 wind energy turbines with a combined capacity of 379 MW were decommissioned. The number of turbines decommissioned exceeds the number of newly installed turbines. On average, the turbines decommissioned in the first half of 2024 were operated for a period of 22 years. Many of the decommissioned turbines will be replaced by a smaller number of new, more powerful turbines as part of repowering projects. Repowering accounts for 29% of the turbines installed in the first half of 2024. Some of the old turbines that were replaced were already dismantled in the previous year. Turbines which cannot be repowered, and which have not yet been decommissioned are in continued operation without funding, after having received a funding for 20 years. At the end of June 2024, this affects almost 9,000 turbines with a total capacity of 10 GW. Over the next five years, the funding will gradually expire for turbines installed

between 2004 and 2008, unless they are decommissioned at an earlier date.

Age of dismantled and operating wind turbines

Age	Decommissioning H1 2024		Cumulative 2024-06-30	
	Capacity	Turbines	Capacity	Turbines
>20 Years, no funding claim (COD ≤ 2003)	241 MW	202 WT	10,026 MW	8,995 WT
15 - 20 Years (COD 2004 - 2008)	87 MW	52 WT	8,113 MW	4,506 WT
10 - 15 Years (COD 2009 - 2013)	48 MW	22 WT	11,284 MW	5,067 WT
5 - 10 Years (COD 2014 - 2018)	3 MW	1 WT	20,888 MW	7,308 WT
0 - 5 Years (COD 2019 - 2024)	0 MW	0 WT	11,606 MW	2,735 WT
<b>Total</b>	<b>379 MW</b>	<b>277 WT</b>	<b>61,917 MW</b>	<b>28,611 WT</b>

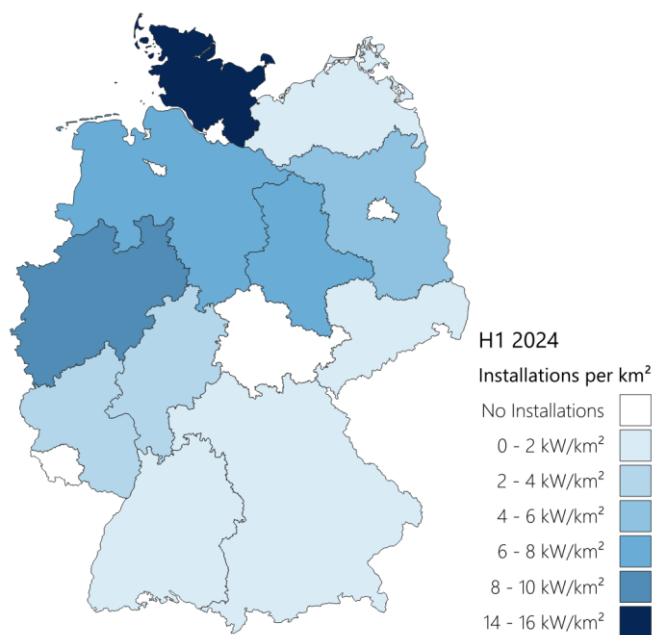


Development of annual decommissioning, annual installed repowering capacity and repowering share

## Regional Distribution of Wind Energy Installation

North Rhine-Westphalia is leading in the comparison of federal states in the first half of 2024 with 298 MW of new installations, just ahead of Lower Saxony with 296 MW. Schleswig-Holstein, the state with the highest additions in 2022 and 2023, is in third place with 247 MW. In terms of new installations per state area, however, Schleswig-Holstein is still well ahead of all other federal states. Together with Brandenburg and Saxony-Anhalt, which are also among the states with the highest additions in the first half of 2024, the top group of federal states accounts for 85% of the total gross additions in Germany. In addition to the city states (Berlin, Bremen, Hamburg), Saarland and Thuringia remain without any new installations in the first half of 2024. With an installation of maximum 10 turbines, Hesse, Rhineland-Palatinate, Mecklenburg-Western Pomerania, Baden-Württemberg, Bavaria and Saxony only make a small contribution to the

further expansion of onshore wind energy in Germany in the first half of 2024.



Base map: © GeoBasis-DE / BKG 2022 | Database: MaStR with own modifications  
Source: Deutsche WindGuard

Regional distribution of gross capacity installation

### Gross installation, dismantling, net installation and repowering in German federal states

Year H1 2024		Gross installations			Dismantling and net installation			Repowering		
Position	Federal state	Capacity Installation	Number of new turbines	Share*	Capacity Dismantling	Number of dismantled Turbines	Net Installation	Capacity Repowering	Number of repowering turbines	Repowering-share**
1	North Rhine-Westphalia	298 MW	62 WT	23%	49 MW	52 WT	249 MW	86 MW	17 WT	29%
2	Lower Saxony	296 MW	53 WT	23%	163 MW	108 WT	133 MW	105 MW	18 WT	35%
3	Schleswig-Holstein	247 MW	49 WT	19%	62 MW	41 WT	186 MW	85 MW	15 WT	34%
4	Brandenburg	138 MW	28 WT	11%	21 MW	15 WT	117 MW	15 MW	3 WT	11%
5	Saxony-Anhalt	136 MW	23 WT	10%	36 MW	30 WT	100 MW	25 MW	5 WT	19%
6	Hesse	57 MW	10 WT	4%	2 MW	3 WT	56 MW	26 MW	4 WT	46%
7	Rhineland-Palatinate	42 MW	7 WT	3%	31 MW	16 WT	11 MW	13 MW	2 WT	31%
8	Mecklenburg-Western Pomerania	39 MW	7 WT	3%	0 MW	0 WT	39 MW	17 MW	3 WT	43%
9	Baden-Württemberg	29 MW	6 WT	2%	0 MW	0 WT	29 MW	6 MW	1 WT	19%
10	Bavaria	21 MW	4 WT	2%	1 MW	1 WT	20 MW	0 MW	0 WT	0%
11	Saxony	6 MW	1 WT	0%	6 MW	5 WT	0 MW	0 MW	0 WT	0%
	Thuringia	0 MW	0 WT	0%	9 MW	6 WT	-9 MW	0 MW	0 WT	-
	Saarland	0 MW	0 WT	0%	0 MW	0 WT	0 MW	0 MW	0 WT	-
	Berlin	0 MW	0 WT	0%	0 MW	0 WT	0 MW	0 MW	0 WT	-
	Hamburg	0 MW	0 WT	0%	0 MW	0 WT	0 MW	0 MW	0 WT	-
	Bremen	0 MW	0 WT	0%	0 MW	0 WT	0 MW	0 MW	0 WT	-
	<b>Germany</b>	<b>1,308 MW</b>	<b>250 WT</b>		<b>379 MW</b>	<b>277 WT</b>	<b>929 MW</b>	<b>377 MW</b>	<b>68 WT</b>	<b>29%</b>

\* Share of gross capacity Installations per federal state in total gross capacity installation

\*\* Share of repowering capacity per federal state in gross capacity installation per federal

## Average Turbine Configuration and Regional Differences

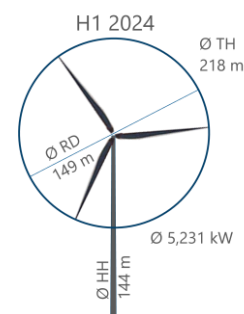
The wind turbines installed in the first half of 2024 have an average turbine capacity of 5,231 kW and an average tip height of 218 m. This represents a 9% increase in turbine capacity compared to the average turbine in the previous year. The trend towards ever more powerful turbines is thus continuing. The tip height has also increased compared to the previous year - by 6%. The average rotor diameter in the first half of 2024 is 149 m and the average hub height is 144 m.

The largest wind turbines on average in terms of capacity were installed in Rhineland-Palatinate in the first half of 2024. With an average capacity of over 6 MW, the turbines have significantly more capacity than turbines in Baden-Württemberg, North Rhine-Westphalia and Brandenburg - where

turbines with the lowest average capacity of less than 5 MW were installed. Only in Schleswig-Holstein is the average tip height of the turbines installed in the first half of 2024 still below 200 m, while in several other federal states, turbines with an average height of over 240 m were built.

### Average wind turbine configuration

Installations H1 2024	Change compared to prior year
Turbine Capacity	+9%
Rotor Diameter	+6%
Hub Height	+6%
Tip Height	+6%



### Average turbine configuration of newly installed wind turbines in German federal states

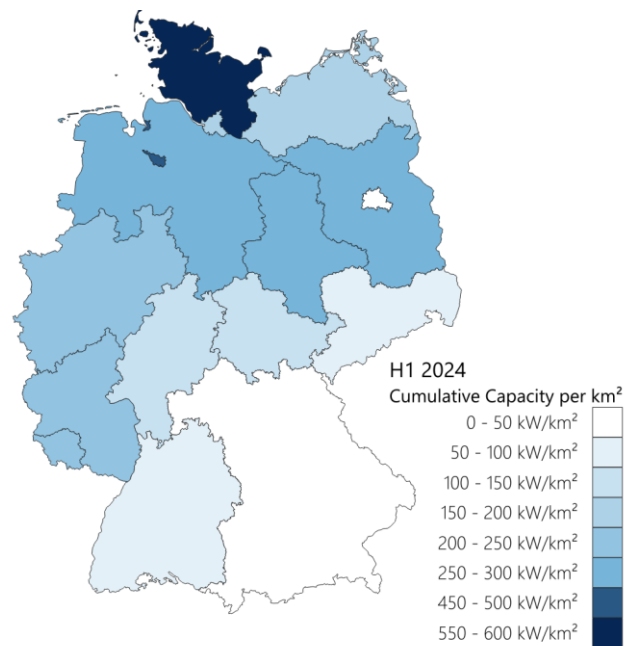
Installations H1 2024	State	Average configuration of newly installed turbines				
		Number of turbines	Turbine capacity	Rotor diameter	Hub height	Tip height
	North Rhine-Westphalia	62 WT	4,804 kW	145 m	141 m	213 m
	Lower Saxony	53 WT	5,581 kW	155 m	155 m	233 m
	Schleswig-Holstein	49 WT	5,043 kW	141 m	107 m	178 m
	Brandenburg	28 WT	4,929 kW	150 m	159 m	234 m
	Saxony-Anhalt	23 WT	5,892 kW	158 m	161 m	240 m
	Hesse	10 WT	5,740 kW	153 m	165 m	241 m
	Rhineland-Palatinate	7 WT	6,014 kW	157 m	163 m	242 m
	Mecklenburg-Western Pomerania	7 WT	5,551 kW	153 m	132 m	209 m
	Baden-Württemberg	6 WT	4,760 kW	149 m	162 m	237 m
	Bavaria	4 WT	5,220 kW	155 m	165 m	242 m
	Saxony	1 WT	5,560 kW	160 m	167 m	247 m
	Thuringia	0 WT	-	-	-	-
	Saarland	0 WT	-	-	-	-
	Bremen	0 WT	-	-	-	-
	Hamburg	0 WT	-	-	-	-
	Berlin	0 WT	-	-	-	-
<b>Germany</b>		<b>250 WT</b>	<b>5,231 kW</b>	<b>149 m</b>	<b>144 m</b>	<b>218 m</b>

## Regional Distribution of the Cumulative Portfolio

At the end of the first half of 2024, the cumulative total number of onshore wind turbines in Germany amounted to 28,611 turbines with a total capacity of 61.9 GW.

Lower Saxony has the highest total installed capacity at just under 12.7 GW and thus accounts for 20% of Germany's total cumulative capacity. Brandenburg and Schleswig-Holstein each contribute 14% to the total cumulative capacity, followed by North Rhine-Westphalia with 12% and Saxony-Anhalt with 9%.

In terms of state area, Schleswig-Holstein has the largest contribution with 552 kW/km<sup>2</sup>. Bremen follows close behind with 483 kW/km<sup>2</sup>. Brandenburg, Lower Saxony and Saxony-Anhalt have a capacity in relation to state area of 250 to 300 kW/km<sup>2</sup>. The capacity in relation to state area is particularly low in Bavaria and Berlin with less than 50 kW/km<sup>2</sup> and in Baden-Württemberg and Saxony with values between 50 and 100 kW/km<sup>2</sup>.



Base map: © GeoBasis-DE / BKG 2022 | Database: MaStR with own modifications  
Source: Deutsche WindGuard

Regional distribution of the cumulative capacity

### Cumulative capacity and number of wind turbines in the German federal states

Cumulative portfolio* (2024-06-30)				
Federal state	Cumulative capacity	Cumulative number	Share	Capacity per area
Lower Saxony	12,661 MW	6,103 WT	20%	265 kW/km <sup>2</sup>
Brandenburg	8,783 MW	4,051 WT	14%	296 kW/km <sup>2</sup>
Schleswig-Holstein	8,720 MW	3,238 WT	14%	552 kW/km <sup>2</sup>
North Rhine-Westphalia	7,413 MW	3,621 WT	12%	217 kW/km <sup>2</sup>
Saxony-Anhalt	5,423 MW	2,737 WT	9%	265 kW/km <sup>2</sup>
Rhineland-Palatinate	4,022 MW	1,770 WT	6%	203 kW/km <sup>2</sup>
Mecklenburg-Western Pomerania	3,761 MW	1,859 WT	6%	161 kW/km <sup>2</sup>
Bavaria	2,653 MW	1,150 WT	4%	38 kW/km <sup>2</sup>
Hesse	2,591 MW	1,187 WT	4%	123 kW/km <sup>2</sup>
Thuringia	1,820 MW	863 WT	3%	112 kW/km <sup>2</sup>
Baden-Württemberg	1,820 MW	786 WT	3%	51 kW/km <sup>2</sup>
Saxony	1,361 MW	867 WT	2%	74 kW/km <sup>2</sup>
Saarland	545 MW	218 WT	1%	212 kW/km <sup>2</sup>
Bremen	203 MW	87 WT	0%	483 kW/km <sup>2</sup>
Hamburg	125 MW	68 WT	0%	166 kW/km <sup>2</sup>
Berlin	17 MW	6 WT	0%	19 kW/km <sup>2</sup>
<b>Germany</b>	<b>61,917 MW</b>	<b>28,611 WT</b>		<b>173 kW/km<sup>2</sup></b>

\* with a minimum turbine capacity of > 100 kW

## Results of Tender Rounds

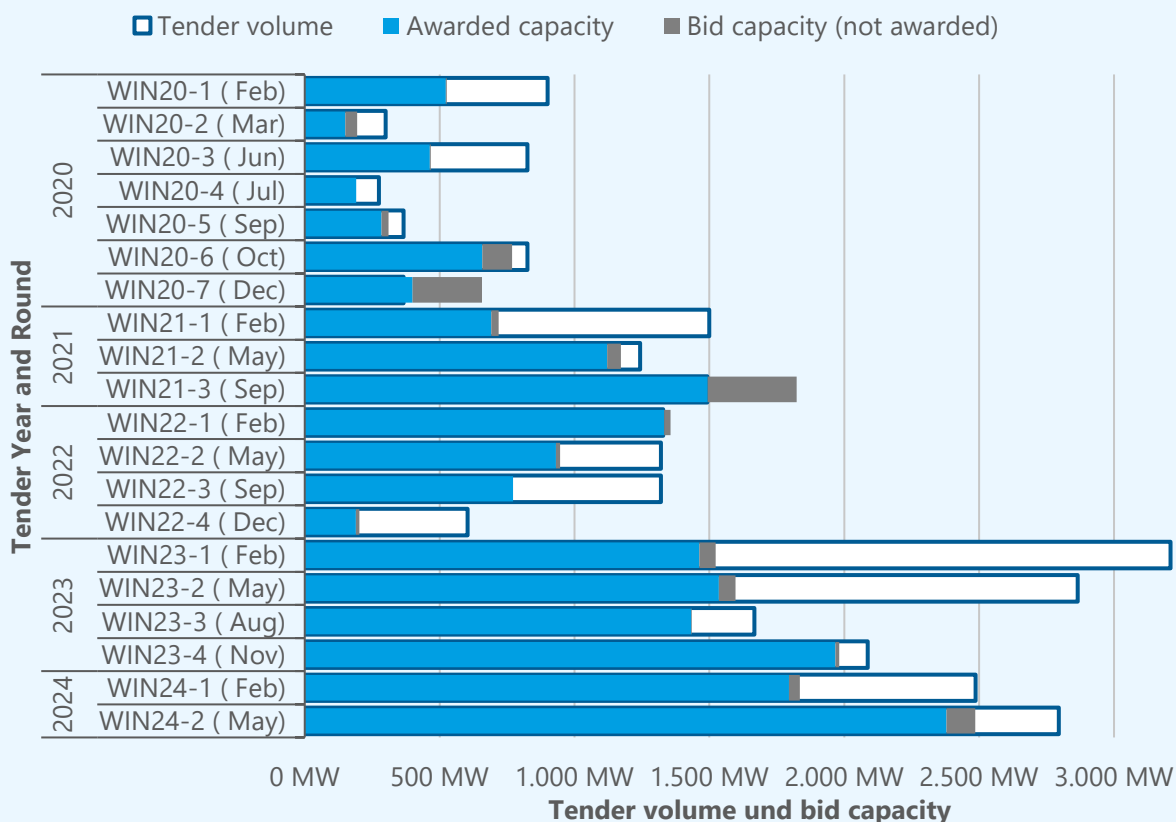
Two rounds of tenders for onshore wind energy were carried out in the first half of 2024. In the first round in February, the planned volume was tendered in full. In the second round in May, however, the tender volume was initially increased by a part of the volumes not awarded in the previous year, but then reduced again due to a lack of competition. The total volume put out to tender in both rounds thus amounted to 5,282 MW.

The capacity actually awarded in the first half of 2024 was 4,175 MW. Although the tender rounds were still undersubscribed, the volume awarded within six months in 2024 represents a new record. The average award value of the tender rounds in the first half of 2024 was 7.33 ct/kWh - just below the maximum permissible value of 7.35 ct/kWh.

There were no changes compared to the previous year with regard to the maximum permissible value or the average award values.

Development of awarded bids of tender rounds for onshore wind energy in Germany (Database: BNetzA)

	Year	Maximum permissible value	Average capacity-weighted award value
Tender Year	2020	6.20 ct/kWh	6.11 ct/kWh
	2021	6.00 ct/kWh	5.88 ct/kWh
	2022	5.88 ct/kWh	5.81 ct/kWh
	2023	7.35 ct/kWh	7.33 ct/kWh
	H1 2024	7.35 ct/kWh	7.33 ct/kWh

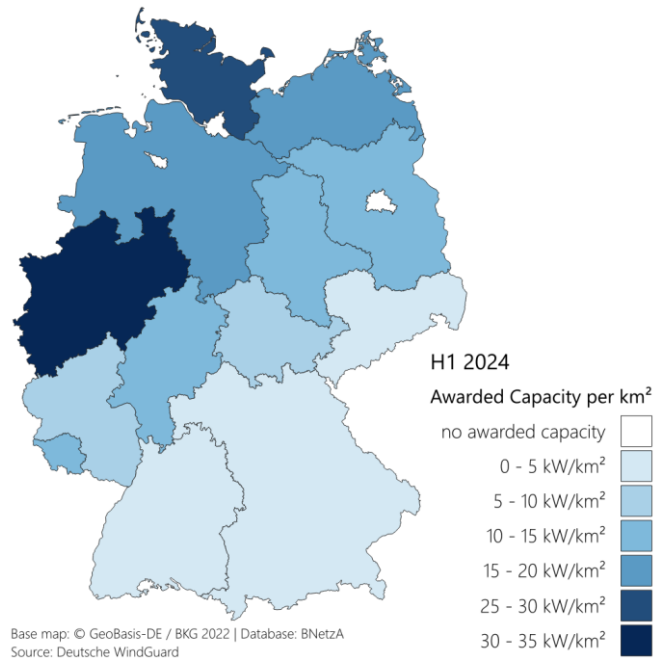


Competitive situation in tender system for onshore wind energy (Database: BNetzA)

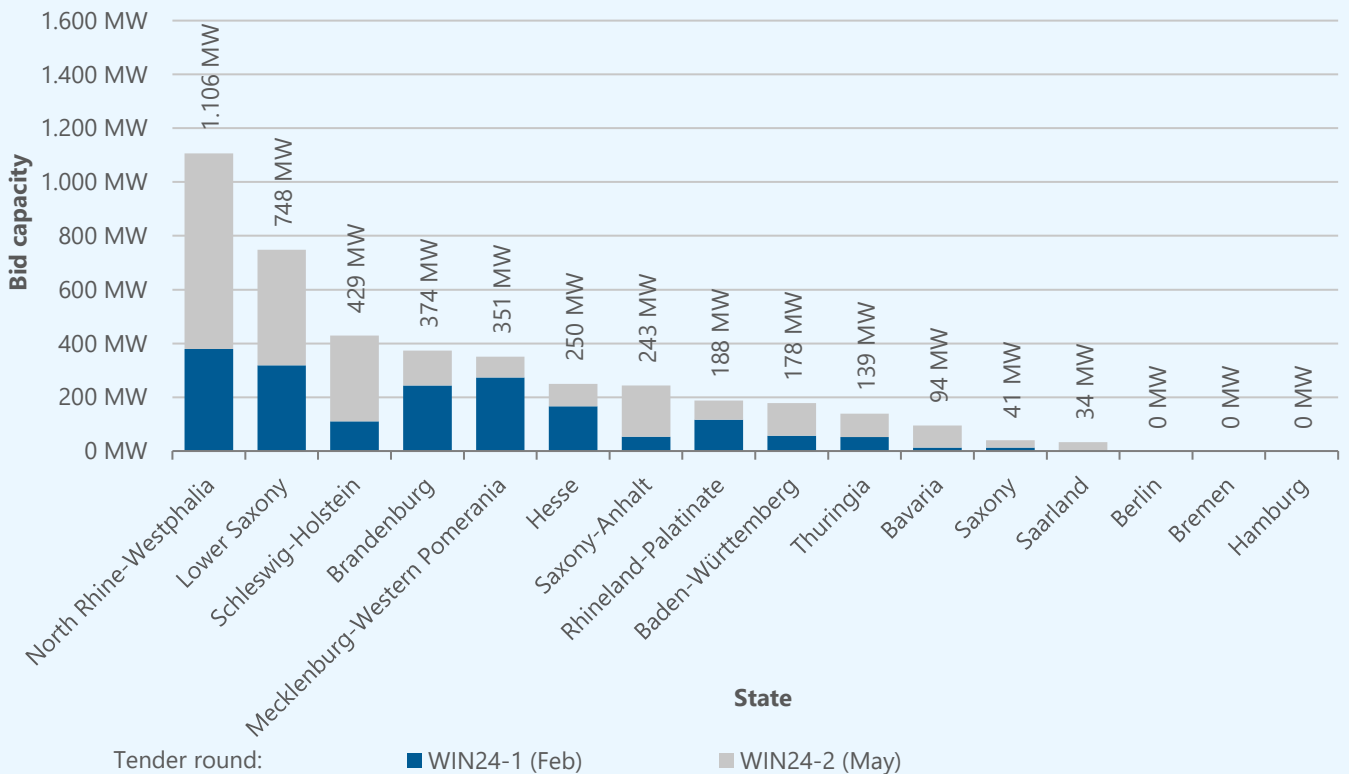


## Regional Distribution of Awarded Bids

With the exception of the city states, wind energy turbines from all federal states were awarded in at least one of the two tendering rounds in the first half of 2024. North Rhine-Westphalia made the largest contribution with a share of 26% of the tender volume. This is followed by the federal states of Lower Saxony with a share of 18% and Schleswig-Holstein with a share of 10%. Brandenburg accounts for 9% of the awarded capacity, Mecklenburg-Western Pomerania for 8% and Hesse and Saxony-Anhalt for 6% each. In the first half of 2024, the other federal states accounted for 4% or less of the awarded volume. The federal states in the south of the country are in the bottom half of the ranking. The north-south divide that has existed for years is thus continuing, both in terms of absolute values and in terms of capacity related to federal state area.



Regional distribution of awarded capacity across the federal states (Database: BNetzA)



Regional distribution of awarded capacity across the German federal states (Database: BNetzA)

## Development Status of Awarded Turbines

Of the 26.8 GW of wind energy capacity awarded since the introduction of the tenders in Germany, 11.5 GW have been realized to date. The regular realization period for unused awards amounting to 3.7 GW has already expired in mid-2024. If no extension of the deadline has been issued, these awards will expire. Once their awards have expired, turbines with a permit can participate in the tender rounds again. The average realization rate over the tender years 2018 to 2021, for which the realization deadline has already expired by mid-2024, is 88%.

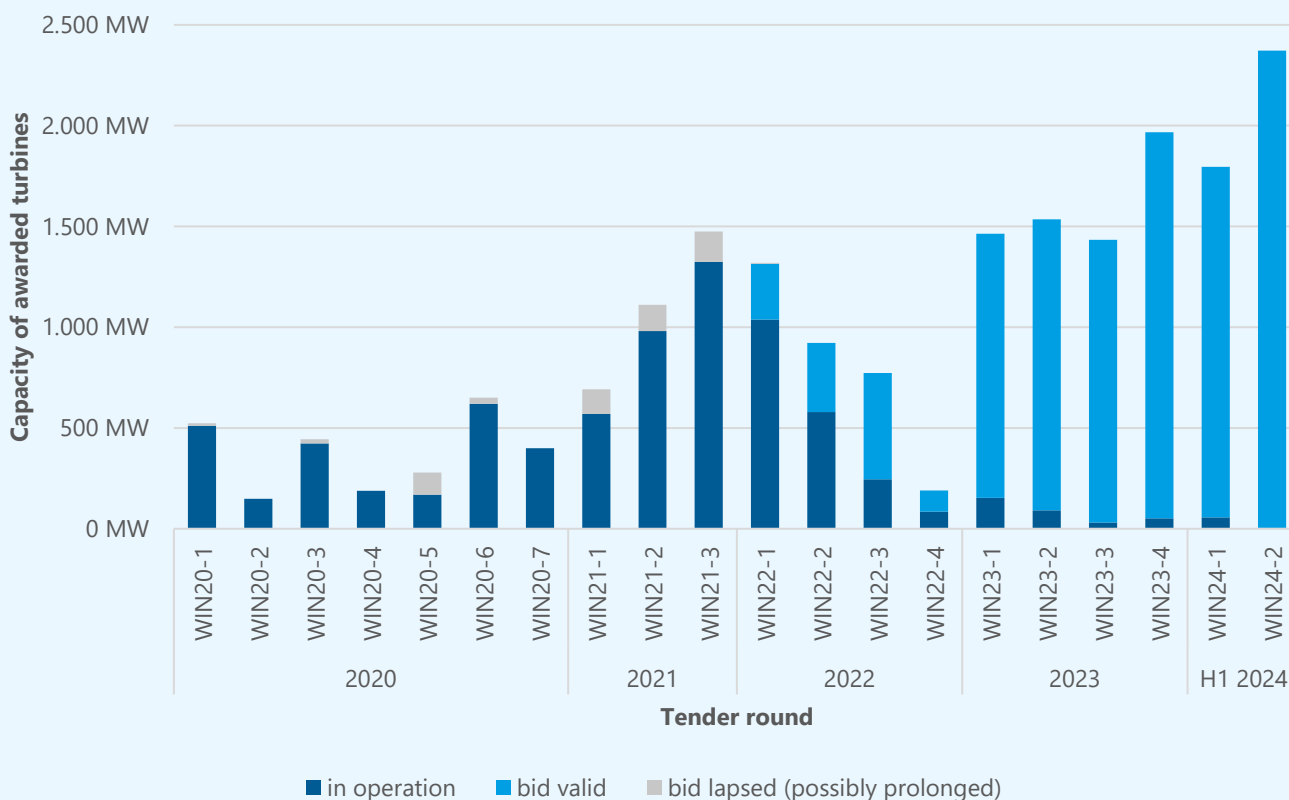
The implementation deadline for awards from 2022 onwards has not yet expired on 30 June 2024. At the end of the first half of 2024, 60% of the capacity awarded in 2022 had already been commissioned. The realization of the turbines

awarded in 2023 and the first half of 2024 is only just beginning, so the realization rates are still correspondingly low.

Realized capacity\* of tenders for onshore wind energy in Germany

	Year	Realized capacity*	Realization rate
Year of tender	2020	2,460 MW	92%
	2021	2,874 MW	87%
	2022	1,948 MW	60%
	2023	327 MW	5%
	H1 2024	60 MW	1%

\* The evaluations represent an assessment of the development status based on an analysis of the MaStR and the awards issued by BNetzA. Deviations from actually allocated awards are possible. It was assumed that the award volume corresponds to the permitted/installed capacity.



Development status\* of awarded capacity (Database: BNetzA, MaStR, own research and assumptions)

## Permitted Capacity and Future Tender Rounds

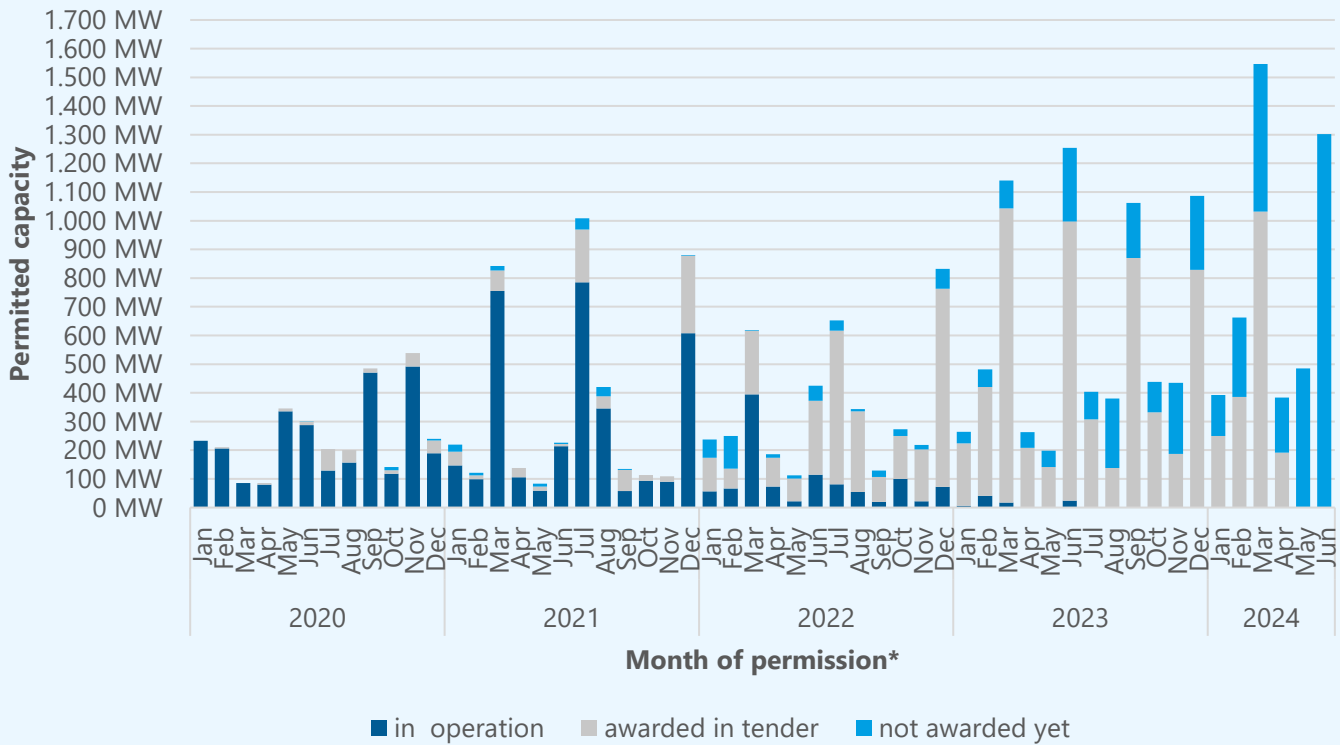
In the first half of 2024, permits were issued for 847 new wind turbines with a total capacity of 4,772 MW. Compared to the first half of the previous year, this represents an increase of 32%. At the end of the first half of 2024, the volume of permits issued already exceeded the volume permitted in 2021 and 2022 for the entire year. 39% of the newly approved turbines were already awarded with a claim to funding under the Renewable Energy Act (EEG) in the tenders during the first half of 2024. Turbines with permits issued in May and June 2024 have not yet been able to participate in a tender. They can take part in the two planned tendering rounds in the second half of the year, each with a maximum tender volume of 4,094 MW.

Some wind turbines with older permits have so far refrained from participating in the tenders.

Around 5% of the turbines permitted from 2020 to 2022 have not yet been awarded in a tender round for onshore wind energy. The realization of the turbines permitted in 2020 and 2021 is already well advanced. The realization of the turbines permitted in 2022 is ramping up, while only a few of the turbines permitted in 2023 are already in operation.

Annual permitted capacity

	Year	Permitted capacity	Permitted wind turbines
Year of permission	2020	3,067 MW	689 WT
	2021	4,297 MW	887 WT
	2022	4,278 MW	833 WT
	2023	7,409 MW	1,356 WT
	H1 2024	4,772 MW	847 WT



\* Permits with an updated permit date have been dated back to the date of the first registration in MaStR.

Monthly permitted capacity including status

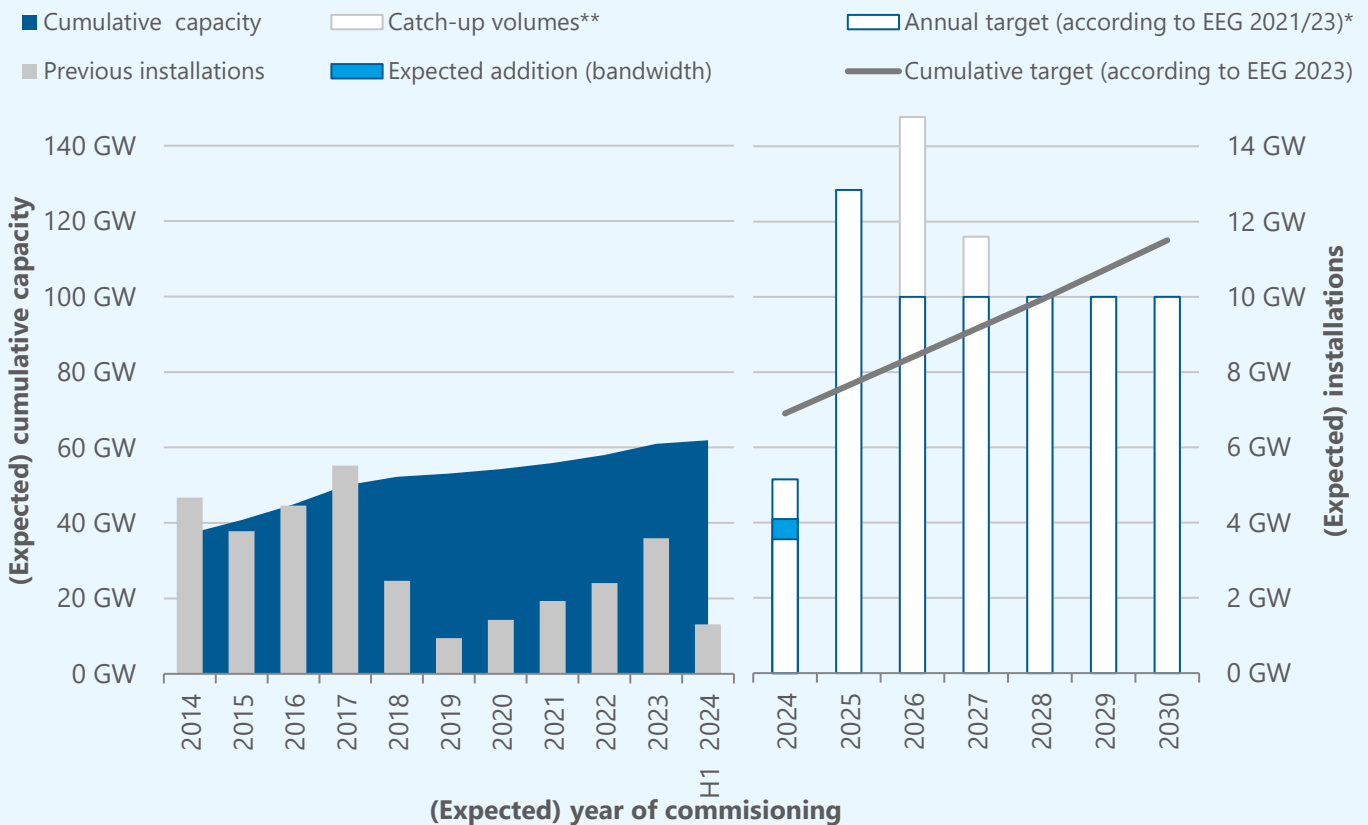
## Expected Development and Political Target

The EEG 2023 sets out the expansion path for onshore wind energy in Germany. In 2024, 69 GW of installed capacity is to be achieved. By the middle of 2024, the cumulative capacity is just under 62 GW, meaning that a further 7 GW would be required by the end of the year to achieve the legally defined expansion target. According to the EEG 2023, total capacity across Germany is set to rise to 115 GW by 2030.

The tendering volumes defined in the EEG determine the annual gross additions required to reach the target and compensate for the expected decommissioning. The EEG stipulates that tender volumes that are not awarded at the scheduled

time can be put out to tender again in the following year as so-called catch-up volumes. As a result, reductions in tender volumes due to lack of competition and the undersubscription of tender rounds will automatically increase demand in the following years - until the targets can be met.

For 2024, an expansion of 3.6 to 4.1 GW was expected based on the previous awards for wind turbines and assuming a stable realization speed and comparable failure rates. The expansion in the first half of 2024 still falls short of these expectations. Accordingly, increased expansion will be required in the second half of 2024 in order to achieve the expected development.



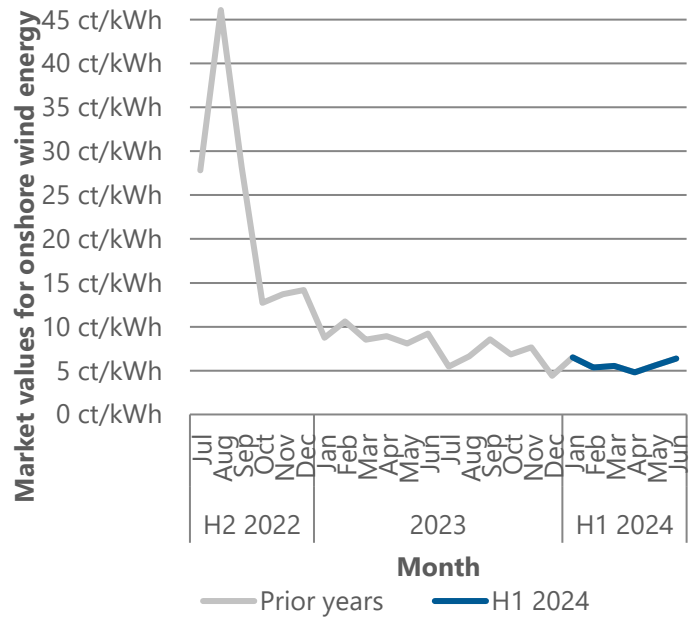
Expected installations in 2024 and political targets according to EEG 2021/23

\*\*derived from the (planned) tender quantities in the year before the previous year  
 \*\*Tender volume corrected in accordance with § 28 EEG

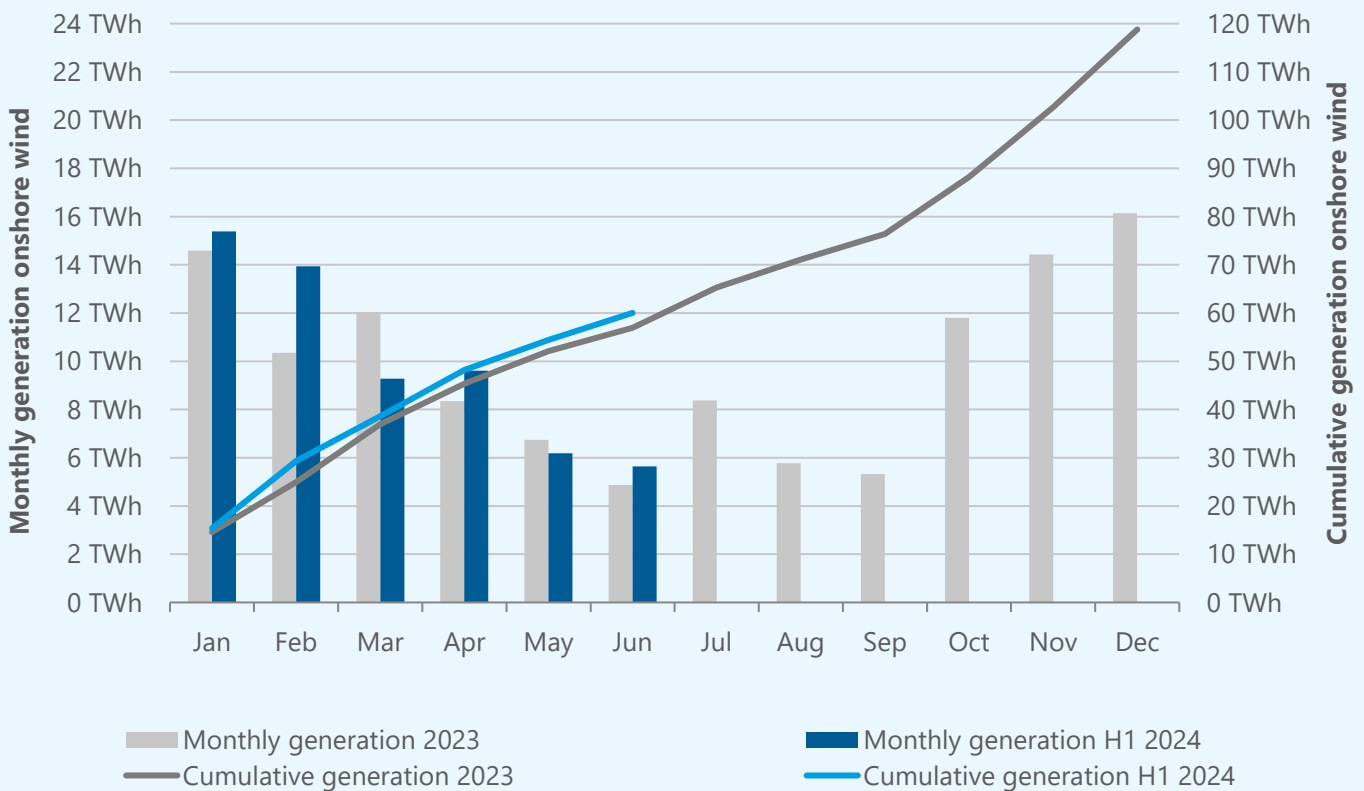
## Power Generation and Market Values

The onshore wind turbines installed in Germany generated 60 TWh of electricity in the first half of 2024. Compared to the first half of the previous year, this corresponds to an increase of 5%. With a share of 27% of total generation, onshore wind energy remains the most important energy source for electricity generation in Germany.

In the first half of 2024, the average monthly market values for onshore wind energy remained stable at between 4.8 ct/kWh and 6.5 ct/kWh. The volume-weighted average monthly market value in the first half of 2024 was 5.71 ct/kWh. Compared to 2023, the average monthly market value for electricity from onshore wind energy has therefore fallen by 25%.



Monthly market values for onshore wind energy (Database: Netztransparenz)



Power generation onshore wind (Database: Bundesnetzagentur | SMARD.de)

### **About Deutsche WindGuard**

In the complex energy market, Deutsche WindGuard is committed to providing unbiased, manufacturer-independent consulting and comprehensive scientific, technical and operational services. The broad portfolio creates extensive synergy effects: Whether due diligence, market analysis, contract consulting or feasibility studies – each of them contains expertise and know-how of the entire WindGuard group. Deutsche WindGuard has been publishing the semi-annual statistics on wind energy development since 2012.

### **About Bundesverband Windenergie e.V. [German Wind Energy Association (BWE)]**

BWE, a member of Bundesverband Erneuerbare Energie [German Renewable Energy Federation (BEE)] with approximately 17,000 members, represents the entire wind industry in Germany. Members of BWE range from industry suppliers in the fields of mechanical engineering and manufacturing over project developers to legal experts, the financial sector, electricity traders, network operators, energy suppliers, and companies specialized in logistics, construction, service/maintenance, and storage technologies. Its broad membership makes of BWE the primary point of contact for politics, business, science, and the media in all matters linked to wind energy.

### **About VDMA Power Systems**

VDMA Power Systems is the association of the energy plant manufacturers. It represents the interests of manufacturers of wind energy and hydropower plants, fuel cells, thermal plants and storage systems in Germany and abroad. For them, VDMA Power Systems serves as an information and communication platform for all industry topics such as energy policy, legislation, market analyses, trade fairs, standardisation as well as press and public relations. VDMA Power Systems is a trade association within the German Engineering Federation VDMA e.V.