50hertz
| Elia Group

Almanac 2023

Plan, Build, Operate – We deliver!

About this document

This interactive document uses mouse-over effects. Key figures in diagrams and tables can be displayed or hidden simply by moving the mouse pointer over them. The icon on the left indicates where this feature is available.

Where external sources are referenced, they are mentioned underneath the corresponding graphic.

You can also use the navigation at the top to navigate forwards and backwards or jump directly to the desired chapter.

Contents

Key data for 50Hertz

As a transmission system operator in the heart of Europe, 50Hertz is committed to the secure integration of renewable energy sources, the development of the European electricity market and the maintenance of a high standard of supply security. We operate the electricity transmission system in the north and east of Germany, and are expanding it to meet the requirements of the energy transition. We are leaders in the secure integration of renewable energy sources – by 2032, we aim to achieve 100 per cent coverage for the load in our grid area from renewable energy sources, averaged over the year.

Transparent and non-discriminatory business practices are at the core of our commitment to social responsibility. Our Almanac provides a concise overview of the most important data and facts on the transmission system and 50Hertz grid area in a German and European context.

Find out more at: 50Hertz.com

Conversion table

kV (kilovolt)	1,000 volts, voltage
kW (kilowatt)	1,000 watts, power
MW (megawatt)	1,000 kilowatts
GW (gigawatt)	1 million kilowatts
kWh (kilowatt-hour)	1,000 watt-hours, work
MWh (megawatt-hour)	1,000 kilowatt-hours
GWh (gigawatt-hour)	1 million kilowatt-hours
TWh (terawatt-hour)	1 billion kilowatt-hours

Key data for 2023

An overview of 50Hertz	
Investment volume	EUR 1,686 million (EUR 1,086 million in 2022)
Profit IFRS	EUR 220 million (EUR 136 million in 2022)
Employees	Around 1,800
New employees	323
Proportion of women in the workforce overall	Around 25.5%

Circuit length (km)	**10,658**	**(≈28%*)**
Circuit length of 380 kV AC overhead lines	7,535	
Circuit length of 220 kV AC overhead lines	2,375	
Circuit length of 380 kV AC cables	55	
Circuit length of 400 kV DC cables (HVDC)	15	
Circuit length of 220 kV AC cables	3	
Circuit length of 150 kV AC offshore cables	290	
Circuit length of 220 kV AC offshore cables	385	

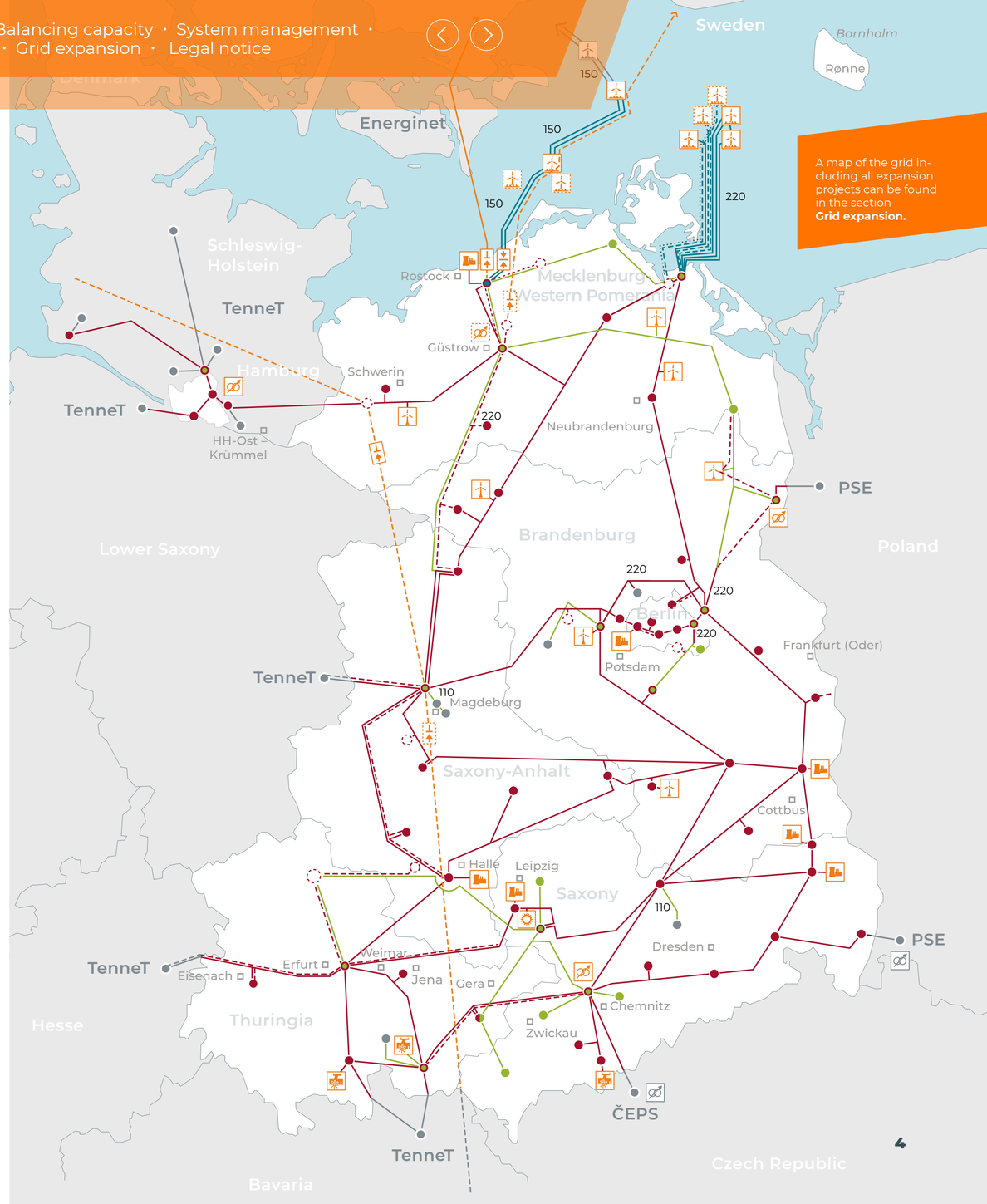
Number of installations	**81**
Substations	67
Switching stations	10
Third-party substations and switching stations	4

Transformer capacity (MVA)	**67,660**
EHV/EHV (Extra-High Voltage/Extra-High Voltage)	23,500
EHV/HV (Extra-High Voltage/High Voltage)	44,160

General information		
Geographical area (km²)	109,715	(≈31%*)
Population (millions)	18.2	(≈22%*)

* Proportion of total for Germany

ⓘ There may be rounding differences in the summing up of the individual values.



A map of the grid including all expansion projects can be found in the section **Grid expansion.**

Capacity and generation

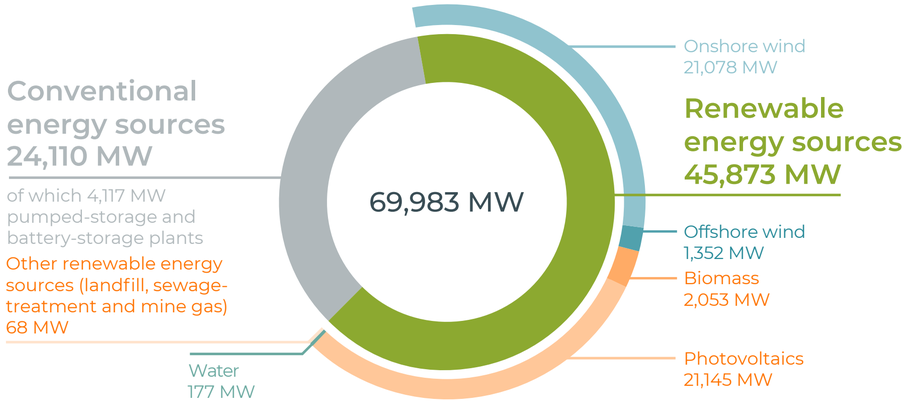
Installed capacity in the 50Hertz grid area

Installed capacity

Figures in MW	2019	2020	2021*	2022*	2023*
Renewable energy sources					
Wind, onshore	18,711	19,138	19,748	20,414	21,078
Wind, offshore	1,068	1,068	1,093	1,093	1,352
Water	284	281	174	174	177
Photovoltaics	12,204	13,552	16,359	18,175	21,145
Landfill, sewage-treatment and mine gas	70	67	59	60	68
Biomass	1,980	2,023	2,037	2,069	2,053
Total for renewable energy sources	**34,316**	**36,129**	**39,470**	**41,986**	**45,873**
Conventional energy sources					
Lignite	9,762	9,729	10,234	10,103	9,872
Coal	3,234	3,234	1,624	1,586	1,584
Natural gas	5,738	5,680	5,900	6,330	6,509
Oil	979	795	1,089	1,153	1,199
Nuclear energy	0	0	0	0	0
Waste	419	473	473	496	477
Pumped-storage plants	2,793	2,793	2,793	2,793	2,793
Battery-storage plants	–	–	237	521	1,324
Other energy sources	192	192	195	338	352
Total for conventional energy sources	**23,116**	**22,896**	**22,544**	**23,320**	**24,110**
Total	**57,432**	**59,025**	**62,014**	**65,306**	**69,983**

Sources: Installed capacity of renewable energy sources: 50Hertz's EEG database for the reporting years 2019 and 2020, Core Energy Market Data Register (MaStR) of the German Federal Network Agency for the reporting year 2021 onwards, data extracted at the end of January 2024, as at a reporting date of 31/12/2023; installed net capacity of conventional energy sources: German Federal Network Agency power plant list, data extracted in November 2023, and Core Energy Market Data Register, data extracted in January 2024, as at a reporting date of 31/12/2023.

Installed capacity in the 50Hertz grid area by energy source, 2023

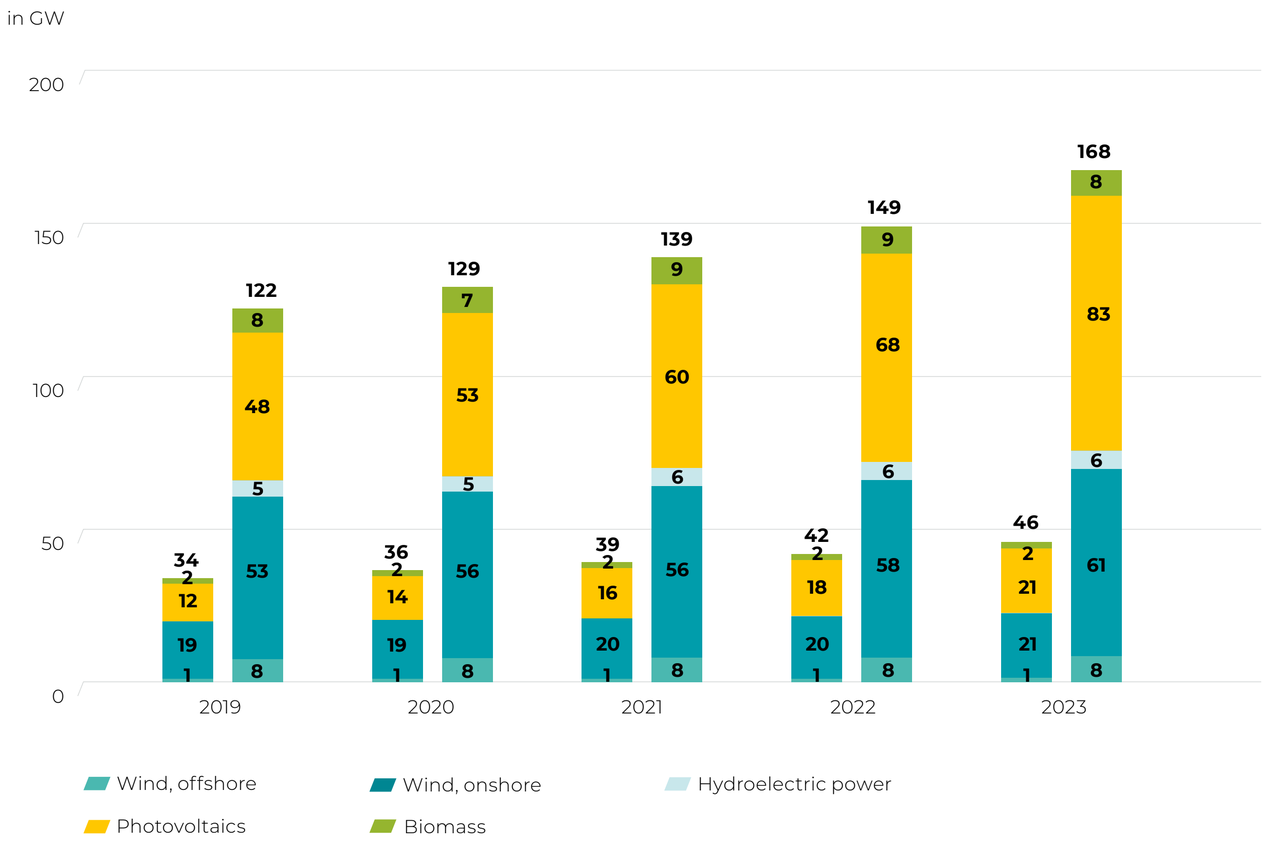


* In the 2021 reporting year, the source used for the installed capacity of renewable energy sources was changed to the gross installed capacity from the Core Energy Market Data Register (MaStR). The Core Energy Market Data Register is maintained by the German Federal Network Agency and is the central data source for master data relating to all plant operators and installations on the basis of Sections 111e and 111f of the German Energy Industry Act and the German Ordinance on the Registration of Energy Industry Data (MaStRV).

There may be rounding differences in the summing up of the individual values.

Capacity and generation

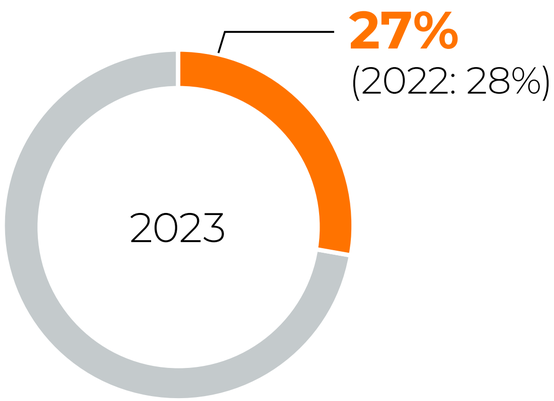
Development of the installed capacity of renewable energy sources in the 50Hertz grid area and in Germany



ⓘ The left-hand bar of each pair indicates the values for 50Hertz, the right-hand bar indicates the values for Germany. The low quantities of water, landfill, sewage treatment and mine gas cannot be depicted but are included in the totals.

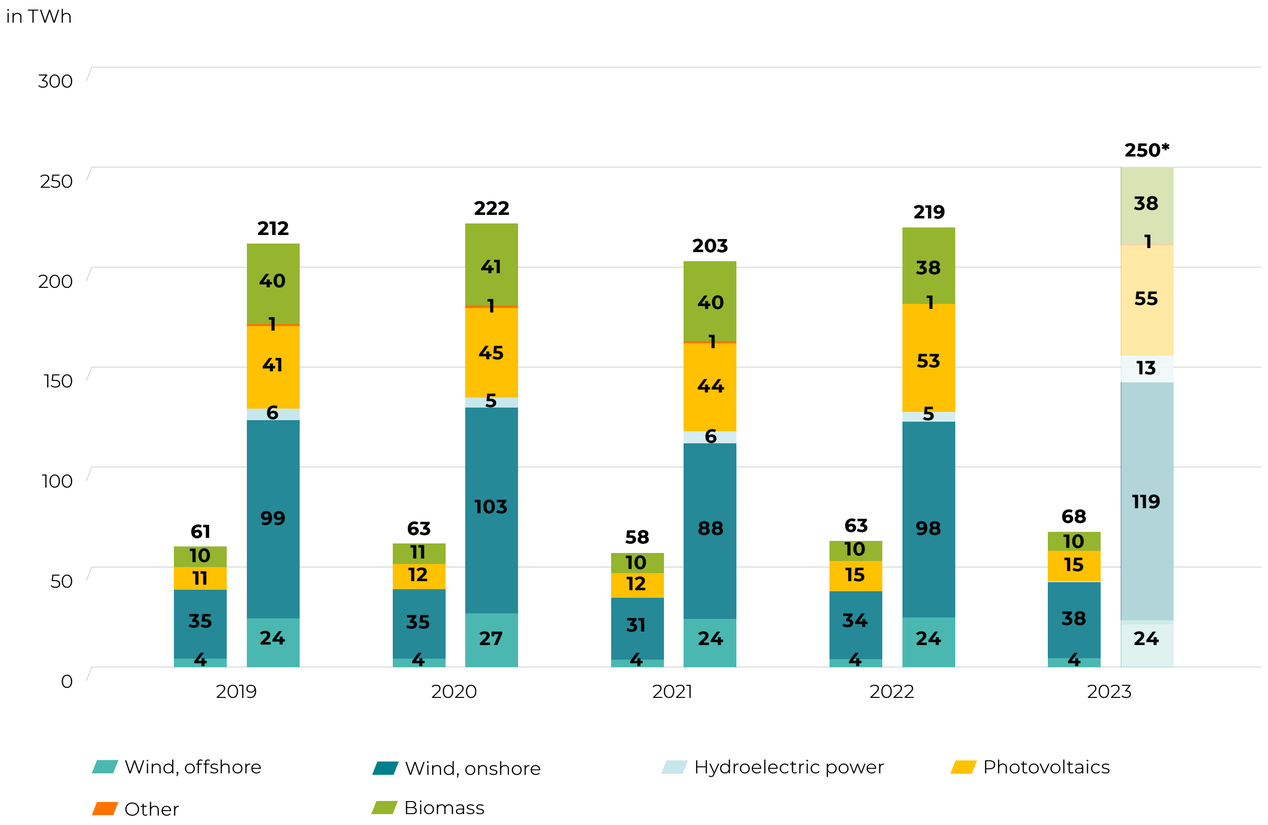
Source: Values for Germany: ENTSO-E Transparency Platform for 2019 and 2020, gross installed capacity from the Core Energy Market Data Register (MaStR) of the German Federal Network Agency from 2021 onwards.

50Hertz's share of the installed capacity of renewable energy sources in Germany in 2023



Capacity and generation

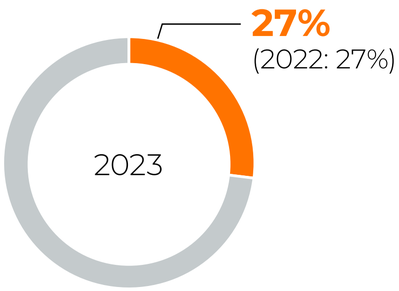
Development of the input from renewable energy sources in the 50Hertz grid area and in Germany



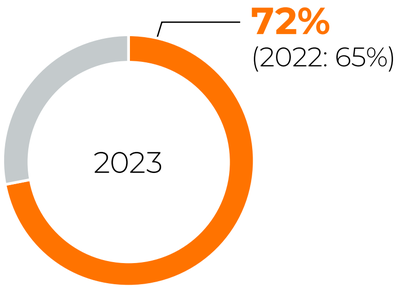
ⓘ The left-hand bar of each pair indicates the values for 50Hertz, the right-hand bar indicates the values for Germany. There may be rounding differences in the summing up of the individual values.

Source: Values for Germany: EEG annual account for 2019 to 2022, *2023 extrapolation values from the ENTSO-E Transparency Platform.

50Hertz's share of the input from renewable energy sources in Germany in 2023

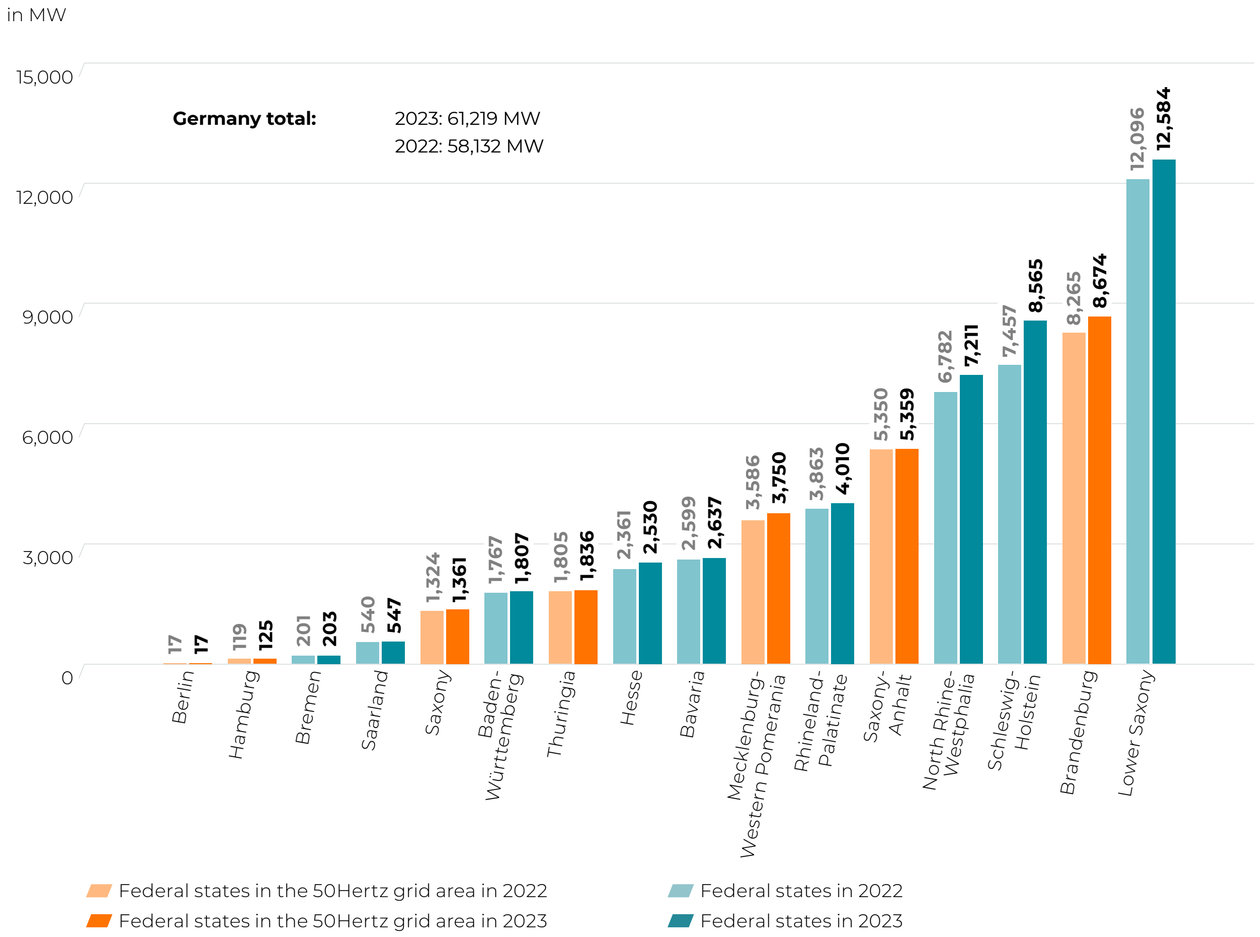


Share of the input from renewable energy sources as a proportion of total consumption in the 50Hertz grid area in 2023



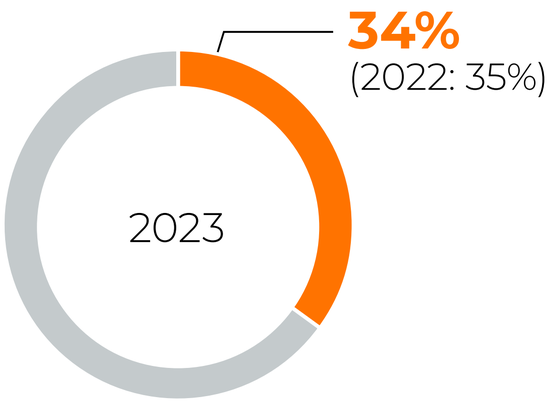
Capacity and generation

Geographical distribution of the installed onshore wind-power capacity in Germany by federal states in 2023



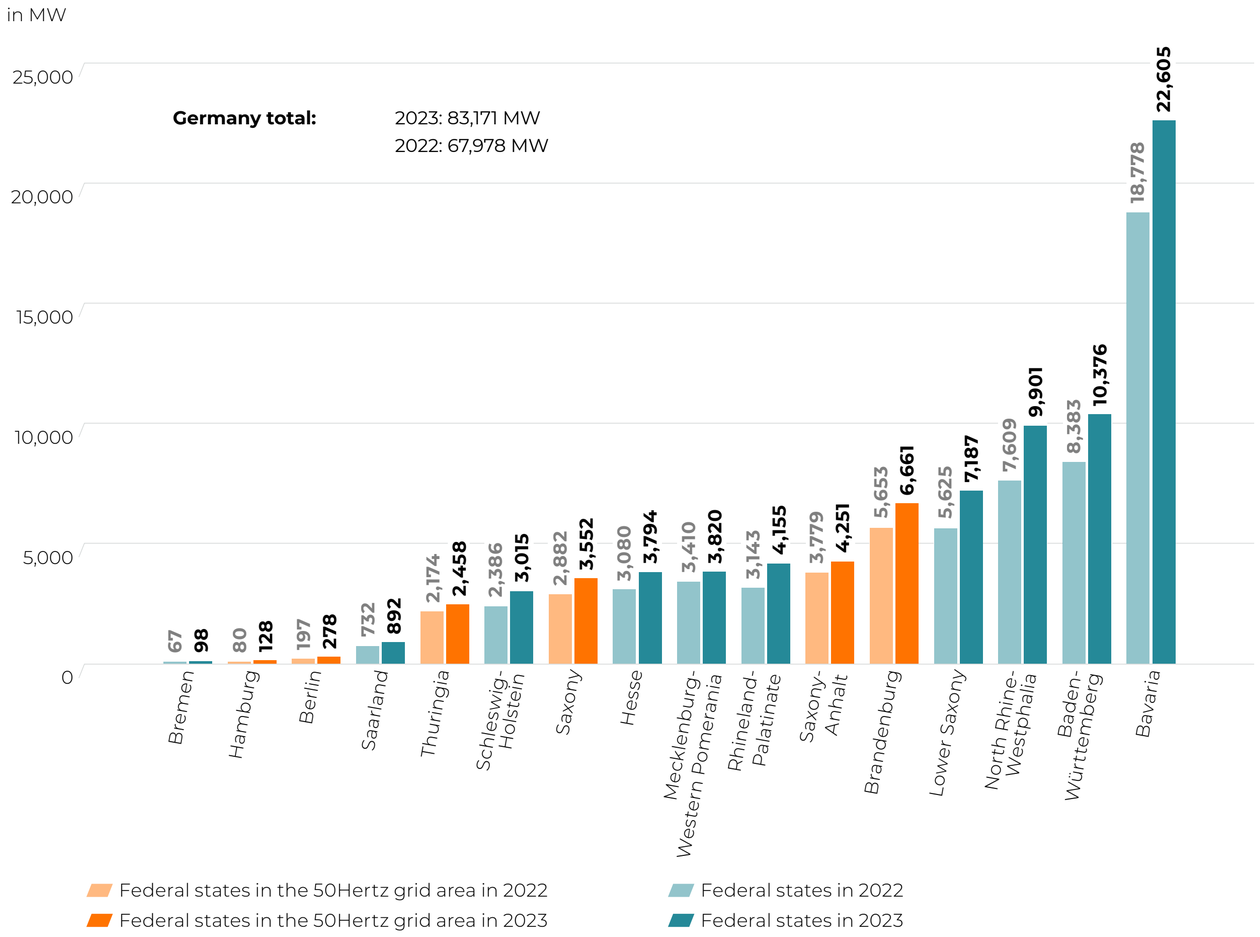
Source: Core Energy Market Data Register (MaStR), extracted at the end of January 2024 as at a reporting date of 31/12/2023.

50Hertz's share of installed onshore wind-power capacity in Germany in 2023



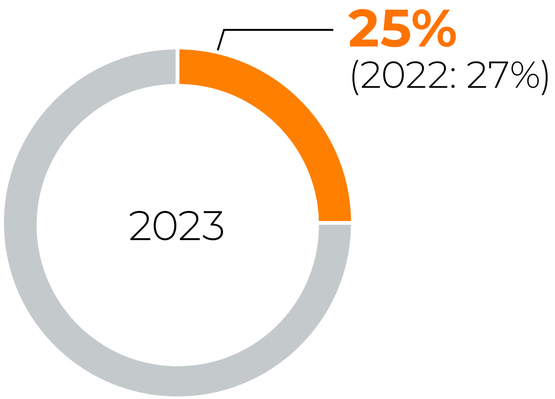
Capacity and generation

Geographical distribution of the installed photovoltaic capacity in Germany by federal states in 2023



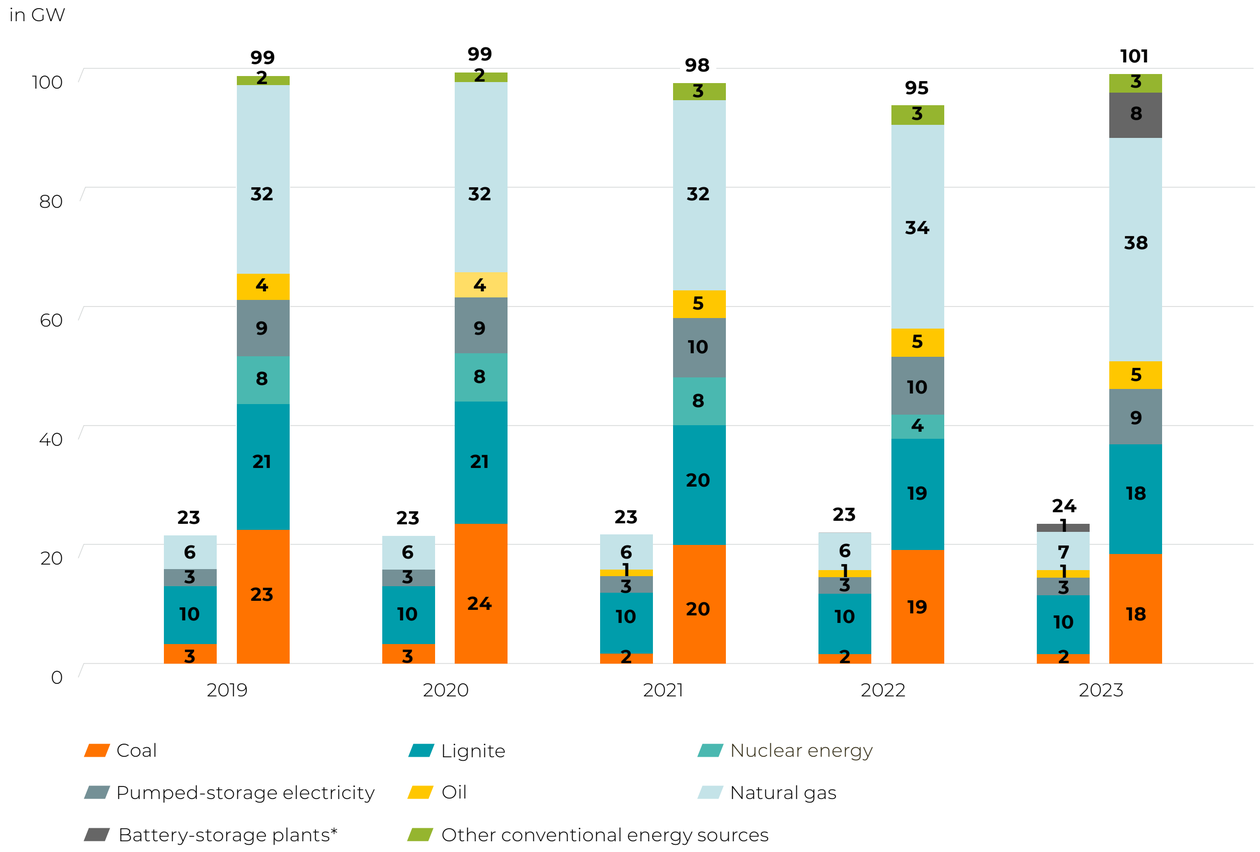
Source: Core Energy Market Data Register (MaStR), extracted at the end of January 2024 as at a reporting date of 31/12/2023.

50Hertz's share of installed photovoltaic capacity in Germany in 2023



Capacity and generation

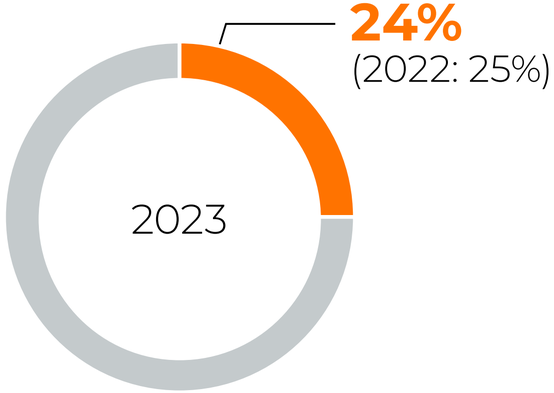
Development of the installed net capacity of conventional power plants in the 50Hertz grid area and in Germany



ⓘ The left-hand bar of each pair indicates the values for 50Hertz, the right-hand bar indicates the values for Germany.
No figures are shown for values < 1 GW.
There may be rounding differences in the summing up of the individual values.

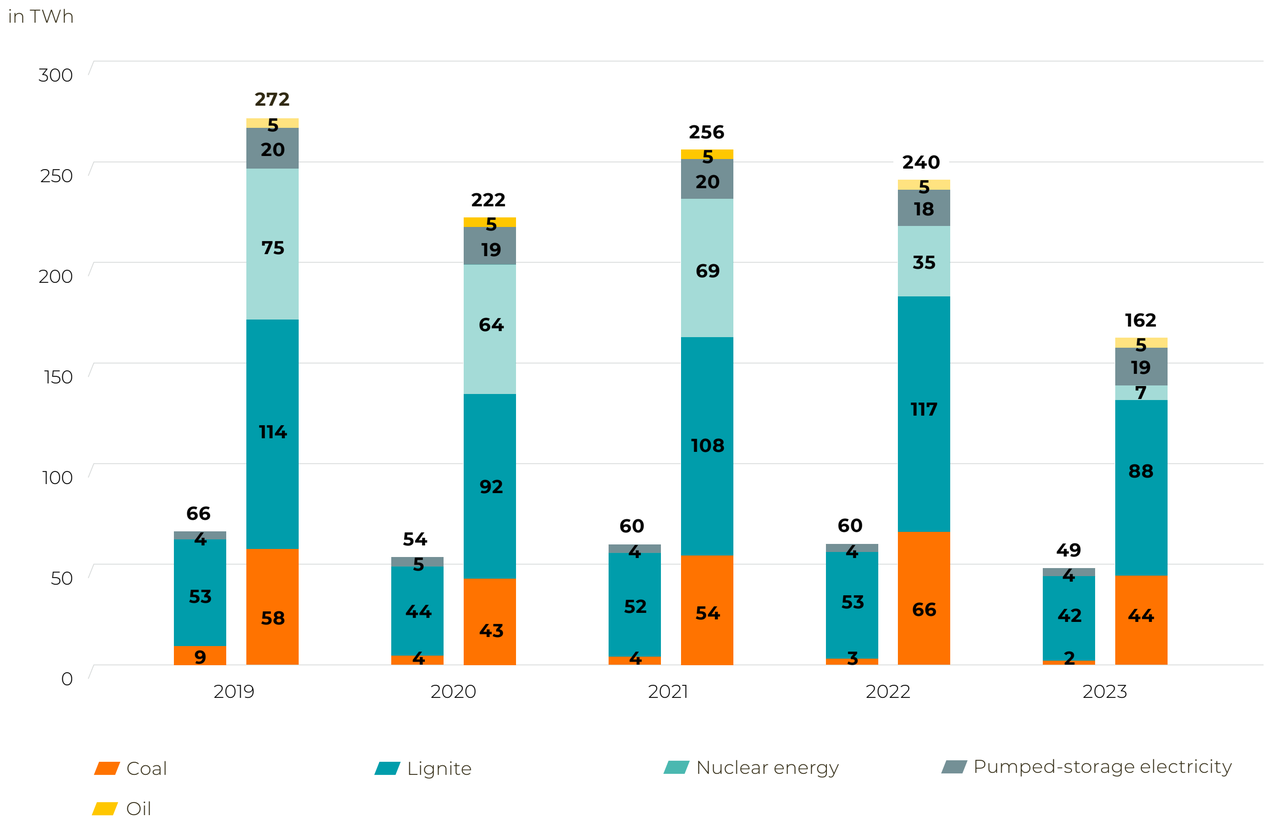
Source for Germany values: Power plant list and Core Energy Market Data Register (MaStR) of the German Federal Network Agency.
* Battery storage plants have only been recognised as energy sources since 2023.

50Hertz's share of the installed net capacity of conventional power plants in Germany in 2023



Capacity and generation

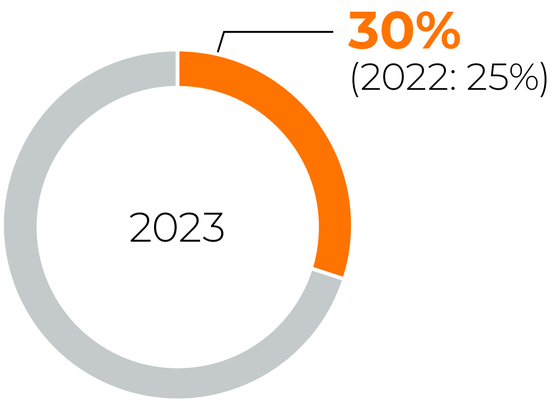
Development of the input from conventional energy sources to the 50Hertz extra-high-voltage grid and in Germany



ⓘ The left-hand bar of each pair indicates the values for 50Hertz, the right-hand bar indicates the values for Germany. There may be rounding differences in the summing up of the individual values.

Source for Germany values: German local association of Energy and Water Industries (BDEW), preliminary figures.

50Hertz's share of the input from conventional energy sources in Germany in 2023



Capacity and generation

Key figures for the input from wind turbines (onshore and offshore) in the 50Hertz grid area

Figures in MW	2022	2023
Maximum simultaneous input	16,885	17,887
Minimum input	3	14
Biggest one-hour spike	3,277	2,975
Biggest one-hour drop	–2,590	–2,893
Biggest 15-minute spike	1,522	1,907
Biggest 15-minute drop	–1,412	–1,018
Biggest one-day spike	10,950	14,494

ⓘ Data based on extrapolated figures (15-minute mean capacity figures), including direct marketing.

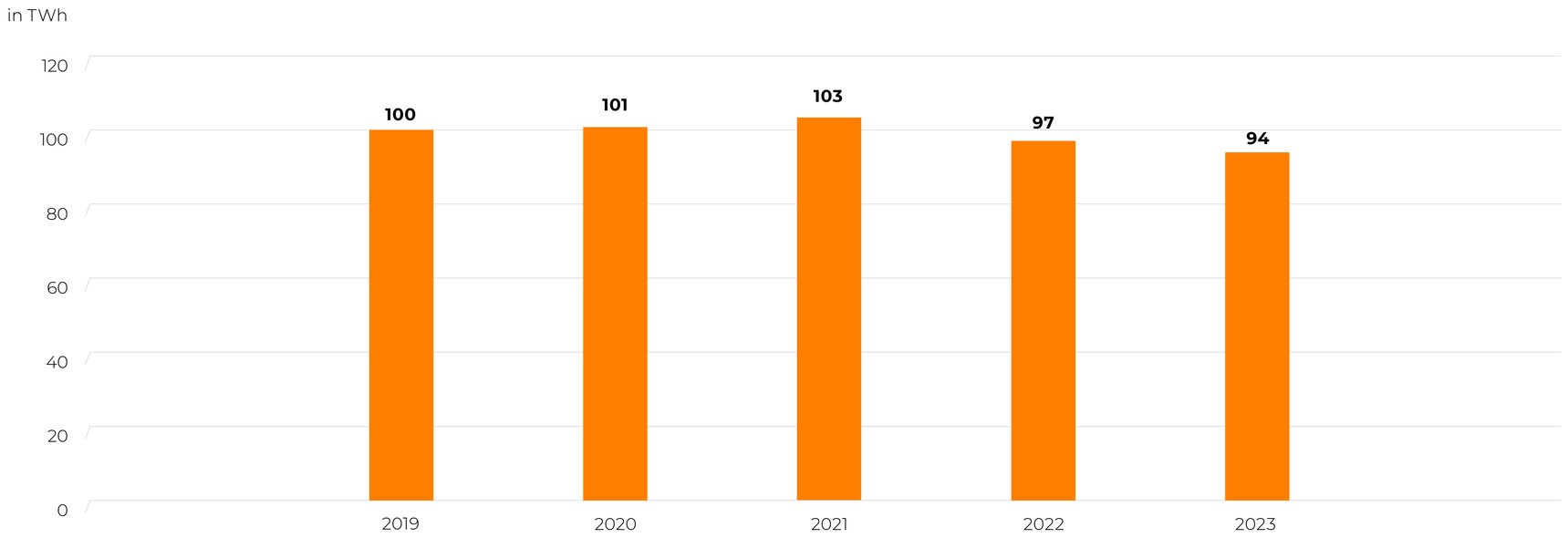
Key figures for the input from photovoltaic plants in the 50Hertz grid area

Figures in MW	2022	2023
Maximum simultaneous input	11,062	11,895
Minimum input	0	0
Biggest one-hour spike	2,950	3,188
Biggest one-hour drop	–2,874	–2,844
Biggest 15-minute spike	805	1,333
Biggest 15-minute drop	–834	–775

ⓘ Data based on extrapolated figures (15-minute mean capacity figures), including direct marketing.

Load and consumption

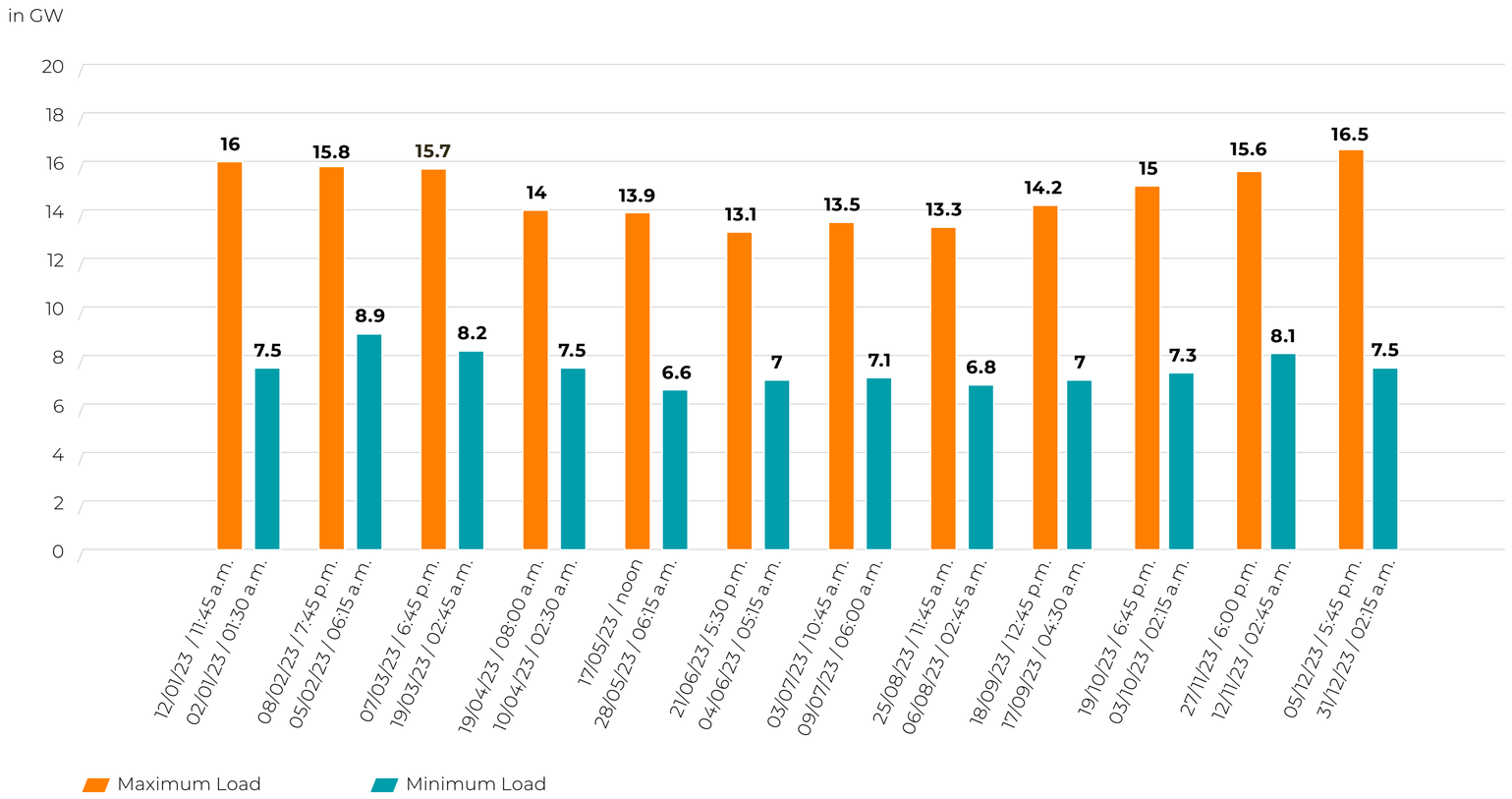
Development of electricity consumption in the 50Hertz grid area



ⓘ For the year 2019, electricity consumption consisted of end consumption in accordance with the German Renewable Energy Sources Act (EEG) and self-supply subject to the EEG levy. Since 01/01/2020, the network losses of transmission system operators and distribution system operators have also been taken into account, as have pumped-storage plant losses. The foundation of the data for the electricity consumption in accordance with the EEG has also been abolished together with the EEG levy. Since 01/01/2022, the electricity consumption has been calculated based on the quantities withdrawn from the balancing zone accounting, and continues to include the network losses and pumped-storage plant losses.

Load and consumption

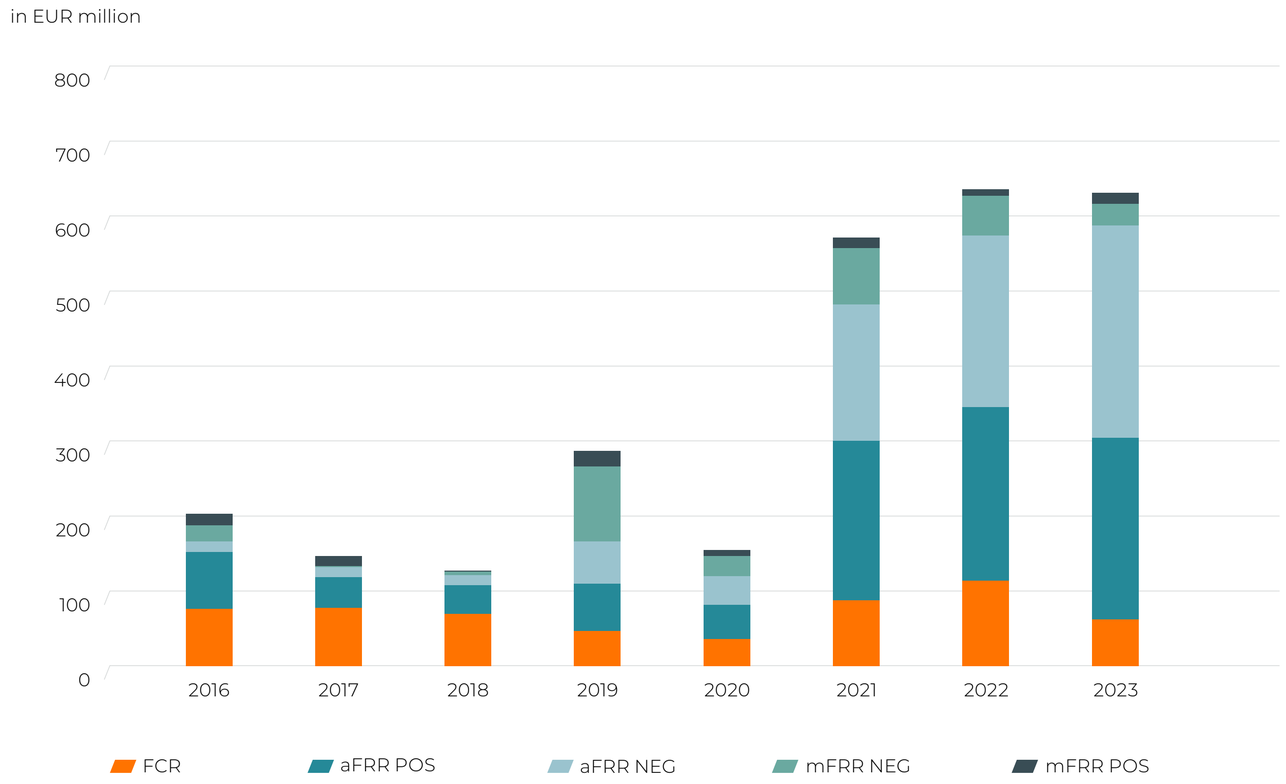
Monthly maximum and minimum load in the 50Hertz grid area, 2023



Annual maximum	16,462 MW on 05/12/2023 at 17:45
Annual minimum	6,649 MW on 28/05/2023 at 6:15

Balancing capacity

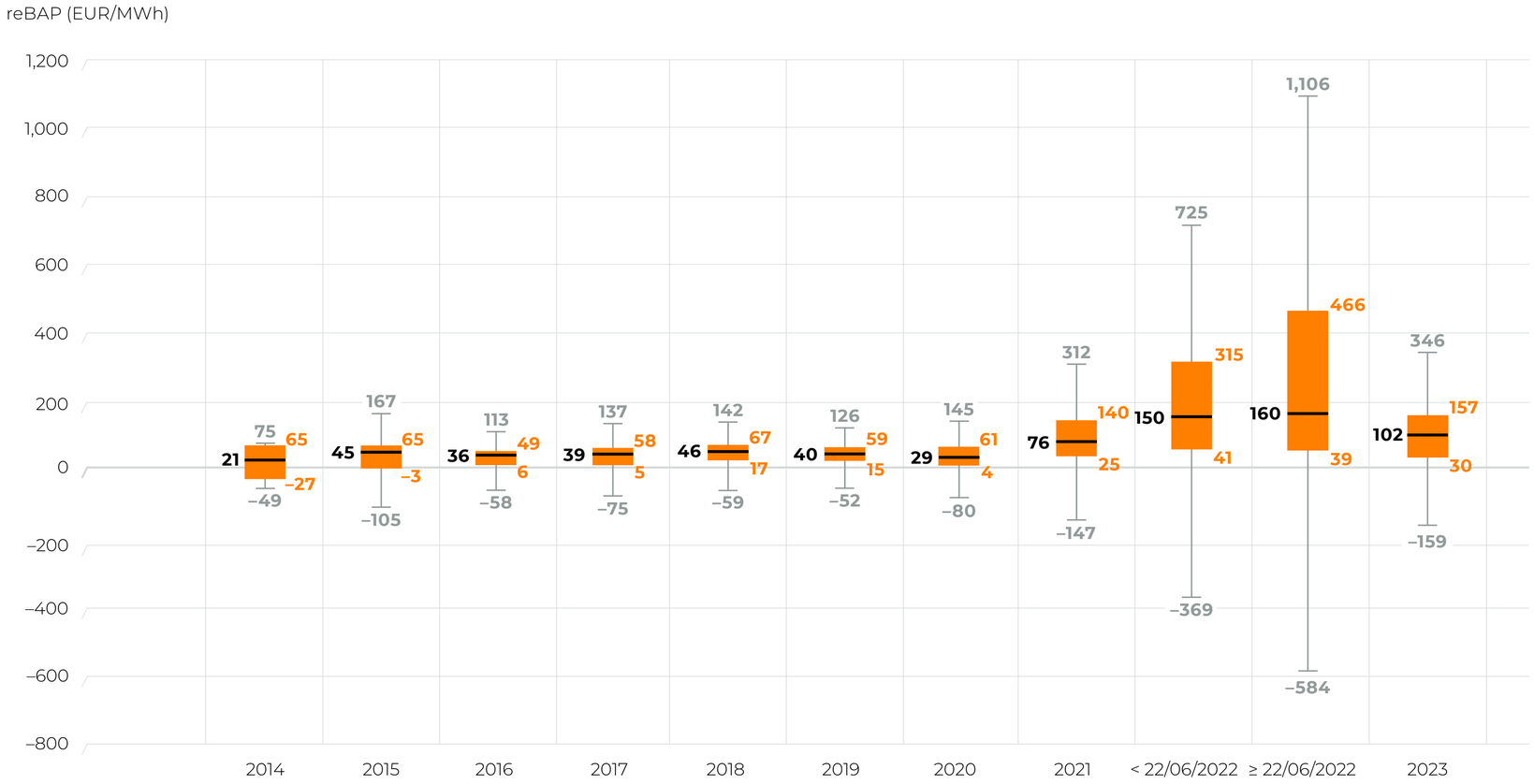
Development of costs by type of balancing capacity in Germany



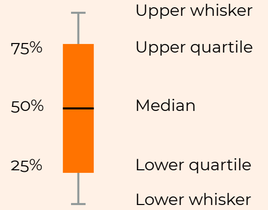
ⓘ More information and the source of the above figures can be found at: regelleistung.net

Balancing capacity

Development of the imbalance price (reBAP)



The “box plot scheme” is a suitable format for presenting the distribution of the quarter-hourly imbalance price (reBAP) in the respective years. The edges of the box enclose 50% of the time period (i.e: 50% of all quarter hours in a year) and are bounded by the lower (Q1 = 25%) and upper quartile (Q3 = 75%). This excludes the quarter hours with the cheapest or most expensive 25% of the reBAPs that occur. The line within the box shows the median (Q2 = 50%) of all occurring values; i.e. half of all data points are larger and half are smaller. Together with the quantiles, the median gives an indication of the dispersion and skewness of the data. The whiskers indicate the level up to which the values are within the limits of Q1 – 1.5 × (Q3 – Q1) and Q3 + 1.5 × (Q3 – Q1). The whiskers thus show how the extremes of the data set are spread and give an impression of the volatility of the reBAP. Extreme outliers (quarter hours with particularly high/low prices) are not included in this box plot.

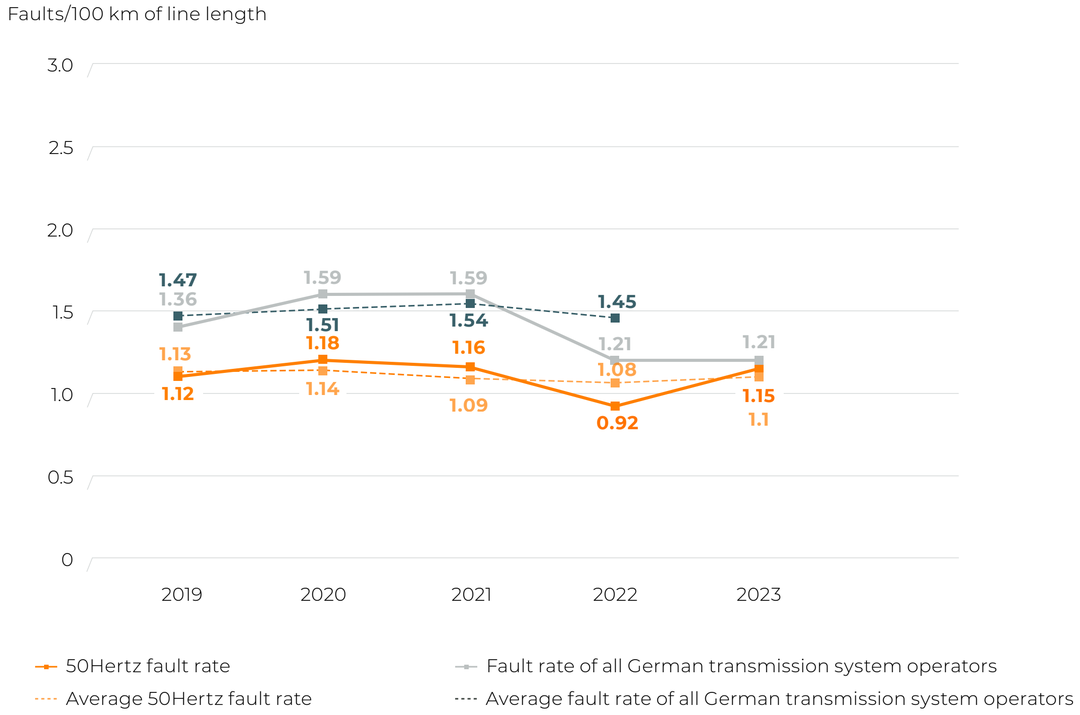


Outliers are not depicted.
Extensive market changes came into effect on 22/06/2022: Introduction of the redesigned European electricity balancing market, implementation of imbalance settlement harmonisation methodology (ISHM).

Find out more at: netztransparenz.de/Daten-zur-Regelenergie/reBAP

System management

Comparison between the 50Hertz fault rate and that of the German transmission system operators

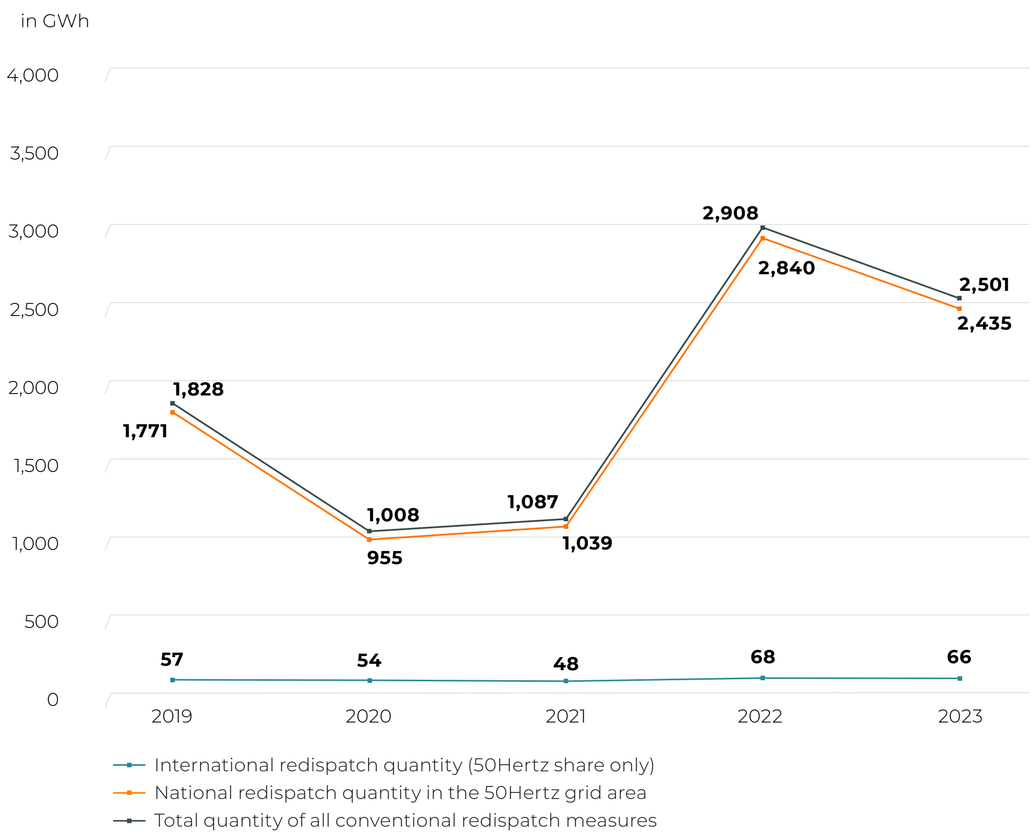


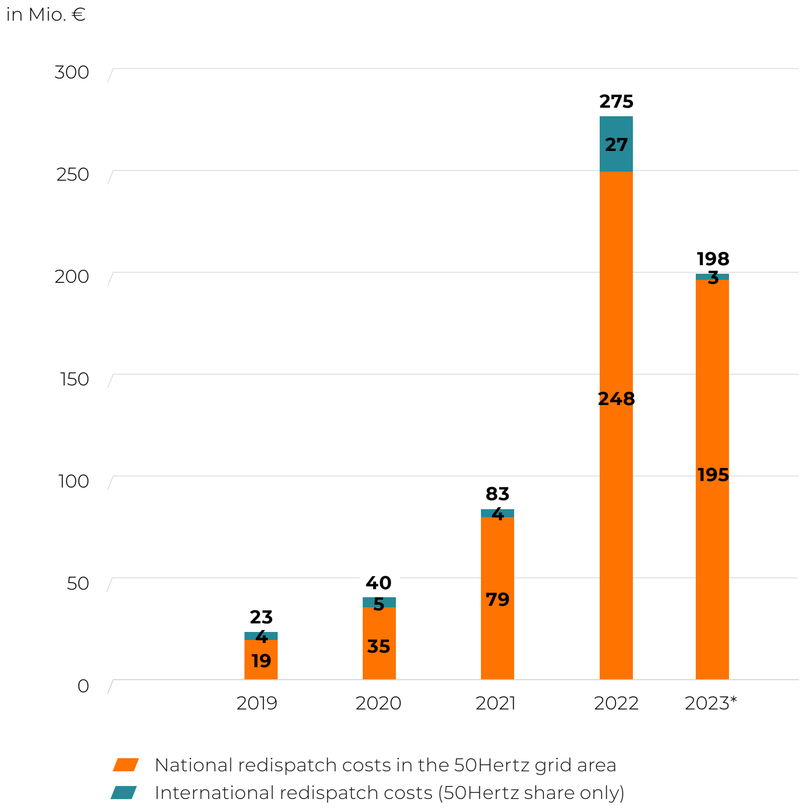
ⓘ An unwanted change of the “normal operating state” is classed as an error that leads to a fault. This takes into account incidents that occur in the active grid used for transmission. Other errors are only recorded if they lead to an unwanted change of the normal operating state of the grid concerned.

Source for the average for all German transmission system operators: Annual report of the “Forum Netztechnik/Netzbetrieb” im VDE (“Forum for System Technology/System Operations” in the German Association for Electrical, Electronic & Information Technologies), the value for 2023 is not yet available at the time of publication.

System management

Development of congestion management measures (conventional redispatch) – quantities and costs





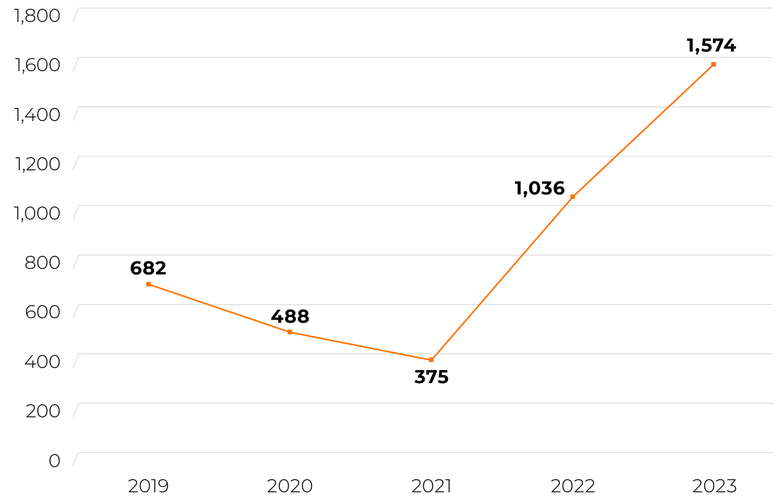
* Preliminary figure

ⓘ There may be rounding differences in the summing up of the individual values.

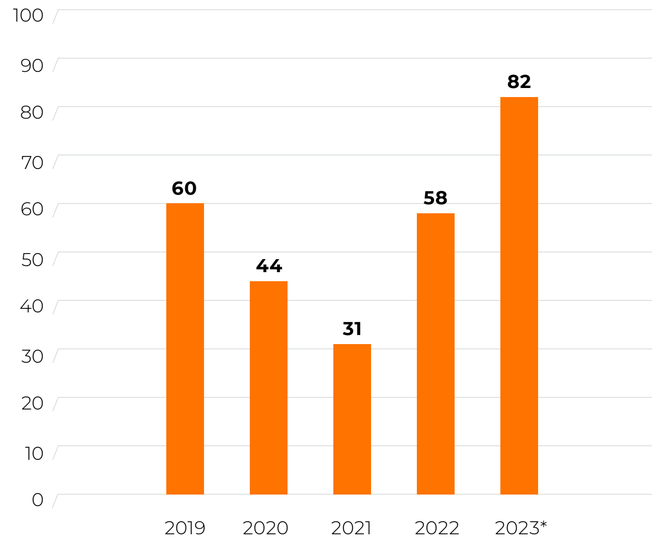
System management

Development of congestion management measures due to the input reduction for renewable energy plants (for 50Hertz directly and the distribution network) – quantities and costs

in GWh



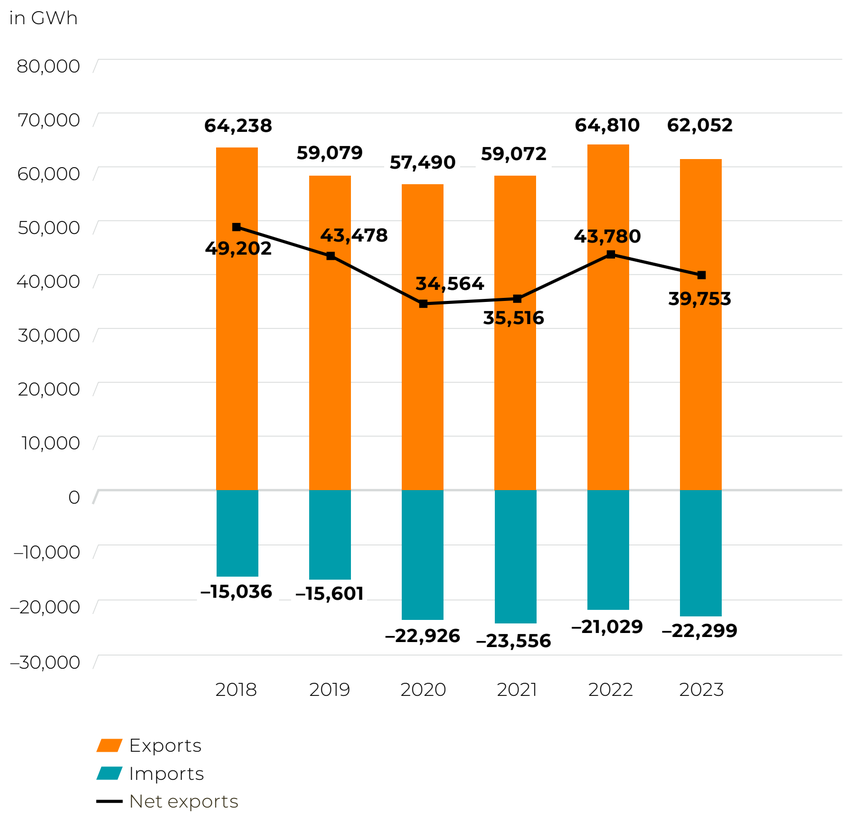
in EUR million



* Preliminary figure

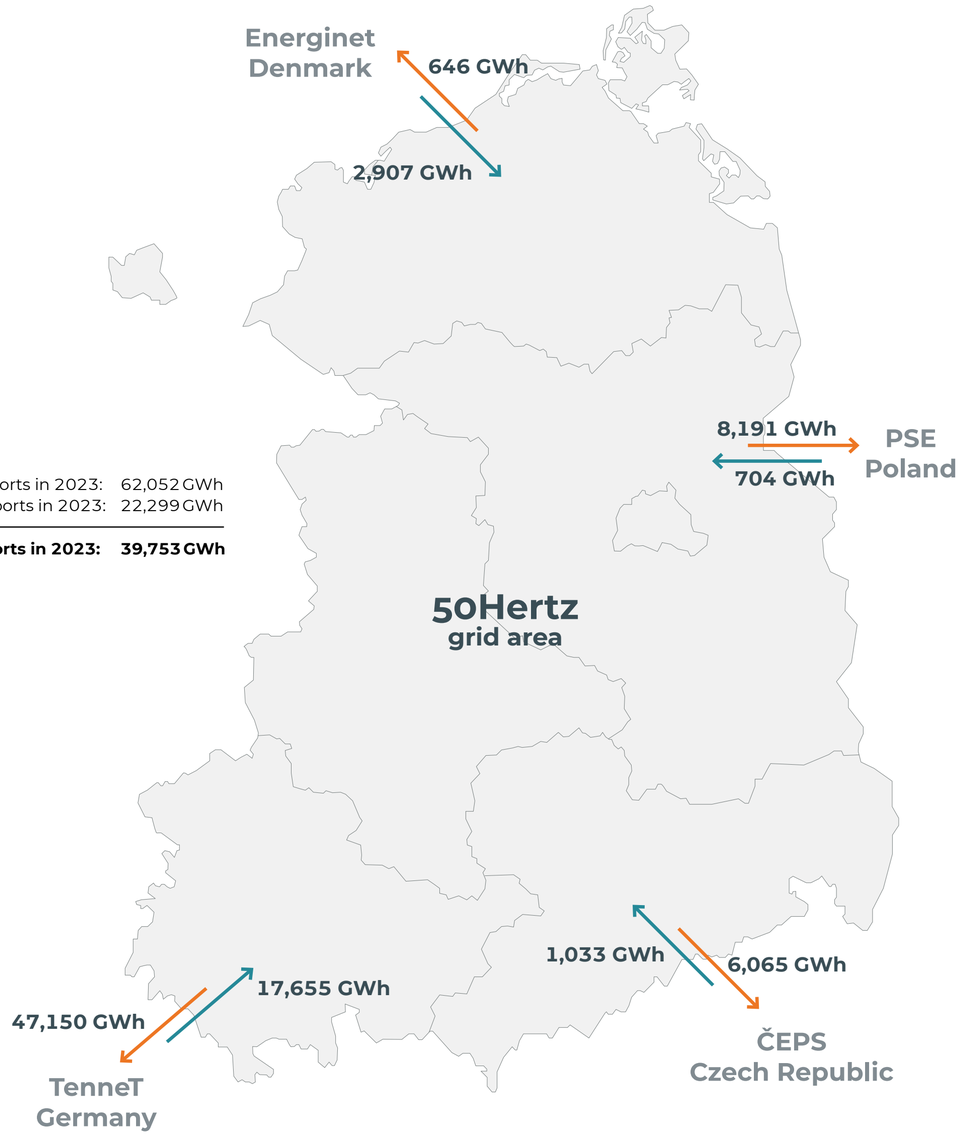
Exchange and transport

Development of exports and imports at the 50Hertz grid area boundaries



Total exports in 2023: 62,052 GWh
Total imports in 2023: 22,299 GWh

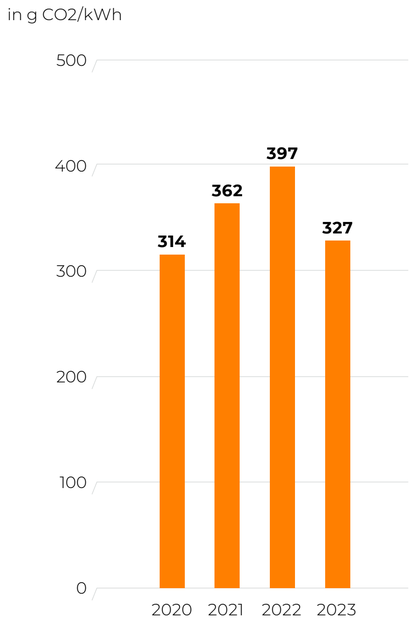
Net exports in 2023: 39,753 GWh



Climate and environmental protection

Climate protection:

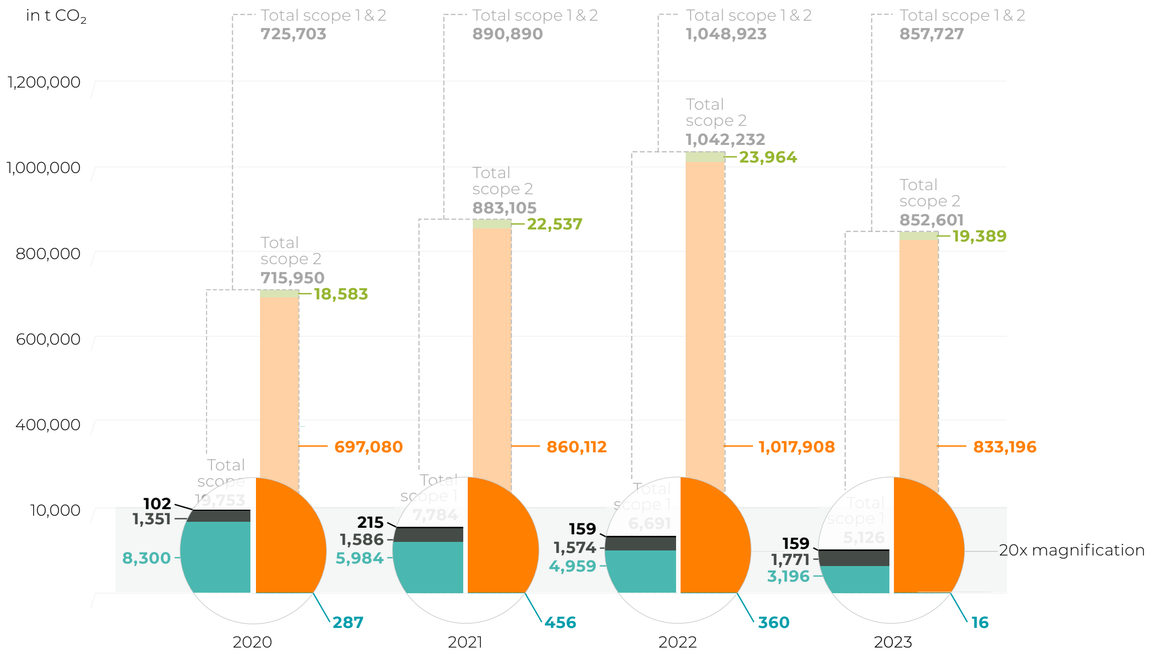
Greenhouse gas emissions from the German electricity mix



Since this issue, the value has been calculated on an adjusted basis, which has also been applied to the previous year's values since 2020 in order to ensure comparability. For details see: eco2grid.50hertz.com/calculation.

Find out more at:
eco2grid.50hertz.com

Greenhouse gas emissions of 50Hertz



Scope 1 direct emissions

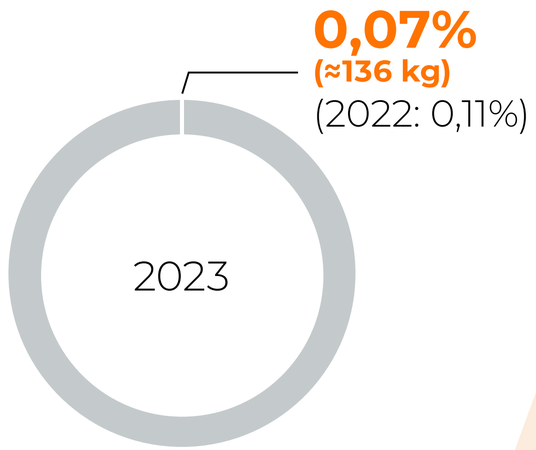
- SF6 losses
- Fleet
- Natural gas

Scope 2 indirect emissions

- District heat
- Grid losses*
- Operational electricity consumption (technical & administrative)

* Energy losses are inevitable with electricity transmission. The energy to cover the grid losses must be procured by 50Hertz in accordance with EnWG ("Energiewirtschaftsgesetz": Energy Industry Act) and StromNZV ("Stromnetzzugangsverordnung": German Ordinance on Access to the Electricity Grid)

SF6 leak rate (sulphur hexafluoride)



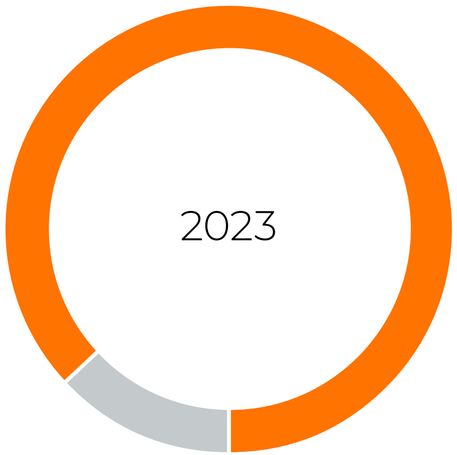
Climate and environmental protection

Environmental protection:

Share of ecologically managed forest routes

87% (670 km)

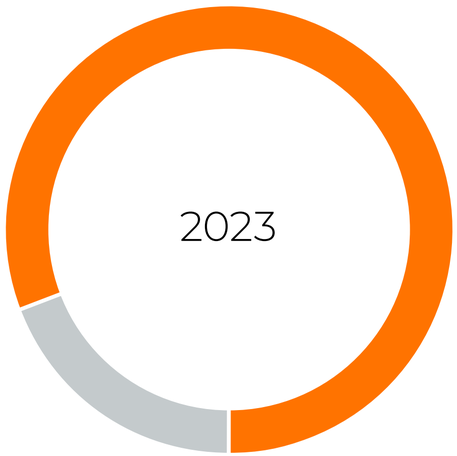
(2022: 85%)



Share of line sections fitted with bird-protection markers over the entire line length in European Bird Sanctuaries or migration and resting sites

81% (325 km)

(2022: 76%)



More information can be found at: csr.50hertz.com

Grid expansion

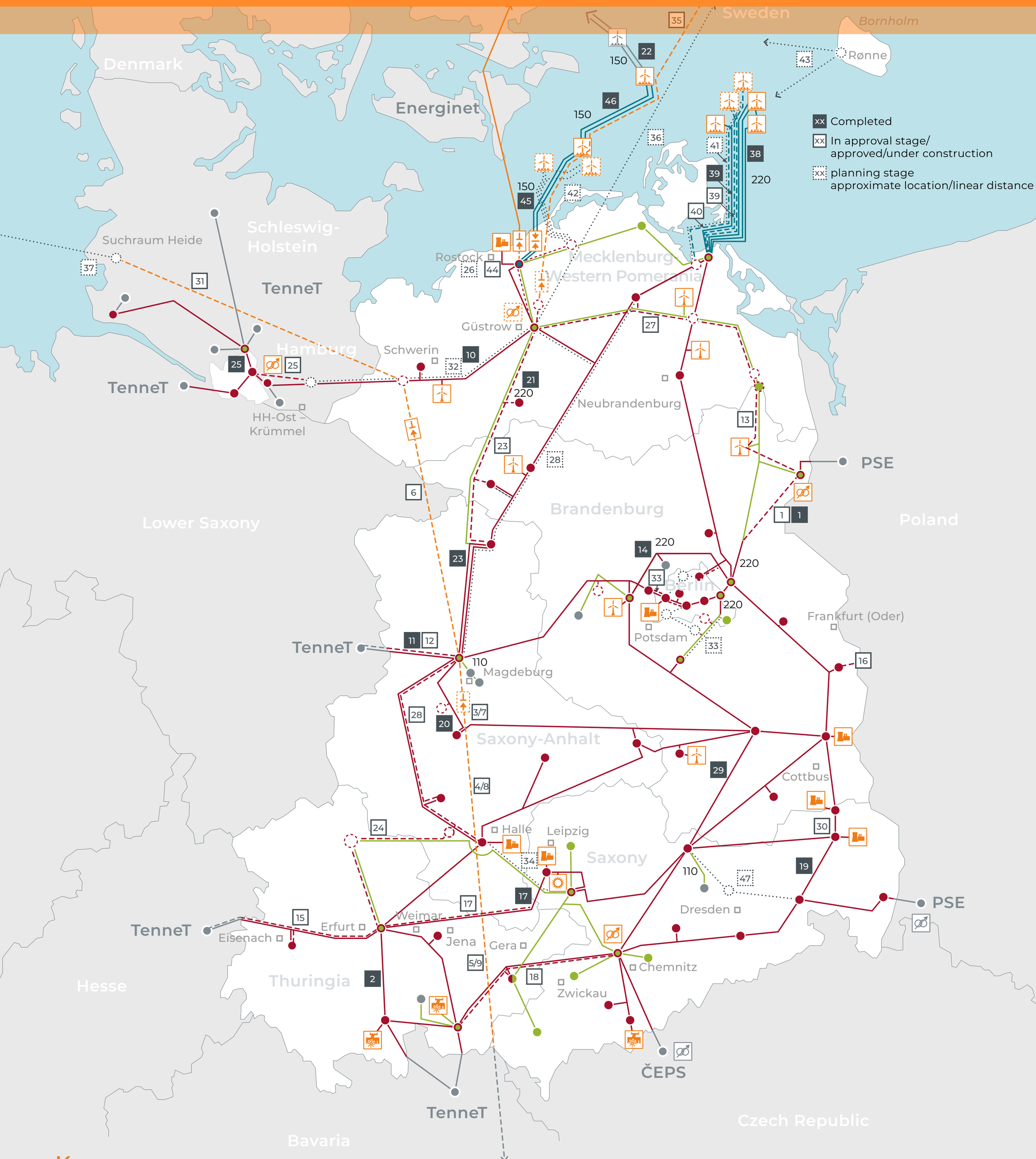
Grid expansion projects since 2009 according to EnLAG, BBPlG as well as offshore projects

Map number	P no.	Legal basis	Project	Planning stage	Approval stage	Approved/under construction	Completed
1	3	EnLAG	Uckermark line (Neuenhagen – Bertikow/Vierraden – Krajnik (Poland))			26	97
2	4	EnLAG	South-western interconnector (Lauchstädt – Redwitz)				159
3	5	BBPlG	Extra-high-voltage line Wolmirstedt – Isar (SOL A1); direct current		87		
4	5	BBPlG	Extra-high-voltage line Wolmirstedt – Isar (SOL A2); direct current		94		
5	5	BBPlG	Extra-high-voltage line Wolmirstedt – Isar (SOL B); direct current		84		
6	5a	BBPlG	Extra-high-voltage line Klein Rogahn search area – Isar (SOL+ north segment); direct current		220		
7	5a	BBPlG	Extra-high-voltage line Klein Rogahn search area – Isar (SOL+ segment A1); direct current		70		
8	5a	BBPlG	Extra-high-voltage line Klein Rogahn search area – Isar (SOL+ segment A2); direct current		94		
9	5a	BBPlG	Extra-high-voltage line Klein Rogahn search area – Isar (SOL+ segment B); direct current		84		
10	9	EnLAG	Wind bus bar (Hamburg/Krümmel – Schwerin)				65
11	10	BBPlG	Wolmirstedt – Helmstedt – Wahle (M24a)				46
12	10	BBPlG	Wolmirstedt – Helmstedt – Wahle (M24b)		47		
13	11	BBPlG	Bertikow – Pasewalk			7	25
14	11	EnLAG	380-kV-Berlin Northern Ring (Neuenhagen – Hennigsdorf – Wustermark)				71
15	12	BBPlG	Vieselbach – Eisenach – Mecklar		87		
16	12	EnLAG	3. interconnector (Eisenhüttenstadt – Baczyna (Poland))		8		
17	13	BBPlG	Pulgar – Vieselbach			75	30
18	14	BBPlG	Röhrsdorf – Weida – Remptendorf			63	46
19	26	BBPlG	Bärwalde – Schmölln				46
20	27	BBPlG	Walsleben – Förderstedt branch				12
21	28	BBPlG	Parchim South – Neuburg branch				1
22	29	BBPlG	Offshore connection Kriegers Flak – Baltic 2 (Combined Grid Solution)				50
23	39	BBPlG	Güstrow – Parchim South – Perleberg – Stendal West – Wolmirstedt		63	59	69
24	44	BBPlG	Südharz grid connection (Schraplau/Obhausen – Wolkramshausen – Vieselbach)		146		
25	51	BBPlG	Hamburg North – Hamburg East – Büchen/ Breitenfelde/Schwarzenbek-Land collective municipalities		28		31
26	52	BBPlG	Rostock region grid reinforcement (P215 Bentwisch – Güstrow – Gnewitz)		68		
27	53	BBPlG	Güstrow – Siedenbrünzow – Iven/Krusenfelde/Krien/ Spantekow/Werder/Bartow – Pasewalk North – Pasewalk		152		
28	60	BBPlG	Siedenbrünzow – Güstrow – Putlitz South – Perleberg – Osterburg – Stendal West – Wolmirstedt – Schwanebeck – Kloster-mansfeld – Schraplau/Obhausen – Lauchstädt	283		156	
29	61	BBPlG	Ragow – Streumen				89
30	62	BBPlG	Graustein – Bärwalde		22		
31	81	BBPlG	NordOstLink (Heide search area – Klein Rogahn search area)		≈106		
32	85	BBPlG	Güstrow – Krümmel	147			
33	87	BBPlG	Grid expansion and reinforcement Berlin	67	8		
34	93	BBPlG	Central Germany energy triangle (Lauchstädt – Leuna/Merseburg/Weißenfels – Pulgar)	59			
35	69	BBPlG	Hansa PowerBridge (Güstrow – Sweden)		25	150	
36	83	BBPlG	Hansa PowerBridge 2	35			
37			NOR-11-1 (LanWin3)	212			
38			Ostwind 1				289
39			Ostwind 2			176	98
40			Ostwind 3		3	101	
41			Ostwind 4 – high-voltage direct current connection (HVDC)	≈110			
42			OST-6-1 Gennaker	252			
43			Bornholm Energy Island (BEI)	≈184			
44			KONTEK grid connection			15	
45			Baltic 1				77
46			Baltic 2				192
47			Streumen – Dresden North search area – Schmölln	92			
				≈1,441	**≈1,496**	**828**	**1,493**

EnLAG – Energieleitungsausbaugesetz [German Energy Line Extension Act]
BBPIG – Bundesbedarfsplanungsgesetz [German Federal Requirements Plan Act]

ⓘ Figures in kilometres; length of route for onshore projects in the 50Hertz grid area, length of cabling systems for offshore projects (including onshore sections where applicable)

Find out more at:
50hertz.com/en/Grid/Griddevelopement and netzausbau.de/EN/Englisch-node.html



Key

Switching stations (most with links to distribution system operators)

- 380 kV
- 220 kV
- Transformation 380/220 kV
- Transformation 380/150 kV
- In approval stage/construction
- Planning stage
- Other companies
- 110 Operating voltage in kV

* New construction largely along existing route

Line	380 kV	
Line in approval stage/ under construction*	380 kV	
Line	220 kV	
HVDC/direct-current connection	400 kV	
HVDC/direct-current connection in approval stage/under construction	300/400/525 kV	
Other companies	380/220 kV	
HDVC/back-to-back converter	380/150 kV	
HVDC/converter	400 kV	
HVDC/converter in approval stage/under construction	300/525 kV	
Offshore grid connection	150/220 kV	
Offshore grid connection in approval stage/under construction	150/220 kV	
In approval stage		

Grid users:
Our customers are regional distribution system operators and power stations, pumped storage plants, wind farms and large industrial facilities that are connected to the transmission system.

- Conventional power station
- Pumped storage plant
- Phase-shifting transformers
- Onshore wind farm/Offshore wind farm
- Photovoltaic (PV)
- Onshore wind farm in approval stage/under construction
- Offshore wind farm in approval stage/under construction
- PV farm in approval stage/ under construction

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