50hertz
| Elia Group

Almanac 2024

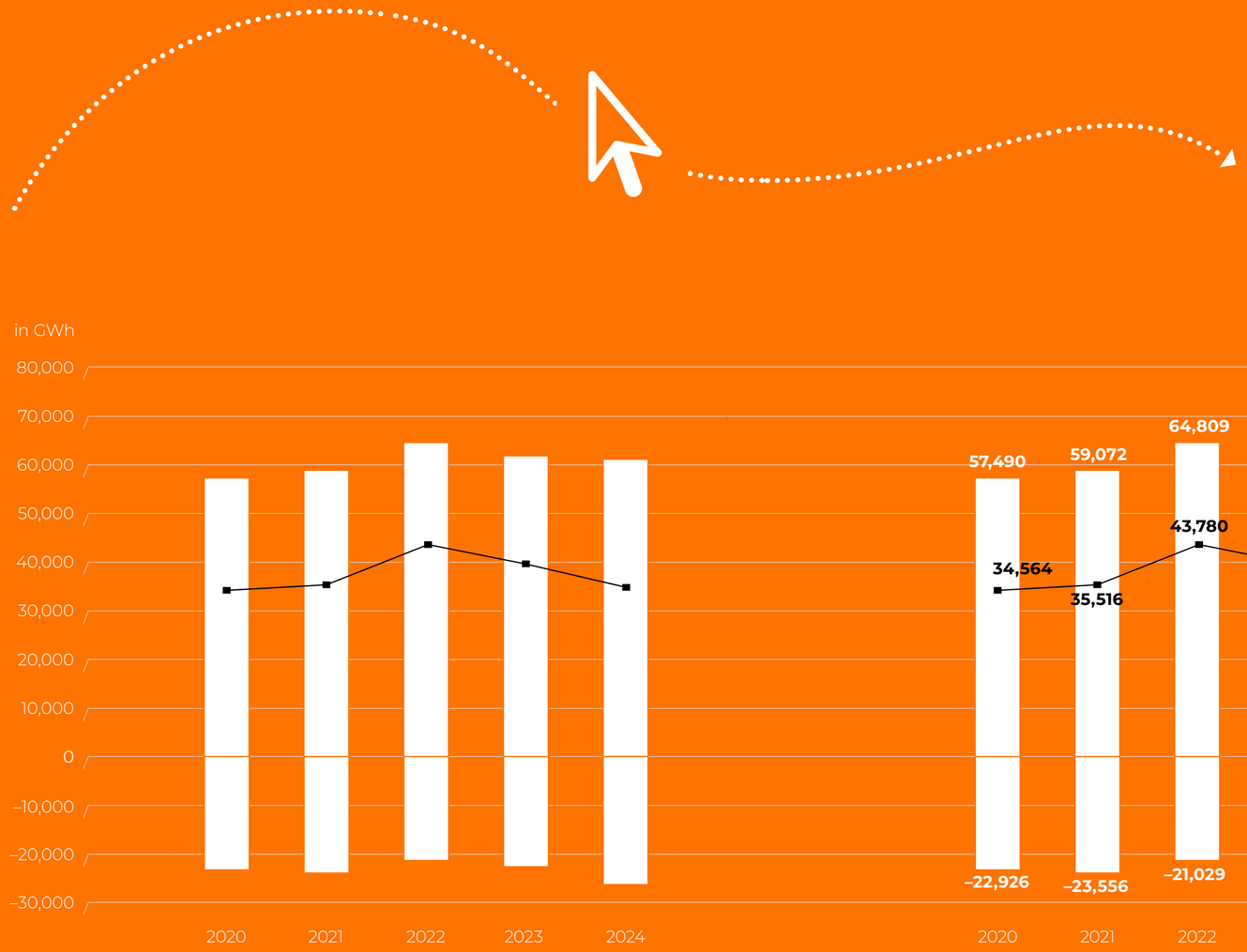
Stability for the energy transition

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 as cost-effective and resilient as possible in the interests of society. We are leaders in the secure integration of renewable energy sources – by 2032, we aim to achieve 100 per cent coverage of 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 2024

An overview of 50Hertz		
Investment volume	EUR 3,627 million (EUR 1,686 million in 2023)	
Profit IFRS	EUR 309,8 million (EUR 220 million in 2023)	
Employees	2,089	
New employees	435	
Proportion of women in the workforce overall	26.35 %	
Circuit length (km)	**10,838**	**(≈ 30 %*)**
Circuit length of 380 kV AC overhead lines	7,840	
Circuit length of 220 kV AC overhead lines	2,075	
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	560	
Number of installations	**87**	
Substations	69	
Switching stations	10	
Third-party substations and switching stations	8	
Transformer capacity (MVA)	**67,110**	
EHV/EHV (Extra-High Voltage/Extra-High Voltage)	23,000	
EHV/HV (Extra-High Voltage/High Voltage)	44,110	
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

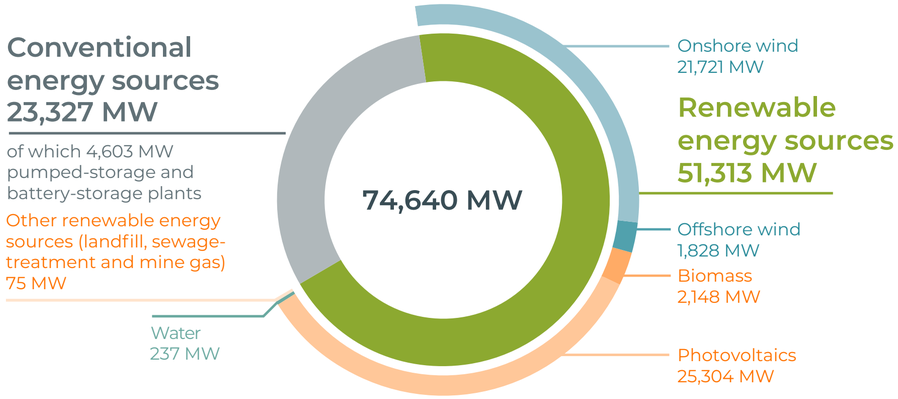
Installed capacity in the 50Hertz grid area

Installed capacity

Figures in MW	2020	2021*	2022*	2023*	2024*
Renewable energy sources					
Wind, onshore	19,138	19,748	20,414	21,078	21,721
Wind, offshore	1,068	1,093	1,093	1,352	1,828
Water	281	174	174	177	237
Photovoltaics	13,552	16,359	18,175	21,145	25,304
Landfill, sewage-treatment and mine gas	67	59	60	68	75
Biomass	2,023	2,037	2,069	2,053	2,148
Total for renewable energy sources	**36,129**	**39,470**	**41,986**	**45,873**	**51,313**
Conventional energy sources					
Lignite	9,729	10,234	10,103	9,872	8,795
Coal	3,234	1,624	1,586	1,584	1,584
Natural gas	5,680	5,900	6,330	6,509	6,383
Oil	795	1,089	1,153	1,199	1,244
Nuclear energy	0	0	0	0	0
Waste	473	473	496	477	472
Pumped-storage plants	2,793	2,793	2,793	2,793	2,694
Battery-storage plants	–	237	521	1,324	1,909
Other energy sources	192	195	338	352	246
Total for conventional energy sources	**22,896**	**22,544**	**23,320**	**24,110**	**23,327**
Total	**59,025**	**62,014**	**65,306**	**69,983**	**74,640**

Sources: Installed capacity of renewable energy sources: 50Hertz's EEG database for the 2020 reporting year, 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 2025, as at a reporting date of 31/12/2024; installed net capacity of conventional energy sources: German Federal Network Agency power plant list until 2023, Core Energy Market Data Register from 2024 onwards, data extracted at the end of January 2025, as at a reporting date of 31/12/2024.

Installed capacity in the 50Hertz grid area by energy source, 2024

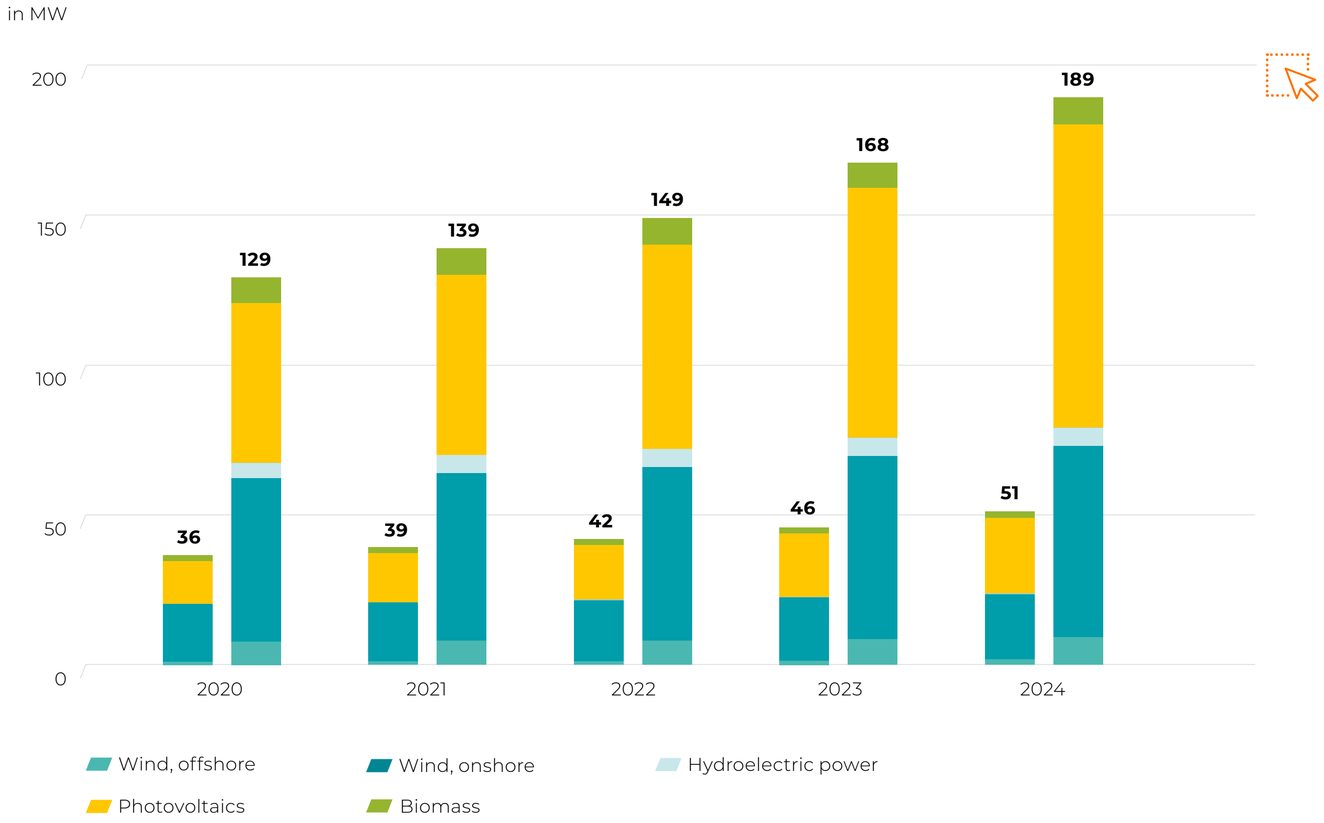


* In the 2021 reporting year, the source used for the installed capacity of renewable energy sources was changed to the gross installed capacity from the Core Energy Market Data Register (MaStR). The Core Energy Market Data Register is maintained by the German Federal Network Agency and is the central 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

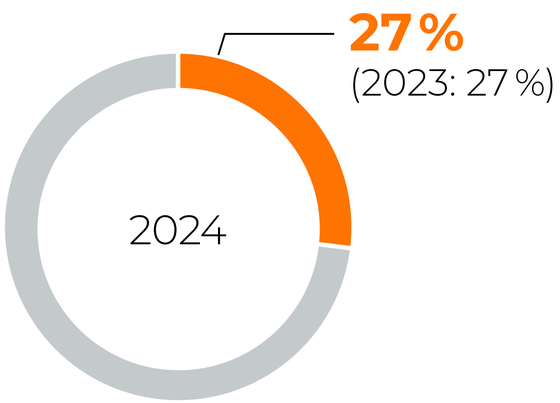
Development of the installed capacity of renewable energy sources in the 50Hertz grid area and in Germany



ⓘ 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.

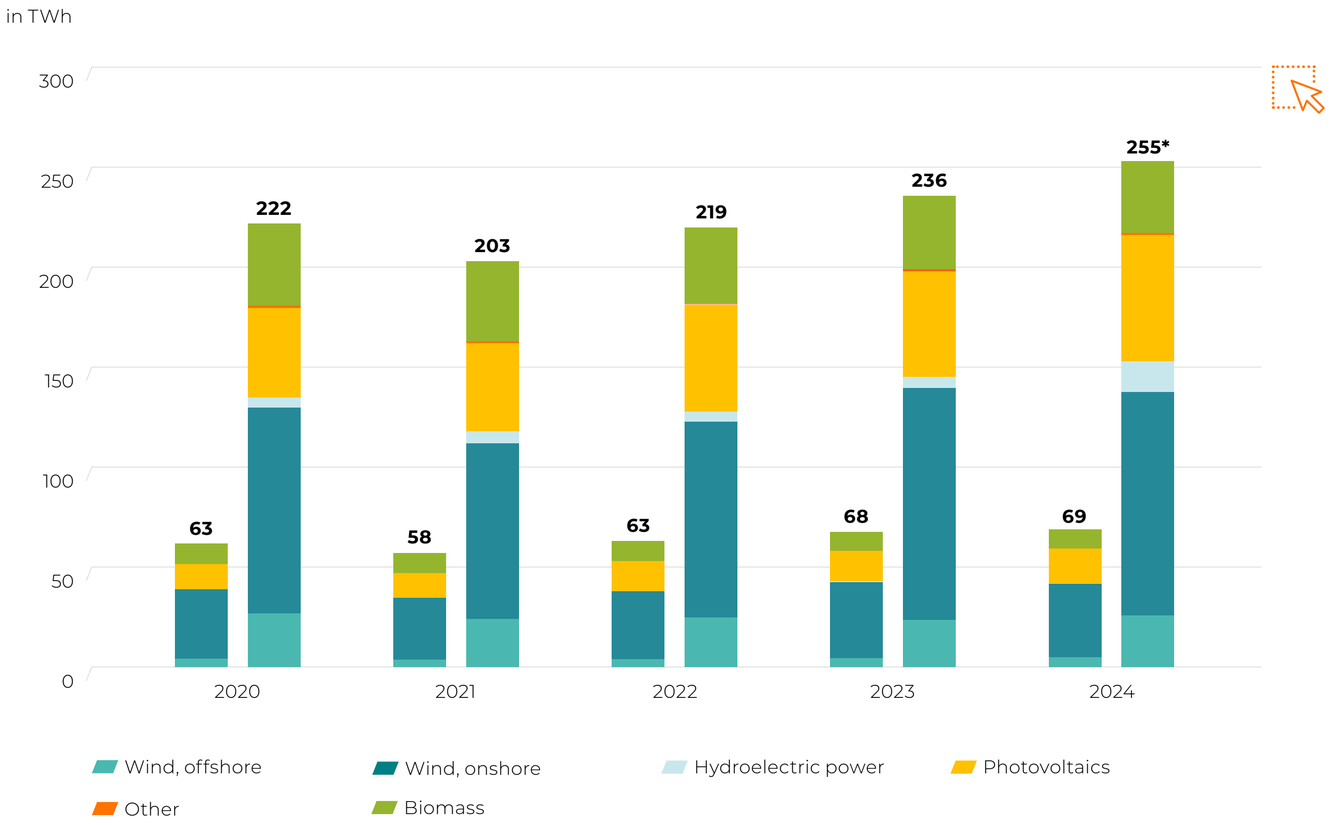
Source: Values for Germany: ENTSO-E Transparency Platform for 2020, gross installed capacity from the Core Energy Market Data Register (MaStR) of the German Federal Network Agency from 2021 onwards.

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



Capacity and generation

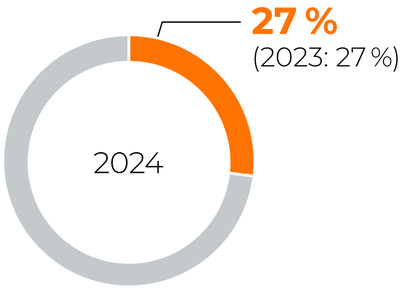
Development of feed-in from renewable energy sources in the 50Hertz grid area and in Germany



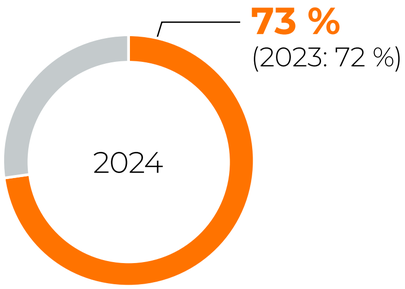
ⓘ The left-hand bar of each pair indicates the values for 50Hertz, the right-hand bar indicates the values for Germany. There may be rounding differences in the summing up of the individual values.

Source: Values for Germany: EEG annual account for 2020 to 2023, *2024 extrapolation values from the ENTSO-E Transparency Platform.

50Hertz's share of feed-in from renewable energy sources in Germany in 2024

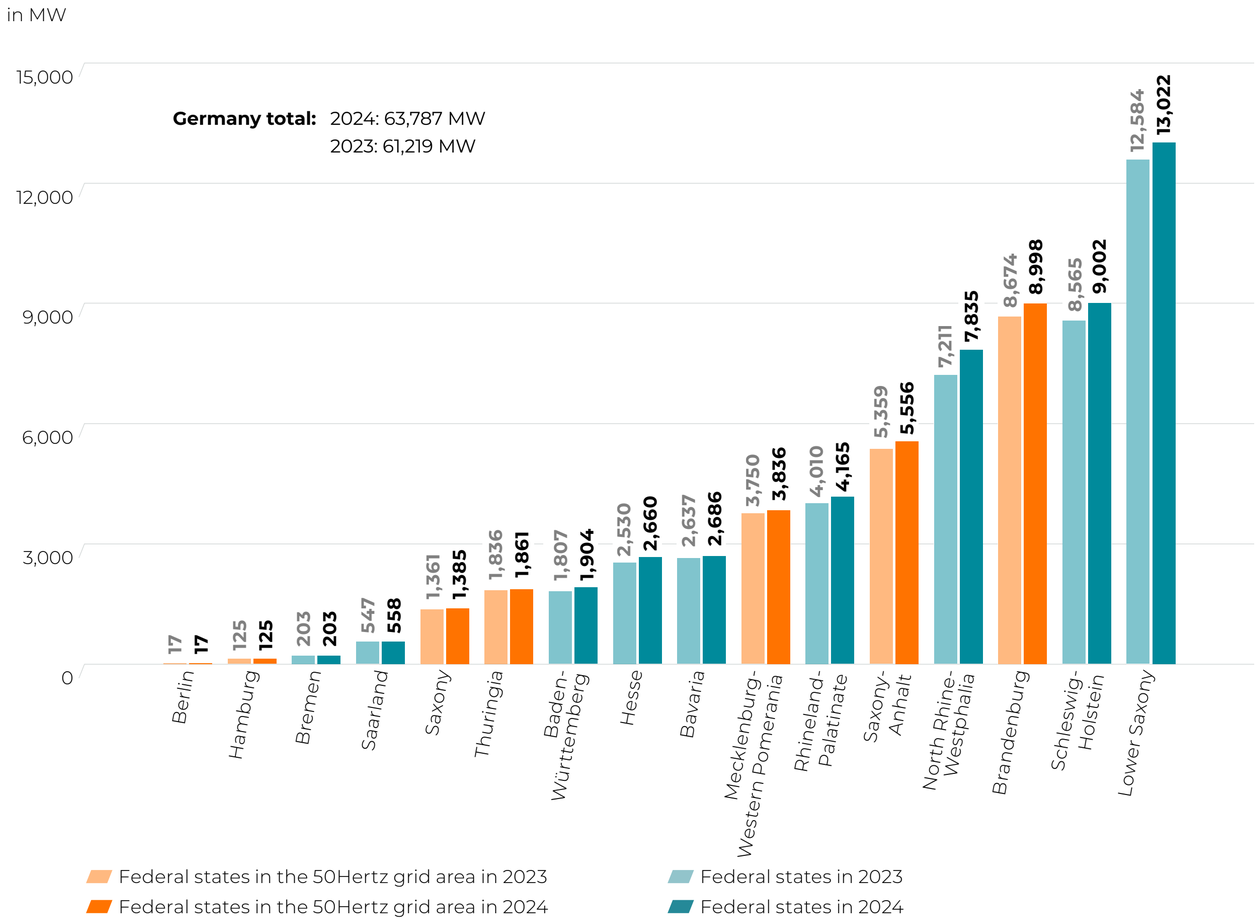


50Hertz's share of feed-in from renewable energy sources as a proportion of total consumption in the 50Hertz grid area in 2024



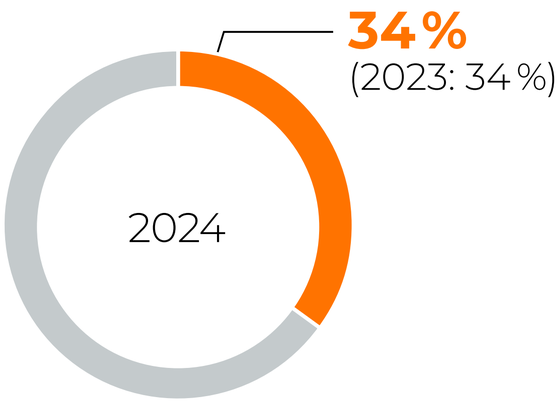
Capacity and generation

Geographical distribution of the installed onshore wind-power capacity in Germany by federal states in 2024



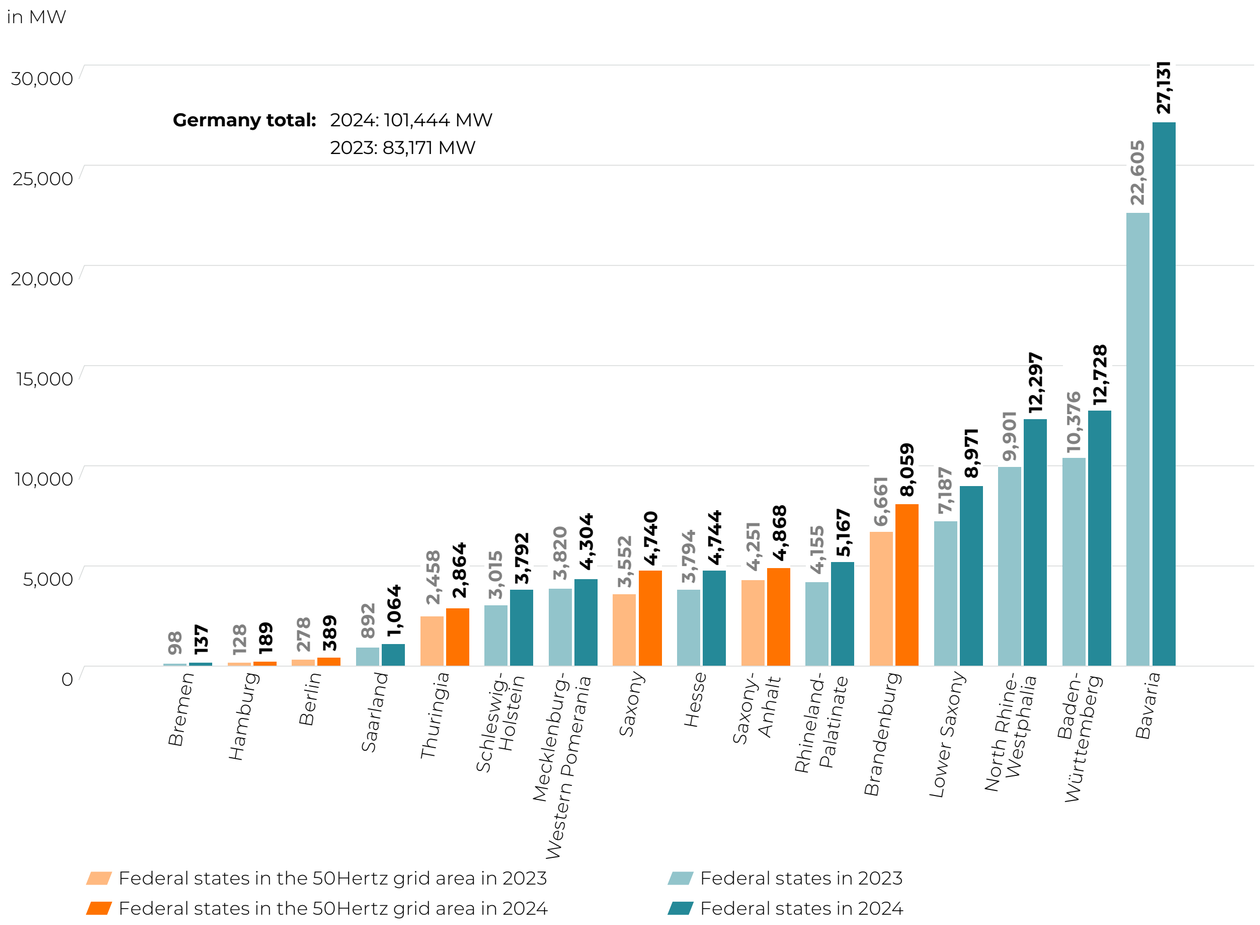
Source: Core Energy Market Data Register (MaStR), extracted at the end of January 2025 as at a reporting date of 31/12/2024.

50Hertz's share of installed onshore wind-power capacity in Germany in 2024



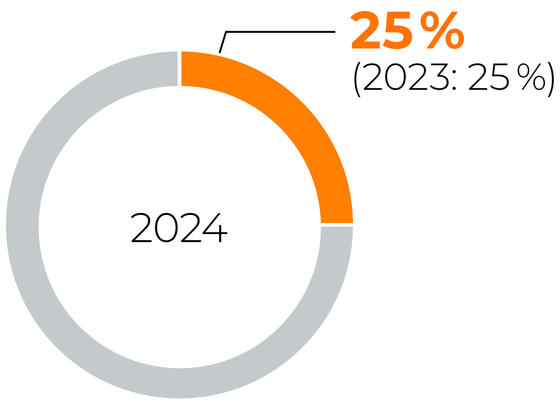
Capacity and generation

Geographical distribution of the installed photovoltaic capacity in Germany by federal states in 2024



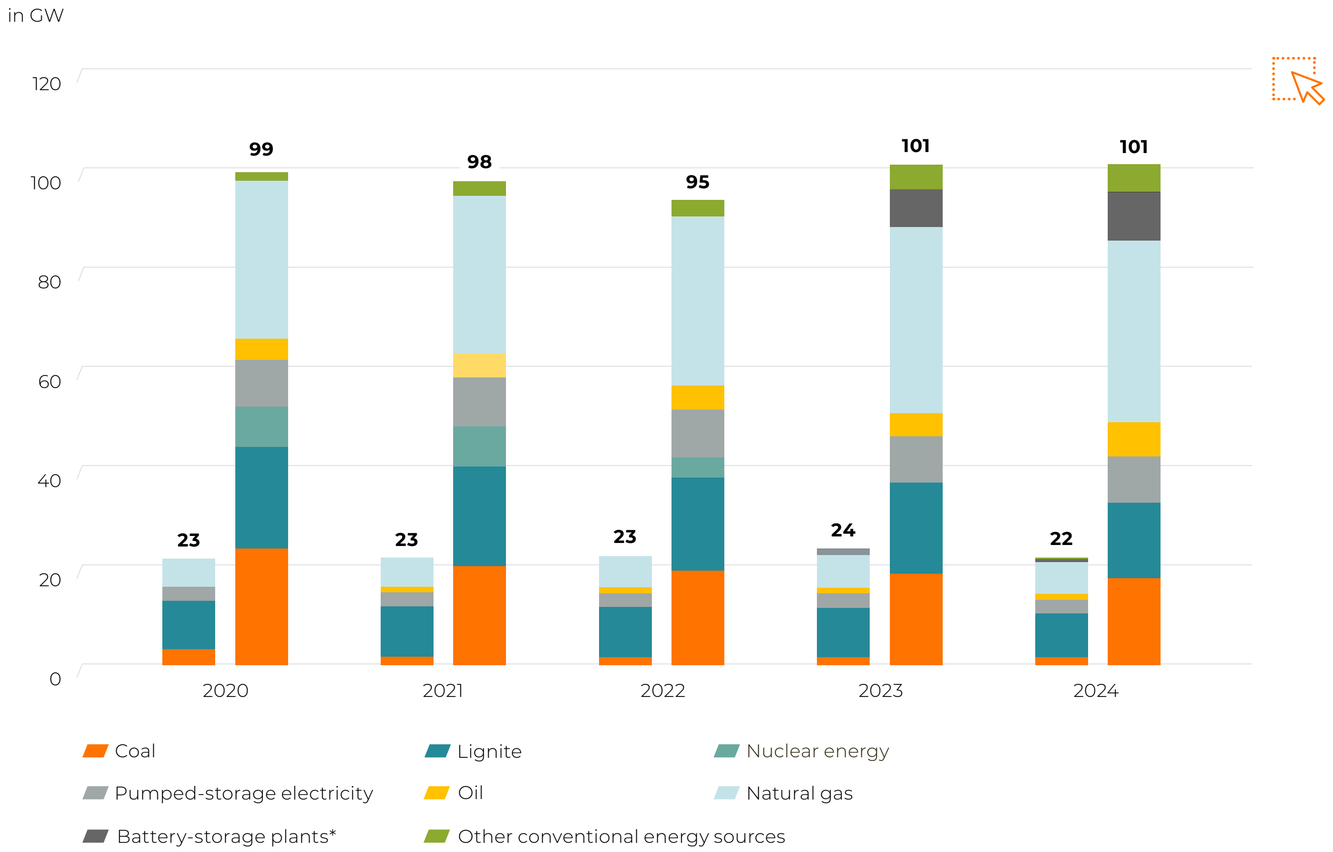
Source: Core Energy Market Data Register (MaStR), extracted at the end of January 2025 as at a reporting date of 31/12/2024.

50 Hertz's share of installed photovoltaic capacity in Germany in 2024



Capacity and generation

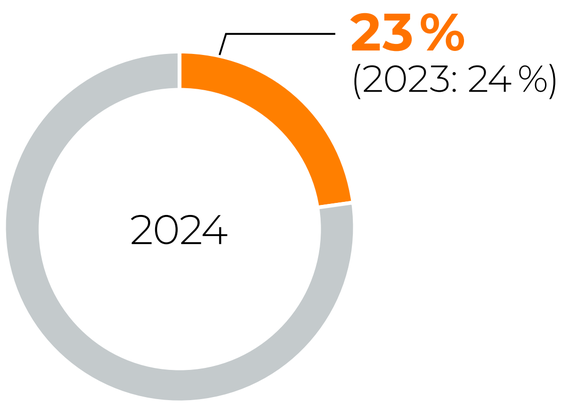
Development of the installed net capacity of conventional power plants in the 50Hertz grid area and in Germany



ⓘ 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.

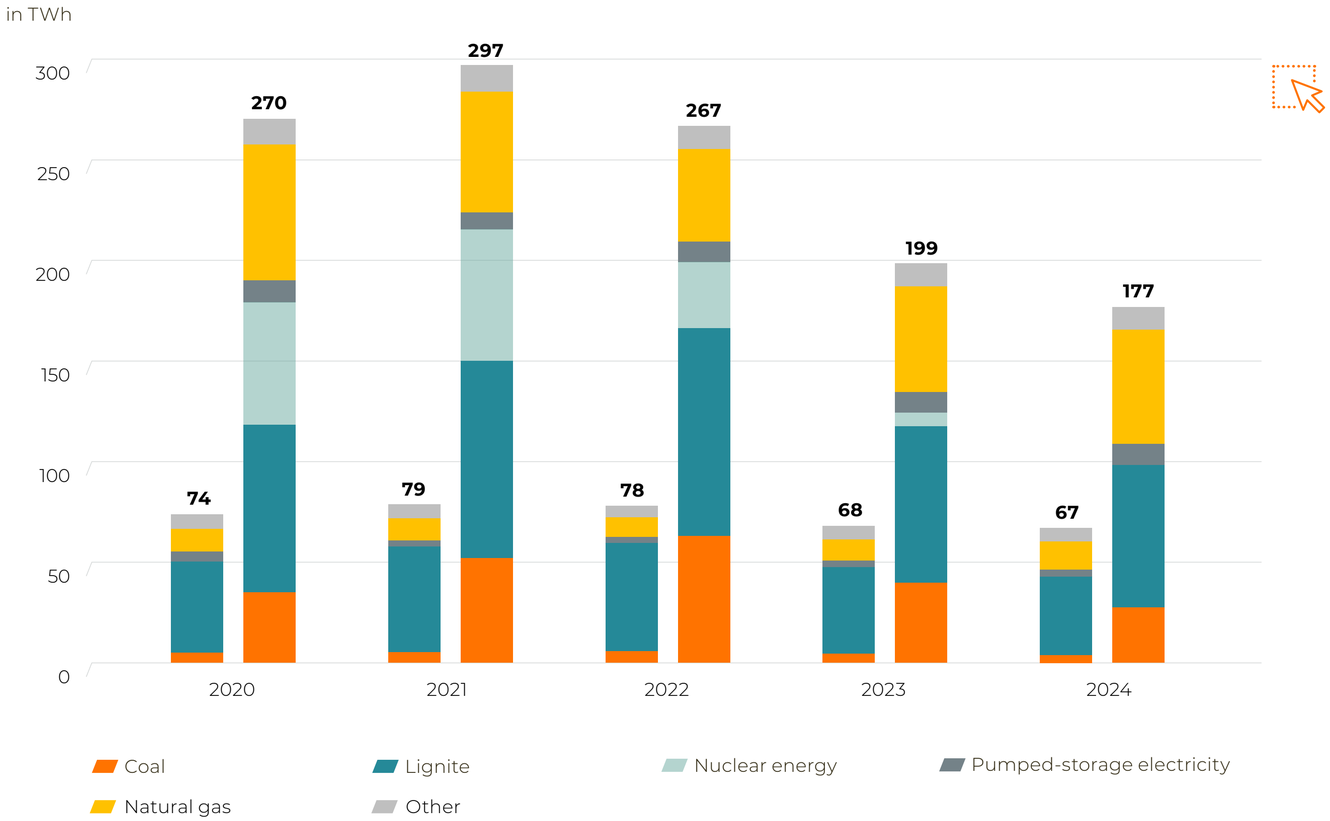
Source for Germany values: Power plant list and Core Energy Market Data Register (MaStR) of the German Federal Network Agency.
* Battery storage plants have only been recognised as energy sources since 2023.

50Hertz's share of the installed net capacity of conventional power plants in Germany in 2024



Capacity and generation

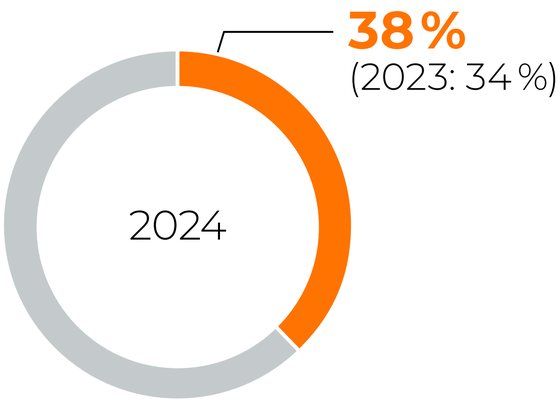
Development of feed-in from conventional energy sources to the 50Hertz extra-high-voltage grid and in Germany



ⓘ 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: ENTSO-E Transparency Platform.

50Hertz's share of feed-in from conventional energy sources in Germany in 2024



Capacity and generation

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

Figures in MW	2023	2024
Maximum simultaneous feed-in	17,887	17,091
Minimum feed-in	14	6
Biggest one-hour spike	2,975	3,367
Biggest one-hour drop	–2,893	–3,499
Biggest 15-minute spike	1,907	1,557
Biggest 15-minute drop	–1,018	–1,401
Biggest one-day spike	14,494	15,631

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

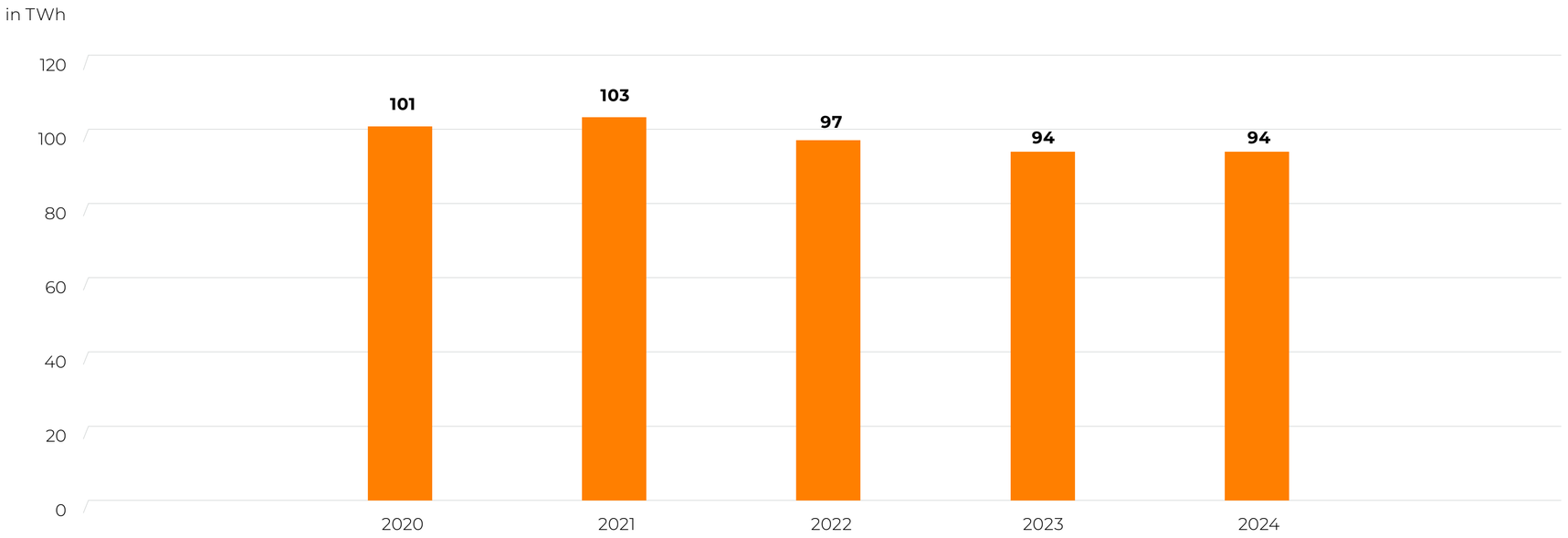
Key figures for the input from photovoltaic plants in the 50Hertz grid area

Angaben in MW	2023	2024
Maximum simultaneous feed-in	11,895	13,449
Minimum feed-in	0	0
Biggest one-hour spike	3,188	3,517
Biggest one-hour drop	–2,844	–3,470
Biggest 15-minute spike	1,333	1,012
Biggest 15-minute drop	–775	–1,206
Biggest one-day spike	11,895	13,449

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

Load and consumption

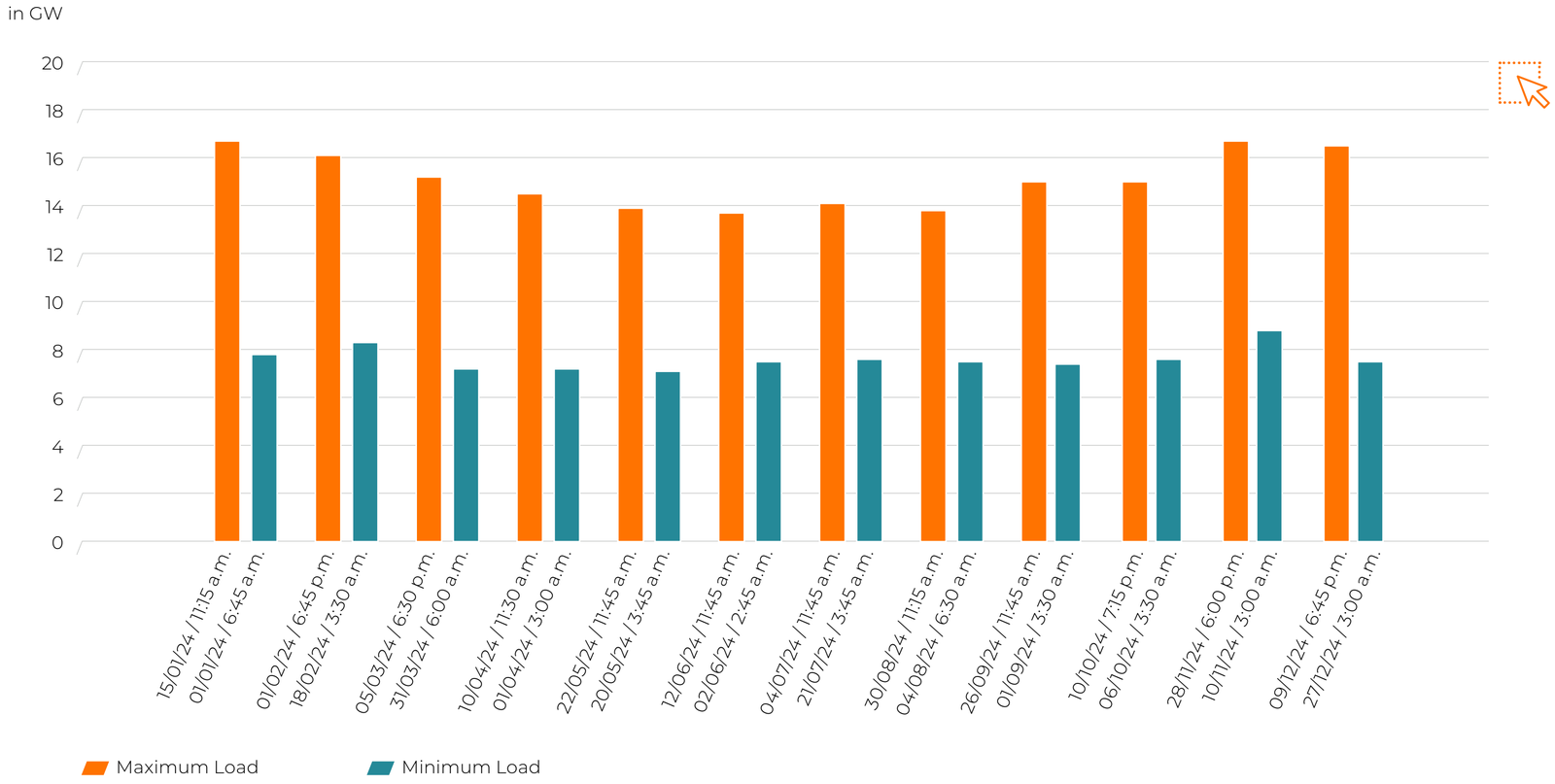
Development of electricity consumption in the 50Hertz grid area



ⓘ Source: In the 2020 and 2021 reporting figures, consumption was calculated from the end consumption in accordance with the EEG (German Renewable Energy Sources Act) levy and the losses in the TSO and DSO grids, as well as the pumped-storage plant losses.

Load and consumption

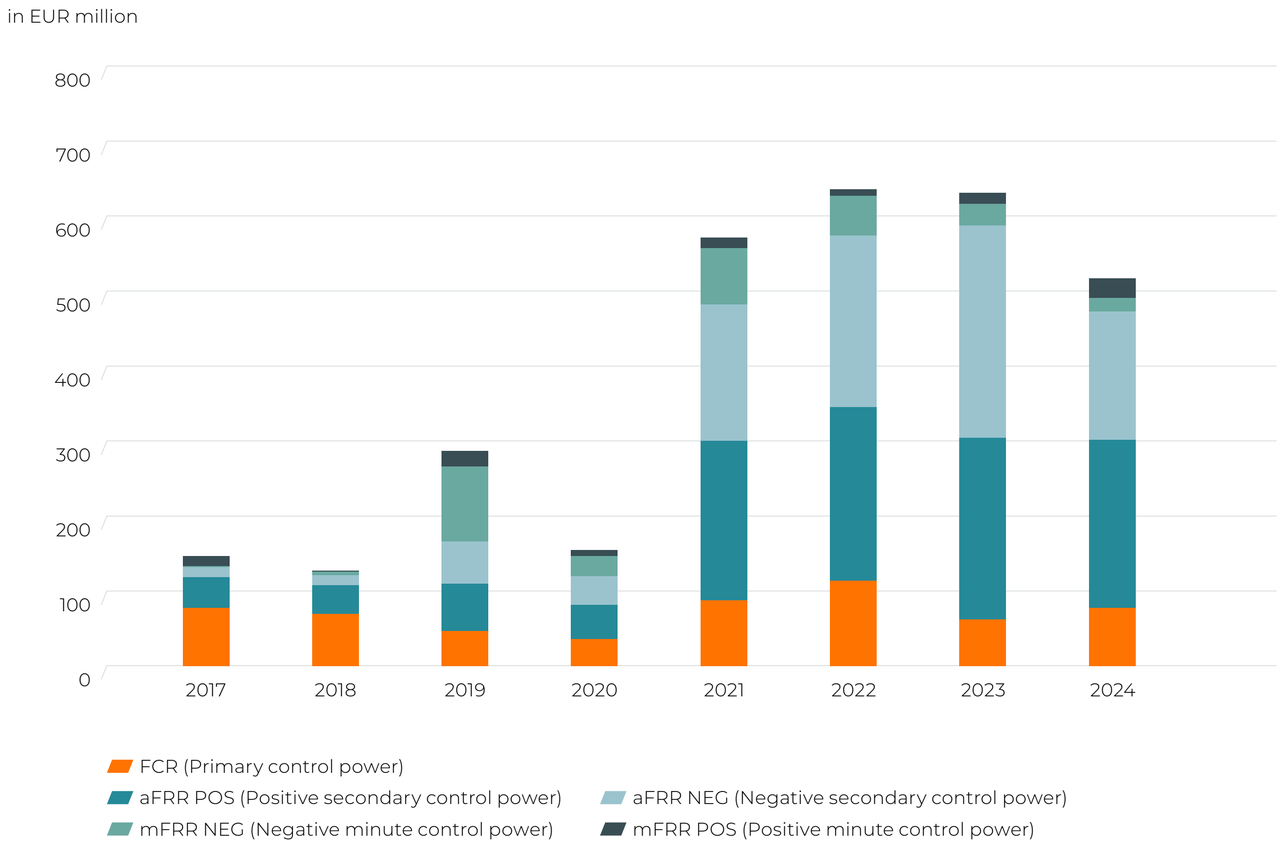
Monthly maximum and minimum load in the 50Hertz grid area, 2024



Annual maximum	16,725 MW on 28/11/2024 at 6:00 p.m.
Annual minimum	7,074 MW on 20/05/2024 at 3:45 a.m.

Balancing capacity

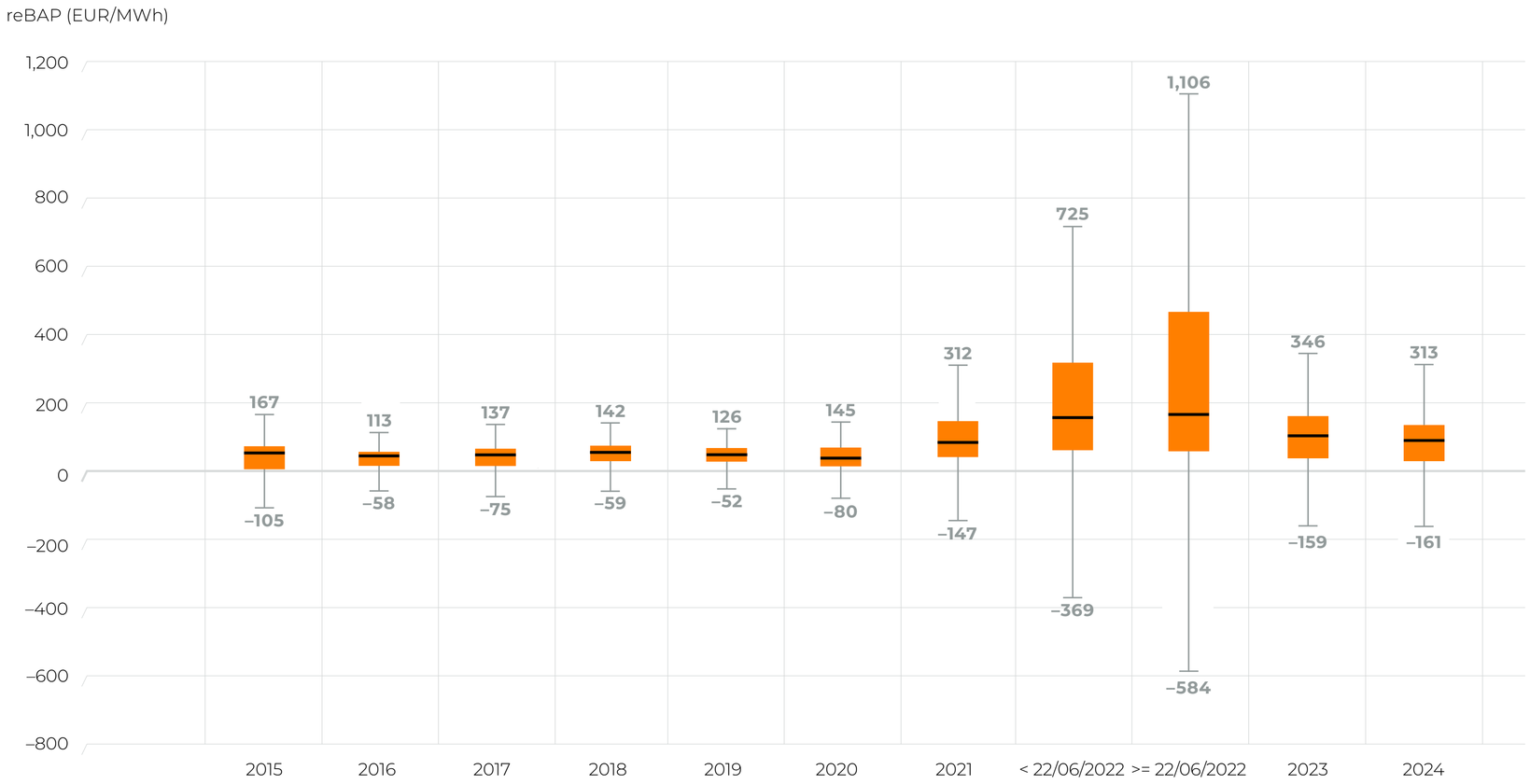
Development of costs by type of balancing capacity in Germany



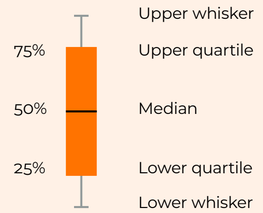
ⓘ More information and the source of the above figures can be found at: regelleistung.net

Balancing capacity

Development of the cross-control area uniform imbalance price



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.

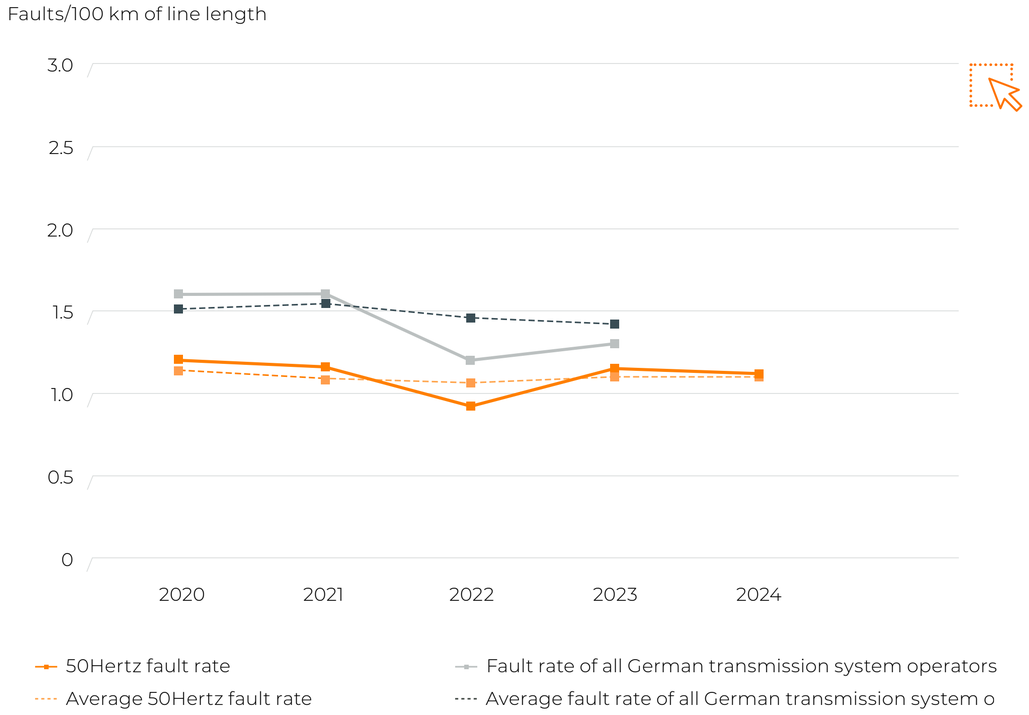


ⓘ Outliers are not depicted.
Extensive market changes came into effect on 22/06/2022: Introduction of the redesigned European electricity balancing market, implementation of imbalance settlement harmonisation methodology (ISHM).

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

System operation

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

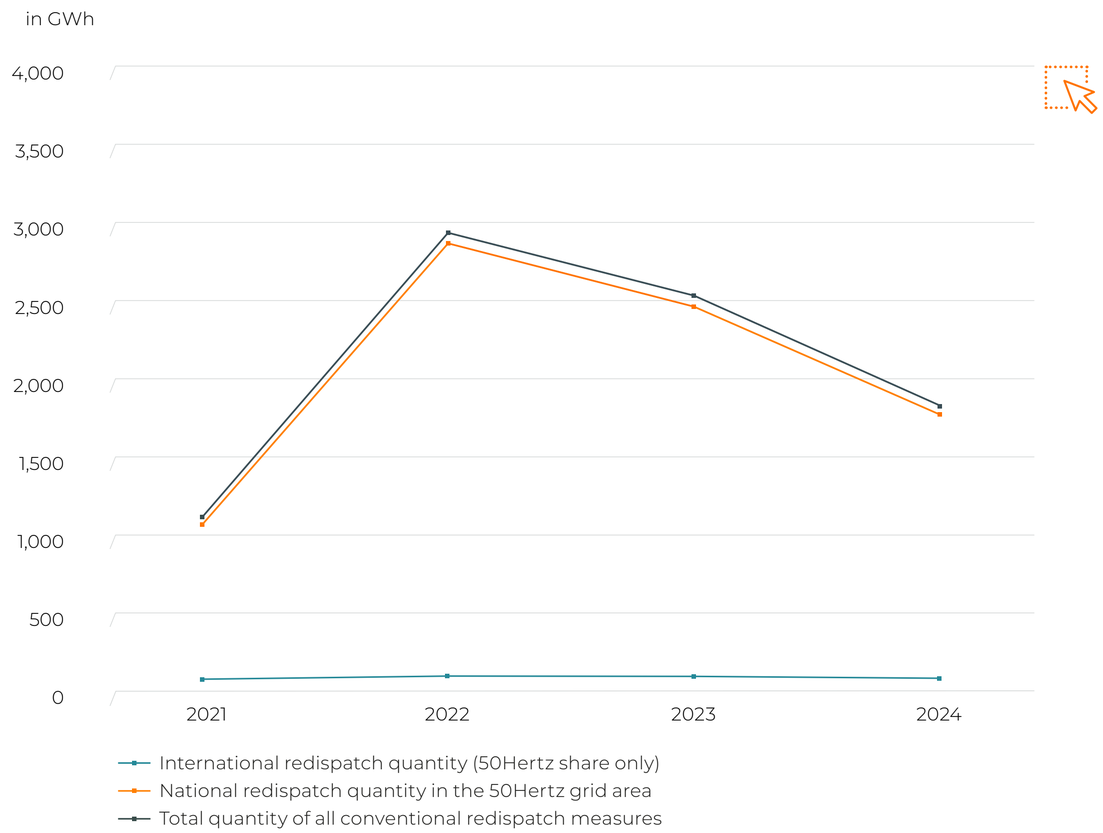


ⓘ An unwanted change of the “normal operating state” is classed as an error that leads to a fault. This takes into account incidents that occur in the active grid used for transmission. Other errors are only recorded if they lead to an unwanted change of the normal operating state of the grid concerned.

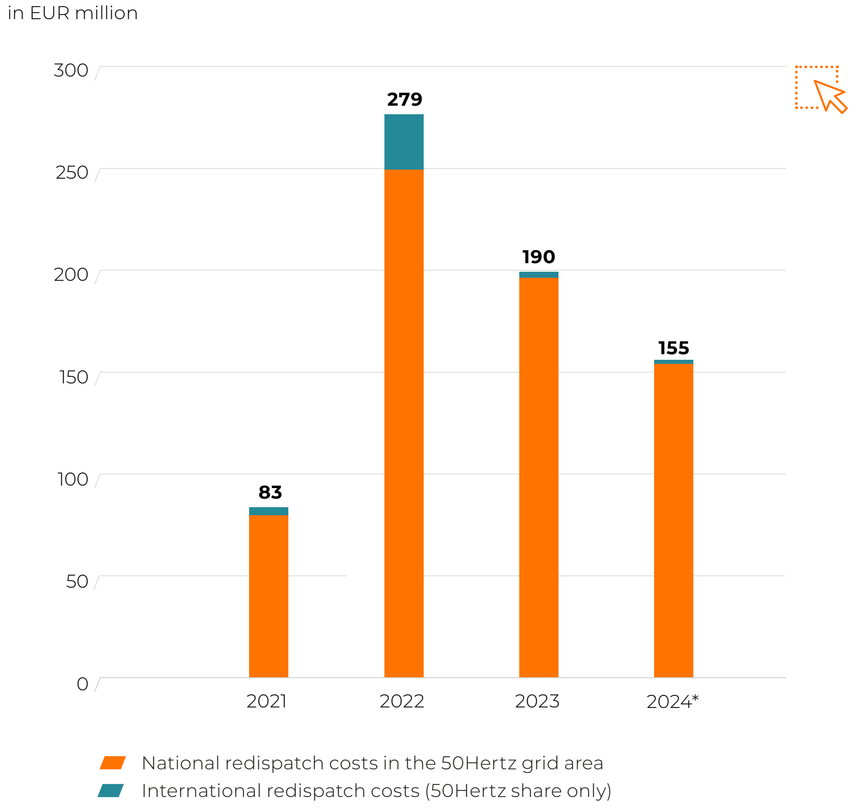
Source for the average for all German transmission system operators: Annual report of the “Forum Netztechnik/Netzbetrieb” im VDE (“Forum for System Technology/System Operations” in the German Association for Electrical, Electronic & Information Technologies), the value for 2024 is not yet available at the time of publication.

System operation

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



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

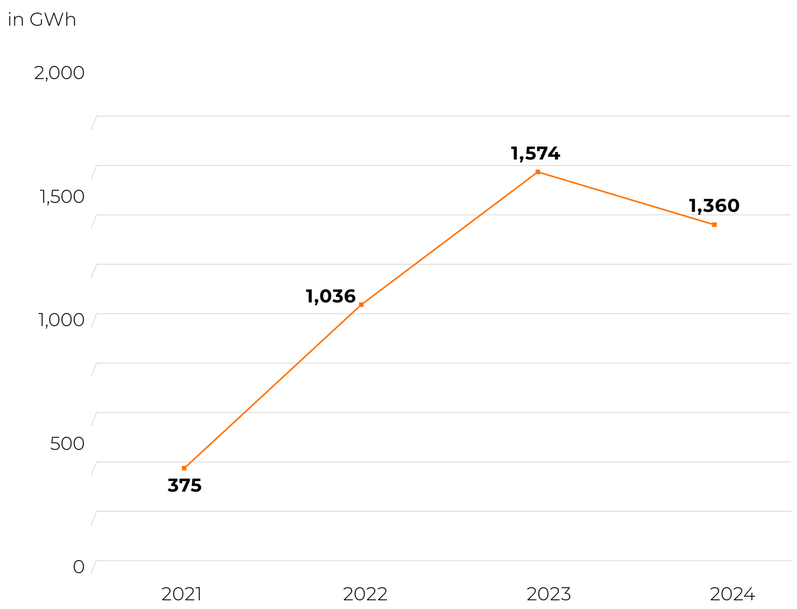


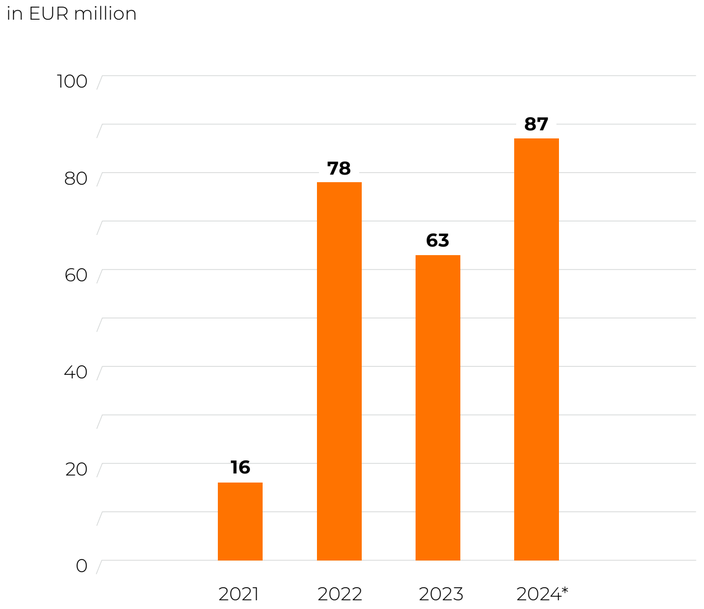
* Preliminary figure

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

System operation

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

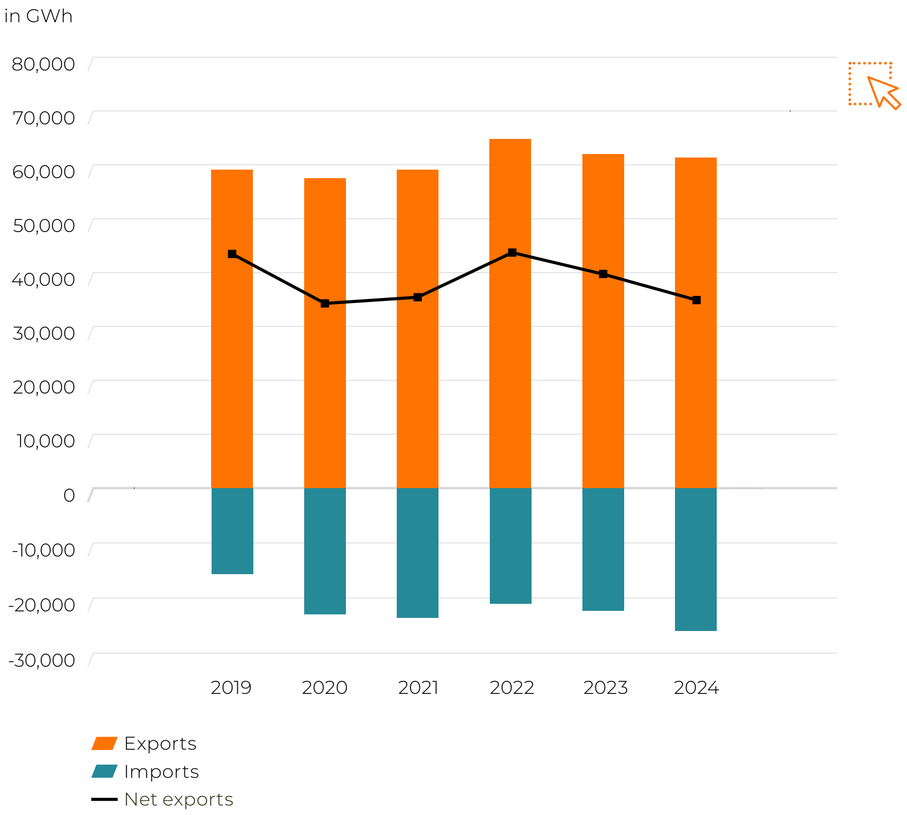




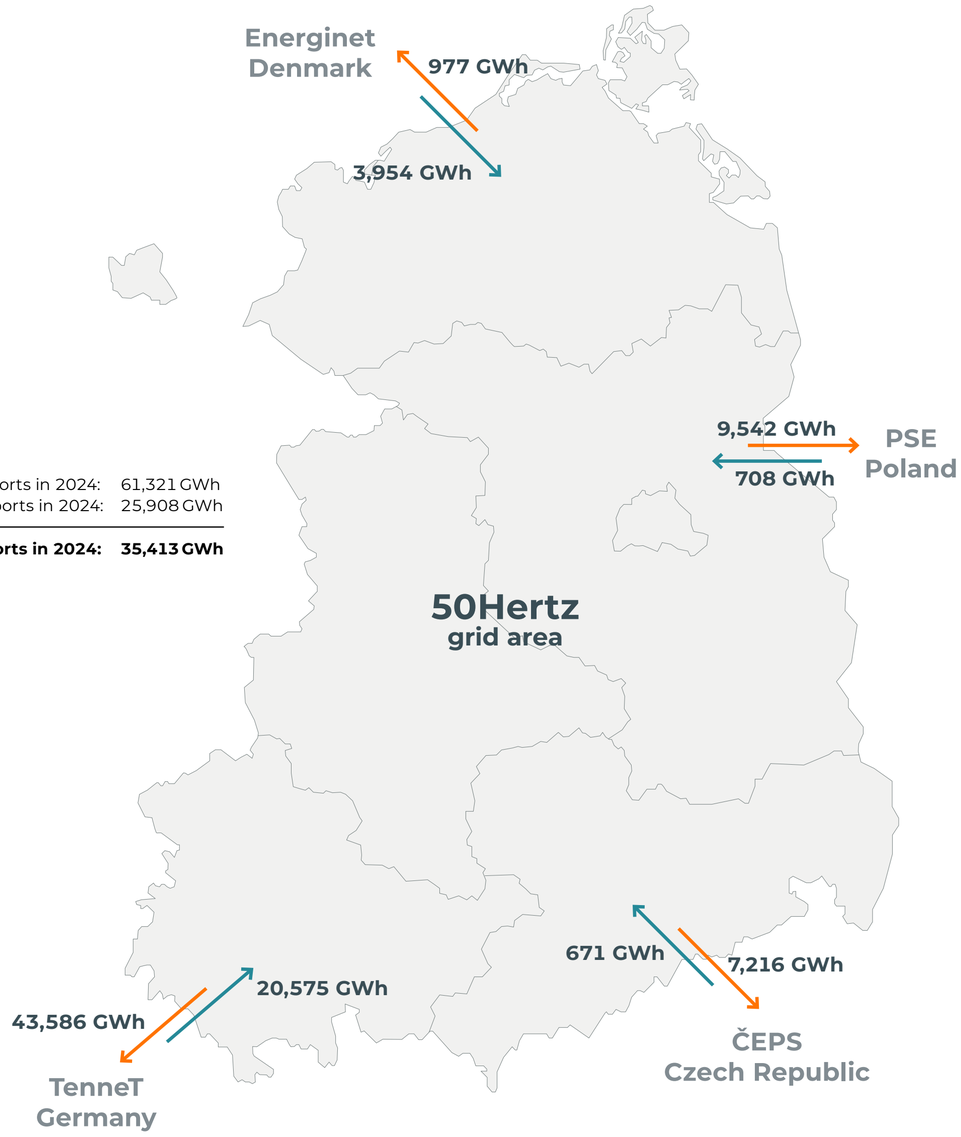
* Preliminary figure

Exchange and transport

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

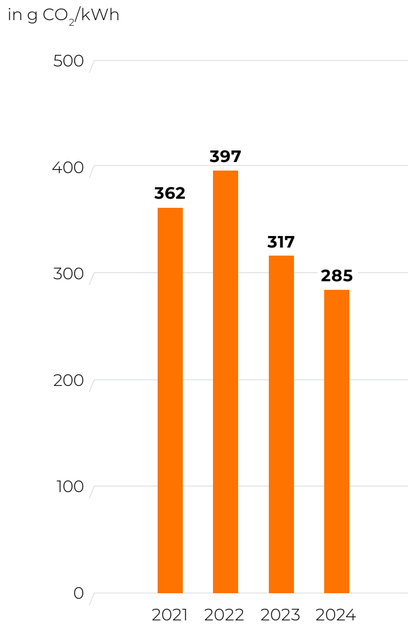


Total exports in 2024:	61,321 GWh
Total imports in 2024:	25,908 GWh
Net exports in 2024:	**35,413 GWh**



Climate protection

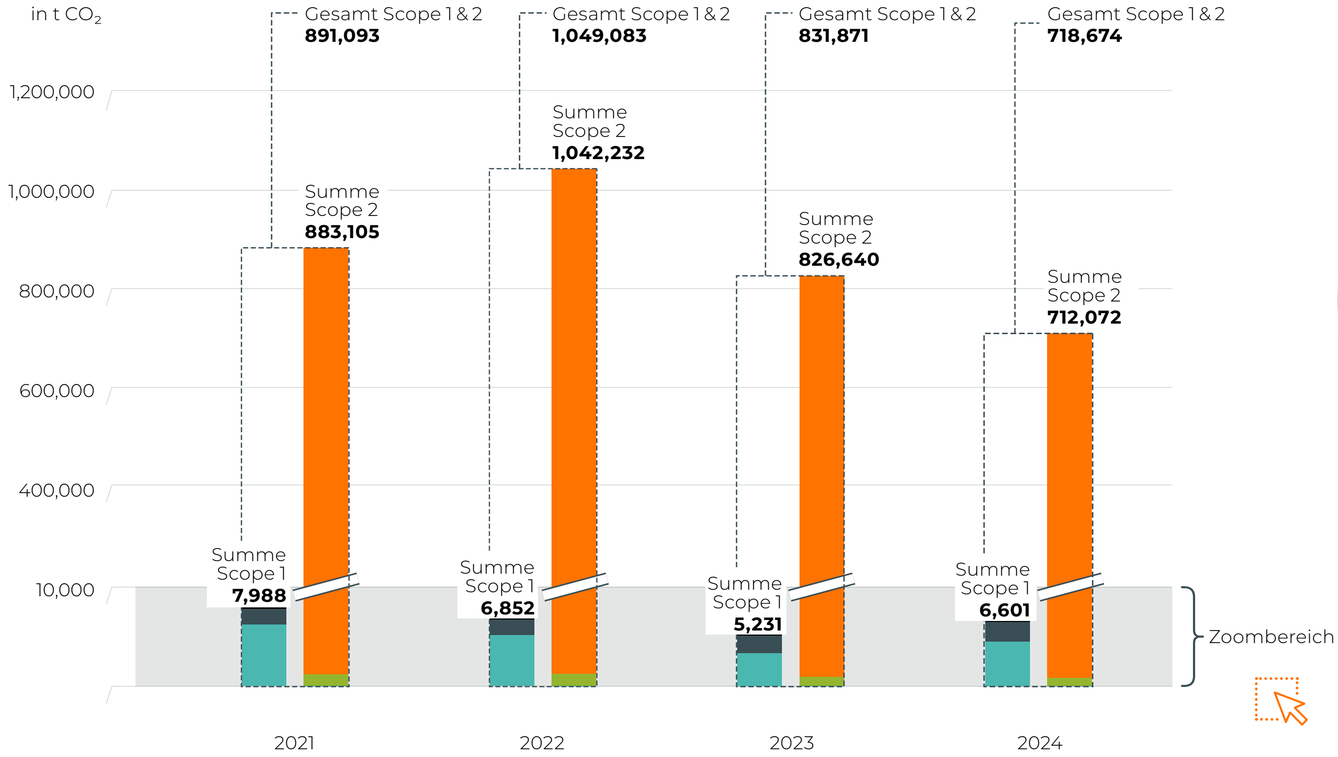
Greenhouse gas emissions from the German electricity mix



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

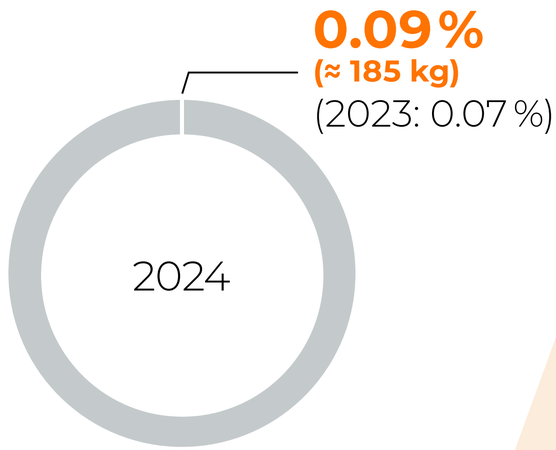
- SF6 losses
- Fleet
- Natural gas

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)



Grid expansion

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

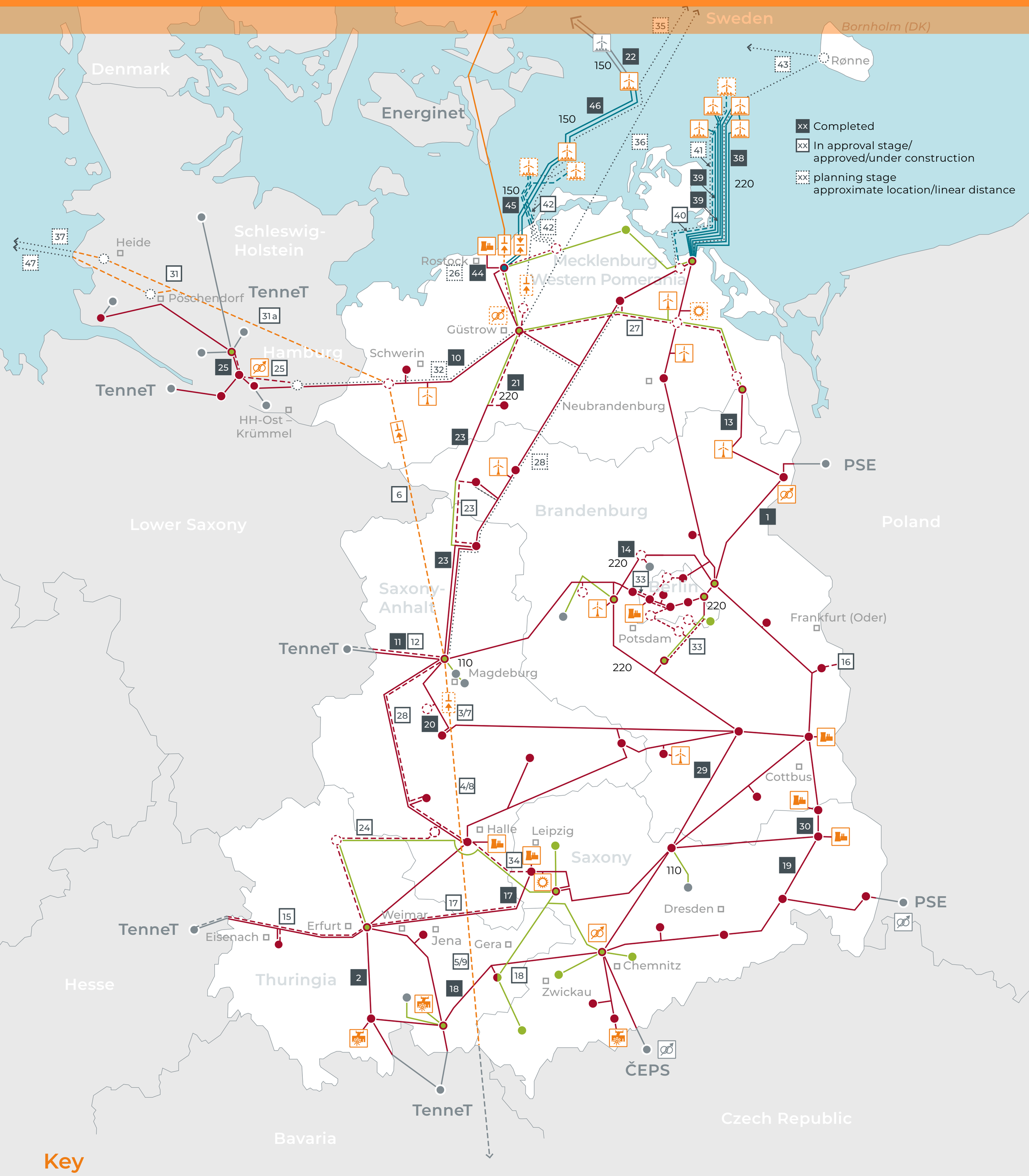
Map number	P no.	Legal basis	Project	Planning stage	Approval stage	Approved/under construction	Completed
1	3	EnLAG	Uckermark line (Neuenhagen – Bertikow/Vierraden – Krajnik (Poland))				123
2	4	EnLAG	South-western interconnector (Lauchstädt – Redwitz)				159
3	5	BBPlG	Extra-high-voltage line Wolmirstedt – 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		88		
6	5a	BBPlG	Extra-high-voltage line Klein Rogahn search area – Isar (SOL+ segment A1); direct current		93		
7	5a	BBPlG	Extra-high-voltage line Klein Rogahn search area – Isar (SOL+ segment A2); direct current			70	
8	5a	BBPlG	Extra-high-voltage line Klein Rogahn search area – Isar (SOL+ segment B); direct current			94	
9	5a	BBPlG	Wind bus bar (Hamburg/Krümmel – Schwerin)			84	
10	9	EnLAG	Wolmirstedt – Helmstedt – Wahle (M24a)				65
11	10	BBPlG	Wolmirstedt – Helmstedt – Wahle (M24b)				46
12	10	BBPlG	Bertikow – Pasewalk		47		
13	11	BBPlG	380-kV-Berlin Northern Ring (Neuenhagen – Hennigsdorf – Wustermark)				31
14	11	EnLAG	Vieselbach – Eisenach – Mecklar				71
15	12	BBPlG	3. interconnector (Eisenhüttenstadt – Baczyna (Poland))			87	
16	12	EnLAG	Pulgar – Vieselbach		8		
17	13	BBPlG	Röhrsdorf – Weida – Remptendorf			54	52
18	14	BBPlG	Bärwalde – Schmölln			1	108
19	26	BBPlG	Walsleben – Förderstedt branch				46
20	27	BBPlG	Parchim South – Neuburg branch				12
21	28	BBPlG	Offshore connection Kriegers Flak – Baltic 2 (Combined Grid Solution)				1
22	29	BBPlG	Güstrow – Parchim South – Perleberg – Stendal West – Wolmirstedt				50
23	39	BBPlG	Südharz grid connection (Schraplau/Obhausen – Wolkramshausen – Vieselbach)		63	53	75
24	44	BBPlG	Netzanbindung Südharz (Schraplau/Obhausen – Wolkramshausen – Vieselbach)		146		
25	51	BBPlG	Hamburg North – Hamburg East – Büchen/ Breitenfelde/Schwarzenbek-Land		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 – Klostermansfeld – 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)		96,5		
31 a	81 a	BBPlG	NordOstLink DC 32 (Pöschendorf / Hadenfeld / Kaisborstel / Agethorst / Mehlbek – Klein Rogahn / Stralendorf / Warsow / Holthusen / Schossin; 50Hertz share)		96,5		
32	85	BBPlG	Güstrow – Krümmel	147			
33	87	BBPlG	Grid expansion and reinforcement Berlin	4	71		
34	93	BBPlG	Central Germany energy triangle (Lauchstädt – Leuna/Merseburg/Weißenfels – Pulgar)		59		
35	69	BBPlG	Hansa PowerBridge (Güstrow – Sweden)	175			
36	83	BBPlG	Hansa PowerBridge 2	35			
37			NOR-11-1 (LanWin3)	212			
38			Ostwind 1				289
39			Ostwind 2				274
40			Ostwind 3			105	
41			Ostwind 4 – high-voltage direct current connection (HVDC)	83	30		
42			OST-6-1 Gennaker	126	127		
43			Bornholm Energy Island (BEI)	174			
44			KONTEK grid connection				15
45			Baltic 1				77
46			Baltic 2				192
47			NOR-12-3 (LanWin6)	273	39		
				1.512	**1.212**	**969**	**1.828**

EnLAG – Energieleitungsausbaugesetz [German Energy Line Extension Act]

BBPlG – Bundesbedarfsplanungsgesetz [German Federal Requirements Plan

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

ⓘ 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)



xx Completed

xx In approval stage/ approved/under construction

xx planning stage approximate location/linear distance

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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