50hertz
| Elia Group

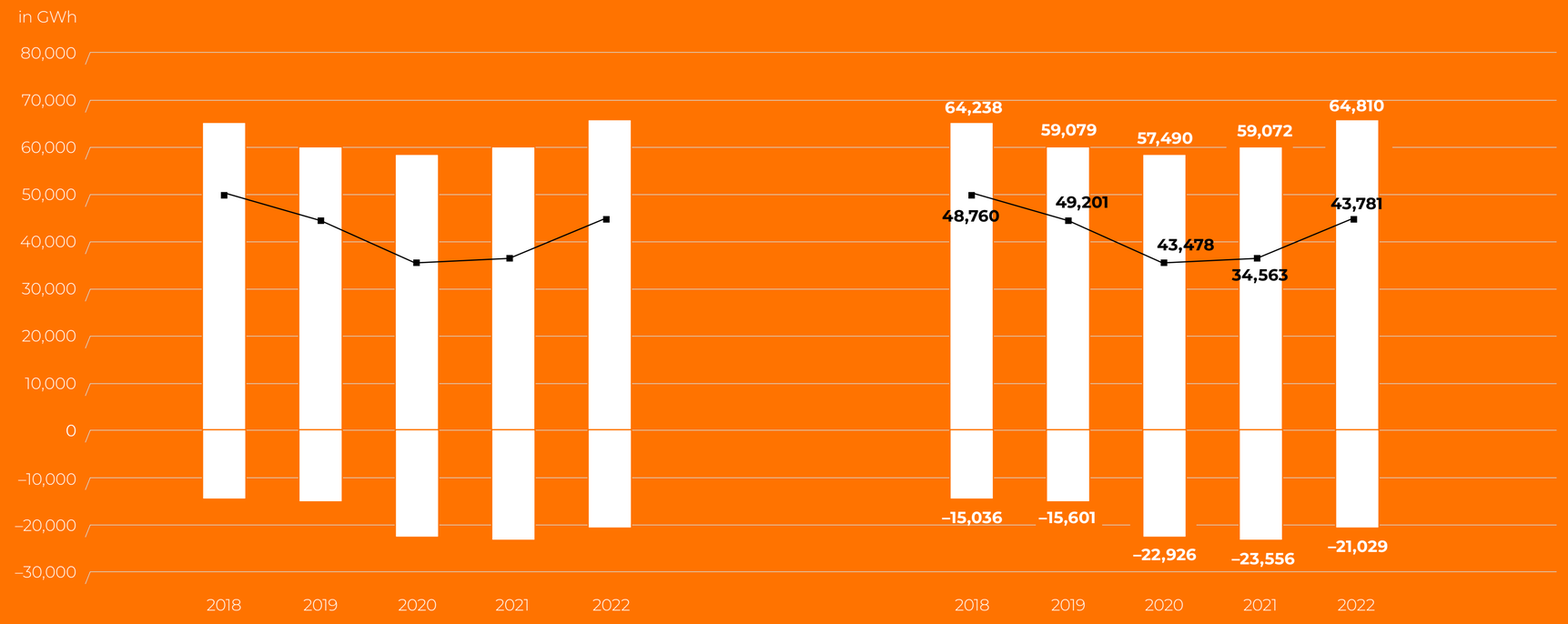
Almanac 2022

Accelerated grid expansion. Successful 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.



The cover image shows the offshore platform Arcadis Ost, taken in Aalborg.

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: www.50Hertz.com/en/

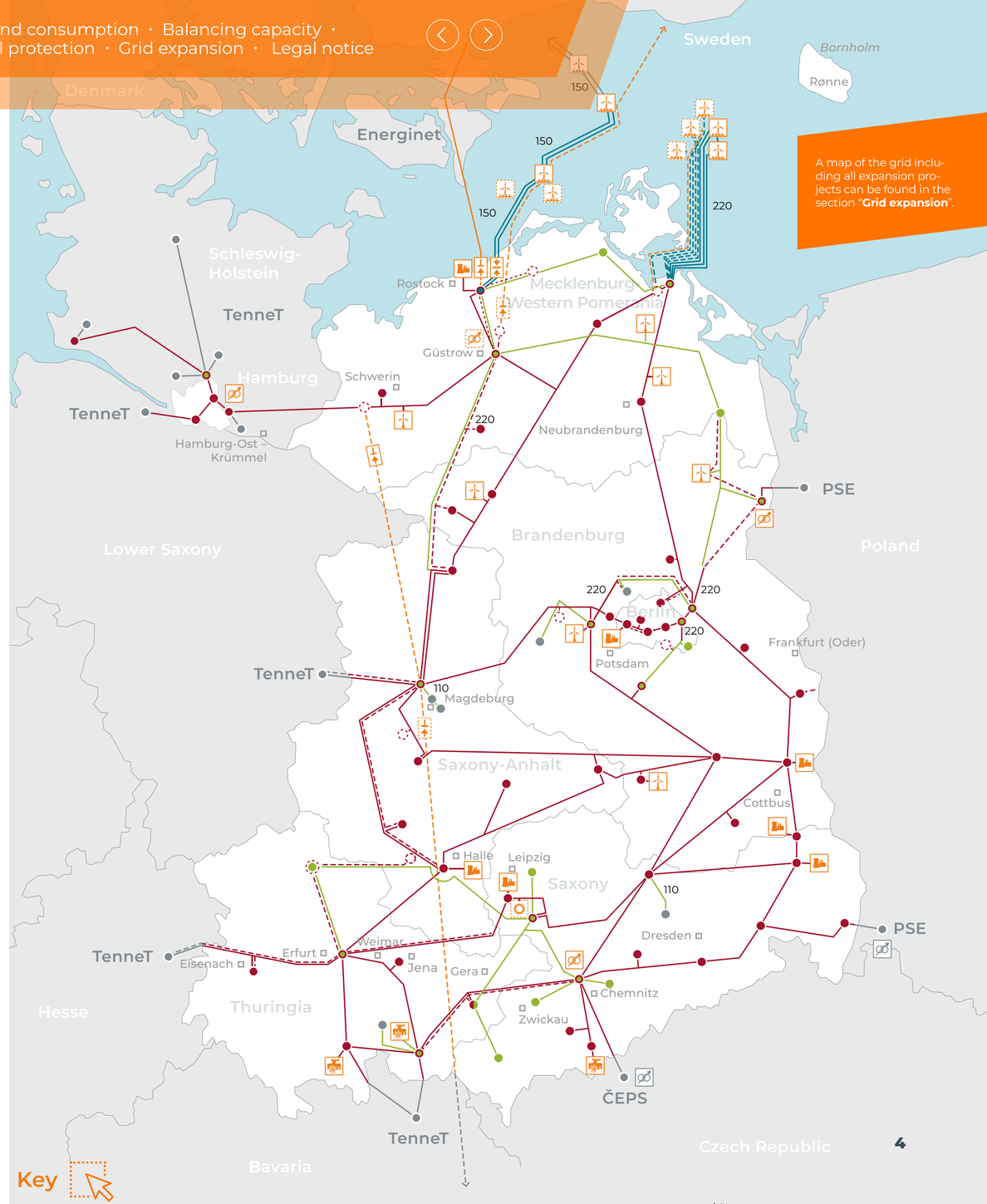
Conversion table	
kV (kilovolt)	1,000 volts, voltage
kW (kilowatt)	1,000 watts, power
MW (megawatt)	1,000 kilowatts
GW (gigawatt)	1 million kilowatts
kWh (kilowatt-hour)	1,000 watt-hours, work
MWh (megawatt-hour)	1,000 kilowatt-hours
GWh (gigawatt-hour)	1 million kilowatt-hours
TWh (terawatt-hour)	1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

Key data for 2022

An overview of 50Hertz		
Investment volume	EUR 1,086 million (EUR 851 million in 2021)	
Profit IFRS	EUR 236 million (EUR 165 million in 2021)	
Employees	Around 1,600	
New employees	250	
Proportion of women in the workforce overall	Around 25%	
Circuit length [km]	**10,500**	**(~27%*)**
Circuit length of 380 kV AC overhead lines	7,480	
Circuit length of 220 kV AC overhead lines	2,370	
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	290	
Number of installations	**79**	
Substations	66	
Switching stations	9	
Third-party substations and switching stations	4	
Transformer capacity [MVA]	**62,420**	
EHV/EHV (Extra-High Voltage/Extra-High Voltage)	21,100	
EHV/HV (Extra-High Voltage/High Voltage)	41,320	
General information		
Geographical area [km²]	109,712	(~31%*)
Population [millions]	18	(~22%*)

* Proportion of total for Germany

(i) 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

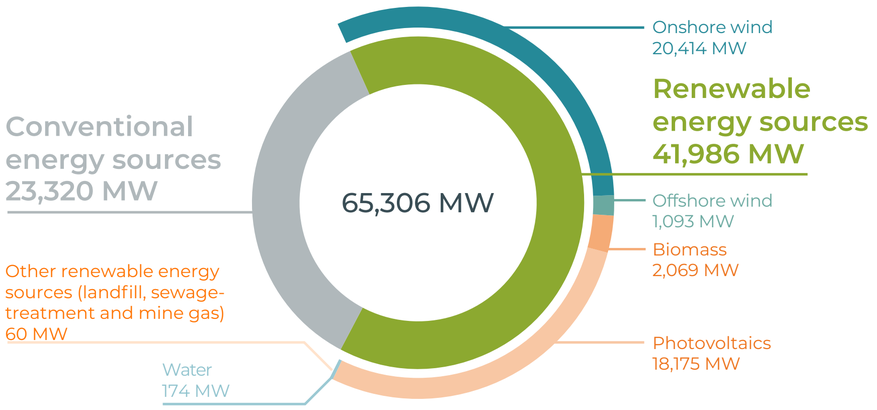
Installed capacity in the 50Hertz grid area

Installed capacity

Figures in MW	2018	2019	2020	2021*	2022*
Renewable energy sources					
Wind, onshore	18,346	18,711	19,138	19,748	20,414
Wind, offshore	1,068	1,068	1,068	1,093	1,093
Water	279	284	281	174	174
Photovoltaics	11,219	12,204	13,552	16,359	18,175
Landfill, sewage-treatment and mine gas	71	70	67	59	60
Biomass	1,912	1,980	2,023	2,037	2,069
Total for renewable energy sources	**32,895**	**34,316**	**36,129**	**39,470**	**41,986**
Conventional energy sources					
Lignite	9,885	9,762	9,729	10,234	10,103
Coal	3,355	3,234	3,234	1,624	1,586
Natural gas	5,297	5,738	5,680	5,900	6,330
Oil	1,042	979	795	1,089	1,153
Nuclear energy	0	0	0	0	0
Waste	421	419	473	473	496
Pumped-storage plants	2,793	2,793	2,793	2,793	2,793
Battery-storage plants	–	–	–	237	521
Other energy sources	216	192	192	195	338
Total for conventional energy sources	**23,009**	**23,116**	**22,896**	**22,544**	**23,320**
Total	**55,904**	**57,432**	**59,025**	**62,014**	**65,306**

Sources: Installed capacity of renewable energy sources: 50Hertz's EEG database for the reporting years 2017 to 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 2023 as at a reporting date of 31/12/2022; installed net capacity of conventional energy sources: German Federal Network Agency power plant list, data extracted in November 2022, and Core Energy Market Data Register, data extracted in January 2023, as at a reporting date of 31/12/2022.

Installed capacity in the 50Hertz grid area by energy source, 2022

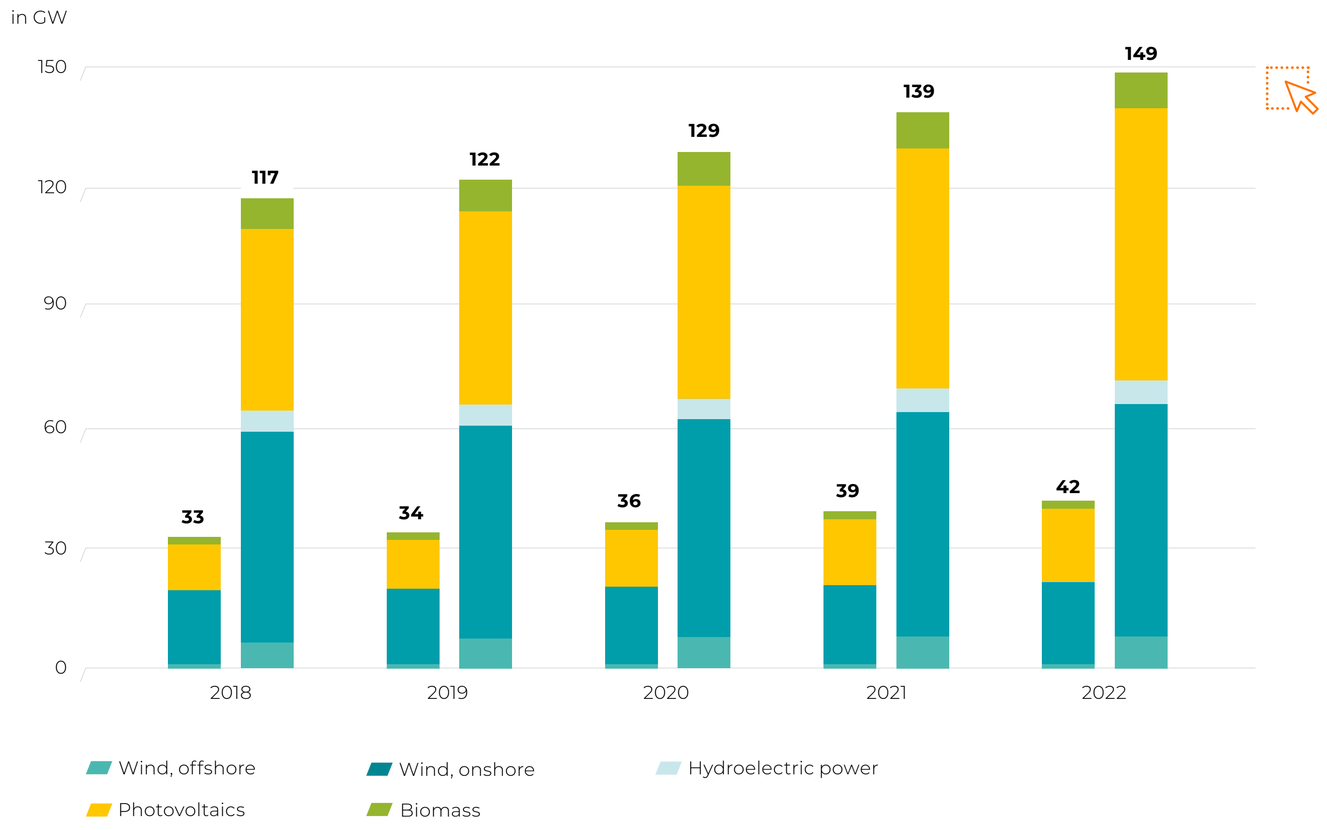


* In the 2021 reporting year, the source used for the installed capacity of renewable energy sources was changed to the gross installed capacity from the Core Energy Market Data Register (MaStR). The Core Energy Market Data Register is maintained by the German Federal Network Agency and is the central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

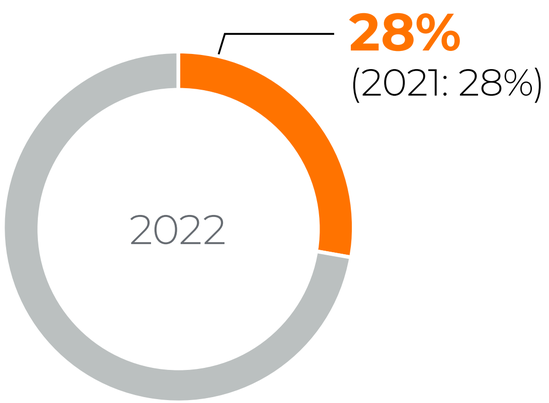
Development of the installed capacity of renewable energy sources in the 50Hertz grid area and in Germany



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 2017 to 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 2022



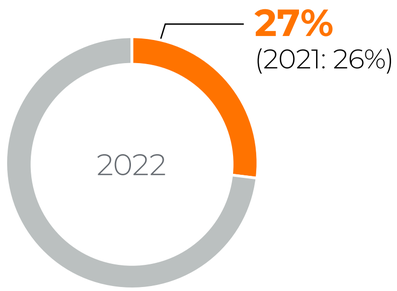
Capacity and generation

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

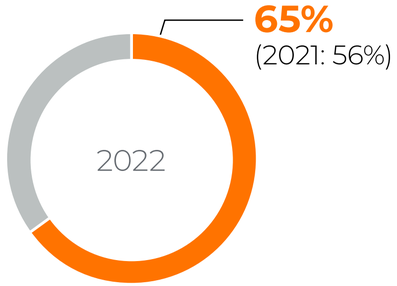
ⓘ The left-hand bar of each pair indicates the values for 50Hertz, the right-hand bar indicates the values for Germany.

Source: Values for Germany: EEG annual account for 2017 to 2021, German Federal Statistical Office for 2022

50Hertz's share of the input from renewable energy sources in Germany in 2022

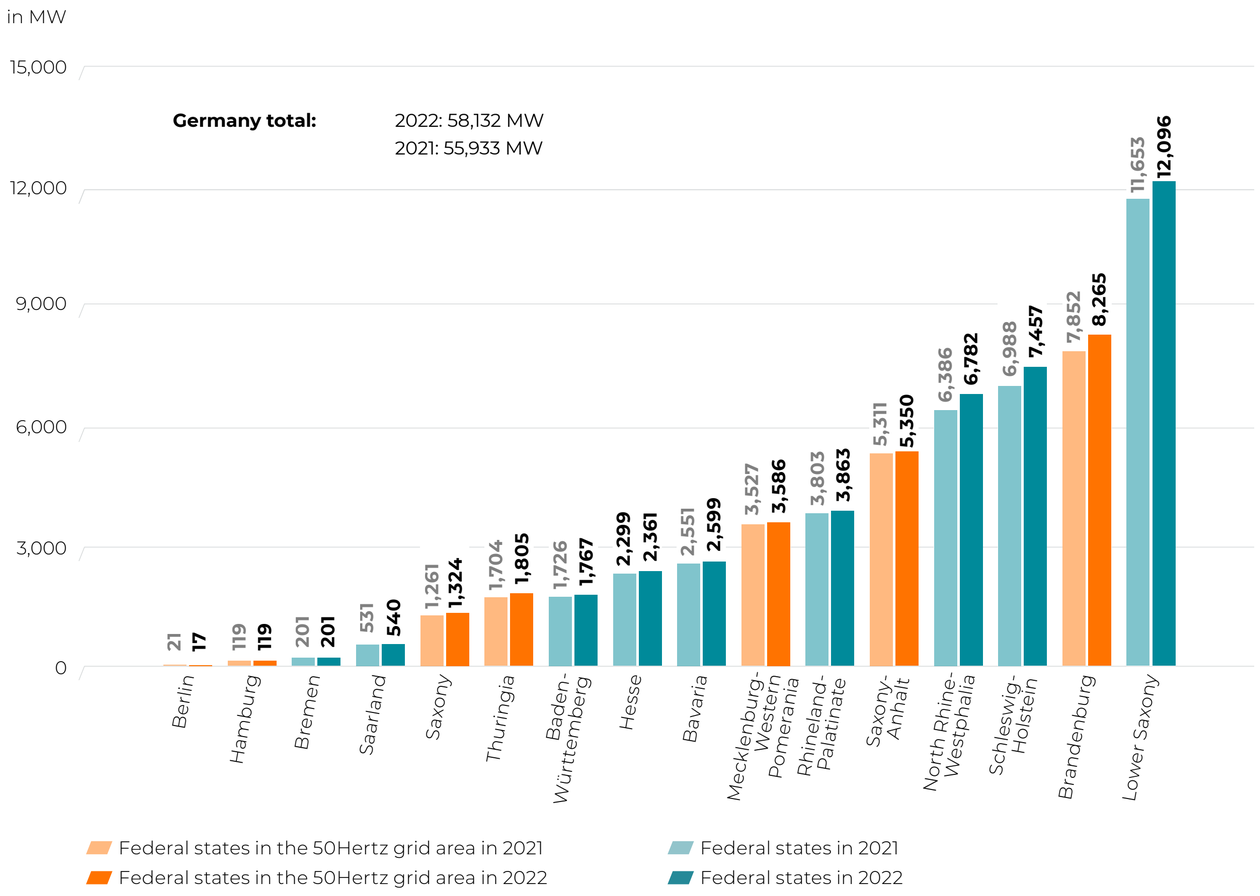


Share of the input from renewable energy sources as a proportion of total consumption in the 50Hertz grid area in 2022



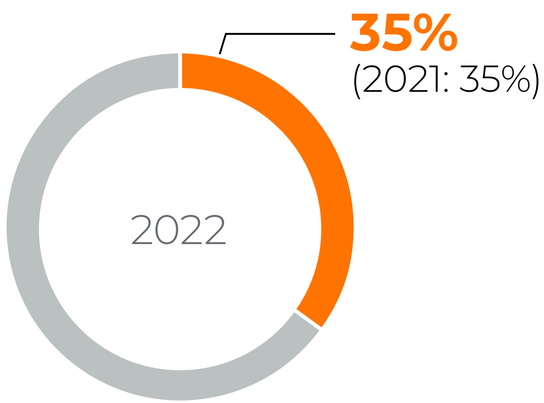
Capacity and generation

Geographical distribution of the installed onshore wind-power capacity in Germany by federal states in 2022



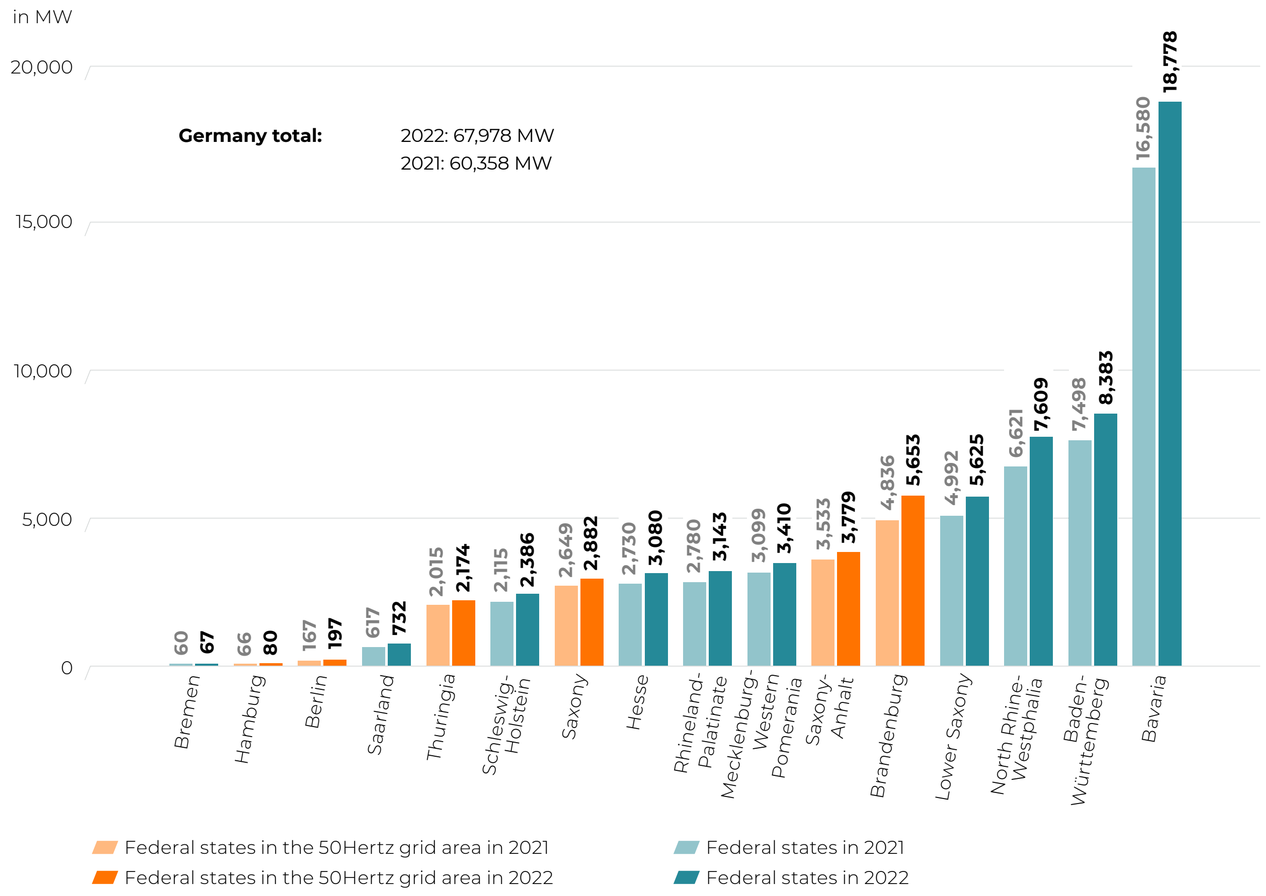
Source: Core Energy Market Data Register (MaStR), extracted at the end of January 2023 as at a reporting date of 31/12/2022

50Hertz's share of installed onshore wind-power capacity in Germany in 2022



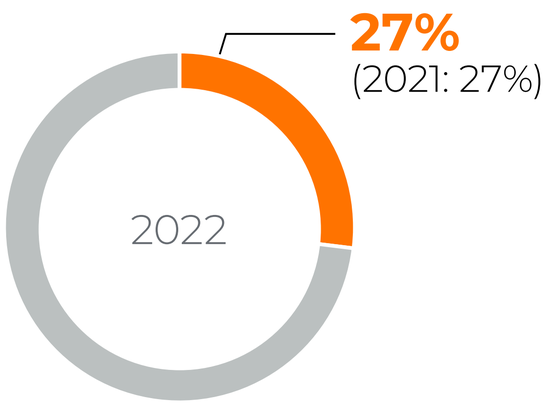
Capacity and generation

Geographical distribution of the installed photovoltaic capacity in Germany by federal states in 2022



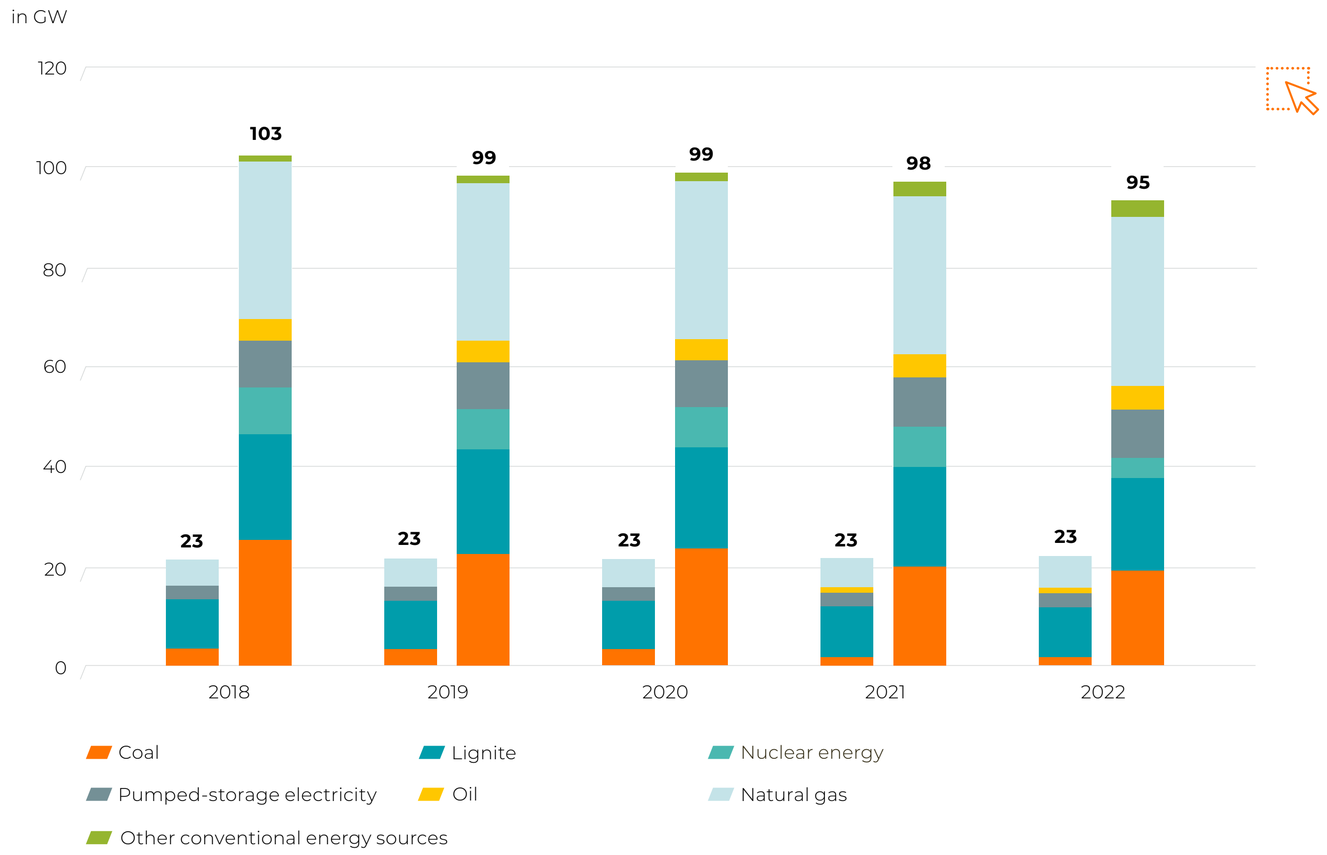
Source: Core Energy Market Data Register (MaStR), extracted at the end of January 2023 as at a reporting date of 31/12/2022

50Hertz's share of installed photovoltaic capacity in Germany in 2022



Capacity and generation

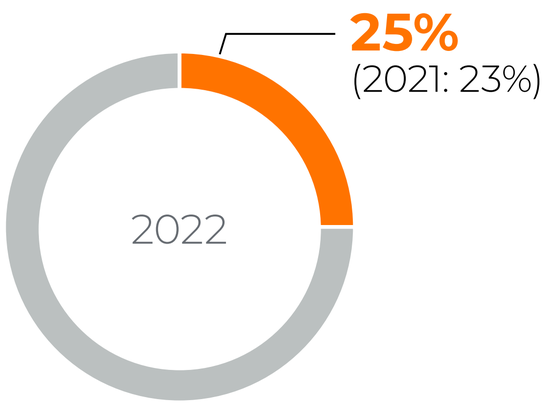
Development of the installed net capacity of conventional power plants in the 50Hertz grid area and in Germany



ⓘ 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.

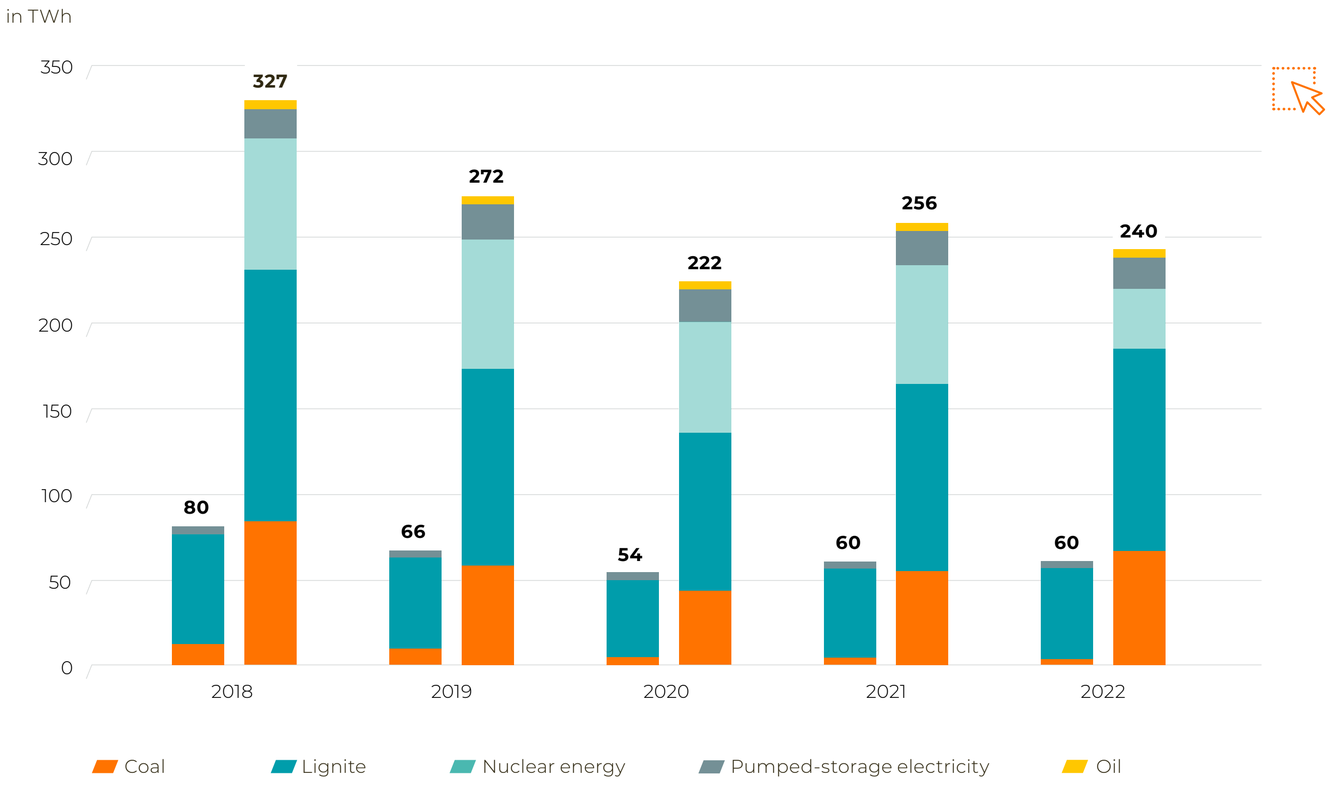
Source for Germany values: Power plant list and Core Energy Market Data Register (MaStR) of the German Federal Network Agency

50Hertz's share of the installed net capacity of conventional power plants in Germany in 2022



Capacity and generation

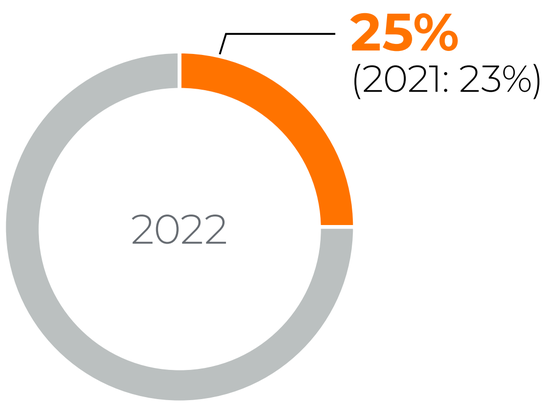
Development of the input from conventional energy sources to the 50Hertz extra-high-voltage grid and in Germany



The left-hand bar of each pair indicates the values for 50Hertz, Hertz, 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 Association of Energy and Water Industries (BDEW), preliminary figures

50Hertz's share of the input from conventional energy sources in Germany in 2022



Capacity and generation

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

Figures in MW	2022	2021
Maximum simultaneous input	16,885	16,728
Minimum input	3	5
Biggest one-hour drop	-2,590	-3,562
Biggest one-hour spike	3,277	3,230
Biggest 15-minute drop	-1,412	-1,344
Biggest 15-minute spike	1,522	1,179
Biggest one-day spike	10,950	13,878

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

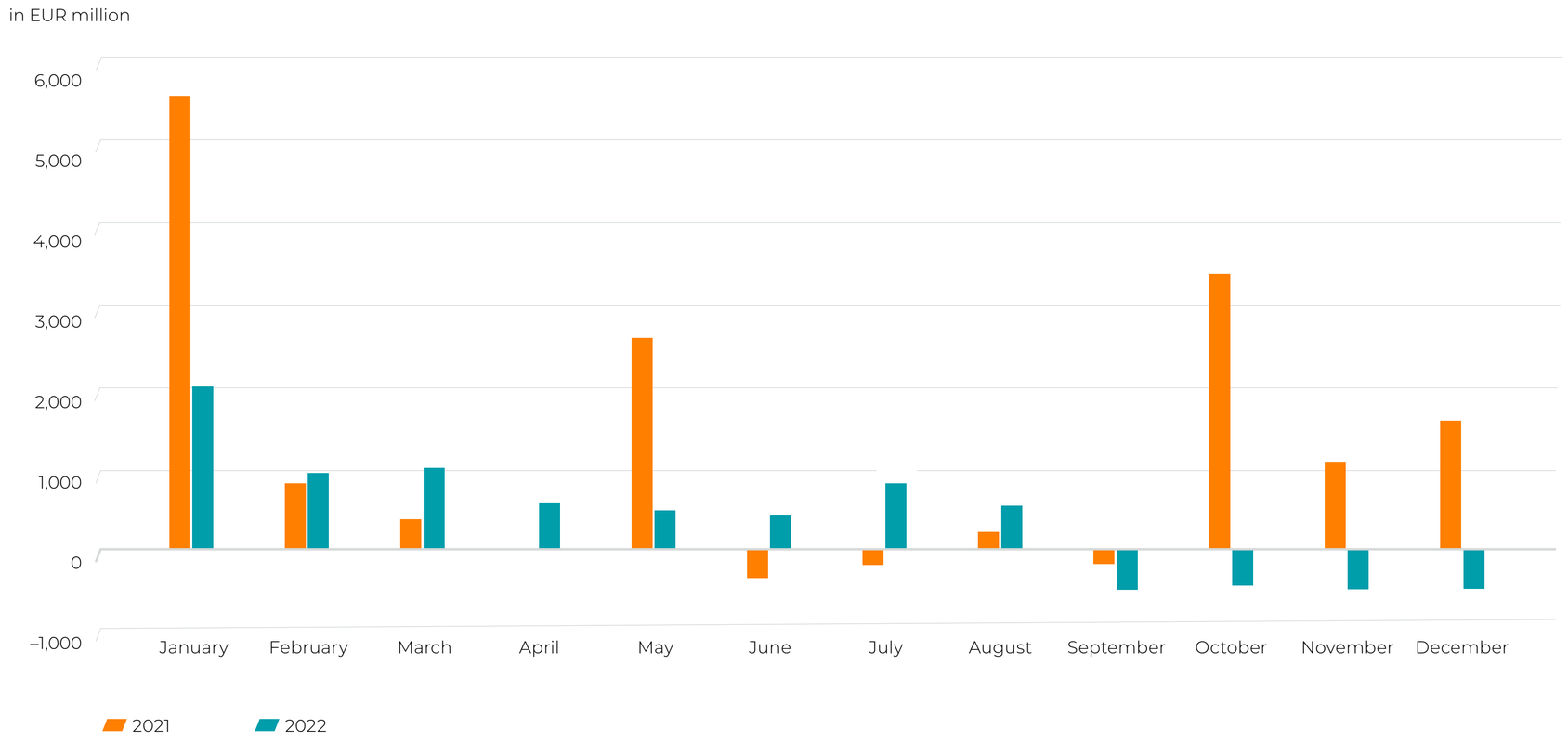
Key figures for the input from photovoltaic plants in the 50Hertz grid area

Figures in MW	2022	2021
Maximum simultaneous input	11,062	10,471
Minimum input	0	0
Biggest one-hour spike	2,950	2,725
Biggest one-hour drop	-2,874	-2,658
Biggest 15-minute spike	805	751
Biggest 15-minute drop	-834	-732
Biggest one-day spike	11,062	10,471

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

EEG account

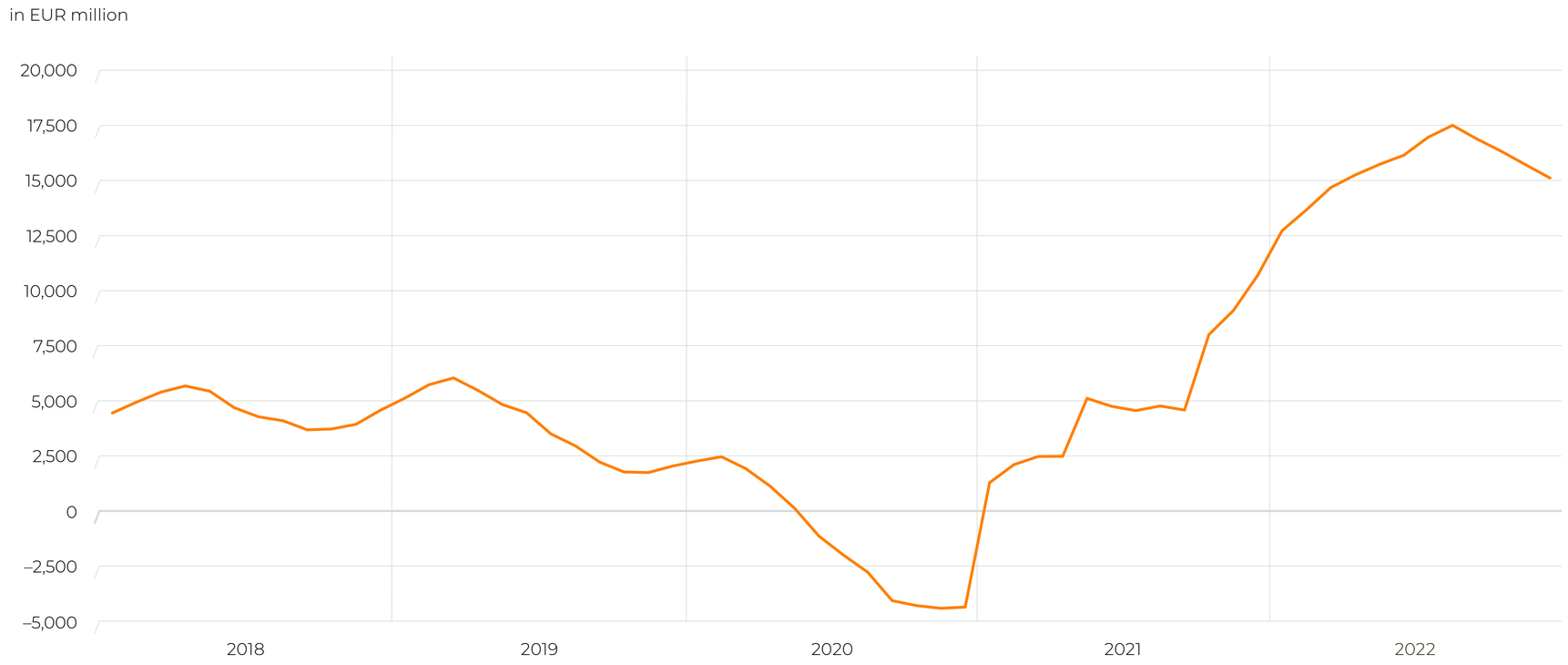
Monthly balance of income and outgoings for the EEG account



More information and the source of the above figures can be found at netztransparenz.de

EEG account

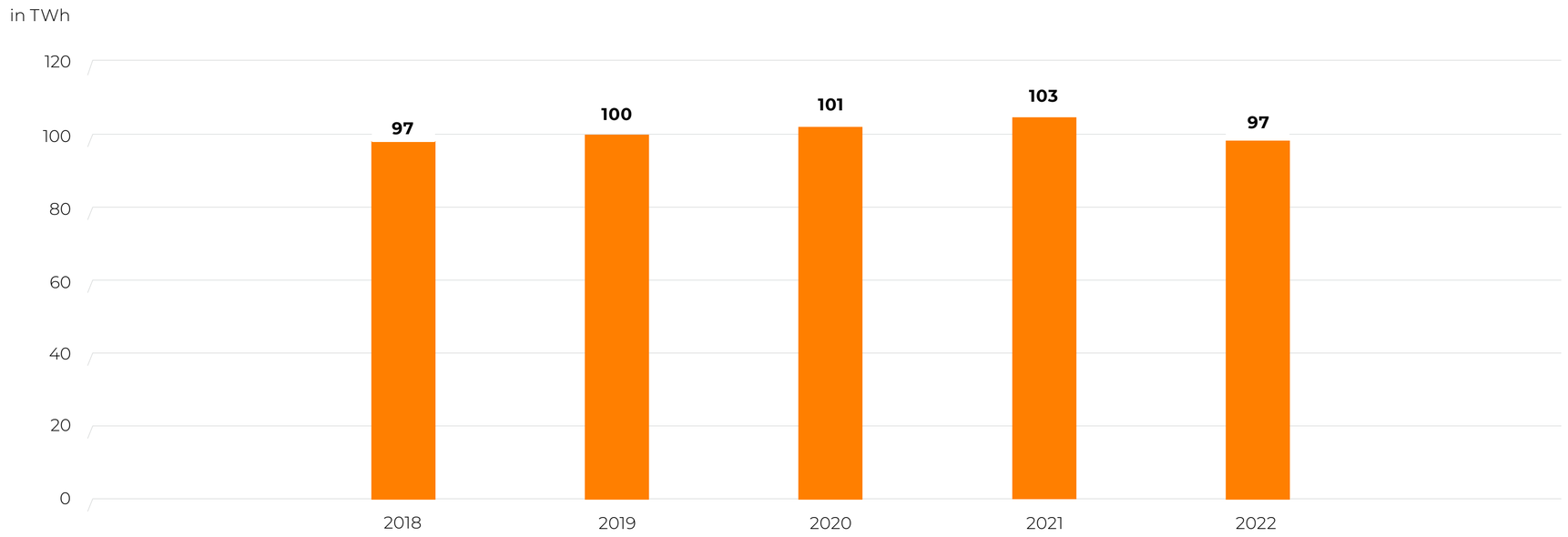
Development of the EEG account



More information and the source of the above figures can be found at netztransparenz.de

Load and consumption

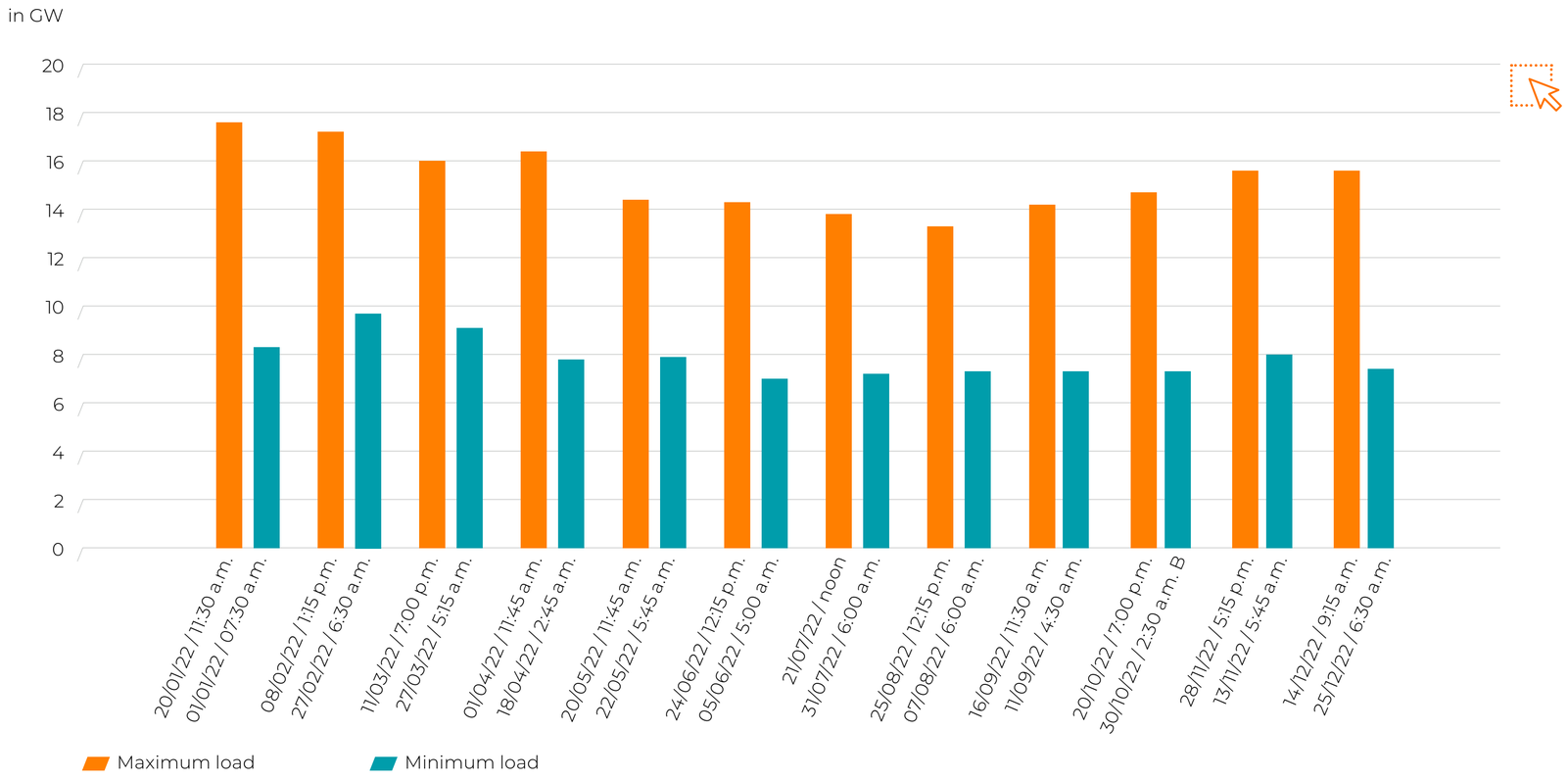
Development of electricity consumption in the 50Hertz grid area



For the years 2018 and 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

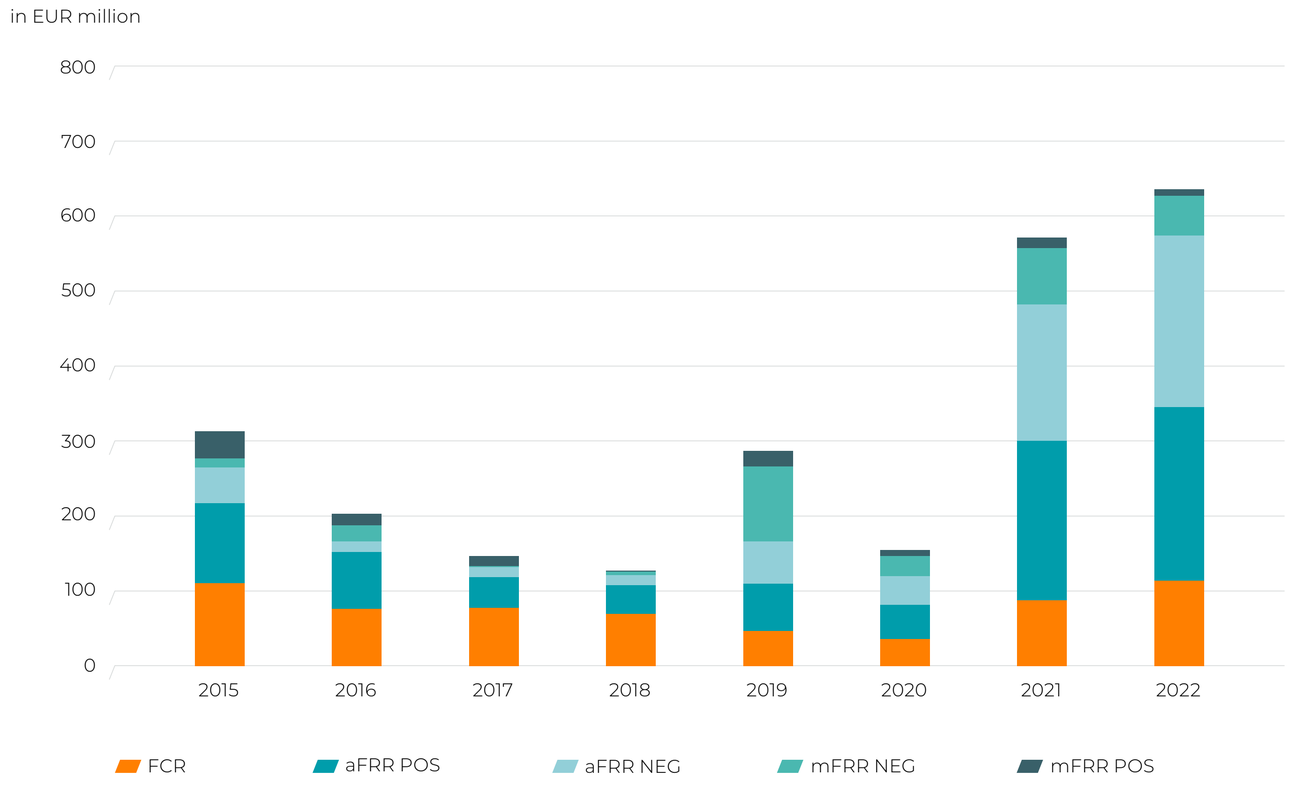
Monthly maximum and minimum load in the 50Hertz grid area



Annual maximum	17,608 MW on 20/01/2022 at 11:30 a.m.
Annual minimum	7,027 MW on 05/06/2022 at 5:00 a.m.

Balancing capacity

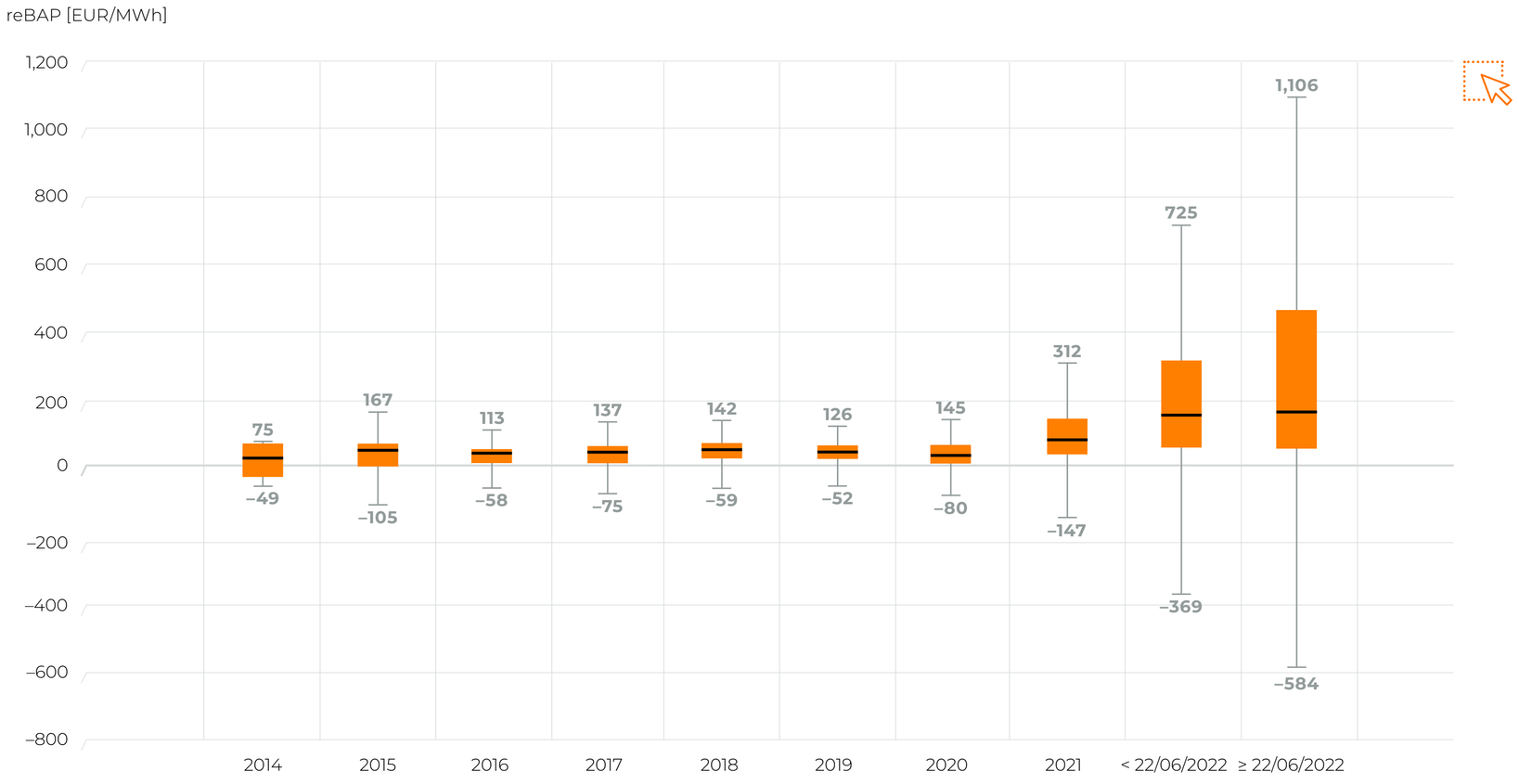
Development of costs by type of balancing capacity in Germany



More information and the source of the above figures can be found at: regelleistung.net/en-us/

Balancing capacity

Development of the imbalance price (reBAP)

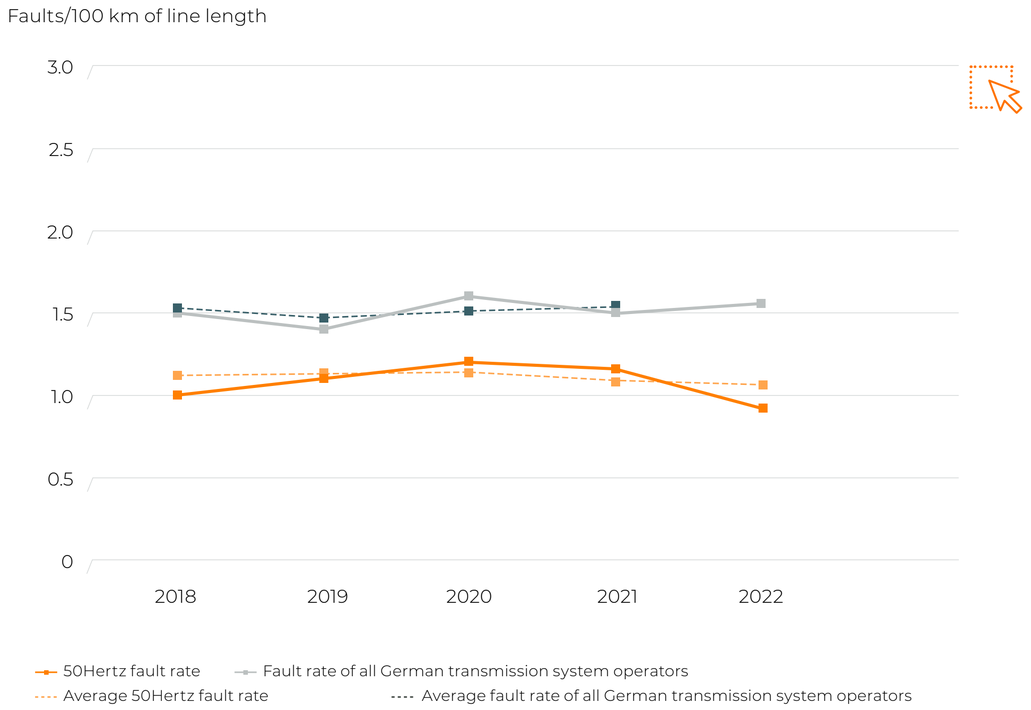


Outliers are not depicted.
Extensive market changes came into effect on 22/06/2022: Introduction of the redesigned European electricity balancing market, implementation of imbalance settlement harmonisation methodology (ISHM).

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

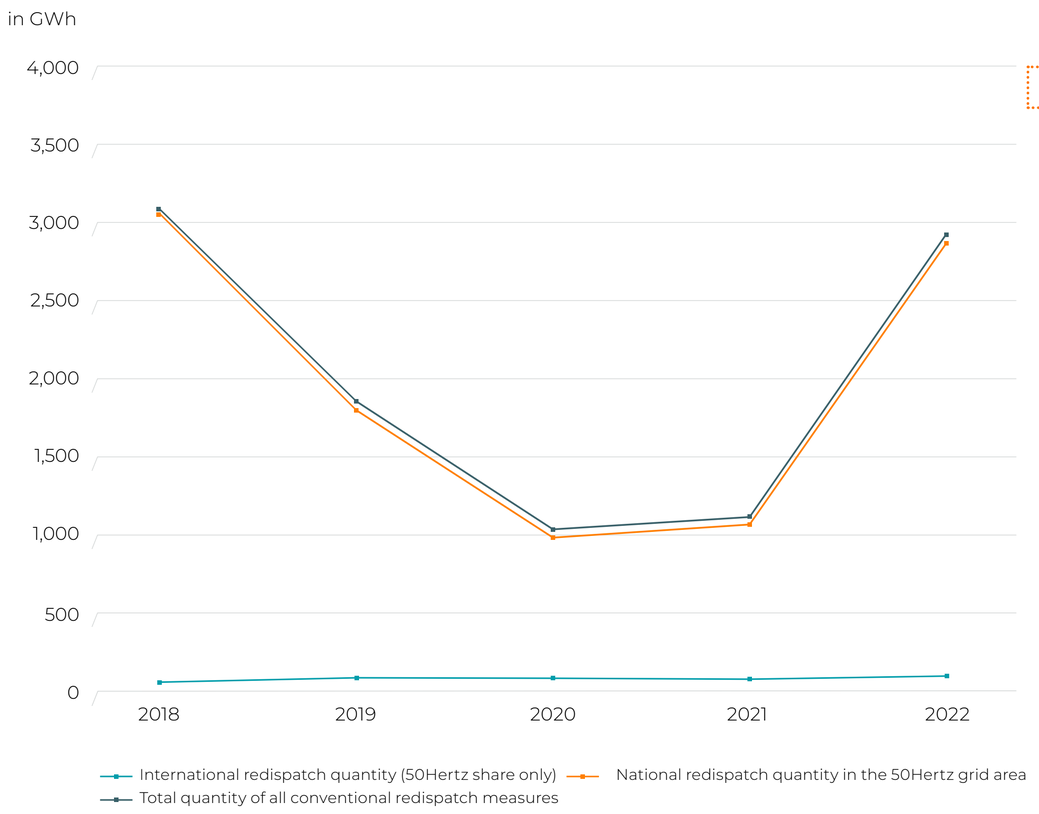


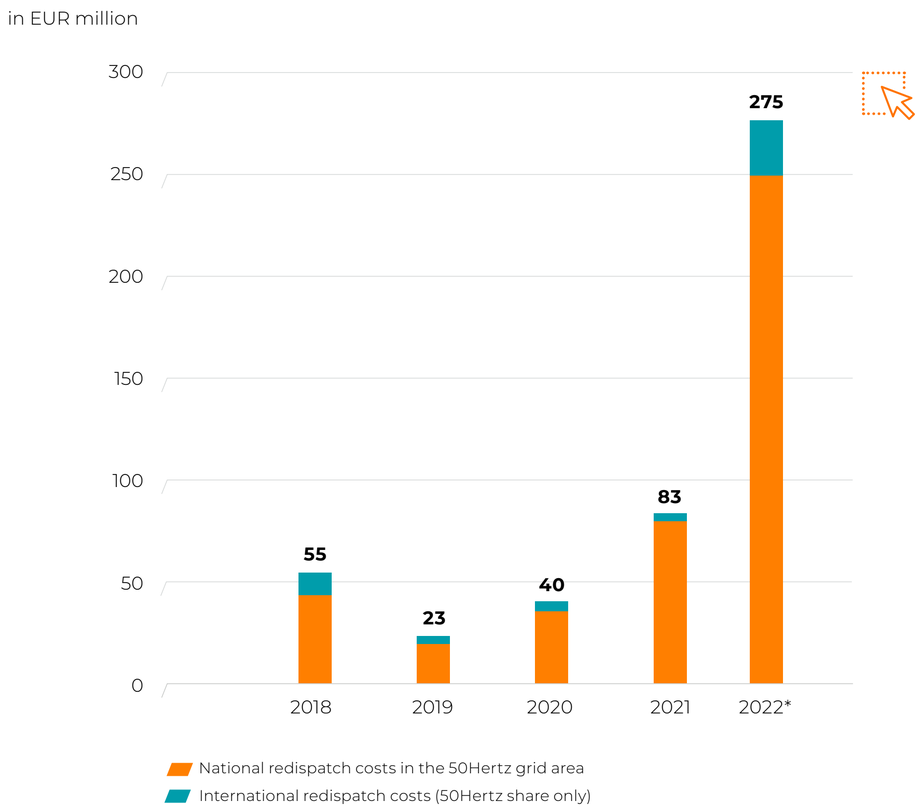
An unwanted change of the "normal operating state" is classed as an error that leads to a fault. This takes into account incidents that occur in the active grid used for transmission. Other errors are only recorded if they lead to an unwanted change of the normal operating state of the grid concerned.

Source for the value 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 current value is published at the mid-year of the following year.

System management

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



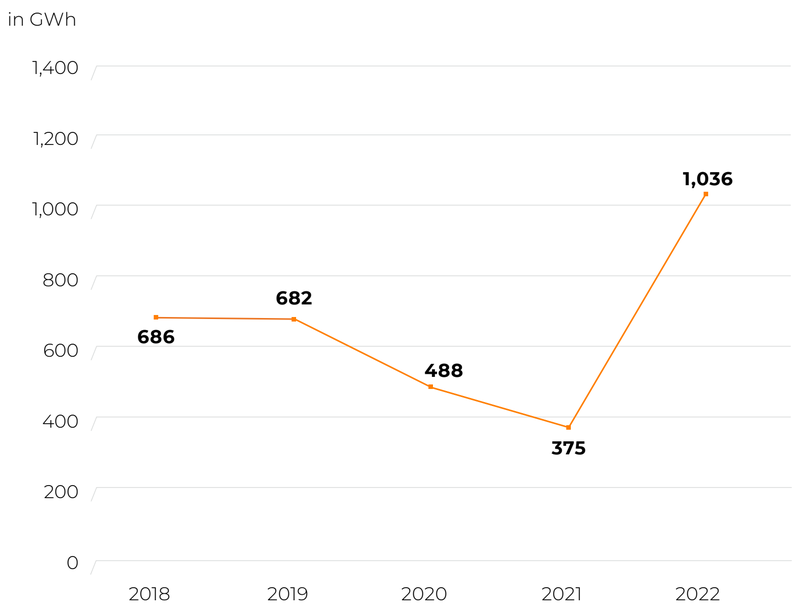


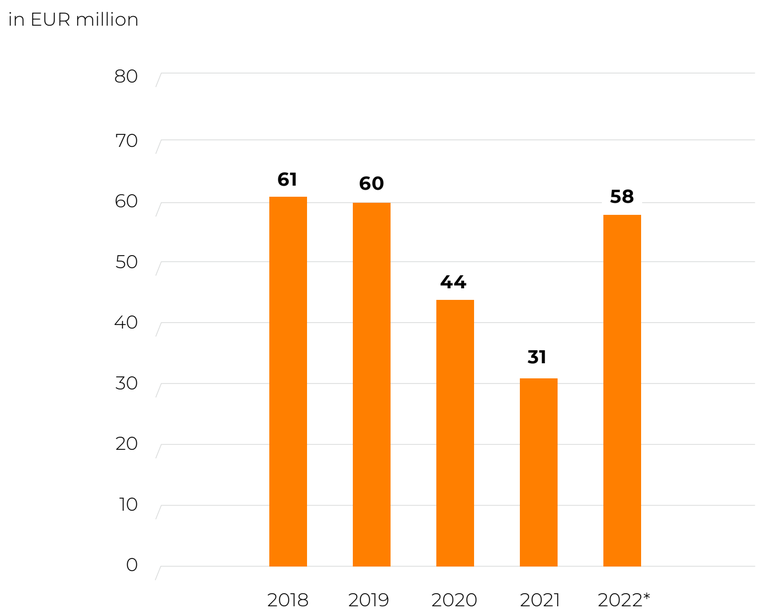
* Preliminary figures

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

System management

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

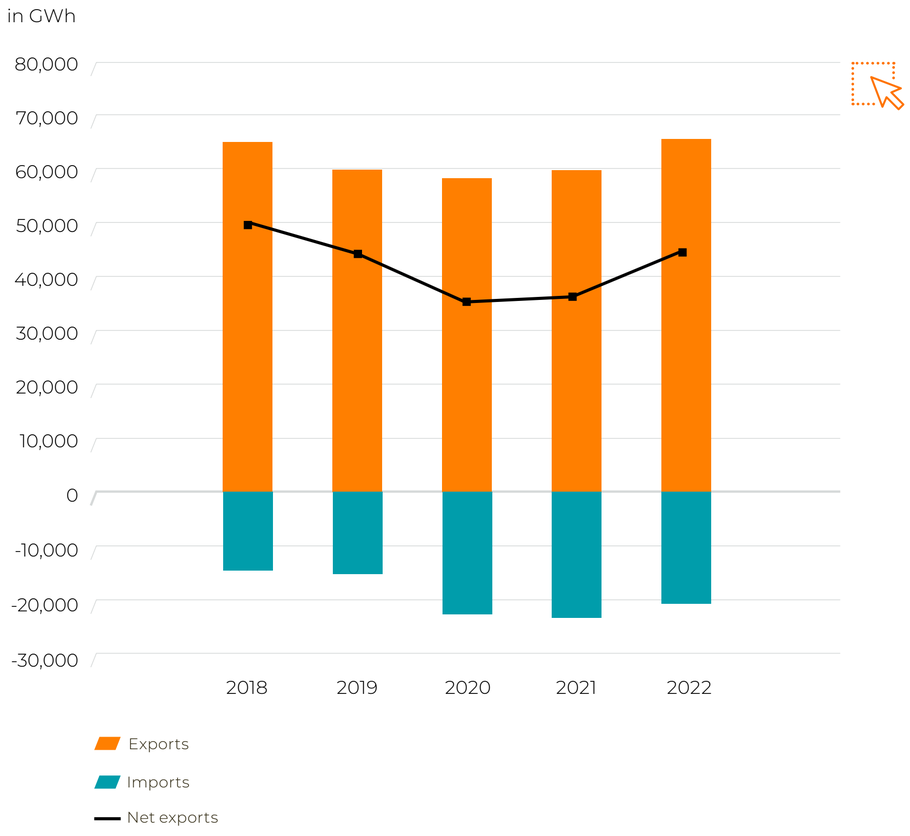




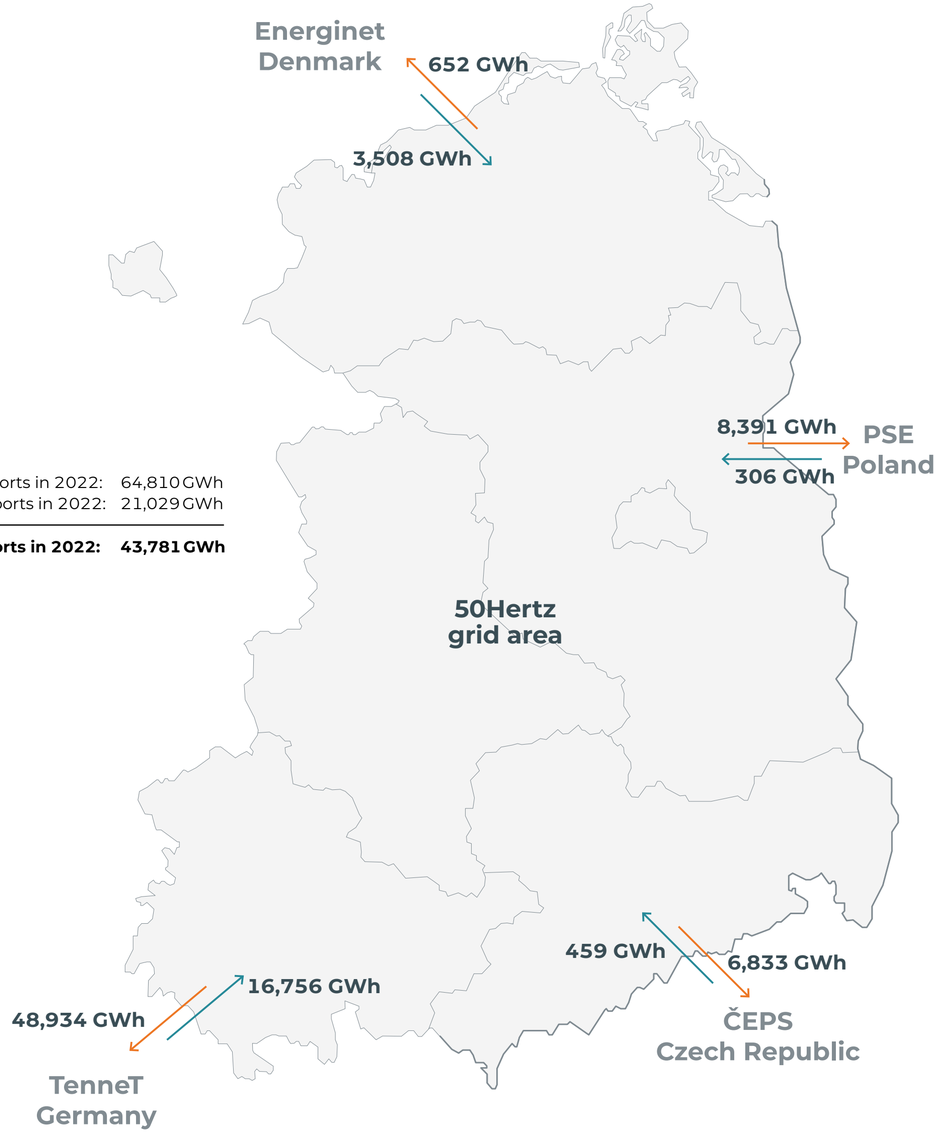
* Preliminary figure

Exchange and transport

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



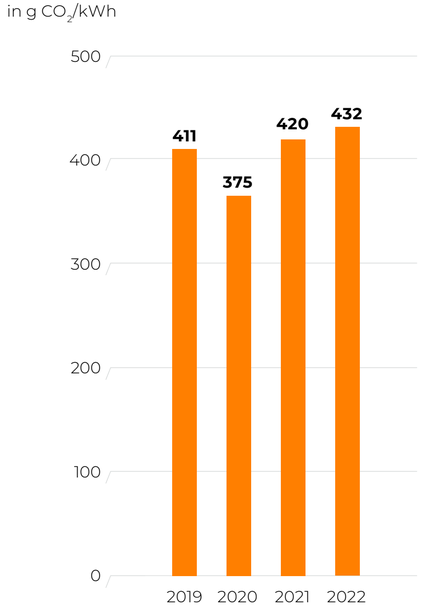
Total exports in 2022:	64,810 GWh
Total imports in 2022:	21,029 GWh
Net exports in 2022:	**43,781 GWh**



Climate and environmental protection

Climate protection:

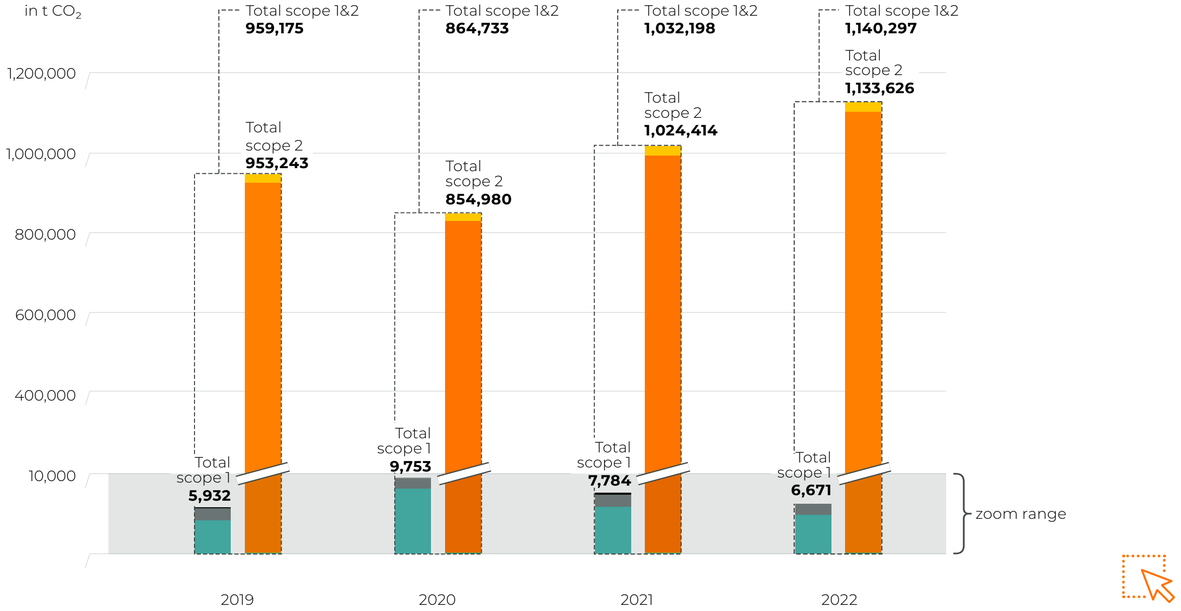
Greenhouse gas emissions from the German electricity mix



Source: "Entwicklung der spezifischen Treibhausgas-Emissionen des deutschen Strommix in den Jahren 1990–2021" [Development of the specific greenhouse gas emissions from the German electricity mix in the years 1990–2021], German Federal Statistical Office, own calculations for 2022

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

Greenhouse gas emissions of 50Hertz



Scope 1 direct emissions

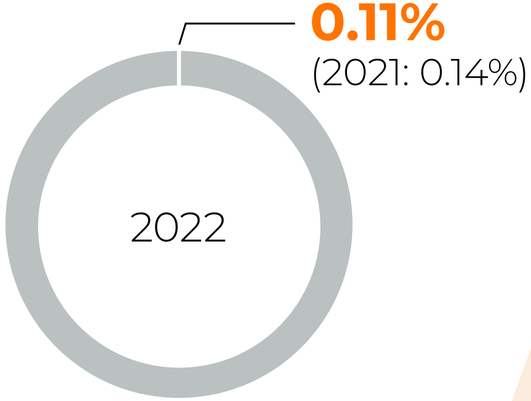
- SF6 losses
- Fleet
- Natural gas

Scope 2 indirect emissions

- District heat
- Grid losses*
- Administrative operating consumption (electricity)
- Technical operating consumption (electricity)

* * 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]

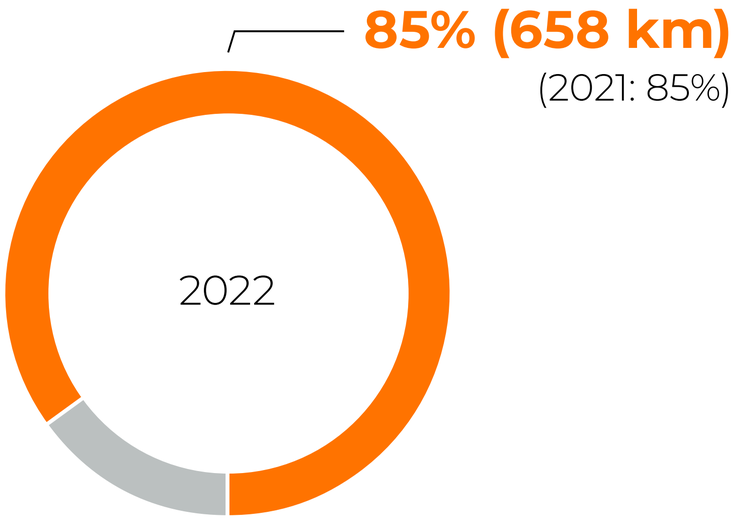
SF6 leak rate (sulphur hexafluoride)



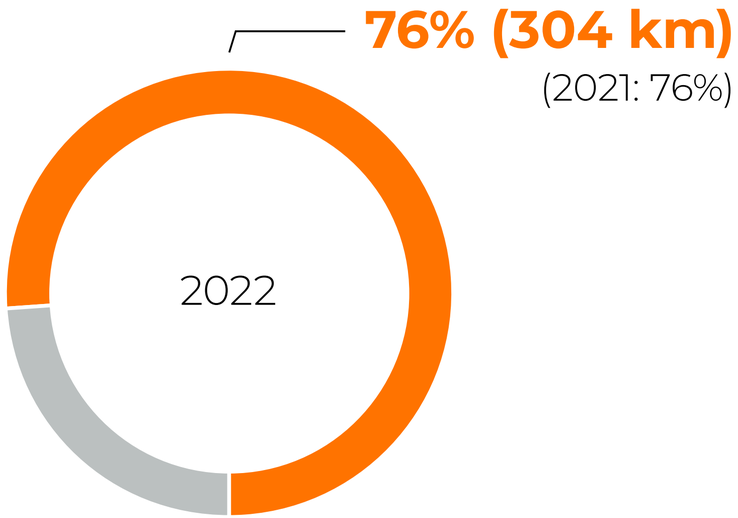
Climate and environmental protection

Environmental protection:

Share of ecologically managed forest routes



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



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

Grid expansion

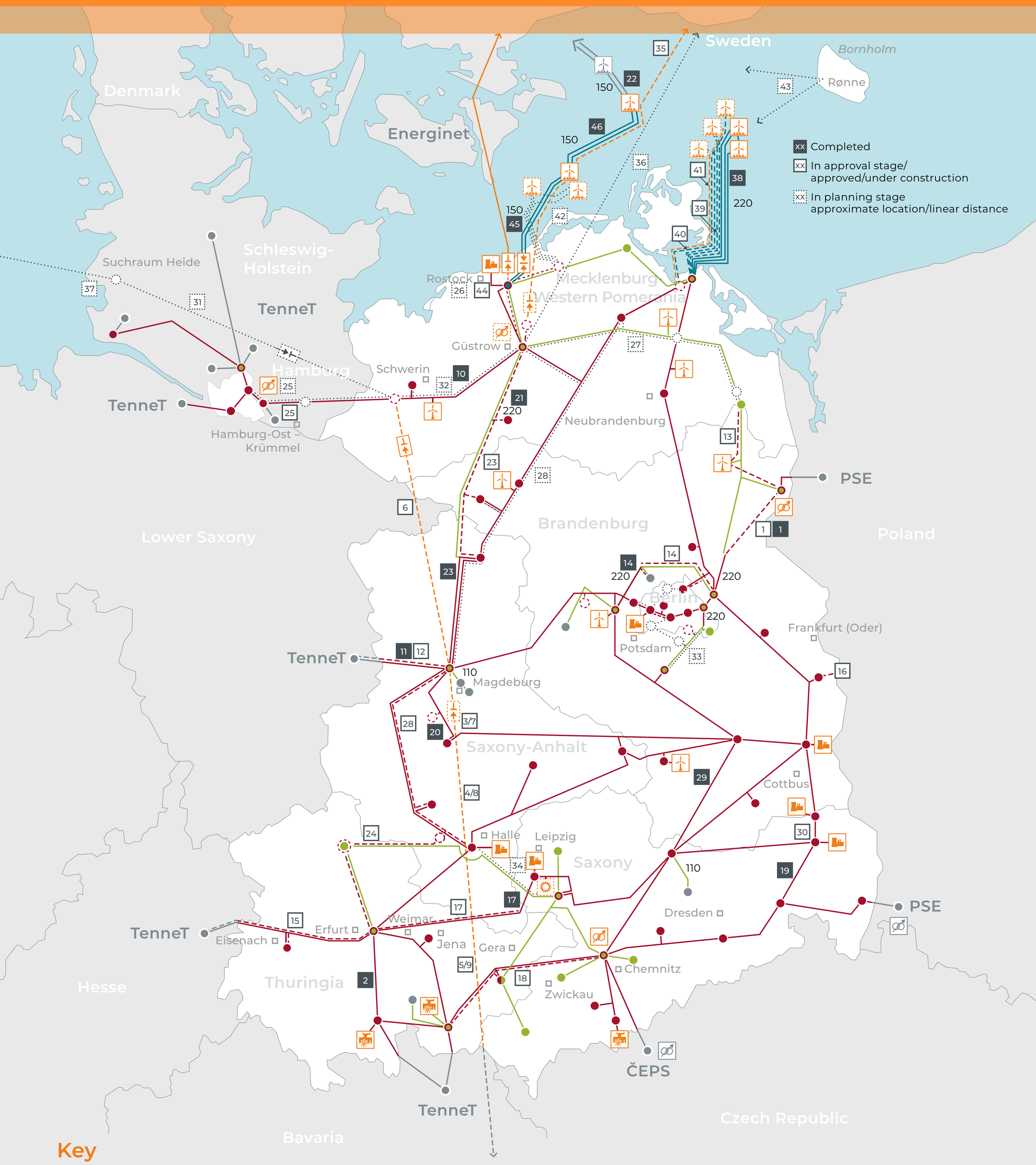
Grid expansion projects since 2009 according to EnLAG, BBPIG as well as offshore projects

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))			78	45
2	4	EnLAG	South-western interconnector (Lauchstädt – Redwitz)				159
3	5	BBPIG	Extra-high-voltage line Wolmirstedt – Isar (SOL* A1); direct current		87		
4	5	BBPIG	Extra-high-voltage line Wolmirstedt – Isar (SOL A2); direct current		94		
5	5	BBPIG	Extra-high-voltage line Wolmirstedt – Isar (SOL B); direct current		84		
6	5a	BBPIG	Extra-high-voltage line Klein Rogahn search area – Isar (SOL+ north segment); direct current		237		
7	5a	BBPIG	Extra-high-voltage line Klein Rogahn search area – Isar (SOL+ segment A1); direct current		70		
8	5a	BBPIG	Extra-high-voltage line Klein Rogahn search area – Isar (SOL+ segment A2); direct current		94		
9	5a	BBPIG	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	BBPIG	Wolmirstedt – Helmstedt – Wahle (M24a)				46
12	10	BBPIG	Wolmirstedt – Helmstedt – Wahle (M24b)		47		
13	11	BBPIG	Bertikow – Pasewalk			31	
14	11	EnLAG	380-KV Berlin Northern Ring (Neuenhagen – Hennigsdorf – Wustermark)			22	56
15	12	BBPIG	Vieselbach – pumped-storage plant, Schmalwasser dam (Sonneborn point) – Mecklar		87		
16	12	EnLAG	3rd interconnector (Eisenhüttenstadt – Baczyna (Poland))		8		
17	13	BBPIG	Pulgar – Vieselbach		78		27
18	14	BBPIG	Röhrsdorf – Weida – Remptendorf			109	
19	26	BBPIG	Bärwalde – Schmölln				46
20	27	BBPIG	Walsleben – Förderstedt branch				12
21	28	BBPIG	Parchim South – Neuburg branch				1
22	29	BBPIG	Combined Grid Solution				50
23	39	BBPIG	Güstrow – Parchim South – Perleberg – Stendal/West – Wolmirstedt		133	7	51
24	44	BBPIG	Südharz grid connection (Lauchstädt – Wolkramshausen – Vieselbach)		146		
25	51	BBPIG	Hamburg North – Hamburg East – Büchen/ Breitenfelde/Schwarzenbek-Land collective municipalities	28	31		
26	52	BBPIG	Rostock region grid reinforcement (P215 Bentwisch – Güstrow – Gnewitz)		68		
27	53	BBPIG	Güstrow – Pasewalk (P216)	152			
28	60	BBPIG	Siedenbrünzow – Güstrow – Putlitz South – Perleberg – Osterburg – Stendal West – Wolmirstedt – Schwanebeck – Klostermansfeld – Schraplau/Obhausen – Lauchstädt	283	156		
29	61	BBPIG	Ragow – Streumen				89
30	62	BBPIG	Graustein – Bärwalde		22		
31	81	BBPIG	NordOstLink (Heide search area – Klein Rogahn search area)	106			
32	85	BBPIG	Güstrow – Krümmel	147			
33	87	BBPIG	Grid expansion and reinforcement Berlin	75			
34	93	BBPIG	Central Germany energy triangle (Lauchstädt – Leuna – Pulgar)	59			
35	69	BBPIG	Hansa PowerBridge (Güstrow – Sweden)		175		
36	83	BBPIG	Hansa PowerBridge 2	35			
37			NOR-11-1 (LanWin3)	212			
38			Ostwind 1				289
39			Ostwind 2			274	
40			Ostwind 3		106		
41			Ostwind 4 – Extra-high-voltage line		~ 110		
42			OST-6-1 Gennaker	251			
43			Bornholm Energy Island (BEI)	~ 150			
44			KONTEK grid connection			15	
45			Baltic 1				77
46			Baltic 2				192
				1,498	**1,917**	**536**	**1,205**

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

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

Find out more at: 50hertz.com/en/Grid/Griddevelopement or 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/under construction
- In 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	
HVDC/converter in planning stage	300/525 kV	
Offshore grid connection	150/220 kV	
Offshore grid connection in approval stage/under construction	150/220 kV	
In planning 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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