

Electricity generation in Germany in 2023

Prof. Dr. Bruno Burger
Freiburg, 10.01.2024
www.energy-charts.info

Agenda

- 1. Summary**
- 2. Electricity generation, share of renewable energies, full load hours**
- 3. Imports and exports**
- 4. Electricity prices**
- 5. Installed capacity**
- 6. Emissions and climate data**
- 7. Appendix and explanations**

Net electricity generation in 2023

Renewable energies: solar and wind

Photovoltaic systems generated approx. 59.9 TWh of electricity in 2023. Of this, approx. 53.5 TWh was fed into the public grid and 6.4 TWh was consumed. Total production increased by approx. 1 TWh or 1.4% compared to the previous year. Installed PV capacity totalled 80.7 GW at the end of November. Additions in 2023 up to November totalled approx. 13.2 GW. The maximum solar power fed into the grid was approx. 40.1 GW on 7 July 2023 at 13:15. The maximum share of solar energy in total electricity generation at this time was 68% and the maximum share of total daily energy from all electricity sources was 36.8%.

Wind power plants produced approx. 139.8 TWh in 2023 and were approx. 14.1% higher than production in 2022. Wind energy was once again the strongest energy source of the year, followed by lignite, solar, natural gas, biomass, hard coal, hydropower and nuclear energy. The maximum wind power generated was approx. 53 GW on 21 December 2023 at 11:00 a.m. The share of onshore wind amounted to approx. 115.3 TWh and offshore wind generated approx. 23.5 TWh. At the end of November 2023, the installed capacity of onshore wind was 60.5 GW and offshore wind 8.4 GW.

1 TWh = 1 terawatt hour = 1000 gigawatt hours (GWh) = 1 million megawatt hours (MWh) = 1 billion kilowatt hours (kWh)

Net electricity generation in 2023

Renewable energies: Hydropower and biomass

Hydropower produced approx. 19.5 TWh compared to 16.3 TWh in 2022. The installed capacity is approx. 4.94 GW. It has hardly changed compared to previous years.

Approx. 42.3 TWh were produced from **biomass**. Production is therefore 1.3 TWh lower than in 2022, with installed capacity totalling 9 GW.

In total, the **renewable energy sources** solar, wind, water and biomass produced approx. 260 TWh in 2023. This is 7.2% above the previous year's level of 242 TWh. The share of renewable energy fed into the public electricity grid in Germany in relation to the load, i.e. the electricity mix that actually comes out of the socket, was 56.9% compared to 50.2% in 2022.

In addition to net public electricity generation, total net electricity generation also includes solar self-consumption and self-generation by industrial and commercial enterprises. This is mainly generated using gas.

The share of renewable energies in total net electricity generation, including the power plants of "businesses in the manufacturing, mining and quarrying sectors", is around 54.9% compared to 45.5% in 2022.

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Net electricity generation in 2023

Non-renewable generation

Nuclear power plants generated 6.7 TWh of electricity in straight-line operation until their shutdown on 15 April 2023.

Lignite-fired power plants produced 77.5 TWh net for public electricity consumption and 3.7 TWh for industrial own consumption. This is 26.8 TWh less than in 2022. Gross electricity generation fell to the level of 1963.

Net production from **hard coal-fired power plants** for public electricity consumption totalled 36.1 TWh and 0.7 TWh for industrial own consumption. It was 21.4 TWh lower than in 2022. Gross electricity generation fell to the level of 1955.

Gas-fired power plants produced 45.8 TWh net for public electricity supply and 29.6 for industrial own consumption. This was 1.1 TWh below the previous year's level.

Lignite and hard coal-fired power plants generated more electricity than usual in 2022 due to the outage of many French nuclear power plants and high gas prices. The situation on the electricity market eased again in 2023, which led to a sharp reduction in coal-fired power generation.

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Net electricity generation in 2023

Export surplus

In 2023, Germany had a net import surplus of around 11.7 TWh in **cross border electricity trading** (planned or scheduled). The main reason for the imports was low electricity prices in neighbouring countries in the summer. The majority of imports came from Denmark (10.7 TWh), Norway (4.6 TWh) and Sweden (2.9 TWh). Germany exported electricity to Austria (5.8 TWh) and Luxembourg (3.6 TWh).

In 2022, a lot of electricity was still produced for export due to high exchange electricity prices, resulting in an export surplus of 27 TWh.

The **cross border physical flows** show an import surplus of 8.6 TWh compared to an export surplus of 27.5 TWh in 2022. The physical electricity flows do not provide any information on whether the electricity was actually consumed in the country or whether it was forwarded to neighbouring countries as transit electricity. It therefore makes little sense to analyse the individual countries here.

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Net electricity generation in 2023

Load, exchange electricity prices and market values

The **load** on the electricity grid was 457 TWh. This is around 26 TWh less than in 2022. Due to the high electricity prices and higher temperatures, electricity was probably saved significantly. Added to this is the increase in self-consumption of solar power, which also reduces the load.

The load includes electricity consumption and grid losses, but not pumped electricity consumption, self-consumption by conventional power plants and self-consumption by solar power plants.

The average volume-weighted **day-ahead** exchange electricity price was €92.29/MWh or 9.23 cents/kWh. This is significantly less than in 2022 (€230.57/MWh) and is almost exactly the same as in 2021 (€93.36/MWh).

The average volume-weighted **intraday** hourly price was €97.92/MWh or 9.79 cents/kWh. In 2022 it was € 232.55/MWh and in 2021 € 99.90/MWh.

Due to the coronavirus pandemic, 2020 should not be used for price comparisons.

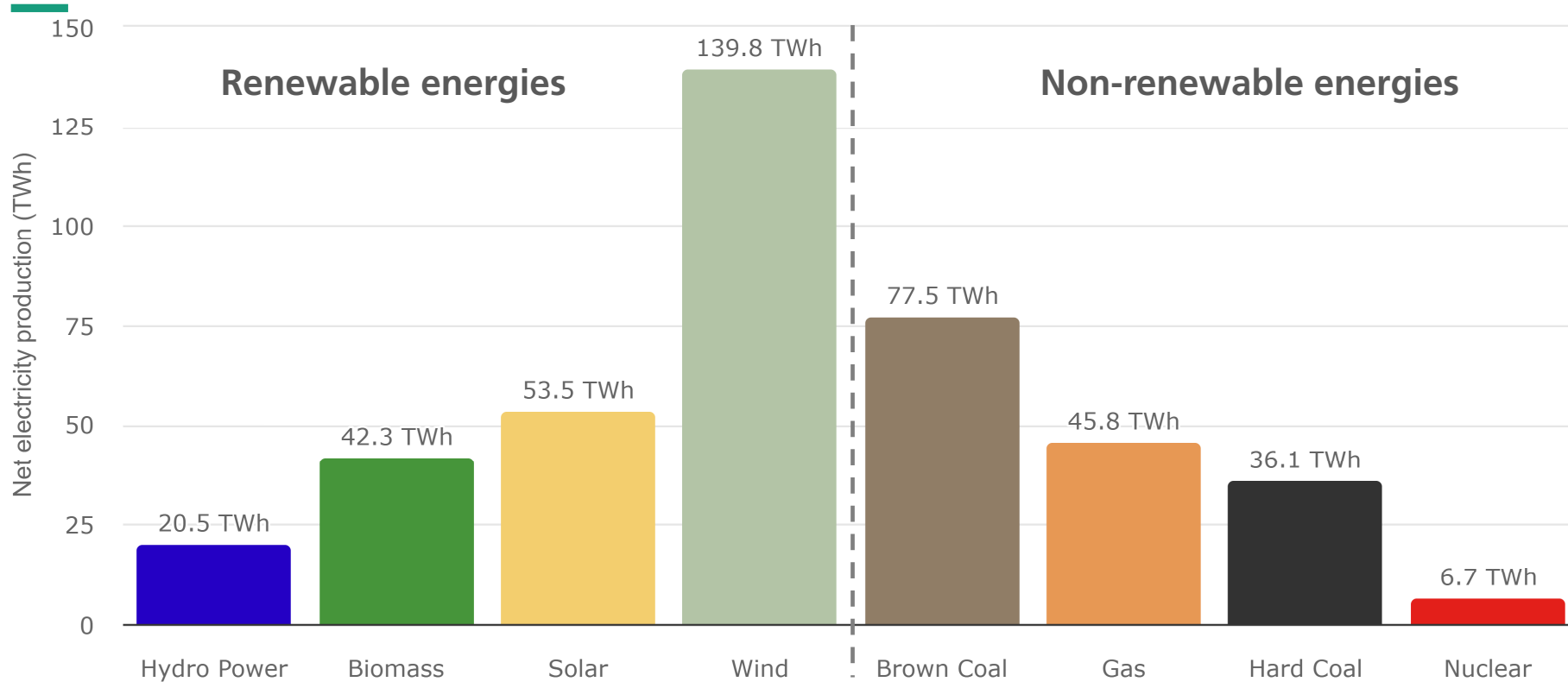
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Public net electricity generation

Year 2023

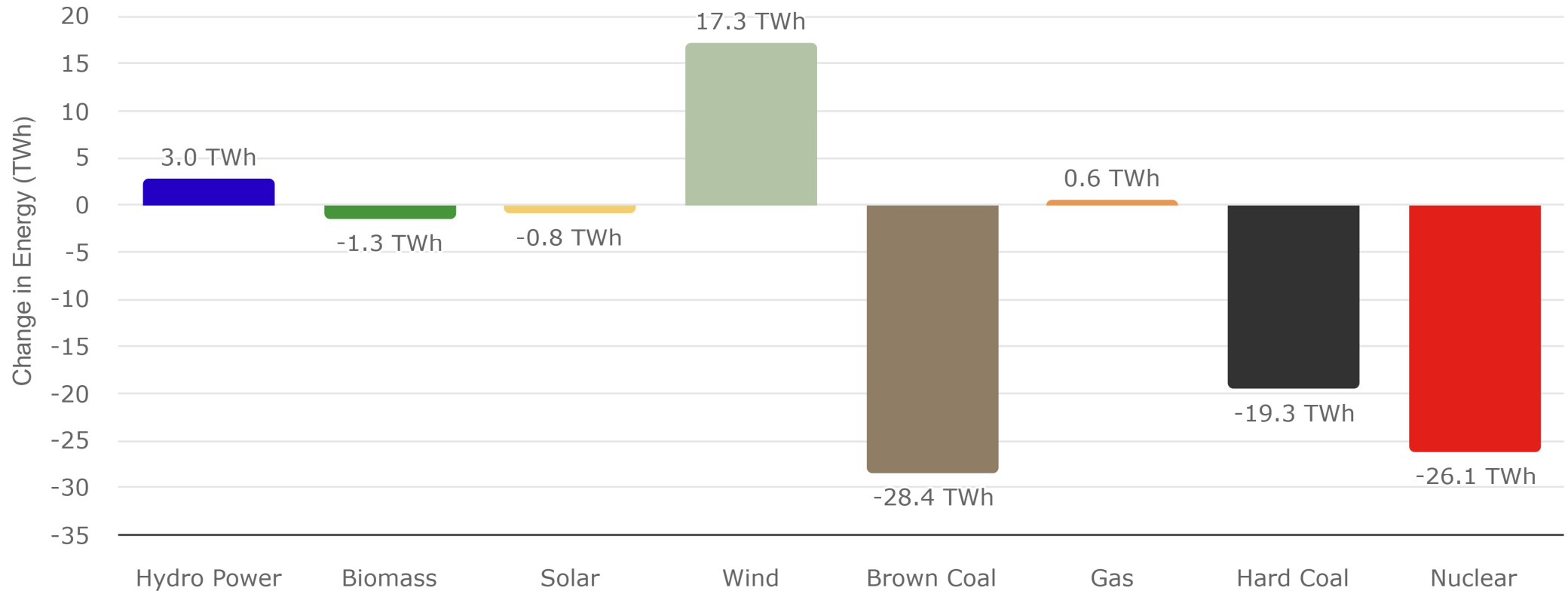


The graph shows the net electricity generation from power plants for public power supply. This is the electricity mix that actually comes out of the socket. Self-consumption of solar power and generation from power plants of "companies in the manufacturing industry and in mining and quarrying", i.e. industrial generation for self-consumption, is not included in this chart.

Source: <https://energy-charts.info/charts/energy/chart.htm?l=en&c=DE&year=2023&stacking=grouped&interval=year>

Absolute change in public net electricity generation

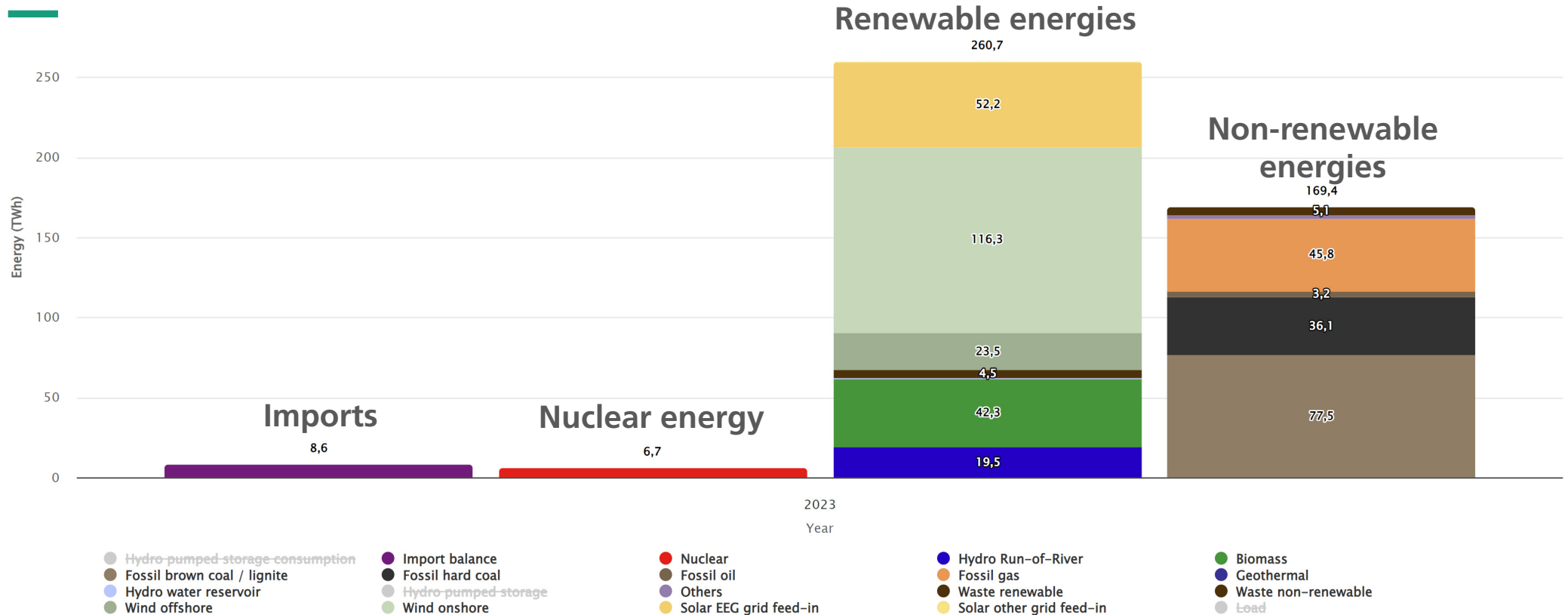
Year 2023 compared to year 2022



Graphic: B. Burger, Fraunhofer ISE; Data: DESTATIS and Leipzig Electricity Exchange EEX, energy-corrected values

Public net electricity generation

Year 2023

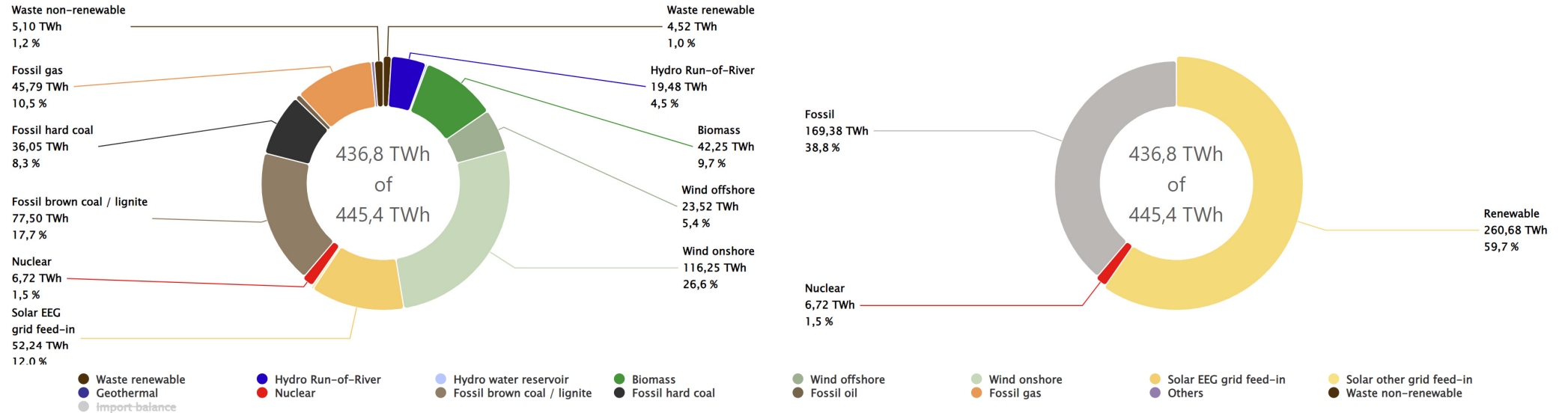


Energy-Charts.info - last update: 10.01.2024, 16:48 MEZ

Source: <https://www.energy-charts.info/charts/energy/chart.html?l=en&c=DE&interval=year&legendItems=01111111111011111110&year=2023>

Public net electricity generation

Year 2023



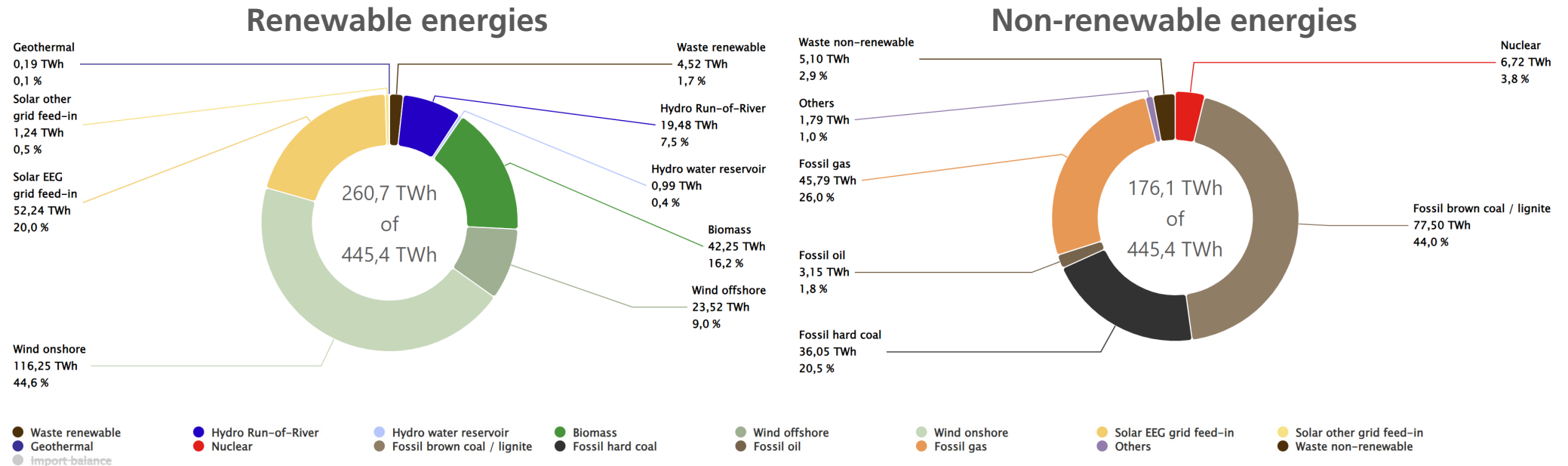
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Source: https://www.energy-charts.info/charts/energy_pie/chart.html?l=en&c=DE&interval=year&year=2023

Public net electricity generation

Year 2023



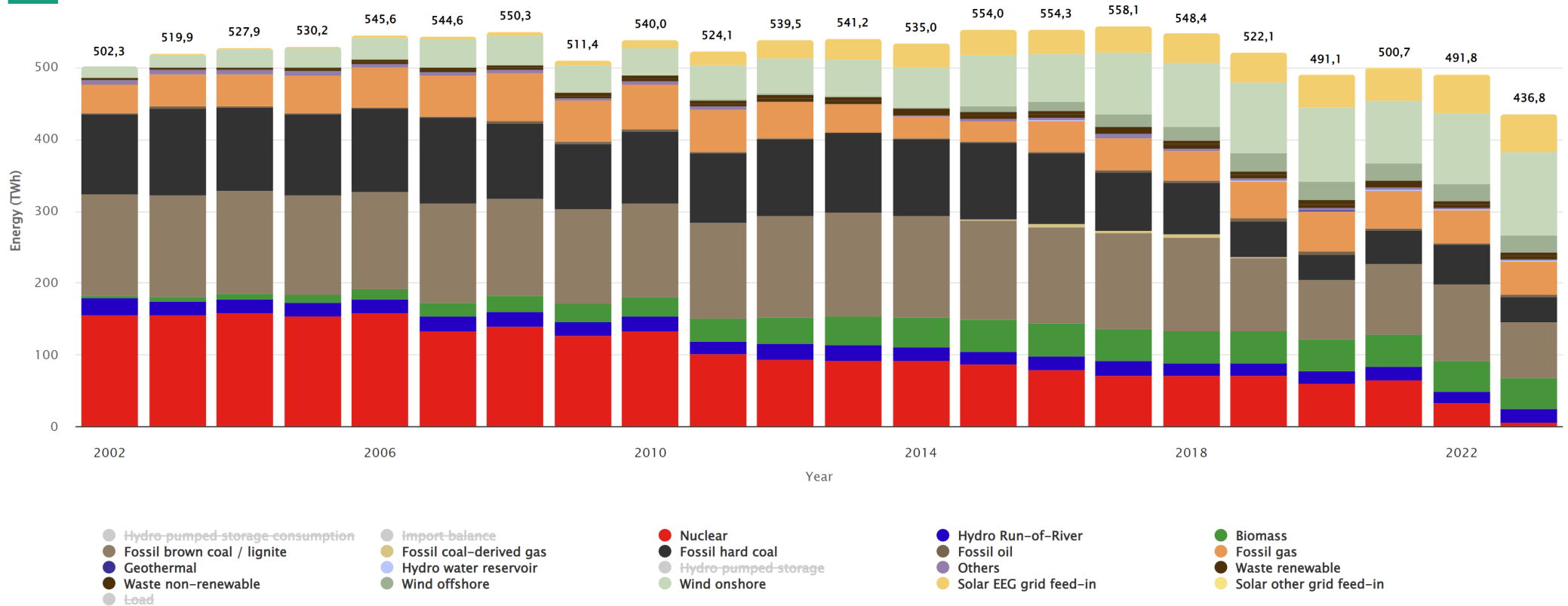
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Source: https://www.energy-charts.info/charts/energy_pie/chart.html?l=en&c=DE&interval=year&year=2023

Public net electricity generation

Year 2002 - 2023

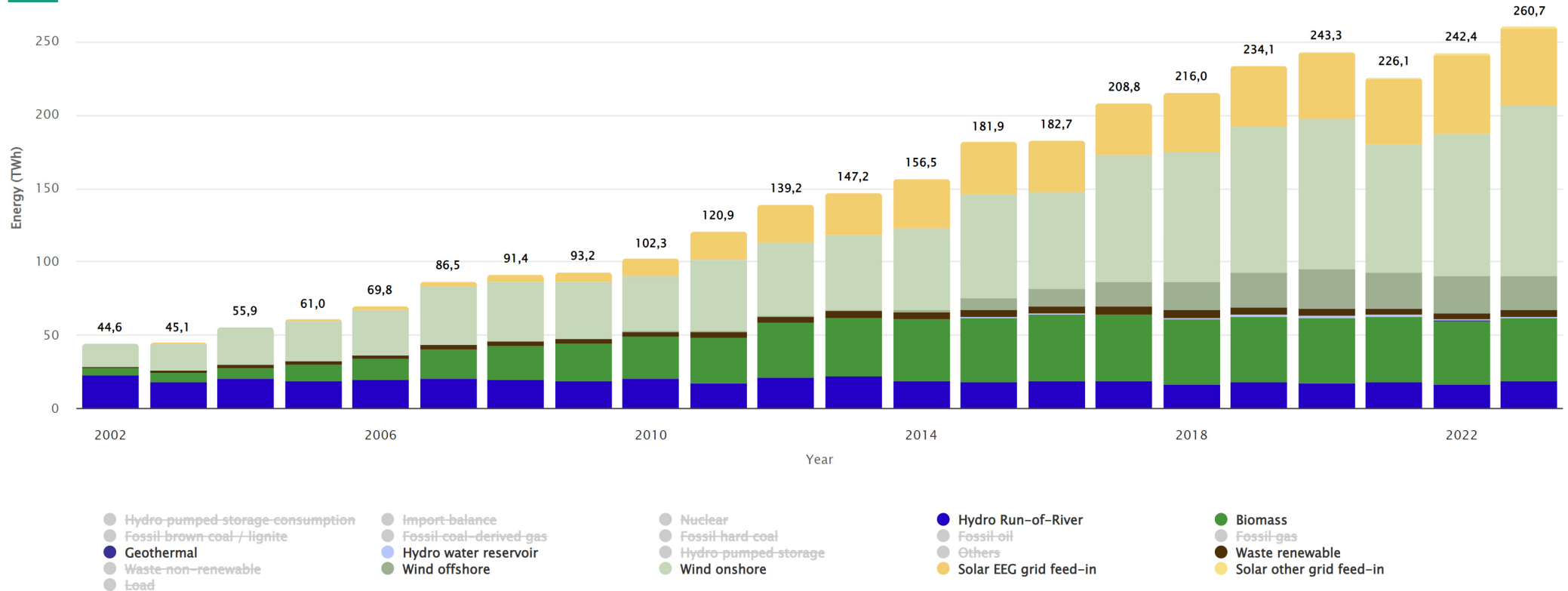


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Source: <https://www.energy-charts.info/charts/energy/chart.htm?!=en&c=DE&chartColumnSorting=default&interval=year&year=-1>

Net public electricity generation from renewable energies

Year 2002 - 2023

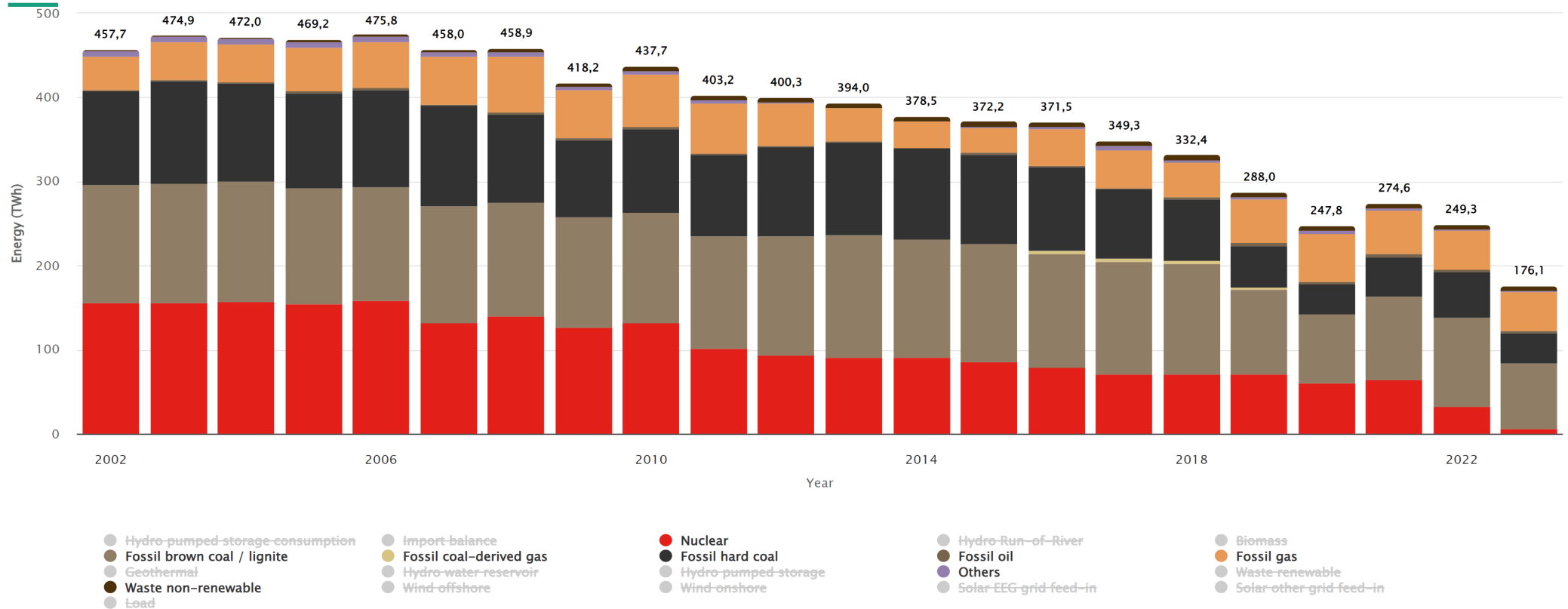


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Source: <https://www.energy-charts.info/charts/energy/chart.htm?!=en&c=DE&chartColumnSorting=default&interval=year&year=-1&sum=1>

Public net electricity generation from non-renewable sources

Year 2002 - 2023

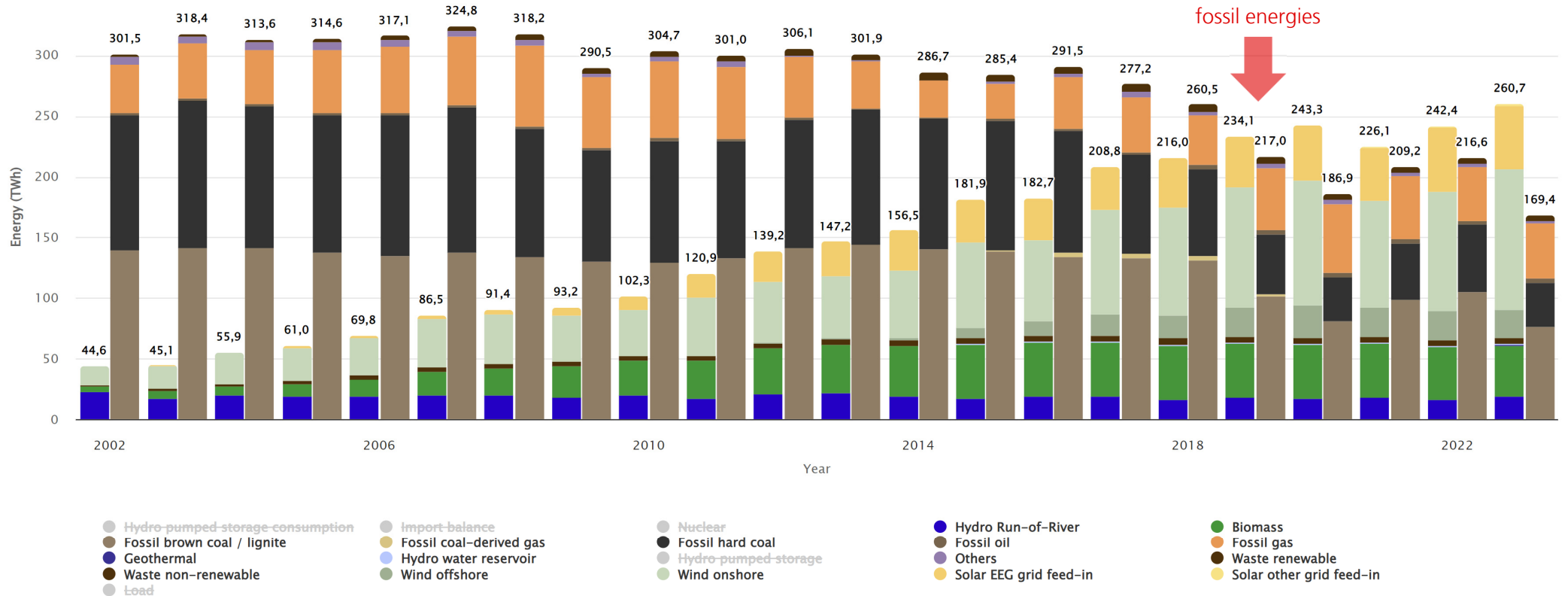


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Source: <https://www.energy-charts.info/charts/energy/chart.htm?!=en&c=DE&chartColumnSorting=default&interval=year&year=-1&sum=1>

Public net electricity generation from renewable and fossil sources

Year 2002 - 2023

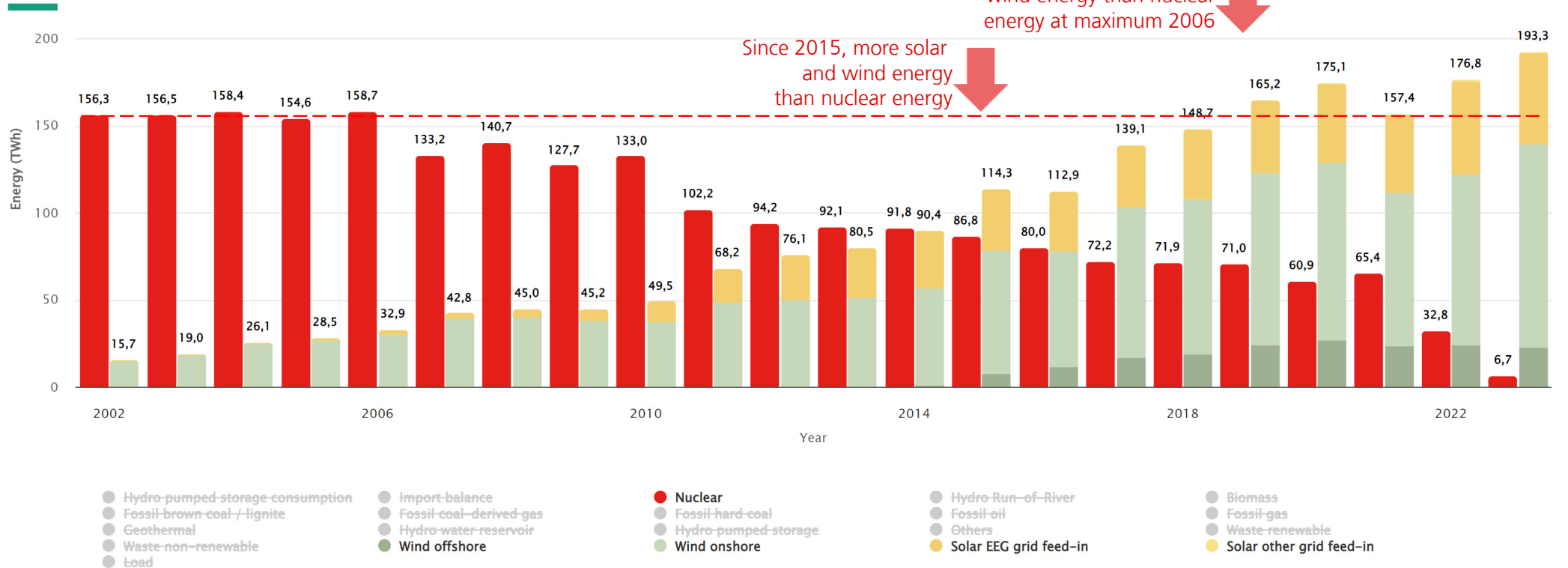


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Source: https://www.energy-charts.info/charts/energy/chart.htm?!=en&c=DE&chartColumnSorting=default&interval=year&year=-1&sum=1&stacking=stacked_grouped

Net public electricity generation from nuclear, solar and wind energy

Year 2002 - 2023

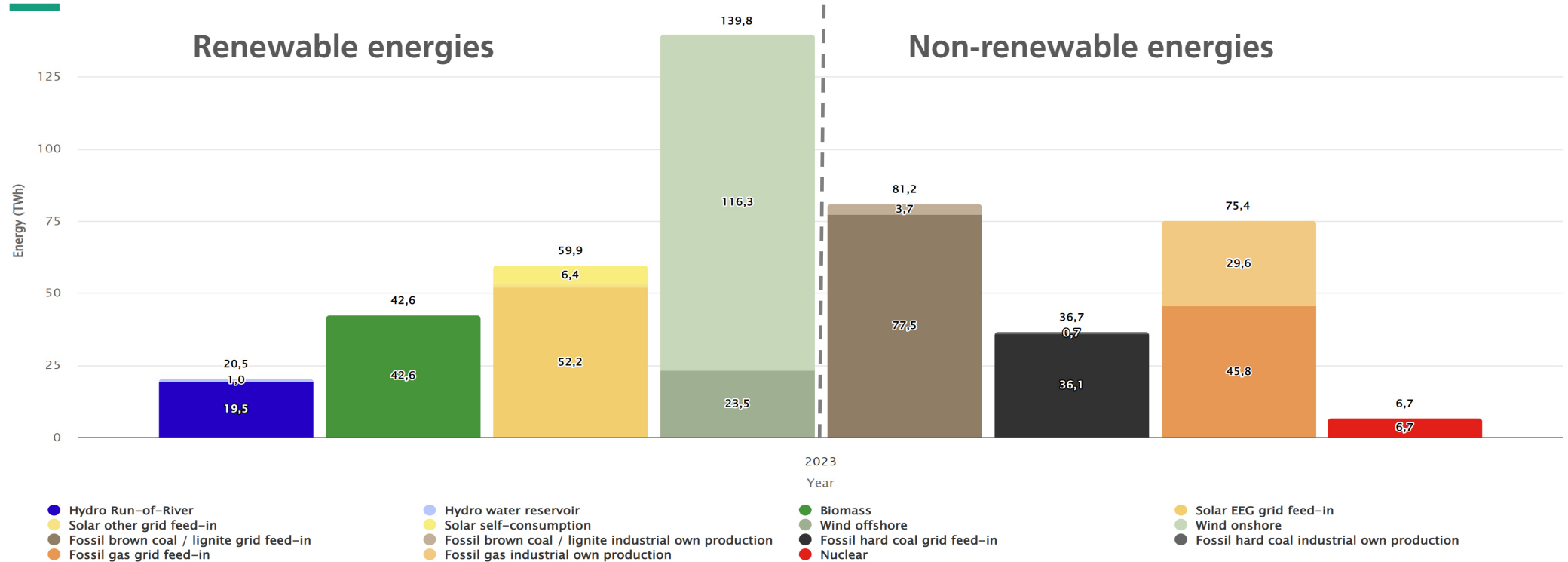


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Source: https://www.energy-charts.info/charts/energy/chart.htm?!=en&c=DE&chartColumnSorting=default&interval=year&year=-1&stacking=stacked_grouped&sum=1

Total net electricity generation

Year 2023



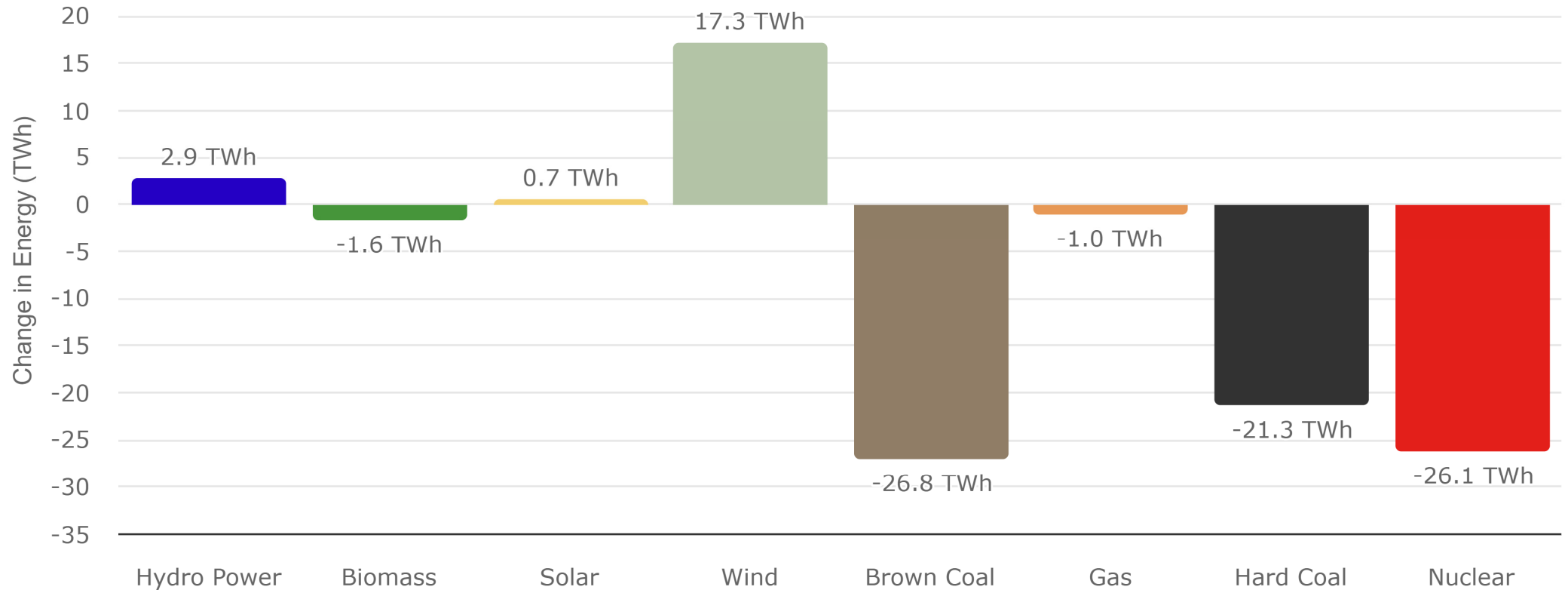
Energy-Charts.info - last update: 10.01.2024, 14:07 MEZ

The chart shows total net electricity generation. This is the sum of net public electricity generation and the generation of "companies in the manufacturing industry and in mining and quarrying" for their own use.

Source: <https://www.energy-charts.info/charts/energy/chart.htm?!=en&c=DE&interval=year&source=total&partsum=1&stacking=single&year=2023>

Absolute change in total net electricity generation

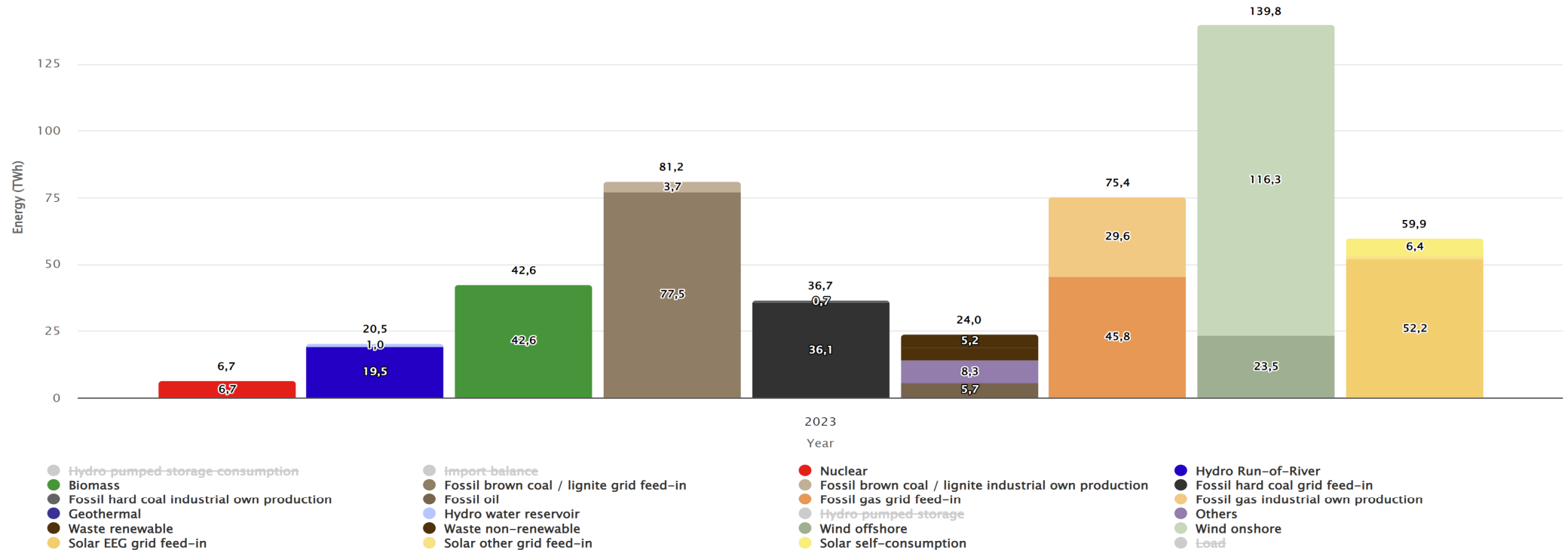
Year 2023 compared to year 2022



Graphic: B. Burger, Fraunhofer ISE; Data: DESTATIS and Leipzig Electricity Exchange EEX, energy-corrected values

Total net electricity generation

Year 2023



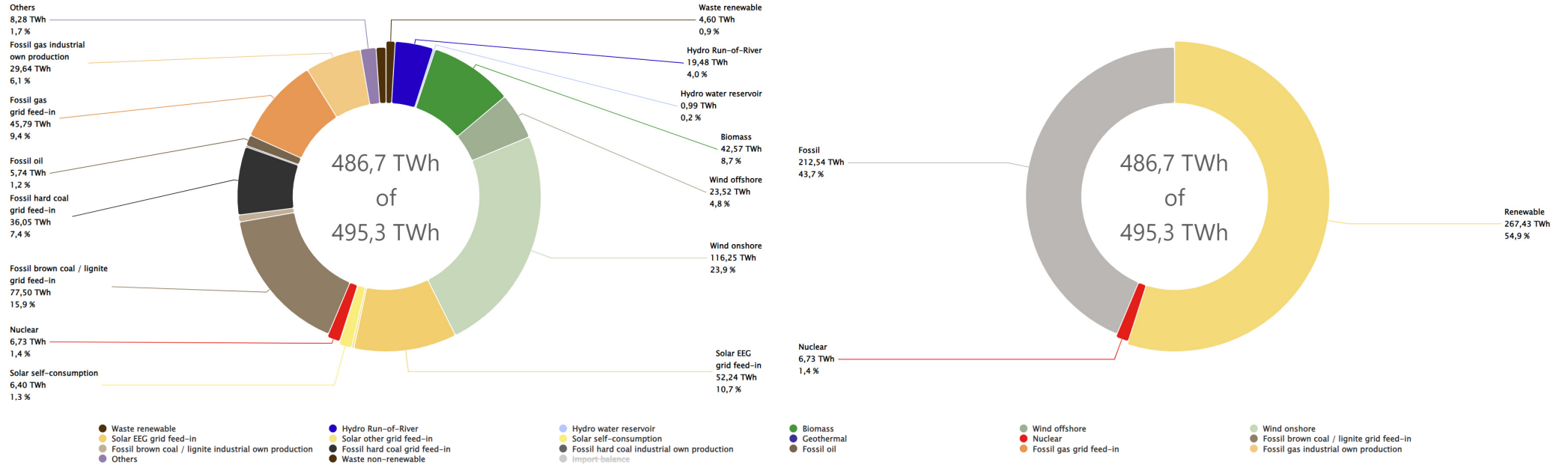
Energy-Charts.info - last update: 10.01.2024, 17:43 MEZ

The chart shows total net electricity generation. This is the sum of net public electricity generation and the generation of "companies in the manufacturing industry and in mining and quarrying" for their own use.

Source: <https://www.energy-charts.info/charts/energy/chart.htm?!=en&c=DE&interval=year&source=total&partsum=1&stacking=single&year=2023>

Total net electricity generation

Year 2023



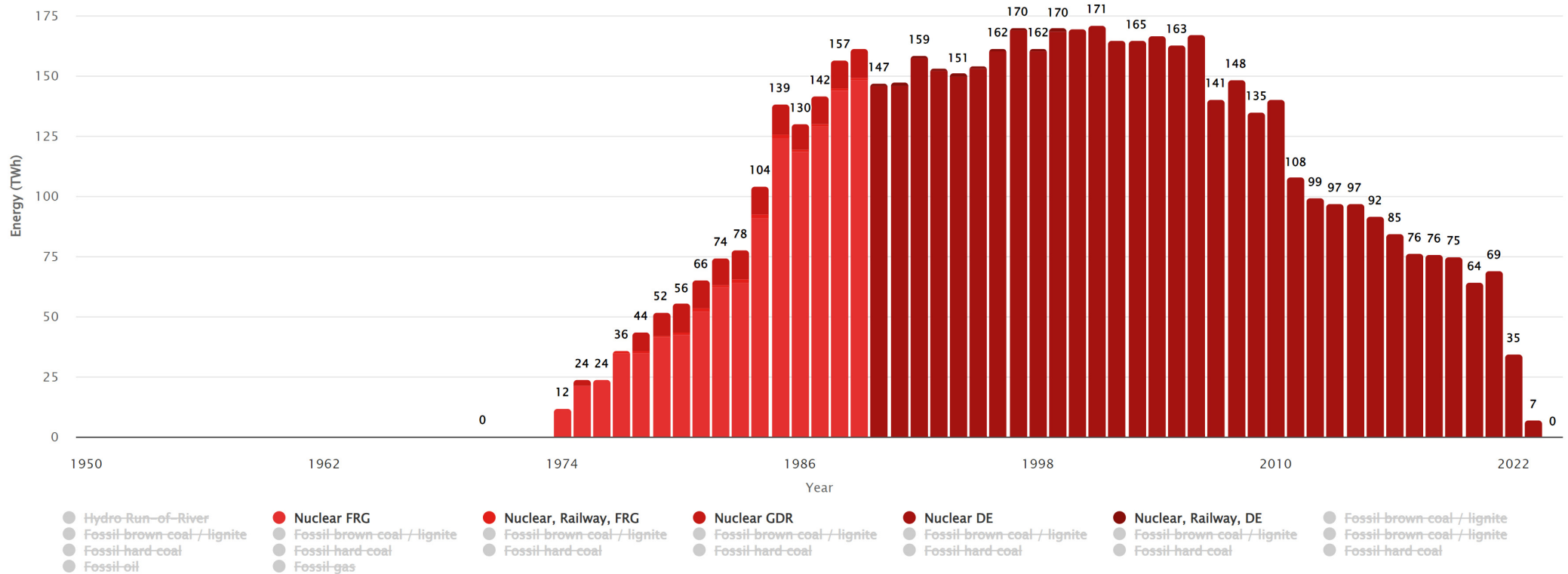
Energy-Charts.info - last update: 10.01.2024, 17:43 MEZ

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Quelle: https://www.energy-charts.info/charts/energy_pie/chart.htm?l=de&c=DE&interval=year&source=total

Gross electricity generation from nuclear energy

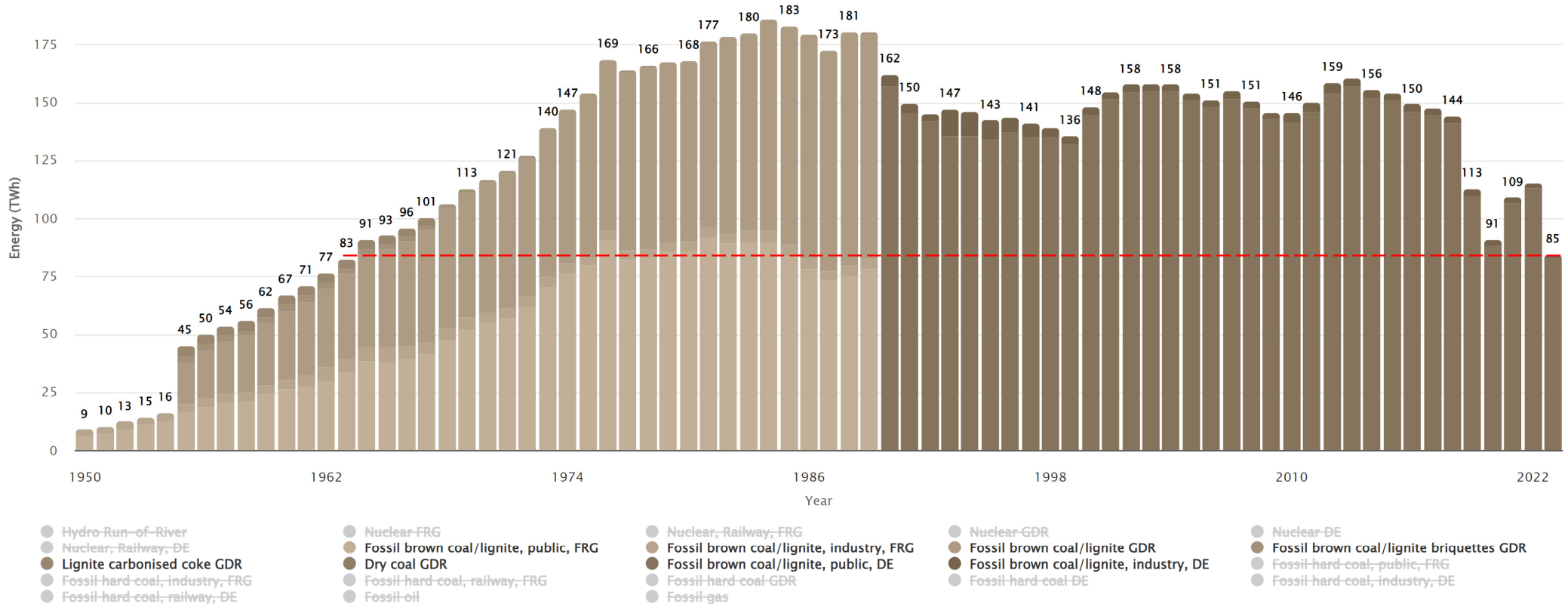
Year 1950 to 2023



Energy-Charts.info - last update: 01.01.2024, 19:52 MEZ

Gross electricity generation from lignite

Year 1950 to 2023

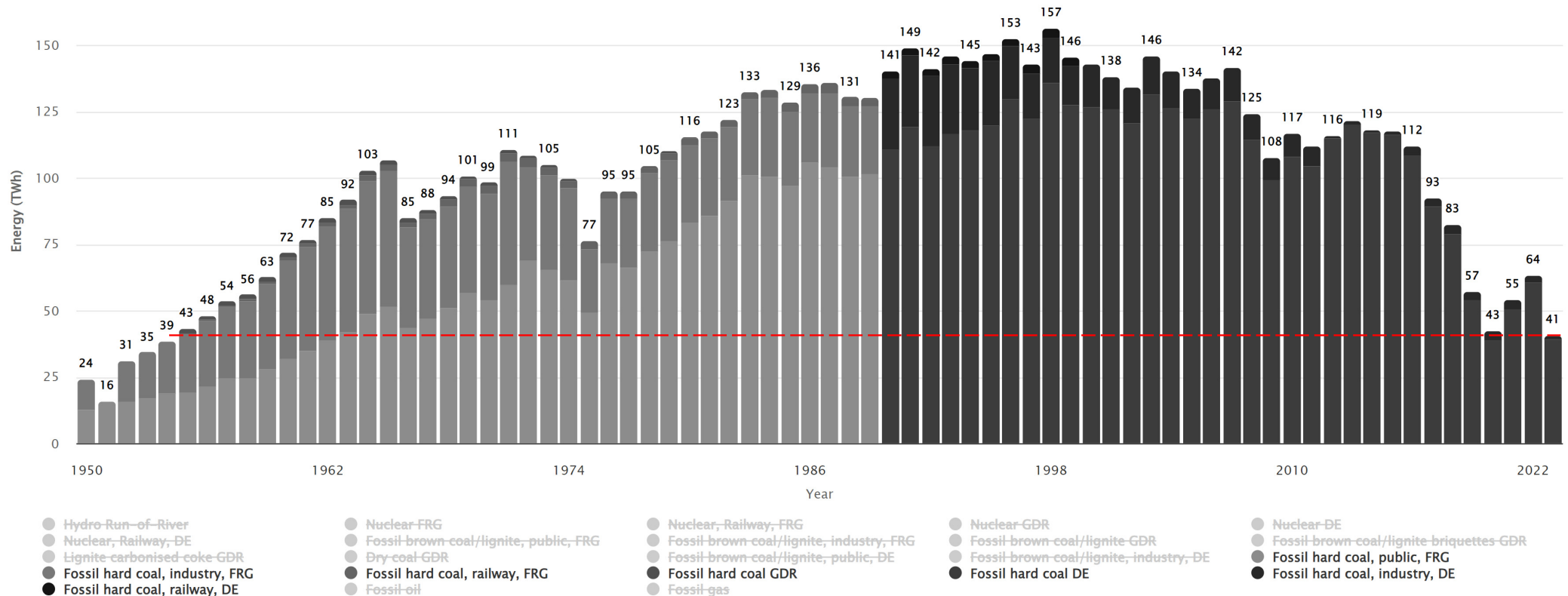


Energy-Charts.info - last update: 01.01.2024, 19:52 MEZ

Gross electricity generation from lignite in 2023 was at the same level as in 1963.

Gross electricity generation from hard coal

Year 1950 to 2023



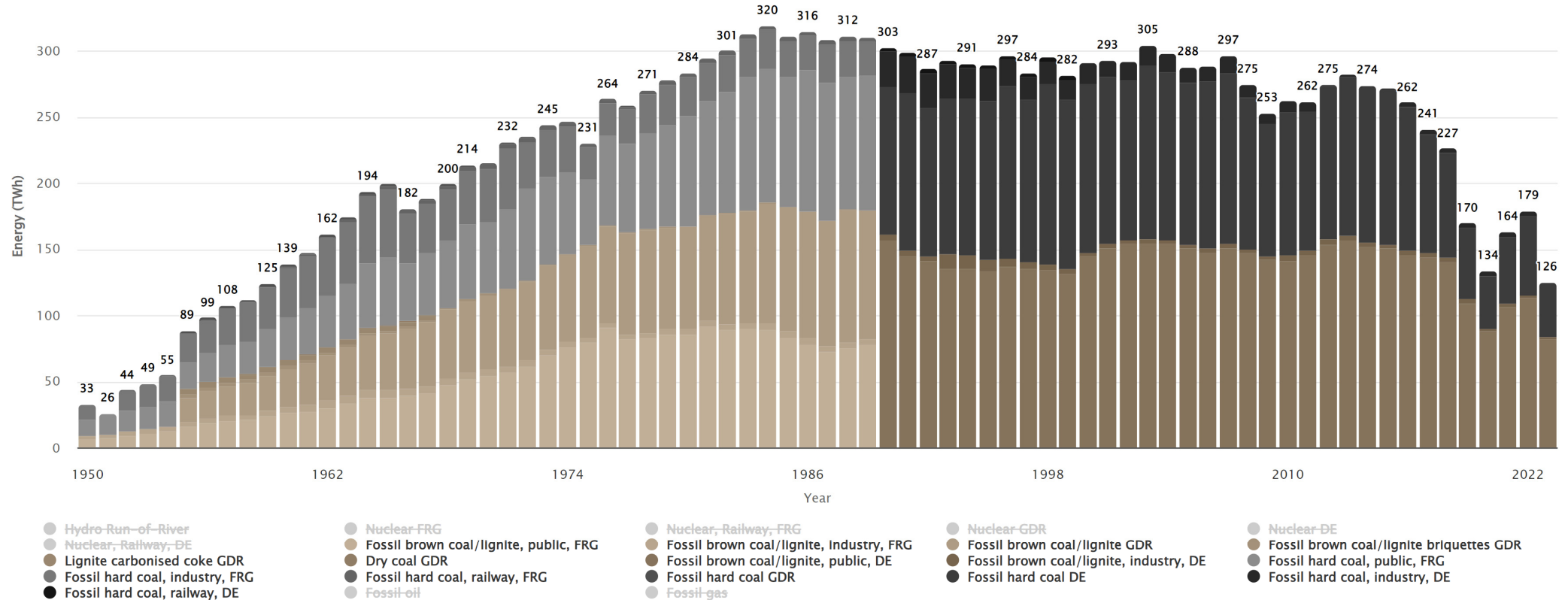
Energy-Charts.info - last update: 01.01.2024, 19:52 MEZ

Gross electricity generation from hard coal in 2023 was at the level of 1955.

25

Gross electricity generation from lignite and hard coal

Year 1950 to 2023

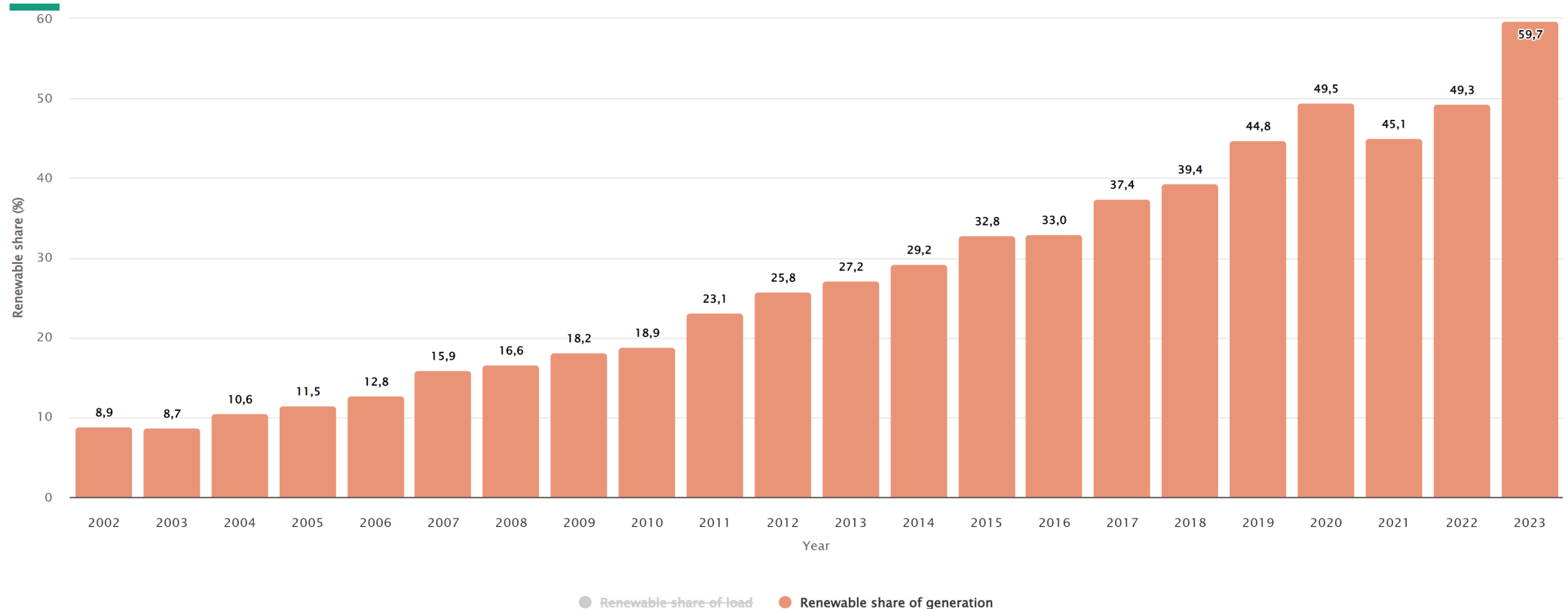


Energy-Charts.info - last update: 01.01.2024, 19:52 MEZ

Gross electricity generation from coal in 2023 was at the same level as in 1959.

Share of renewable energies in net public electricity generation

Year 2002 to 2023

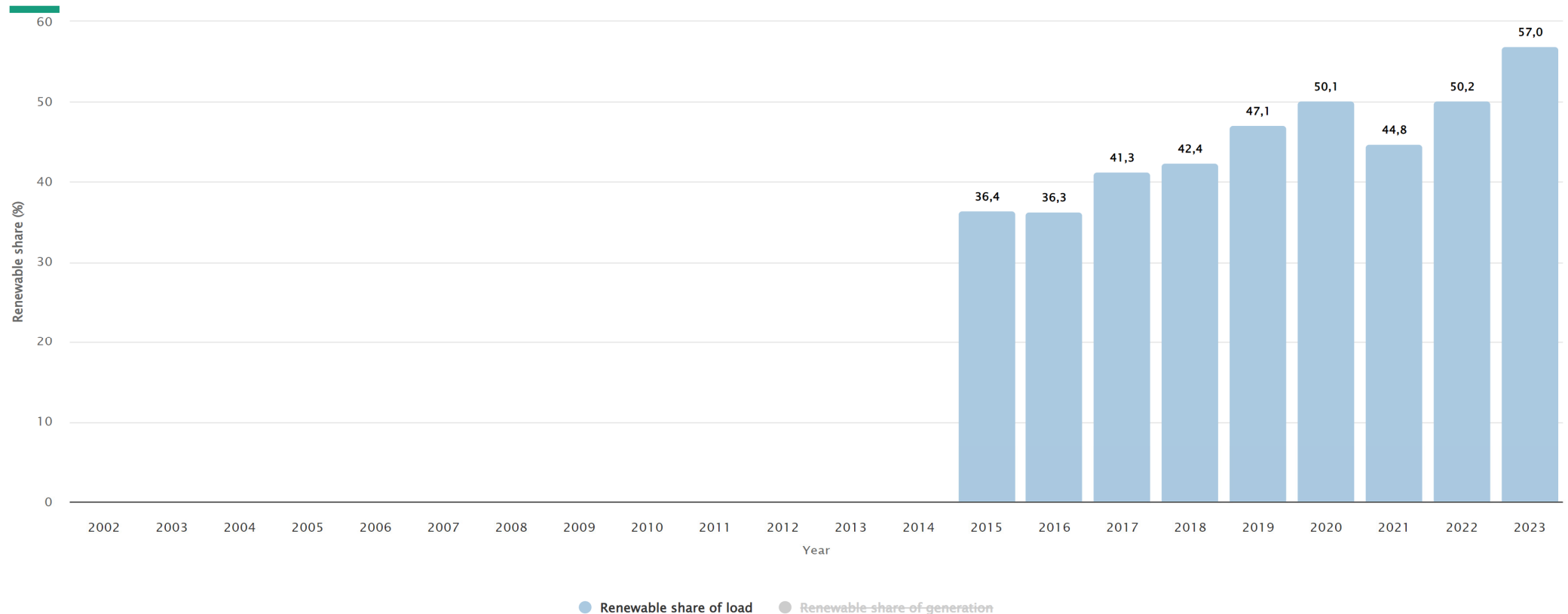


Energy-Charts.info - last update: 10.01.2024, 18:48 MEZ

Source: https://www.energy-charts.info/charts/renewable_share/chart.htm?l=en&c=DE&interval=year&legendItems=01&share=ren_share

Share of renewable energies in the load (electricity consumption + grid losses)

Year 2015 to 2023

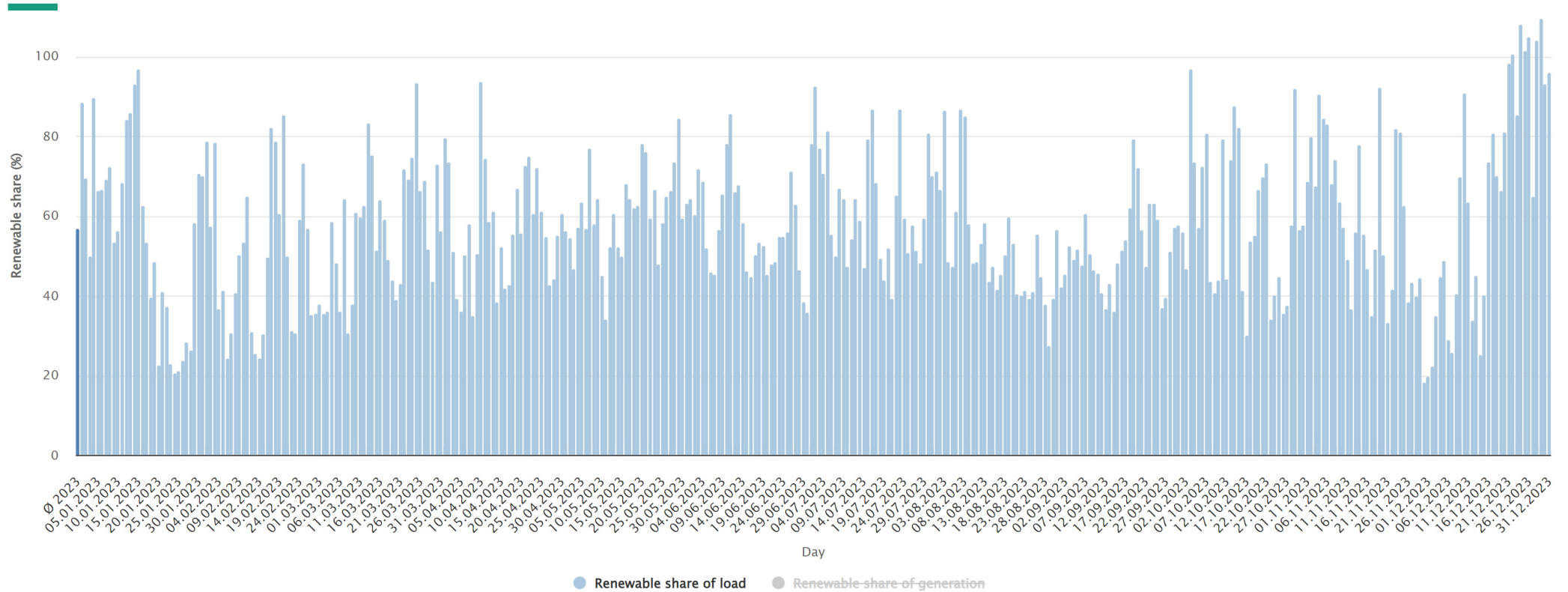


Energy-Charts.info - last update: 10.01.2024, 18:48 MEZ

Source: https://www.energy-charts.info/charts/renewable_share/chart.htm?l=en&c=DE&interval=year&sum=0&partsum=1&legendItems=01

Daily share of renewable energies in the load

Year 2023

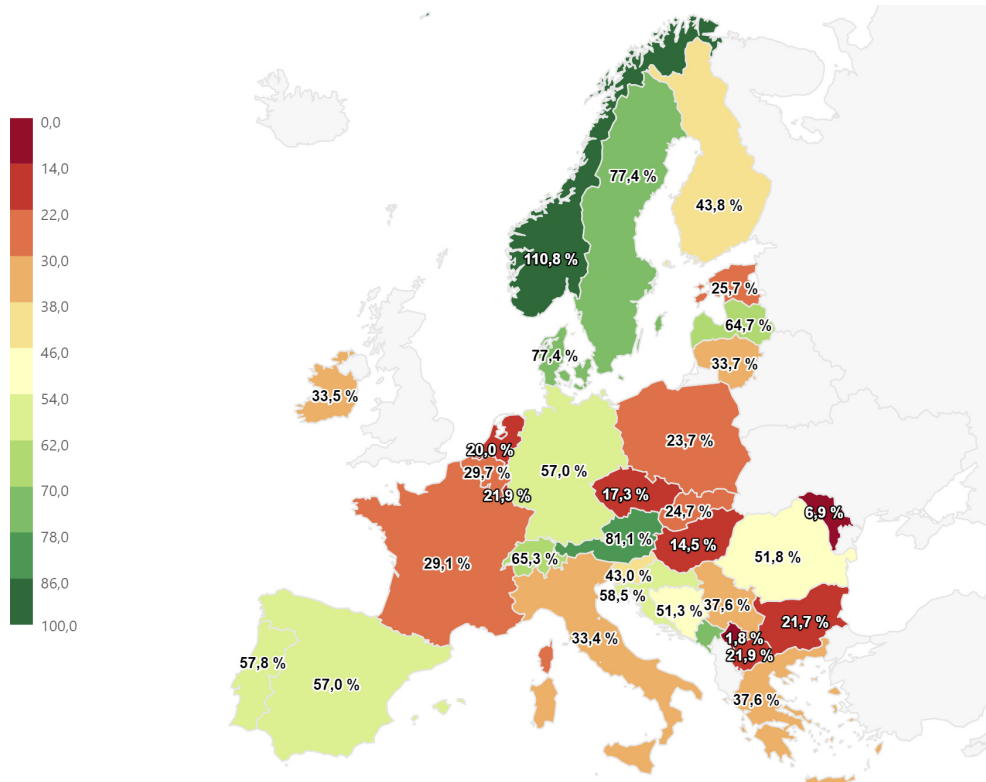


Energy-Charts.info - last update: 10.01.2024, 18:49 MEZ

Source: https://www.energy-charts.info/charts/renewable_share/chart.html?l=en&c=DE&interval=day&sum=0&partsum=0&legendItems=01

Share of renewable energies in the electrical load in Europe

Year 2023



Energy-Charts.info; Last Update: 10.01.2024, 18:55 MEZ

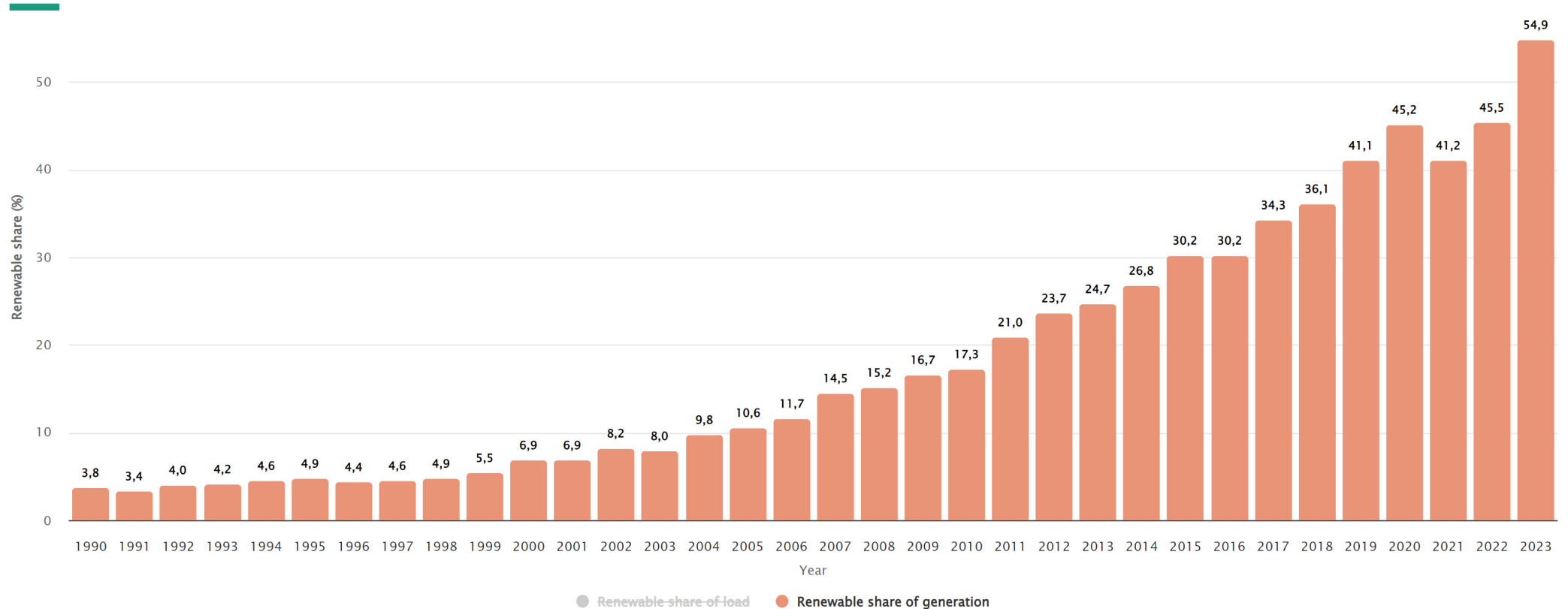
Norway	110.8%
Austria	81.1%
Denmark	77.4%
Sweden	77.4%
Montenegro	71.7%
Georgia	70.8%
Switzerland	65.3%
Latvia	64.7%
Croatia	58.5%
Portugal	57.8%
Germany	57.1%
Spain	57.0%
Romania	51.8%
Bosnia-Herzegovina	50.1%

Finland	43.8%
Slovenia	43.0%
Greece	37.6%
Serbia	37.6%
Lithuania	33.7%
Ireland	33.5%
Italy	33.4%
Belgium	29.7%
France	29.1%
Estonia	25.7%
Slovakia	24.7%
Poland	23.7%
Luxembourg	21.9%
North Macedonia	21.9%
Bulgaria	21.7%
The Netherlands	20.0%
Czech Republic	17.3%
Hungary	14.5%
Moldova	6.9%
Kosovo	1.8%

Source: https://www.energy-charts.info/charts/renewable_share_map/chart.html?l=en&c=DE&interval=year&year=2023

Share of renewable energies in total net electricity generation

Year 1990 to 2023

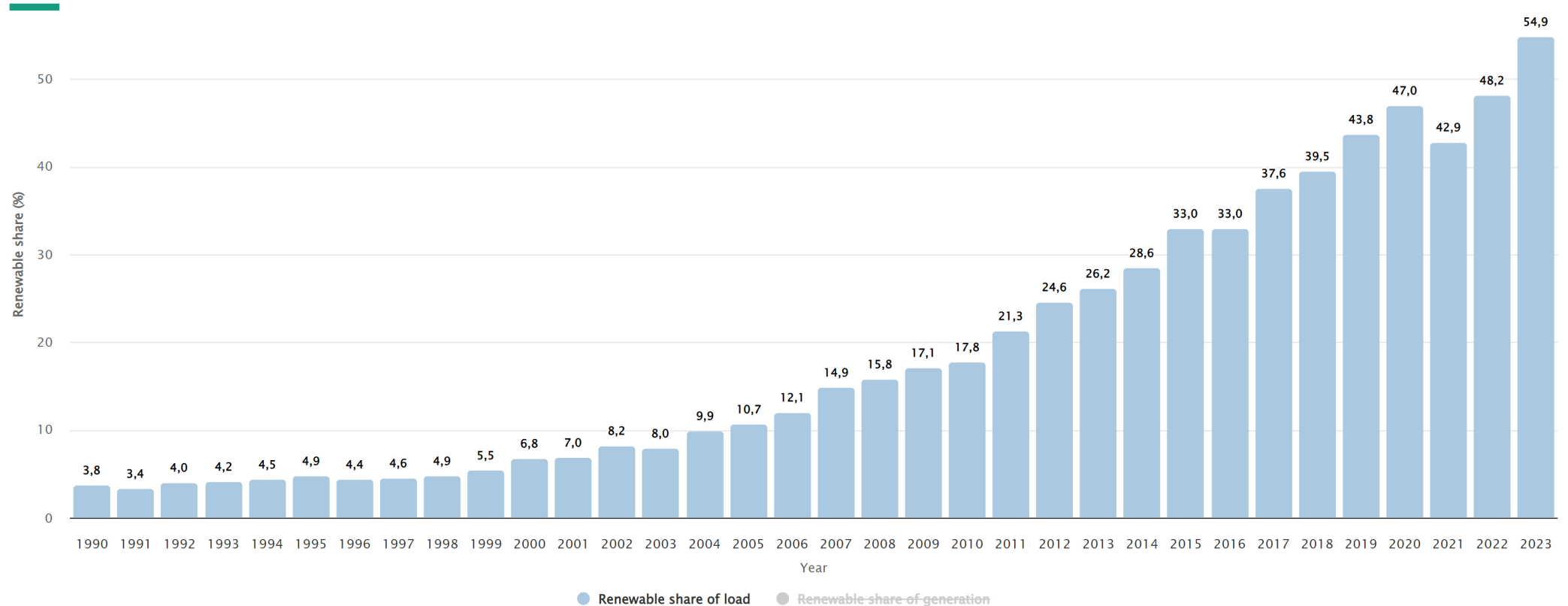


Energy-Charts.info - last update: 10.01.2024, 18:42 MEZ

Source: https://www.energy-charts.info/charts/renewable_share/chart.htm?l=en&c=DE&interval=year&share=ren_share_total&legendItems=01

Share of renewable energies in total load

Year 1990 to 2023

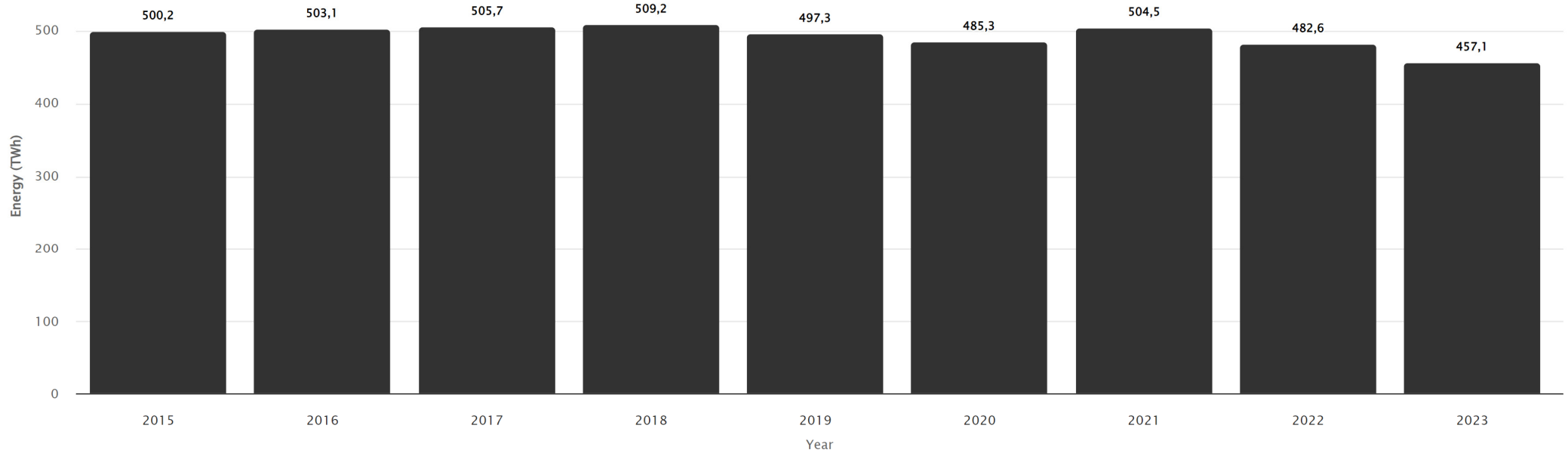


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Source: https://www.energy-charts.info/charts/renewable_share/chart.htm?l=en&c=DE&interval=year&share=ren_share_total&legendItems=10

Load (power consumption + grid losses)

Year 2015 to 2023



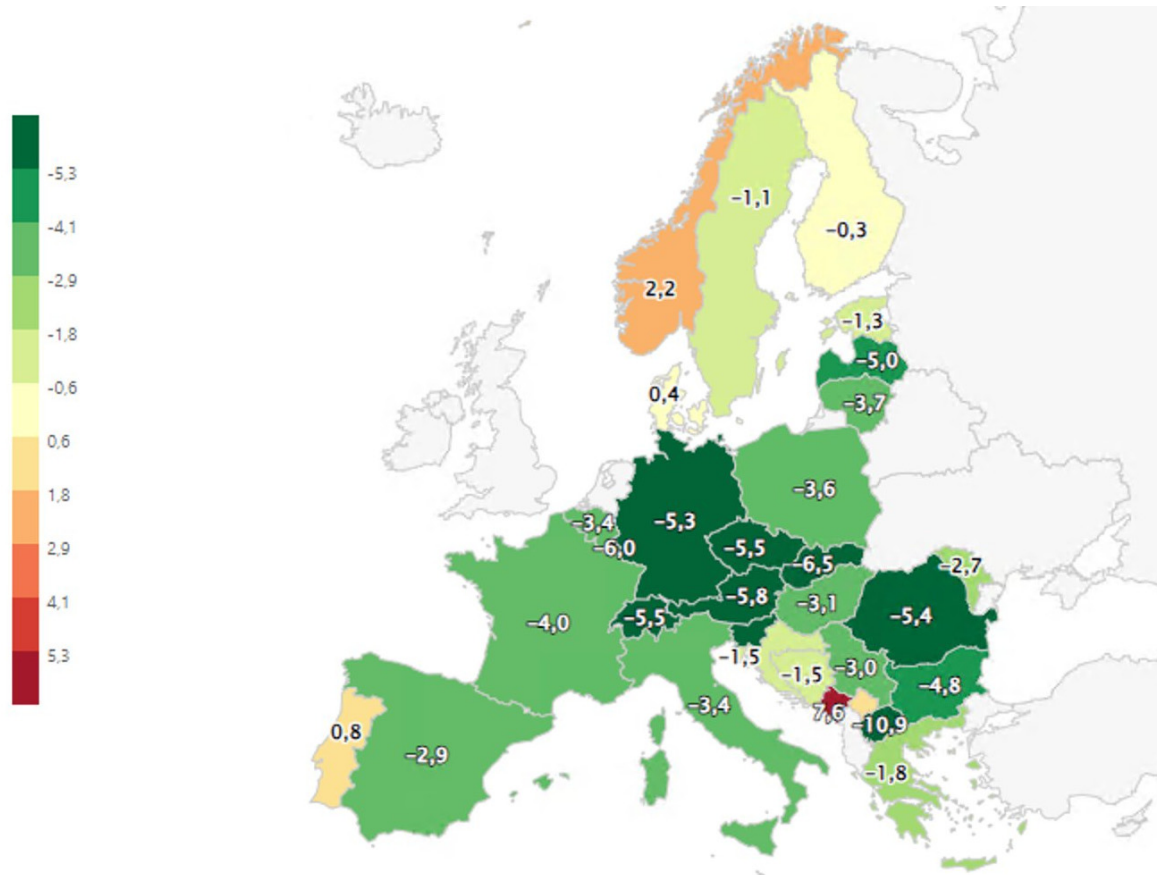
- Hydro-pumped-storage-consumption
- Fossil-brown-coal-/lignite
- Geothermal
- Waste-non-renewable
- Load
- Import-balance
- Fossil-coal-derived-gas
- Hydro-water-reservoir
- Wind-offshore
- Nuclear
- Fossil-hard-coal
- Hydro-pumped-storage
- Wind-onshore
- Hydro-Run-of-River
- Fossil-oil
- Others
- Solar-EEG-grid-feed-in
- Biomass
- Fossil-gas
- Waste-renewable
- Solar-other-grid-feed-in

Energy-Charts.info - last update: 10.01.2024, 18:48 MEZ

Source: <https://www.energy-charts.info/charts/energy/chart.htm?!=en&c=DE&interval=year&year=-1&chartColumnSorting=default&sum=1>

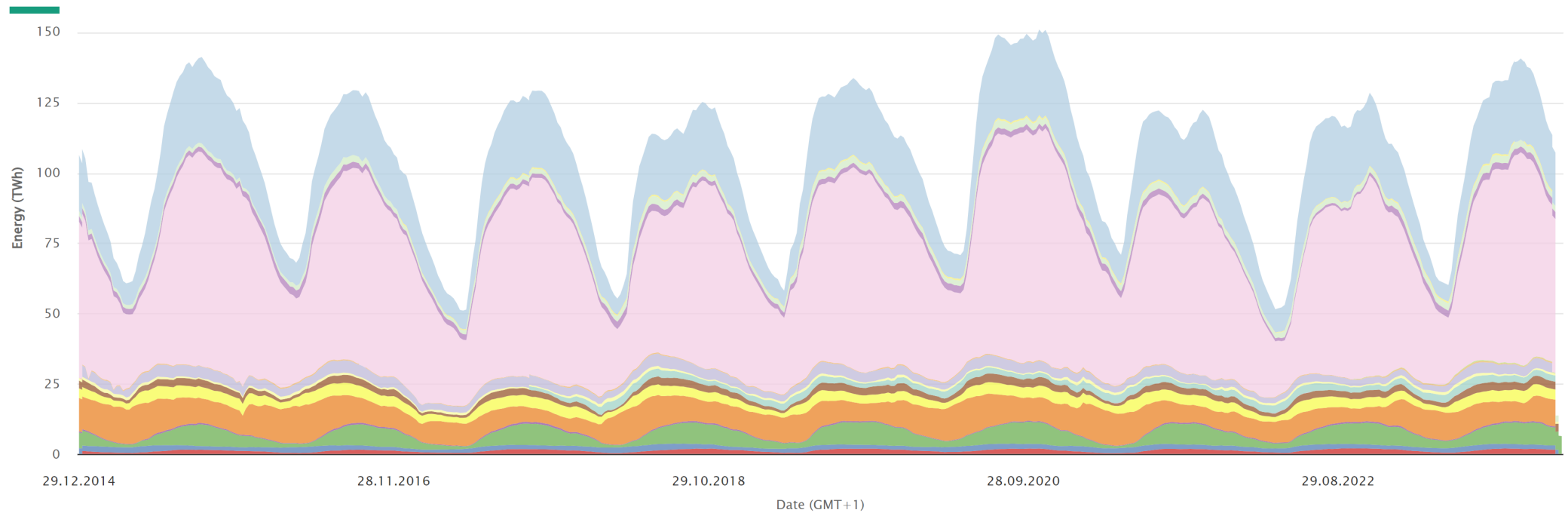
Percentage change in load (power consumption + grid losses)

Year 2023 compared to 2022



Filling level of storage water and pumped storage power plants in Europe

Year 2015 to 2023



- Austria
- Bulgaria
- Switzerland
- Germany
- Spain
- Finland
- France
- Georgia
- Greece
- Croatia
- Italy
- Lithuania
- Latvia
- Montenegro
- North Macedonia
- Norway
- Portugal
- Romania
- Serbia
- Slovenia
- Sum
- Sweden

Energy-Charts.info - last update: 10.01.2024, 04:54 MEZ

Source: https://www.energy-charts.info/charts/filling_level/chart.htm?l=en&c=ALL&stacking=stacked_absolute_area

Full load hours of offshore wind, onshore wind and solar

Year 2015 to 2023

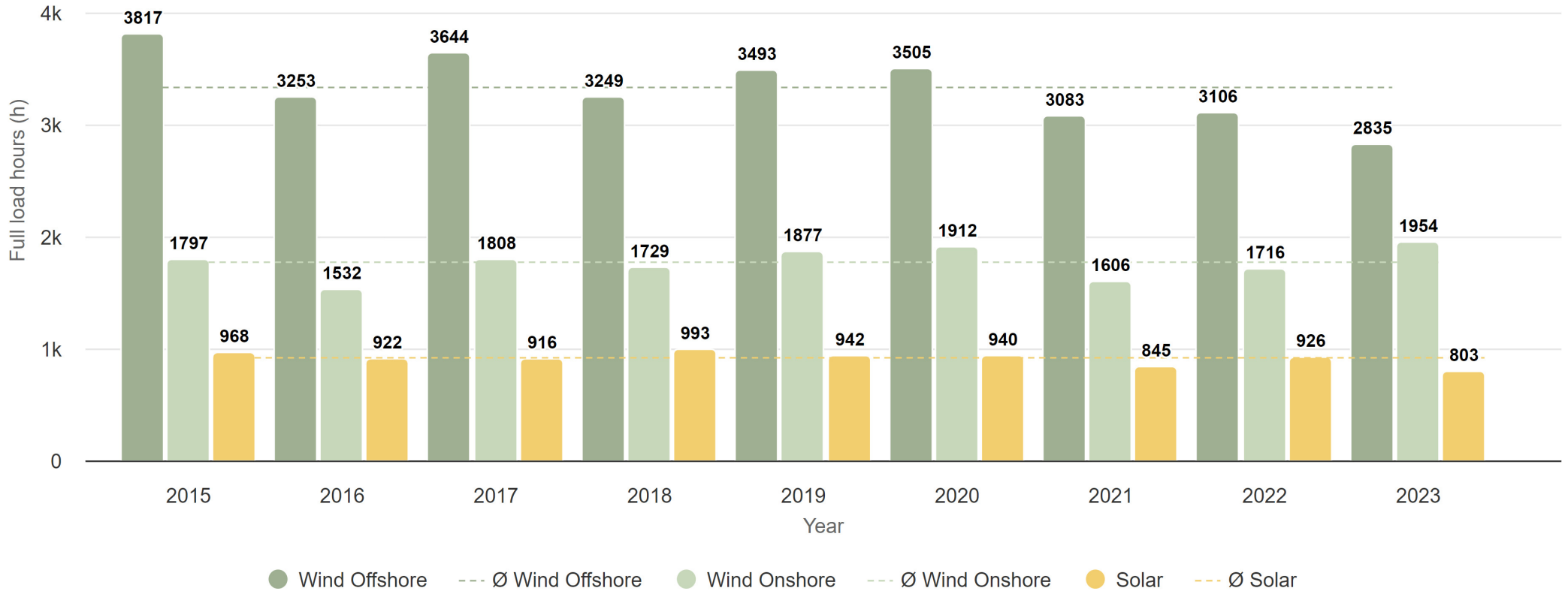


Chart: B. Burger, Fraunhofer ISE

*Data on total electricity generation

Full load hours of nuclear energy, lignite, hard coal and natural gas

Year 2015 to 2023

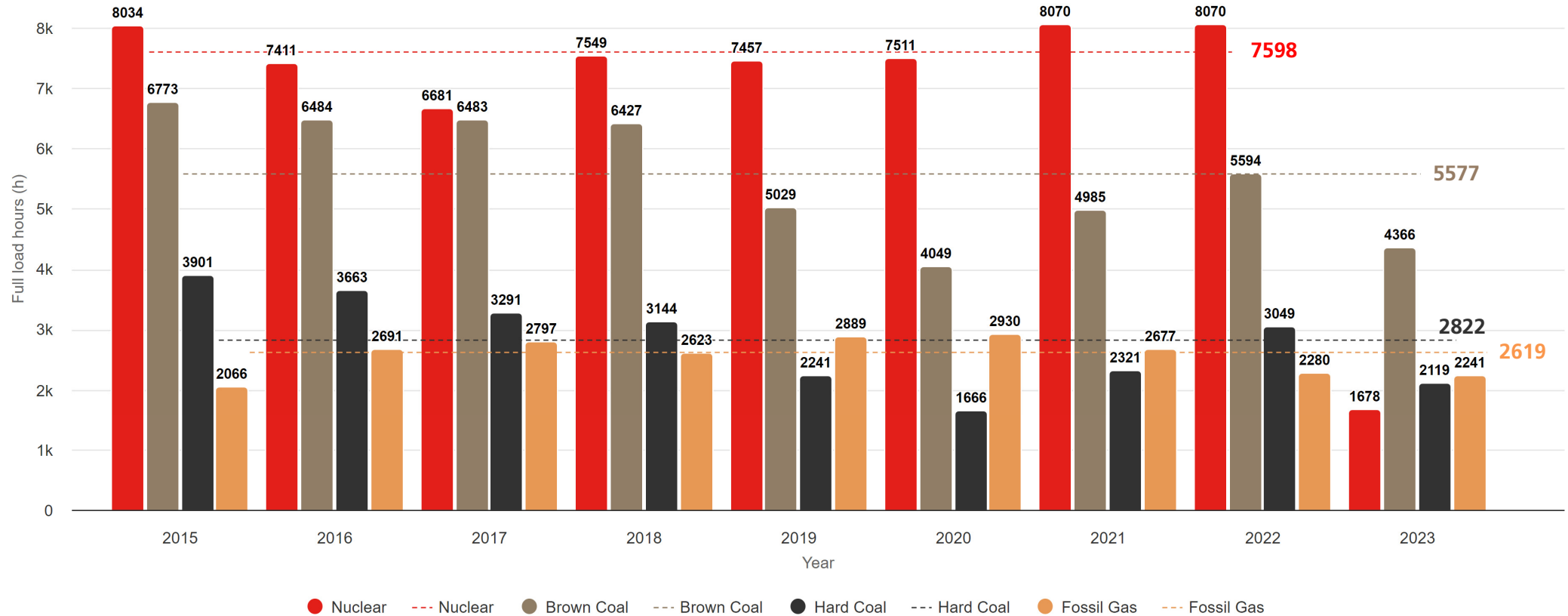


chart: B. Burger, Fraunhofer ISE

*Data on total electricity generation

Percentage full load hours of offshore wind, onshore wind and solar

Year 2015 to 2023

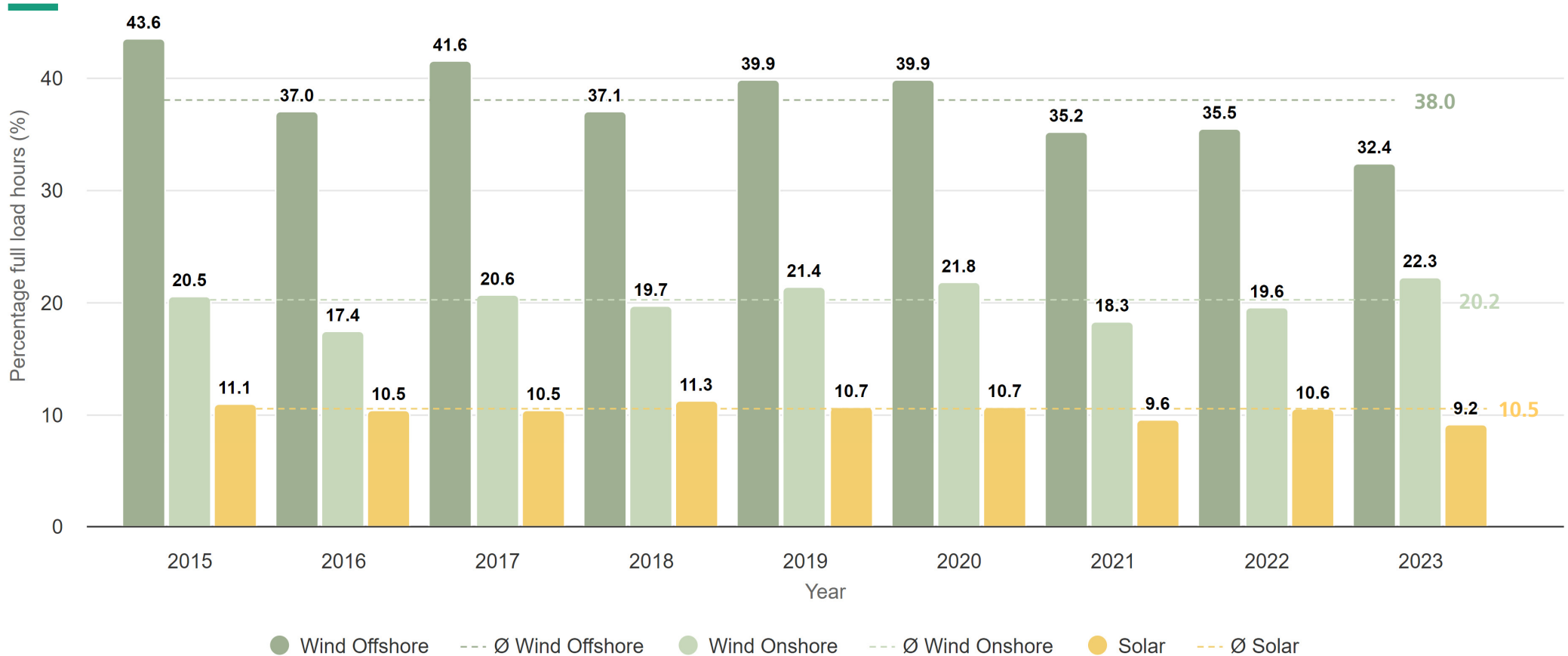


Chart: B. Burger, Fraunhofer ISE

*Data on total electricity generation

Percentage full load hours of nuclear energy, lignite, hard coal, natural gas

Year 2015 to 2023

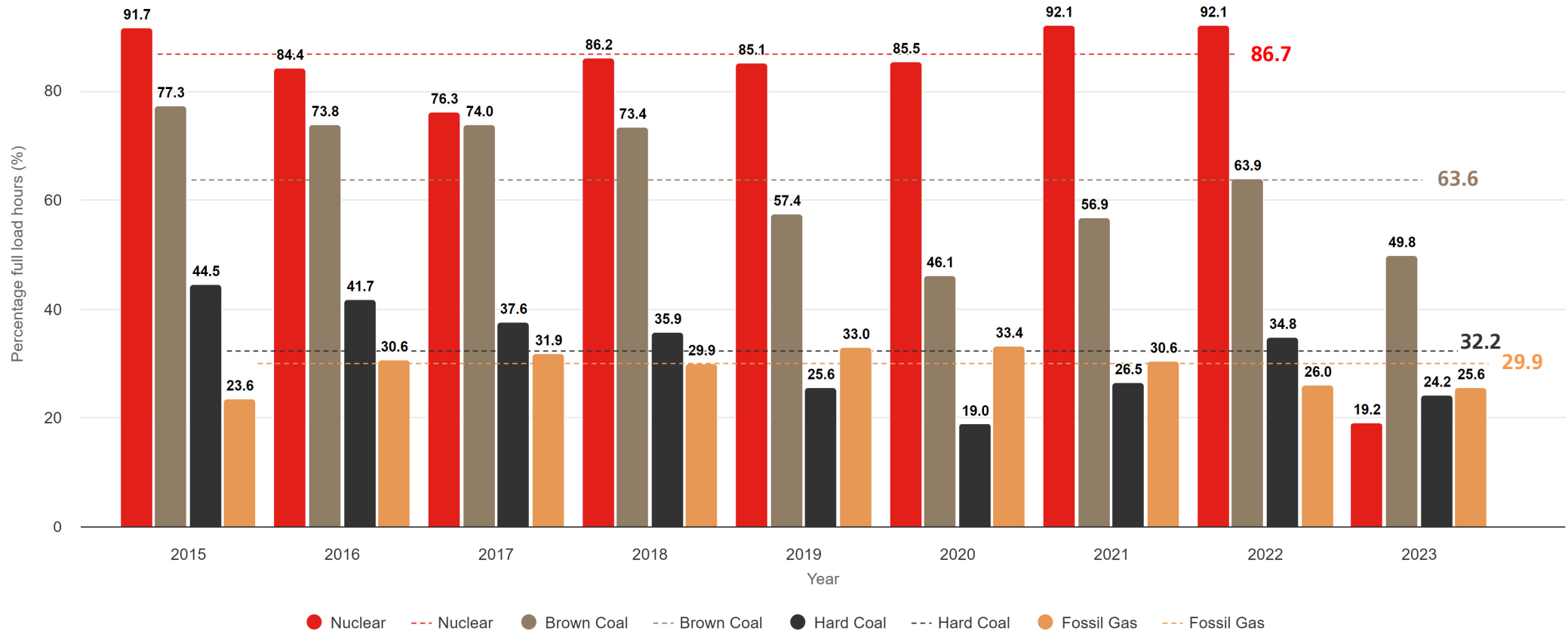
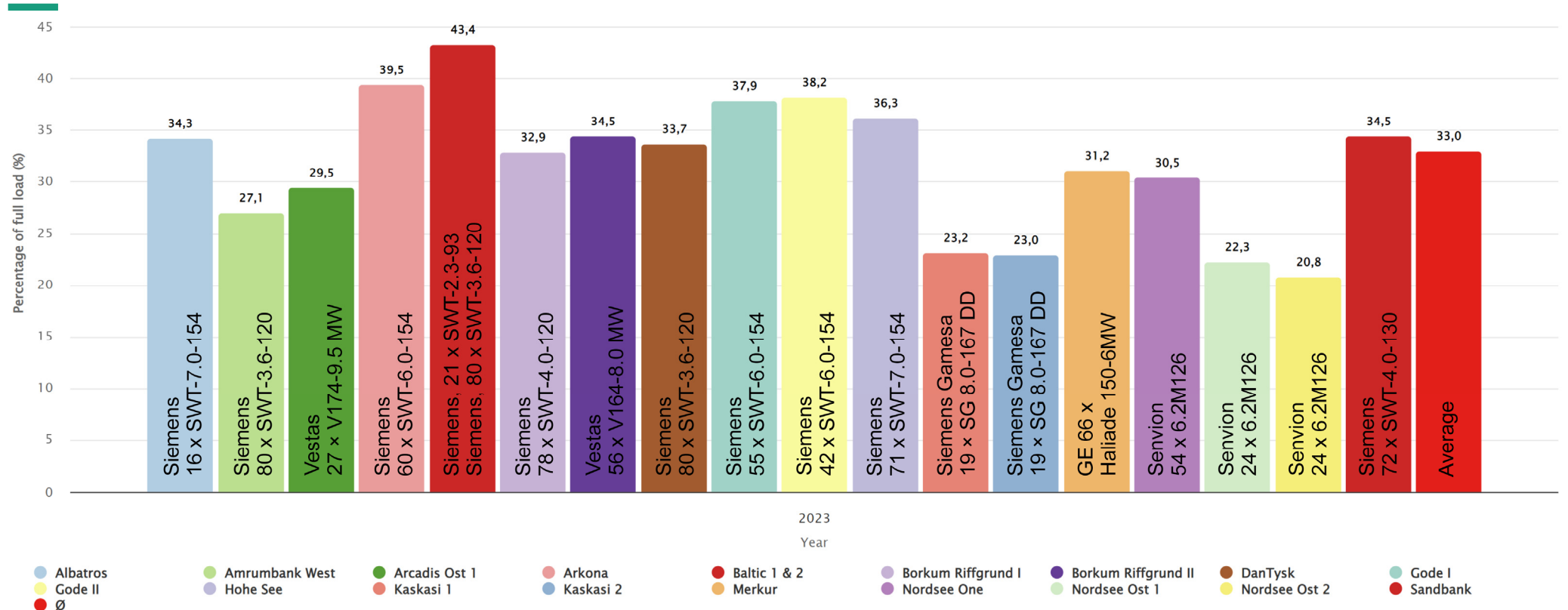


Chart: B. Burger, Fraunhofer ISE

*Data on total electricity generation

Percentage full load hours of offshore wind

Year 2023



Source: https://www.energy-charts.info/charts/percentage_full_load/chart.html?l=en&c=DE&chartColumnSorting=default&source=wind_offshore_unit_eex&partsum=1&year=2023

Monthly wind power generation onshore and offshore

Year 2023



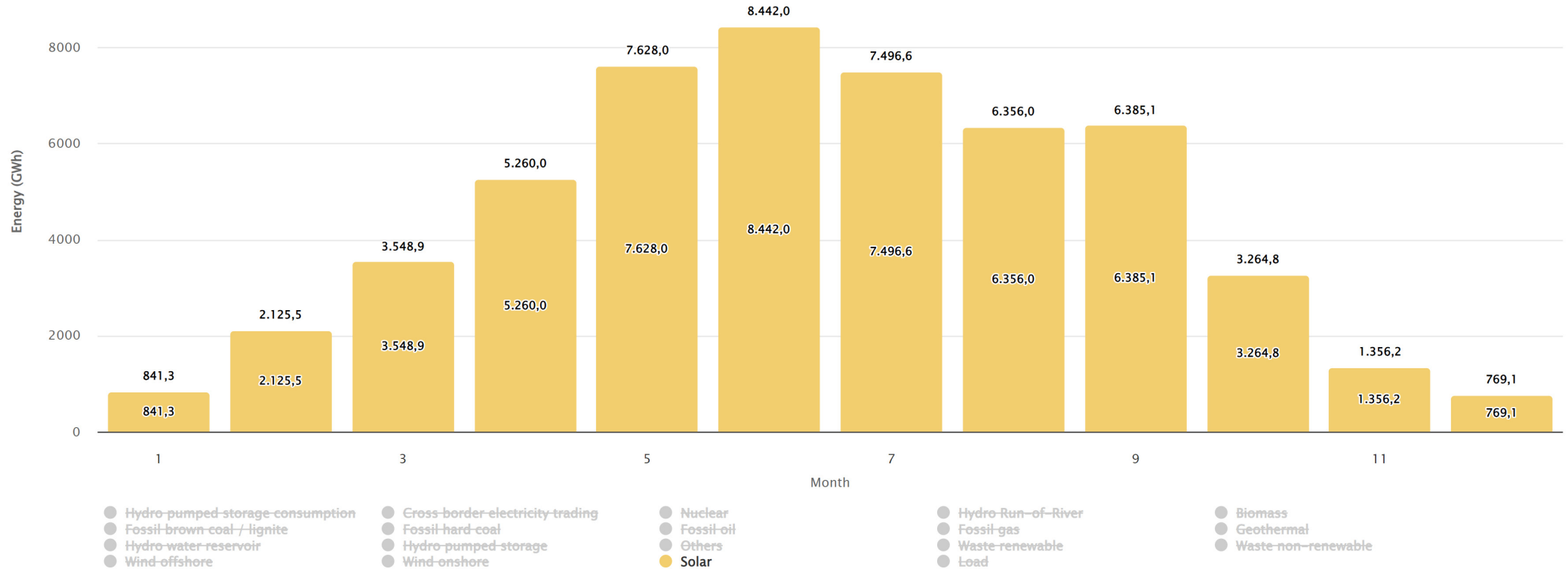
Energy-Charts.info - last update: 11.01.2024, 14:52 MEZ

Source: https://www.energy-charts.info/charts/energy/chart.htm?l=en&c=DE&month=-1&stacking=stacked_grouped&year=2023&partsum=1

*Data on public power generation

Monthly solar power generation

Year 2023



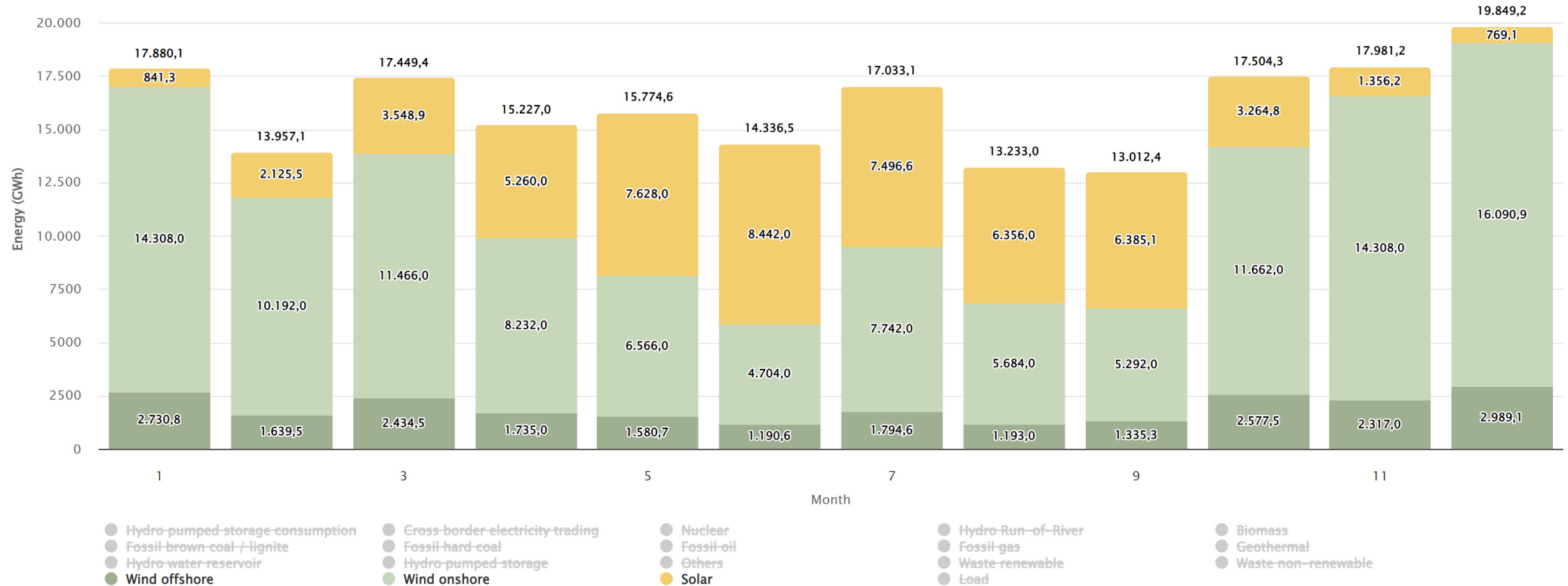
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Source: https://www.energy-charts.info/charts/energy/chart.htm?l=en&c=DE&month=-1&stacking=stacked_grouped&year=2023&partsum=1

*Data on public power generation

Monthly wind and solar power generation

Year 2023



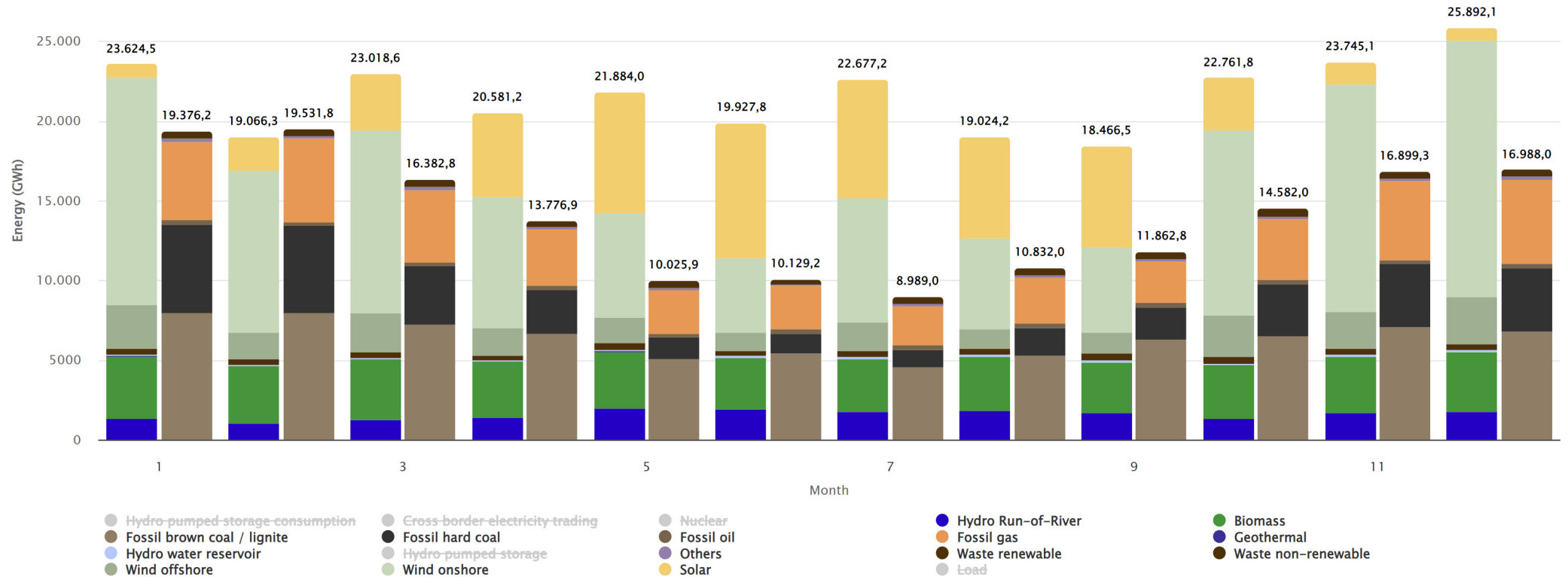
Energy-Charts.info - last update: 11.01.2024, 14:52 MEZ

Source: https://www.energy-charts.info/charts/energy/chart.htm?l=en&c=DE&month=-1&stacking=stacked_grouped&year=2023&partsum=1

*Data on public power generation

Monthly renewable and fossil power generation

Year 2023



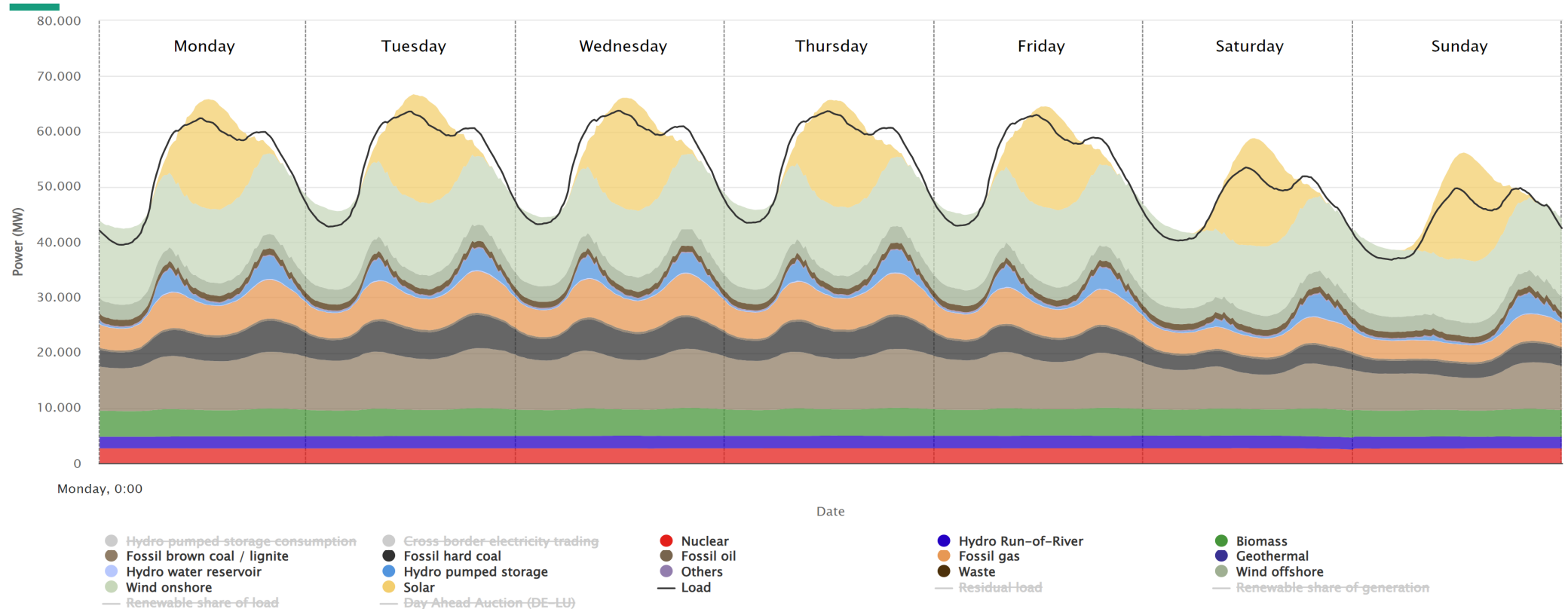
Energy-Charts.info - last update: 11.01.2024, 14:52 MEZ

Source: https://www.energy-charts.info/charts/energy/chart.htm?l=en&c=DE&month=-1&stacking=stacked_grouped&year=2023

*Data on public power generation

Average power generation in one week

Year 2023



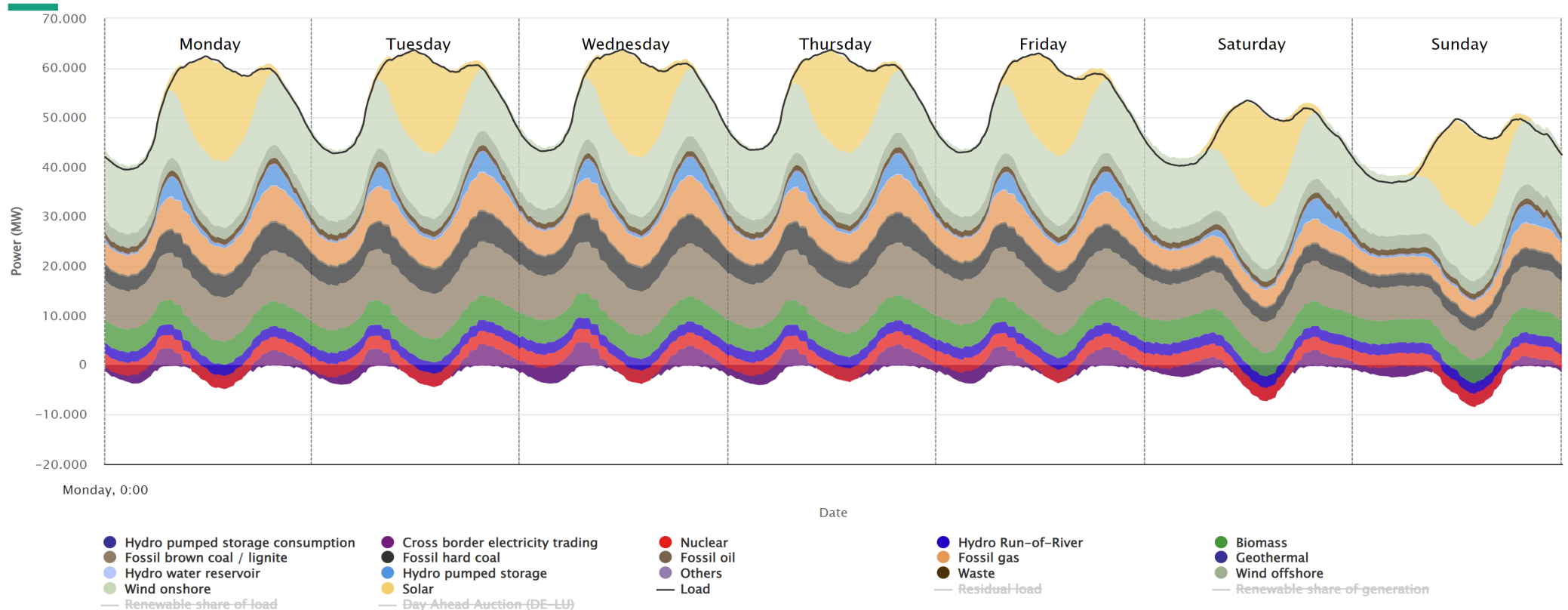
Energy-Charts.info - last update: 11.01.2024, 14:46 MEZ

Source: <https://www.energy-charts.info/charts/power/chart.html?l=en&c=DE&week=-2&year=2023>

*Data on public power generation

Average power generation in one week

Year 2023; with import/export and generation/consumption of pumped storage

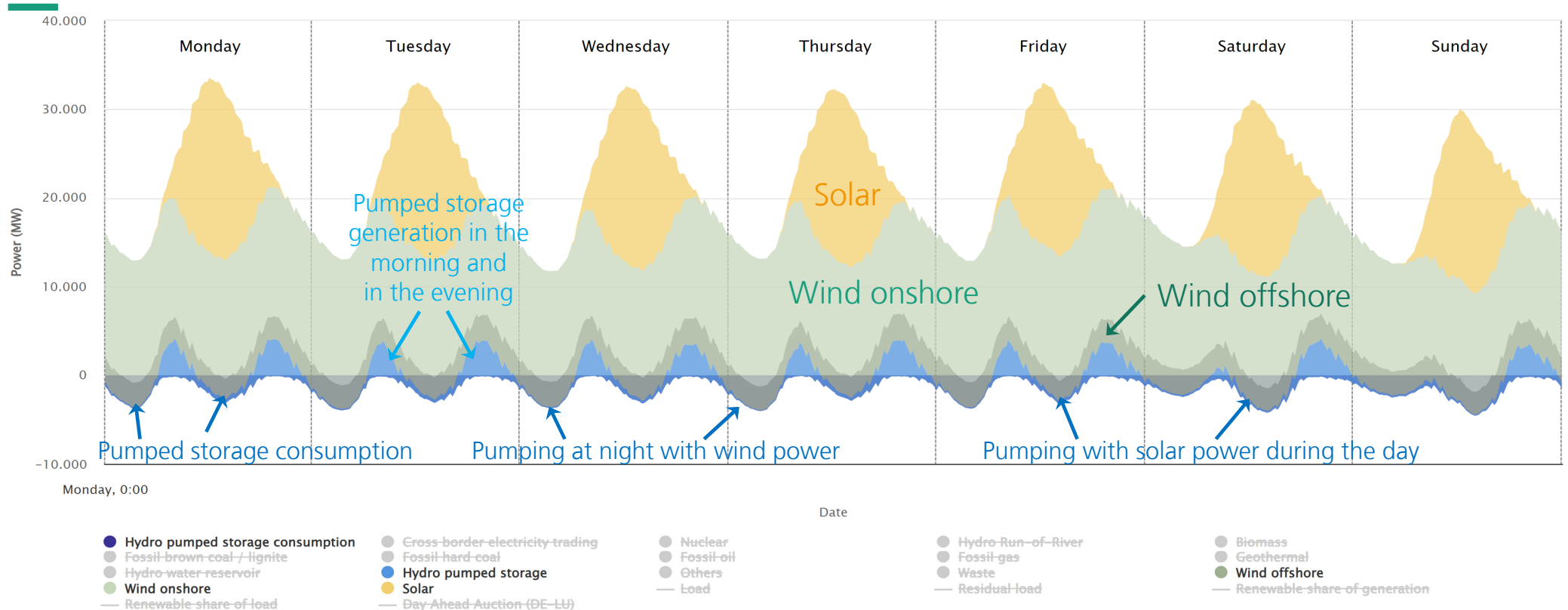


Source: <https://www.energy-charts.info/charts/power/chart.html?l=en&c=DE&week=-2&year=2023&legendItems=11111111111111110000>

*Data on public power generation

Average power generation in one week

Year 2023; solar, wind, pumped storage generation and pumped storage consumption



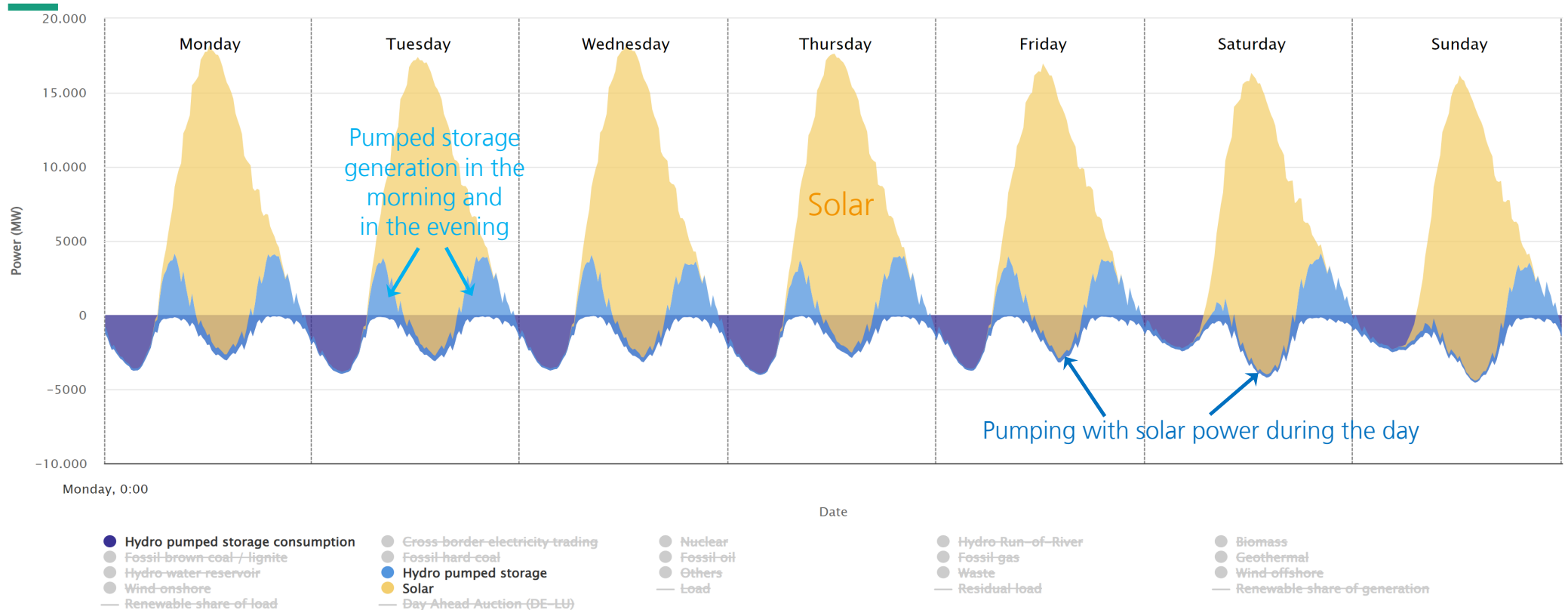
Energy-Charts.info - last update: 11.01.2024, 14:46 MEZ

Source: <https://www.energy-charts.info/charts/power/chart.htm?l=en&c=DE&week=-2&year=2023&legendItems=100000000010011100000>

*Data on public power generation

Average power generation in one week

Year 2023; solar, pumped storage generation and pumped storage consumption



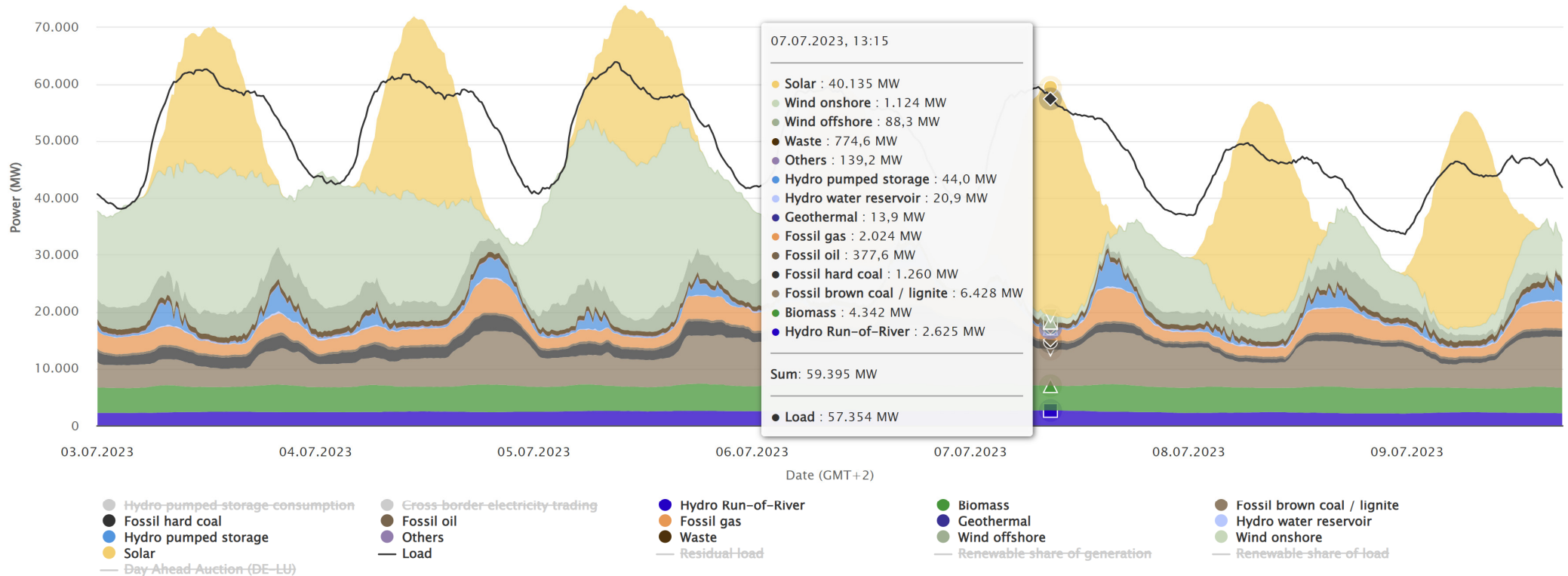
Energy-Charts.info - last update: 11.01.2024, 14:46 MEZ

Source: <https://www.energy-charts.info/charts/power/chart.htm?l=en&c=DE&week=-2&year=2023&legendItems=1000000000010000100000>

*Data on public power generation

Highest power generation from solar energy

Year 2023



Energy-Charts.info - last update: 11.01.2024, 14:46 MEZ

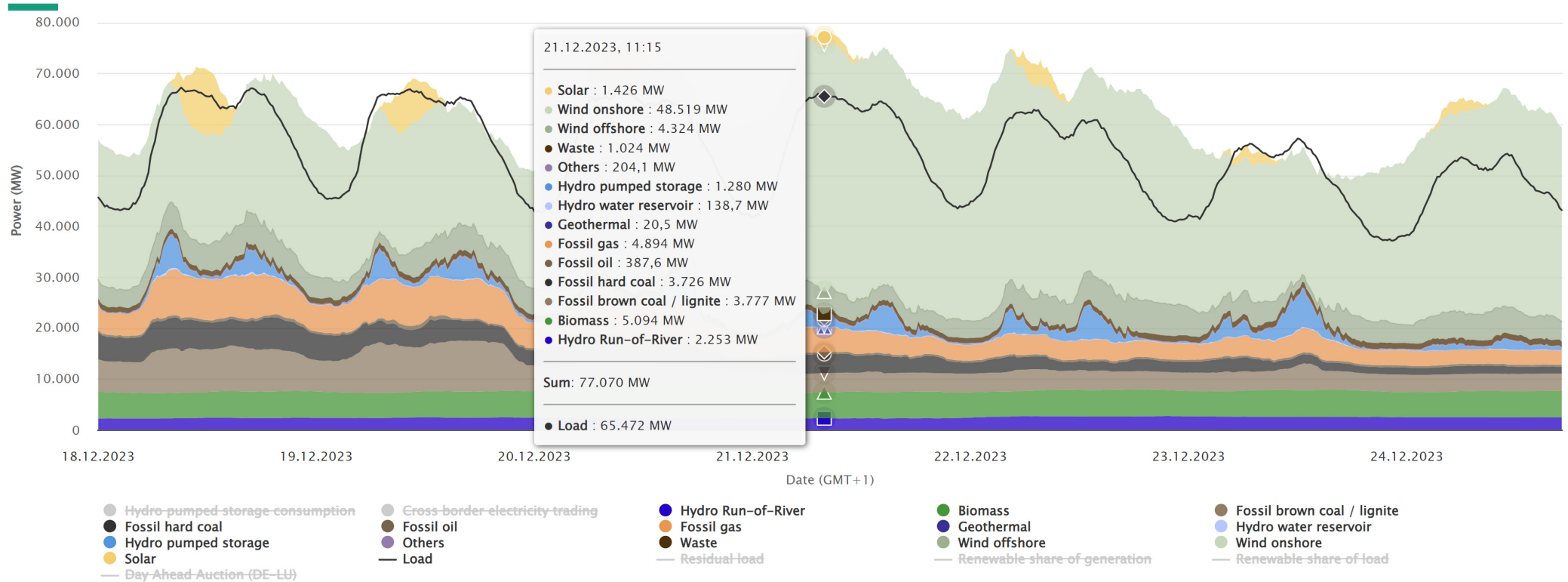
The maximum solar output was approx. 40.1 GW on 7 July 2023 at 13:15. At this time, renewable energies supplied 85% of the load.

Source: <https://www.energy-charts.info/charts/power/chart.htm?l=en&c=DE&week=27&year=2023>

*Data on public power generation

Highest electricity generation from onshore wind

Year 2023



Energy-Charts.info - last update: 11.01.2024, 14:46 MEZ

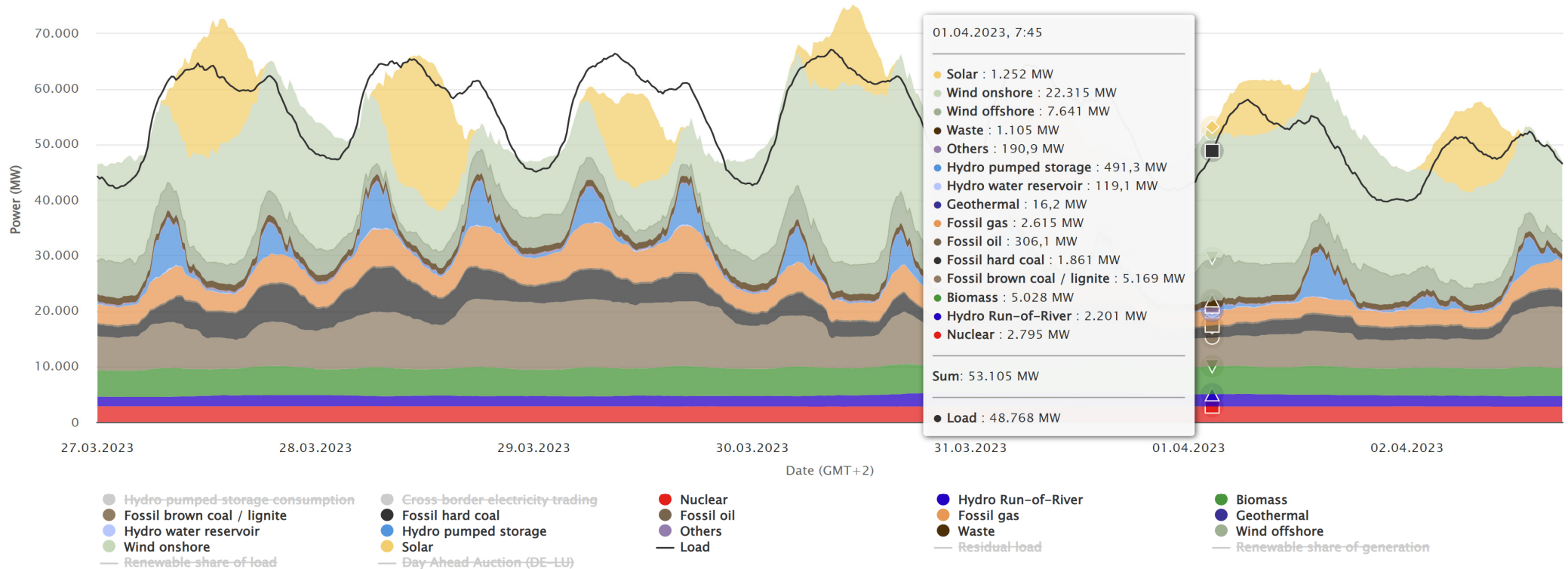
The maximum capacity of onshore wind was approx. 48.5 GW on 21 December 2023 at 11:15 a.m. At this time, renewable energies supplied 93.1% of the load.

Source: <https://www.energy-charts.info/charts/power/chart.htm?l=en&c=DE&year=2023&interval=week&week=51>

*Data on public power generation

Highest electricity generation from offshore wind

Year 2023



Energy-Charts.info - last update: 11.01.2024, 14:46 MEZ

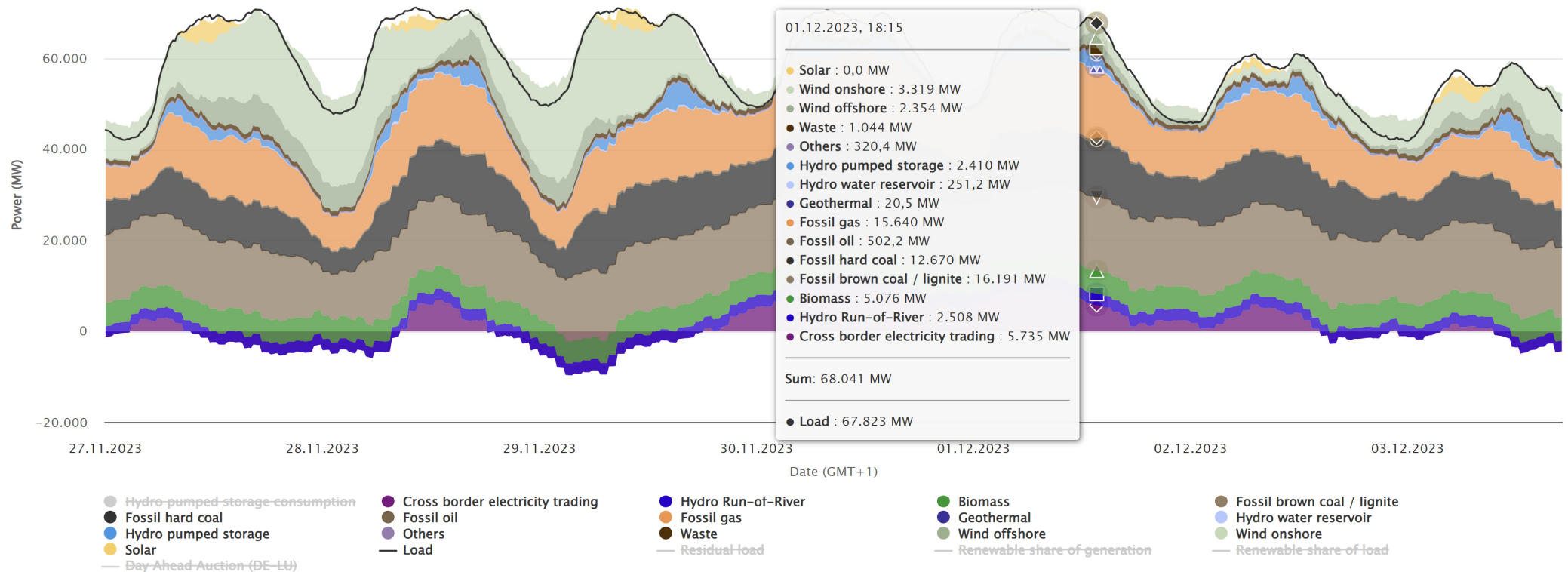
The maximum capacity of offshore wind was approx. 7.6 GW on 1 April 2023 at 07:45. At this time, renewable energies supplied 79.5% of the load.

Source: <https://www.energy-charts.info/charts/power/chart.htm?l=en&c=DE&year=2023&interval=week&week=13>

*Data on public power generation

Highest fossil power generation

Year 2023



Energy-Charts.info - last update: 11.01.2024, 15:42 MEZ

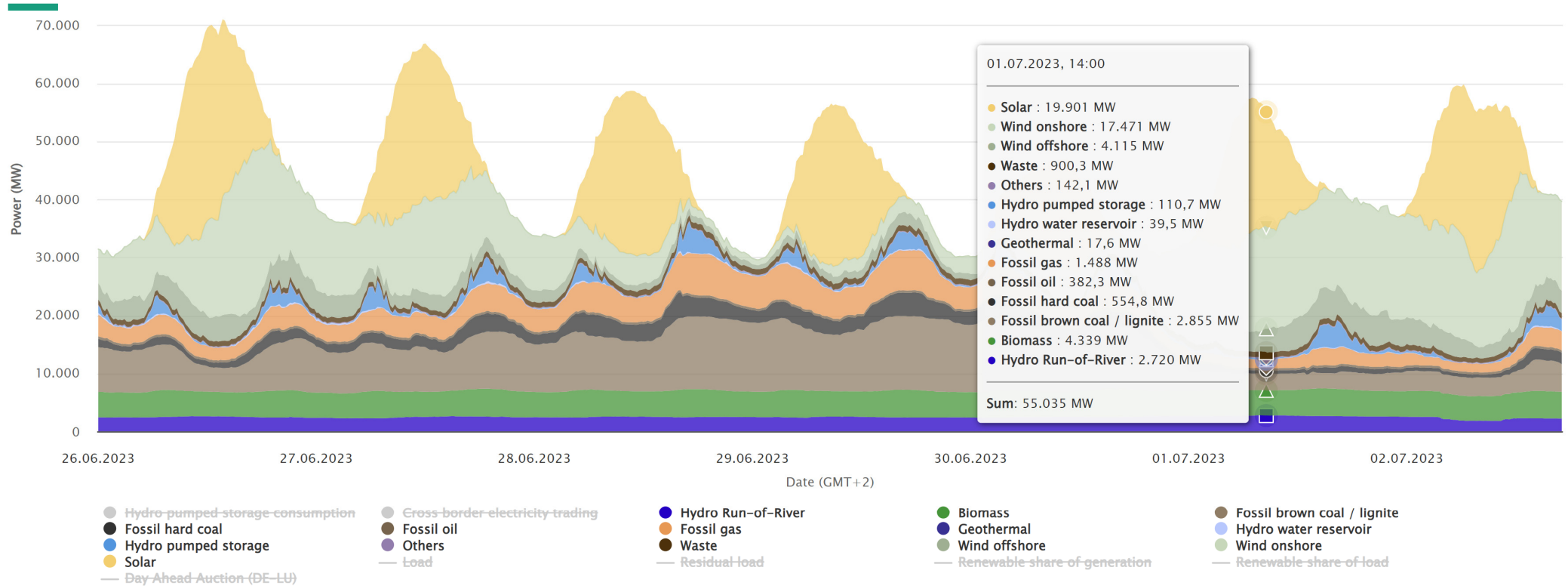
The maximum fossil capacity was approx. 45.0 GW on 1 December 2023 at 18:15. At this time, fossil fuels supplied 66.2% of the load.

Source: <https://www.energy-charts.info/charts/power/chart.htm?!=en&c=DE&week=48&year=2023>

*Data on public power generation

Lowest fossil power generation

Year 2023



Energy-Charts.info - last update: 11.01.2024, 15:42 MEZ

The minimum fossil capacity was approx. 5.3 GW on 1 July 2023 at 14:00. At this time, fossil fuels supplied 9.4% of the load.

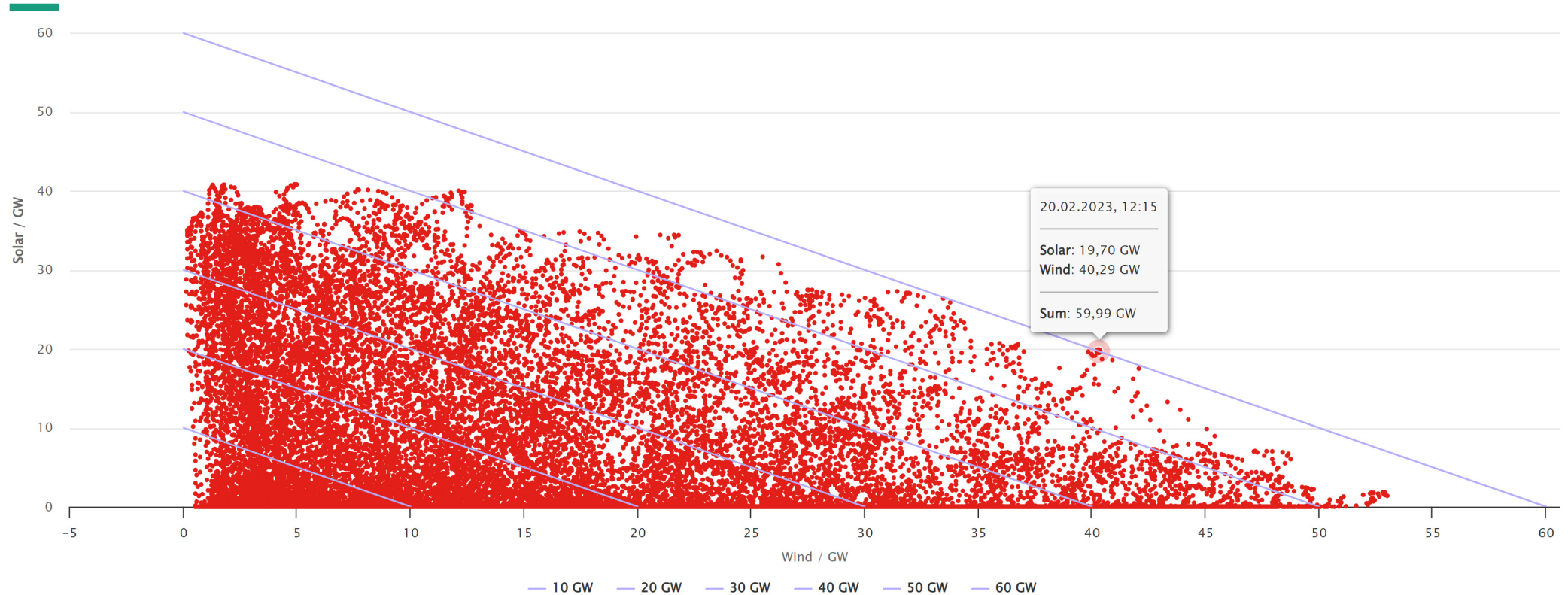
Source: <https://www.energy-charts.info/charts/power/chart.htm?l=en&c=DE&year=2023&interval=week&week=26&legendItems=00111111111111100000>

*Data on public power generation

53

Scatter chart for solar and wind power

Quarter-hourly values from 2023



Energy-Charts.info - last update: 11.01.2024, 04:26 MEZ

Source: https://www.energy-charts.info/charts/power_scatter/chart.html?l=en&c=DE&interval=year&year=2023

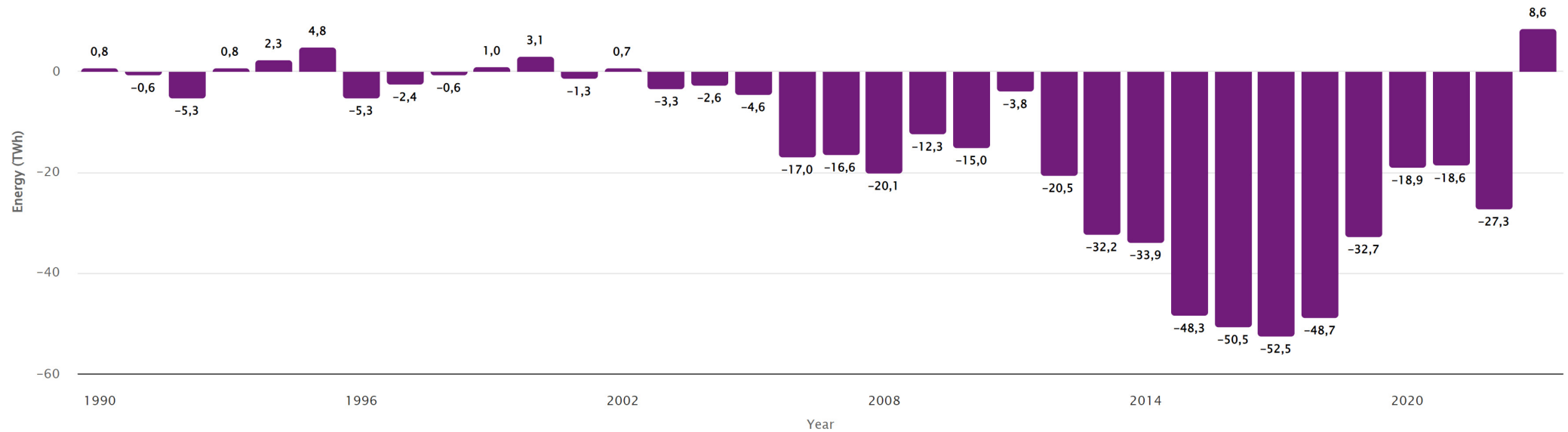
*Data on public power generation

Agenda

1. Summary
2. Electricity generation, share of renewable energies, full load hours
3. Imports and exports
4. Electricity prices
5. Installed capacity
6. Emissions and climate data
7. Appendix and explanations

Power exchange balance

Year 2002 to 2023



- Hydro-pumped-storage-consumption
- Biomass
- Fossil-coal-derived-gas
- Fossil-oil
- Geothermal
- Waste-renewable
- Solar-EEG-grid-feed-in
- Import balance
- Fossil-brown-coal / lignite
- Fossil-hard-coal
- Fossil-gas
- Hydro-water-reservoir
- Waste-non-renewable
- Solar-other-grid-feed-in
- Nuclear
- Fossil-brown-coal / lignite-grid-feed-in
- Fossil-hard-coal-grid-feed-in
- Fossil-gas-grid-feed-in
- Hydro-pumped-storage
- Wind-offshore
- Solar-self-consumption
- Hydro-Run-of-River
- Fossil-brown-coal / lignite-industrial-own-production
- Fossil-hard-coal-industrial-own-production
- Fossil-gas-industrial-own-production
- Others
- Wind-onshore
- Load

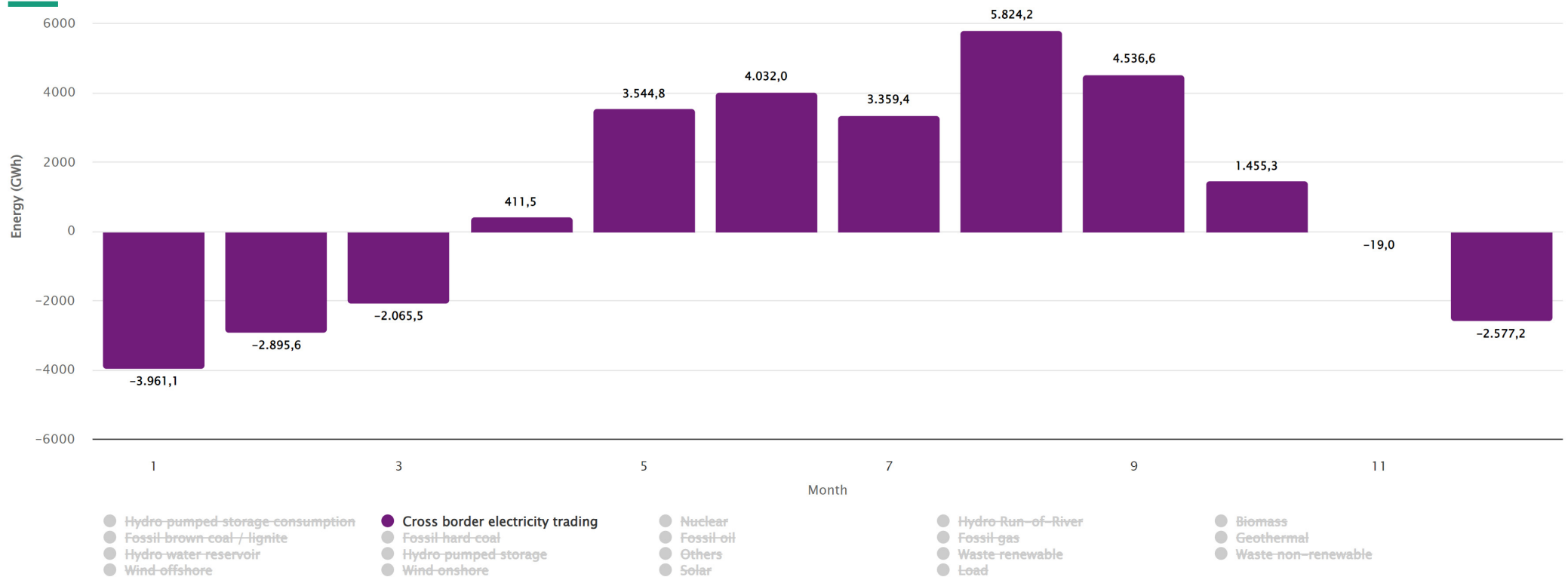
Energy-Charts.info - last update: 11.01.2024, 15:41 MEZ

Positive values mean imports. Negative values mean exports.

Source: <https://www.energy-charts.info/charts/energy/chart.htm?l=en&c=DE&interval=year&year=-1&chartColumnSorting=default&sum=1&source=total>

Monthly imports and exports

Year 2023



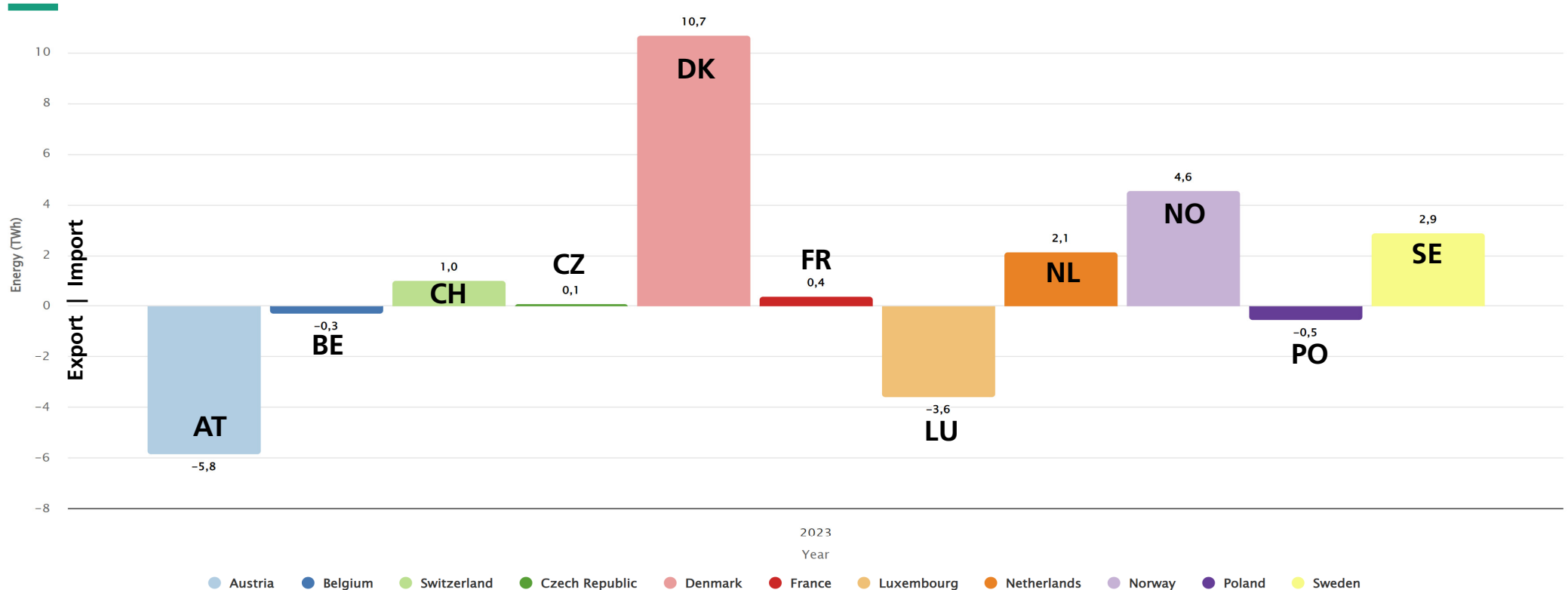
Energy-Charts.info - last update: 11.01.2024, 15:48 MEZ

Positive values mean imports. Negative values mean exports.

Source: https://www.energy-charts.info/charts/energy/chart.html?l=en&c=DE&chartColumnSorting=default&source=public&month=-1&sum=1&stacking=stacked_grouped&year=2023

Electricity import and export, scheduled commercial exchanges

Year 2023



2023
Year

● Austria ● Belgium ● Switzerland ● Czech Republic ● Denmark ● France ● Luxembourg ● Netherlands ● Norway ● Poland ● Sweden

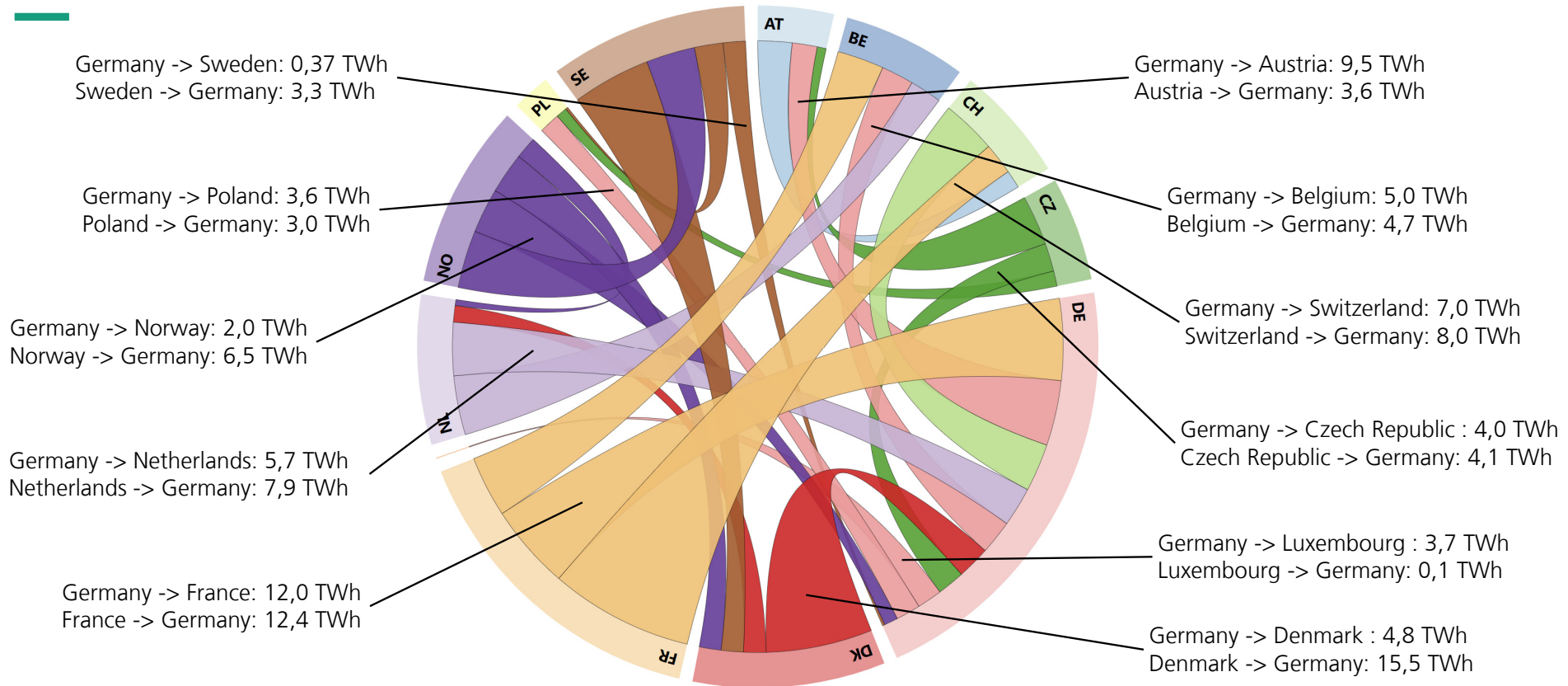
Energy-Charts.info - last update: 11.01.2024, 16:18 MEZ

Positive values mean imports. Negative values mean exports.

Source: https://www.energy-charts.info/charts/energy/chart.html?l=en&c=DE&chartColumnSorting=default&source=tcs_saldo&interval=year&sum=0&partsum=1&year=2023

Electricity import and export, scheduled commercial exchanges

Year 2023



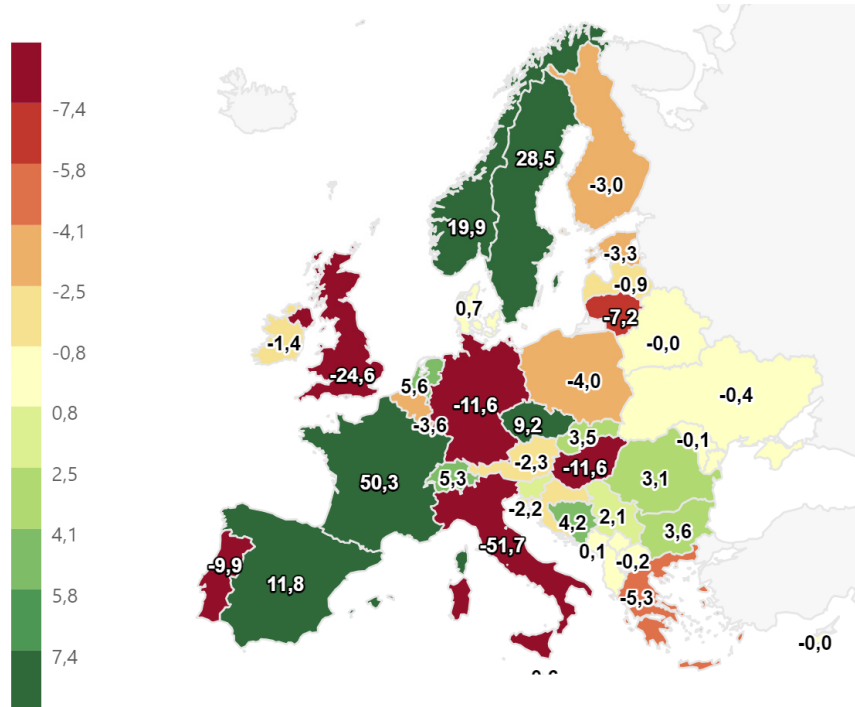
Germany: 69.3 TWh Imports; 57.6 TWh Exports; Balance: 11.7 TWh Imports

Source: https://www.energy-charts.info/charts/import_export/chart.htm?!=en&c=DE&year=2023

Scheduled commercial exchanges and cross border physical flows in Europe

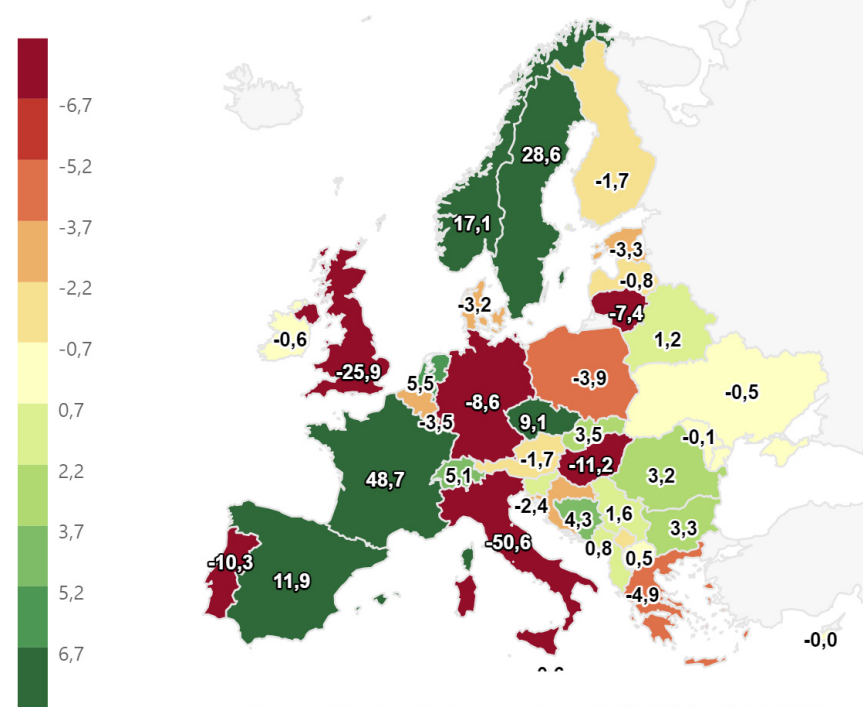
Year 2023

Scheduled commercial exchanges



Energy-Charts.info; Last Update: 11.01.2024, 16:24 MEZ

Cross border physical flows



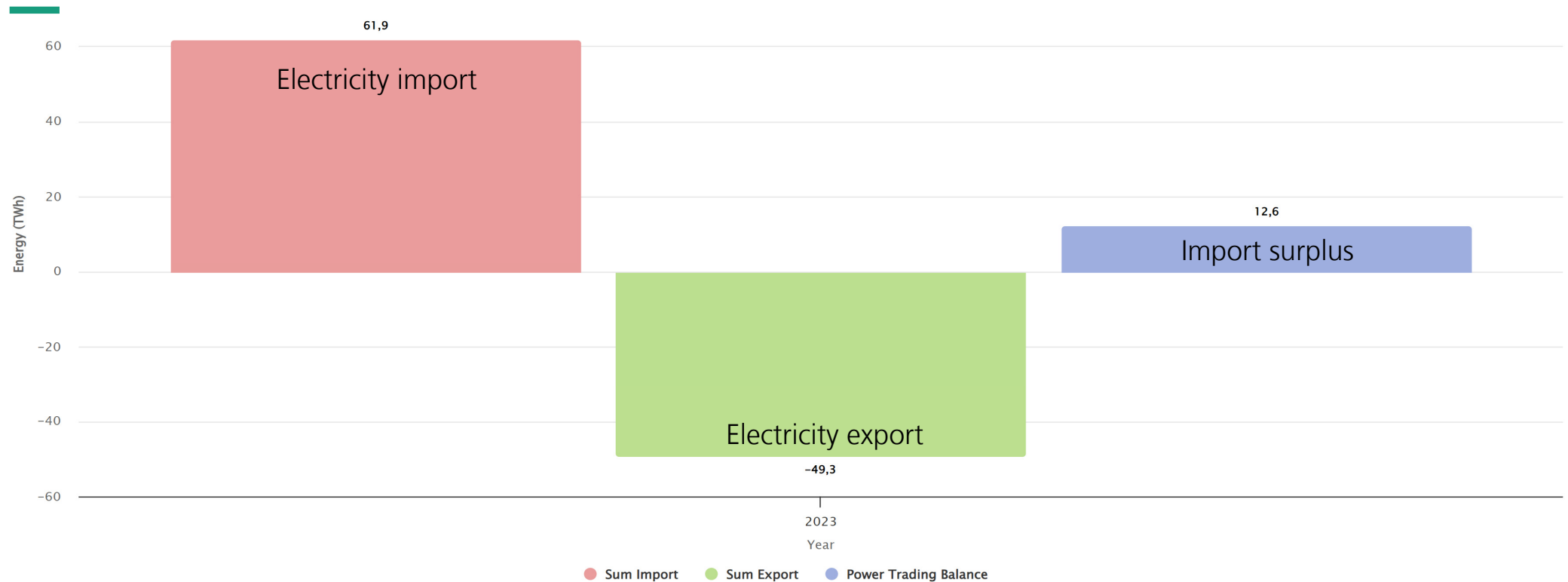
Energy-Charts.info; Last Update: 11.01.2024, 16:14 MEZ

In TWh, positive values (green) mean export surpluses, negative values (red) mean import surpluses.

Source: https://www.energy-charts.info/charts/import_export_map/chart.htm?l=en&c=DE&interval=year&year=2023

Foreign trade statistics for electricity in TWh

Year 2023



Energy-Charts.info - last update: 27.12.2023, 18:18 MEZ

*Data up to and including October 2023
Source: German Federal Statistical Office

Physical flows. Positive values mean import. Negative values mean export.

Source: https://energy-charts.info/charts/power_trading/chart.htm?l=en&c=DE&interval=year&dataBase=trade_sum_twh&partsum=1&year=2023

Foreign trade statistics for electricity in Euro

Year 2023



Energy-Charts.info - last update: 27.12.2023, 18:19 MEZ

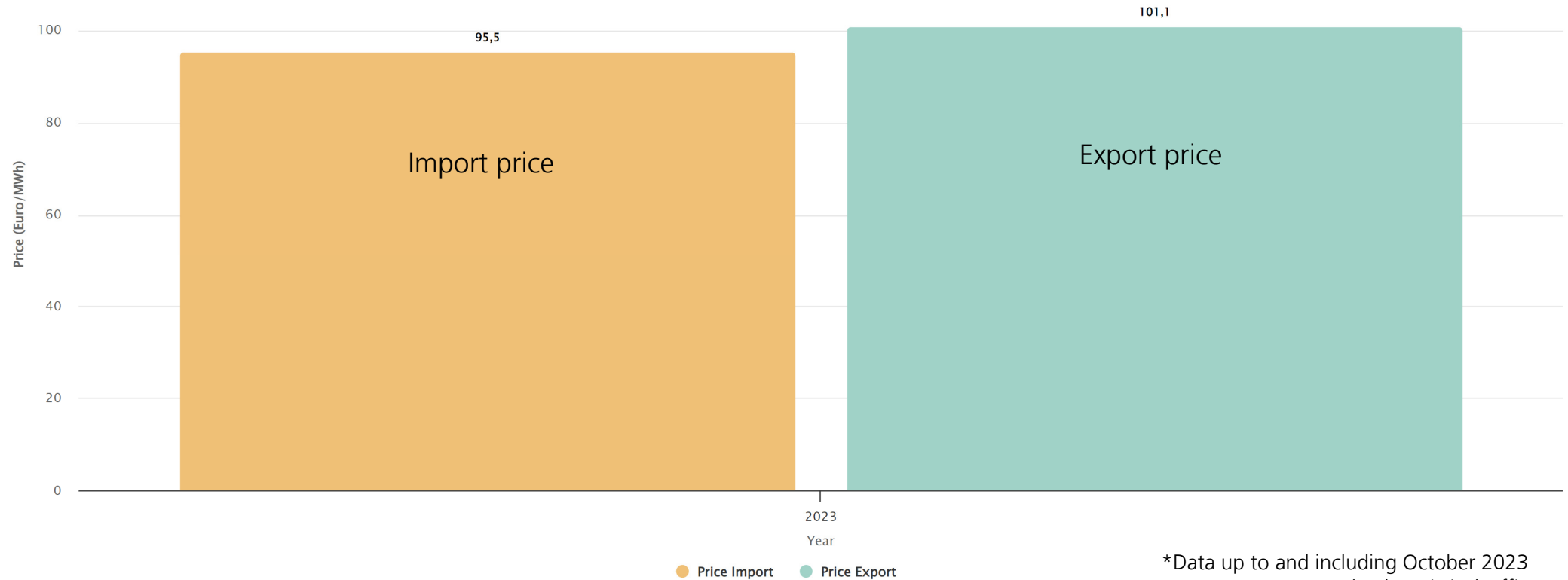
*Data up to and including October 2023
Source: German Federal Statistical Office

Positive values mean income. Negative values mean expenditure.

Source: https://energy-charts.info/charts/power_trading/chart.htm?l=en&c=DE&interval=year&dataBase=trade_sum_euro&partsum=1&year=2023

Foreign trade statistics for electricity in Euro

Year 2023



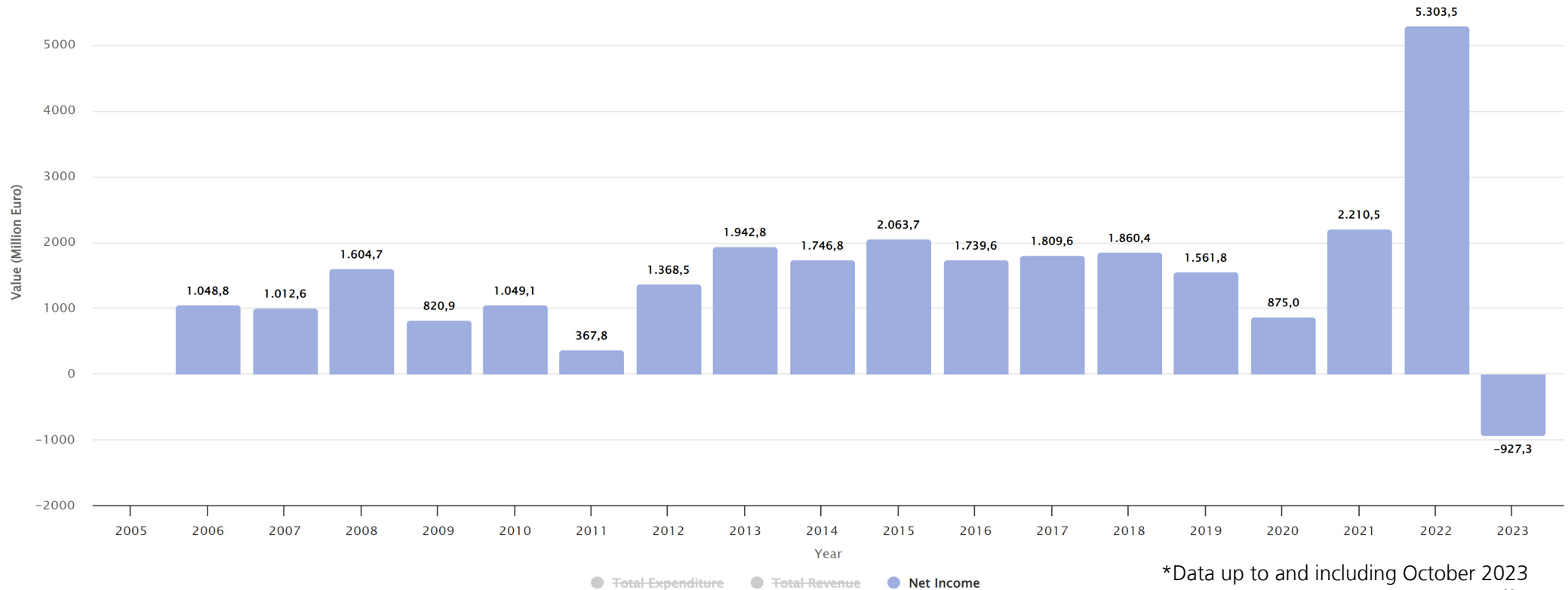
*Data up to and including October 2023
Source: German Federal Statistical Office

Energy-Charts.info - last update: 27.12.2023, 18:19 MEZ

Source: https://energy-charts.info/charts/power_trading/chart.html?l=en&c=DE&interval=year&dataBase=trade_sum_euro_mwh&partsum=1&year=2023

Foreign trade in electricity

Balance of income 2006 to 2023



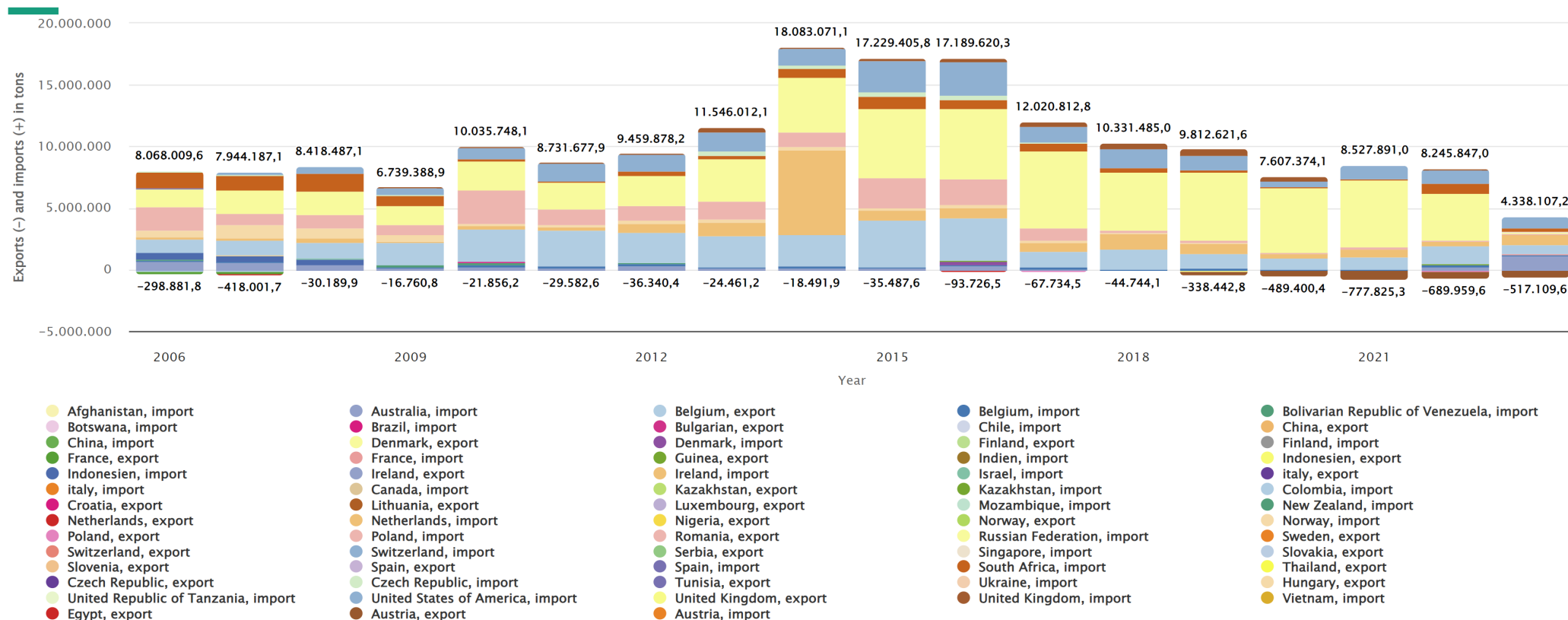
*Data up to and including October 2023
Source: German Federal Statistical Office

Energy-Charts.info - last update: 27.12.2023, 18:18 MEZ

Source: https://energy-charts.info/charts/power_trading/chart.html?l=en&c=DE&interval=year&dataBase=trade_sum_euro&partsum=1&year=-1

Export and import of hard coal

Year 2006 to 2023



*Data up to and including October 2023

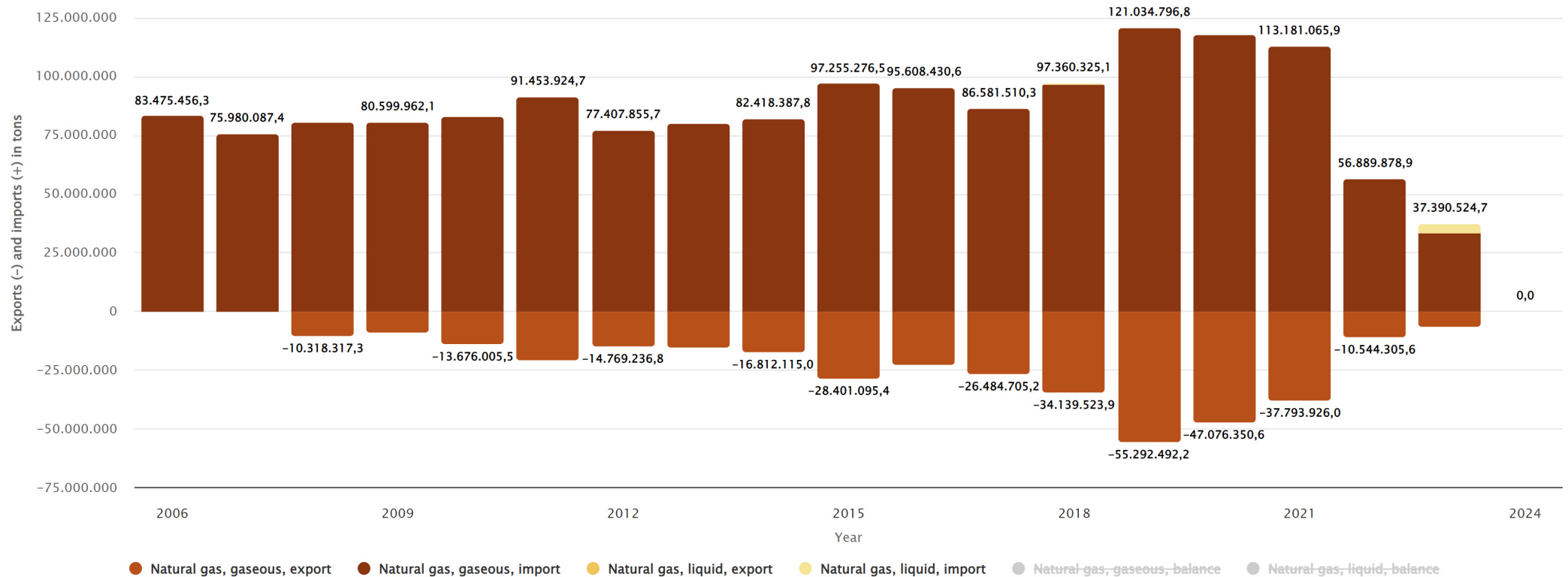
Source: German Federal Statistical Office

Energy-Charts.info - last update: 11.01.2024, 14:57 MEZ

Source: https://www.energy-charts.info/charts/energy_source_trade/chart.htm?l=en&c=DE&sum=1&interval=year&year=-1&dataType=hard_coal_import_export_absolute

Export and import of fossil gas

Year 2006 to 2023



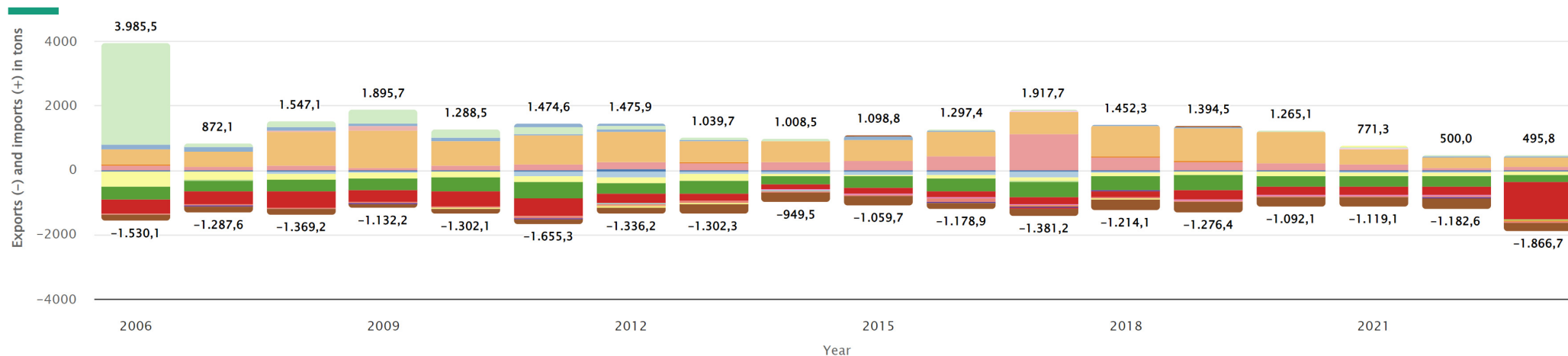
Energy-Charts.info - last update: 11.01.2024, 14:57 MEZ

*Data up to and including October 2023
Source: German Federal Statistical Office

Source: https://www.energy-charts.info/charts/energy_source_trade/chart.htm?l=en&c=DE&sum=1&interval=year&year=-1&dataType=gas_import_export_absolute

Export and import of hydrogen

Year 2006 to 2023



- Algeria, export
- Brazil, export
- Estonia, export
- Hong Kong, export
- Japan, import
- Latvia, export
- Malta, export
- Oman, export
- Republic of Korea, export
- Sweden, export
- Slovenia, export
- Czech Republic, export
- Hungary, import
- United Kingdom, import
- Syrian Arab Republic, export
- Chile, export
- Finland, export
- Iraq, export
- Jordanien, export
- Liberia, export
- Mongolei, export
- Papua New Guinea, export
- Republic of Korea, import
- Sweden, import
- Spain, export
- Czech Republic, import
- Uzbekistan, export
- Cyprus, export
- Australia, export
- China, export
- France, export
- Islamic Republic of Iran, export
- Canada, export
- Libya, export
- Netherlands, export
- Peru, export
- Romania, export
- Switzerland, export
- Spain, import
- Turkmenistan, export
- United Arab Emirates, export
- Egypt, export
- Belarus, export
- China, import
- France, import
- Israel, export
- Kazakhstan, export
- Liechtenstein, export
- Netherlands, import
- Poland, export
- Russian Federation, export
- Switzerland, import
- South Africa, export
- Turkey, export
- United States of America, export
- Egypt, import
- Belgium, export
- Denmark, export
- Georgia, export
- Italy, export
- Katar, export
- Luxembourg, export
- North Macedonia, export
- Poland, import
- Russian Federation, import
- Singapore, export
- Taiwan, export
- Ukraine, export
- United States of America, import
- Austria, export
- Belgium, import
- Denmark, import
- Greece, export
- Italy, import
- Colombia, export
- Malaysia, export
- Norway, export
- Portugal, export
- Saudi Arabia, export
- Slovakia, export
- Thailand, export
- Hungary, export
- United Kingdom, export
- Austria, import

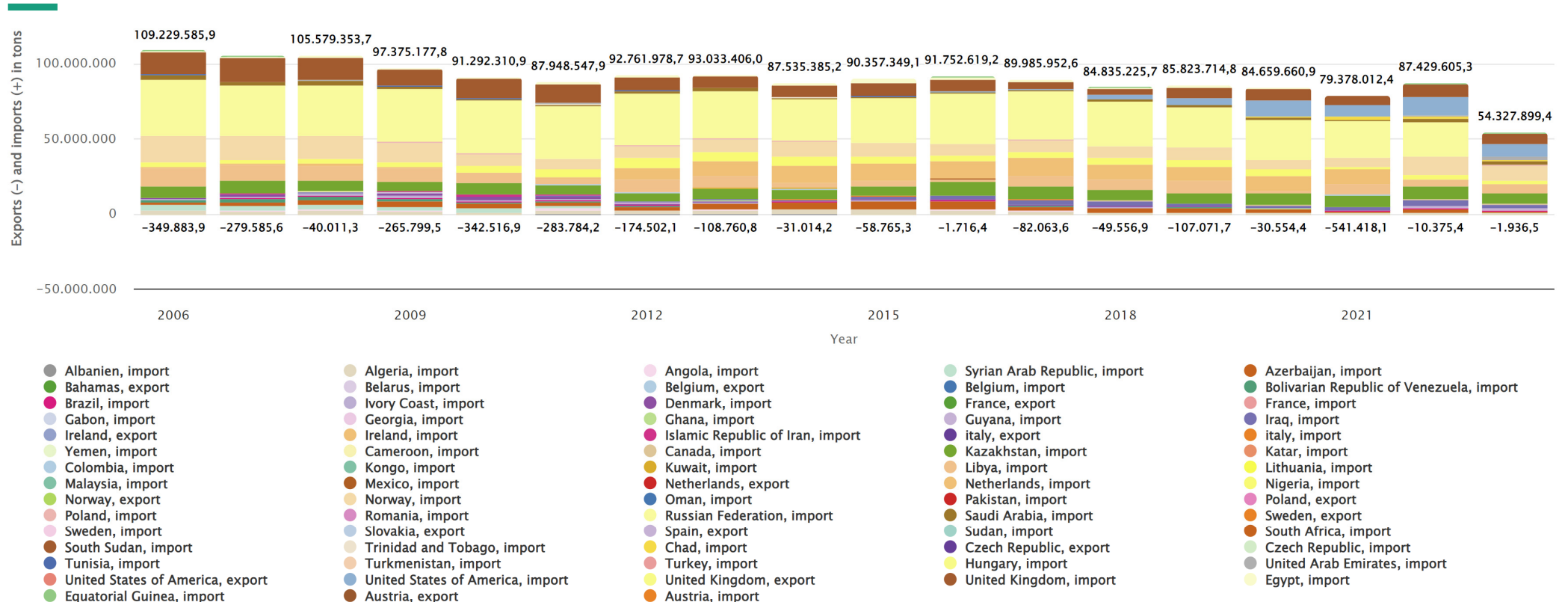
Energy-Charts.info - last update: 11.01.2024, 14:58 MEZ

*Data up to and including October 2023
Source: German Federal Statistical Office

Source: https://www.energy-charts.info/charts/energy_source_trade/chart.htm?l=en&c=DE&sum=1&interval=year&year=-1&dataType=hydrogen_import_export_absolute

Export and import of crude oil and oil from bituminous minerals

Year 2006 to 2023



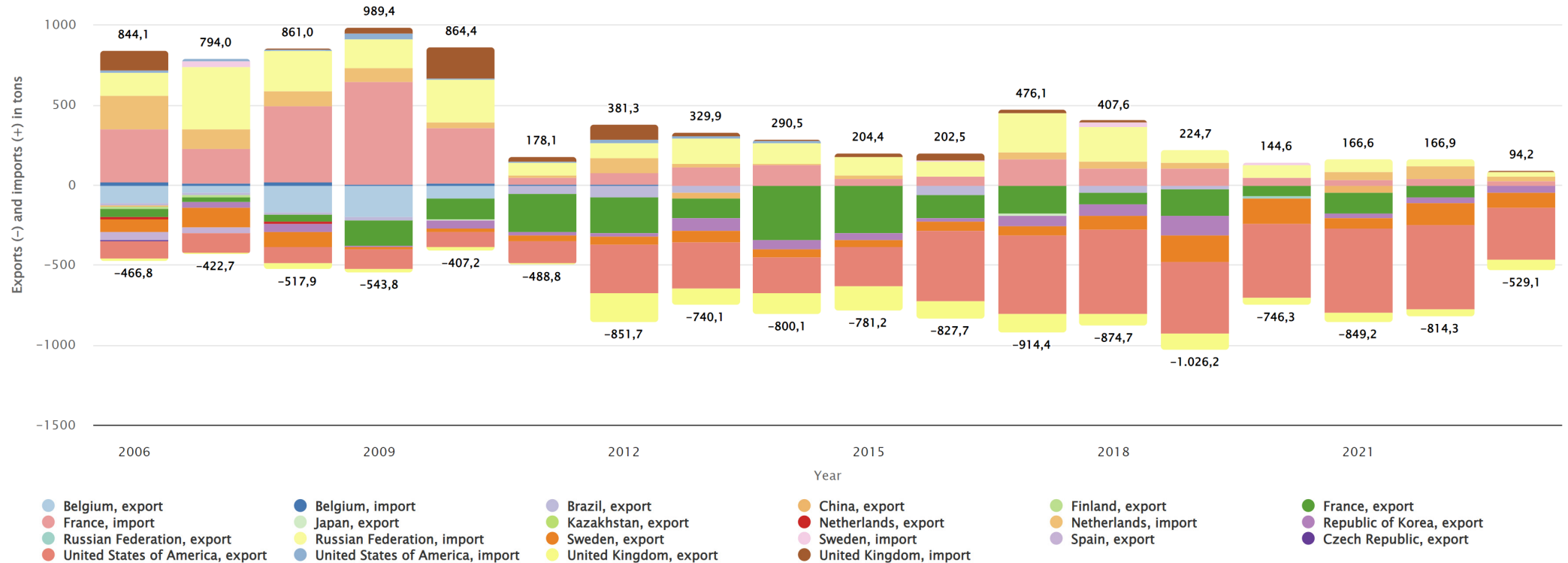
*Data up to and including September 2023

Source: German Federal Statistical Office

Source: https://www.energy-charts.info/charts/energy_source_trade/chart.htm?l=en&c=DE&sum=1&interval=year&year=-1&dataType=oil_import_export_absolute

Export and import of enriched uranium 235

Year 2006 to 2023



Energy-Charts.info - last update: 11.01.2024, 15:00 MEZ

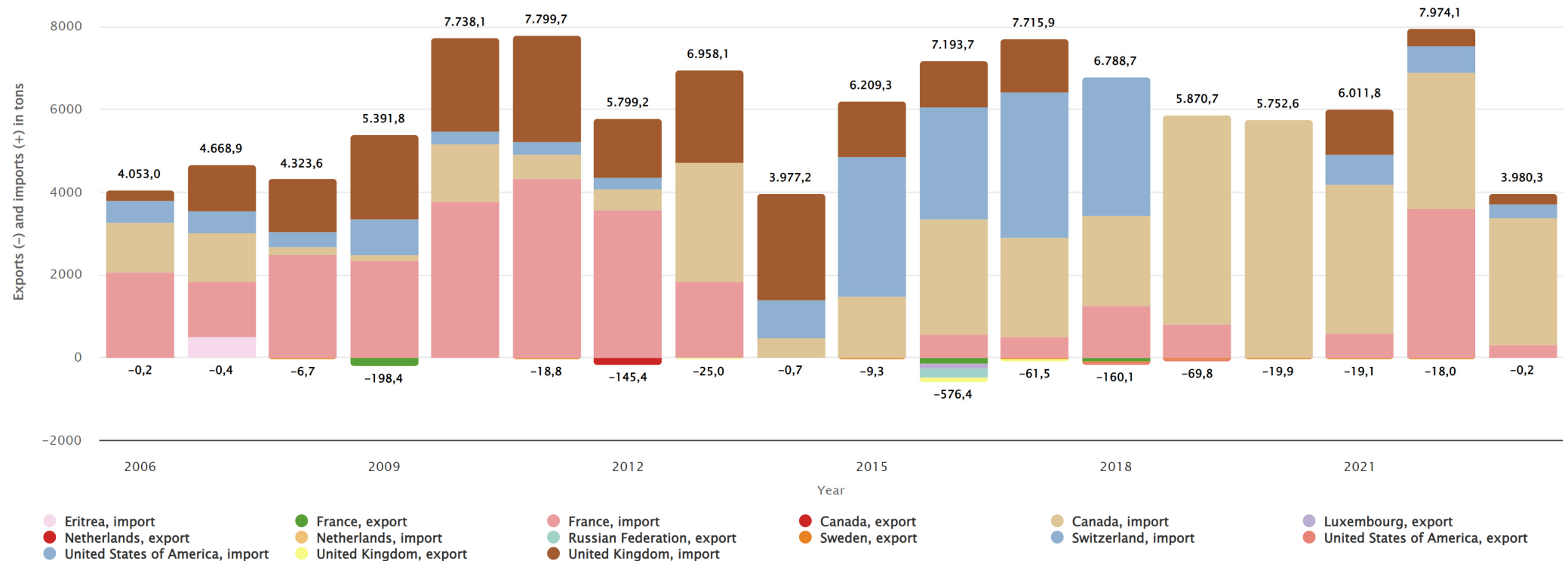
*Data up to and including October 2023

Source: German Federal Statistical Office

Source: https://www.energy-charts.info/charts/energy_source_trade/chart.htm?l=en&c=DE&sum=1&interval=year&year=-1&dataType=uranium_enriched_import_export_absolute

Export and import of natural uranium and its compounds

Year 2006 to 2023



Energy-Charts.info - last update: 11.01.2024, 15:01 MEZ

Data up to and including October 2023

Source: German Federal Statistical Office

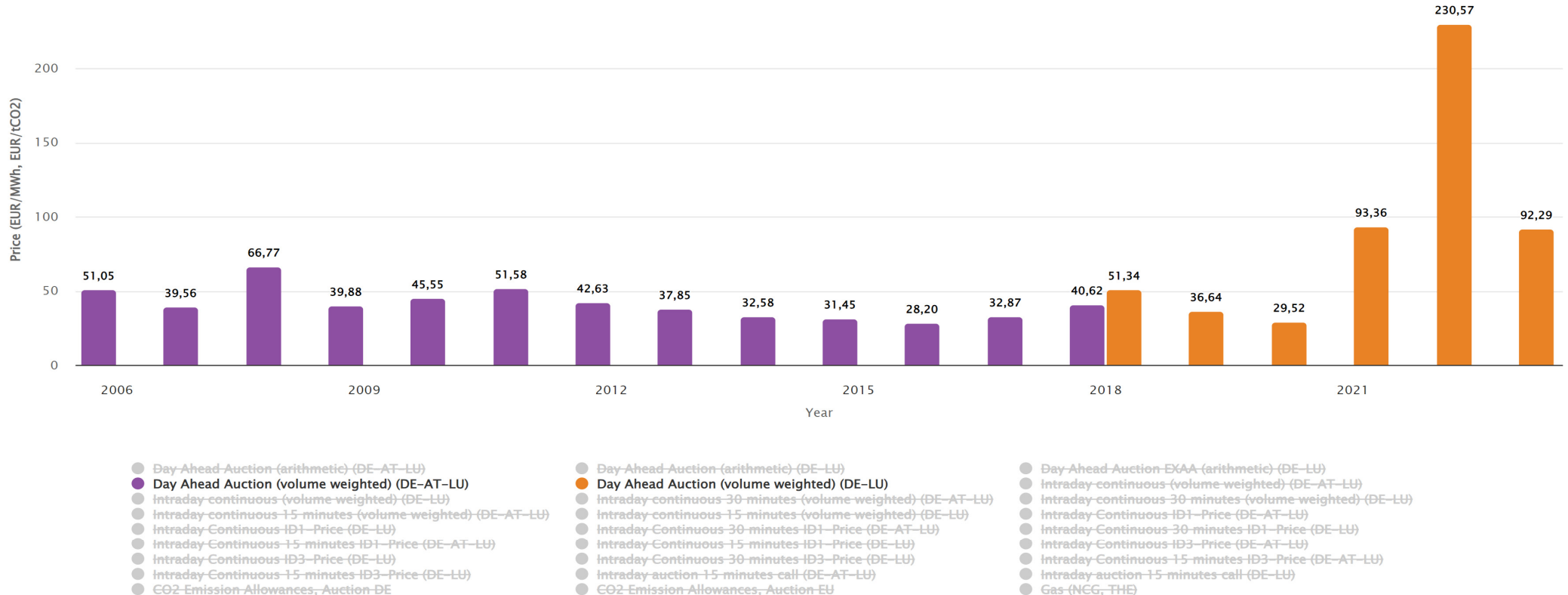
Source: https://www.energy-charts.info/charts/energy_source_trade/chart.htm?l=en&c=DE&sum=1&interval=year&year=-1&dataType=uranium_natural_compounds_import_export_absolute

Agenda

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EPEX Spotpreis Day-Ahead

Volumengewichtet, nicht inflationsbereinigt



Energy-Charts.info - last update: 11.01.2024, 17:51 MEZ

Source: https://www.energy-charts.info/charts/price_average/chart.html?l=en&c=DE&chartColumnSorting=default&interval=year&year=-1&partsum=1&legendItems=00011000000000000000000000000000

Negative day-ahead exchange electricity prices

Hours per year

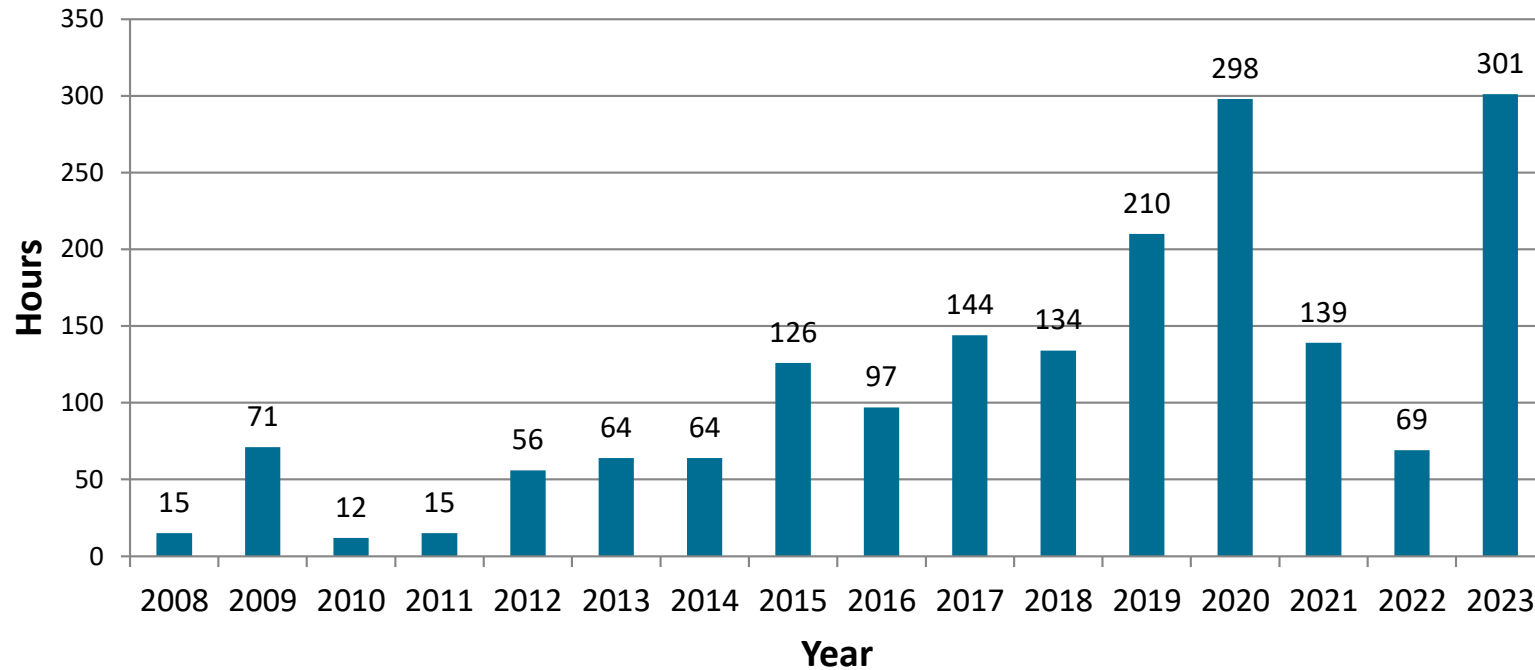
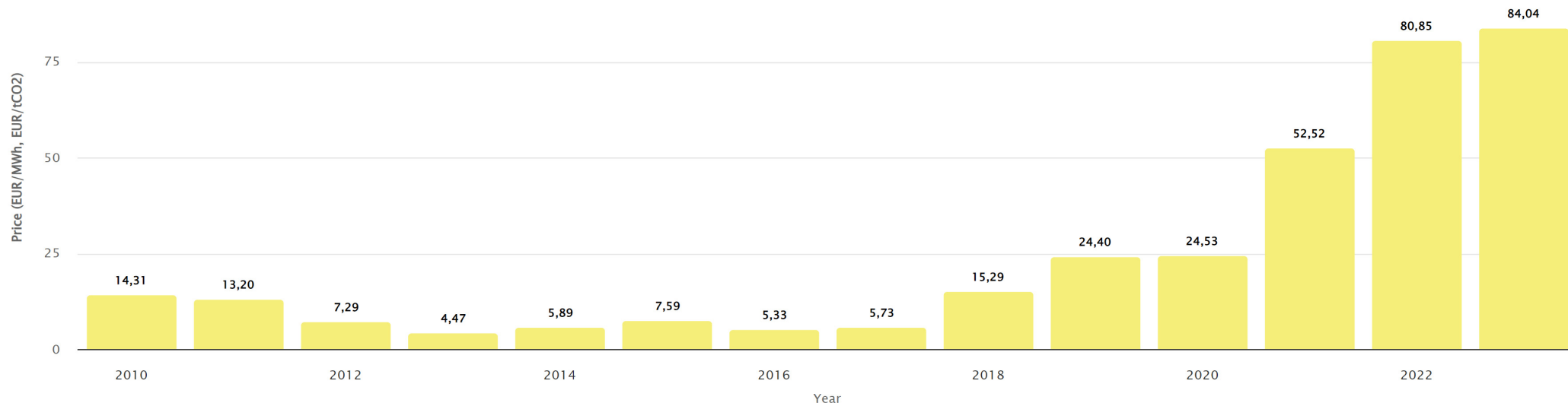


Chart: B. Burger, Fraunhofer ISE; Data: EPEX

Price of CO2 emission allowances (EUAs)

Year 2010 to 2023



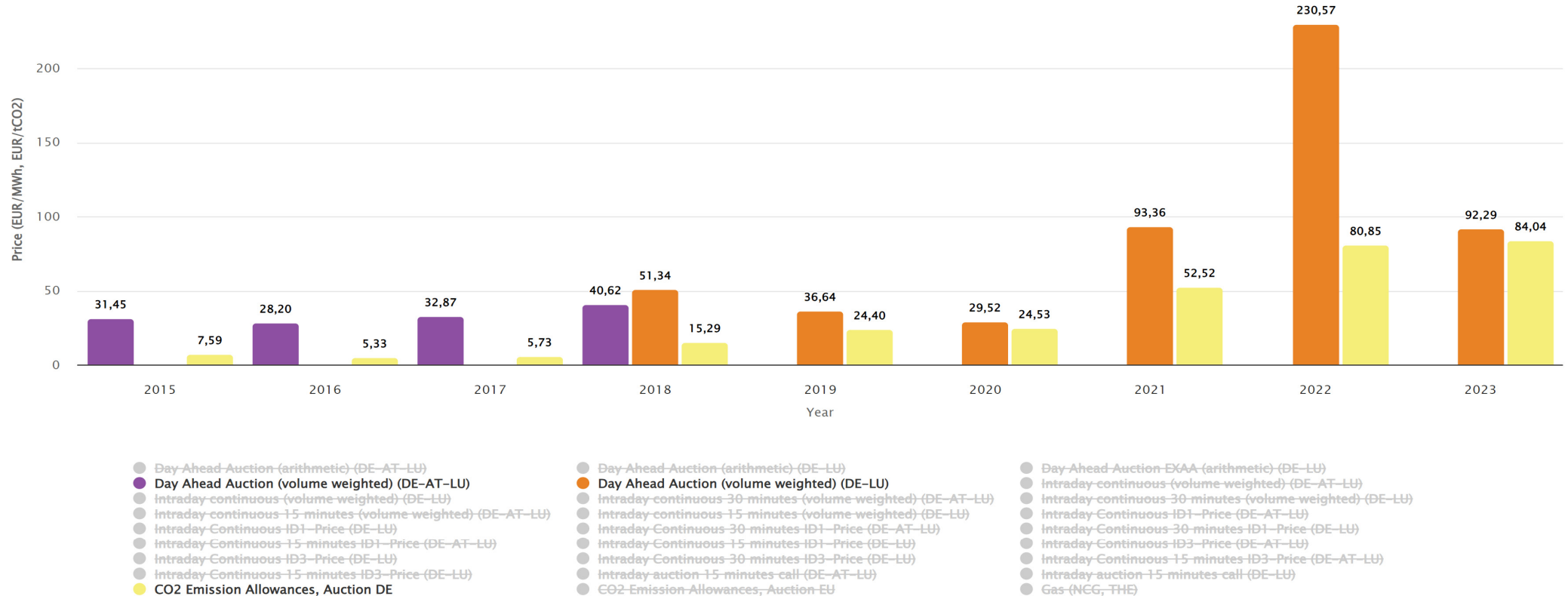
- Day Ahead Auction (arithmetic) (DE-AT-LU)
- Day Ahead Auction (volume-weighted) (DE-AT-LU)
- Intraday continuous (volume-weighted) (DE-LU)
- Intraday continuous 15 minutes (volume-weighted) (DE-AT-LU)
- Intraday Continuous ID1-Price (DE-LU)
- Intraday Continuous 15 minutes ID1-Price (DE-AT-LU)
- Intraday Continuous ID3-Price (DE-LU)
- Intraday Continuous 15 minutes ID3-Price (DE-LU)
- CO2 Emission Allowances, Auction DE
- Day Ahead Auction (arithmetic) (DE-LU)
- Day Ahead Auction (volume-weighted) (DE-LU)
- Intraday continuous 30 minutes (volume-weighted) (DE-AT-LU)
- Intraday continuous 15 minutes (volume-weighted) (DE-LU)
- Intraday Continuous ID1-Price (DE-AT-LU)
- Intraday Continuous 30 minutes ID1-Price (DE-AT-LU)
- Intraday Continuous 15 minutes ID1-Price (DE-LU)
- Intraday Continuous 30 minutes ID3-Price (DE-LU)
- Intraday auction 15 minutes call (DE-AT-LU)
- CO2 Emission Allowances, Auction EU
- Day Ahead Auction EXAA (arithmetic) (DE-LU)
- Intraday continuous (volume-weighted) (DE-AT-LU)
- Intraday continuous 30 minutes (volume-weighted) (DE-LU)
- Intraday Continuous ID1-Price (DE-AT-LU)
- Intraday Continuous 30 minutes ID1-Price (DE-LU)
- Intraday Continuous ID3-Price (DE-AT-LU)
- Intraday Continuous 15 minutes ID3-Price (DE-AT-LU)
- Intraday auction 15 minutes call (DE-LU)
- Gas (NCG, THE)

Energy-Charts.info - last update: 11.01.2024, 17:51 MEZ

Source: https://www.energy-charts.info/charts/price_average/chart.html?l=en&c=DE&chartColumnSorting=default&interval=year&year=-1&partsum=1&legendItems=0000000000000000000000100

Day-ahead electricity price and CO2 certificate price

Year 2010 to 2023

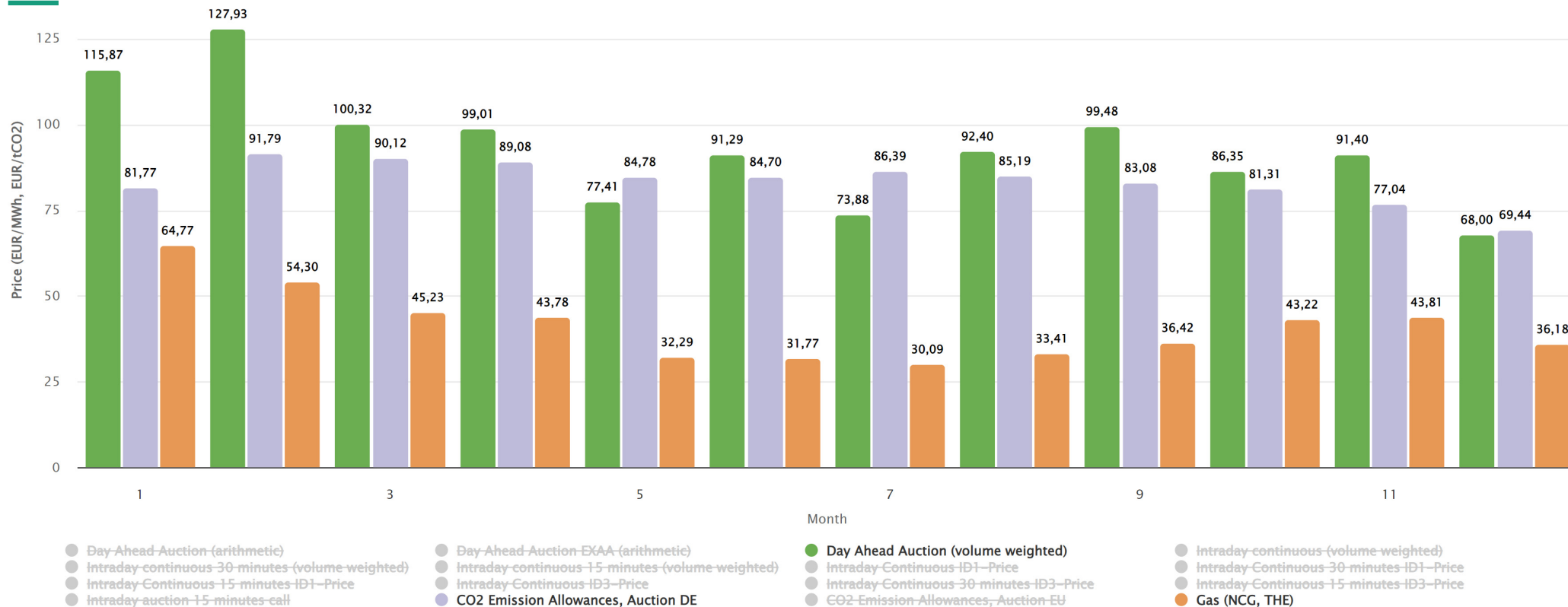


Energy-Charts.info - last update: 11.01.2024, 17:51 MEZ

Source: https://www.energy-charts.info/charts/price_average/chart.html?l=en&c=DE&chartColumnSorting=default&interval=year&year=-1&partsum=1&legendItems=000110000000000000000000100

Day-ahead electricity price, CO2 certificate price and gas price

Months in 2023

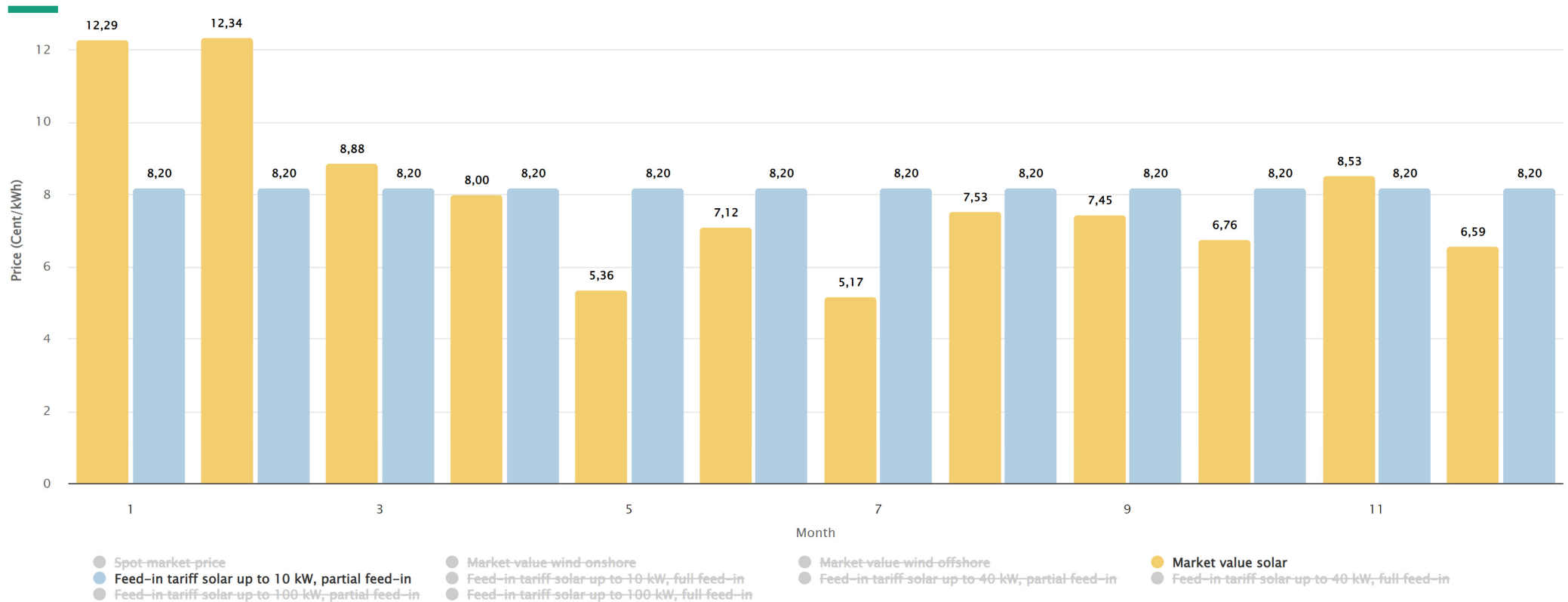


Energy-Charts.info - last update: 11.01.2024, 17:52 MEZ

Source: https://www.energy-charts.info/charts/price_average/chart.html?l=en&c=DE&chartColumnSorting=default&interval=month&year=2023&partsum=1&month=-1&legendItems=001000000000101

Solar market value and EEG remuneration for new systems

Months in 2023

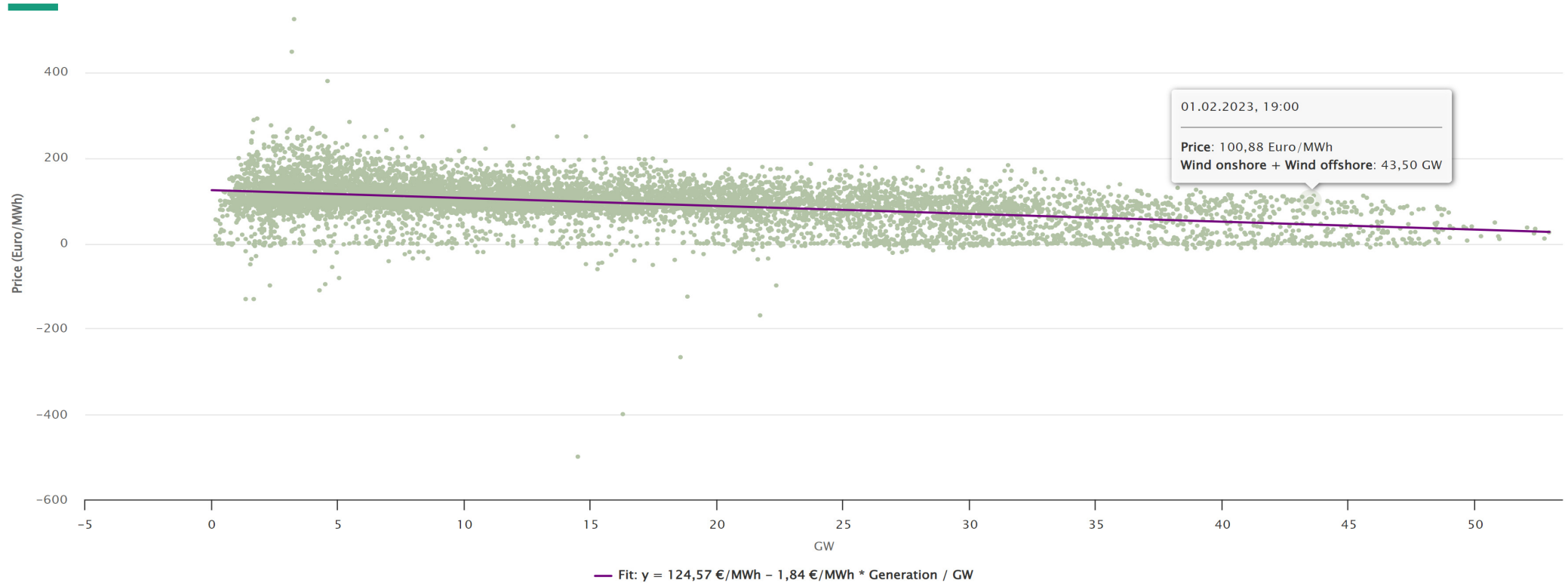


Energy-Charts.info - last update: 11.12.2023, 12:02 MEZ

Source: https://www.energy-charts.info/charts/market_values/chart.html?l=en&c=DE&year=2023

Day-ahead exchange electricity price above wind power

Hourly values in 2023



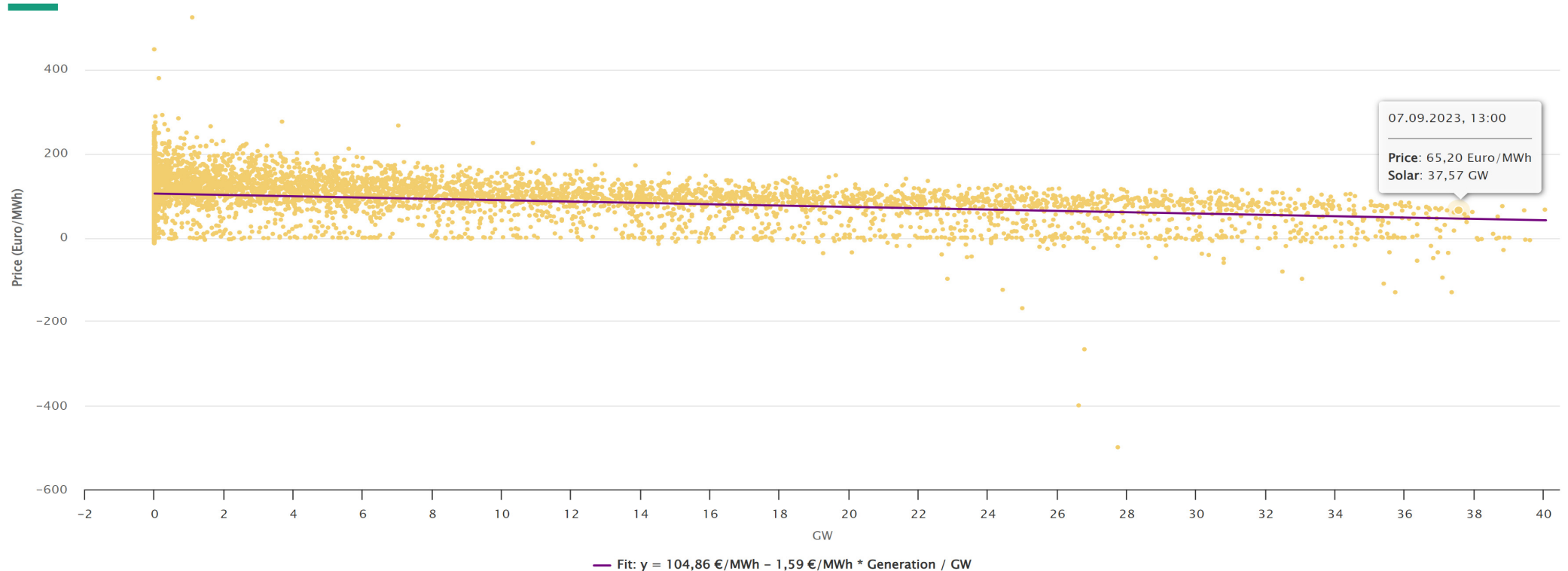
Energy-Charts.info - last update: 11.01.2024, 17:42 MEZ

Wind feed-in lowers the day-ahead exchange electricity price. Each additional GW of wind feed-in lowers the price by €1.84/MWh.

Source: https://www.energy-charts.info/charts/price_scatter/chart.htm?l=en&c=DE&wind_onshore=1&solar=0&wind_offshore=1&year=2023

Day-ahead exchange electricity price above the solar output

Hourly values in 2023



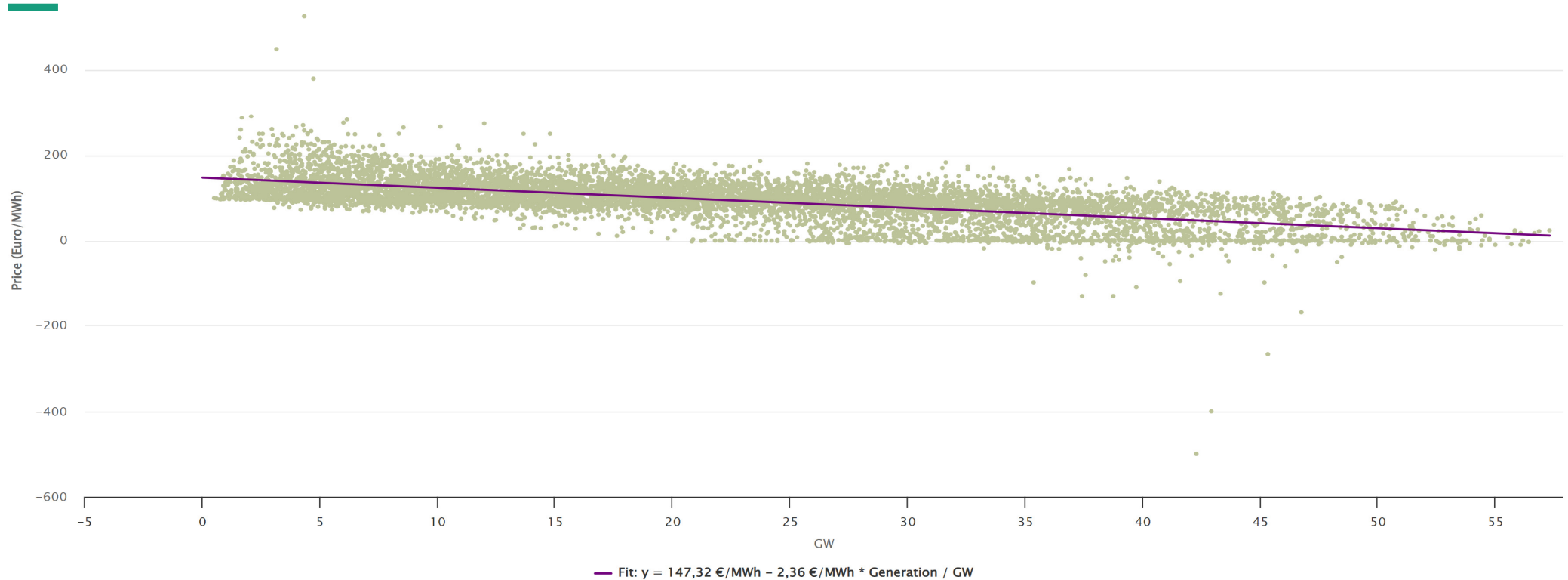
Energy-Charts.info - last update: 11.01.2024, 17:42 MEZ

Solar feed-in lowers the day-ahead exchange electricity price. Each additional GW of solar feed-in lowers the price by EUR 1.59/MWh.

Quelle: https://www.energy-charts.info/charts/price_scatter/chart.htm?l=en&c=DE&wind_onshore=0&solar=1&wind_offshore=0&year=2023

Day-ahead exchange electricity price above the sum of wind and solar

Hourly values in 2023



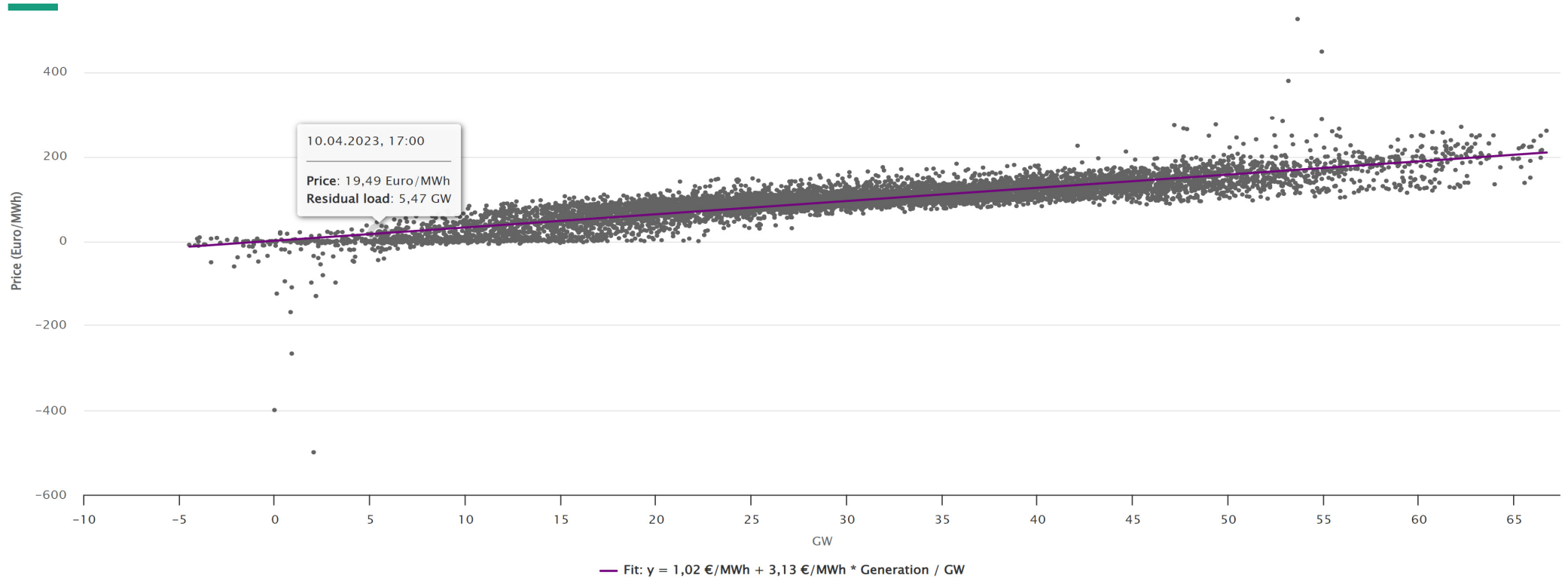
Energy-Charts.info - last update: 11.01.2024, 17:42 MEZ

The sum of wind and solar lowers the day-ahead exchange electricity price. Each additional GW of feed-in lowers the price by €2.36/MWh.

Source: https://www.energy-charts.info/charts/price_scatter/chart.htm?l=en&c=DE&wind_onshore=1&solar=1&wind_offshore=1&year=2023

Day-ahead exchange electricity price above the residual load

Hourly values in 2023



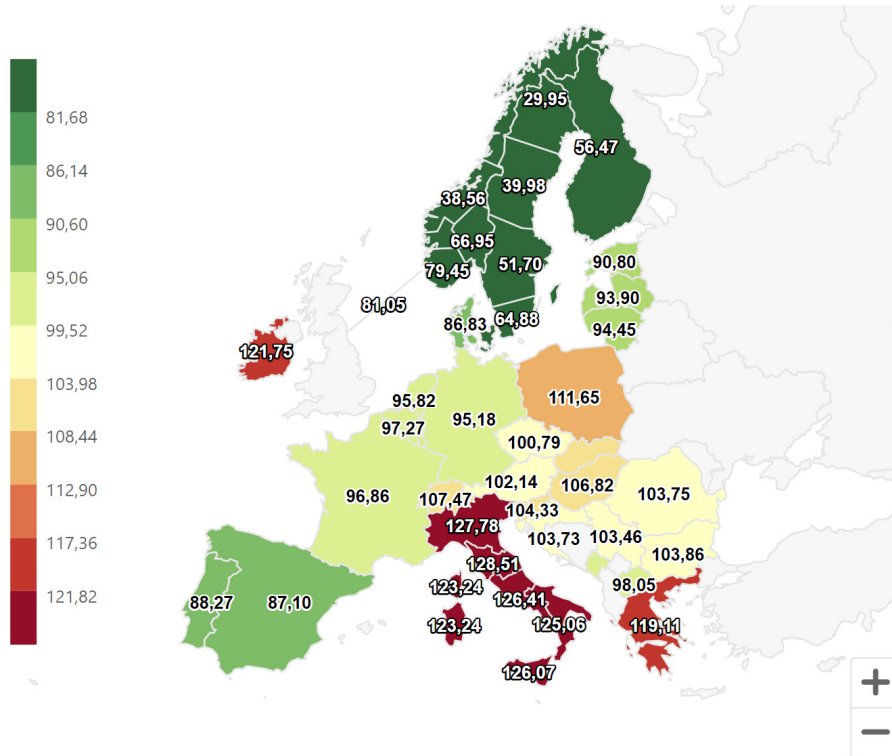
Energy-Charts.info - last update: 11.01.2024, 17:42 MEZ

The residual load increases the day-ahead exchange electricity price by EUR 3.14/MWh per GW of additional load.

Source: https://www.energy-charts.info/charts/price_scatter/chart.htm?l=en&c=DE&wind_onshore=0&solar=0&wind_offshore=0&residual_load=1&year=2023

European day-ahead electricity prices

Year 2023, arithmetic mean values



Energy-Charts.info; Last Update: 11.01.2024, 17:42 MEZ

Source: https://www.energy-charts.info/charts/price_average_map/chart.html?l=en&c=DE&interval=year&year=2023

Day-ahead electricity prices in Germany and its neighbouring countries

Year 2023

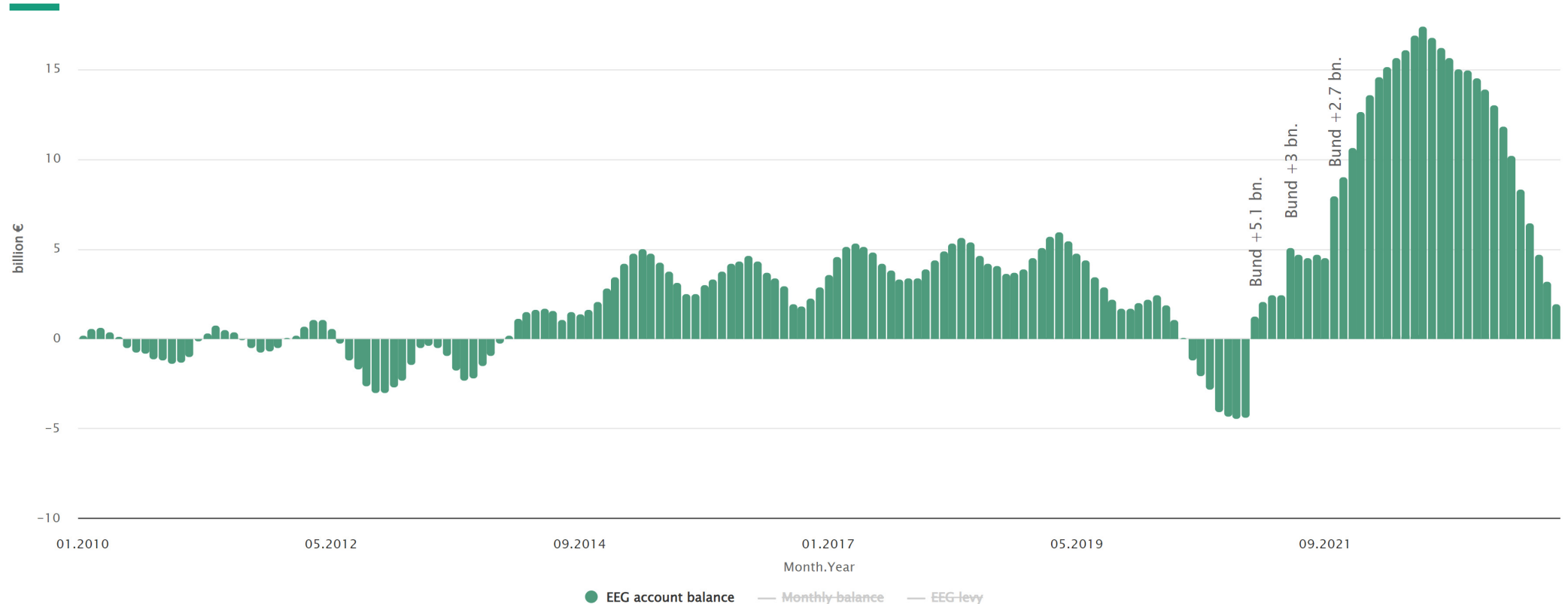


Energy-Charts.info - last update: 11.01.2024, 18:42 MEZ

Source: https://energy-charts.info/charts/price_average/chart.html?l=en&c=ALL&chartColumnSorting=ascending&interval=year&partsum=1&year=2023

EEG account balance

Monthly values, year 2010 to 2023



Energy-Charts.info - last update: 11.12.2023, 17:16 MEZ

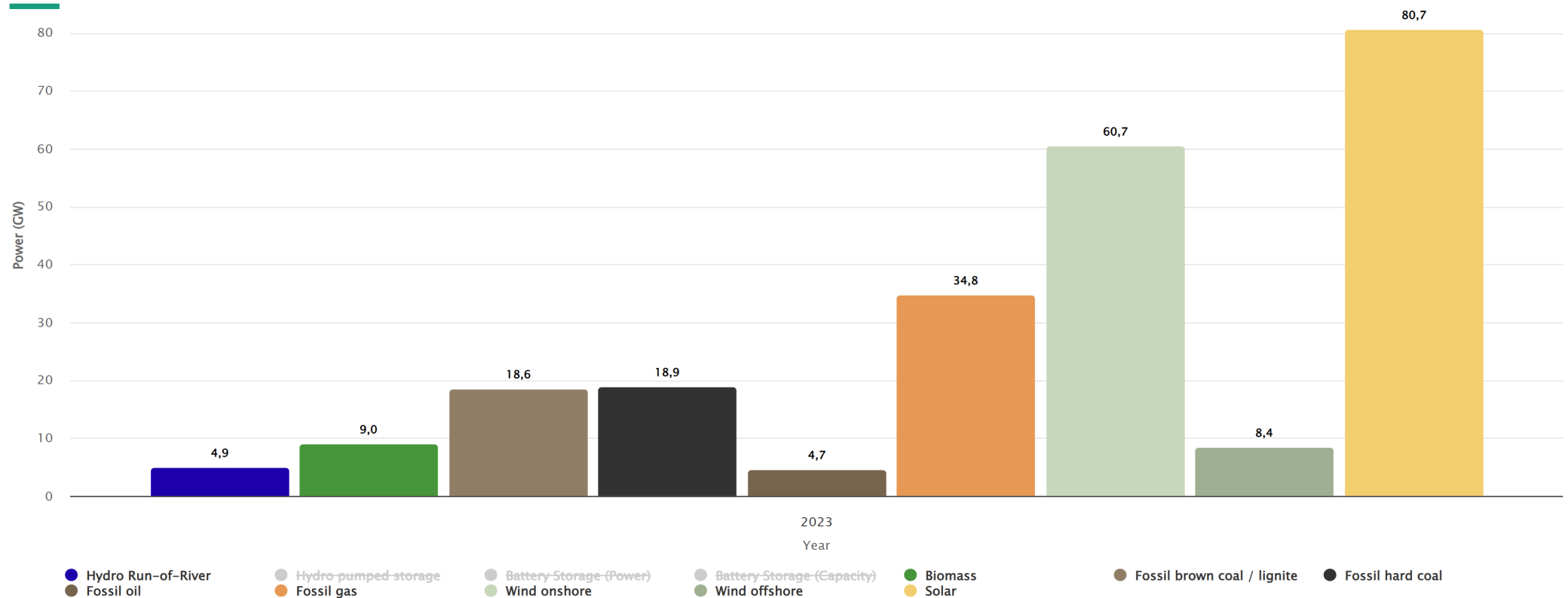
Source: https://energy-charts.info/charts/eeg_account/chart.htm?l=en&c=DE

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1. Summary
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Installed capacity for power generation

Year 2023



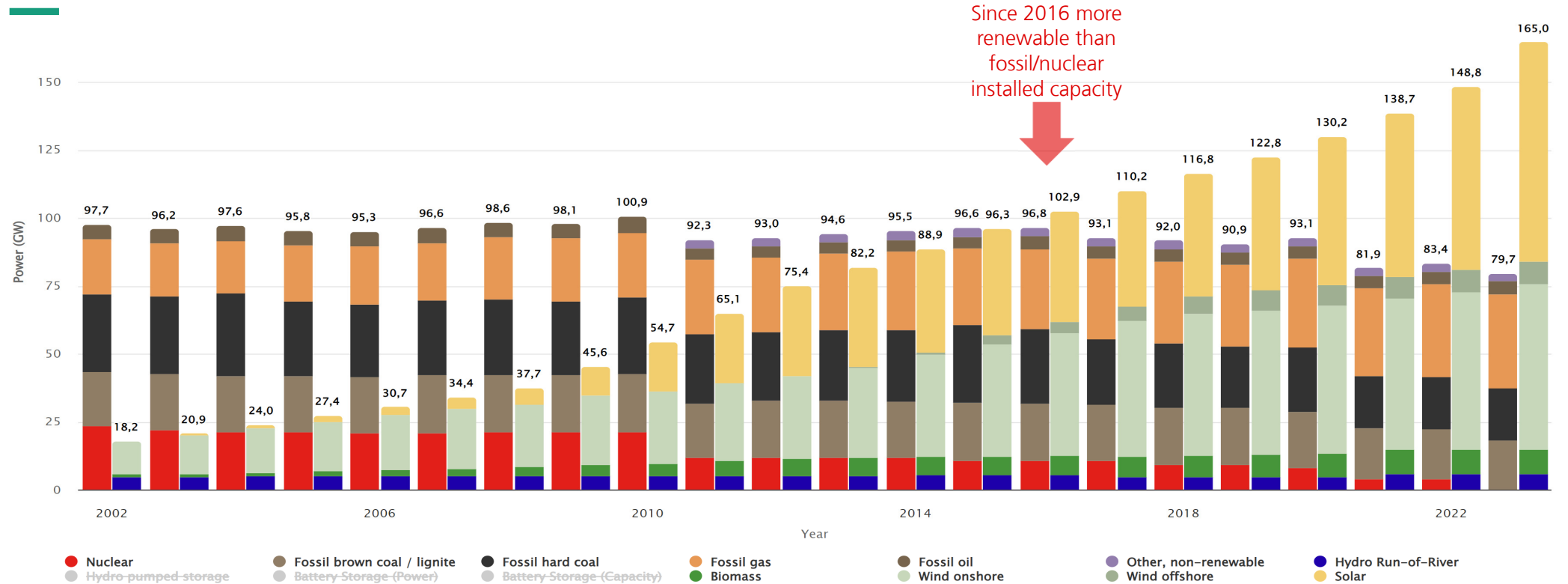
Energy-Charts.info - last update: 20.12.2023, 19:57 MEZ

DEUTSCHES ENERGIEBÜRO NOVEMBER 2023

Source: https://energy-charts.info/charts/installed_power/chart.htm?l=en&c=DE&year=2023

Installed capacity for power generation

Year 2002 to 2023



Energy-Charts.info - last update: 20.12.2023, 19:57 MEZ

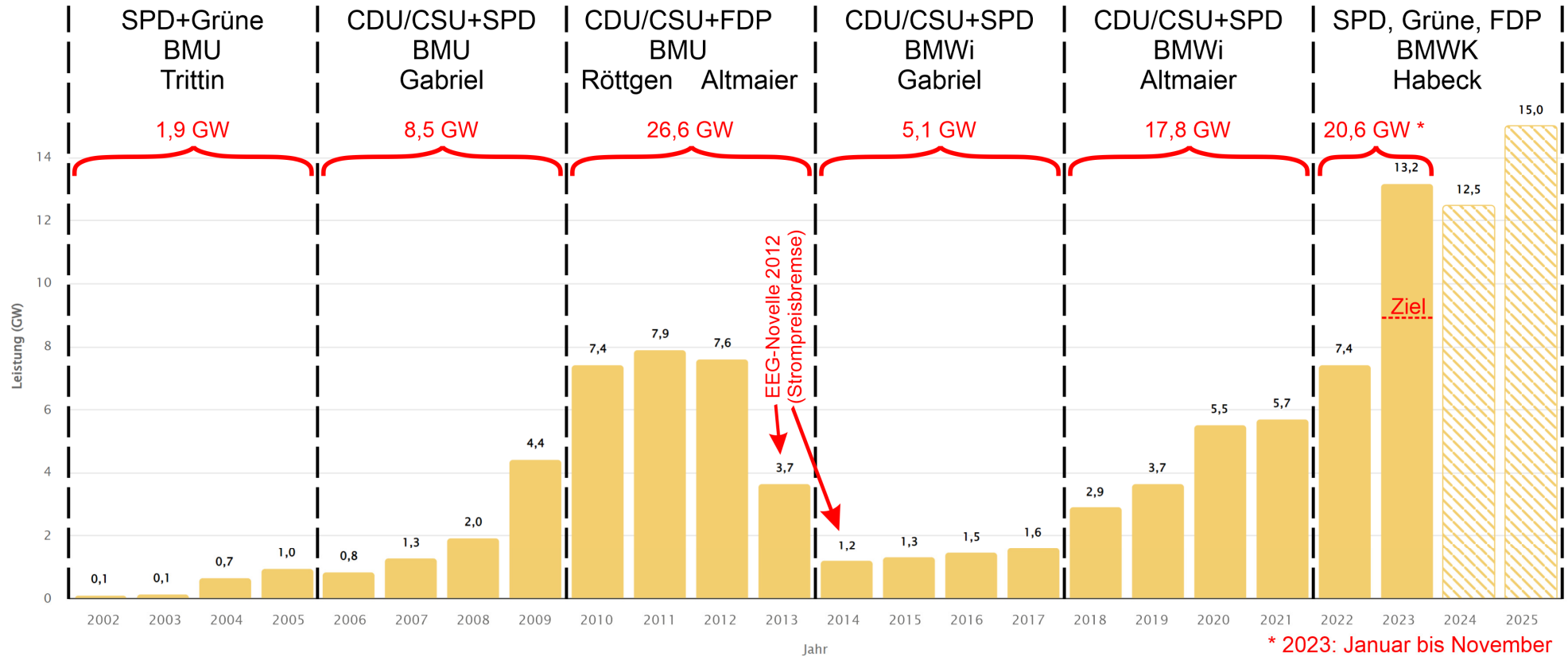
Fossil/nuclear (left bar) and renewable (right bar). Since 2016, the installed capacity of renewable energies has been greater than the installed capacity of fossil/nuclear.

source: https://energy-charts.info/charts/installed_power/chart.htm?l=en&c=DE&year=-1&stacking=stacked_grouped

*Data up to and including November 2023

Annual expansion of installed solar capacity

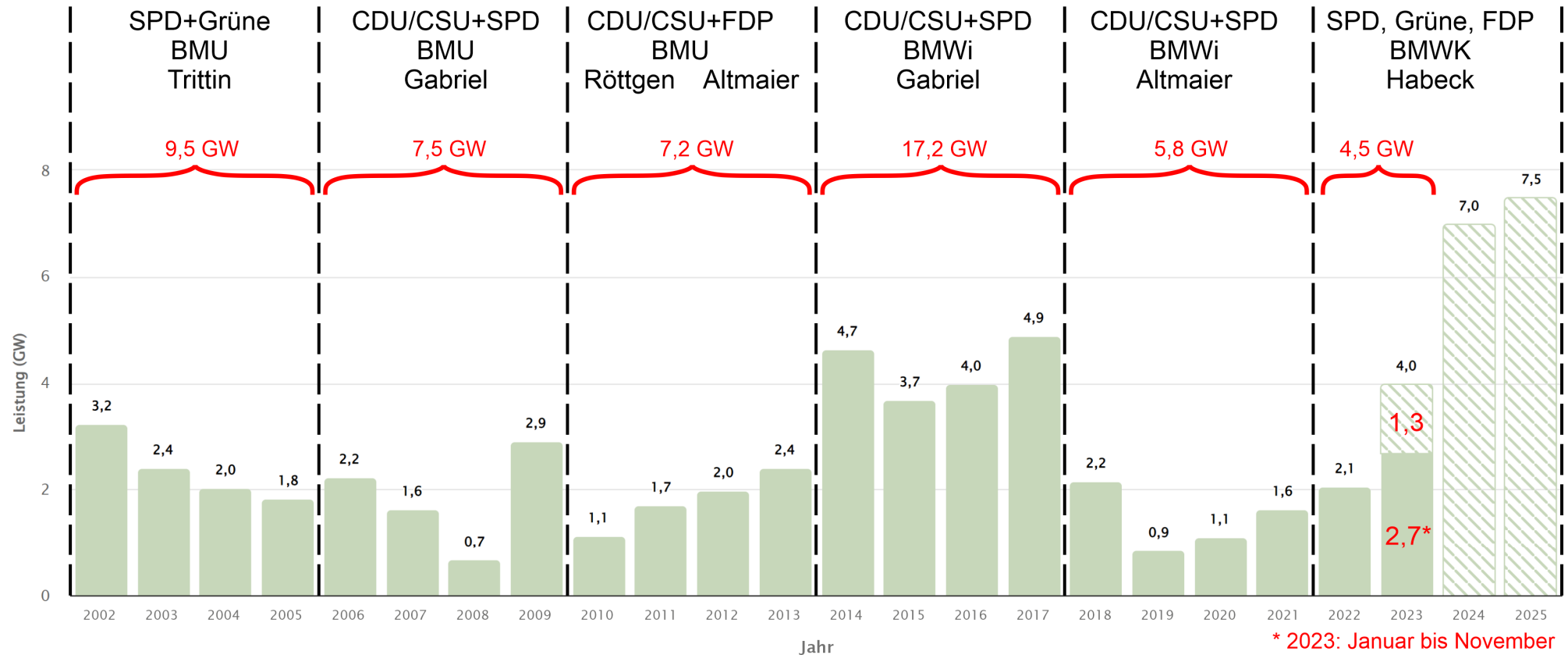
Actual values from 2002 to 2023 and planning until 2025



Source: https://energy-charts.info/charts/installed_power/chart.htm?l=en&c=DE&year=-1&expansion=installation_decommission

Annual expansion of installed wind onshore capacity

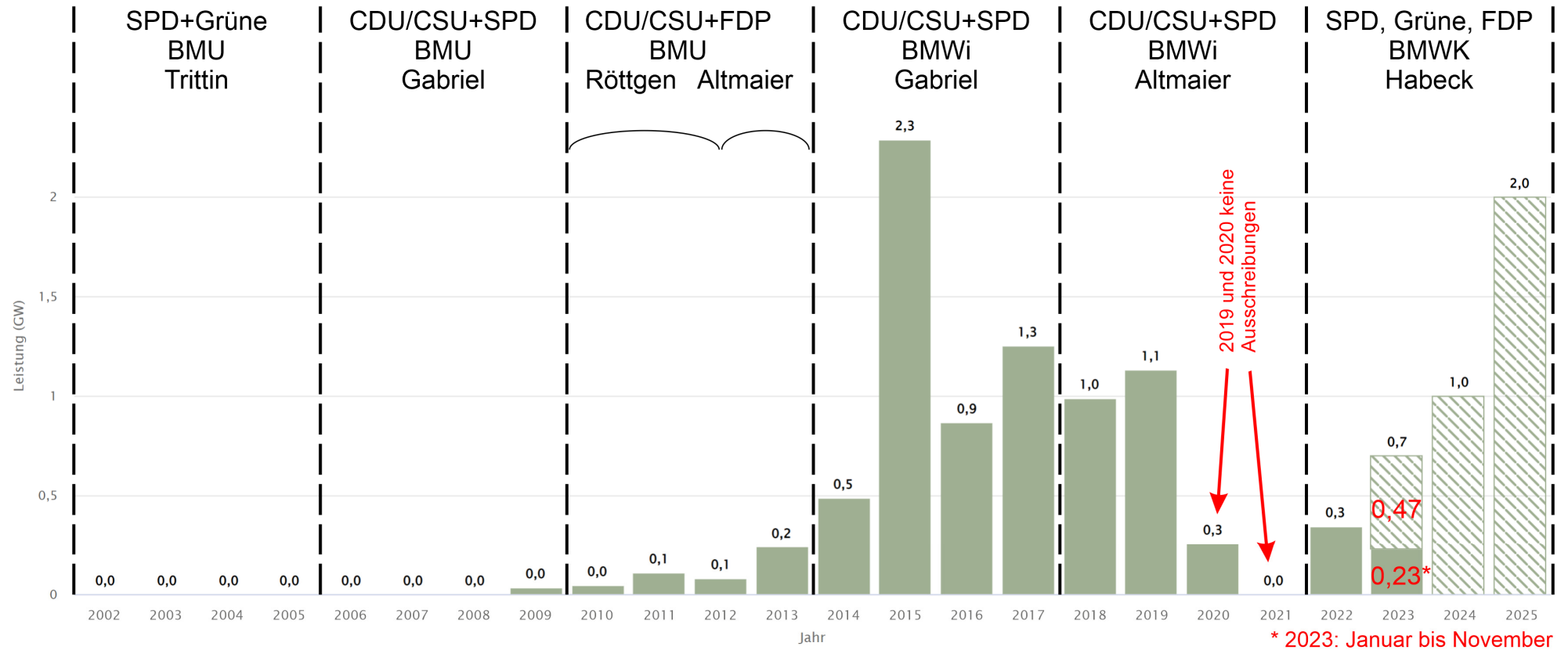
Actual values from 2002 to 2023 and planning until 2025



Source: https://energy-charts.info/charts/installed_power/chart.htm?l=en&c=DE&year=-1&expansion=installation_decommission

Annual expansion of installed wind offshore capacity

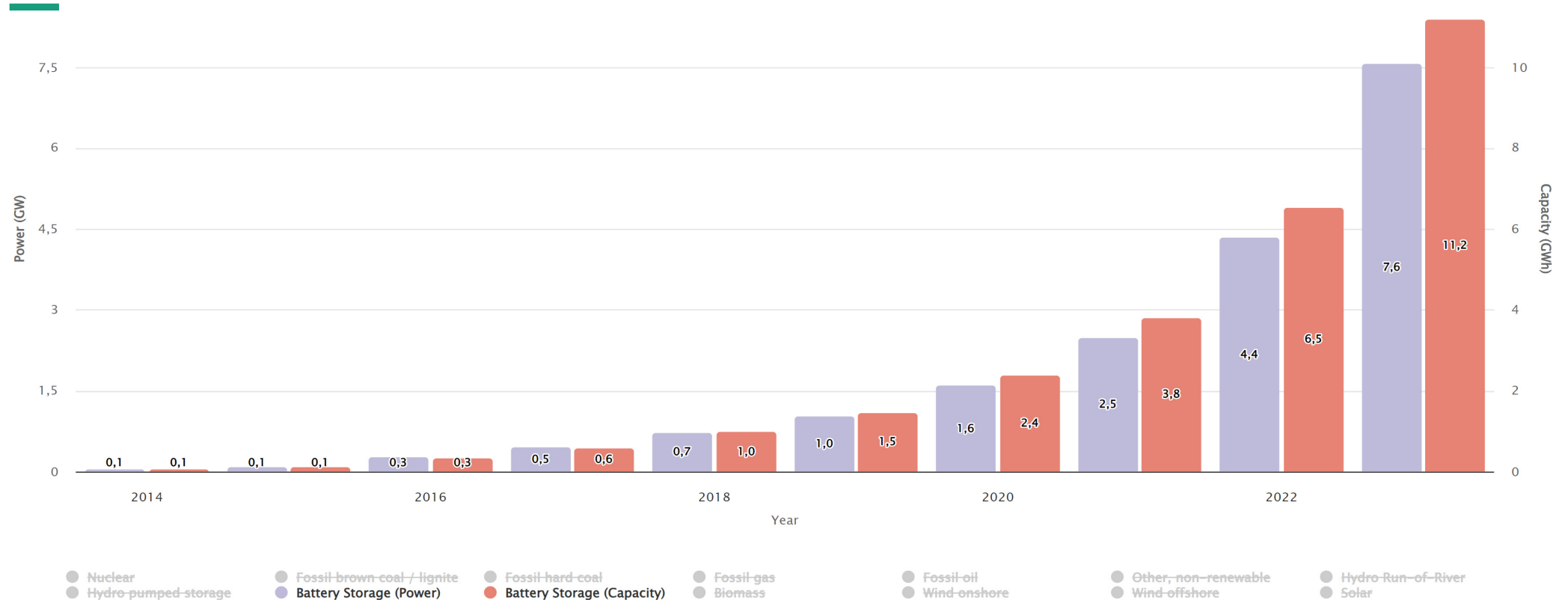
Actual values from 2002 to 2023 and planning until 2025



Source: https://energy-charts.info/charts/installed_power/chart.htm?l=en&c=DE&year=-1&expansion=installation_decommission

Installed power and capacity of battery storage systems

Year 2014 to 2023



Energy-Charts.info - last update: 20.12.2023, 19:57 MEZ

*Data up to and including November 2023

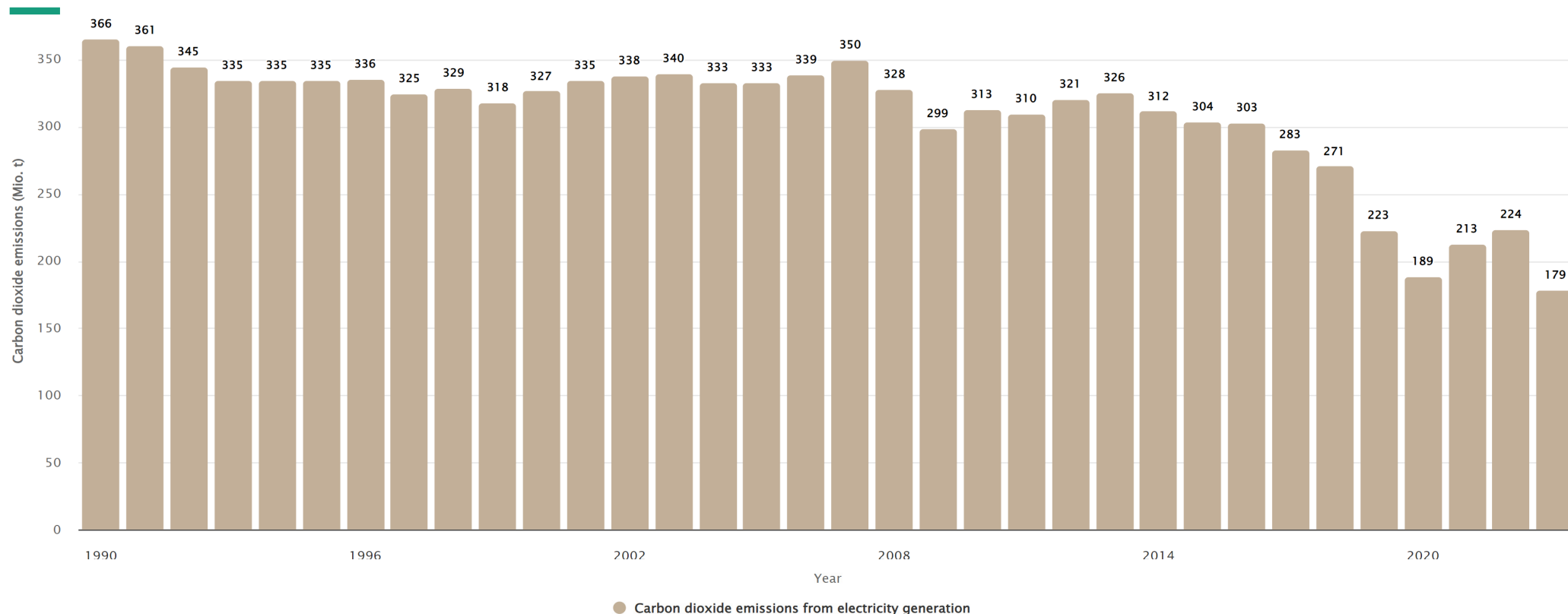
Source: https://energy-charts.info/charts/installed_power/chart.html?l=en&c=DE&year=-1&expansion=installed_power&partsum=1&sum=0&legendItems=00000000110000×lider=0&min=12&max=21

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Carbon dioxide emissions (CO₂) from electricity generation

Year 1990 to 2023

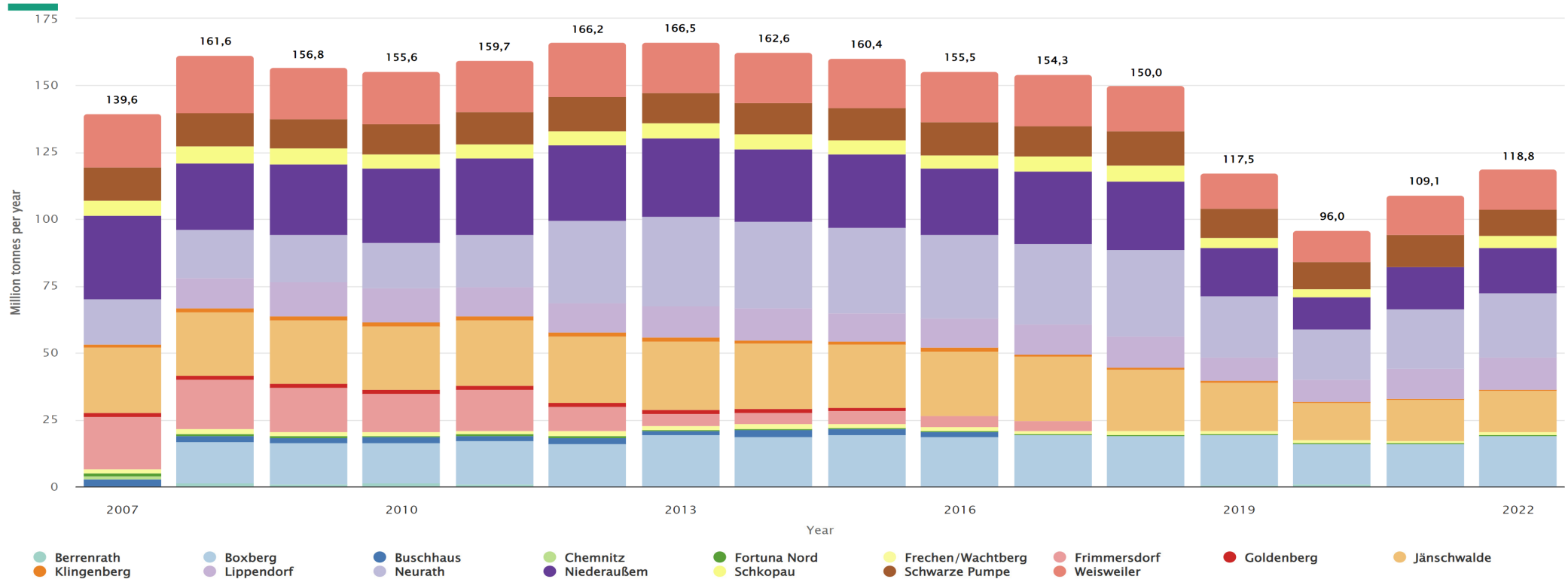


Energy-Charts.info - last update: 27.12.2023, 19:40 MEZ

Source: Umweltbundesamt, Data for 2023 provisional.

Carbon dioxide emissions (CO₂) from power plants

Brown coal/lignite



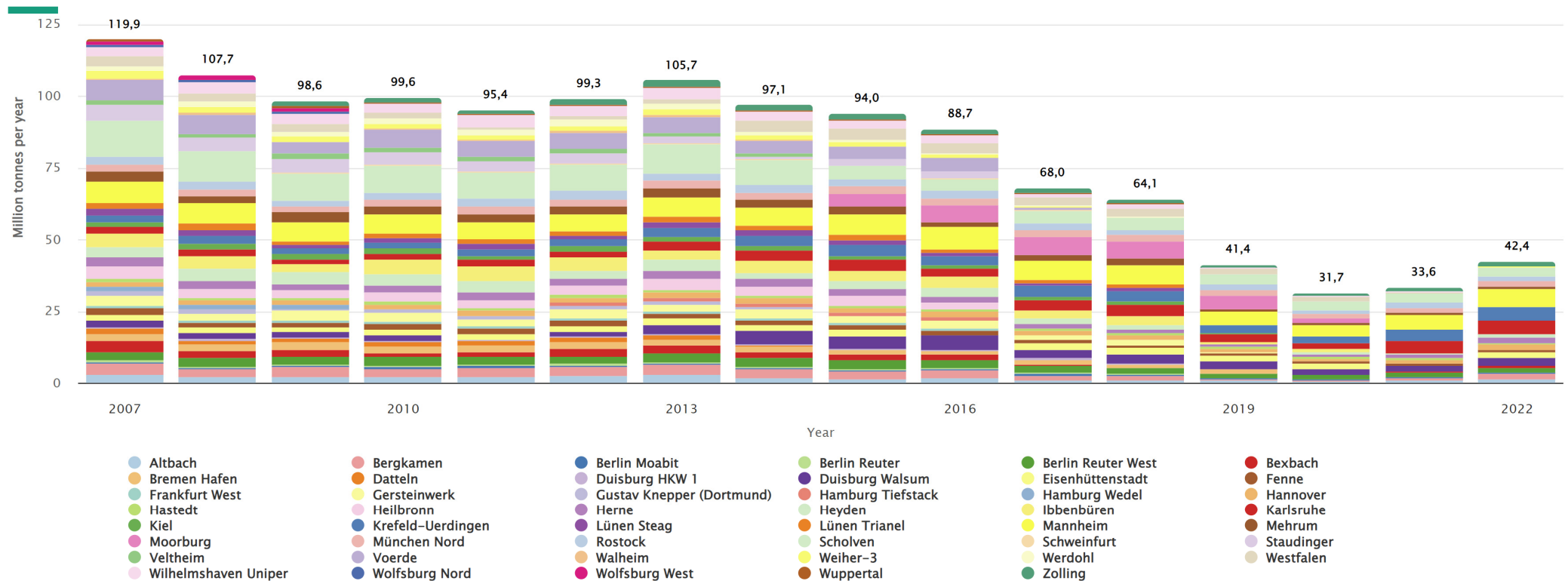
Energy-Charts.info - last update: 11.01.2024, 14:41 MEZ

Releases into the air. Pollutant threshold value: 0.1 million tonnes of CO₂ per year. Data source: Federal Environment Agency (UBA), E-PRTR Register

Source: <https://energy-charts.info/charts/emissions/chart.htm?l=en&c=DE&chartColumnSorting=default&year=-1&sum=1&source=lignite>

Carbon dioxide emissions (CO₂) from power plants

Hard coal



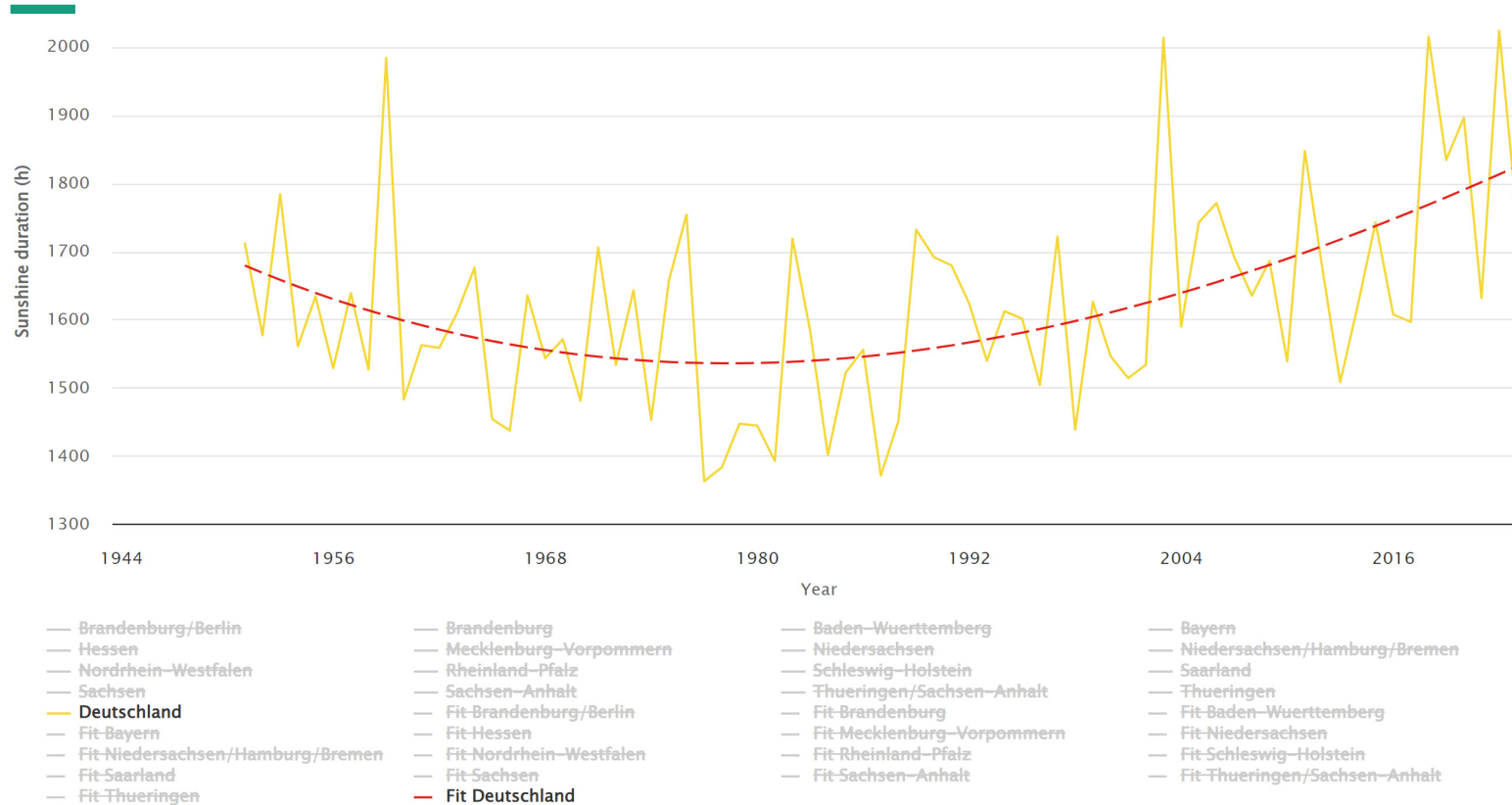
Energy-Charts.info - last update: 11.01.2024, 14:40 MEZ

Releases into the air. Pollutant threshold value: 0.1 million tonnes of CO₂ per year. Data source: Federal Environment Agency (UBA), E-PRTR Register

Source: https://energy-charts.info/charts/emissions/chart.htm?l=en&c=DE&chartColumnSorting=default&year=-1&sum=1&source=hard_coal

Sunshine duration in Germany

Year 1951 to 2023

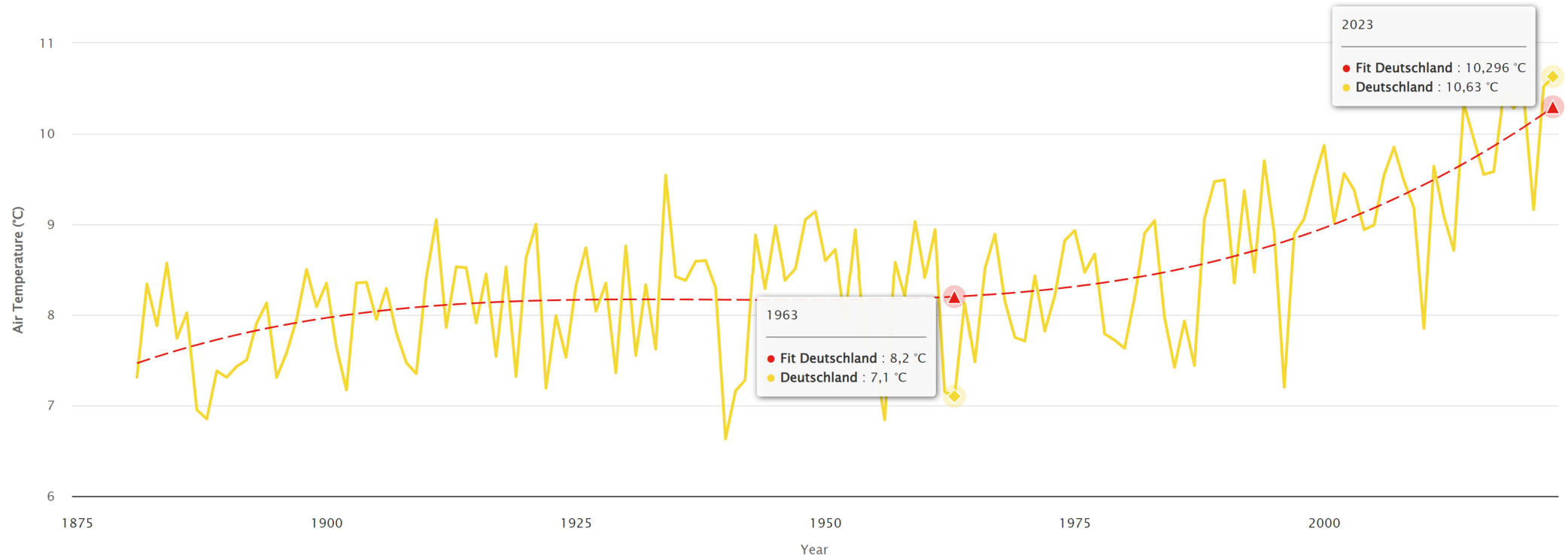


In 2023, the average sunshine duration in Germany was 1753 hours. This is 13.4% less than in 2022.

Source: https://energy-charts.info/charts/climate_annual_average/chart.html?l=en&c=DE&legendItems=00000000000000010000000000000010&source=sun_dur

Average air temperature in Germany

Year 1881 to 2023

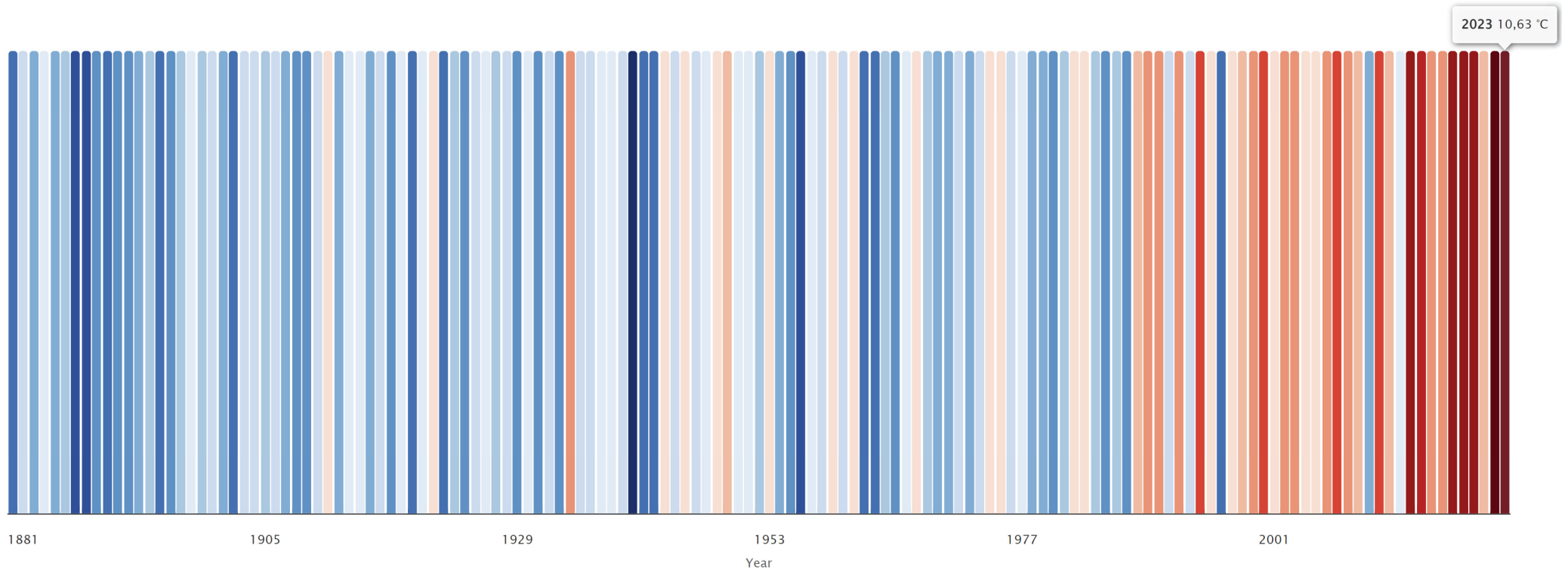


In 2023, the average air temperature in Germany was 10.63 °C. This is 2.43 °C higher than the long-term average (1961-1990) of 8.2 °C.

Source: https://energy-charts.info/charts/climate_annual_average/chart.htm?l=en&c=DE&legendItems=00000000000000010000000000000010&source=air_color_flat

Average air temperature in Germany

Warming stripes from 1881 to 2023



Datenquelle: Deutscher Wetterdienst (DWD)

Source: https://energy-charts.info/charts/climate_annual_average/chart.htm?l=en&c=DE&source=air_color_flat

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Electricity generation in Germany in 2023

Version 1

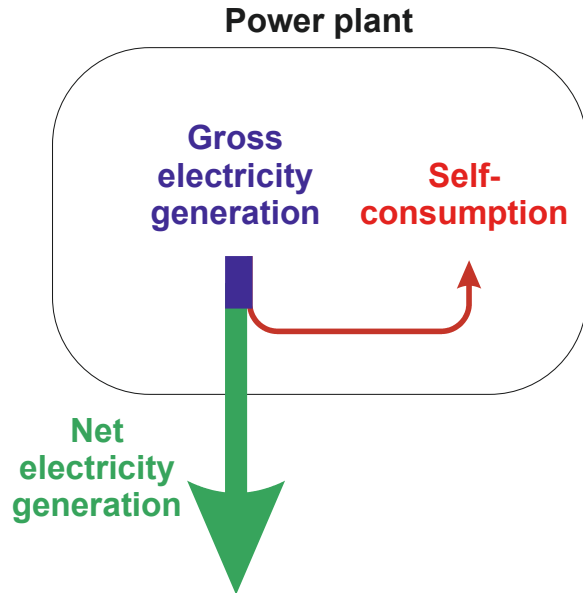
The first version of the 2023 annual evaluation from 1 January 2024 takes into account all electricity generation data from the Leipzig electricity exchange EEX up to and including 31 December 2023. The quarter-hourly values from EEX and Entsoe were energetically corrected using the available monthly data from the Federal Statistical Office (Destatis) on electricity generation up to and including September 2023 and the monthly data on electricity imports and exports up to and including October 2023. For the remaining months, the correction factors were estimated on the basis of past annual data. The extrapolated values are subject to larger tolerances.

You can find hourly updated data on the energy charts :

<https://www.energy-charts.info>

Difference between net and gross electricity generation

Net electricity generation



This report presents data on German **net electricity generation** for public electricity supply. When using net figures, a power plant's own consumption is supplied directly from the power plant's gross electricity generation. The difference between gross electricity generation and own consumption is the net electricity generation that is fed into the grid. According to this convention, a coal mill in a lignite-fired power plant, for example, is supplied directly from the electricity generated by the power plant and is therefore operated exclusively with lignite-based electricity.

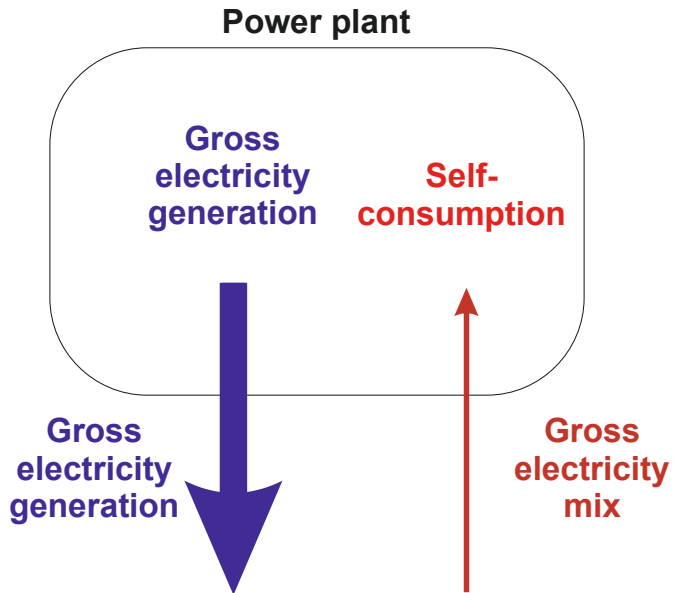
The entire electricity industry calculates with net figures, e.g. for electricity trading, grid calculation, grid utilisation, power plant deployment planning, etc.

Only net electricity generation is traded on the German electricity exchange EEX, the transmission system operators calculate with net flows, Entsoe only provides net figures and only net figures are measured for cross-border electricity flows.

Public net electricity generation represents the electricity mix that actually comes out of the socket at home and is consumed in the household or used to charge electric vehicles in public. The electricity meter in the home measures the net electricity that is consumed or fed into the grid.

Difference between net and gross electricity generation

Gross electricity generation



Gross electricity generation also includes the power plants' own consumption, which is used directly in the power plant and is not physically fed into the public electricity grid. On the consumption side, the power plants' own consumption is added to the gross electricity consumption so that the balance is correct again. According to this convention, a coal mill in a lignite-fired power plant, for example, is operated with the gross electricity mix and thus with approx. 45% renewable energies.

In addition, the gross electricity generation also includes the electricity generated by industry itself, the so-called "companies in the manufacturing industry and in mining and quarrying". This in-house generation is consumed directly by the companies and is not fed into the public grid. Gross figures are only collected for statistical purposes, but are not used in the daily electricity industry.

The data on net public electricity generation and total gross electricity generation differ significantly. This also results in significantly different shares of renewable energies in electricity generation and electricity consumption.

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