

# PRESS RELEASE

03.01.2025 || Page 1 | 7

## German Net Power Generation in 2024: Electricity Mix Cleaner than Ever

In Germany, net public electricity generation from renewable energy sources reached a record share of 62.7 percent in 2024. Solar power generation reached a new record of 72.2 terawatt hours in 2024, and the expansion of photovoltaics continued to exceed the federal government's targets. As the share of electricity generation from lignite (-8.4%) and hard coal (-27.6%) continued to fall sharply, the carbon dioxide emissions in the German electricity mix were lower than ever before. The balance of imported electricity rose to 24.9 terawatt hours. These figures are the results of an analysis presented by the Fraunhofer Institute for Solar Energy Systems ISE. The analysis is based on the data available on the platform [energy-charts.info](https://energy-charts.info).

**Wind power** was once again the most important source of electricity in 2024, contributing 136.4 terawatt hours (TWh) or 33 percent to net public electricity generation. In 2024 the contribution from onshore wind power fell to 110.7 TWh (2023: 115.3 TWh), while offshore production was slightly above the previous year's level at 25.7 TWh (2023: 23.5 TWh). The expansion of wind power, however, remains well behind the scheduled plan. Only 2.44 gigawatts (GW) of onshore wind had been newly installed by November 2024, compared to the planned 7 GW. The expansion of offshore installations was slightly better than in previous years. Here, 0.7 GW were newly installed in 2024 (5-7 GW planned annually until 2026 and 30 GW in total by 2030).

**Photovoltaic systems** generated approx. 72.2 TWh in 2024, of which 59.8 TWh was fed into the public grid and 12.4 TWh was used for self-consumption. Total production increased by around 10.8 TWh or 18 % compared to the previous year. Their share of net public electricity generation was 14 percent. At 8.7 TWh, July 2024 was the month with the highest solar power generation. As in 2023, photovoltaic expansion again exceeded the German government's targets in 2024. Instead of the planned 13 gigawatts, 13.3 gigawatts were installed by November. All of the energy data for 2024 is not yet available, however, estimates project new PV capacity to reach around 15.9 gigawatts by the end of 2024. PV expansion in Germany therefore remains at a double-digit level.

At 21.7 TWh, **hydropower** was roughly on par with the previous year (19.7 TWh). The installed capacity of run-of-river plants rose sharply from 4.94 GW to 6.4 GW. **Biomass** contributed 36 TWh to electricity generation, with installed capacity remaining unchanged at 9.1 GW.

In total, **renewable energy plants** produced around 275.2 TWh of electricity in 2024, 4.4% more than in 2023 (267 TWh). The share of renewable energy generated in

---

### Contact us

**Claudia Hanisch M. A.** | Communication | Phone +49 761 4588-5448 | [claudia.hanisch@ise.fraunhofer.de](mailto:claudia.hanisch@ise.fraunhofer.de)

**Prof. Bruno Burger** | Energy-Charts | Phone +49 761 4588-5237 | [bruno.burger@ise.fraunhofer.de](mailto:bruno.burger@ise.fraunhofer.de)

Fraunhofer Institute for Solar Energy Systems ISE | Heidenhofstraße 2 | 79110 Freiburg | [www.ise.fraunhofer.de](http://www.ise.fraunhofer.de)

Germany in the load, i.e. the electricity mix that comes out of the socket, was 56 percent compared to 55.3 percent in 2023.

In addition to the net public electricity generation, the total net electricity generation also includes electricity generated by industry and commerce for their own use, which is mainly gas-fired. The share of renewable energy in the total net electricity generation, including the power plants of "companies in the processing, mining and quarrying industries", is around 58.6% (2023: 54.7%).

Due to the increasing share of renewable energies and the decline in coal-fired power generation, electricity generation is lower in CO<sub>2</sub> emissions than ever before; since 2014, emissions from electricity generation have halved (from 312 to approx. 152 million tons of CO<sub>2</sub> per year). Carbon dioxide emissions from German electricity generation were 58 percent lower than at the start of data collection in 1990.

**The load** on the electricity grid amounted to 462 TWh and is thus slightly above the level of 2023 (458 TWh). It should be noted that own consumption of solar power has increased by around 12.4 TWh. According to the definition, the own electricity consumption does not count as load, but indicates an overall increase in electricity consumption. The load includes the electricity consumption from the grid and the grid losses, but not the pumped electricity consumption and the own consumption of conventional power plants.

---

03.01.2025 || Page 2 | 7

---

### **Battery storage systems developing rapidly**

Parallel to the expansion of renewable energy capacity in Germany is the increasing demand for storage capacity. Decentralized battery storage systems are particularly well suited to buffering the generation of wind and solar power. New photovoltaic systems in private households are usually installed together with a home storage system. However, most small systems still lack the intervention options for grid-friendly operation. In the large-scale storage segment, the installed capacity could multiply over the next few years if all of the pre-registered projects in the Federal Network Agency's market master data register are implemented.

In 2024 the installed battery capacity increased from 8.6 to 12.1 GW, and the storage capacity from 12.7 GWh to 17.7 GWh. The capacity of German pumped storage plants is around 10 GW.

**First full year without nuclear power. Coal-fired power generation continues to decline**

03.01.2025 || Page 3 | 7

2024 was the first full year in Germany without electricity generation from nuclear power since 1962. The last three nuclear power plants Emsland A, Neckarwestheim 2 and Isar 2 were shut down in April 2023. In their last year of operation, the three plants supplied 6.3 percent of public electricity generation. This amount was replaced by renewable energy generation.

Net public electricity generation from German coal-fired power plants continues to fall, as **lignite** supplied 71.1 TWh, which is 8.4 percent less than in the previous year (77.6 TWh). An additional 1.3 TWh was used for industrial own consumption.

Net production from **hard coal-fired power plants** fell even more sharply, supplying 24.2 TWh in 2024, a drop of 27.6 percent compared to 2023 (33.4 TWh). No electricity was generated from hard coal for industrial own consumption.

In order to compare today's generation with historical values, gross electricity generation must be considered, as figures for net electricity generation have only been available since 2002. The total gross electricity generation from lignite and hard coal is estimated to be around 108 TWh at the end of 2024. The last time we had such a low level in Germany was in 1957.

On the other hand, the use of **natural gas** for electricity generation rose by 9.5% compared to 2023, totaling 48.4 TWh for the public electricity supply and 25.6 TWh for industrial own consumption.

**Exports and Electricity Exchange Price**

In 2023, Germany recorded a net import surplus of 9.2 TWh for the first time. This was due, in particular, to the lower electricity generation costs in neighboring European countries in the summer and the high cost of CO<sub>2</sub> certificates. Imports rose to a net total of 24.9 TWh in 2024, with the most important import countries being France (import balance 12.9 TWh), Denmark (12.0 TWh), Switzerland (7.1 TWh) and Norway (5.8 TWh). On balance, Germany exported electricity to Austria (7.2 TWh), Poland (3.5 TWh), Luxembourg (3.5 TWh) and the Czech Republic (2.8 TWh).

Electricity exchange prices rose significantly in November and December, which made fossil fuel-based electricity generation at times more profitable than it had been in the summer. As a result, imports fell. In contrast to its neighboring countries (Austria,

Switzerland, France), Germany has sufficient power plant capacity in winter to produce electricity for export.

The average volume-weighted day-ahead **exchange electricity price** fell by around 15.5% to € 78.01/MWh, or 7.8 cents/kWh, (2023: € 92.29/MWh or 9.23 cents/kWh), which is below the level of 2021 (€ 93.36/MWh). In 2022, the exchange electricity price was very high at € 230.57/MWh, due to the resulting energy crisis after the attack on the Ukraine as well as to the unavailability of many nuclear power plants in France.

**More information:**

A detailed presentation of the data on electricity generation, imports/exports, prices, installed capacity, emissions and climate data can be found on the [Energy Charts Server](#).

**The data basis**

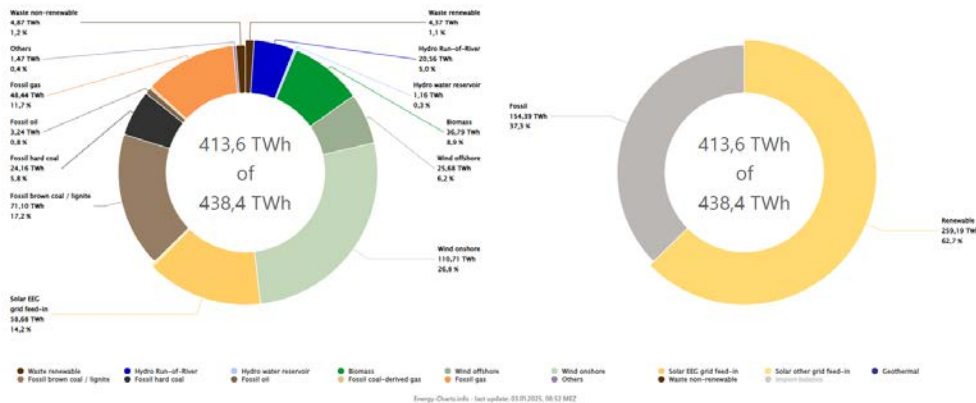
This first version of the annual energy data evaluation takes into account all electricity generation data from the Leipzig Electricity Exchange (EEX) and the European Network of Transmission System Operators for Electricity (ENTSO-E) up to and including 31.12.2024. The quarter-hourly values from the EEX were corrected using the available monthly data from the Federal Statistical Office of Germany on electricity generation up to September 2024. For the remaining months, the correction factors were estimated on the basis of past monthly and annual data. The extrapolated values from October to December are subject to larger tolerances.

The data analysis is based on the data for German **net electricity generation** for the public electricity supply. This is the energy that is fed into the public grid and is defined as the gross electricity generation minus the consumption of the power plants' auxiliary services. The electric power industry calculates with net figures, e.g. for electricity trading and grid utilization, and only net electricity generation is traded on the electricity exchanges. It represents the electricity mix that actually comes out of the socket.

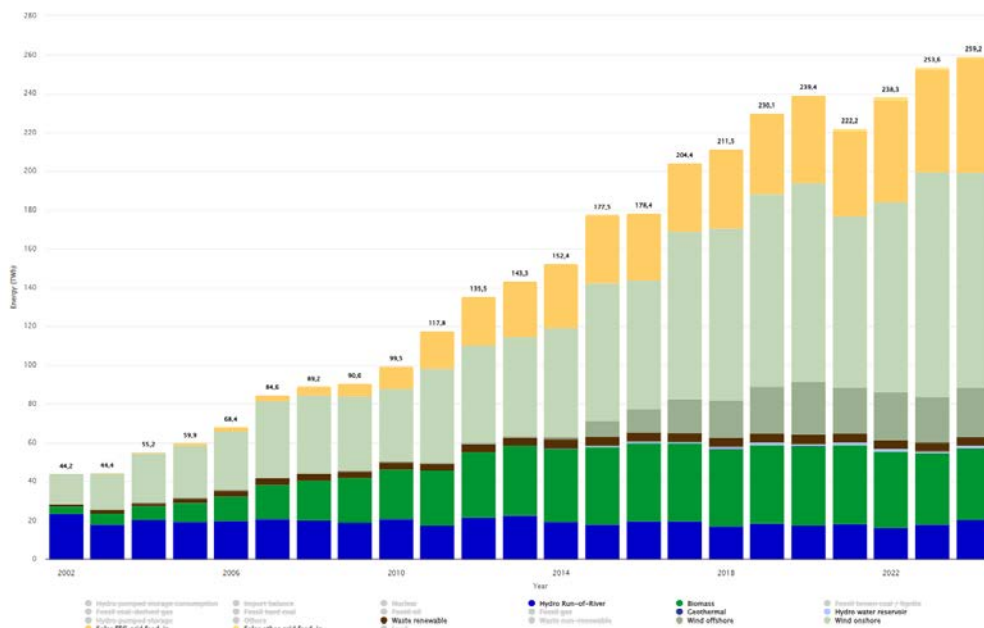
Hourly updated data on electricity generation can be found on the Energy Charts website: <https://www.energy-charts.info>

## FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS ISE

03.01.2025 || Page 5 | 7

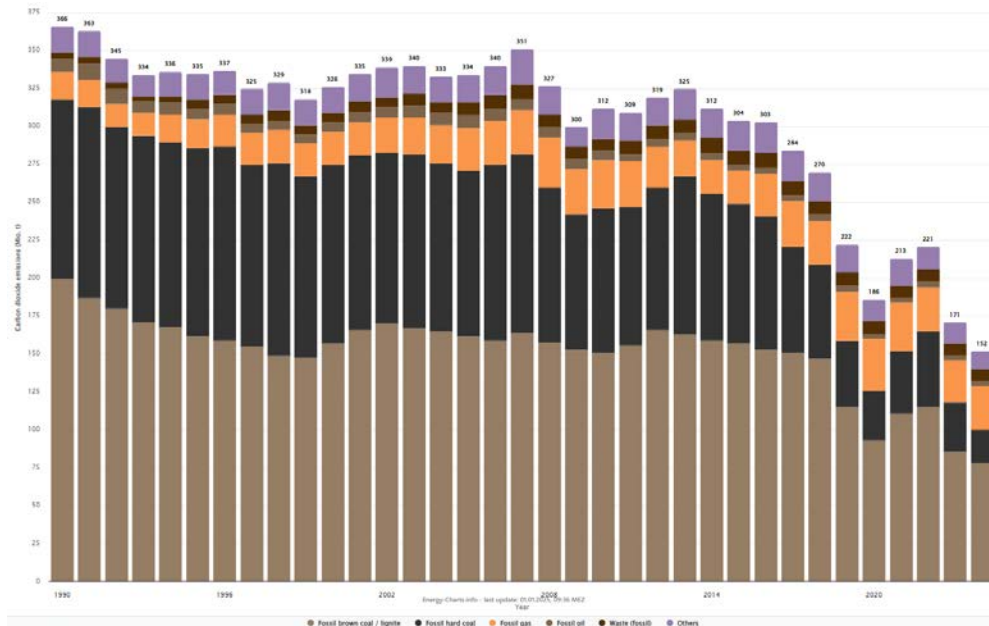


Shares of the various energy sources in net public electricity generation. ©Fraunhofer ISE/energy-charts.info



The **Fraunhofer-Gesellschaft**, based in Germany, is the world's leading organization for applied research. With its focus on key technologies relevant to the future and on the exploitation of results in business and industry, it plays a central role in the innovation process. As a guide and driving force for innovative developments and scientific excellence, it helps to shape our society and our future. Founded in 1949, the organization currently operates 76 institutes and research units in Germany. Around 32,000 employees, most of them with vocational training in the natural sciences or engineering, work with an annual research budget of 3.4 billion euros. Of this, 3.0 billion euros is spent on contract research.

The **Fraunhofer-Gesellschaft**, based in Germany, is the world's leading organization for applied research. With its focus on key technologies relevant to the future and on the exploitation of results in business and industry, it plays a central role in the innovation process. As a guide and driving force for innovative developments and scientific excellence, it helps to shape our society and our future. Founded in 1949, the organization currently operates 76 institutes and research units in Germany. Around 32,000 employees, most of them with vocational training in the natural sciences or engineering, work with an annual research budget of 3.4 billion euros. Of this, 3.0 billion euros is spent on contract research.

**FRAUNHOFER INSTITUTE FOR SOLAR ENERGY SYSTEMS ISE**


03.01.2025 || Page 7 | 7

CO<sub>2</sub> emissions from electricity generation from 1990 to 2024. 2024 values are an extrapolation. ©Fraunhofer ISE/energy-charts.info

The **Fraunhofer-Gesellschaft**, based in Germany, is the world's leading organization for applied research. With its focus on key technologies relevant to the future and on the exploitation of results in business and industry, it plays a central role in the innovation process. As a guide and driving force for innovative developments and scientific excellence, it helps to shape our society and our future. Founded in 1949, the organization currently operates 76 institutes and research units in Germany. Around 32,000 employees, most of them with vocational training in the natural sciences or engineering, work with an annual research budget of 3.4 billion euros. Of this, 3.0 billion euros is spent on contract research.