

NEWS

NEWSJanuary 15, 2020 || Page 1 | 4

Public Net Electricity Generation in Germany 2019: Share from Renewables Exceeds Fossil Fuels

Researchers at the Fraunhofer Institute for Solar Energy Systems ISE have presented the newest figures on the annual electricity generation in Germany. The share of renewables in the net electricity generation, that is, the amount coming from the socket, rose from 40.6 percent in 2018 to 46 percent in 2019, and surpassed the share from fossil fuels (40 percent) for the first time. Electricity production by wind evidenced the largest growth, increasing by 17.3 TWh. Production from brown coal-fired plants declined the most, producing 29.3 TWh less than 2018.

In 2019, German photovoltaic (PV) plants fed about 46.5 TWh into the public electricity grid, an increase of 1.7 percent compared to 2018. New photovoltaic installations of 3.3 gigawatts increased the installed capacity to ca. 48.6 gigawatts (as of the end of October). On April 19, 2019 at 1 p.m., solar power production peaked at 33 gigawatts, corresponding to 48 percent of the total electricity production at this point in time. From March to September 2019 German photovoltaic plants generated more electricity per month than hard coal power plants.

Electricity from wind amounted to about 127 TWh in 2019, an increase of 15.7 percent. As a result, wind became the main electricity source in Germany for the first time. In eight months of the past year, the electricity generation from wind surpassed brown coal and in twelve months nuclear. Wind power production peaked at ca. 46 GW on March 15 at 7 p.m. In 2019, onshore wind produced 102.6 TWh and offshore wind increased its output to 24.4 TWh, up from 19.1 TWh in 2018. On the other hand, the number of new onshore wind installations dropped drastically: By the end of October 2019, only 660 MW of new capacity had gone online so that the installed power of onshore wind was 53.1 GW and of offshore 7.6 GW, respectively.

Together wind and solar power plants generated a total of ca. 173 TWh electricity in 2019. The ratio of wind and solar is still imbalanced. For an optimal wind to solar ratio, 15 GW of installed solar power were lacking at the end of 2019.

Of all the renewable sources, hydropower experienced the greatest percentage increase (21.2 %) and contributed 19.2 TWh to the net electricity generation in 2019. Biomass contributed 44 TWh, slightly under production in 2018.

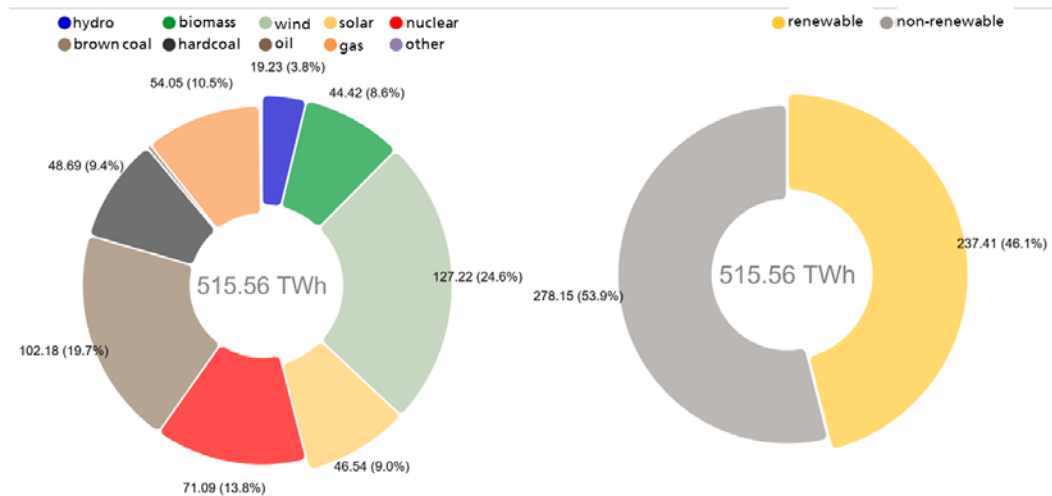
In 2019 the total electricity production from all renewable sources was about 237 TWh, an increase of 7 percent compared to 2018, and above fossil fuel carriers (207 TWh) for the first time.

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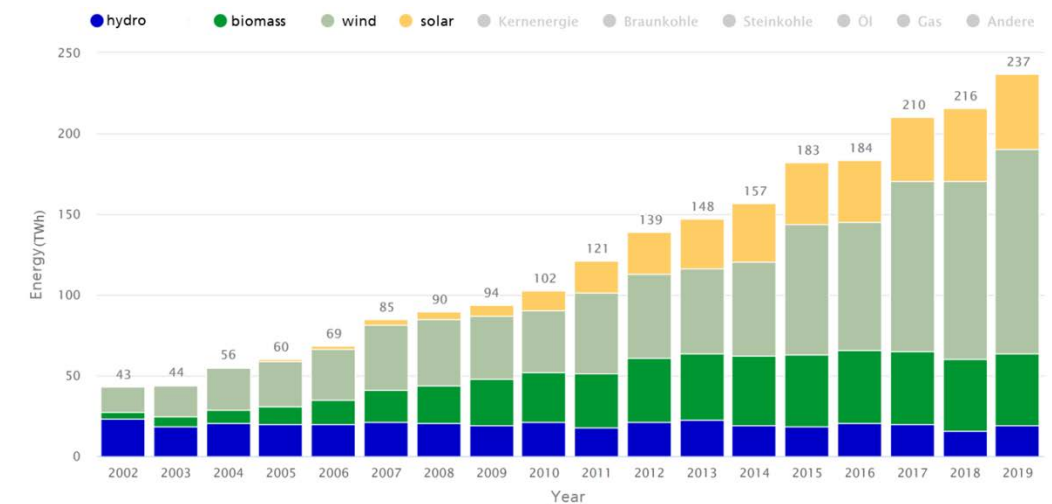
The electricity generated by nuclear plants was 71.1 TWh, slightly less than 2018. In all, the share of non-renewable energy sources in the electricity mix decreased by 14 percent.

NEWS

January 15, 2020 || Page 2 | 4



Net electricity generation from power plants supplying the public grid. The electricity generation from power plants in the manufacturing, mining and quarrying industries, i.e. the self-generation of electricity in industry, is not included. ©Fraunhofer ISE/Bruno Burger



The share of renewables contributing to Germany's public net electricity generation (the electricity mix coming from the socket) from 2002 to 2019. The electricity generation from power plants in the manufacturing, mining and quarrying industries, i.e. the self-generation of electricity in industry, is not included. ©Fraunhofer ISE/Bruno Burger

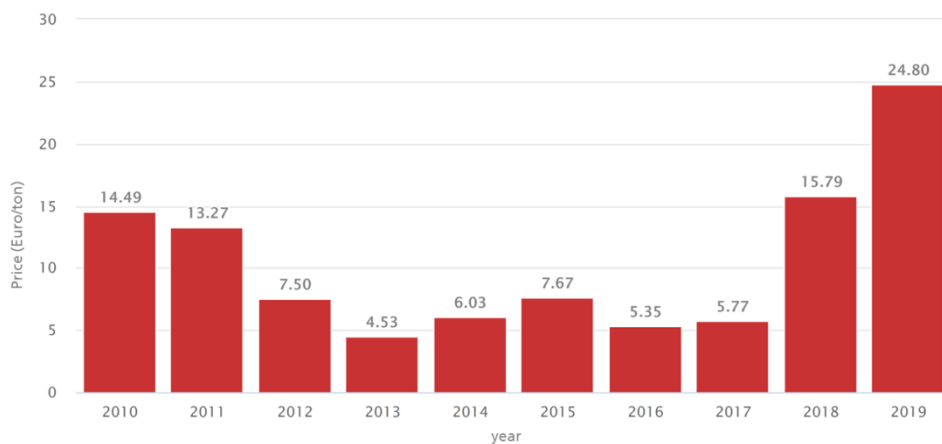
Decline in Electricity Generation by Coal Plants

In 2019, the output from brown coal-fired plants decreased sharply: Compared to 2018, net electricity production from brown coal fell by 22.3 percent (or 29.3 TWh) to 102.2 TWh. The net electricity production from hard coal declined by 32.8 percent (or 23.7 TWh) to 48.7 TWh.

This large decline can be attributed to several factors: First, the electricity from wind rose sharply, forcing coal-fired power plants to reduce capacity. Secondly, carbon certificates became much more expensive, rising on average from 15.79 Euro/ton in 2018 to 24.80 Euro/ton in 2019. Due to the high share of renewable production, the electricity price on the market was low, which lowered the price difference between the carbon emissions and electricity on the market. The margin for coal fell accordingly. The average volume-weighted day-ahead electricity price declined 15 percent to 36.64 Euro/MWh from 43.26 Euro/MWh in 2018.

NEWS

January 15, 2020 || Page 3 | 4



Development of the CO₂ certificate price (European Emission Allowances) from 2010 ©Fraunhofer ISE/Bruno Burger

One megawatt hour of electricity generated by brown coal produces about one ton of carbon dioxide emissions. Therefore, brown coal-fired plants no longer operate profitably when the CO₂ price (Euro/ton) is near the market price of electricity (Euro/MWh). Furthermore, the energy load fell 9.5 percent in 2019. This led to lower electricity prices on the market and thus worsening conditions for brown coal electricity production.

In addition, gas prices were very low in 2019. Gas-fired plants produce far less carbon emissions than brown coal fired power plants, and therefore require less carbon certificates. At times, the combined cost of the gas and the carbon certificates for gas-fired plants was lower than just the carbon certificate costs of brown coal-fired power plants. Despite zero fuel costs, brown coal power plants could no longer operate competitively. Particularly in the months of May, June and December, a switchover

from brown coal to gas occurred. As a result, the electricity production from gas-fired power plants increased by 21.4 percent in 2019, producing a total of 54.1 TWh. This was not only an effect witnessed in Germany, but also in neighboring countries, who found it cheaper, due to the high CO₂ prices, to generate electricity using their own gas-fired power plants than to buy electricity produced by brown coal in Germany.

NEWSJanuary 15, 2020 || Page 4 | 4

Export surplus declines

Electricity exports also decreased strongly, falling from 48 TWh in 2018 to about 30 TWh in 2019. The majority of electricity was exported to Austria (11.7 TWh) followed second by Poland (10 TWh). Poland transmitted part of this electricity from the New German States to Southern Germany via the Czech Republic. 6.5 TWh was exported to Switzerland, who transmitted the majority to Italy. Germany imported 11.9 TWh electricity from France and transmitted most of it to neighboring countries. The average amount of exported power was 3.4 GW, equivalent to three nuclear power plants. During 6310 hours (72 percent) of the year, electricity was exported by Germany, and during 2450 hours, electricity was imported. At the end of October, Germany had an export surplus of 24.2 TWh and revenues valuing around 1.2 billion euros. Imported electricity cost 45.08 Euro/MWh on average and exported electricity 46.99 Euro/MWh respectively.

Data Sources and Information

This first version from January 2, 2020 considers all of the electricity data of the European Electricity Exchange (EEX) in Leipzig through December 31, 2019. The hourly energy values were corrected using the available monthly data on electricity generation from the Federal Statistical Office (Destatis) up to and including October 2019 and the monthly data for electricity import and export up to and including October 2019. For the rest of the months, the correction factors were estimated based on data from the past years. The extrapolated values are subject to larger tolerances.

Hourly updated data can be found in the Energy Charts:

<https://energy-charts.de/index.htm>