Agorameter – Documentation

Version 8.1 – July 2019

Notes on data used for displaying current power generation, power consumption, exports, imports and the market spot price in the Agorameter, available at www.agora-energiewende.de

The current power generation and consumption situation in Germany is shown graphically at Agora Energiewende's website, which enables tracking the energy transition progress at all times based on current data. The power generation and consumption data is updated hourly and is available to the general public (with a delay of about 1–2 hours). The core idea behind the Agorameter is to display power generated by renewable energy sources separated into wind, solar, hydropower and biomass. The power generated from conventional energy sources is also reported, broken down into nuclear, lignite, hard coal, natural gas, pumped storage hydroelectricity, and other. The Agorameter also provides data on domestic power consumption, commercial power imports and exports as well as the electricity spot price in the day-ahead market.

The data is derived from a number of different sources. In cases where complete data sources are not available, the figures are based on our own calculations and estimates. The individual parameters are displayed according to their availability (i.e. price data is available earlier and may therefore be ahead of generation data). Suggestions for how the data can be improved or where better estimates can be made are always welcome.

The time resolution in the chart is 1 hour for time ranges up to 30 days. The time resolution is reduced to 1 day for longer time ranges in order to ensure quicker loading. Therefore, the daily mean values are calculated based on hourly values of each respective day. Missing data is not filled in by means of interpolation but treated as a blank value, which is why the daily mean values are calculated based on reduced information. In general, the time required to process and display data increases as the chosen time range grows larger.

Agora Energiewende aims to continuously improve its presentation of the current power generation and consumption situation. All data sources and calculations are documented as follows.

1 Methodological approach

In general, power generation can be stated in gross (including internal consumption by power plants) or net figures. The Agorameter only shows the net generation since net power generation describes the quantity of electricity that is actually made available to the power system. How much electricity was consumed by a power plant itself is not actually relevant for displaying the current generation situation in Germany. For this reason, the internal consumption by the various generation plants is not shown in the graphs. It must be noted, however, that the expansion and generation goals for renewable energy are given in gross generation figures as a share of gross domestic consumption.

Agora Energiewende does not collect any data itself. All of the raw data presented here is published by the transparency platforms of the European transmission network operators

ENTSO-E (from 2018 onwards) and the Leipzig-based European Energy Exchange EEX (from 2012 up to and including the year 2017). The data is selected and processed in the Agorameter immediately after being published by these transparency platforms. Because the transparency platform operators make considerable adjustments to the data at regular intervals, the raw data is retrieved again once a day during a period of 28 days after the first download and updated as necessary.

Because the various data sets only represent part of the power generation system, the data used by Agora Energiewende is in some cases adjusted based on methods set forth in this document.

1.1 Standard calculation

Agora Energiewende uses the following methodology for the metrics displayed by the Agorameter:

Power generation: The data for power generation is based on the hourly publications of the EEX (2012-2017) or ENTSO-E (from 2018), respectively, for current power generation by each energy source. However, depending on the energy source, the data published by the EEX/ENTSO-E usually only covers part of the actual quantity of electricity generated. To compensate for these differences, the EEX/ ENTSO-E data series are adjusted.

Power demand: The domestic power demand is calculated as the difference between net hourly power generation and the current balance of trade with countries abroad.

Cross-border electricity trading: The data for current electricity imports and exports (day-ahead market) is taken from ENTSO-E and are incorporated unchanged.

Market spot price: The published market spot prices are the results of the day-ahead auctions on the European electricity market EPEX-Spot for the German/Austrian/Luxembourgian market region till September 2018 or the German/Luxembourgian market region from October 1, 2018, respectively. The data is provided in hourly values by ENTSO-E and is incorporated unchanged.

CO_2-Emissions: Emissions data represents those CO_2-Emissions, which are directly emitted during the power production in Germany. These are based on the corrected, hourly power generation data published by the EEX or ENTSO-E, which are then multiplied by their respective emissions factors. Only direct emissions of the power production are displayed.

2 Power generation

2.1 Wind energy

Between 2012 and 2018, the gross power generation from wind energy increased from 51.7 terawatt-hours to 111.5 terawatt-hours. The gross generation is equal to the net generation for wind energy because wind turbines require barely any electricity for their own operation.

The generation data shown for wind energy is taken from the EEX (2012-2017) or ENTSO-E (from 2018), respectively, and is updated hourly, as soon as it becomes available. The data is based on measurements by the transmission network operators (ÜNB) at various reference sites and is then extrapolated by the ÜNB to all of Germany. This data is used by the ÜNB to balance the load on the grid.

Data for the power production from onshore and offshore plants is shown combined for the years 2012 to 2014. For this purpose, the hourly feed-in time series for all wind plants published by the EEX are used as a base reference. Then, based on the available monthly generation data, the hourly values are adjusted by the monthly correction factor (Table 1).

From 2015 onwards, the data for onshore and offshore plants is reported separately. Due to varying data availability, for 2015 an interims solution has been used. Here, analogous to the period 2012–2014, the feed-in series for all wind power plants are first used as a basis and then scaled with monthly correction factors to yield total wind generation. The EEX feed-in time series available for 2015 is then scaled for offshore wind plants using the annual correction factor (2015: 2.04). As this calculation may lead to values which exceed the factually installed capacity of wind offshore power plants, the calculated values may not exceed 3,294.9 megawatt. This equals the capacity available at the end of 2015. To obtain the feed-in series for onshore wind plants, offshore generation is then subtracted from total generation for each hour.

Starting 2016, separate feed-in series are available for onshore and offshore wind generation. In order to depict the hourly generation, we use the hourly feed-in series provided by EEX (2012-2017) or ENTSO-E (from 2018), respectively. Based on the available monthly generation data, the hourly values are adjusted by monthly correction factors.

To calculate the current year, we apply the annual correction factor from the previous year (for 2019 – onshore wind: 1.03; offshore wind: 1.01).

Table 1: Annual and monthly power generation and correction factors for wind energy

Wind energy	2012	2013	2014	2015	2016	2017	2018	2019[1]
	TWh							
Gross power generation[2]	**51.7**	**52.9**	**58.5**	**80.5**	**80.2**	**105.6**	**111.5**	
onshore	51.7	52.0	57.0	72.2	67.9	88.0	92.2	
offshore	0.0	0.9	1.5	8.3	12.3	17.6	19.3	
Self consumption[3]	**0%**							
Net power generation[4]	**51.7**	**52.9**	**58.5**	**80.5**	**80.2**	**105.6**	**111.5**	
onshore	51.7	52.0	57.0	72.2	67.9	88.0	92.2	
offshore	0.0	0.9	1.5	8.3	12.3	17.6	19.3	
January	7.8	5.5	6.9	9.6	9.3	8.1	14.9	
February	5.1	3.5	6.9	5.4	9.9	10.3	8.2	
March	4.4	5.1	5.1	7.4	6.0	9.7	11.0	
April	3.7	3.6	4.0	5.4	5.9	8.4	9.2	
May	3.2	3.1	4.1	5.4	6.1	5.9	7.4	
June	3.2	3.7	2.8	4.2	3.4	7.4	5.9	
July	2.9	1.9	2.6	6.0	4.7	5.7	4.6	
August	2.4	2.6	3.7	4.0	4.8	5.7	6.3	
September	3.3	3.7	2.7	5.6	4.2	6.5	8.2	
October	4.1	6.0	4.2	4.0	5.6	13.0	11.0	
November	4.3	4.7	4.4	10.6	8.1	10.7	10.2	
December	6.2	8.2	9.9	11.5	9.3	15.3	14.8	
Generation by fuel source EEX/ENTSO-E[5]	**45.9**	**47.2**	**50.9**	**78.9**	**77.0**	**102.5**	**108.6**	
onshore				69.2	65.0	85.1	89.5	
offshore				3.0	11.9	17.4	19.1	
January	7.0	5.0	6.2	9.6	9.3	7.8	14.5	
February	4.6	3.2	5.8	5.2	9.8	9.9	7.9	
March	4.0	4.7	4.6	7.4	6.0	9.3	10.7	
April	3.4	3.3	3.6	5.4	5.9	8.0	8.9	
May	2.9	2.9	3.7	5.4	6.1	5.7	7.2	
June	2.9	3.4	2.5	4.2	3.3	7.1	5.7	
July	2.6	1.7	2.3	6.1	4.7	5.5	4.4	
August	2.2	2.3	3.3	4.0	4.8	5.4	6.1	
September	3.0	3.4	2.5	5.5	4.2	6.3	8.0	
October	3.7	5.5	3.8	4.0	5.6	12.5	10.7	
November	3.9	4.3	4.0	10.6	8.0	10.3	9.9	
December	5.6	7.5	8.8	11.7	9.3	14.7	14.4	
Correction factor[6]	**1.13**	**1.12**	**1.15**					
onshore				**1.04**	**1.04**	**1.03**	**1.03**	**1.03**
offshore				**2.80**	**1.03**	**1.01**	**1.01**	**1.01**
January	1.10	1.10	1.11	1.00	1.01	1.04	1.03	
February	1.10	1.10	1.19	1.05	1.00	1.04	1.03	
March	1.10	1.10	1.11	1.01	1.00	1.04	1.03	
April	1.10	1.10	1.11	1.00	1.01	1.05	1.03	
May	1.10	1.10	1.12	1.00	1.01	1.04	1.03	
June	1.11	1.09	1.11	1.00	1.01	1.04	1.03	
July	1.10	1.10	1.12	1.00	1.01	1.04	1.03	
August	1.10	1.09	1.14	1.00	1.01	1.05	1.03	
September	1.10	1.10	1.12	1.00	1.02	1.04	1.03	
October	1.10	1.10	1.13	1.01	1.01	1.04	1.03	
November	1.10	1.10	1.12	1.00	1.01	1.04	1.03	
December	1.11	1.10	1.12	0.99	1.00	1.04	1.03	

[1] For the extrapolation of the current year, the annual value from the previous year is used in each case
[2] AG Energiebilanzen 2019a
[3] Oeko-Institut 2013
[4] Own calculation based on BDEW 2012-2018
[5] EEX 2012-2017, ENTSO-E from 2018
[6] Own calculation based on the degree of coverage

2.2 Photovoltaics

The gross power generation from photovoltaic plants (PV) has grown over the past few years from 26.4 terawatt-hours in 2012 to 46.2 terawatt-hours in 2018. Because barely any electricity is required to operate the PV power plants themselves, gross generation corresponds to net generation.

The generation data shown for photovoltaics is taken from the EEX (2012–2017) or ENTSO-E (from 2018), respectively, and is entered hourly as soon as they become available. The data is based on measurements by the ÜNB at various reference sites and is then extrapolated by the ÜNB to all of Germany. This data is used by the ÜNB to balance the load on the grid.

To calculate the hourly feed to the grid from photovoltaic power plants, first the hourly feed-in time series for PV plants published by the EEX (2012–2017) or ENTSO-E (from 2018), respectively, is used as a base reference. Then, based on the available monthly generation data, the hourly values are adjusted by the monthly correction factors (Table 2).

To calculate the figure for the current year, the feed-in time series provided by ENTSO-E is used and adjusted by the annual overall correction factor from the previous year (2019: 1.12).

Table 2: Annual and monthly power generation and correction factors for photovoltaics

Photovoltaics	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**[1]
	TWh							
Gross power generation[2]	**26.4**	**31.0**	**36.1**	**38.7**	**38.1**	**39.4**	**46.2**	
Self consumption[3]	**0%**							
Net power generation[4]	**26.4**	**31.0**	**36.1**	**38.7**	**38.1**	**39.4**	**46.2**	
January	0.5	0.4	0.8	0.6	0.7	0.9	0.8	
February	1.0	0.7	1.8	1.5	1.4	1.6	2.0	
March	2.2	2.4	3.6	3.1	2.6	3.5	2.9	
April	2.5	3.3	4.0	4.9	4.2	4.3	5.4	
May	3.8	3.7	4.5	4.9	5.2	5.7	6.7	
June	3.4	4.5	5.3	5.1	5.3	6.0	6.0	
July	3.6	5.4	4.9	5.5	5.5	5.5	6.9	
August	3.7	4.3	4.3	5.1	5.2	5.1	5.8	
September	2.8	2.8	3.2	3.6	4.3	3.4	4.6	
October	1.7	2.0	2.2	2.2	1.9	2.4	3.1	
November	0.8	0.8	1.1	1.3	1.1	0.9	1.3	
December	0.3	0.8	0.4	1.0	0.9	0.6	0.6	
Generation by fuel source EEX/ENTSO-E[5]	**27.7**	**29.7**	**32.7**	**34.9**	**34.5**	**35.9**	**41.2**	
January	0.5	0.3	0.7	0.6	0.7	0.8	0.7	
February	1.0	0.7	1.6	1.4	1.3	1.5	1.8	
March	2.3	2.3	3.3	2.9	2.3	3.2	2.7	
April	2.6	3.2	3.7	4.4	3.9	3.9	4.8	
May	4.0	3.5	4.1	4.4	4.7	5.1	5.9	
June	3.6	4.3	4.8	4.6	4.7	5.4	5.3	
July	3.7	5.1	4.4	4.9	4.8	4.9	6.2	
August	3.9	4.1	3.9	4.6	4.7	4.6	5.2	
September	2.9	2.6	2.9	3.2	3.8	3.1	4.1	
October	1.8	1.9	2.0	1.9	1.7	2.1	2.7	
November	0.8	0.8	1.0	1.1	1.0	0.8	1.2	
December	0.4	0.7	0.4	0.8	0.8	0.5	0.5	
Correction factor[6]								**1.12**
January	0.95	1.04	1.09	1.08	1.08	1.08	1.09	
February	0.96	1.03	1.14	1.08	1.08	1.08	1.09	
March	0.96	1.03	1.09	1.08	1.15	1.08	1.09	
April	0.95	1.04	1.10	1.11	1.07	1.12	1.12	
May	0.95	1.04	1.10	1.11	1.11	1.12	1.12	
June	0.95	1.04	1.10	1.11	1.12	1.12	1.12	
July	0.95	1.05	1.10	1.11	1.15	1.12	1.12	
August	0.95	1.05	1.11	1.11	1.11	1.12	1.12	
September	0.95	1.05	1.10	1.12	1.11	1.12	1.12	
October	0.95	1.05	1.11	1.12	1.11	1.12	1.12	
November	0.96	1.05	1.10	1.12	1.11	1.12	1.12	
December	0.78	1.23	1.11	1.12	1.11	1.12	1.13	

[1] For the extrapolation of the current year, the annual value from the previous year is used in each case

[2] AG Energiebilanzen 2019a

[3] Oeko-Institut 2013

[4] Own calculation based on BDEW 2012-2018

[5] EEX 2012-2017, ENTSO-E from 2018

[6] Own calculation based on the degree of coverage

2.3 Hydropower

Between 2012 and 2017 the gross power generation from hydropower plants (which, according to the definition from AG Energiebilanzen, includes run-of-river and storage hydropower plants as well as generation from the natural inflows into pumped storage plants) remained relatively stable (2012: 22.1 terawatt-hours; 2017: 20.3), but experienced a downturn in 2018 (16.6 terawatt-hours) due to the drought during the summer months. With internal consumption of about 2 per cent, this corresponds to net power generation of about 21.7 terawatt-hours (2012) and 16.3 terawatt-hours (2018).

To calculate the feed-in time series for hydropower plants between 2012 and 2018, the feed-in series provided by the EEX (2012-2017) or ENTSO-E (from 2018), respectively, for run-of-river hydropower plants is used (Table 3). To correct deviations in the reporting, an annual correction factor and from 2018 onwards monthly correction factors are applied.

To calculate the hourly feed-in for the current year, the hourly feed-in time series for run-of-river power plants published by ENTSO-E is used as a base reference and scaled using the annual correction factor from the previous year (2019: 1.07).

Table 3: Annual power generation and correction factors for hydropower

Hydropower	2012	2013	2014	2015	2016	2017	2018	2019[1]
	TWh							
Gross power generation[2]	**22.1**	**23.0**	**19.6**	**19.0**	**20.5**	**20.3**	**16.6**	
Self consumption[3]	**2%**							
Net power generation[4]	**21.7**	**22.5**	**19.2**	**18.6**	**20.1**	**19.9**	**16.3**	
January							1.8	
February							1.5	
March							1.5	
April							1.7	
May							1.7	
June							1.5	
July							1.3	
August							1.1	
September							1.1	
October							0.9	
November							0.8	
December							1.5	
Generation by fuel source EEX/ENTSO-E[5]	**5.0**	**4.7**	**5.1**	**4.4**	**5.5**	**6.5**	**15.3**	
January							1.4	
February							1.2	
March							1.1	
April							1.4	
May							1.7	
June							1.6	
July							1.4	
August							1.2	
September							1.2	
October							1.0	
November							1.0	
December							1.1	
Correction factor[6]	**4.37**	**4.75**	**3.79**	**4.27**	**3.64**	**3.07**		**1.07**
January							1.3	
February							1.3	
March							1.3	
April							1.2	
May							1.0	
June							0.9	
July							0.9	
August							0.9	
September							1.0	
October							0.9	
November							0.8	
December							1.4	

[1] For the extrapolation of the current year, the annual value from the previous year is used in each case
[2] AG Energiebilanzen 2019a
[3] Oeko-Institut 2013
[4] Own calculation based on AG Energiebilanzen 2019a and BDEW 2018 (monthly values)
[5] EEX 2012-2017, ENTSO-E from 2018
[6] Own calculation based on the degree of coverage

2.4 Biomass (including biogenic municipal waste)

Between 2012 and 2018 the gross power generation from biomass including biogenic municipal waste increased from 43.4 terawatt-hours to a total of about 51.4 terawatt-hours. With an internal consumption of about 9 per cent (20 per cent for biogenic municipal waste), this corresponds to net power generation of about 39.1 terawatt-hours (2012) and 46.3 terawatt-hours (2018).

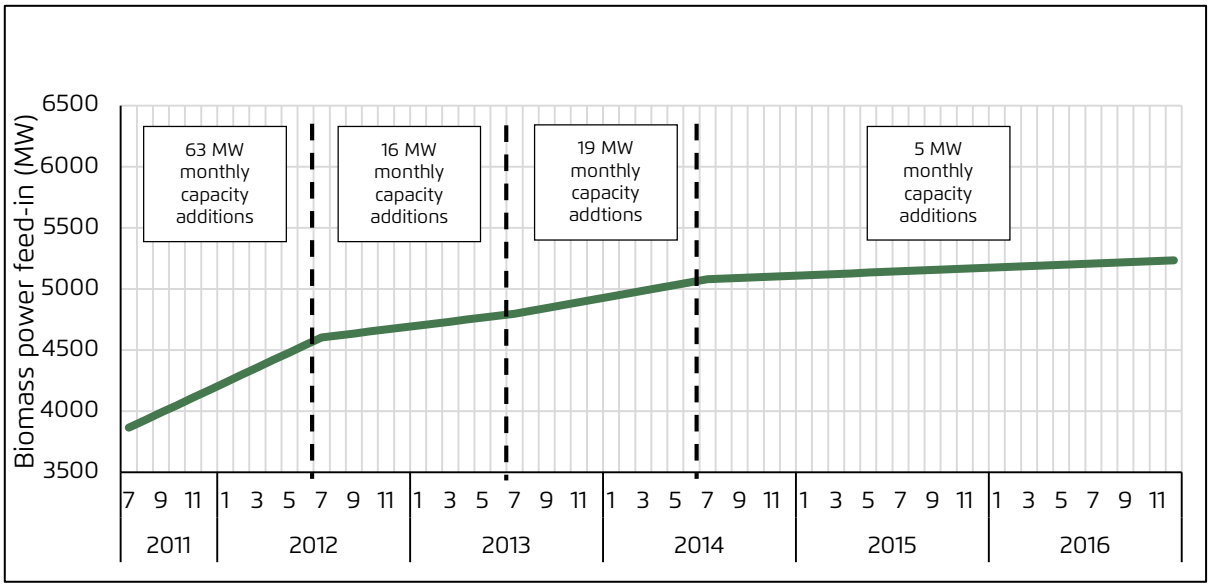
Till 2016, there were no current and regularly published time series with adequate coverage of electricity produced from biomass (incl. biogenic municipal waste). For this reason, in the years from 2012 to 2016, this figure was estimated using the known total electricity generation from

the previous years. The majority of biomass and waste incineration plants operate at a constant rate whenever possible because this is most advantageous from an economic point of view. For the Agorameter, it was therefore assumed that these plants produced power overall in the form of baseload volume (Table 4).

For a more precise estimate of the electricity production on a particular day in the past, however, the expansion of plants throughout the year have also been taken into account. The annual increase in output was therefore distributed over the year on a monthly basis and linearly. The averaged mean generation was achieved in the middle of the year (in July). Thus, the average monthly expansion always refers to the period July to June. Therefore, there was thus a monthly expansion of 63 megawatt for the year 2011/12, 16 megawatt for the year 2012/13, and 19 megawatt for the year 2013/14 (Figure 1).

To predict the generation from July 2014 onwards, the expansion was limited to 100 megawatt per year, as foreseen under the 2014 German Renewable Energy Sources Act. If an average of 6,000 full-load hours per plant was assumed, then this corresponded to a monthly increase in the generation capacity of 5.3 megawatt per month.

Figure 1: Change in the average feed-in for biomass in the Agorameter



To calculate the hourly feed to the grid from biomass power plants from 2017 on, first the hourly feed-in time series for PV plants published by ENTSO-E is used as a base reference. Then, based on the available monthly generation data, the hourly values are adjusted by the monthly correction factor (Table 4).

To calculate the figure for the current year, the feed-in time series provided by ENTSO-E is used and adjusted by the annual overall correction factor from the previous year (2019: 1.15).

Table 4: Annual power generation and mean feed-in from biomass

Biomass (incl. biogenic municipal waste)	2012	2013	2014	2015	2016	2017	2018	2019[1]
	TWh							
Gross power generation[2]	**43.4**	**45.5**	**48.3**	**50.4**	**50.9**	**51.0**	**51.4**	
Self consumption[3]	**9% bis 20%**							
Net power generation[4]	**39.1**	**41.0**	**43.5**	**45.4**	**45.9**			
Mean feed-in[4] (GW)	**4.5**	**4.7**	**5.0**	**5.2**	**5.2**			
Net power generation[5]						**0.0**	**0.0**	
January						4.0	4.0	
February						3.7	3.8	
March						4.0	4.0	
April						3.9	3.8	
May						3.9	4.0	
June						3.7	3.7	
July						3.8	3.8	
August						3.8	3.9	
September						3.8	3.7	
October						3.9	4.0	
November						3.9	3.9	
December						4.1	4.1	
Generation by fuel source ENTSO-E[6]						**38.4**	**40.2**	
January						3.4	3.6	
February						3.2	3.2	
March						3.5	3.4	
April						3.3	3.3	
May						3.3	3.4	
June						3.1	3.2	
July						3.1	3.2	
August						3.1	3.3	
September						2.8	3.1	
October						3.1	3.4	
November						3.2	3.5	
December						3.3	3.6	
Correction factor[7]								**1.15**
January						1.16	1.11	
February						1.16	1.17	
March						1.16	1.17	
April						1.16	1.17	
May						1.18	1.16	
June						1.20	1.16	
July						1.21	1.19	
August						1.23	1.18	
September						1.34	1.19	
October						1.28	1.18	
November						1.24	1.13	
December						1.22	1.16	

[1] For the extrapolation of the current year, the annual value from the previous year is used in each case
[2] AG Energiebilanzen 2019a
[3] Own calculation based on Oeko-Institut 2013
[4] Own calculation
[5] Own calculation based on AG Energiebilanzen 2019a and BDEW 2012-2018 (monthly values)
[6] ENTSO-E 2017-2018
[7] Own calculation based on the degree of coverage

2.5 Nuclear power

Between 2012 and 2018, the gross power generation from nuclear power plants decreased from 99.5 terawatt-hours to about 76 terawatt-hours. With an internal consumption of about 5 per

cent, this corresponds to a net power generation of about 94.5 terawatt-hours (2012) and 72.2 terawatt-hours (2018).

To calculate the hourly feed to the grid from nuclear power plants between 2013 and 2018, first the hourly feed-in time series for nuclear power plants published by the EEX (2012-2017) or ENTSO-E (from 2018), respectively, are used as a base reference. Then, based on the available monthly generation data, the hourly values are adjusted by monthly correction factors. Because there are no comprehensive monthly generation volumes available for 2012, in this case an annual correction factor is applied (Table 5).

The same applies for the calculation for the current year: to adjust the feed-in time series provided by ENTSO-E, the overall annual correction factor from the previous year is used (2019: 1.01).

Table 5: Annual and monthly power generation and correction factors for nuclear power

Nuclear	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**[1]
	TWh							
Gross power generation[2]	**99.5**	**97.3**	**97.1**	**91.8**	**84.6**	**76.3**	**76.0**	
Self consumption[3]	**5%**							
Net power generation[4]	**94.5**	**92.4**	**92.2**	**87.2**	**80.4**	**72.5**	**72.2**	
January	8.3	8.9	8.5	8.7	7.8	5.7	6.7	
February	8.0	8.1	8.0	8.0	7.2	4.6	6.1	
March	8.2	8.9	8.4	7.7	7.7	4.9	6.2	
April	5.5	7.0	7.4	7.2	5.1	4.8	5.2	
May	6.4	6.3	6.1	7.4	4.9	5.7	4.9	
June	6.4	6.6	6.7	6.7	6.0	6.4	5.8	
July	6.4	6.2	6.2	5.1	6.2	5.4	6.2	
August	8.1	7.1	7.4	7.1	7.0	7.1	6.7	
September	7.6	7.8	7.5	7.3	6.9	6.4	5.6	
October	7.6	8.3	8.8	6.7	7.8	7.4	5.8	
November	7.8	8.4	8.6	7.5	7.4	6.9	6.5	
December	7.6	8.8	8.7	7.7	6.3	7.3	6.8	
Generation by fuel source EEX[5]	**92.9**	**91.3**	**91.0**	**86.8**	**80.0**	**72.1**	**71.8**	
January	8.8	8.9	8.4	8.7	7.8	5.7	6.7	
February	8.4	7.6	8.0	7.9	7.2	4.5	6.1	
March	8.6	8.8	8.3	7.7	7.3	4.8	6.2	
April	5.8	6.9	7.3	7.2	5.5	4.8	5.2	
May	6.7	6.3	6.1	7.4	4.9	5.6	4.9	
June	6.7	6.6	6.6	6.7	6.0	6.3	5.7	
July	6.7	6.2	6.2	5.1	6.2	5.3	6.2	
August	8.6	7.1	6.9	7.1	6.9	7.1	6.5	
September	8.0	7.5	7.5	7.3	6.8	6.4	5.6	
October	8.2	8.2	8.8	6.7	7.8	7.4	5.7	
November	8.4	8.3	8.5	7.4	7.4	6.9	6.3	
December	8.1	8.8	8.4	7.7	6.3	7.2	6.8	
Correction factor[6]								**1.01**
January	0.94	1.01	1.01	1.00	1.01	1.01	1.00	
February	0.94	1.00	1.00	1.00	1.00	1.00	1.00	
March	0.95	1.07	1.00	1.00	1.00	1.00	1.00	
April	0.95	1.01	1.00	1.01	1.06	1.00	1.00	
May	0.95	1.00	1.01	1.01	0.94	1.01	1.01	
June	0.95	1.00	1.01	1.00	1.01	1.01	1.02	
July	0.95	1.01	1.02	1.01	1.01	1.01	1.01	
August	0.95	1.01	1.01	1.01	0.99	1.01	1.02	
September	0.95	1.01	1.07	1.01	1.02	1.00	1.00	
October	0.95	1.04	1.01	1.00	1.00	1.01	1.00	
November	0.93	1.00	1.00	1.00	1.00	1.01	1.02	
December	0.93	1.00	1.01	1.00	1.00	1.01	1.01	

[1] For the extrapolation of the current year, the annual value from the previous year is used in each case

[2] AG Energiebilanzen 2019a

[3] Oeko-Institut 2013

[4] Own calculation based on AG Energiebilanzen 2019a and BDEW 2012-2018 (monthly values)

[5] EEX 2012-2017, ENTSO-E from 2018

[6] Own calculation based on the degree of coverage

2.6 Lignite

Between 2012 and 2018 the gross power generation from lignite-fired power plants decreased from about 160.7 terawatt-hours to about 145.5 terawatt-hours. With an internal consumption of approximately 8 per cent, this corresponds to a net power generation of about 147.8 terawatt-hours (2012) and 133.9 terawatt-hours (2018).

To calculate the hourly feed-in to the grid from lignite-fired power plants between 2012 and 2017, the first step is to differentiate between combined heat and power generation and uncoupled power generation (see Table 6).

To calculate uncoupled generation (2017: 132 terawatt-hours), the hourly feed-in time series for lignite-fired power plants published by the EEX are used. Any deviations in the reporting are adjusted using an annual correction factor (2017: 0.99). The feed-in time series for cogeneration are formed as the sum of two feed-in time series assuming, for the purpose of simplification, that cogeneration is thermally driven:

- The first feed-in time series is modelled on the basis of generation from process heat. Based on the limited body of data, it is assumed, again for purposes of simplification, that this is distributed evenly throughout the year.
- The second feed-in time series is combined heat and power generation and is modelled dynamically on the basis of the hourly temperature curve.

Combined heat and power generation with simultaneous generation of thermal energy (2017: 3.7 terawatt-hours) plays a considerably more important role compared to the process heat generation (2017: 0.01 terawatt-hours). The net power generation from lignite-fired power plants is displayed in the Agorameter despite differentiated calculation as a total power quantity.

To calculate the hourly feed-in series from 2018 onwards, it is not differentiated between uncoupled power generation and combined heat and power generation anymore. Instead, the hourly feed-in time series published by ENTSO-E (from 2018 until the current year) for lignite-fired power plants is used as a basis and scaled with the monthly correction factors, based on the available monthly power generation data. To calculate the figure for the current year, the feed-in time series provided by ENTSO-E is used and adjusted by the annual overall correction factor from the previous year (2019: 1.04).

Table 6: Annual power generation and correction factors for lignite

Lignite	2012	2013	2014	2015	2016	2017	2018	2019[1]
	TWh							
Gross power generation[2]	**160.7**	**160.9**	**155.8**	**154.5**	**149.5**	**148.4**		
Self consumption[3]	**8%**							
Net power generation[4]	**147.8**	**148.0**	**143.3**	**142.1**	**137.5**	**136.5**		
Non-CHP[5]	143.5	143.4	139.5	138.1	133.5	132.8		
CHP[5]	4.4	4.6	3.9	4.1	4.0	3.8		
Non-CHP net power generation[6]	**143.5**	**143.4**	**139.5**	**138.1**	**133.5**	**132.8**		
Generation by fuel source EEX[7]	135.1	144.2	137.3	139.0	132.8	133.3		
Correction factor[5]	1.06	0.99	1.02	0.99	1.00	1.00		
CHP net power generation[6]	**4.4**	**4.6**	**3.9**	**4.1**	**4.0**	**3.8**		
Process heat driven fraction[6]	0.0	0.0	0.0	0.0	0.0	0.0		
Thermal heat driven fraction[6]	4.4	4.6	3.9	4.1	4.0	3.8		
January							11.6	
February							11.7	
March							11.8	
April							10.8	
May							10.6	
June							11.5	
July							12.0	
August							11.4	
September							10.9	
October							10.9	
November							11.1	
December							9.5	
Generation by fuel source ENTSO-E[7]							**128.5**	
January							11.1	
February							11.2	
March							11.3	
April							10.2	
May							10.2	
June							11.1	
July							11.6	
August							11.0	
September							10.4	
October							10.7	
November							10.7	
December							9.1	
Correction factor[7]								**1.04**
January							1.05	
February							1.05	
March							1.05	
April							1.05	
May							1.04	
June							1.04	
July							1.04	
August							1.04	
September							1.04	
October							1.02	
November							1.04	
December							1.04	

[1] For the extrapolation of the current year, the annual value from the previous year is used in each case
[2] AG Energiebilanzen 2019a
[3] Oeko-Institut 2013
[4] Own calculation based on AG Energiebilanzen 2019a and BDEW 2018 (monthly values)
[5] Own calculation/estimate based on Statistisches Bundesamt 2012-2016
[6] Own calculation based on the degree of coverage
[7] EEX 2012-2017, ENTSO-E 2018

2.7 Hard coal

Between 2012 and 2018 the gross power generation from hard coal-fired power plants increased from about 116.4 terawatt-hours to about 83.2 terawatt-hours. With an internal consumption of

approximately 8 per cent, this corresponds to a net power generation of about 107.1 terawatt-hours (2012) and 76.5 terawatt-hours (2018).

To calculate the hourly feed-in to the grid from hard coal-fired power plants between 2012 and 2017, analogous to generation from lignite, the first step is to differentiate between combined heat and power generation and uncoupled power generation (Table 7).

To calculate uncoupled generation (2017: 69.9 terawatt-hours), the hourly feed-in time series for hard coal-fired power plants published by the EEX are used. Any deviations in the reporting are adjusted using an annual correction factor (2017: 0.87). The feed-in time series for cogeneration are formed as the sum of two feed-in time series assuming, for the purpose of simplification, that cogeneration is thermally driven:

- The first feed-in time series is modelled on the basis of generation from process heat. Based on the limited body of data, it is assumed, again for purposes of simplification, that this is distributed evenly throughout the year.
- The second feed-in time series is combined heat and power generation is modelled dynamically on the basis of the hourly temperature curve.

For hard coal, combined heat and power generation (2017: 12.7 terawatt-hours) also plays a considerably more dominant role compared to simultaneous process heat generation (2017: 2.6 terawatt-hours). The net power generation from hard coal-fired power plants is displayed in the Agorameter despite differentiated calculation as a total power quantity.

To calculate the hourly feed-in series from 2018 onwards, it is not differentiated between uncoupled power generation and combined heat and power generation anymore. Instead, the hourly feed-in time series published by ENTSO-E (from 2018 until the current year) for hard coal-fired power plants is used as a basis and scaled with the monthly correction factors, based on the available monthly power generation data. To calculate the figure for the current year, the feed-in time series provided by ENTSO-E is used and adjusted by the annual overall correction factor from the previous year (2019: 1.06).

Table 7: *Annual power generation and correction factors for hard coal*

Hard coal	2012	2013	2014	2015	2016	2017	2018	2019[1]
	TWh							
Gross power generation[2]	**116.4**	**127.3**	**118.6**	**117.7**	**112.2**	**92.9**	**83.2**	
Self consumption[3]	**8%**							
Net power generation[4]	**107.1**	**117.1**	**109.1**	**108.3**	**103.2**	**85.5**	**76.5**	
Non-CHP[5]	92.1	100.9	95.5	95.2	90.5	70.1		
CHP[5]	15.0	16.2	13.6	13.0	12.7	15.3		
Non-CHP net power generation[5]	**92.1**	**100.9**	**95.5**	**95.2**	**90.5**	**70.1**		
Generation by fuel source EEX[7]	64.8	74.0	73.4	96.9	98.4	80.3		
Correction factor[6]	1.42	1.36	1.30	0.98	0.92	0.87		
CHP net power generation[5]	**15.0**	**16.2**	**13.6**	**13.0**	**12.7**	**15.3**		
Process heat driven fraction[5]	2.6	2.3	2.1	2.0	2.6	2.6		
Thermal heat driven fraction[5]	12.4	13.9	11.5	11.0	10.2	12.8		
January							5.8	
February							8.6	
March							8.5	
April							4.9	
May							4.3	
June							4.7	
July							6.4	
August							6.1	
September							6.1	
October							7.2	
November							7.9	
December							5.9	
Generation by fuel source ENTSO-E[7]							**72.2**	
January							5.0	
February							8.3	
March							8.0	
April							4.0	
May							3.6	
June							4.6	
July							6.6	
August							5.5	
September							5.9	
October							7.2	
November							7.9	
December							5.6	
Correction factor[6]								**1.06**
January							1.18	
February							1.04	
March							1.06	
April							1.23	
May							1.20	
June							1.02	
July							0.96	
August							1.11	
September							1.03	
October							0.99	
November							1.00	
December							1.06	

[1] For the extrapolation of the current year, the annual value from the previous year is used in each case
[2] AG Energiebilanzen 2019a
[3] Oeko-Institut 2013
[4] Own calculation based on AG Energiebilanzen 2019a and BDEW 2018 (monthly values)
[5] Own calculation/estimate based on Statistisches Bundesamt 2012-2016
[6] Own calculation based on the degree of coverage
[7] EEX 2012-2017, ENTSO-E 2018

2.8 Natural gas

The gross power generation based on natural gas was on a level of about 76.4 terawatt-hours in 2012 and since then has declined during several years. However, in 2017, the gas-based power

generation has increased to about 86.7 terawatt-hours and remained quite stable in 2018 (83.4 terawatt-hours). With internal consumption of about 3 per cent on average, this corresponds to a net power generation of about 74.1 terawatt-hours (2012) and 80.9 terawatt-hours (2018).

To calculate the hourly feed-in to the grid from gas-fired power plants between 2012 and 2018, the first step is to differentiate between the net power production of the utilities for public supply and the net power production of the industry (manufacturing industries, mining and quarrying).

- To calculate the net power production of the utilities for public supply (2018: 43.5 terawatt-hours), first, the hourly feed-in time series for gas-fired power plants published by the EEX (2012-2017) or ENTSO-E (from 2018), respectively, are used. To correct deviations in the reporting, an hourly feed-in time series is added, which is modelled dynamically on the basis of the hourly temperature curve.
- To calculate the net power production of the industry (2018: 37.4 terawatt-hours), first, the hourly feed-in time series for gas-fired power plants published by the EEX (2012-2017) or ENTSO-E (from 2018), respectively, are used. To correct deviations in the reporting, an hourly feed-in time series is added. It is modelled on the basis of generation from process heat. Due to the limited body of data, it is assumed, for purposes of simplification, that this is distributed evenly throughout the year.

To calculate the hourly feed-in for the current year, not differentiating between the net power production of the utilities for public supply and the net power production of the industry, and therefore simply deploying a single scaling factor, would result in a considerable overestimation of the generation capacity of gas-fired power plants for any one hour. For this reason, the same method is used for the generation in the current year as for the historical generation data, but with the use of the net power production of the utilities for public supply (2019: 43.5 terawatt-hours) and the net power production of the industry (2019: 37.4 terawatt-hours) from the previous year.

The net power generation from gas-fired power plants is displayed in the Agorameter as the total power generated, despite the differentiated calculation.

Table 8: *Annual power generation and correction factors for natural gas*

Natural gas	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**[1)]
	TWh							
Gross power generation[2)]	**76.4**	**67.5**	**61.1**	**62.0**	**81.3**	**86.7**	**83.4**	
Self consumption[3)]	**3%**							
Net power generation[4)]	**74.1**	**65.5**	**59.3**	**60.1**	**78.9**	**84.1**	**80.9**	
Public supply [6)]	47.7	37.8	30.3	26.8	43.7	46.7	43.5	43.5
Industry [6)]	26.4	27.7	29.0	33.3	35.1	37.4	37.4	37.4
Generation by fuel source EEX/ENTSO-E[5)]	**16.8**	**12.3**	**13.0**	**23.1**	**30.0**	**31.4**	**33.9**	
Public supply [6)]	15.1	11.0	11.7	20.8	27.0	28.3	30.4	
Industry [6)]	1.7	1.2	1.3	2.3	3.0	3.1	3.5	
Additional load per year [6)]	**57.3**	**53.2**	**46.3**	**37.1**	**48.8**	**52.7**	**47.0**	**47.0**
Public supply [6)]	32.6	26.8	18.6	6.1	16.7	18.4	13.1	13.1
Industry [6)]	24.7	26.4	27.7	31.0	32.1	34.2	33.9	33.9

[1)] For the extrapolation of the current year, the annual value from the previous year is used in each case
[2)] AG Energiebilanzen 2019a
[3)] Oeko-Institut 2013
[4)] Own calculation
[5)] EEX 2012-2017, ENTSO-E from 2018
[6)] Own calculation/estimate based on Statistisches Bundesamt 2012-2017

2.9 Pumped storage

We are not aware of any comprehensive annual outputs published for power generated from pumped storage power plants. Because pumped storage power plants generally optimise their operation in response to the market in the short term, it is assumed that the feed-in time series published by the EEX (2012-2017) or ENTSO-E (from 2018), respectively, for pumped storage power plants cover 100 per cent of the net power generation. For this reason, the feed-in time series from the EEX (2012-2017) or ENTSO-E (from 2018), respectively, are incorporated unchanged for both the historical and the current generation from pumped storage power plants.

2.10 Other energy sources

The generation data shown for the category 'other' comprises generation data from oil-fired power plants and other power plants (e.g. conventional waste incineration plants, industrial wastes, etc.) as well as other plants that is shown as aggregate data for reasons of clarity.

The gross power generation from oil-fired power plants has declined over the past few years from about 7.6 terawatt-hours in 2012 to about 5.2 terawatt-hours in 2018. With an internal consumption of about 9 per cent on average, this corresponds to a net power generation of about 6.9 terawatt-hours (2012) and 4.7 terawatt-hours (2018).

To calculate the hourly feed-in to the grid from oil-fired power plants between 2012 and 2017, the first step is again to differentiate between combined heat and power generation and uncoupled power generation, similar to the case of lignite and hard coal.

To calculate uncoupled generation (2017: 3.6 terawatt-hours), the hourly feed-in time series for oil-fired power plants published by the EEX are used. To correct deviations in the reporting, an annual correction factor is applied (2017: 1.8). The feed-in time series for cogeneration are formed as the sum of two feed-in time series with the assumption, for the purpose of simplification, that cogeneration is thermally driven:

- The first feed-in time series is modelled on the basis of generation from process heat. Based on the limited body of data, it is assumed, again for purposes of simplification, that this is distributed evenly throughout the year.
- The second feed-in time series is combined heat and power generation modelled dynamically on the basis of the hourly temperature curve.

In total, the combined heat and power generation in 2017 is about 0.2 terawatt-hours. The combined heat and power generation in the course of generating process heat is somewhat higher at 1.6 terawatt-hours.

Table 9: Annual power generation and correction factors for oil till 2017

Oil	2012	2013	2014	2015	2016	2017
	TWh					
Gross power generation[2)]	**7.6**	**7.2**	**5.7**	**6.2**	**5.8**	**5.6**
Self consumption[3)]	**9%**					
Net power generation[4)]	**6.9**	**6.6**	**5.2**	**5.6**	**5.3**	**5.1**
Non-CHP	5.2	4.9	3.7	4.0	3.5	3.4
CHP	1.7	1.7	1.5	1.6	1.8	1.7
Non-CHP net power generation[6)]	**5.2**	**4.9**	**3.7**	**4.0**	**3.5**	**3.4**
Generation by fuel source EEX[7)]	2.3	2.5	1.9	2.3	1.7	1.7
Correction factor[5)]	2.22	1.96	1.98	1.78	2.00	1.97
CHP net power generation[6)]	**1.7**	**1.7**	**1.5**	**1.6**	**1.8**	**1.7**
Process heat driven fraction[6)]	1.5	1.5	1.3	1.4	1.5	1.5
Thermal heat driven fraction[6)]	0.3	0.2	0.2	0.2	0.3	0.2

[1)] For the extrapolation of the current year, the annual value from the previous year is used in each case
[2)] AG Energiebilanzen 2018a
[3)] Oeko-Institut 2013
[4)] Own calculation
[5)] Own calculation based on the degree of coverage
[6)] Own calculation/estimate based on Statistisches Bundesamt 2012-2016
[7)] EEX 2017

Between 2012 and 2018, the gross power generation from other sources changed from about 16.6 terawatt-hours to approximately 16.9 terawatt-hours. With an internal consumption of about 10 per cent on average, this corresponds to a net power generation of about 15 terawatt-hours (2012) and 15.2 terawatt-hours (2018).

To calculate the hourly feed-in for the other sources between 2012 and 2017, the feed-in time series provided by the EEX for waste and other plants are used, noting that those cover only a very small fraction of the actual power generation of the remaining power plants (Table 10). The majority of the remaining generation units tend to have a very consistent rate of power generation because they are mostly waste, garbage and blast furnace gas-fired plants, meaning that the missing quantities between 2012 and 2014 are represented by a constant generation volume. Because of the resulting increase in the level of coverage of the EEX feed-in time series compared to the net power generation from 2015 onwards, from this point on a constant scaling factor is used that is also used to calculate the hourly feed-in for the current year.

Table 10: Annual power generation and correction factors for other energy sources till 2017

Others	2012	2013	2014	2015	2016	2017
	TWh					
Gross power generation[2)]	**16.6**	**17.4**	**18.1**	**16.5**	**16.6**	**16.1**
Self consumption[3)]	**10%**					
Net power generation[4)]	**15.0**	**15.7**	**16.2**	**14.9**	**15.0**	**14.5**
Generation by fuel source EEX[5)]	**0.3**	**1.4**	**0.6**	**1.6**	**2.2**	**2.0**
Correction factor[6)]				**9.10**	**6.85**	**7.33**
Additional hourly generation volume[7)] **(in GW)**	**1.68**	**1.62**	**1.79**			

[1)] For the extrapolation of the current year, the annual value from the previous year is used in each case
[2)] AG Energiebilanzen 2018a
[3)] Own estimate based on Oeko-Institut 2013
[4)] Own calculation
[5)] EEX 2017
[6)] Own calculation based on the degree of coverage
[7)] Own estimate based on Statistisches Bundesamt 2012-2014

To calculate the hourly feed-in from 2018 and the current year, it is not differentiated between uncoupled power generation and combined heat and power generation anymore. Instead, the hourly feed-in time series published by ENTSO-E of oil and other power plants in sum for past years (between 2018 and the current year) are used as a basis and scaled with monthly correction factors, based on the available monthly power generation data (Table 11). To calculate the figure for the current year, it is drawn on the annual overall correction factor of the two energy sources in sum from the previous year (2019: 1.14).

Table 11: Annual power generation and correction factors for oil and other energy sources

Oil + Others	**2018**	**2019**[1)]
	TWh	
Gross power generation[2)]	**22.1**	
Oil	**5.2**	
Others (including non-organic waste)	**16.9**	
Self consumption[3)]		
Oil	**9%**	
Others (including non-organic waste)	**10%**	
Net power generation Oil + Others[4)]	**20.0**	
January	1.7	
February	1.6	
March	1.7	
April	1.6	
May	1.6	
June	1.6	
July	1.8	
August	1.8	
September	1.6	
October	1.7	
November	1.7	
December	1.6	
Generation by fuel source ENTSO-E[5)]	**17.5**	
January	1.5	
February	1.3	
March	1.4	
April	1.5	
May	1.3	
June	1.2	
July	1.3	
August	1.9	
September	1.4	
October	1.5	
November	1.7	
December	1.6	
Correction factor[6)]		**1.14**
January	1.10	
February	1.27	
March	1.20	
April	1.08	
May	1.25	
June	1.40	
July	1.37	
August	0.91	
September	1.15	
October	1.13	
November	1.01	
December	1.02	

[1)] For the extrapolation of the current year, the annual value from the previous year is used in each case

[2)] AG Energiebilanzen 2019a

[3)] Oeko-Institut 2013

[4)] Own calculation based on AG Energiebilanzen 2019a and BDEW 2018 (monthly values)

[5)] ENTSO-E 2018

[6)] Own calculation based on the degree of coverage

3 Power consumption

Gross domestic consumption decreased from 2012 to 2018 from about 606.5 terawatt-hours to about 598.9 terawatt-hours. After subtracting the internal consumption of the power plants, pump power consumption and grid losses, this corresponds to a net power consumption of about 526 terawatt-hours for 2018.

To calculate hourly net power consumption, the subtraction method is used. The generation from all energy sources is summed and then adjusted by the hourly balance of trade in electricity.

4 Imports and exports

To calculate the imports and exports, the transparency data from ENTSO-E are used. This data is the reported commercial trade flows (day-ahead cross-border commercial schedules),[1] and is used unchanged.

The only exception includes the electricity trade flows between Germany and Luxembourg (from 2012 to 2015) because the hourly time series have only been available since March 2016. The net export from Germany to Luxembourg over the past few years has been between 4.6 and 4.8 terawatt-hours per year, with only very slight fluctuations over the course of the year (see Oeko Institute 2013). Until 2015, the exports to Luxembourg are therefore displayed as a constant generation volume based on the total generation from the previous year. From 2016 on, the commercial trade flows published by ENTSO-E are used unchanged.

Table 12: Annual export balance and hourly generation volume to Luxembourg

	2012	2013	2014	2015[1)]
	TWh			
Net exports from Germany to ...[2)]				
Luxembourg	4.6	4.6	4.8	
Hourly generation volume	MW			
Luxembourg	524	524	551	546

[1)] For 2015 the values from 2014 are used

[2)] Entso-E 2015

5 Spot prices

The Agorameter shows the day-ahead electricity prices from the EPEX Spot for the German/Austrian/Luxembourgian market region (until September 2018). After the zonal split of

[1] The physical flows are not used because the reported flows of trade for exports and imports are economic variables that were derived from the trade results for the particular electricity purchases. The actual physical electricity flows at any particular time may deviate due to the different voltage and control energy situations. In addition, loop flows that occur in some cases (for example electricity transported from France to Switzerland via Germany) are not actual imports and exports but should instead be considered transit flows. The actual trade flows realised (final cross-border schedule) are only available after seven days and therefore cannot be used. Moreover, since 15 January 2014 this data is no longer published by ENTSO-E.

the joint market area on 1 October 2018, only the day-ahead electricity prices for the German-Luxembourgian market are displayed. The data is retrieved from the ENTSO-E data base.

Each day at 12 noon an EPEX auction is held for electricity sale and purchase for the following day (EPEX Spot 2013). This provides information about the prices for each hour (day-ahead market). These electricity prices are used because the majority of renewable energy sources are sold on the day-ahead market and the liquidity is higher than on the intraday market. To display longer periods, the hourly prices are converted to mean daily prices.

6 Emissions

The emissions of power production in Germany have declined from 322 million tonnes of CO_2 in 2012 to 273 million tonnes in 2018. This decline is a result of dropping hard coal-fired power generation and the increasing share of renewable energies in the electricity mix.

To calculate the total hourly emissions of the power production (in tonnes of CO_2), the hourly feed-in time series for fossil fuel-fired power plants published by the EEX (2012-2017) or ENTSO-E (from 2018), respectively, are, after being processed with the above explained methods, multiplied by a respective emission factor (Table 13) and then added.

The hourly emission factor of the power mix (in grams per kilowatt-hour) is calculated according to the formula of the Umweltbundesamt (UBA). Therefore, the hourly emissions of the power production are divided by the total net power generation (excluding pumped storage) without the hourly line losses. Since to our knowledge, there is no source publishing hourly line losses, a constant percentage of the net load volume based on previous year data (2018: 0.5 per cent per hour) is deducted. The emissions per fuel type are added up and displayed as a specific value per kilowatt-hour and as absolute tonnes.

Further greenhouse gases, which occur during power production, or emissions arising in upstream and downstream stages (for example during the installation or decommissioning of a power plant) are not accounted for. Moreover, the CO_2-emissions from imports are not added and those from exports are not subtracted. Thus, the Agorameter displays those CO_2-emissions that will ultimately be included in the total German CO_2-balance.

Table 13: Annual emissions from fossil power generation and emission factors

Emissions[2]	2012	2013	2014	2015	2016	2017	2018	2019[1]
	Mio t CO_2							
Lignite	166	163	159	157	153	151	148	
Hard coal	94	104	97	92	86	71	61	
Natural gas	27	24	22	22	28	30	28	
Others (incl. fossil waste and oil)	34	35	34	34	33	33	35	
Emission factor of power production by fuel[3]	t CO_2/MWh							
Lignite	1,12	1,10	1,11	1,10	1,11	1,11	1,11	1,11
Hard coal	0,88	0,89	0,89	0,85	0,85	0,81	0,80	0,80
Natural gas	0,37	0,37	0,37	0,37	0,37	0,34	0,35	0,35
Others (incl. fossil waste and oil)	1,56	1,57	1,63	1,59	1,68	1,76	1,75	1,75
Average emission factor of power mix[2]	g/kWh							
	574	573	557	527	523	486	474	

[1] For the extrapolation of the current year, the annual value from the previous year is used in each case

[2] UBA 2019

[3] Own calculation based on UBA 2019

SOURCES

AG Energiebilanzen (2019a): Gross power generation in Germany from 1990 onwards by energy source, available at: http://www.ag-energiebilanzen.de/

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