Renewable Energy in The Netherlands December 2019, by Martien Visser
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This analyses contains information of various sources and own analyses, including estimates. Readers are encouraged to add and improve the quality of the information provided.
The Entrance database on Renewable Energy is regularly improved by the creation and/or refinement of (sub)models

Recent improvements:

From August 2019 onwards, more data from ENTSO-E are used to estimate flows in the Dutch electricity system.
From September 2019 onwards, day-ahead natural gas and power prices are added
In December 2019, the oil demand model have been improved
The fraction renewable energy has been calculated using EU/IPCC regulations. In December, the Netherlands produced on average 8.6% of its final energy consumption in the form of renewables. The 11.4% is an estimate for the average renewable energy in 2020 by PBL in its KEV report of December 2019.
In 2019, the fraction renewable energy was 8.6%, compared to 7.4% last year

- Solar PV generation was 19 PJ, 45% more than last year
- Onshore wind generation was 28 PJ, 3% more than last year
- Offshore wind generation was 13 PJ, similar to last year
- Gross final energy demand was 2095 PJ, 2% less than year
- Energy related CO2 emissions were 155 Mton, 3% less than last year
- The percentage renewable power was 19.2%, up from 16.1% last year

These are preliminary estimates based on a variety of public sources. The official data will be published by CBS in 2020 and 2021.
In December 2019, the fraction renewable energy was 8.6%, compared to 7.9% last year

- The fraction renewable energy was 8.6%, compared to 7.9% last year
- Solar PV generation was 0.5 PJ, 80% more than last year
- Onshore wind generation was 3.1 PJ, similar to last year
- Offshore wind generation was 1.4 PJ, similar to last year
- Gross final energy demand was 219 PJ, 2% more than last year
- Energy related CO2 emissions were 15.3 Mton, similar to last year
- The percentage renewable power was 19%, up from 16% last year
Content

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SELECTED ENERGY DATA FROM DECEMBER 2019
Renewable Energy is produced in various forms. The most important contributors are biomass (biogas, waste, wood and bio-oil) and wind energy. In December 2019, calculated according to the EU/IPCC rules, 8.6% of the gross final energy consumption in the Netherlands was renewable energy.
Renewable energy December 2019 and 2018

Contribution of various sources of renewable energy y-o-y.
Renewable energy appears in various forms. Solar energy has a clear maximum in summer, while in winter, wind is usually stronger. Since biomass is preferentially used for space heating, its consumption in winter is higher than in summer as well.
Energy is used for many various purposes. The most important energy applications in December have been natural gas for industry and oil for various forms of transport. The ‘gross final energy demand’, the nominator in the equation for the calculation of the fraction renewable energy, does not contain feedstock and shipping.
In December 2019, the national energy related CO2-eq. emissions, calculated using the official methods, are estimated at 15.3 Mton, about 1% more than in December 2018. Non-energy (human created) CO2-eq. emissions, mainly agricultural, are estimated at 2.3 Mton.
The capacity in this figure is the so-called name-plate capacity. In practice, not all capacity is available for the market due to planned and unplanned maintenance and mothballing.
In December 2019, power consumption, including transmission losses, has been estimated at 11.3 TWh, equal to December last year.
The daily CO2 emission per kWh produced varies due to variations in the power mix. In December 2019, the average CO2 emissions from power generation, including renewables and cogeneration, are estimated at 390 g/kWh, down from 411 g/kWh in November 2019.
SELECTED MONTHLY PROFILES

(using daily data)
The daily contributions of renewable energy, according to the classification by CBS. In December the average daily gross final energy demand was 1960 GWh per day. One GWh is one million kWh. An average production of 1 GWh/day requires 55 onshore wind turbines of 3 MW each.
Daily energy consumption shows a typical weekday-weekend pattern. Gas demand is mainly dependent of ambient temperature.
Conventional power generation is affected by wind and solar production, variations in electricity demand, maintenance (mainly coal and nuclear) and the balance between power imports and exports.

In this figure, co-firing of biomass in coal-fired power stations has been excluded.
December 2019 was rather windy, while the solar power was low. The average utilization rate of onshore wind turbines was 33% and for offshore wind, it was 57%. For solar PV, the average utilization rate was 3%. 1 GWh is sufficient to provide power for a year for 300 households.
In December, the percentage of renewable power varied between 11% and 36%, with an average of 19.5%. The average percentage of renewable energy was 8.6%. These percentages have been calculated using the formal EU/IPCC methodology.
In December, gas was a marginally attractive source for electricity production. With a gas price of 15 €/MWh and a CO2-price of 25 €/ton, power can be produced at marginal costs for about 40 €/MWh.
SELECTED MONTHLY ENERGY DATA
The gross final consumption of energy is a quantity used to calculate the percentage of renewable energy.

This quantity excludes the energy consumed in the energy sector (mainly due to the generation of electricity); in international shipping; in feedstock; and the energy used for (international) aviation above 6.18% of the total.
Gas consumption in December, excluding gas-to-power, was slightly higher than last year.
Dutch natural gas production is structurally in decline, due to the gradual closure of the Groningen gas field and lower production of the so-called ‘small fields’.
Dutch power demand in December, including transmission losses, has been estimated to be similar to December last year.
In December 2019, onshore wind production was 3.1 PJ, slightly higher than last year. Offshore wind production was 1.5 PJ, similar to last year. The average utilization of wind capacity was 33% for onshore and 57% for offshore wind.
In December 2019, Solar PV reached 0.5 PJ. This is 79% more than in December last year. In December 2019, there was more sunshine than in the same month in 2018. Furthermore, the Netherlands experienced a significant increase in Solar PV capacity. In December, the average utilization rate of solar PV capacity was just 3%.
In December 2019, coal-fired power generation has been estimated to be similar to December 2018. This graph depicts actual coal utilization and does not include co-firing of biomass.
In December 2019, gas-fired power generation (including CCGT’s and Cogen) was slightly lower than last year.
This figure depicts the amount of LNG injected into the gas grid. This year, LNG imports by the Netherlands are at a much higher level than in previous years. The figure excludes the usage of LNG as transport fuel.

1 PJ is equal to about 30 million m3 gas
In December 2019, renewable energy consumption in the Netherlands was 12% higher than last year.
In December, the percentage of renewable energy was 8.6%, compared to 7.9% in December last year. The increase was entirely caused by more renewable energy production, since gross final energy consumption was stable.
In December 2019, according to IPCC rules, Dutch CO$_2$ emissions were 1% higher than in December 2018.
ENERGY DEMAND IN A NUTSHELL
Dutch government has allocated Energy Demand in four categories. These categories (and this figure) do not take into account energy demand for international shipping, aviation and feedstock.

(1 GWh is equal to the average daily energy production of 55 onshore wind turbines of 3 MW each)
The primary energy requirement for Low Temperature Heat, mainly buildings and green houses, varies with ambient temperature.
The primary energy requirement for High Temperature Heat (mainly industry) varies with the economic activity in the Netherlands.
The primary energy requirement for Transportation (excluding international shipping and aviation) varies with the economic activity in the Netherlands. Fuel purchases abroad, e.g. because of lower taxes, are not included in this figure.
The primary energy requirement for the Dutch power sector varies with power demand, the import/export balance and the production of renewable power. The figure excludes the primary energy demand associated with power imports.
This figure presents the daily CO₂ emissions of each of the four energy demand sectors. The figure does not take into account the CO₂ emissions by international shipping and aviation and from the energy for feedstock. (1 kton CO₂ is equal to the average daily CO₂ emission of 95,000 households, each using 1400 m³ gas and 3000 kWh electricity annually.)
The CO₂ emissions from low temperature heat, mainly buildings and green houses, vary with ambient air temperature. December was a relatively cold month and hence, energy demand from buildings was relatively high. The figure excludes the CO₂ emissions due to the production of electricity used for low temperature heating.
Dutch CO$_2$ emissions High-Temperature heat

CO$_2$ emissions from high temperature heat, mainly industry, vary mainly with the economic activity in the Netherlands.
This figure presents the formal CO₂ emissions from Transportation (thus excluding international shipping and aviation). These emissions vary primarily with the economic activity in the Netherlands. CO₂ emissions from fuel that is bought abroad, are, according to international conventions, not included in this figure.
CO₂ emissions from the power sector vary with power demand, the fraction of coal used for power generation, the amount of renewable power produced, and the level of power exports and imports.
SELECTED HOURLY ENERGY DATA
Gas supplies are related to ambient temperatures. When gas storages are being filled, this is represented by negative values. Gas supplies in this figure are used both for Dutch consumption and for exports.
Domestic gas demand in December peaked at 85 GW. In this graph, the term “industry” is defined as the 400 direct connections to the high pressure Gasunie grid including Zebra. The term “distribution” includes households, offices, commercials and small and medium size industries that are connected to the gas distribution grids.
In December 2019, Dutch gas imports were 165 PJ while Dutch gas exports were 145 PJ.
In December 2019, power imports (mainly from Germany and Norway) were 6,4 PJ, while the power exports (mainly to Belgium and UK) were 5,5 PJ. This graph presents the actual power flows, i.e. both intended (traded) and unintended.
December 2019 was characterized by a varying production of wind energy; the average utilization rate of the wind turbines was 33% onshore and 57% offshore. The installed wind power capacity was about 4500 MW in total.
December was very sunny; the utilization rate of solar PV installed was 3%. At the beginning of December, the installed solar power capacity in the Netherlands is estimated at 6350 MW. Solar power capacity in NL increases approximately by 200 MW per month (equal to one solar panel every 4 seconds).
This graph shows the combined renewable electricity production by offshore wind, onshore wind and solar PV.
The following set of graphs presents for each month in 2019 the hourly contributions of various energy sources to total power consumption in The Netherlands.
The following set of slides presents for each week in 2019 the hourly contributions of wind and solar PV to the total power consumption in The Netherlands.
Electricity in The Netherlands 2019
Electricity in The Netherlands 2019

The chart shows the electricity production in the Netherlands in 2019. The labels on the x-axis are Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday, and Monday. The y-axis represents MW (megawatts) of electricity production. The chart includes different sources of electricity production, such as Rest, solar-PV, Wind-onshore, and Wind-offshore.
Electricity in The Netherlands 2019

![Graph showing electricity generation by renewable sources in February 2019, with labels for Rest, solar-PV, Wind-onshore, and Wind-offshore.]
Electricity in The Netherlands 2019

![Graph showing electricity production in The Netherlands for 2019, with data for different days of the week and sources like Rest, solar-PV, Wind-onshore, and Wind-offshore.]
Electricity in The Netherlands 2019

[Bar chart showing electricity consumption by type (Rest, solar-PV, Wind-onshore, Wind-offshore) over a period from 12-Feb to 18-Feb, 2019.]
Electricity in The Netherlands 2019

![Graph showing electricity generation in The Netherlands in 2019 with categories for Rest, solar-PV, Wind-onshore, and Wind-offshore.]
Electricity in The Netherlands 2019
Electricity in The Netherlands 2019

![Graph showing electricity production in The Netherlands for 2019. The graph includes data for Rest, solar-PV, Wind-onshore, and Wind-offshore. The x-axis represents dates from 19-mrt to 25-mrt, and the y-axis represents MW. The graph shows fluctuations in electricity production throughout the week.]
Electricity in The Netherlands 2019
Electricity in The Netherlands 2019

Graph showing daily electricity production in megawatts (MW) from 16-apr to 22-apr, 2019. The graph distinguishes between rest, solar-PV, wind-onshore, and wind-offshore energy sources.
Electricity in The Netherlands 2019

![Graph showing electricity production by source in The Netherlands 2019.]

- Rest
- Solar-PV
- Wind-onshore
- Wind-offshore

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Electricity in The Netherlands 2019

Diagram showing electricity production from various sources from 21-mei to 27-mei, 2019.

- **Rest**
- **solar-PV**
- **Wind-onshore**
- **Wind-offshore**

The graph illustrates the fluctuation in electricity production across different days of the week.
Electricity in The Netherlands 2019

![Graph showing electricity production by source over a week in 2019. The graph includes data for different days of the week and sources such as Rest, solar-PV, Wind-onshore, and Wind-offshore.]
Electricity in The Netherlands 2019

- Graph showing electricity generation from various sources:
  - Rest
  - Solar-PV
  - Wind-onshore
  - Wind-offshore

- Data for June 2019.
Electricity in The Netherlands 2019

![Graph showing electricity production sources in The Netherlands for 2019. The graph indicates the contribution of Rest, solar-PV, Wind-onshore, and Wind-offshore to electricity production on different days of the week.](image)
Electricity in The Netherlands 2019

The chart shows the electricity generation in megawatts (MW) for the week of 9 to 15 July 2019. The sources of electricity generation are categorized as Rest, solar-PV, Wind-onshore, and Wind-offshore. The data indicates fluctuations in power generation across different days of the week.
Electricity in The Netherlands 2019

[Diagram showing electricity generation by source (Rest, solar-PV, Wind-onshore, Wind-offshore) over the week of 23-29 July 2019]
Electricity in The Netherlands 2019

The graph shows the electricity generation from different sources over a period of time in 2019. The x-axis represents different days of the week and dates from 30th July to 5th August. The y-axis represents the electricity generation in MW. The graph is color-coded to distinguish between different sources:
- Grey: Rest
- Orange: solar-PV
- Green: Wind-onshore
- Greenish: Wind-offshore

The graph indicates the fluctuation in electricity generation across different days and sources.
Electricity in The Netherlands 2019

![Graph showing electricity generation by day and energy sources in August 2019. The graph indicates the contribution of solar-PV, Wind-onshore, Wind-offshore, and Rest to the daily electricity generation. Each day from Tuesday to Monday is represented, with data points for each energy source.](image-url)
Electricity in The Netherlands 2019

![Graph showing electricity production by type over a week in September 2019. The graph includes data for Rest, solar-PV, Wind-onshore, and Wind-offshore. The production is measured in MW.](image)
Electricity in The Netherlands 2019

![Diagram showing electricity production by source for 2019 in The Netherlands.](image)

- **Rest**
- **solar-PV**
- **Wind-onshore**
- **Wind-offshore**

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Electricity in The Netherlands 2019

The diagram shows electricity generation from various sources in The Netherlands in 2019. The x-axis represents weeks (1-okt to 7-okt), and the y-axis represents megawatts (MW). The graph indicates the contribution of different energy sources, including Rest, solar-PV, Wind-onshore, and Wind-offshore. The data highlights the trends and variations in electricity generation across different days of the week.
Electricity in The Netherlands 2019
Electricity in The Netherlands 2019

![Graph showing electricity production in November 2019 for Rest, solar-PV, Wind-onshore, and Wind-offshore.]
Electricity in The Netherlands 2019

![Graph showing electricity production by day and source for the week of 19 to 25 November 2019. The graph indicates the contribution of various energy sources including Rest, solar-PV, Wind-onshore, and Wind-offshore.]
Electricity in The Netherlands 2019
Electricity in The Netherlands 2019

Graph showing electricity production from different sources:
- Rest
- Solar-PV
- Wind-onshore
- Wind-offshore

Dates: 3-9 December 2019

Source: EnTrance Centre of Expertise Energy
Electricity in The Netherlands 2019
Electricity in The Netherlands 2019

The graph illustrates the electricity generation in The Netherlands from 17th December 2019 to 23rd December 2019. It shows the daily consumption and the generation from different sources: Rest, solar-PV, Wind-onshore, and Wind-offshore. The data is categorized by days of the week: Tuesday, Wednesday, Thursday, Friday, Saturday, Sunday, and Monday.

The highest consumption and generation are observed on certain days, with variations throughout the week. The graph provides a visual representation of the energy distribution and highlights the importance of renewable sources in the energy mix.
Electricity in The Netherlands 2019

[Chart showing electricity production from different sources over a month, with labels for Rest, solar-PV, Wind-onshore, and Wind-offshore.]
MISCELLANEOUS
In December 2019, the average daily effective temperature (temperature, including wind shield factor) was 3.2 °C, slightly lower than in December 2018 (3.8 °C).
Specific CO₂ Emissions used in this presentation

![Graph showing specific CO₂ emissions for different fuel types, including natural gas, oil, coal, solid biomass, power, Cogen, Hoogovengaas, gas-fired, and coal-fired. The emissions are measured in g/kWh. The highest emission is 798 g/kWh for coal-fired Power Generation.](image)
This presentation is based on numerous sources about energy demand, supply, conversion and production in The Netherlands. Unfortunately, these sources do not cover the entire Dutch energy system, nor do these sources provide the insights needed for this presentation. Thus, various approximations and scaling factors have been derived and are used. The author would like to thank students from Hanze University of Applied Sciences in Groningen and various consulted energy experts for their feedback on the methods used and results derived. Currently, the aggregated results of this work (e.g. monthly and annual data) are in good agreement with data from the Dutch National Office of Statistics (CBS) and Eurostat and consequently, it is believed that this presentation gives a fair presentation of the complex reality of the Dutch energy system.

The author invites readers to comment on the data provided to further improve this work. After all, good and reliable data are at the heart of any successful policy to make our world more sustainable.

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