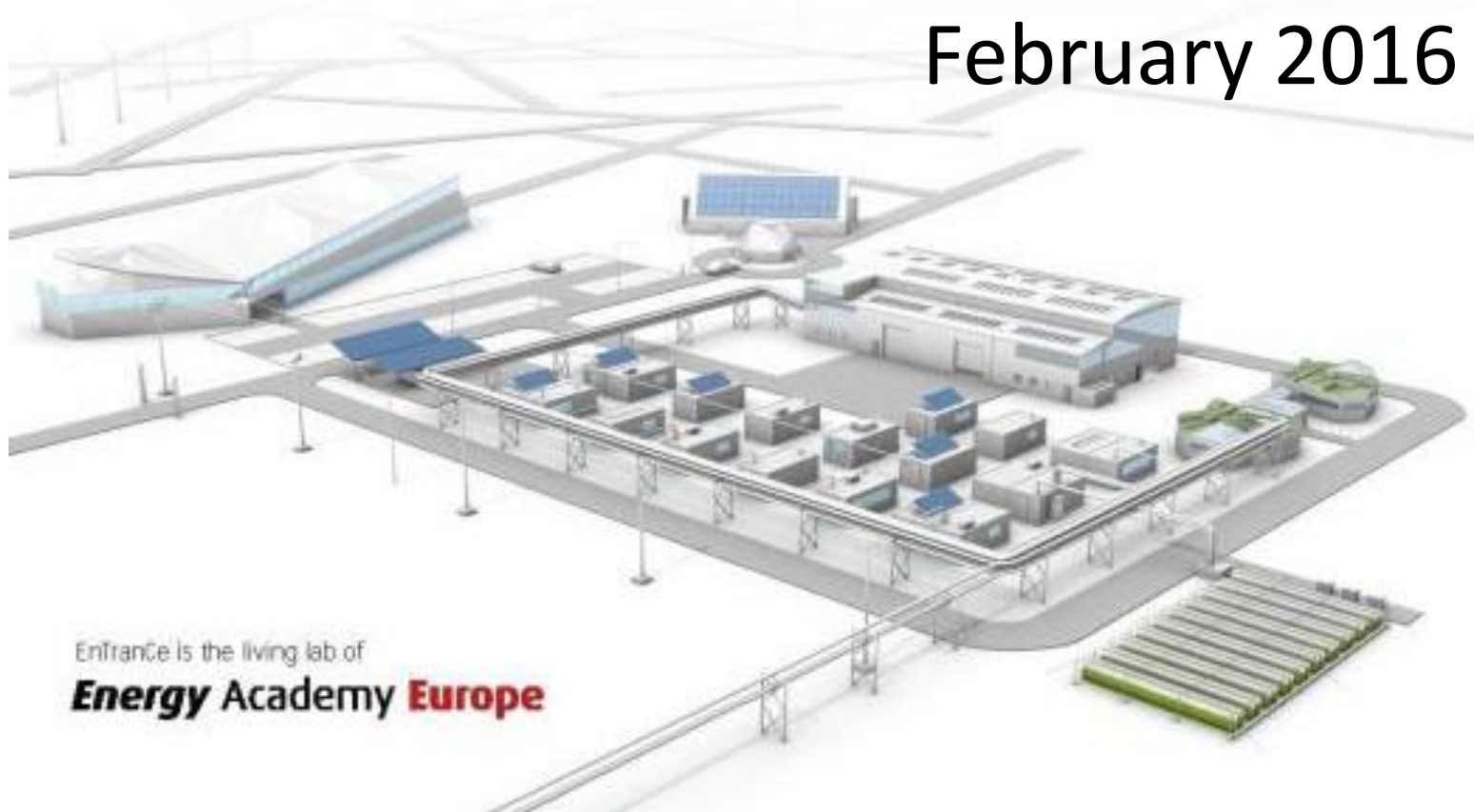


# Renewable Energy in The Netherlands

## February 2016



EnTranCe is the living lab of  
**Energy Academy Europe**

**Dr. Martien Visser**

Professor Energy Transition & Network Integration

Hanze University of Applied Sciences Groningen

Partner of the Energy Academy Europe

E-mail: [b.m.visser@pl.hanze.nl](mailto:b.m.visser@pl.hanze.nl)

This analyses contains information of various sources and own analyses, including various estimates.

Readers are encouraged to add, to improve the quality of the information provided.

February 2016

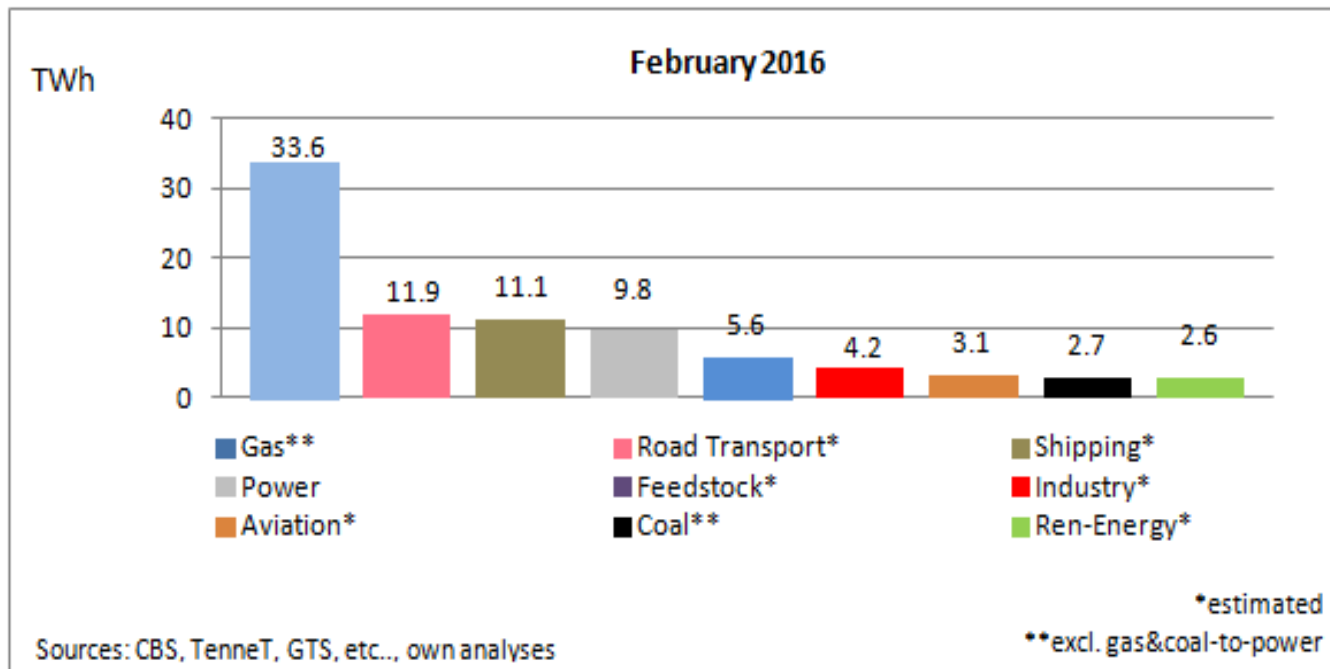
In a Nutshell

- The percentage renewable power was 11.0%, up from 8.8% last year.
- Renewable power varied between 3.7% (on February 26<sup>th</sup>) and 25% on February 7<sup>th</sup>)
- The fraction renewable energy was 4.6%, about 0.4% higher than last year
- Electricity production by wind was 80% higher y-o-y and reached 0.9 TWh.
- Electricity production by solar-PV was 40% higher y-o-y and reached 0.05 TWh
- Average utilization of wind capacity was 34% and of solar-PV, it was 5%
- Coal-fired power increased by 5%, while gas-fired power generation decreased by 11%
- CO2 emissions were stable at 15.6 Mton, although February 2016 had one day more
- Since January 2016, energy demand and CO2 emissions have been allocated to four main functions: low & high temperature heat, transportation and power

- February 2016 data
- Monthly profiles
- Monthly data
- Hourly data
- Miscellaneous

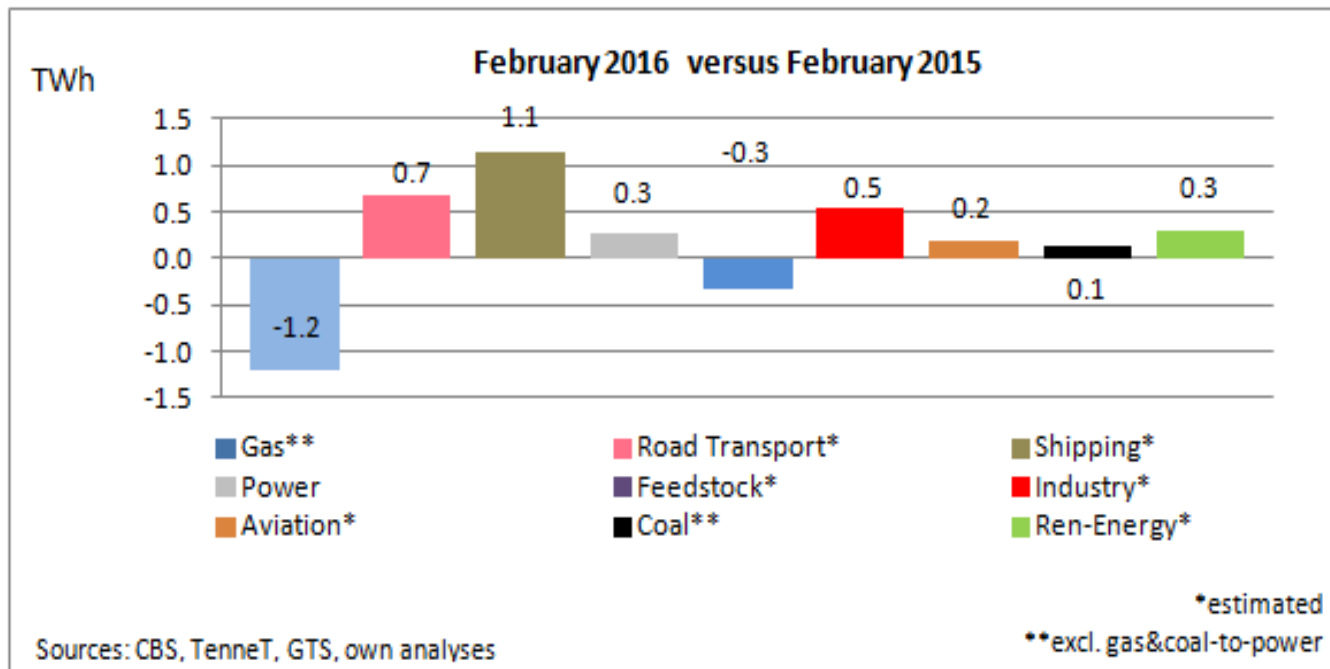
# SELECTED ENERGY DATA FROM FEBRUARY 2016

# Final Energy Demand February 2016



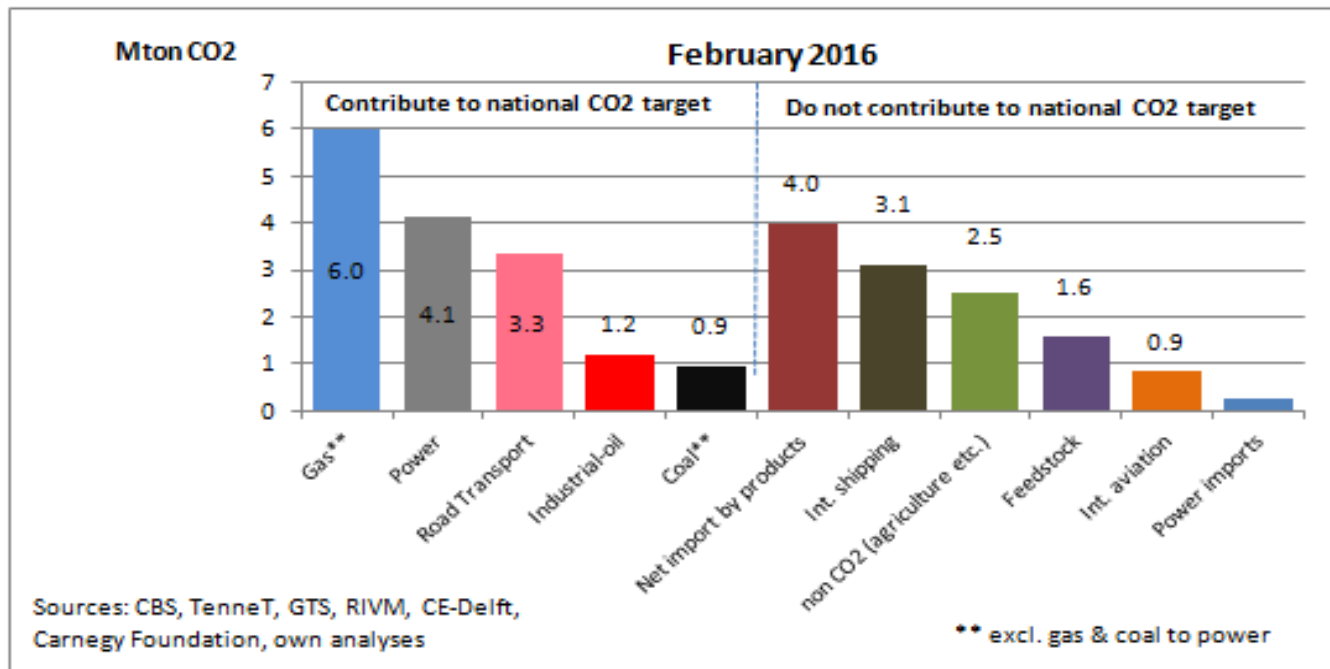
Energy is used for many different purposes. In February 2016, the most important energy applications were gas and various forms of transport.

# Final Energy Demand February 2016 (vs 2014)



In February 2016, gas demand has been lower than last year.

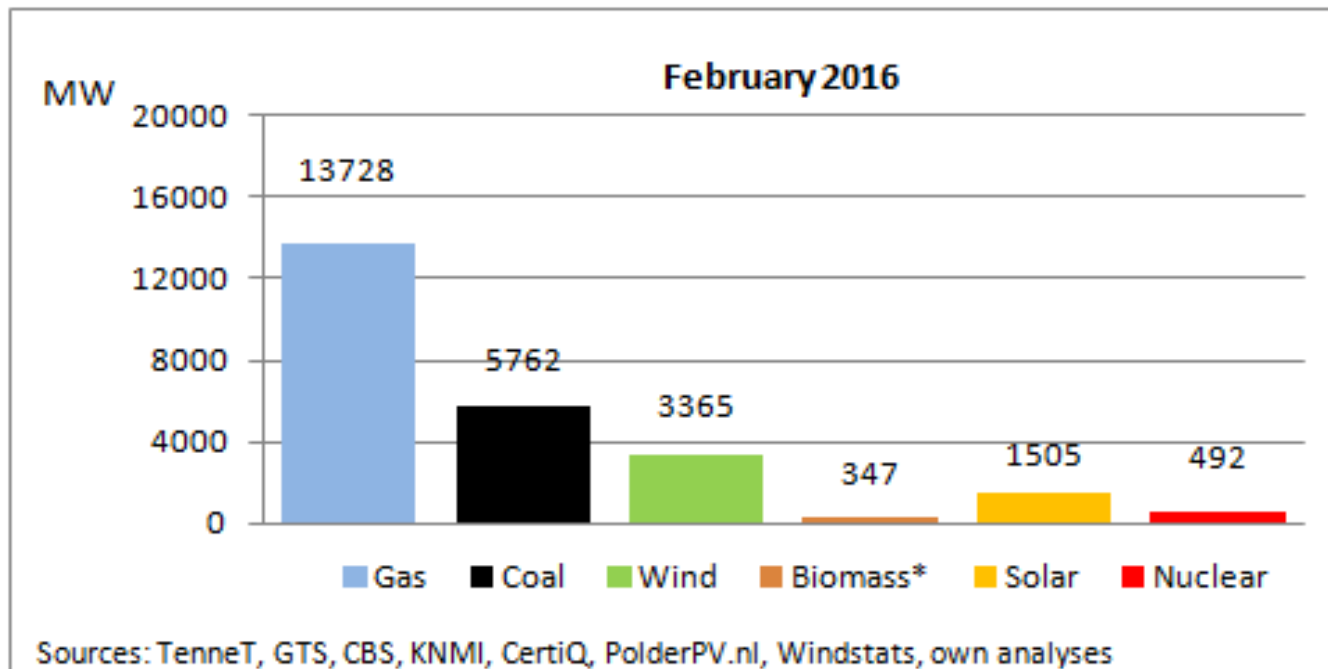
# CO2 Emissions February 2016



In February, the national energy-related CO2 emissions, calculated using the official formulae, are estimated at 15.6 Mton, down from 15.7 Mton in February 2015, although February 2016 had an extra day.

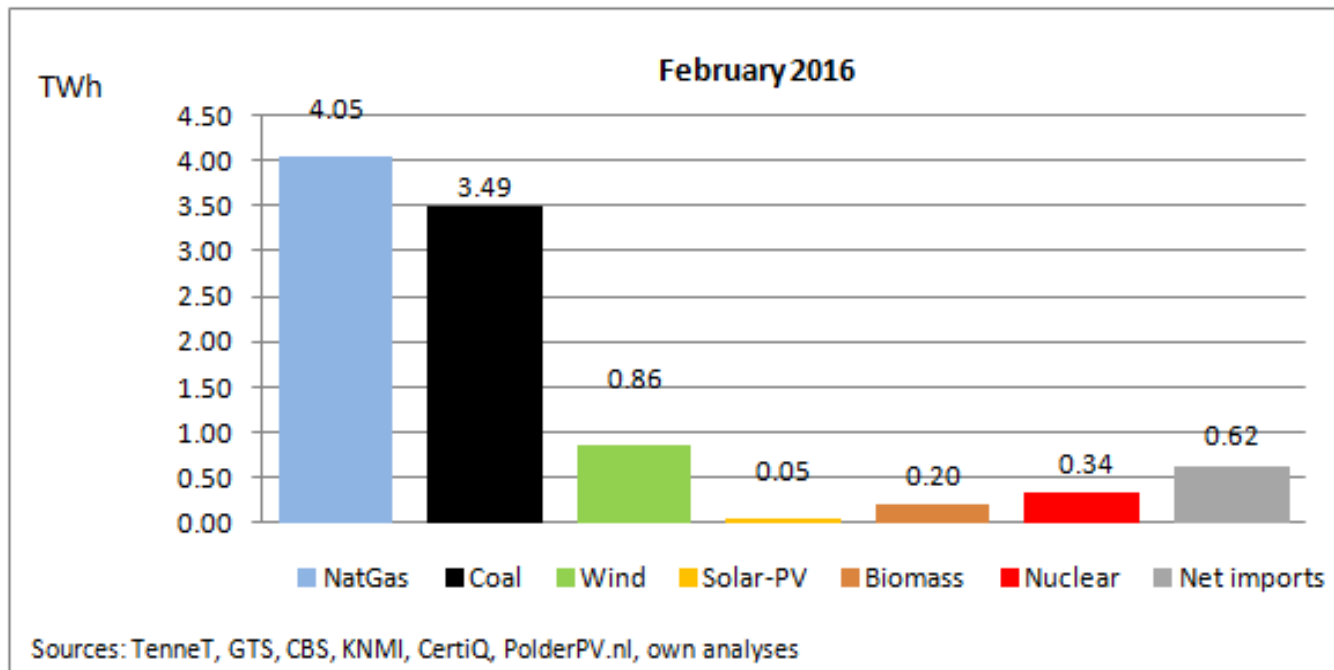


# Power Generation Capacity February 2016



The capacity (beginning of February) is the so-called name-plate capacity. In practice, not all capacity is available for the market due to planned and unplanned maintenance. According to the newspapers, biomass addition to a coal-fired station in Geertruidenberg was ended.

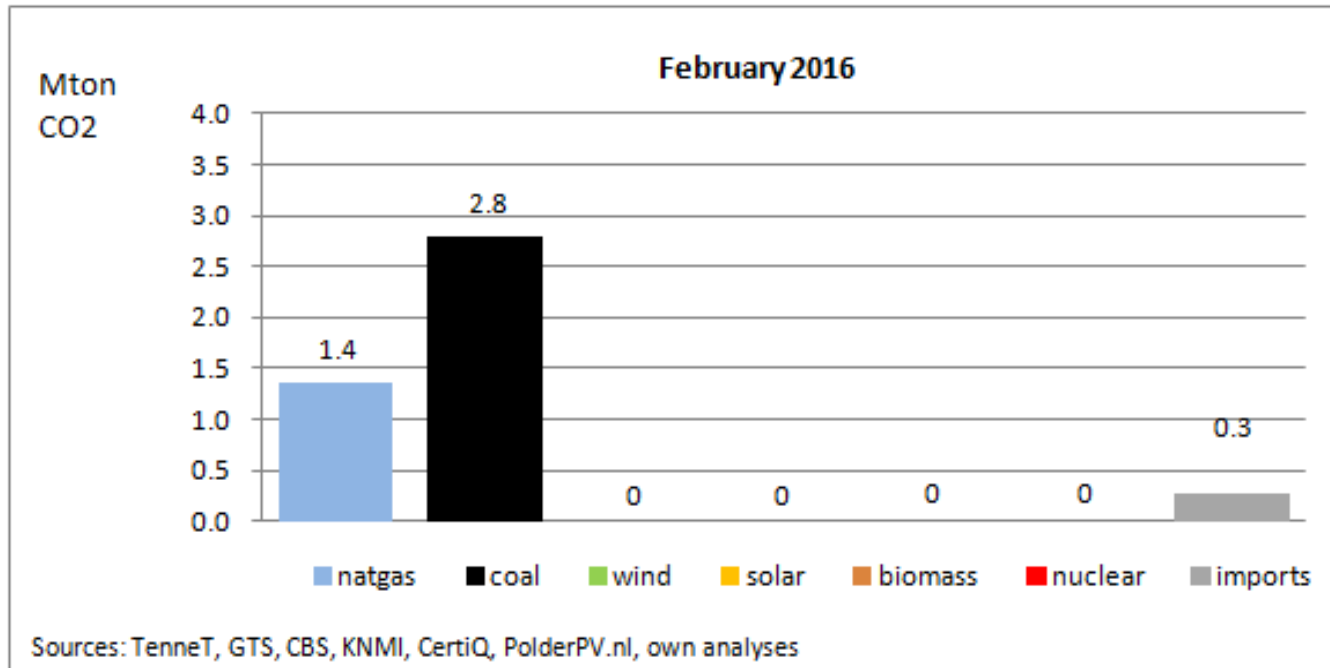
# Power Supplies February 2016



In February 2016, power consumption was 9.8 TWh, 3% higher than last year. In February 2016, there was high availability of wind and renewables accounted for 11% in the power system, up from 9% February 2015. For the second consecutive month, gas-fired power was larger than coal-fired power.

# CO2 from Power Generation

February 2016

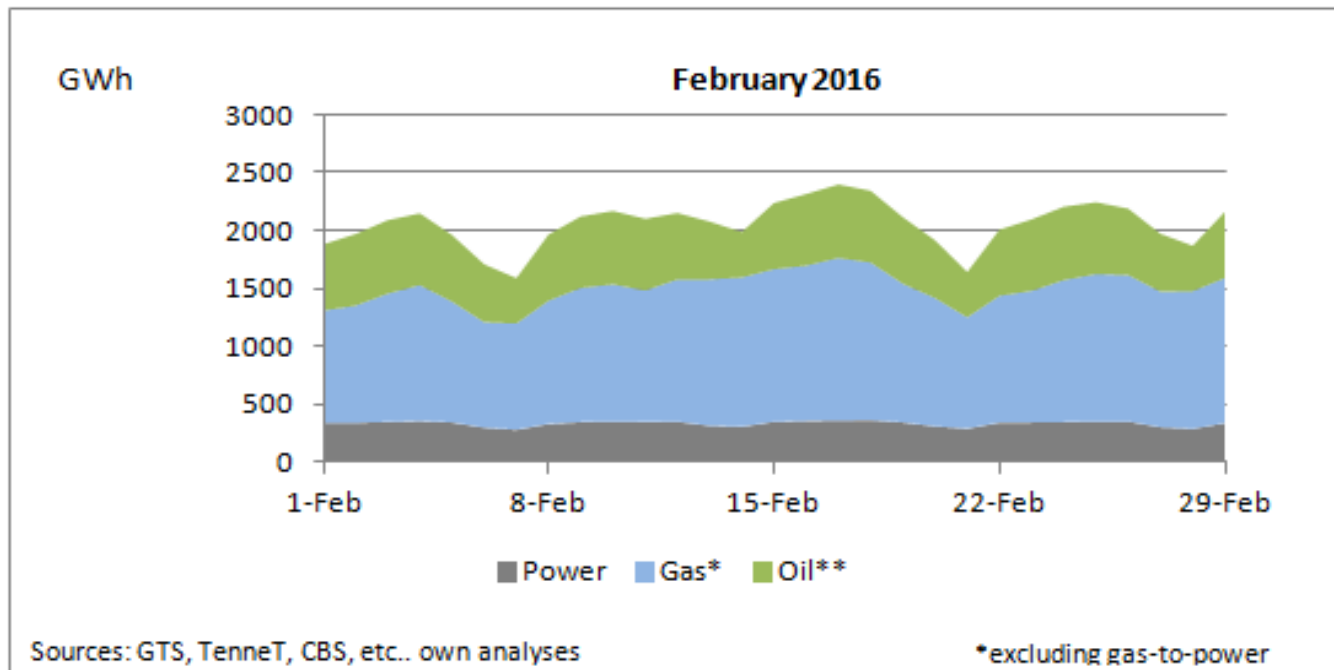


In February 2016, 70% of the CO2 emissions from the power sector came from the coal-fired power stations. The CO2 emissions from imports are given for comparison, since these do not contribute to the National Dutch CO2 emission level.

# SELECTED MONTHLY PROFILES

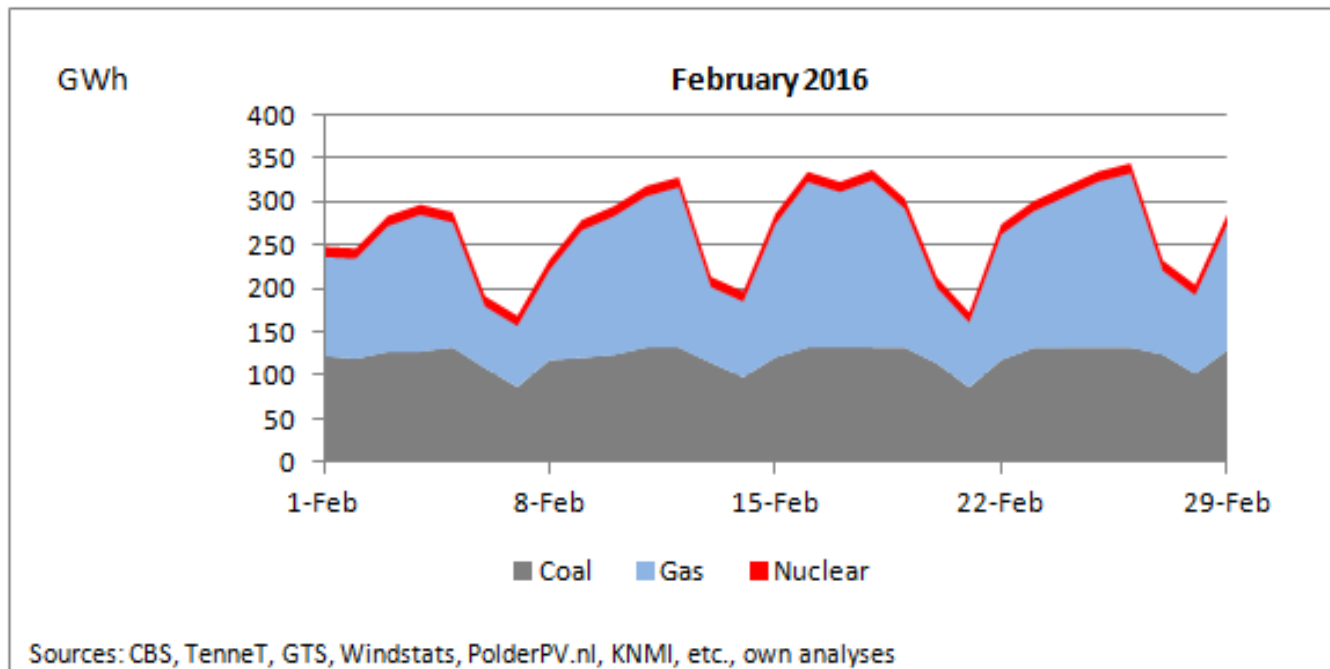
(using daily data)

# Gas and Power Demand February 2016



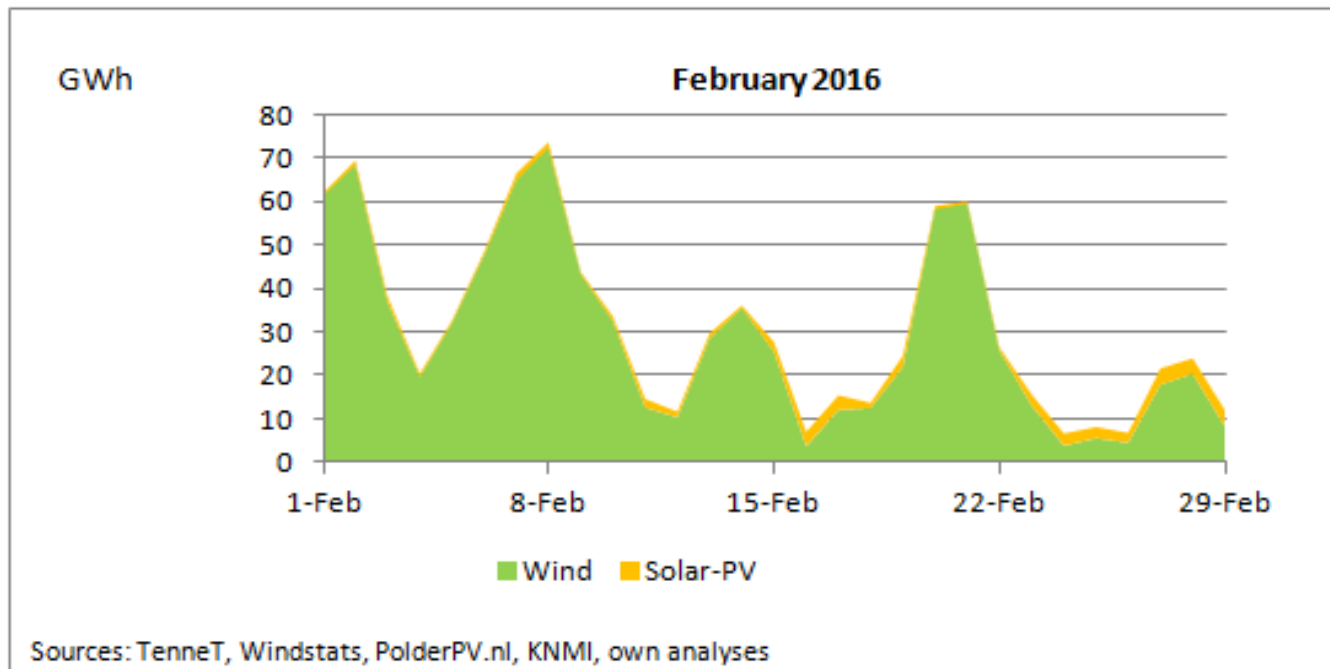
Daily power demand shows a week-weekend pattern. Daily gas demand is mainly determined by ambient air temperature. Oil demand for road transport varies in particular between weekdays and weekends.

# Conventional Power Production February 2016



The week-weekend pattern of the coal-fired power stations is less pronounced than last year, due to the closure of some coal-fired capacity. Gas-fired generation is either must-run capacity or necessary to balance the system.

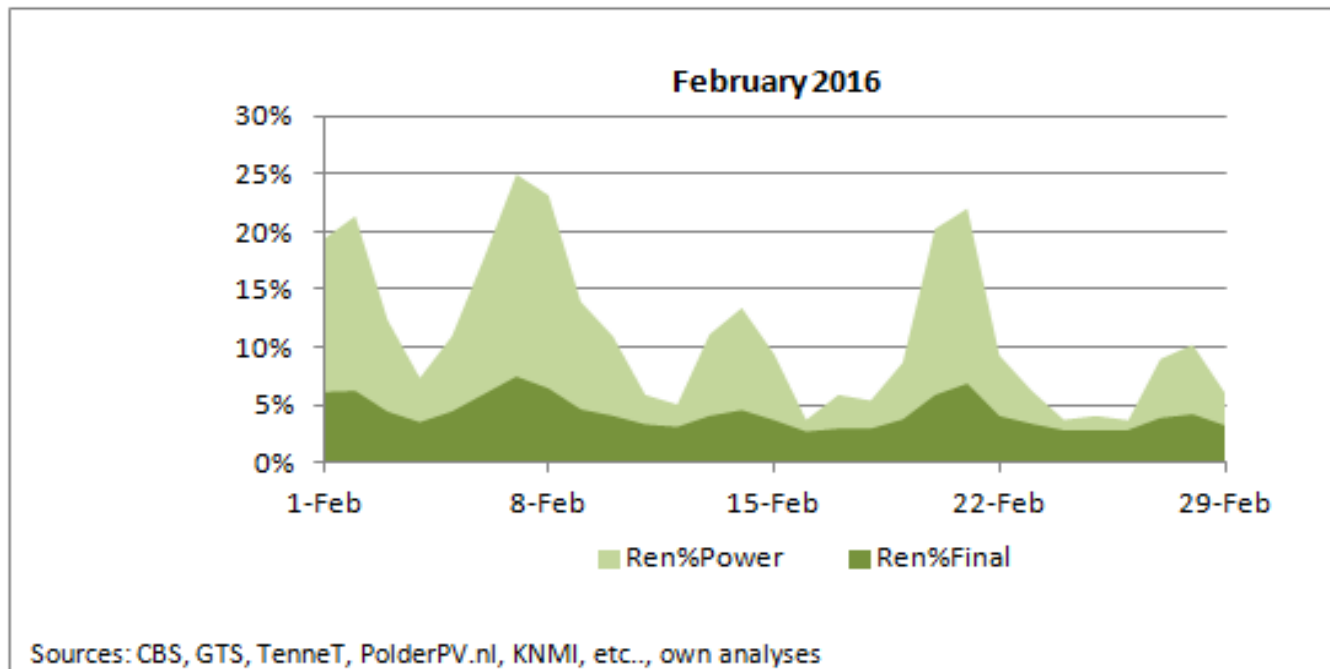
# Wind and Solar Power Production February 2016



February 2016 was rather windy and wind generation was 0.9 TWh, and the utilization rate was 34%. On the other hand, in winter, solar-PV electricity production is rather low; the utilization rate of solar-PV in February was 5%.

1 GWh is sufficient to provide power for a year to 300 households.

# Contribution of Renewable Energy February 2016

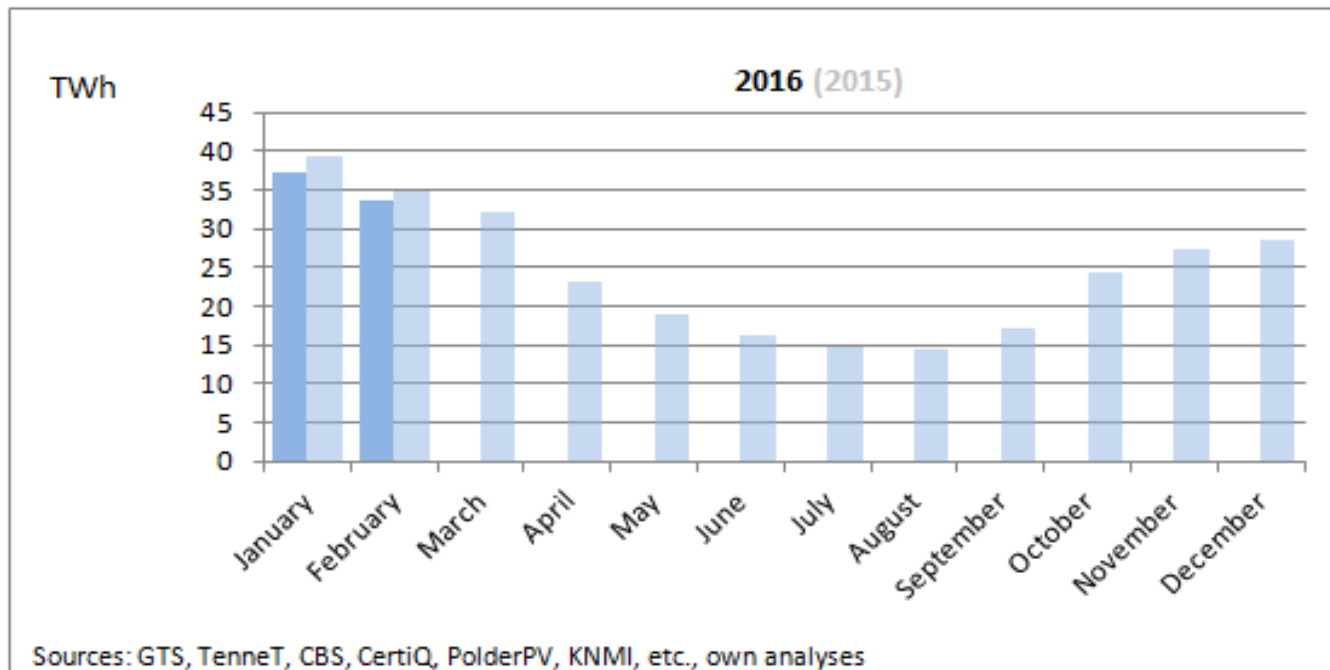


In February, the percentage of renewable power varied widely between 4% and 25%. The percentages renewable power and energy have been estimated using the formal EU/IPCC procedures.



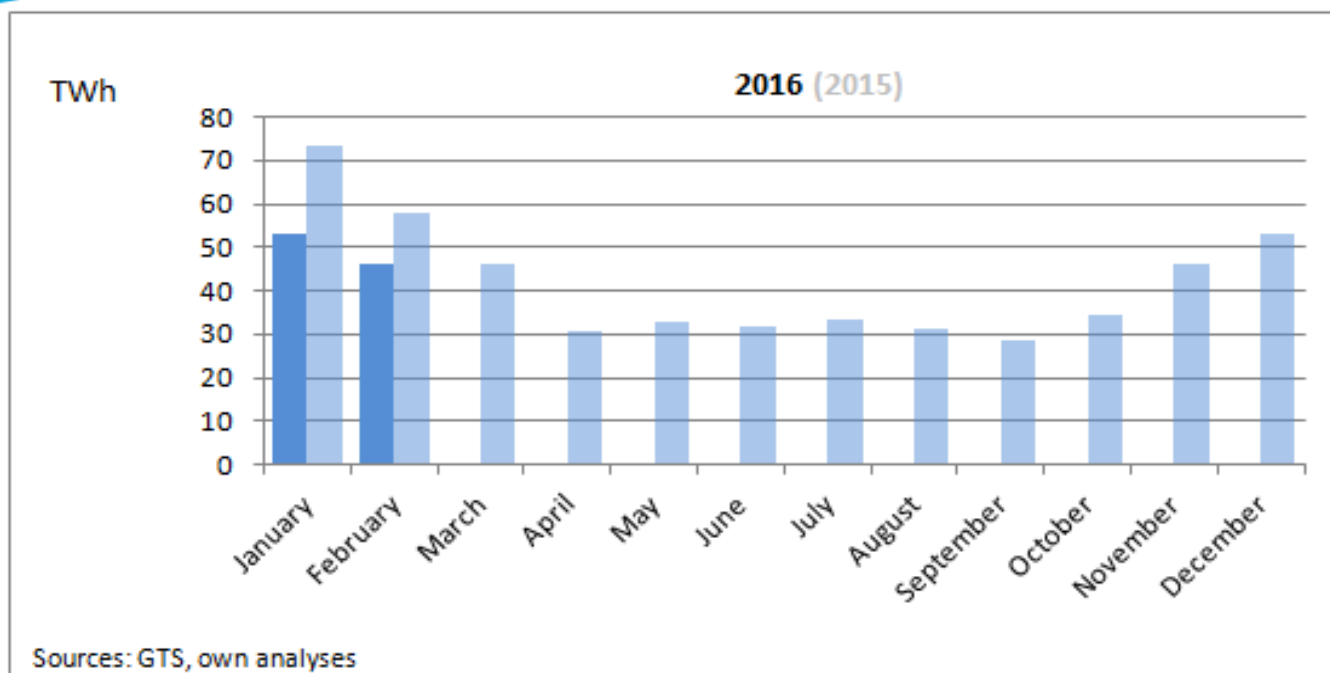
# SELECTED MONTHLY ENERGY DATA

# Gas Demand (excluding gas-to-power) 2016 (and 2015)



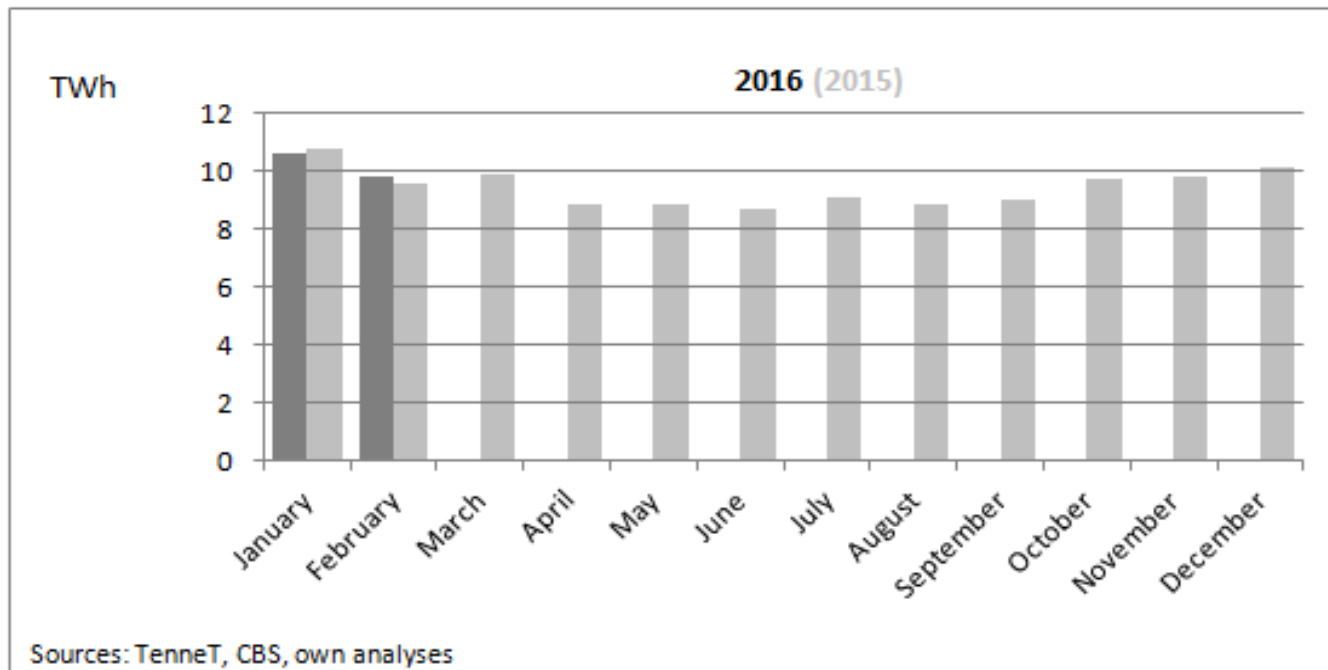
Gas consumption in February, excluding gas-to-power, was lower than last year, mainly due to lower gas demand in the distribution, although the ambient temperature was similar than last year.

# Gas Production 2016 (and 2015)



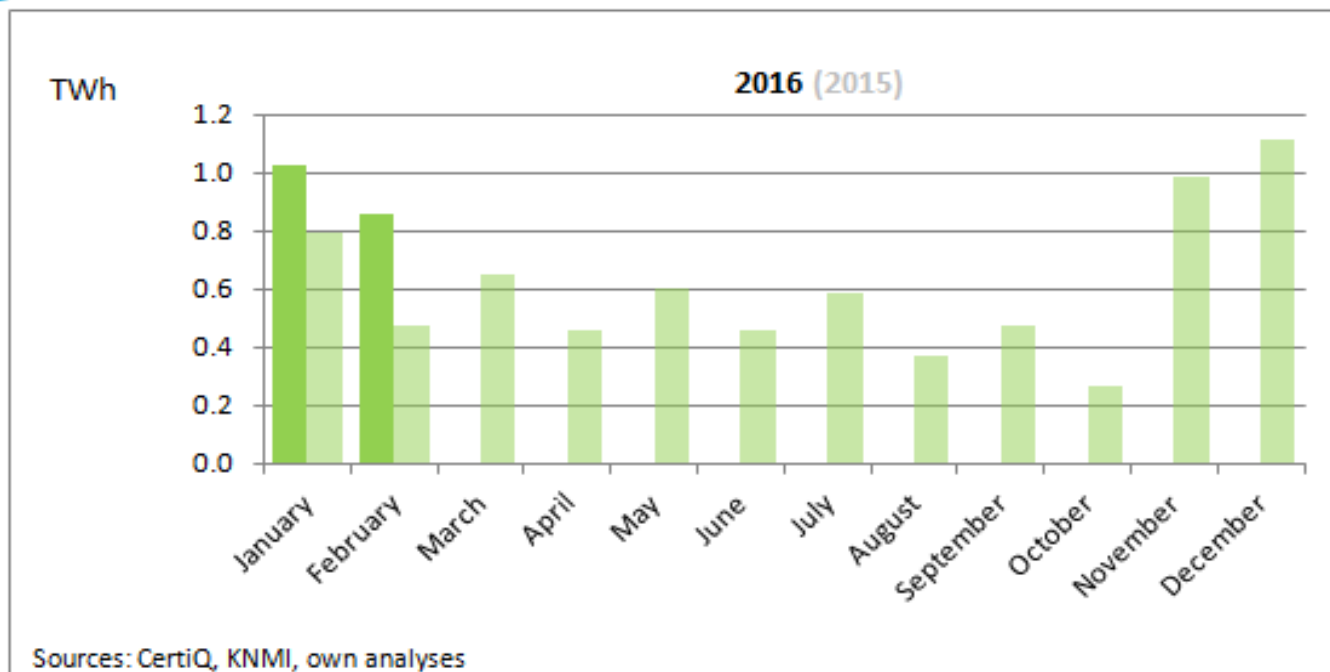
Gas production was lower than last year, due to a lower production from the Groningen gas field and a declining gas production from the North Sea.

# Power Demand 2016 (and 2015)



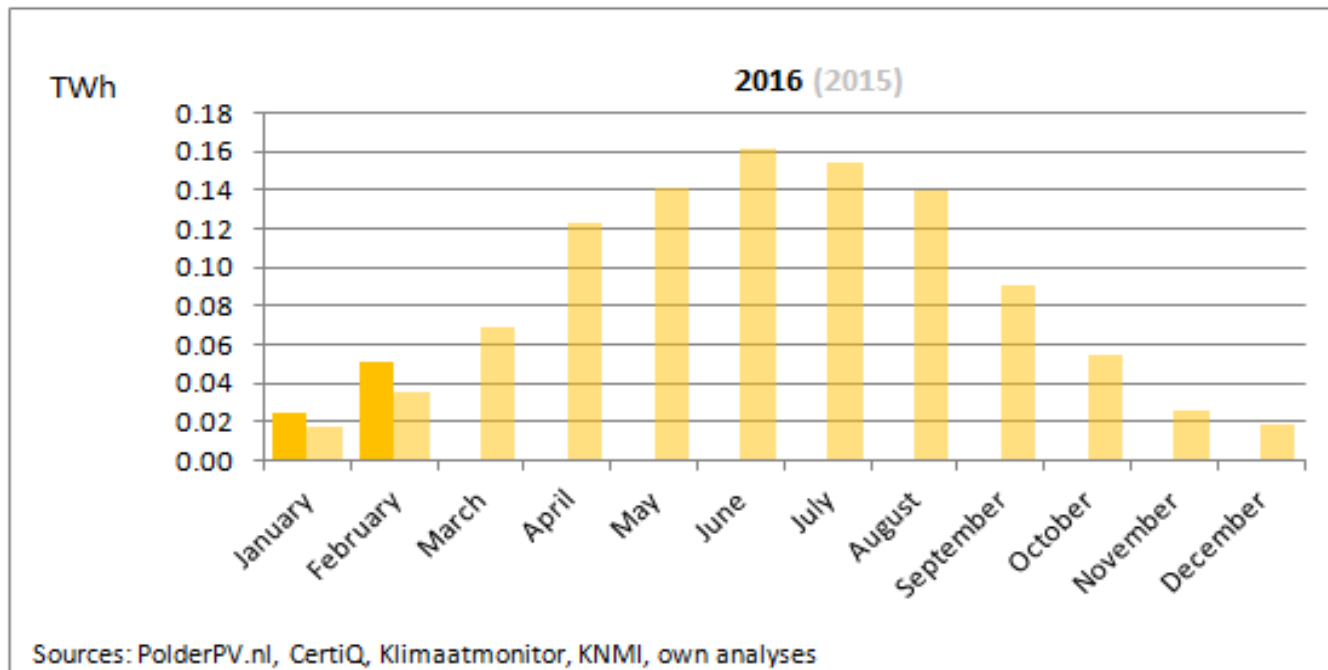
Power demand in February was slightly higher than last year, because February had an extra day in 2016.

# Wind Production 2016 (and 2015)



Wind production in February 2016 was almost 0.9 TWh, significantly higher than in 2015. In February 2016, the average utilization of wind capacity was 34%.

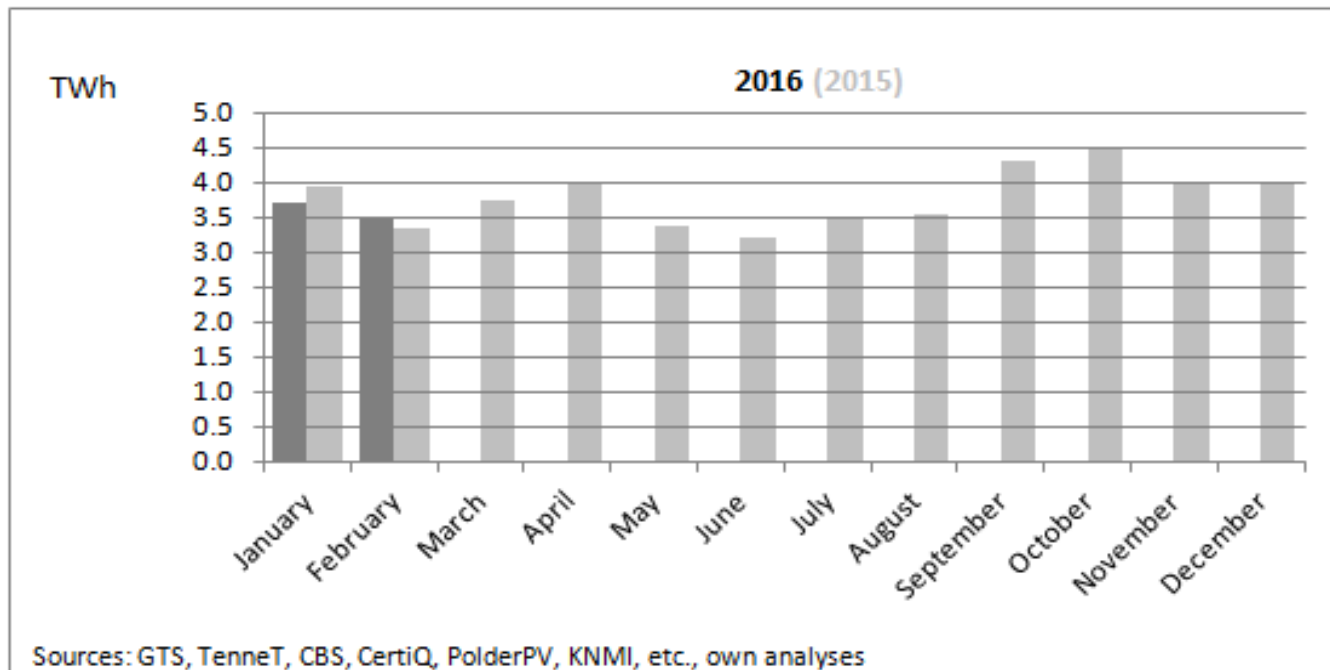
# Solar PV Production 2016 (and 2015)



In February 2016, electricity generation by Solar PV in The Netherlands was much higher than last year, because of an increase in solar-PV capacity and more sunshine.

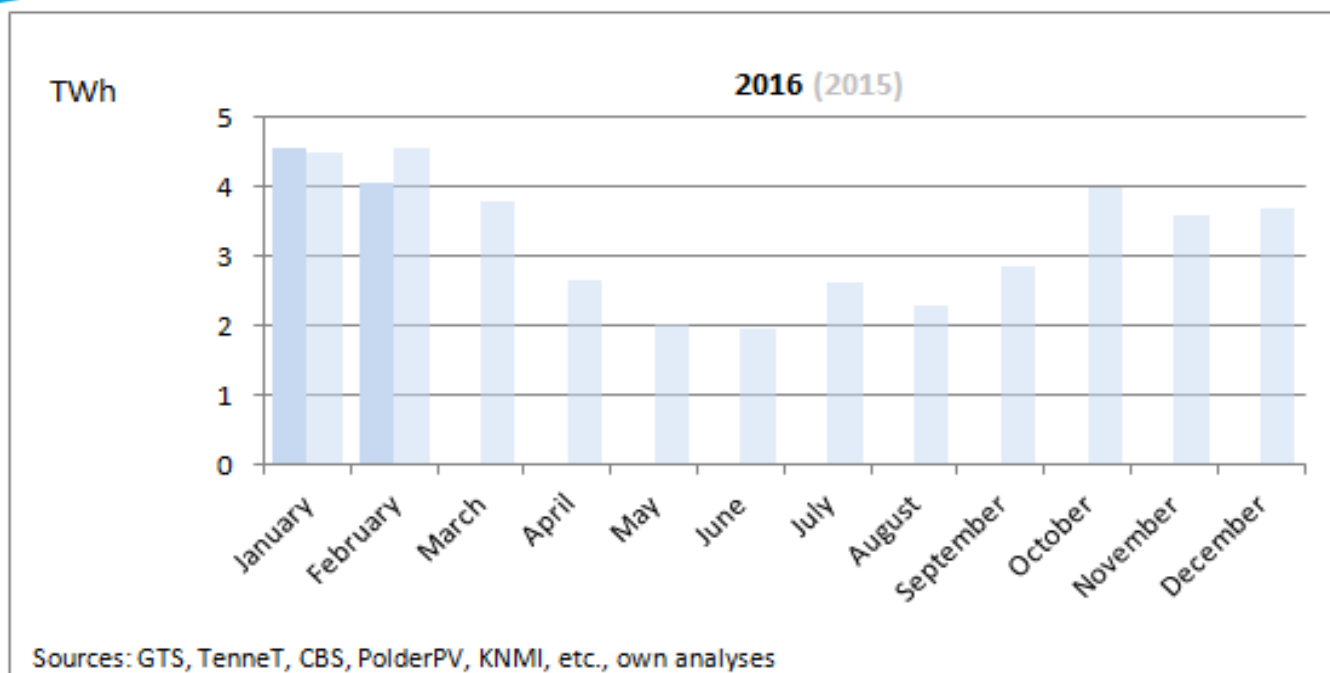
In February, the average utilization rate of solar-PV capacity was 5%.

# Coal-to-Power 2016 (and 2015)



In February coal-fired power generation was slightly higher than last year, mainly because February 2016 had an extra day.

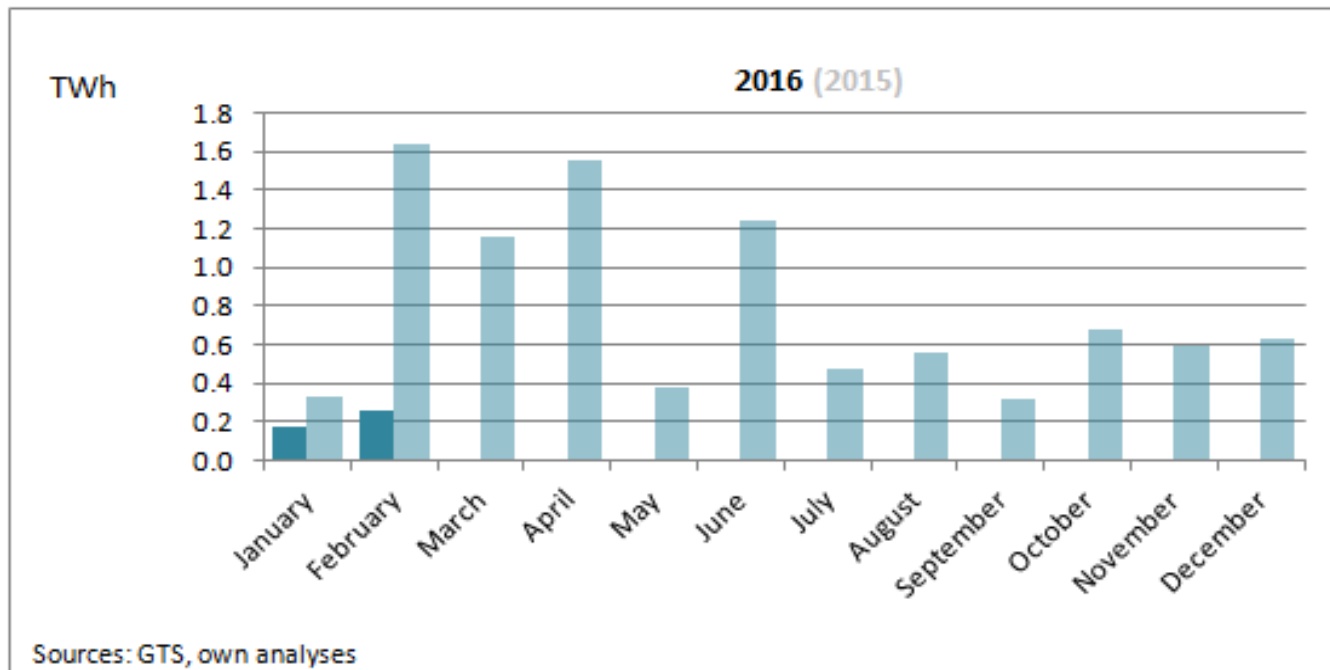
# Gas to Power 2016 (and 2015)



In February 2016, power production by gas-fired power stations and cogeneration was lower than previous year, mainly due to high availability of wind.

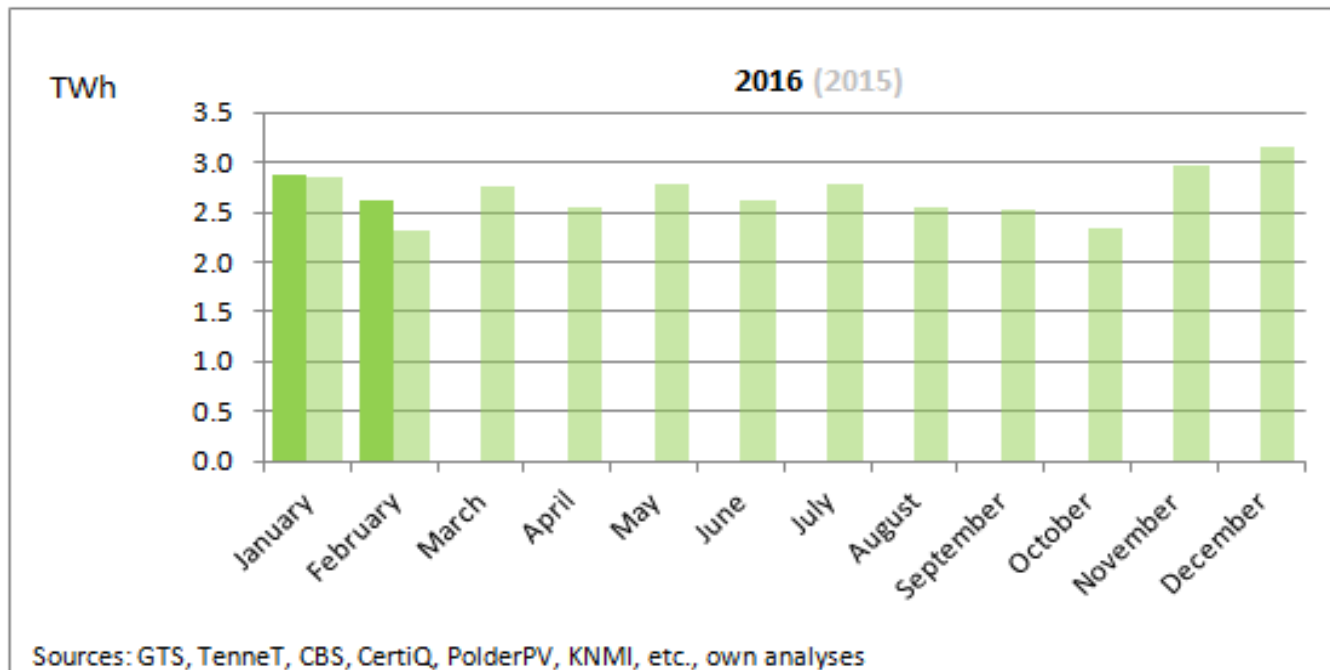


# LNG imports 2016 (and 2015)



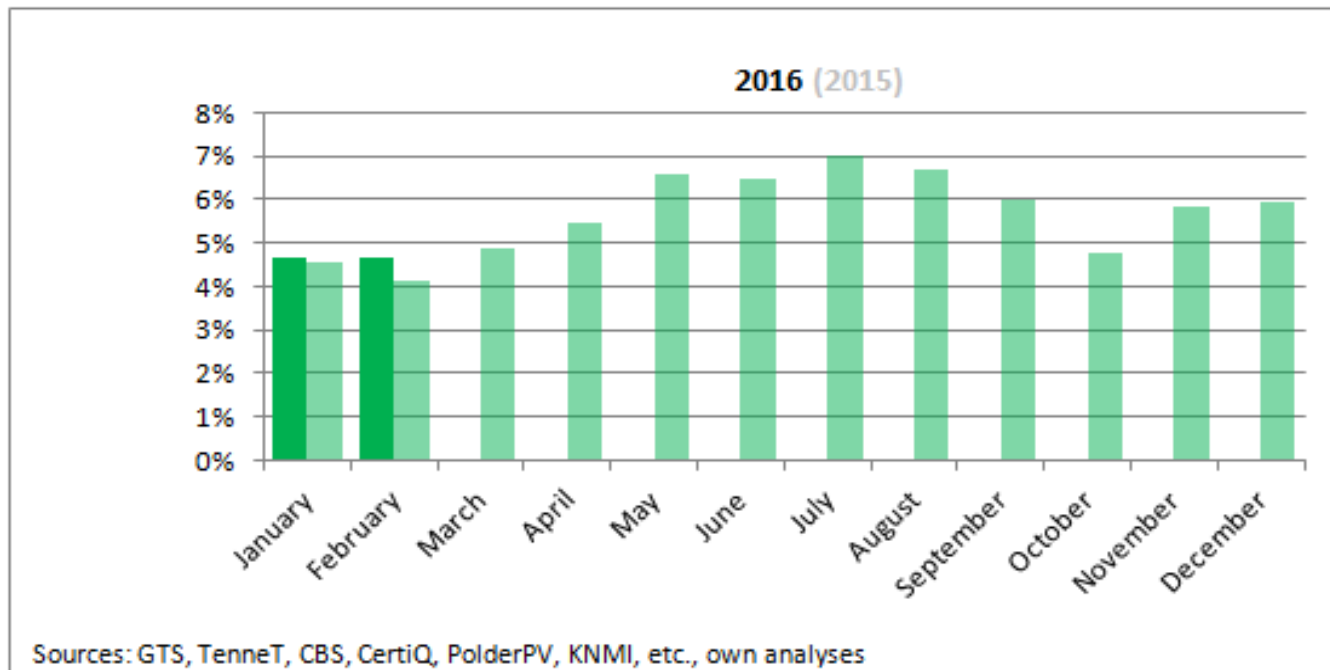
This figure depicts the amount of LNG injected into the gas grid, as presented by GTS. The figure excludes the usage of LNG as transport fuel. In February, LNG imports were substantially lower than a year ago.

# Renewable Energy All Sources 2016 (and 2015)



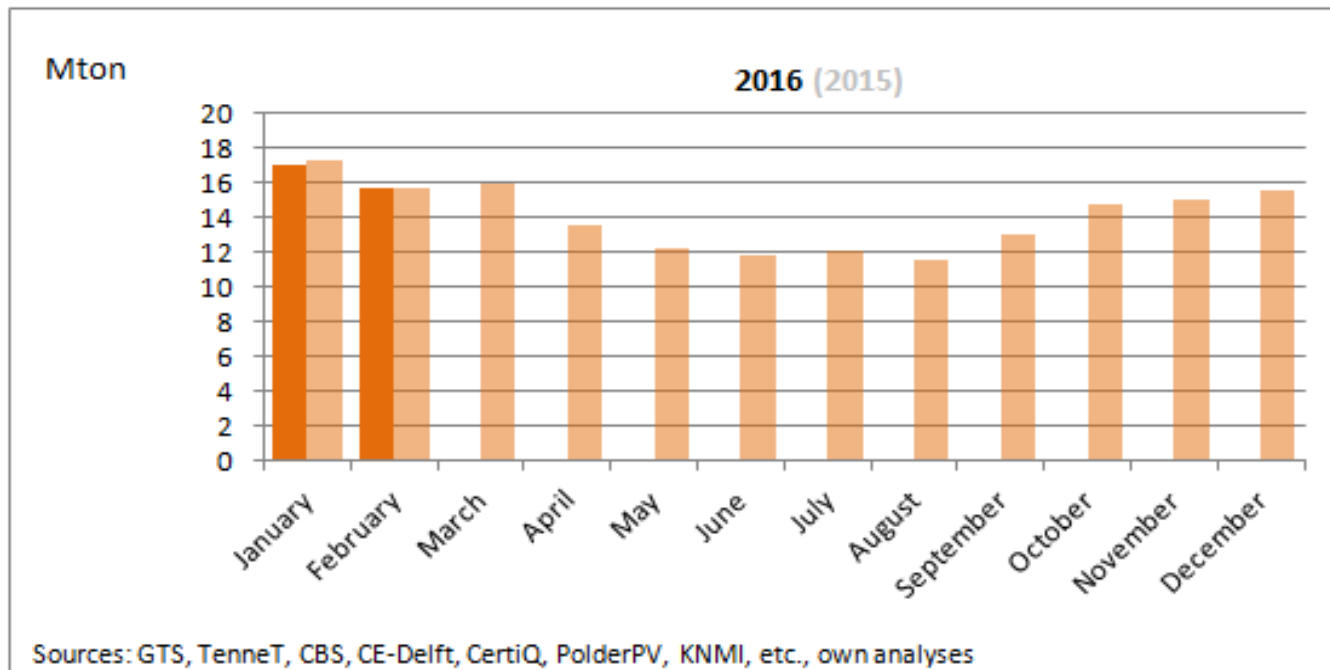
Renewable energy production in The Netherlands was substantially higher than last year. The reduction in biomass has been more than compensated by an increase in wind energy.

# Renewable Energy Percentage 2016 (and 2015)



In February, the percentage of renewable energy, based on final energy usage was higher than last year, due to high availability of wind. The percentage has been calculated according to the formal EU/IPCC procedures.

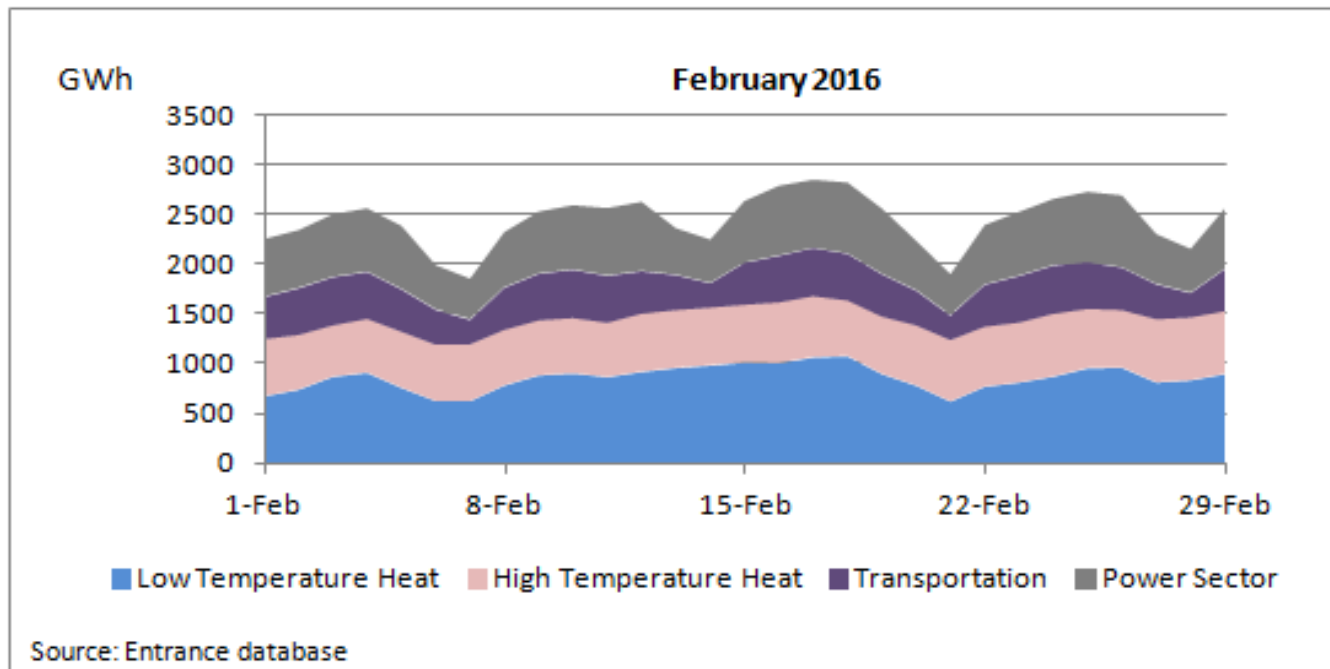
# CO2 Emissions 2016 (and 2015)



After a significant rise of the CO2 emissions in 2015, compared to 2014, the CO2 emissions in February were similar than last year. The extra day in February was compensated by a slightly lower CO2 emission 'per day'.

# ENERGY DEMAND IN A NUTSHELL

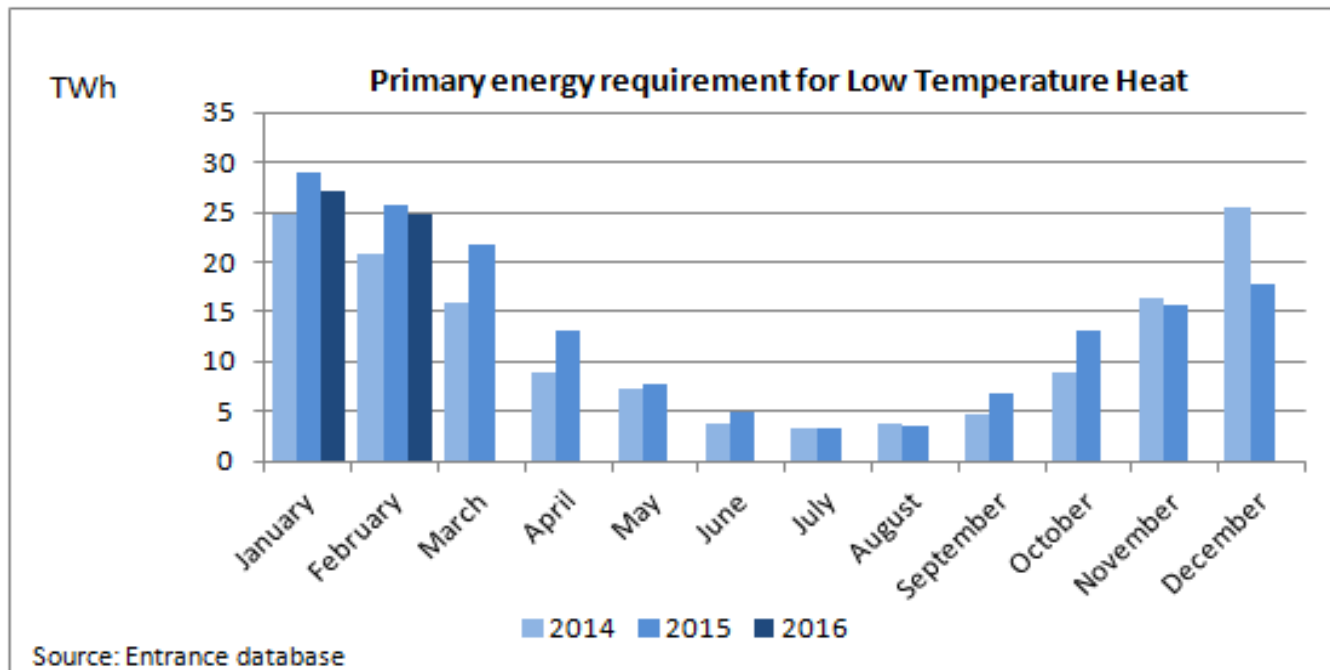
# Energy Demand February 2016



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.

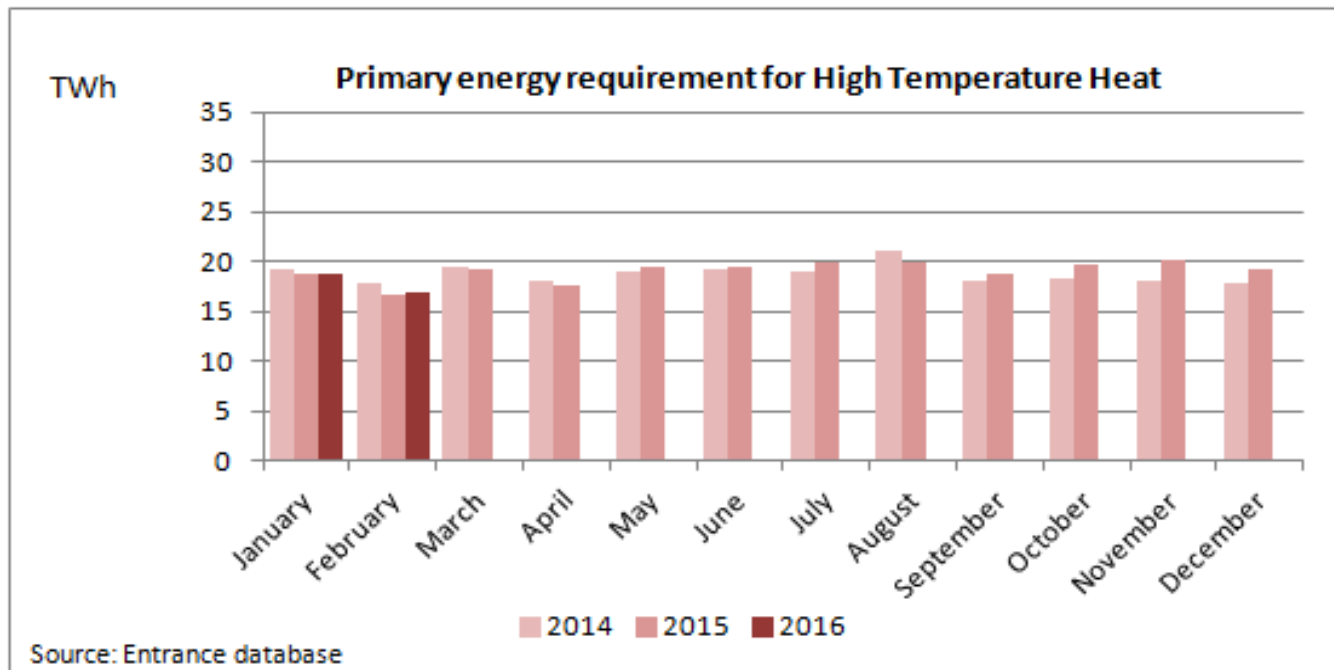
(1 GWh is about equal to the average daily energy production of 40 wind turbines of 3 MW each)

# Energy Demand Low Temperature Heat



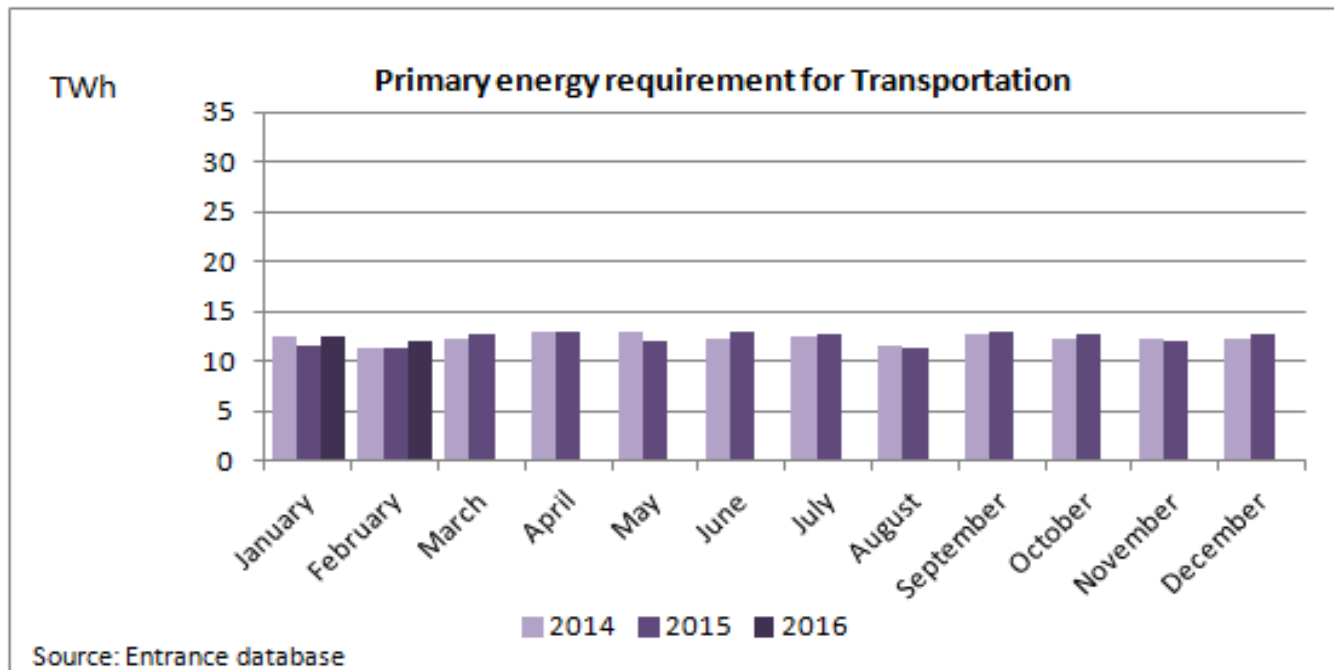
The primary energy requirement for Low Temperature Heat (mainly buildings and green houses) varies mainly with ambient temperature.

# Energy Demand High Temperature Heat

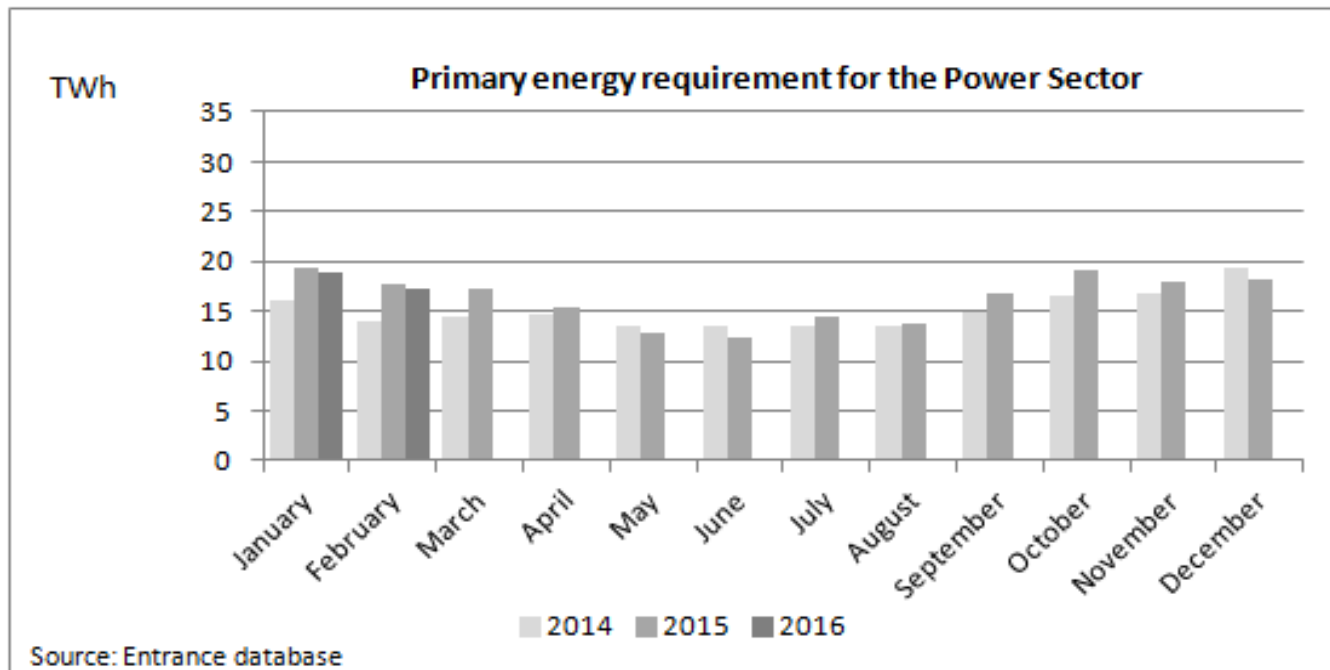


The primary energy requirement for High Temperature Heat (mainly industry) varies with the economic activity in the Netherlands.



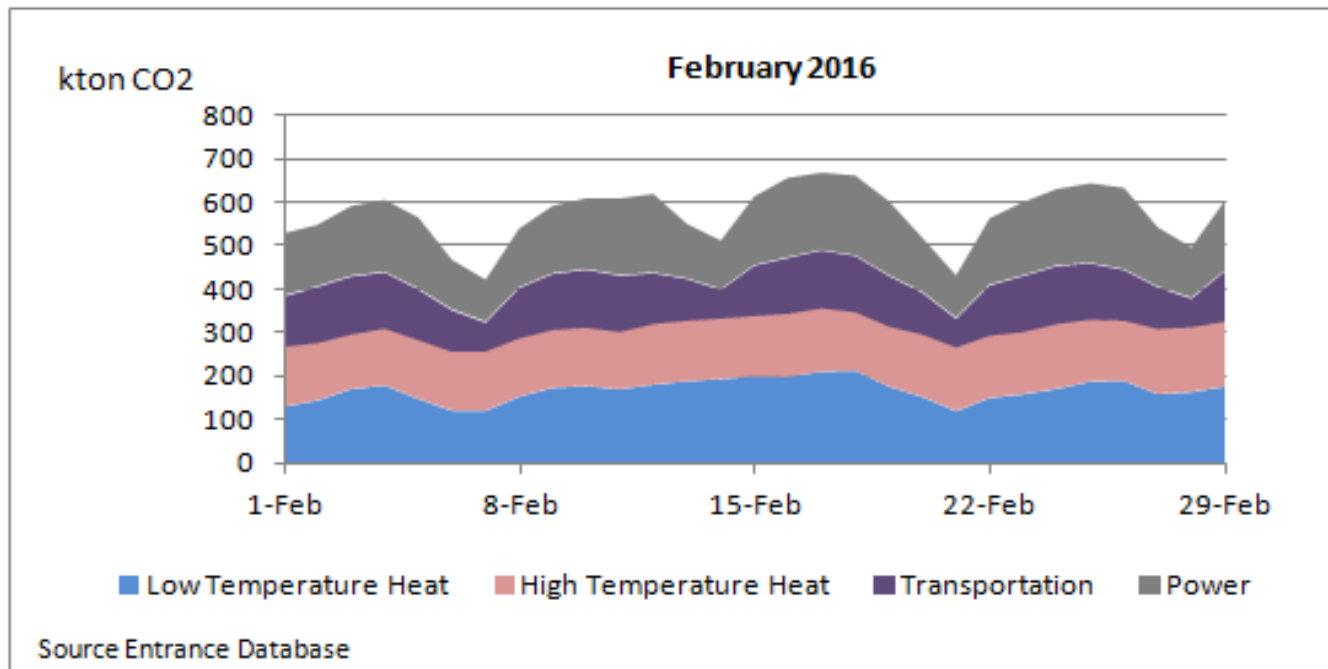


The primary energy requirement for Transportation (excluding international shipping and aviation) varies with the economic activity in the Netherlands. Fuels that are bought abroad, e.g. due to lower taxes, are not included in this figure.



The primary energy requirement for the power sector varies mainly with the economic activity and the fraction of renewable power. This figure excludes the primary energy demand caused by power imports.

# CO2 Emissions February 2016

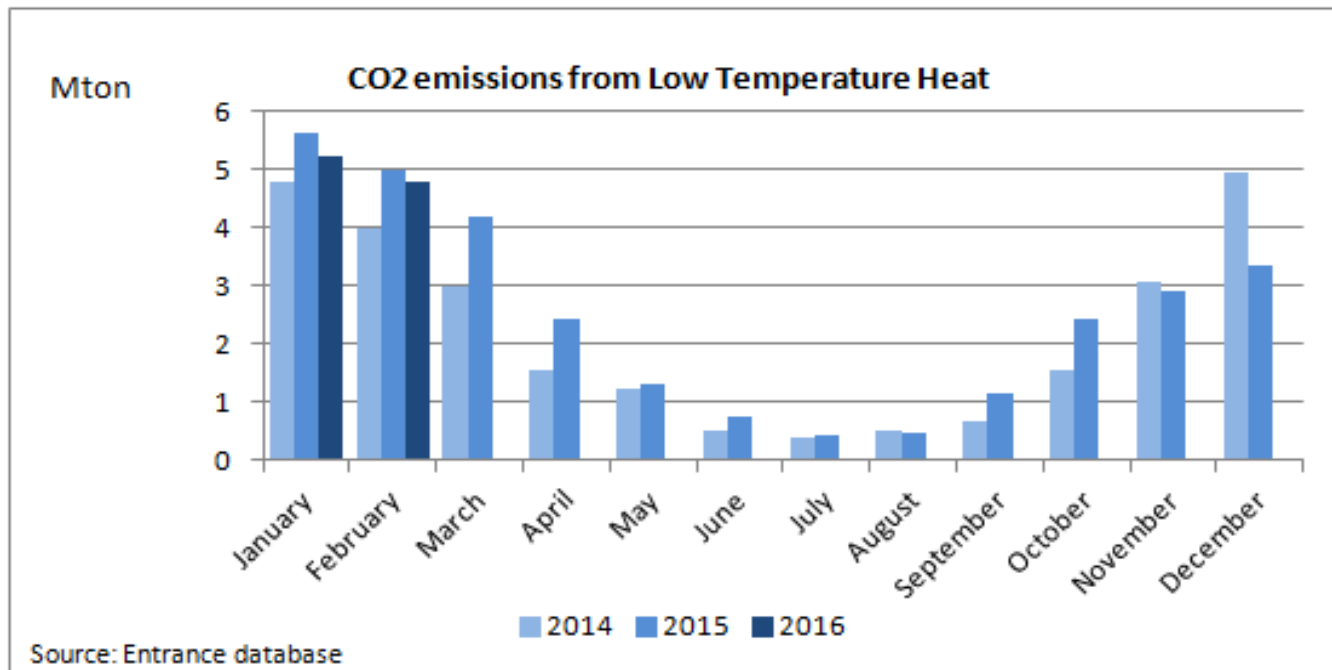


This figure shows the daily CO2 emission of each of the four demand sectors.

This figure does not take into account the energy demand for shipping, aviation and feedstock.

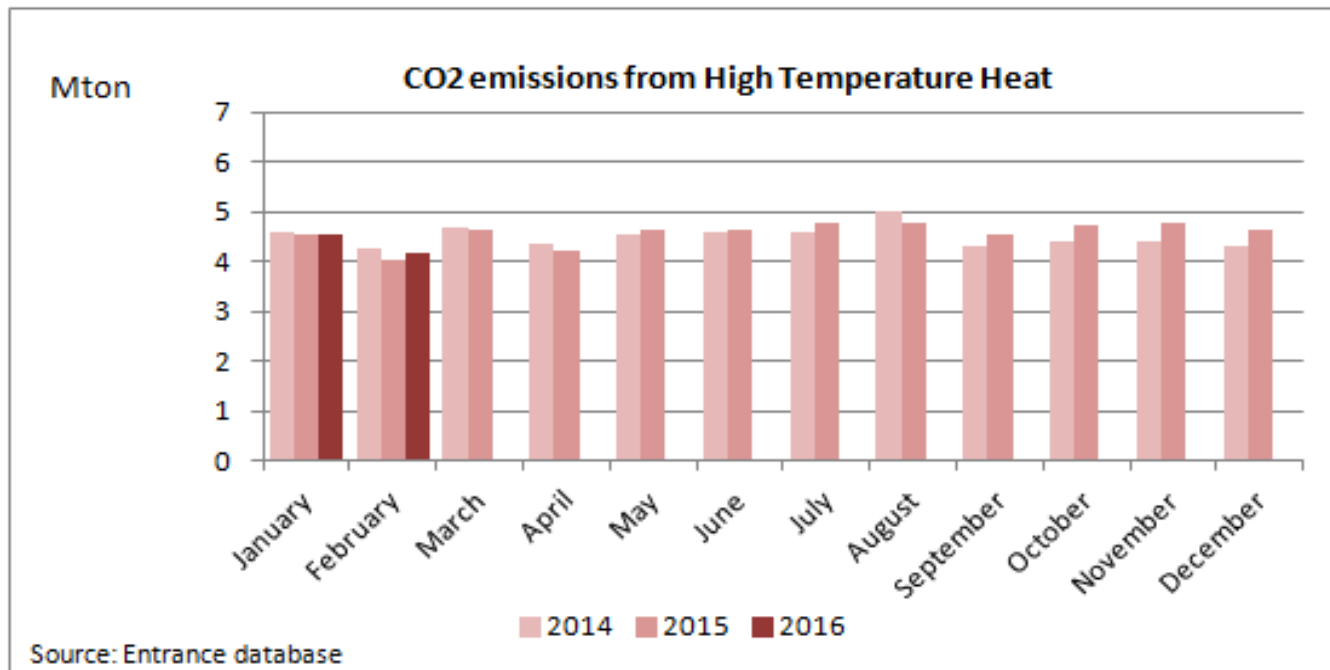
(1 kton CO2 is equal to the average daily CO2 emission of 90.000 households, each using 1500 m3 gas and 3500 kWh electricity annually.

# CO2 emissions Low Temperature Heat



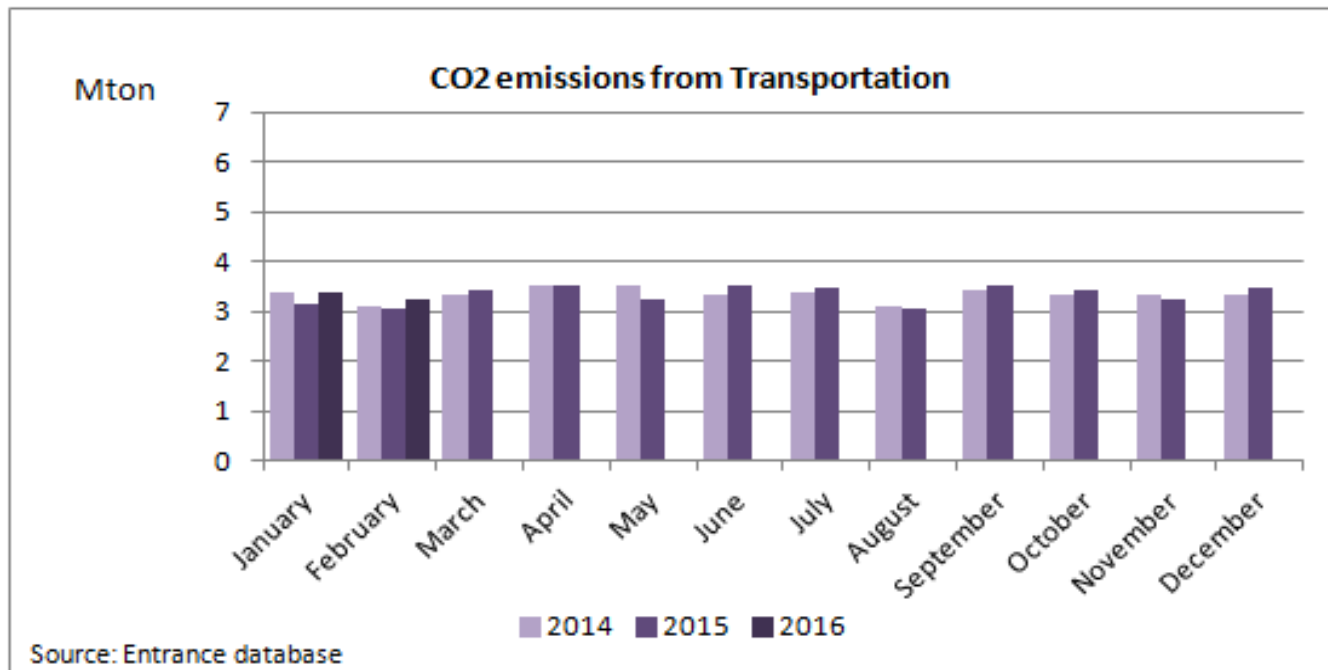
CO2 emissions from Low Temperature Heat , mainly buildings and green houses, vary with ambient air temperature and the fraction of renewable energy which is used, biomass and heat pumps.

# CO2 emissions High Temperature Heat



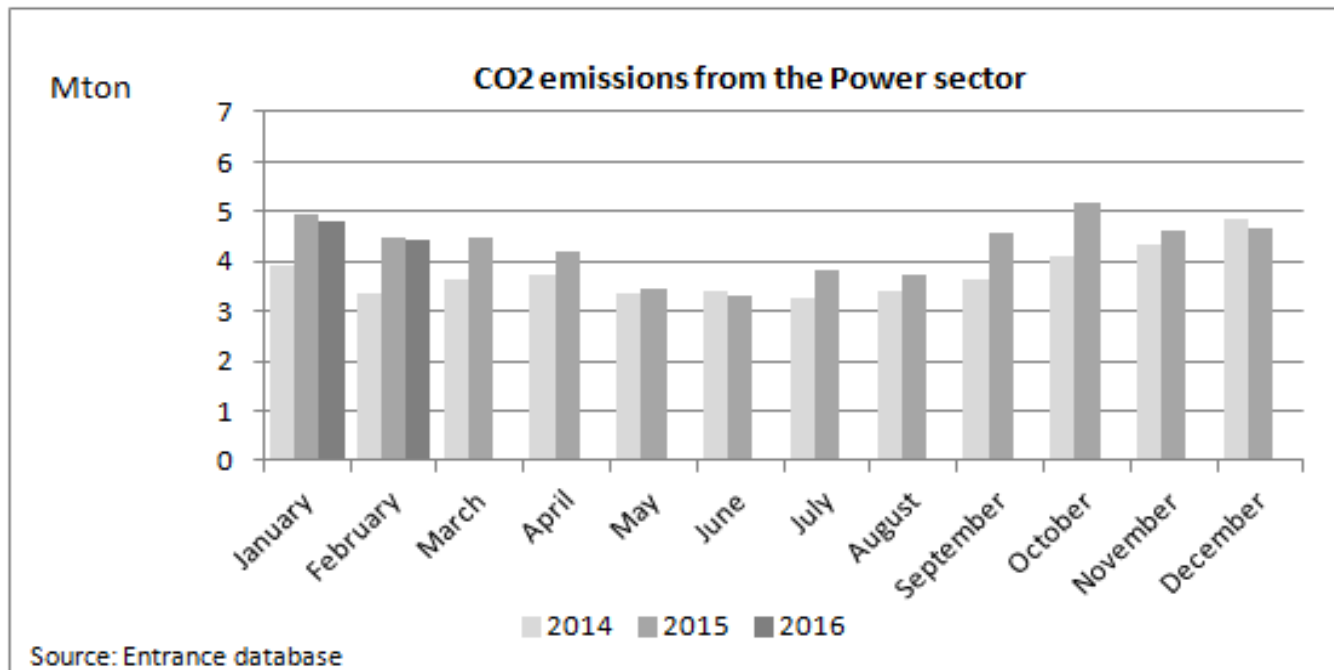
CO2 emissions from High Temperature Heat, mainly industry, vary mainly with the economic activity in the Netherlands.

# CO2 emissions Transportation



CO2 emissions from Transportation (excluding international shipping and aviation) vary with the economic activity in the Netherlands. Fuel that is bought abroad, due to lower taxes, is not included in this figure.

# CO2 emissions Power Sector

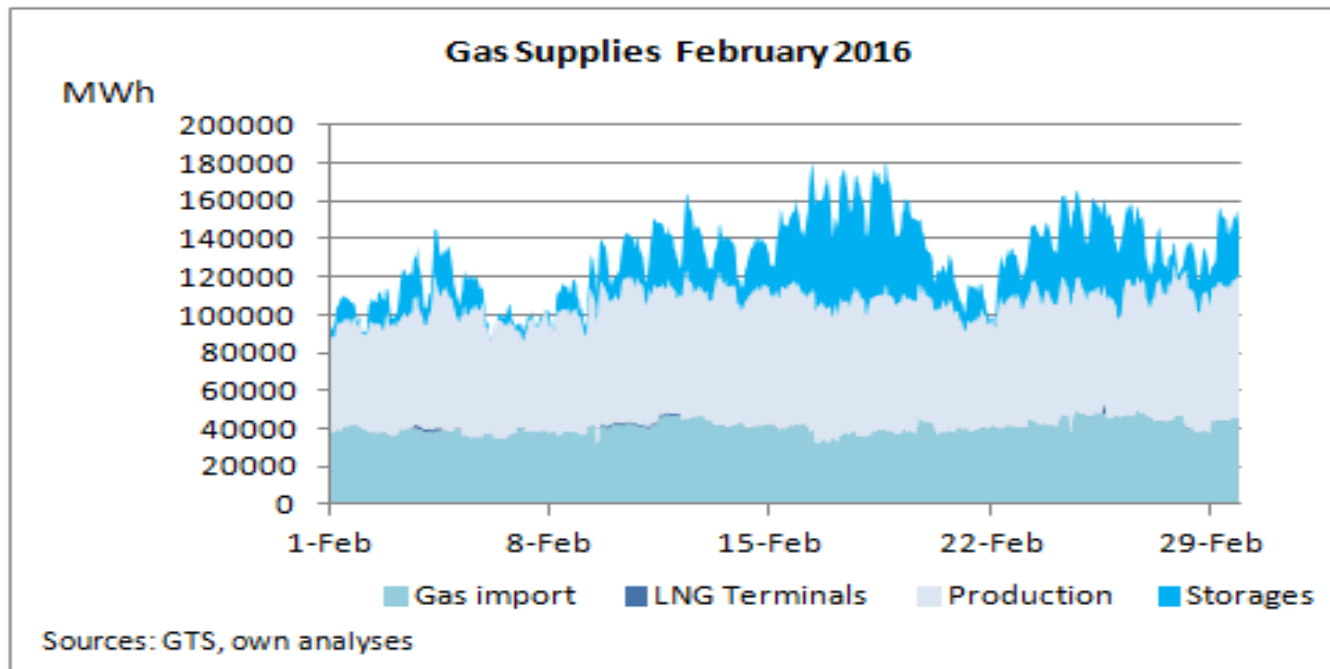


CO2 emissions from the power sector vary with the economic activity in the Netherlands, the amount of coal used for power generation, the amount of renewable power produced, and the level of power imports.

# SELECTED HOURLY ENERGY DATA

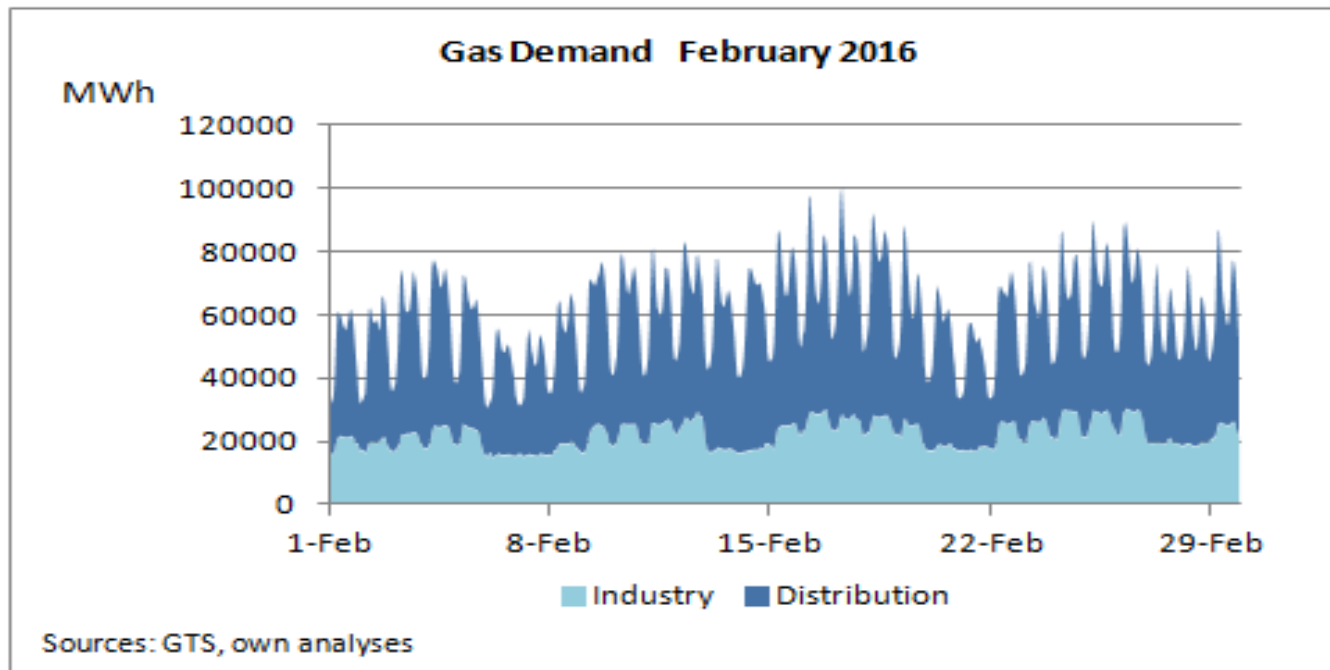


# Gas Supplies February 2016



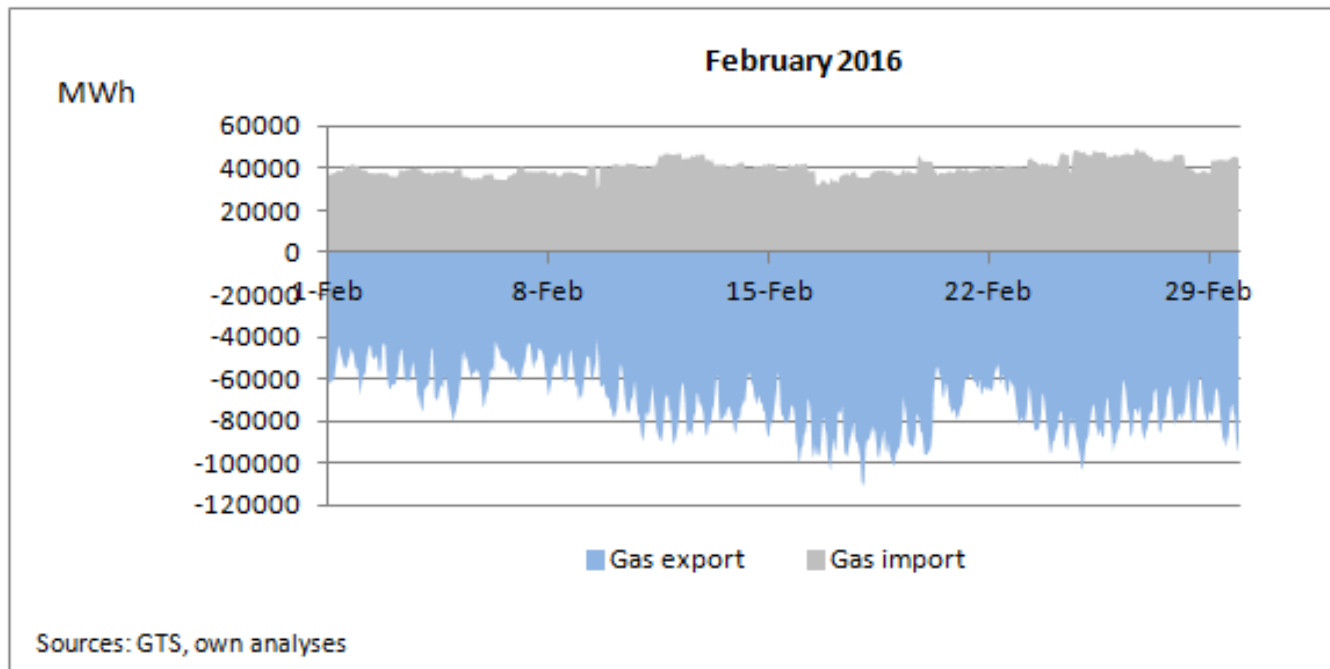
The peak in the gas consumption from 16-20 February has been covered by the gas storages. Gas supply includes Dutch consumption and exports.

# Gas Demand Including Gas-to-Power February 2016



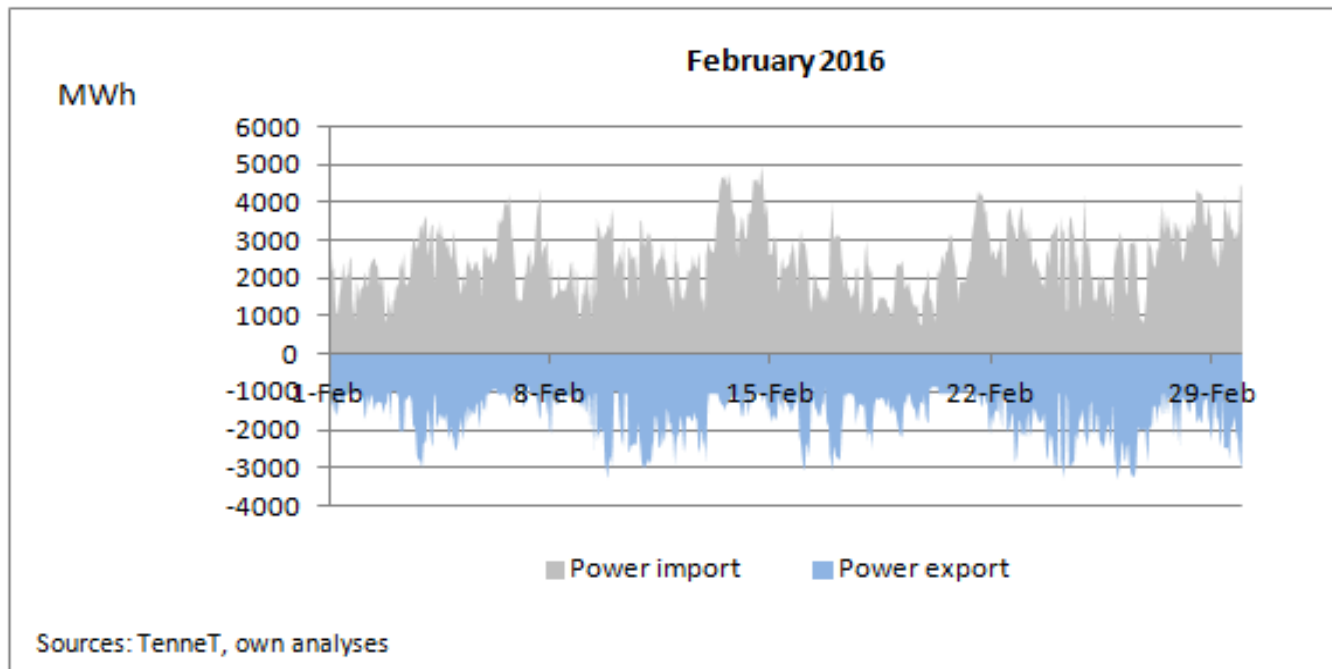
“Industry” is defined as direct connections to the Gasunie grid. ‘Distribution’ includes significant industrial gas demand as well, estimated at 50 TWh annually, or 5700 MWh per hour. These are industries connected to the distribution grids.

# Gas Imports & Exports February 2016



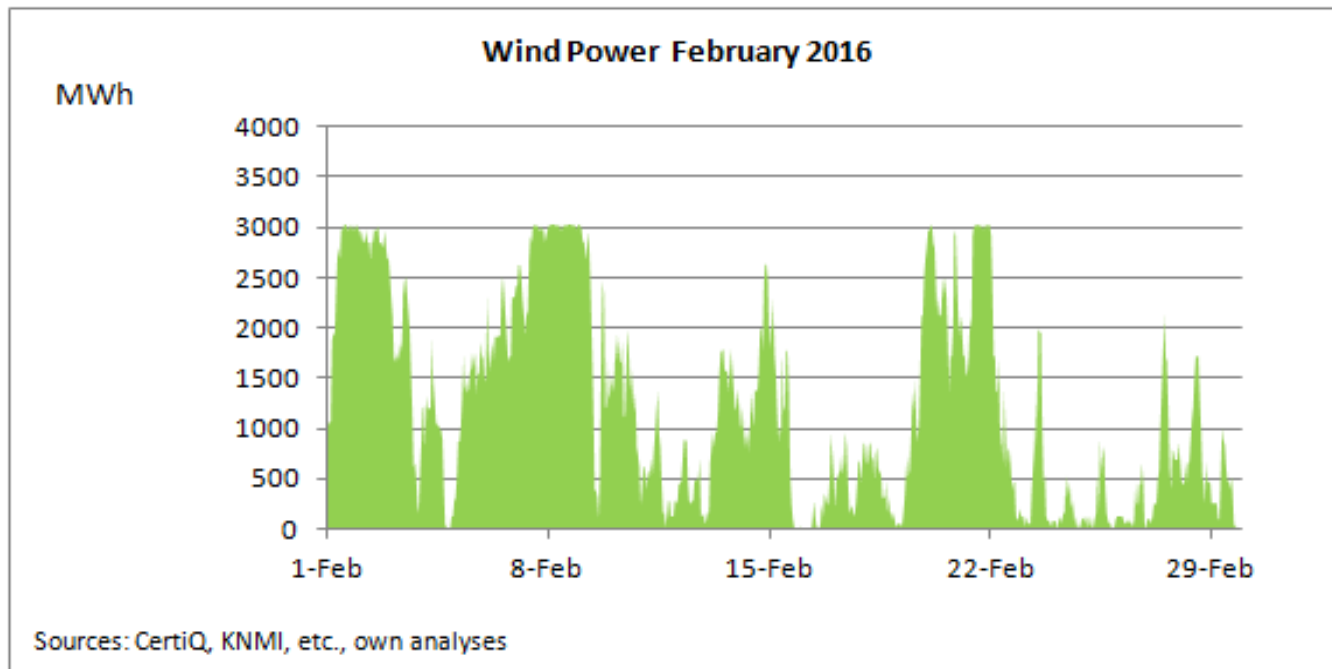
In February, gas exports were considerable higher than gas imports.

# Power Imports & Exports February 2016



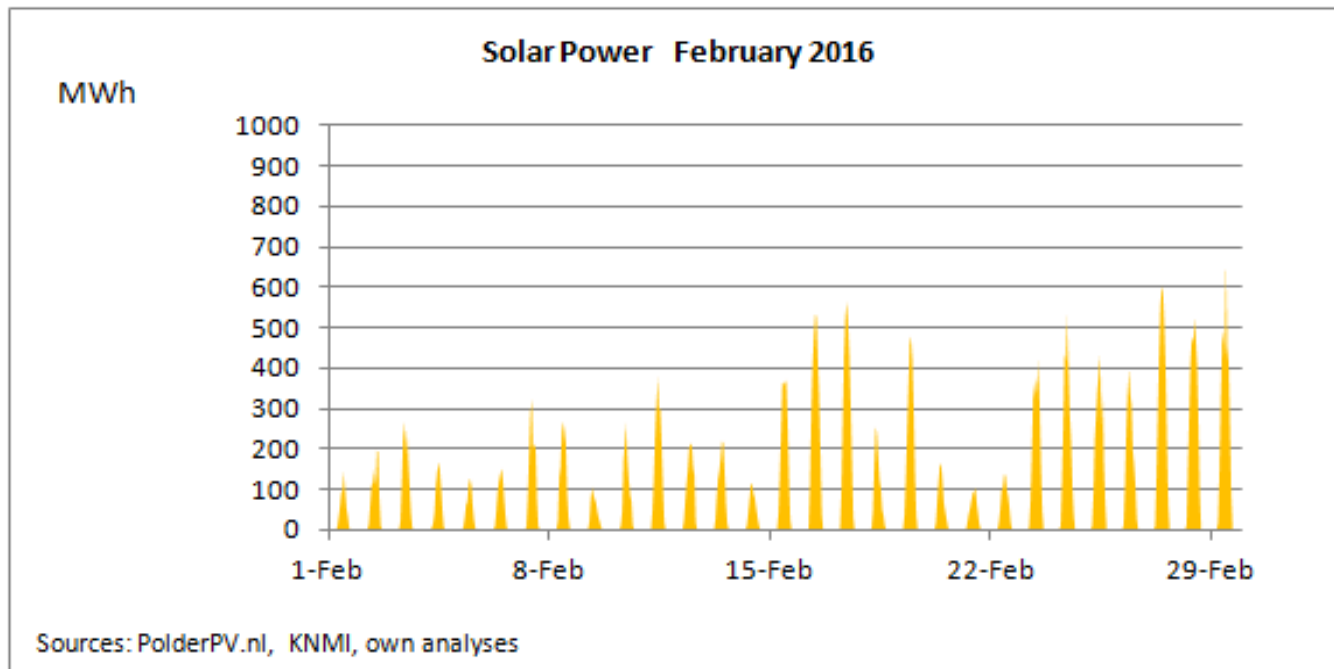
In February 2016, the power imports and exports have been rather volatile. In February power imports were 1.8 TWh, while power exports were 1.1 TWh.

# Wind Power February 2016



February 2016 was characterized by high wind availability in some periods and very low availability in other periods. The average utilization rate was 34%).

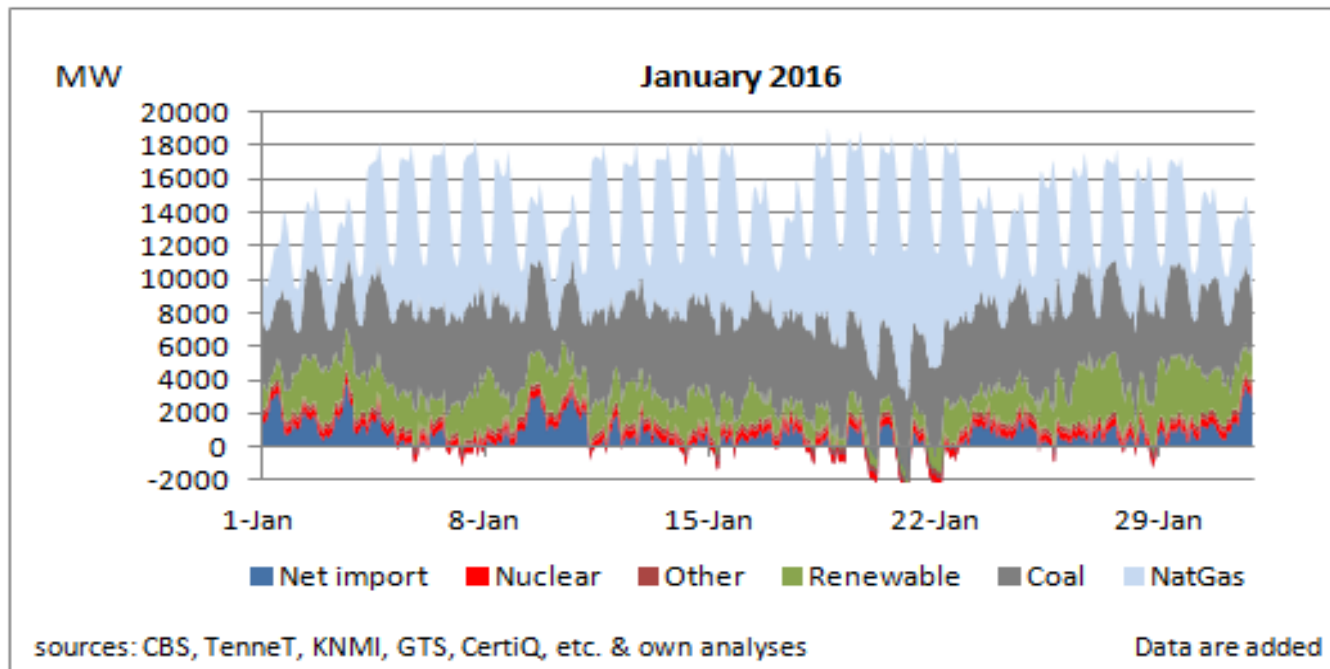
# Solar PV Power February 2016



The second half of February was rather sunny, but in winter, sun intensity is limited. Hence, the utilization rate of more than 1500 MW of solar PV installed was rather low. On average, 5%.

The following set of slides presents for each month in 2016 the hourly contributions of various energy sources to total power consumption in The Netherlands.

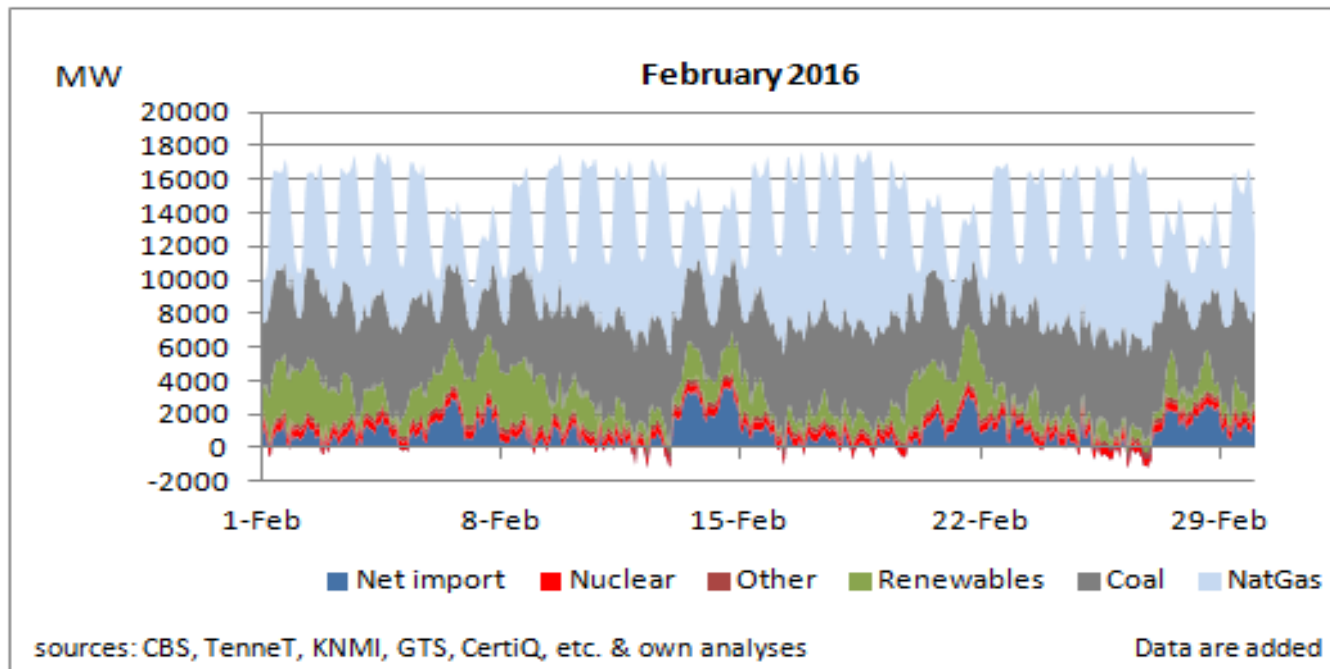
# Power Generation February 2016



In the week of 19-23 February, gas-fired power generation peaked, due to low wind availability and net exports that occurred simultaneously.



# Power Generation February 2016



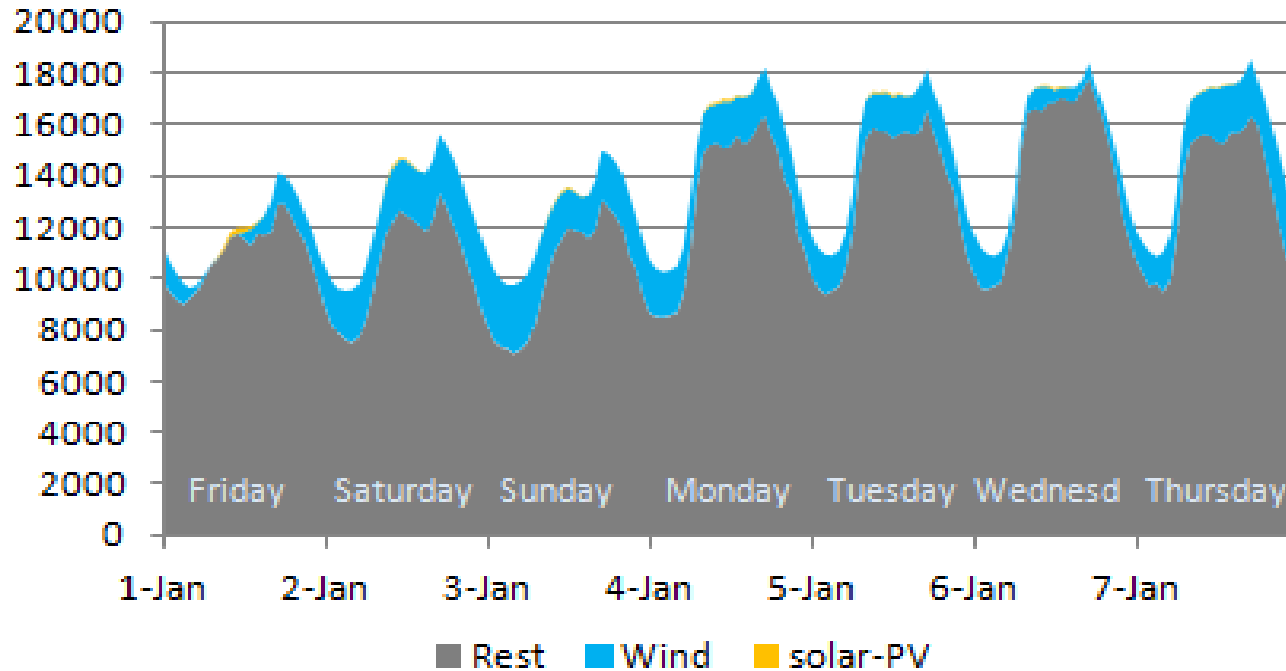
In the second half of February, gas-fired power generation peaked, due to low wind availability and low imports.

The following set of slides presents for each week in 2016 the hourly contributions of wind and solar-PV to the total power consumption in The Netherlands.

# Hourly Solar-PV and Wind Generation 2016

MWh

2016

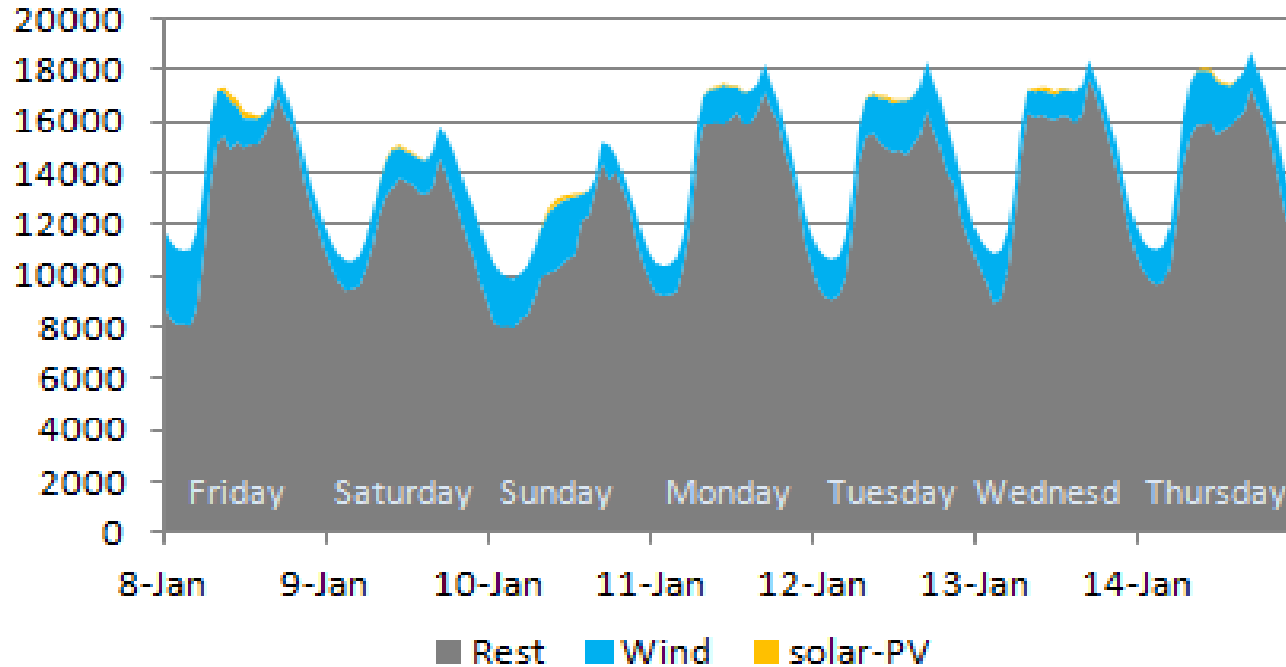


Sources: TenneT, CertiQ, PolderPV.nl, KNMI, etc., own analyses

# Hourly Solar-PV and Wind Generation 2016

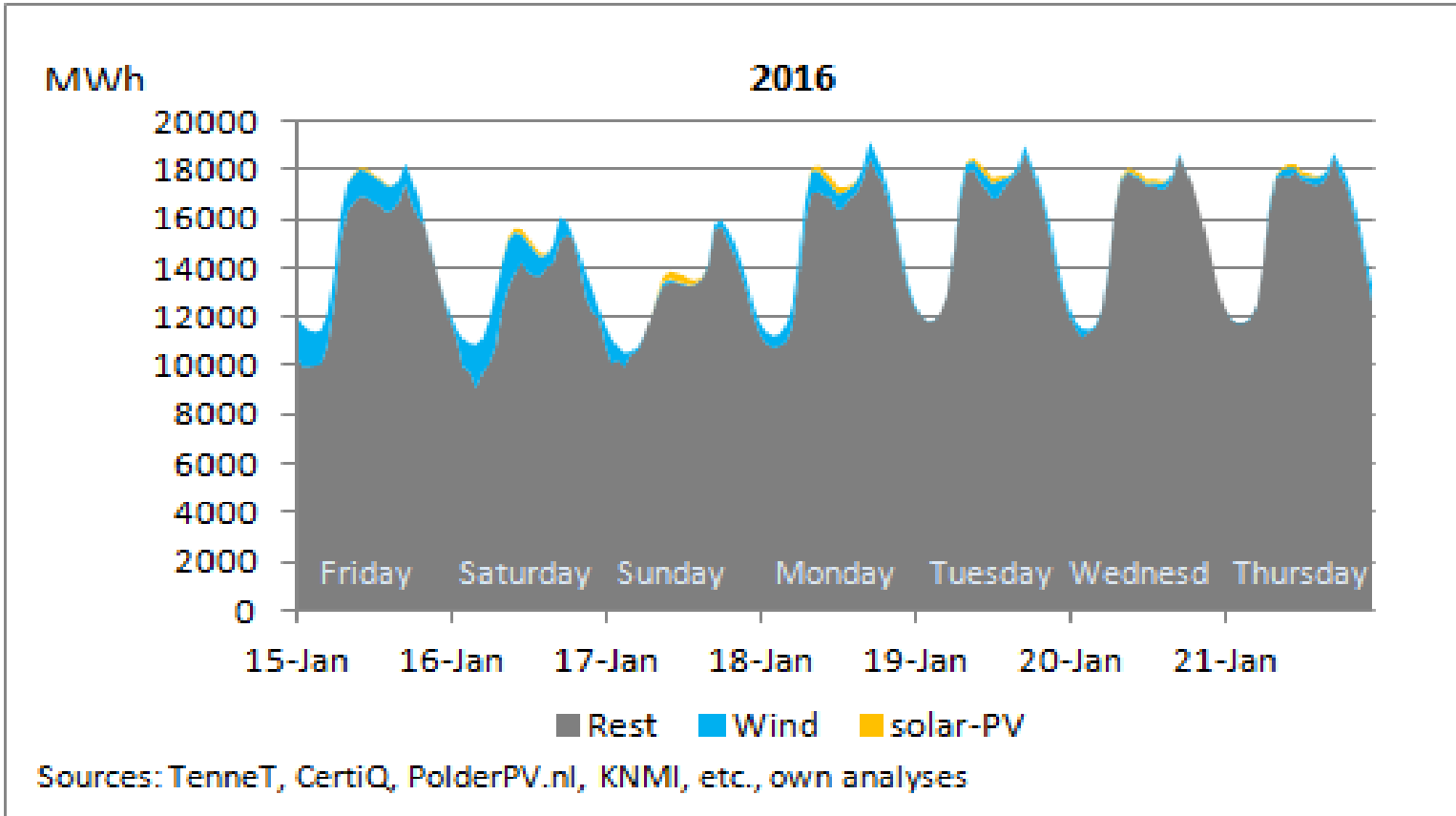
MWh

2016

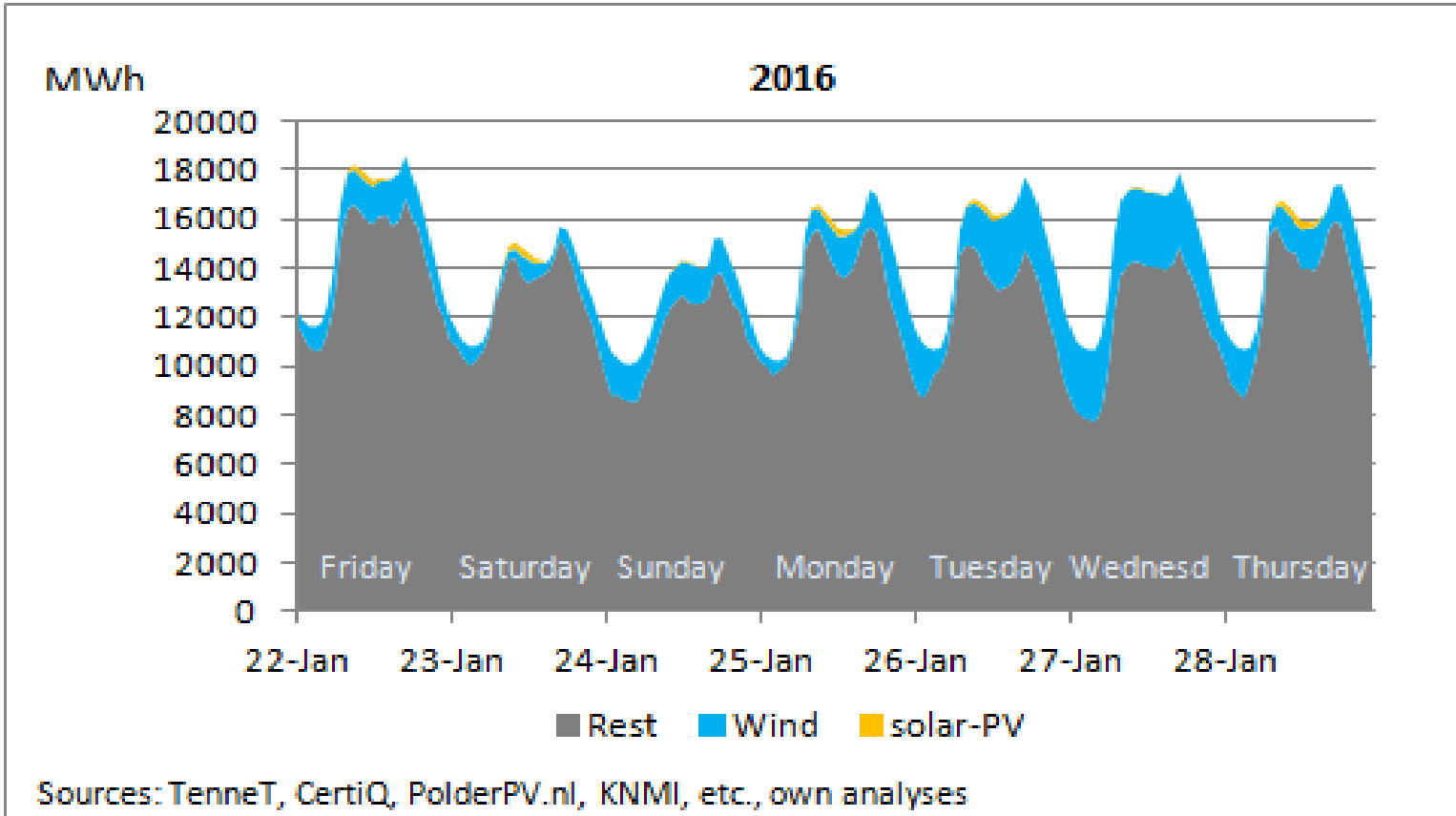


Sources: TenneT, CertiQ, PolderPV.nl, KNMI, etc., own analyses

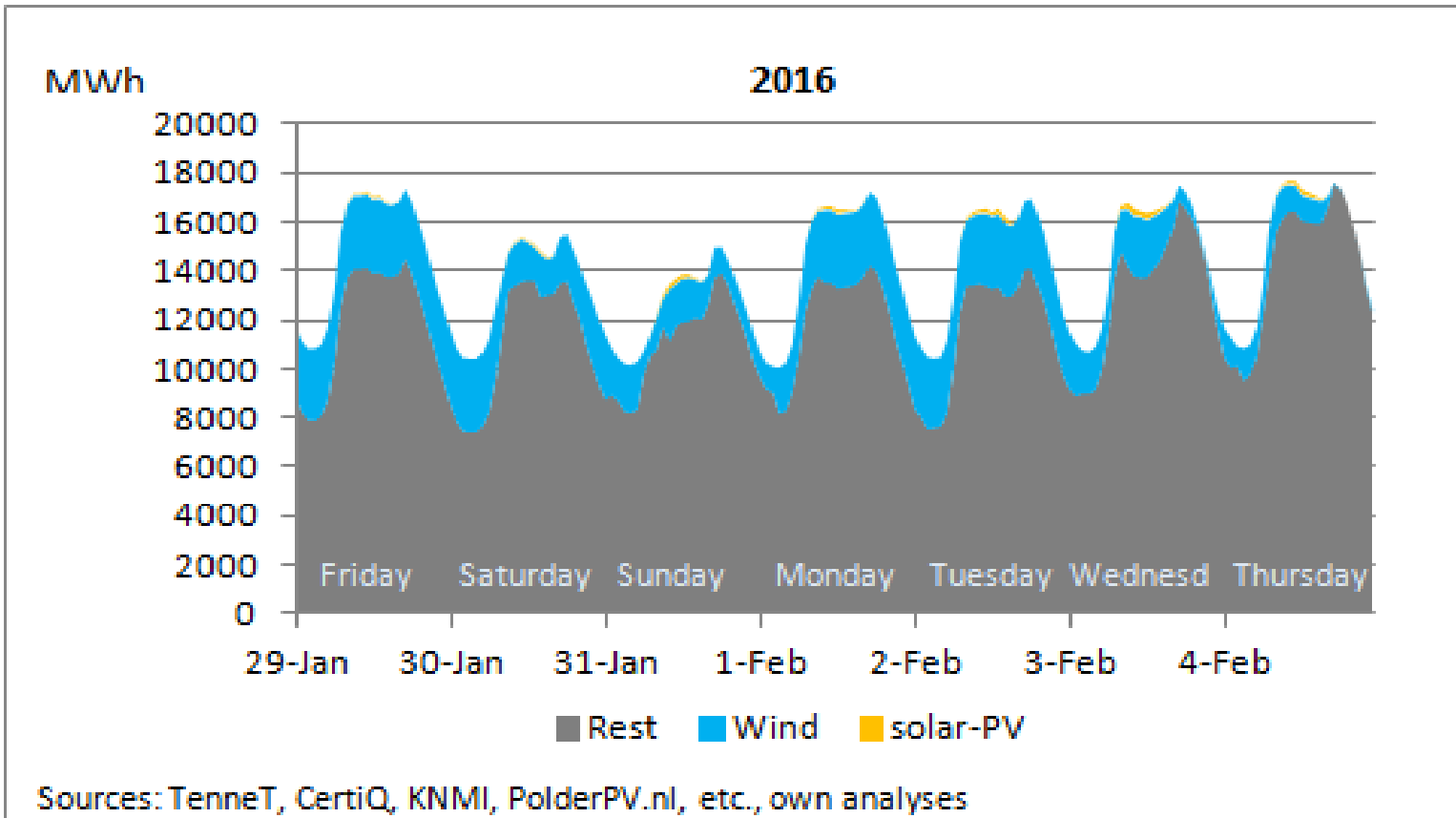
# Hourly Solar-PV and Wind Generation 2016



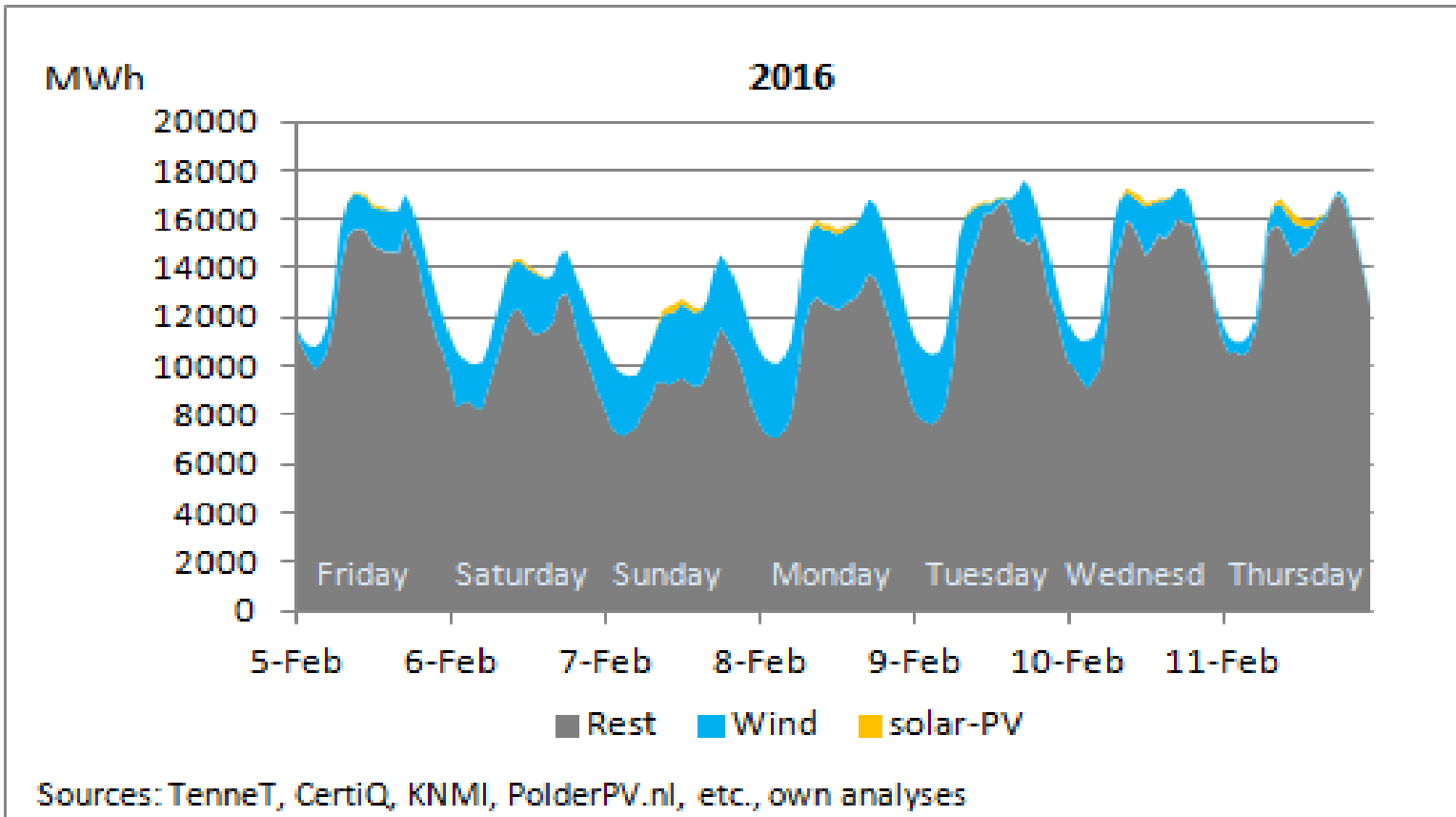
# Hourly Solar-PV and Wind Generation 2016



# Hourly Solar-PV and Wind Generation 2016



# Hourly Solar-PV and Wind Generation 2016

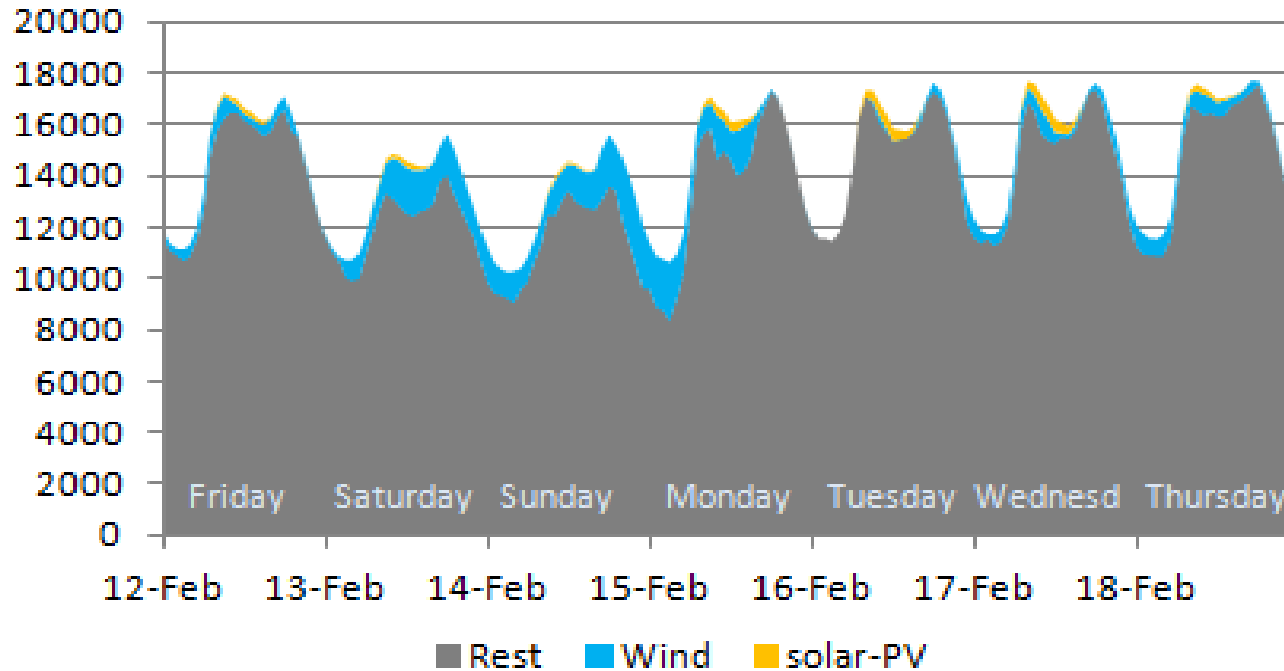




# Hourly Solar-PV and Wind Generation 2016

MWh

2016

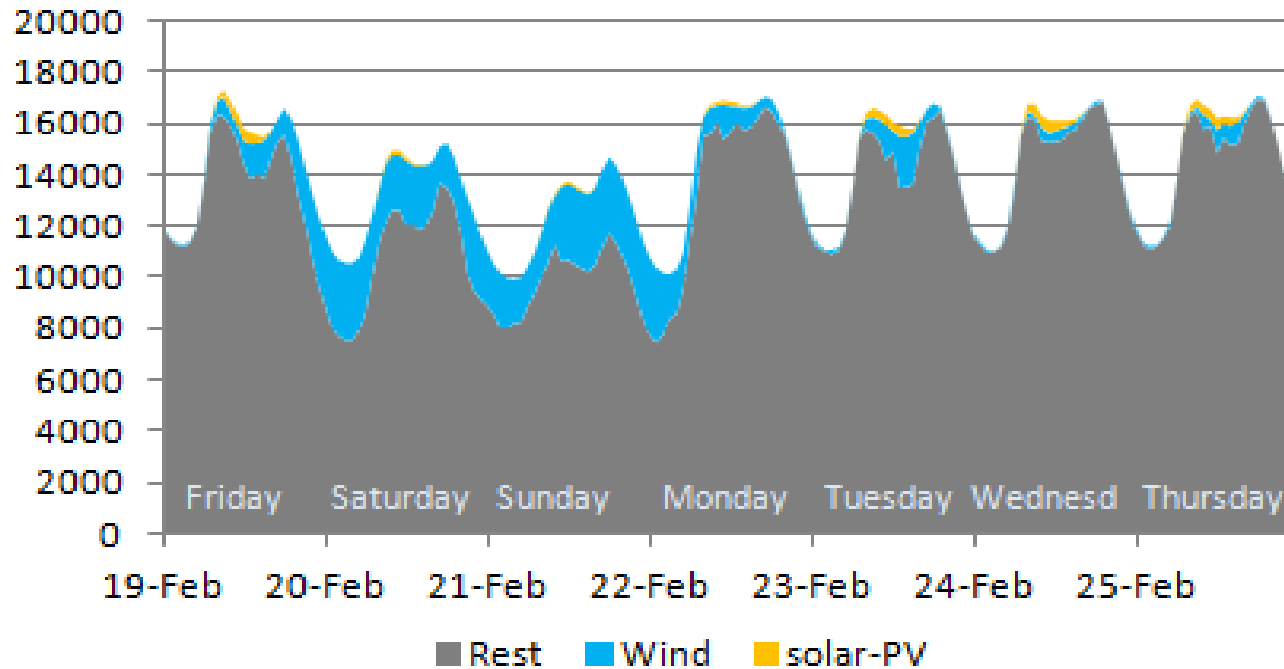


Sources: TenneT, CertiQ, PolderPV.nl, KNMI, etc., own analyses

# Hourly Solar-PV and Wind Generation 2016

MWh

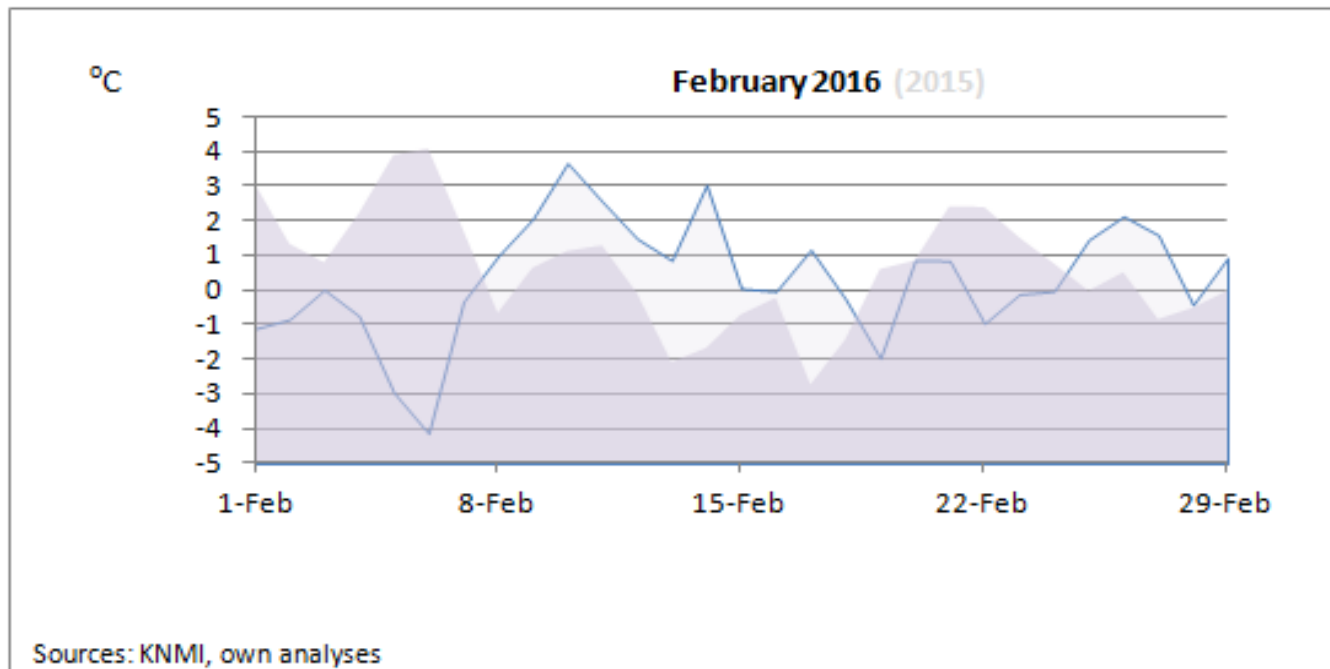
2016



Sources: TenneT, CertiQ, PolderPV.nl, KNMI, etc., own analyses

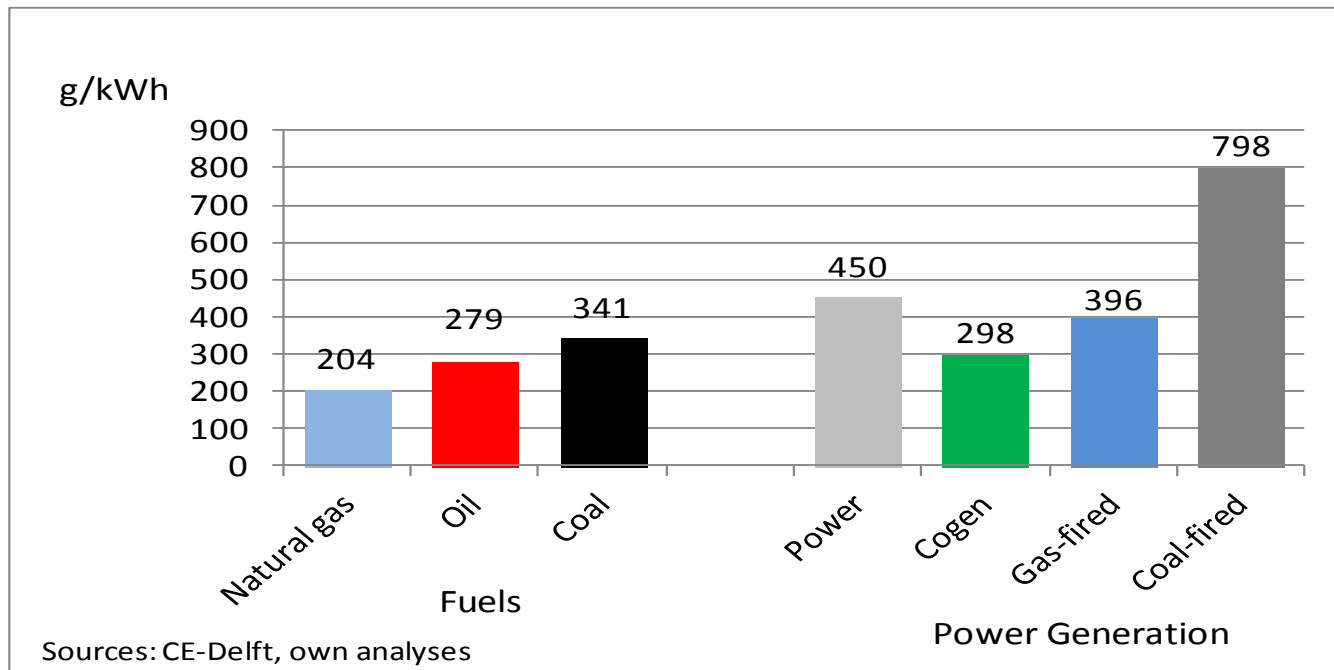
# MISCELLANEOUS

# Effective Temperature February 2016



In February 2016, the average daily effective temperature (temperature including wind shield factor) was 0.6 °C, a bit higher than the same temperature of February 2015 (average 0.3°C).

# Fuel Specific CO2 Emissions



Characteristic CO2 emissions used in this presentation.

# Epilogue

b.m.visser@pl.hanze.nl

This presentation is based on numerous sources which present data on energy demand and supply in The Netherlands. These data, however, do not cover the entire energy system. Some approximations and scaling factors were thus needed. The author would like to thank students from Hanze University of Applied Science in Groningen and various energy experts in The Netherlands which gave suggestions for improvements of the methods used. Currently, the aggregated results of this work are in good agreement with data supplied by the Dutch National Office of Statistics (CBS). It is believed by the author that the detailed results in this presentation give a fair presentation of the complex reality of the Dutch energy system.

Nevertheless, the author invites readers to comment on the data provided with the objective 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.