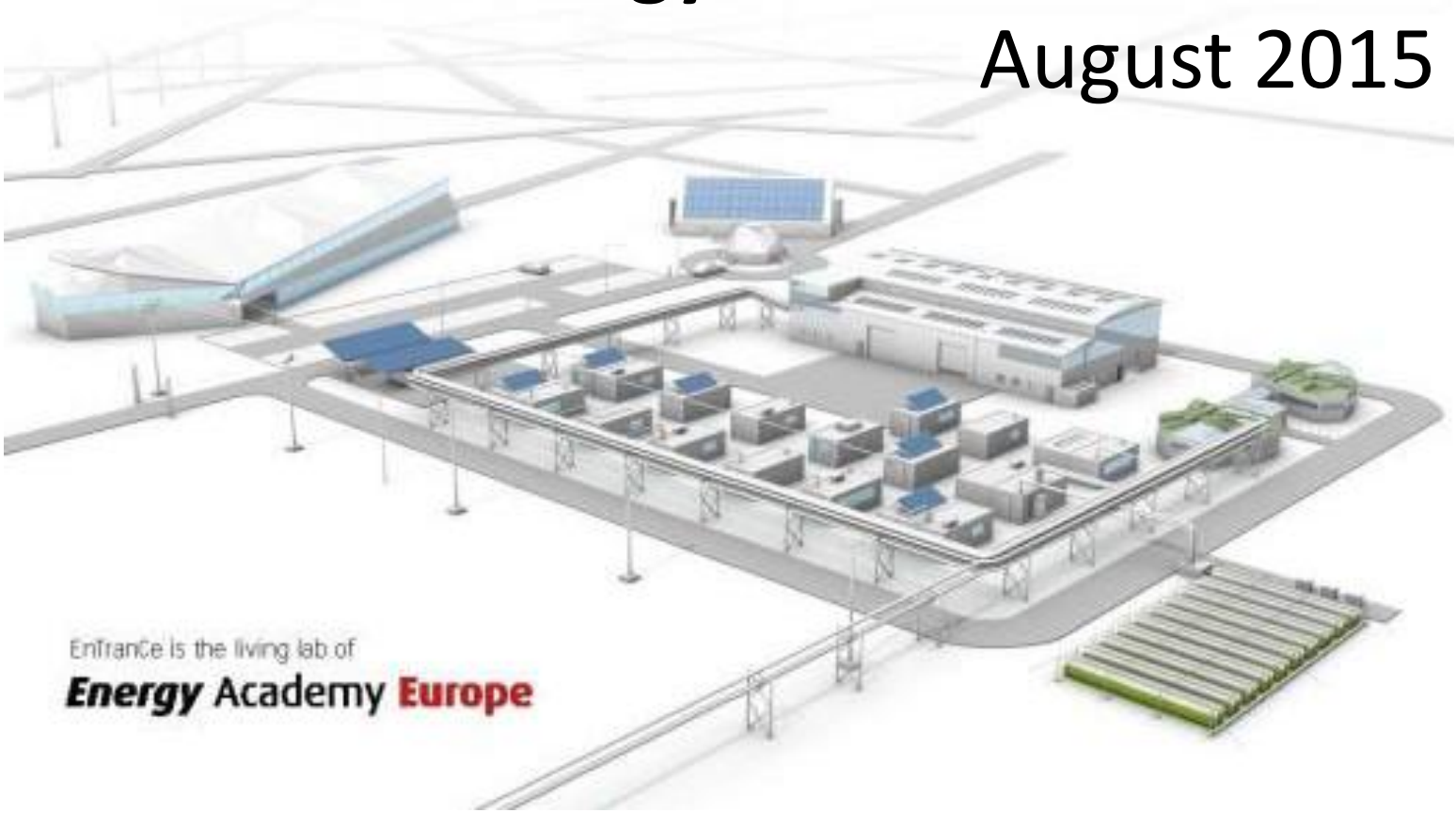
EnTranCe
ENERGY TRANSITION CENTRE

Renewable Energy in The Netherlands
August 2015



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

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.

August 2015

In a Nutshell

EnTranCe
ENERGY TRANSITION CENTRE

- The fraction of renewable energy in The Netherlands was 6.3%.
- Electricity production by wind was 20% lower than in August 2014, although wind capacity increased by 20% y-o-y.
- Average utilization of wind capacity was (just) 17% and of solar-PV, it was 16%
- Coal usage in Dutch power generation increased by 40% y-o-y.
- Dutch CO2 emissions increased by 2% compared to August 2014.
- The fraction renewable power was 9.9%, down from 11.6% in August 2014.
- For each month in 2015, both the production of renewable energy and the emission of CO2 have increased in the Netherlands.

Content

EnTranCe
ENERGY TRANSITION CENTRE

- August 2015 data
- Monthly profiles
- Monthly data
- Hourly data
- Miscellaneous

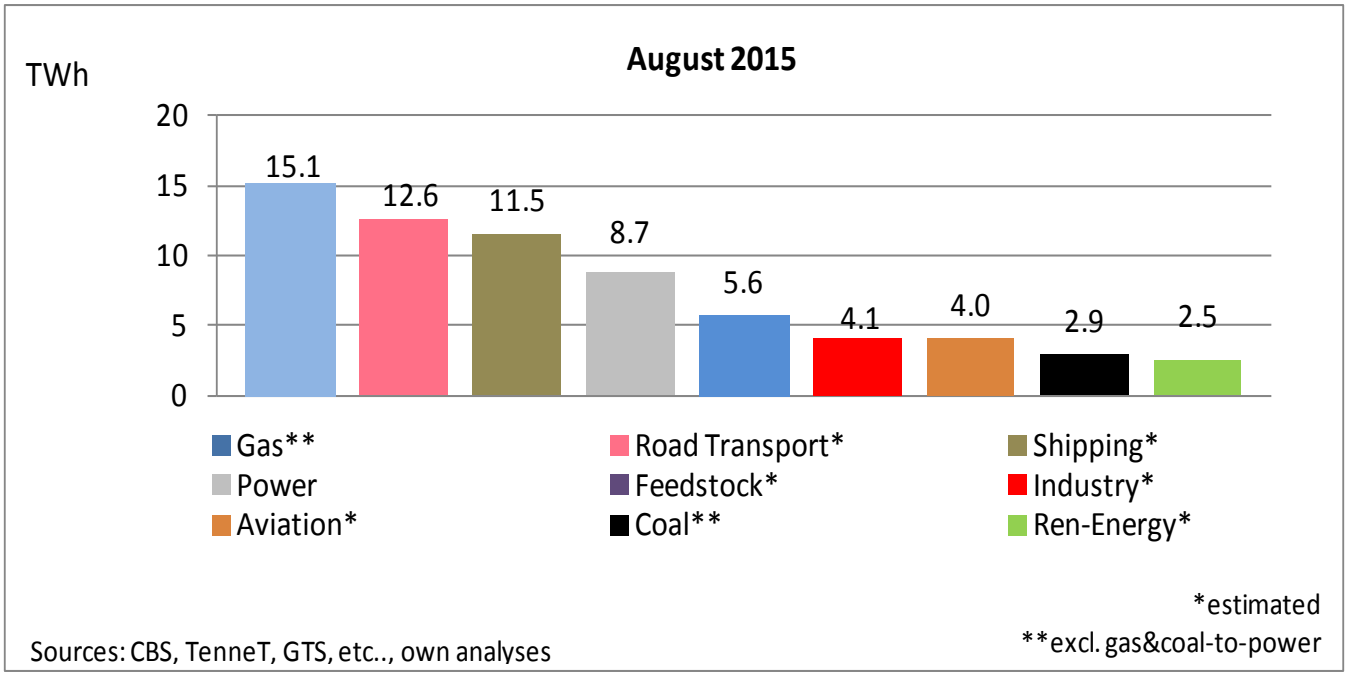
EnTranCe
ENERGY TRANSITION CENTRE

SELECTED ENERGY DATA FROM AUGUST 2015

Final Energy Demand

August 2015

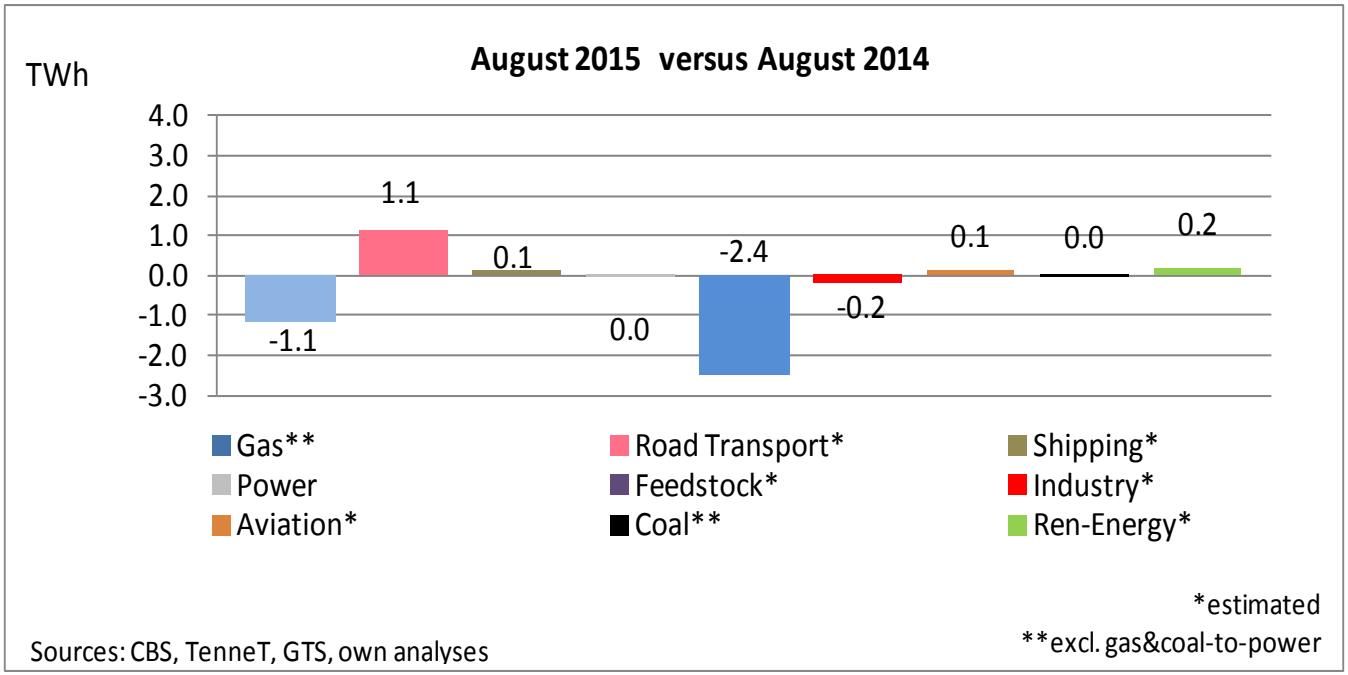
EnTranCe
ENERGY TRANSITION CENTRE



Energy is used for many different purposes. In August 2015, the most important applications were gas and various forms of transport. Renewables are given by comparison.

Final Energy Demand August 2015 (vs 2014)

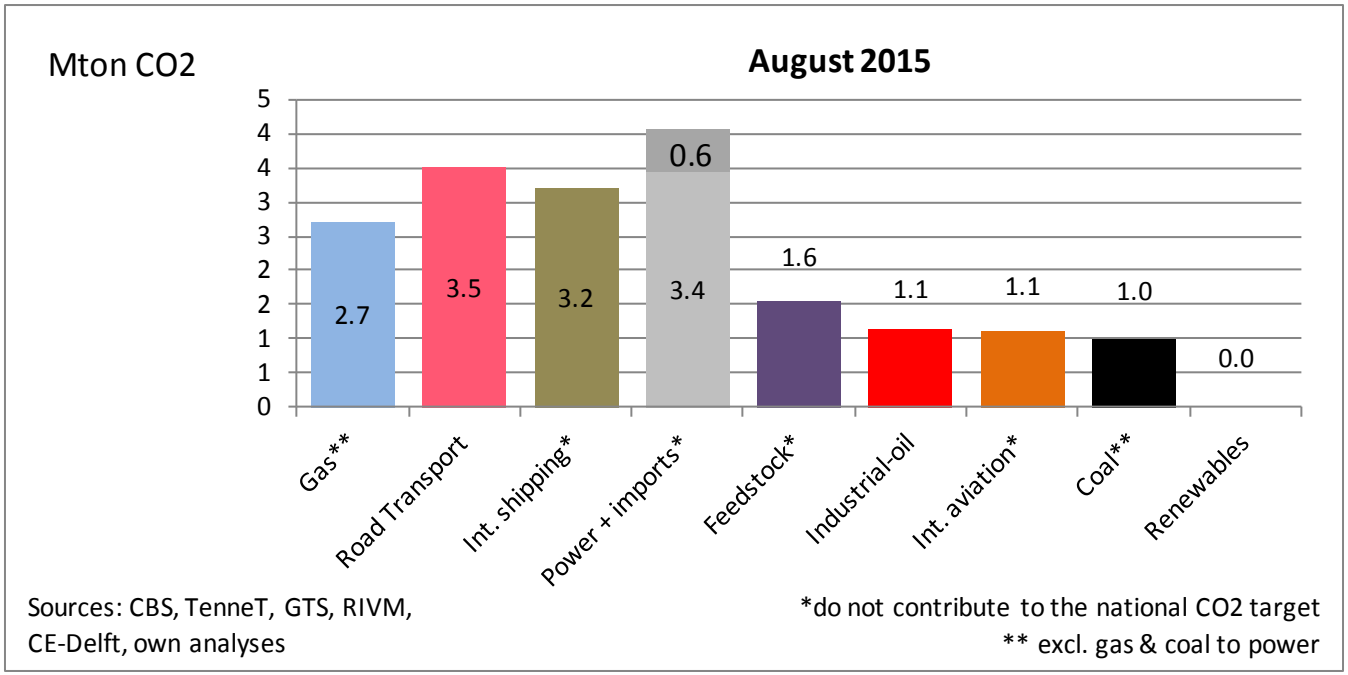
EnTranCe
ENERGY TRANSITION CENTRE



In August 2015, energy used for feedstock has been estimated to be significantly lower than in 2014.

CO2 Emissions

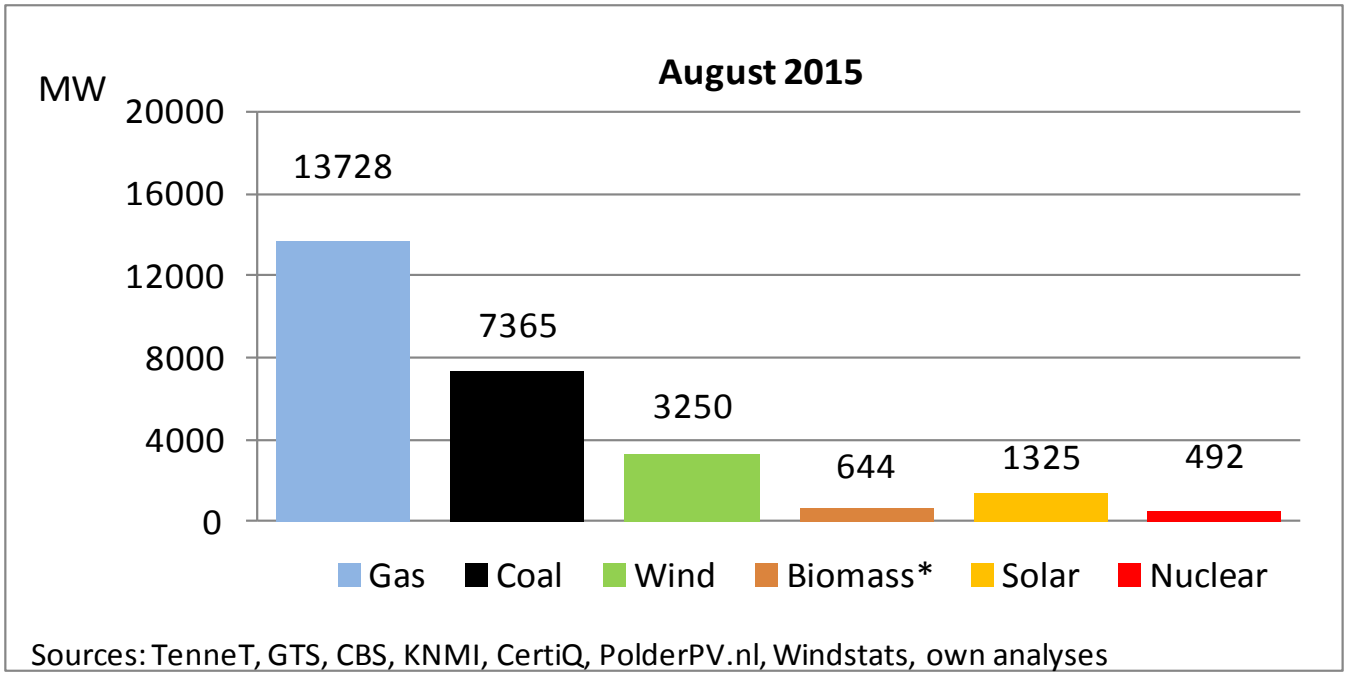
August 2015



The national CO2 emissions for August 2015, excluding power imports, feedstock and international shipping & aviation, are estimated at 11.8 Mton. This is 2% higher than in August 2014. The main CO2 contributions come from the power sector and road transport.

Power Generation Capacity August 2015

EnTranCe
ENERGY TRANSITION CENTRE



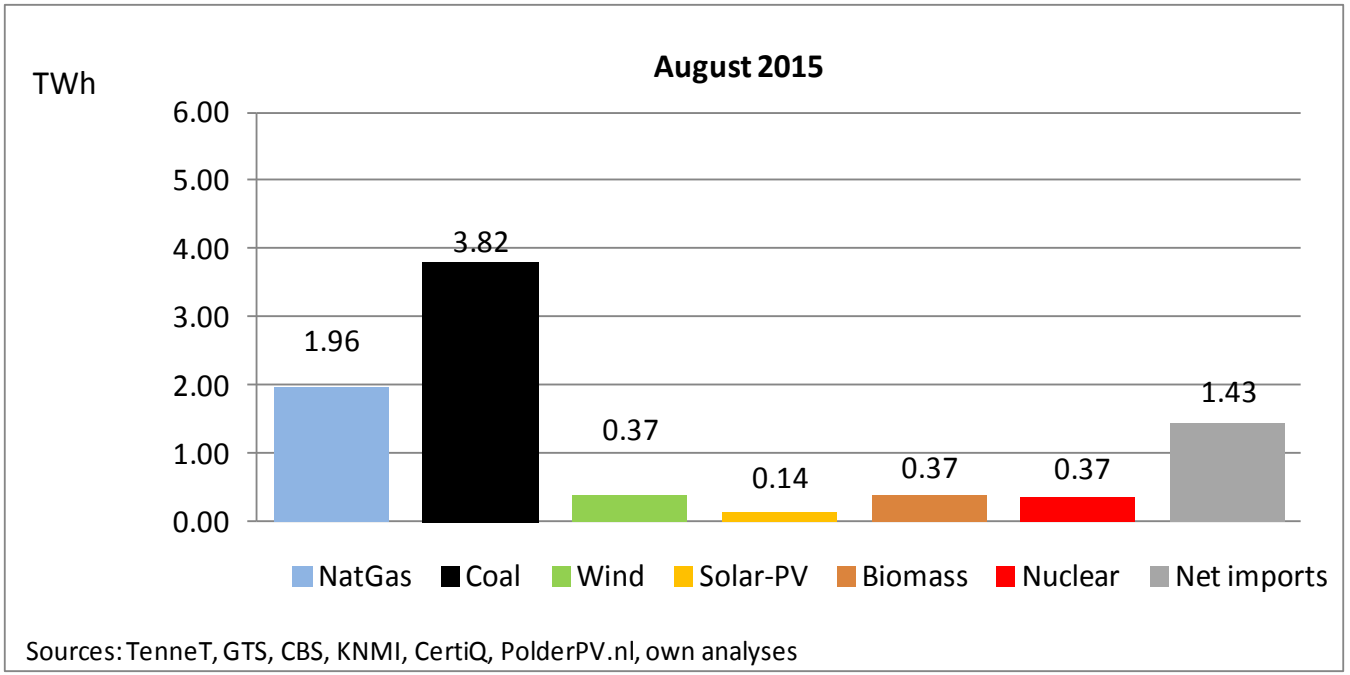
Sources: TenneT, GTS, CBS, KNMI, CertiQ, PolderPV.nl, Windstats, own analyses

This summer, the second 800 MW unit of the RWE coal-fired power station at Eemshaven came online. The growth of wind and solar-PV capacity continued.

Power Supplies

August 2015

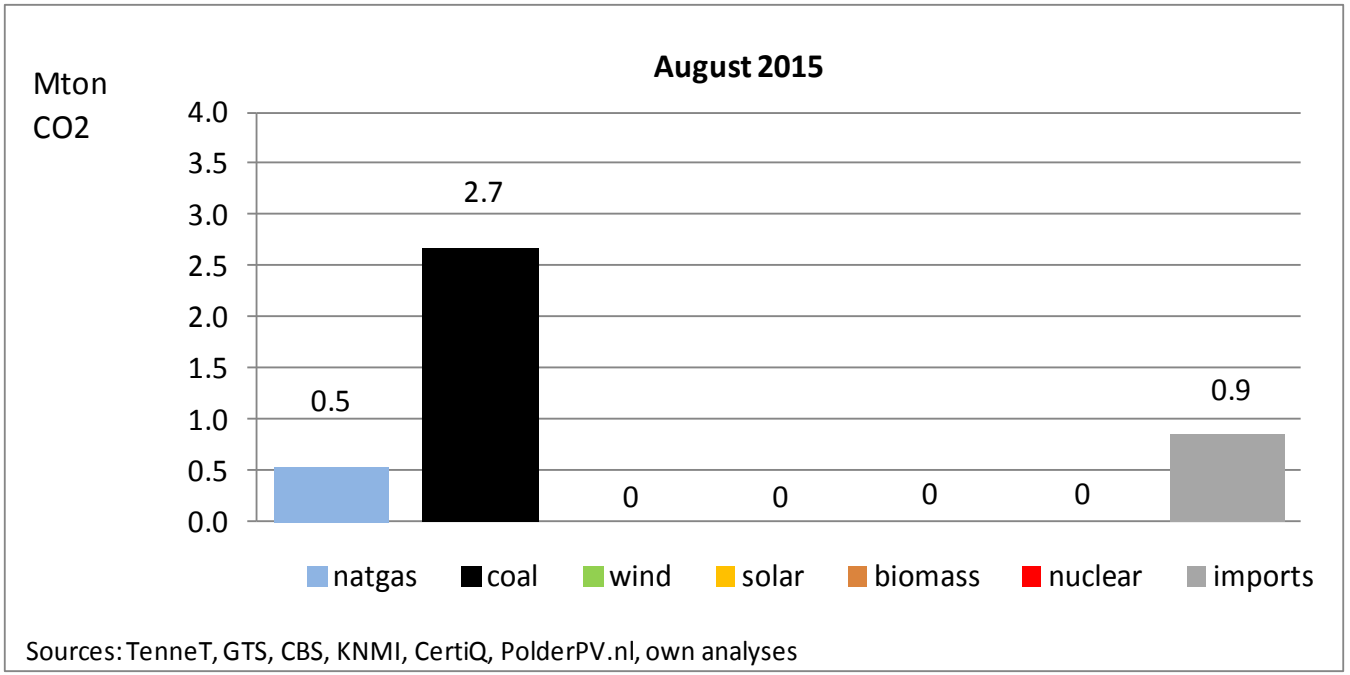
EnTranCe
ENERGY TRANSITION CENTRE



In August 2015, power consumption was 8.7 TWh, the same as last year. Most power has been generated by coal-fired power stations. In August 2015, the average contribution from renewables to the power system was 9.9%, compared to 11.6% in August 2014.

CO2 from Power Generation

August 2015



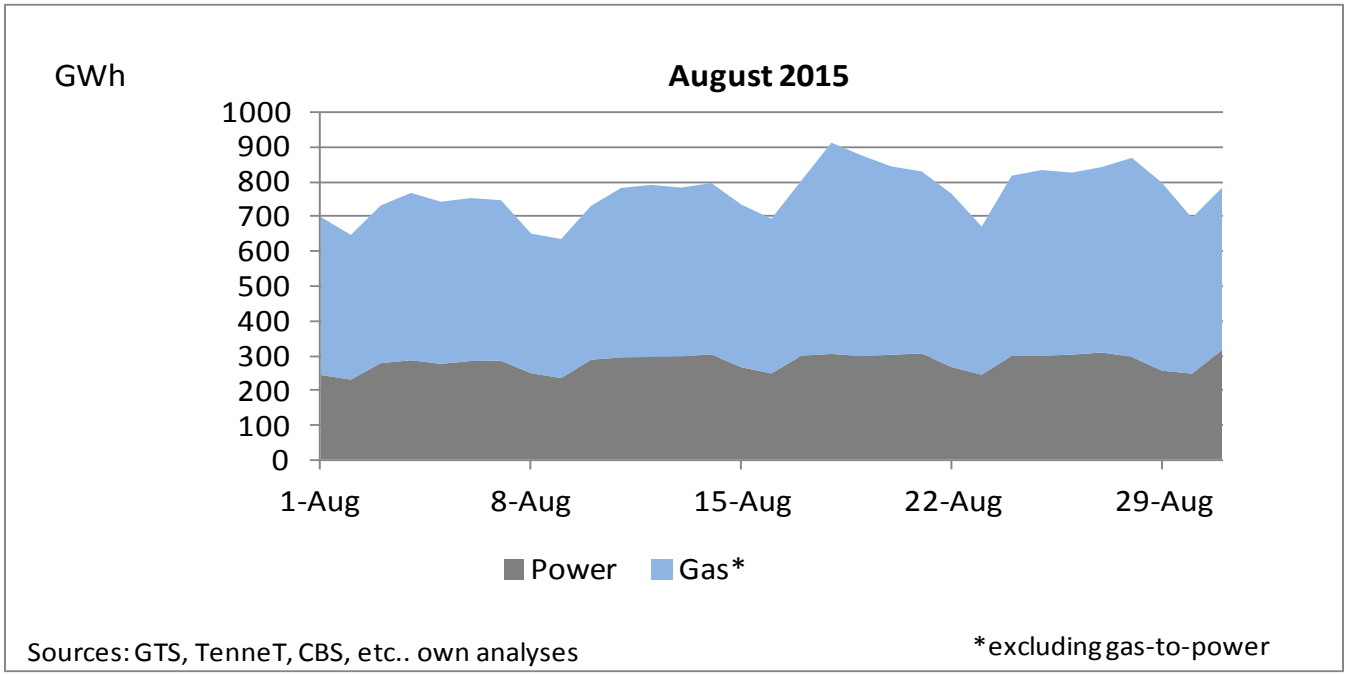
The CO2 emissions from imports are given for comparison, as these emissions do not contribute to the National Dutch CO2 emission level. In August 2015, 85% of the CO2 emissions from the power sector came from coal-fired power stations.

SELECTED MONTHLY PROFILES

(using daily data)

Gas and Power Demand August 2015

EnTranCe
ENERGY TRANSITION CENTRE

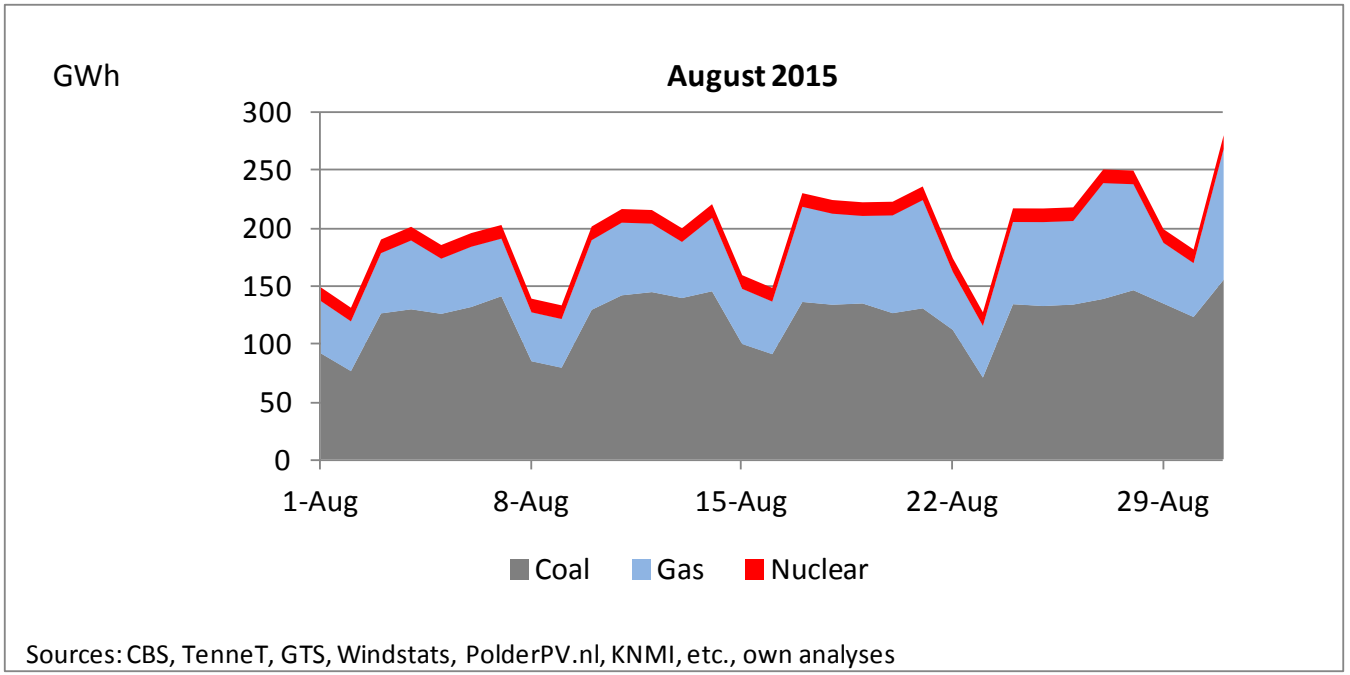


Sources: GTS, TenneT, CBS, etc.. own analyses

*excluding gas-to-power

Daily power demand shows a week-weekend pattern. Daily gas demand (excluding gas demand for power) from industry has a similar pattern. In summer, little gas is used for the heating market.

Conventional Power Production August 2015

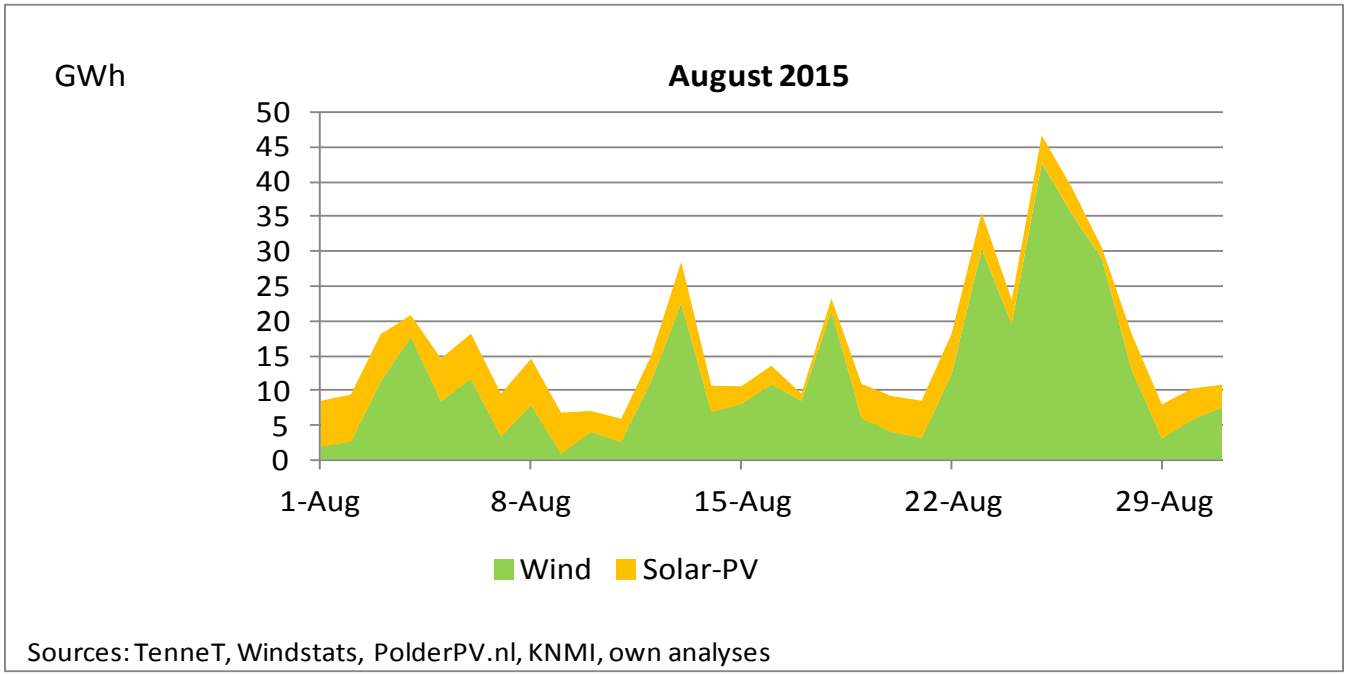


Sources: CBS, TenneT, GTS, Windstats, PolderPV.nl, KNMI, etc., own analyses

Coal-fired power stations showed a week-weekend pattern. Gas-fired generation used, is typically must-run capacity (e.g. cogeneration) and necessary to balance the system.

Wind and Solar Power Production August 2015

EnTranCe
ENERGY TRANSITION CENTRE



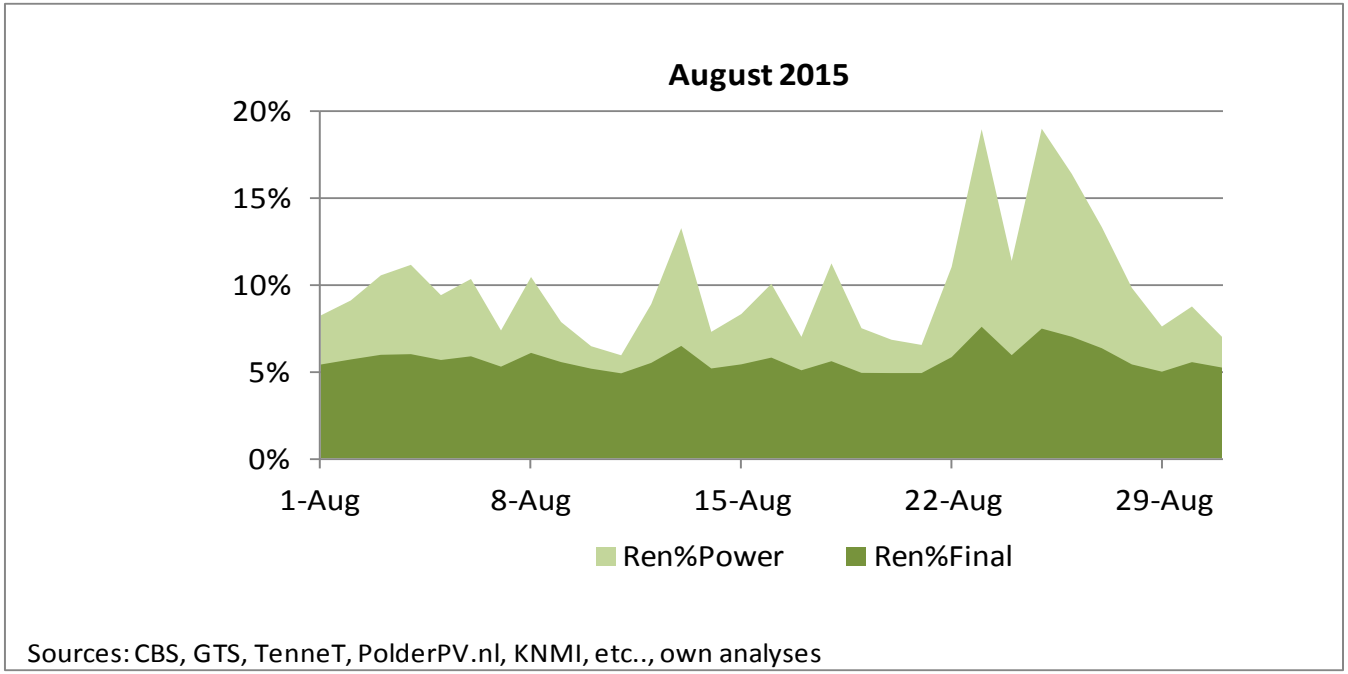
Sources: TenneT, Windstats, PolderPV.nl, KNMI, own analyses

August 2015 had little wind. Hence, although there was a significant increase in installed capacity, less wind energy production decreased by 22% compared to August 2014.

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

Contribution of Renewable Energy August 2015

EnTranCe
ENERGY TRANSITION CENTRE



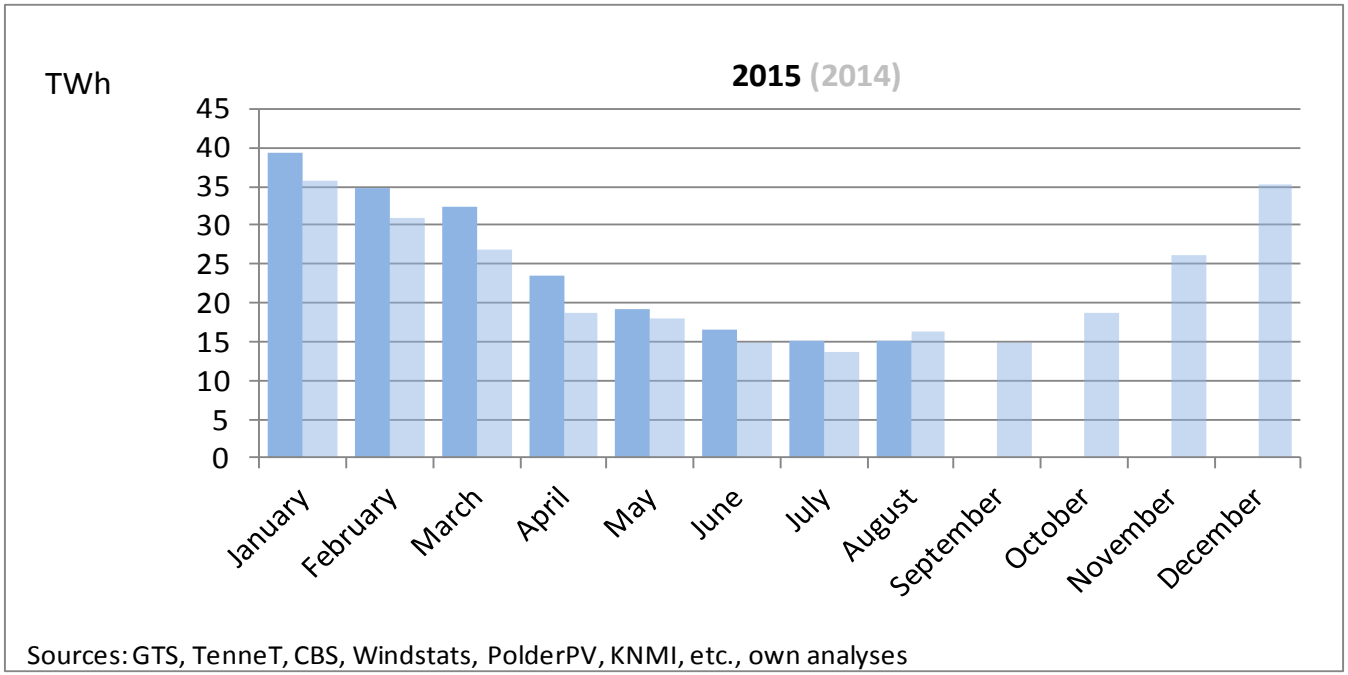
Sources: CBS, GTS, TenneT, PolderPV.nl, KNMI, etc.., own analyses

Renewable energy as a fraction of final energy consumption peaked at 7.6% on august 23rd , while the fraction of renewable power peaked to 18.9% that day.

SELECTED MONTHLY ENERGY DATA

Gas Demand
(excluding gas-to-power)
2015 (and 2014)

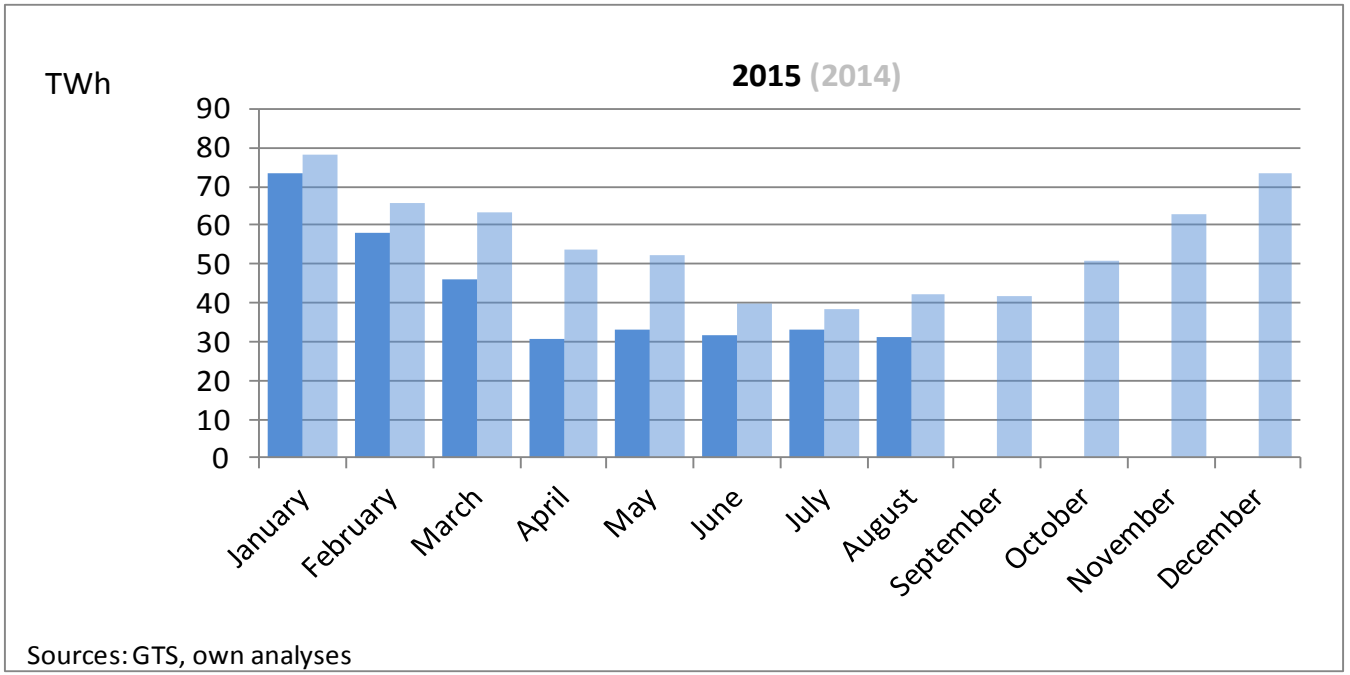
EnTranCe
ENERGY TRANSITION CENTRE



Sources: GTS, TenneT, CBS, Windstats, PolderPV, KNMI, etc., own analyses

For the first time this year, gas demand, excluding gas-to-power, was slightly lower than the same month in 2014.

Gas Production 2015 (and 2014)



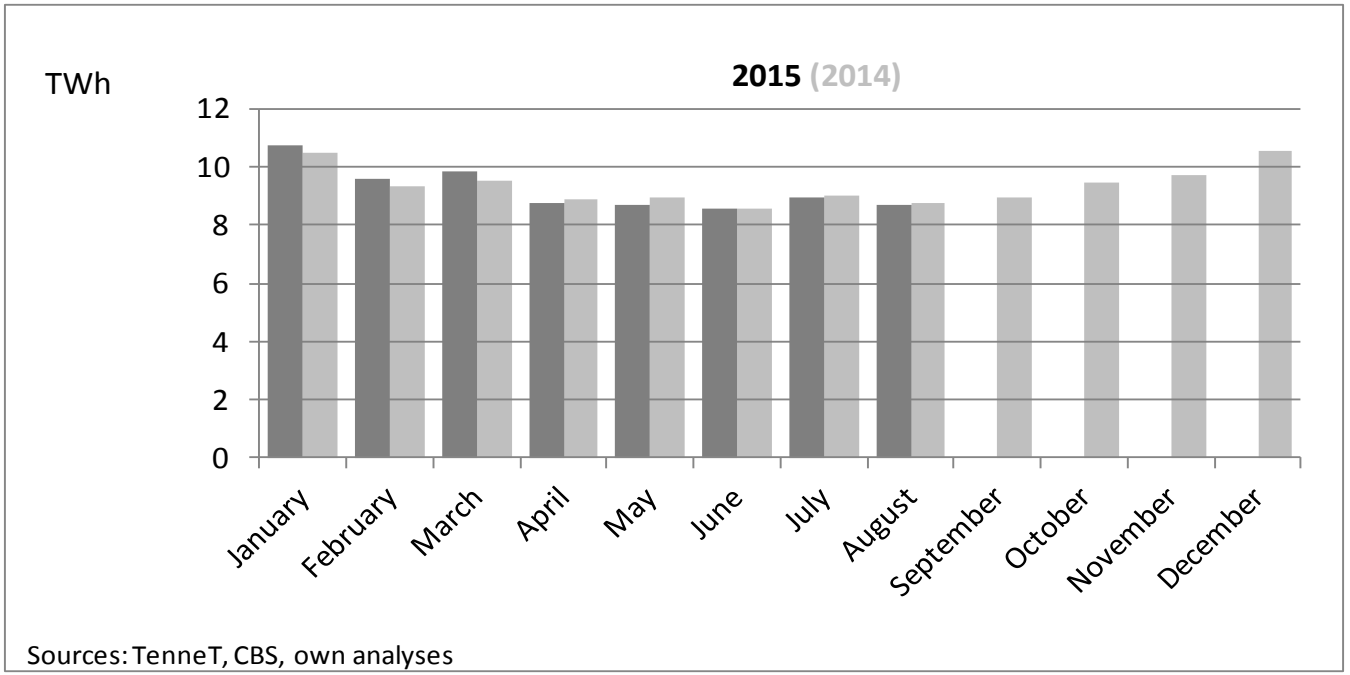
Sources: GTS, own analyses

Due to lower production from the Groningen gas field and declining gas production from the North Sea, Dutch gas production in 2015 is considerable lower than in 2014.

10 TWh gas is sufficient to supply heat to all houses in Amsterdam for two years

Power Demand 2015 (and 2014)

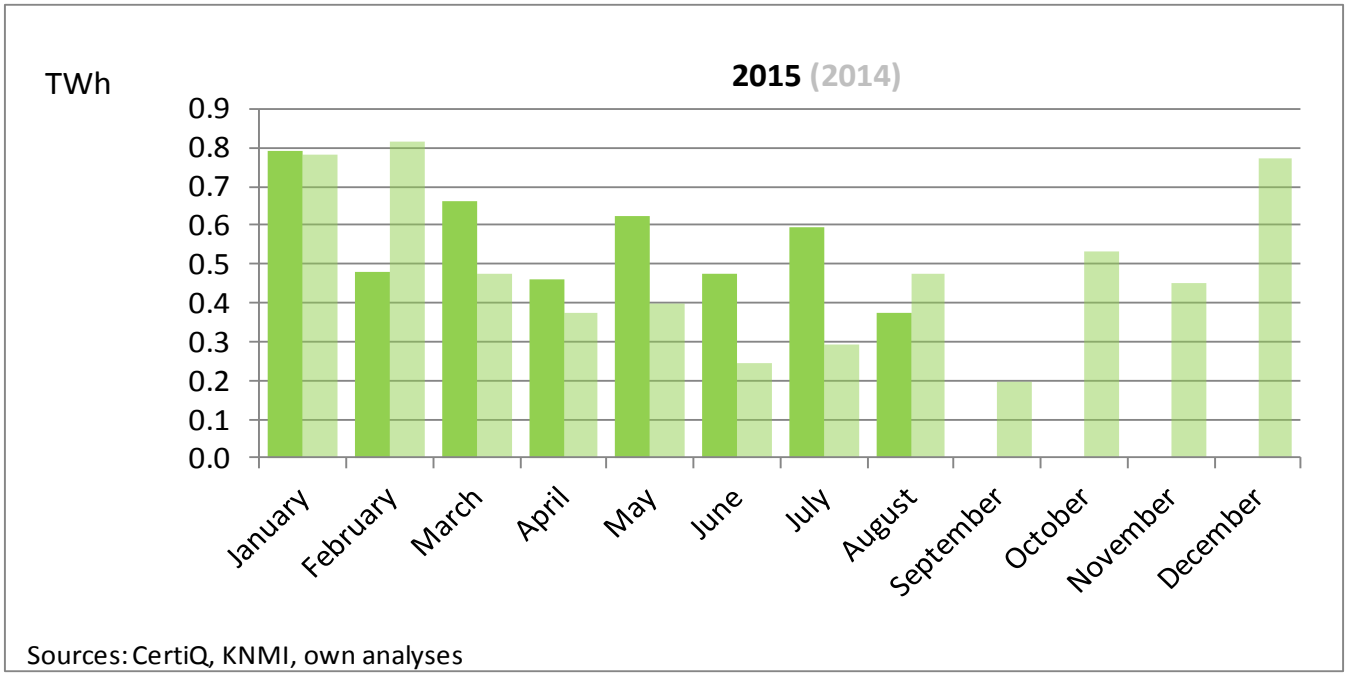
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CBS, own analyses

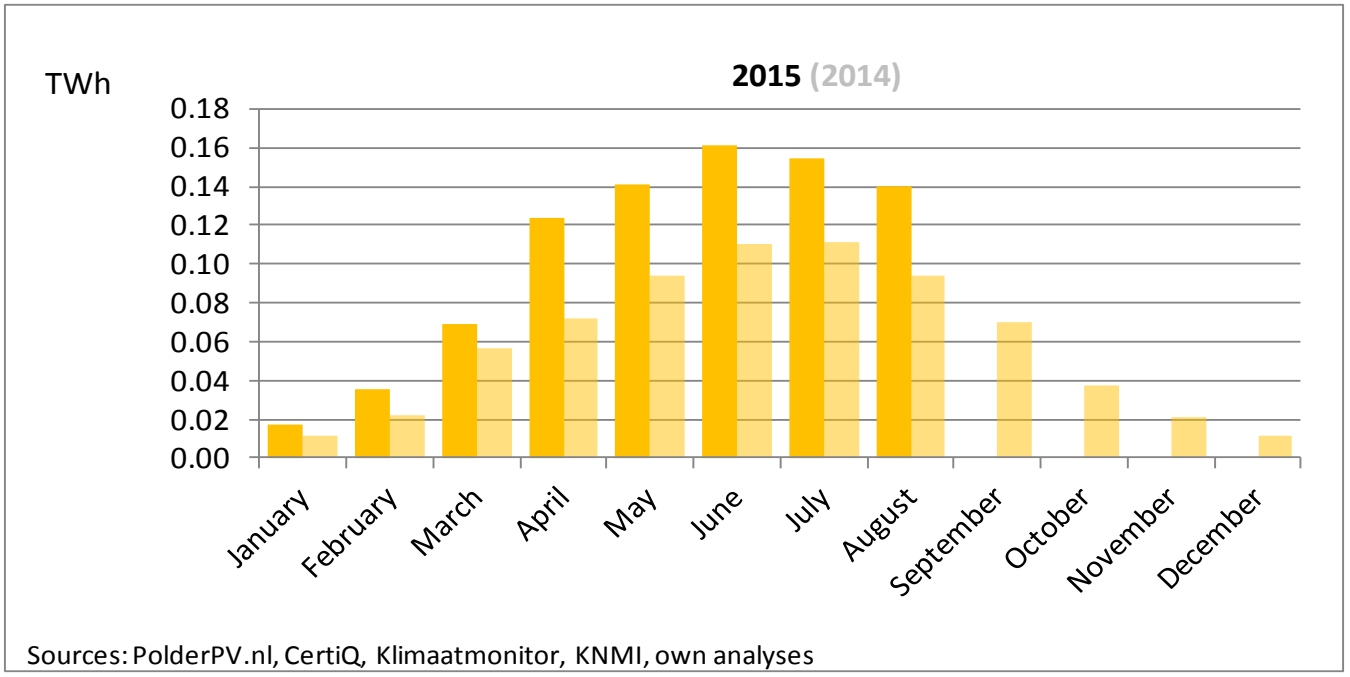
Power demand in August was the same as last year.

Wind Production 2015 (and 2014)



Wind power production is very volatile. Wind production in august 2015 was 22% lower that a year ago, although wind capacity increased by 20% y-o-y.. In August 2015, the average utilization of wind capacity was just 16%.

Solar PV Production 2015 (and 2014)

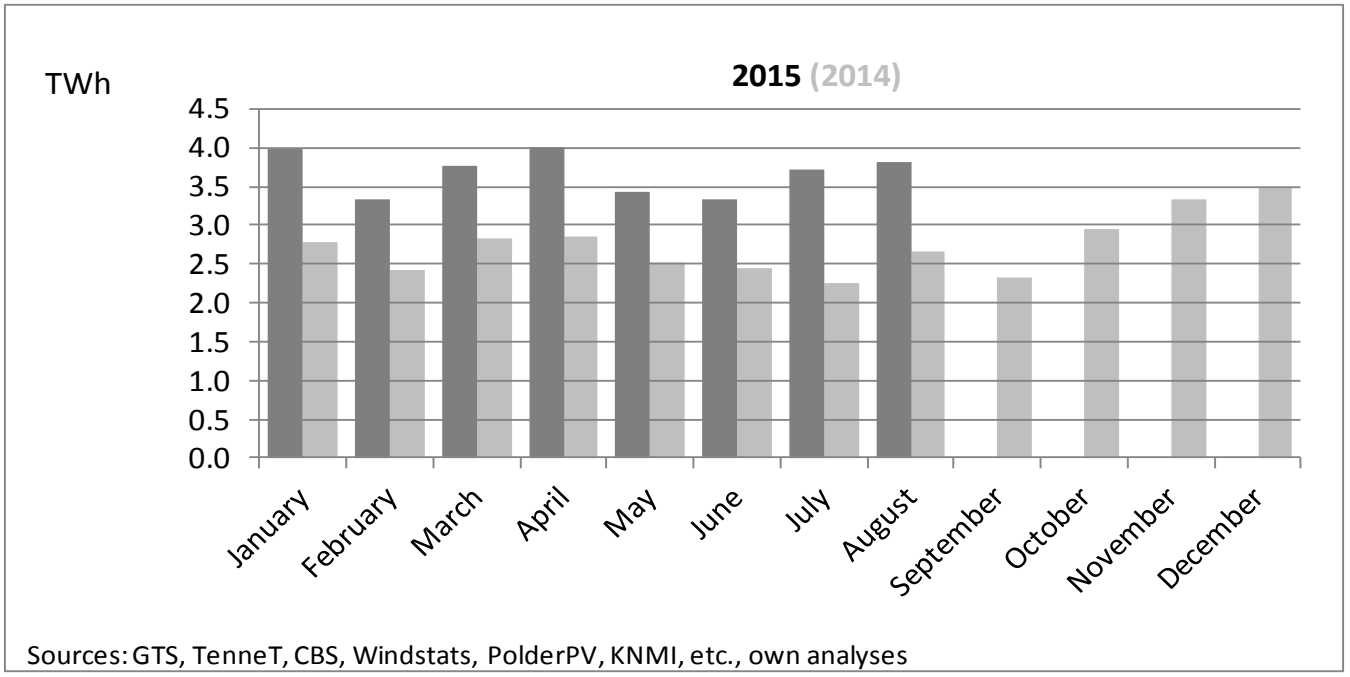


Sources: PolderPV.nl, CertiQ, Klimaatmonitor, KNMI, own analyses

In August 2015, electricity production by Solar PV in The Netherlands was slightly less than the record level s in June and July. The average utilization rate of solar-PV capacity was 15% in August.

Coal-to-Power 2015 (and 2014)

EnTranCe
ENERGY TRANSITION CENTRE

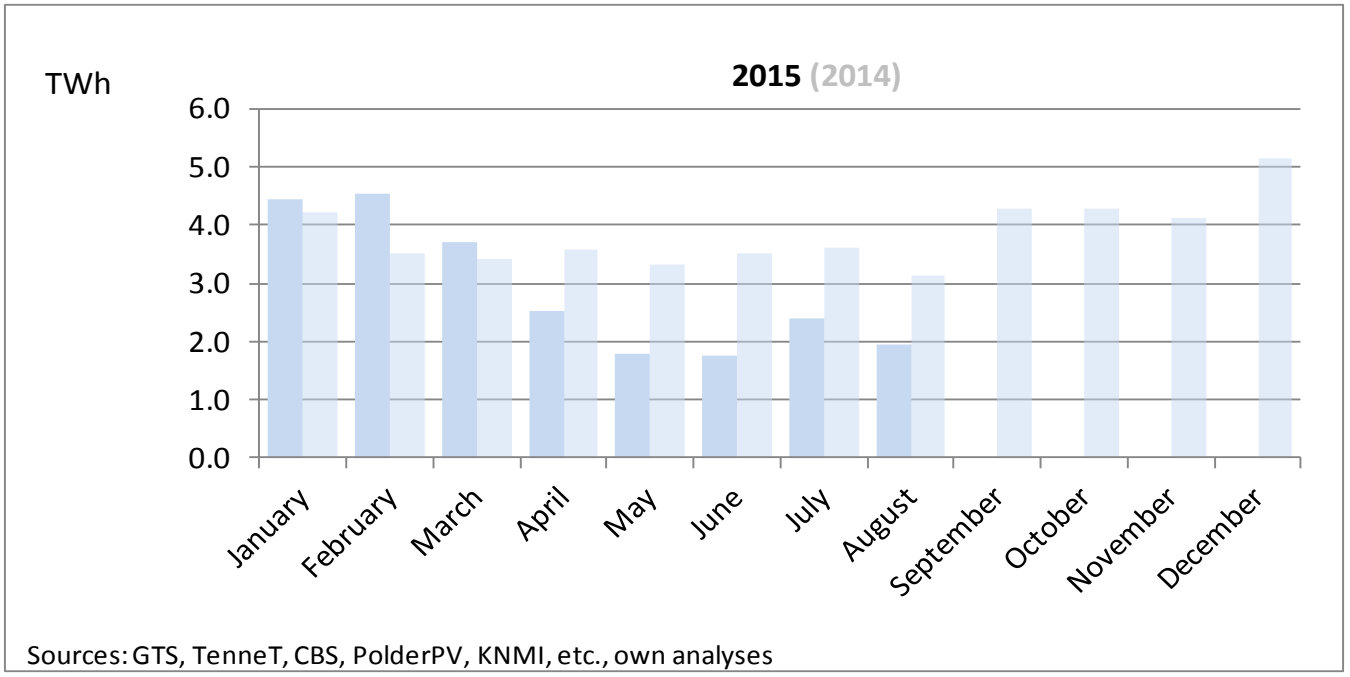


Sources: GTS, TenneT, CBS, Windstats, PolderPV, KNMI, etc., own analyses

Coal utilization for power generation is structurally about 35% higher in 2015 compared to 2014. In August, the average utilization rate of coal-fired power stations in the Netherlands has been calculated at 72%. This percentage includes the effects of maintenance. Excluding maintenance, the utilization rate of coal-fired power has been 78%.

Gas to Power
2015 (and 2014)

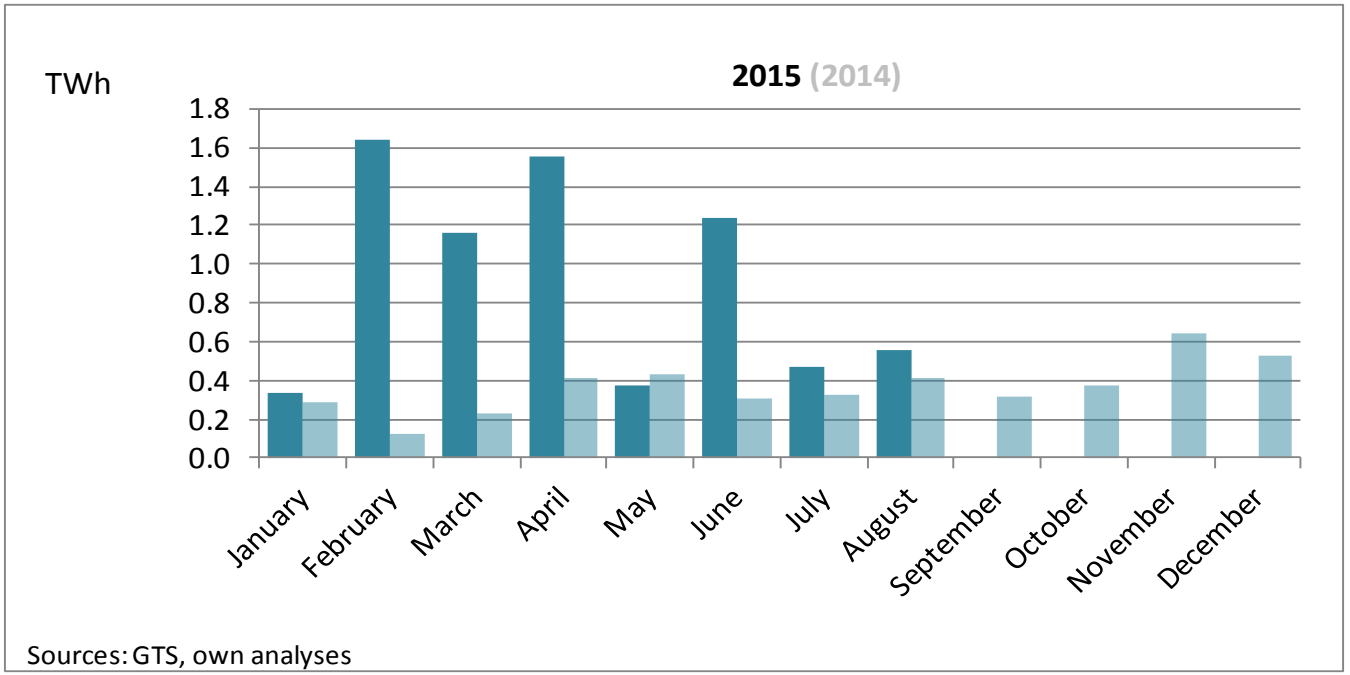
EnTranCe
ENERGY TRANSITION CENTRE



Sources: GTS, TenneT, CBS, PolderPV, KNMI, etc., own analyses

In August 2015, power production by gas-fired power stations and cogeneration was less decreased compared to July 2015. In August, the average utilization rate of gas-fired capacity was 20%. This percentage includes maintenance and mothballed installations.

LNG imports 2015 (and 2014)

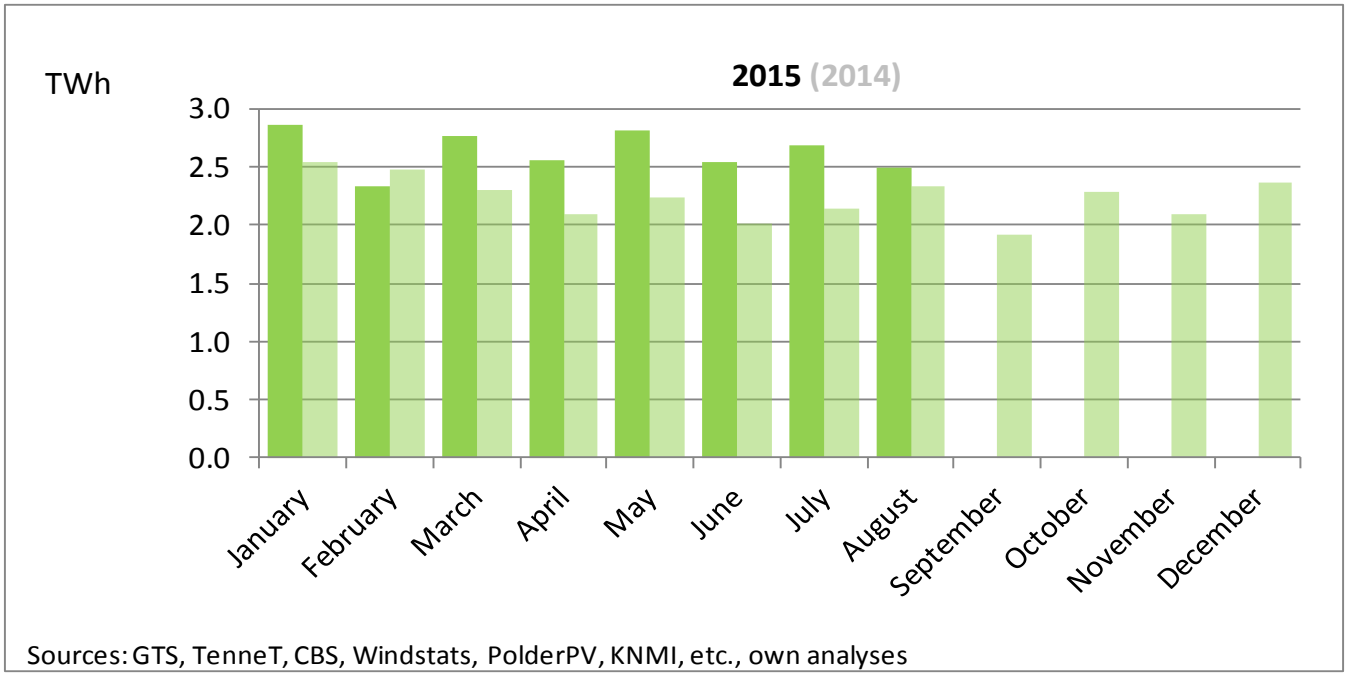


Sources: GTS, own analyses

On average, LNG imports in 2015 increased by 200% compared to 2014. This figure depicts the amount of LNG injected into the gas grid, as presented by GTS. The figure excludes therefore the usage of LNG as transport fuel

Renewable Energy
All Sources
2015 (and 2014)

EnTranCe
ENERGY TRANSITION CENTRE

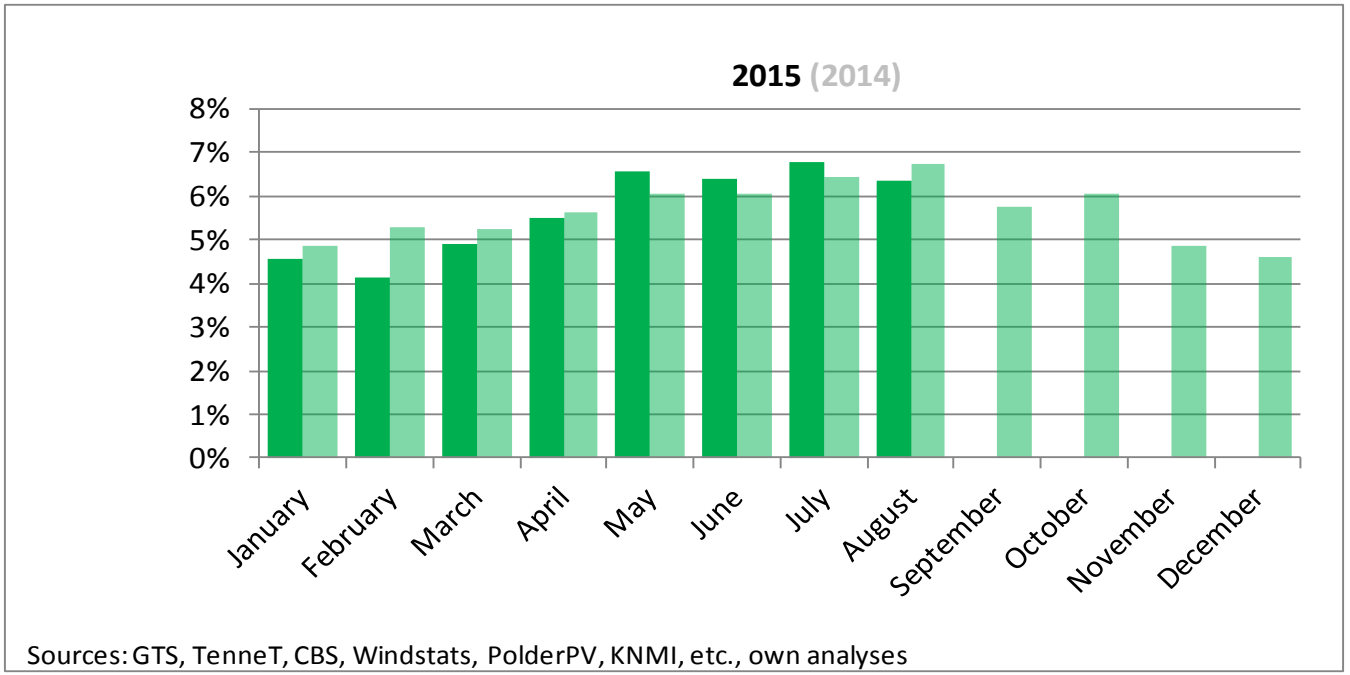


Sources: GTS, TenneT, CBS, Windstats, PolderPV, KNMI, etc., own analyses

The data show that in 2015, the renewable energy in The Netherlands was higher in any month so far. The average increase is 16% y-o-y.

Renewable Energy Percentage 2015 (and 2014)

EnTranCe
ENERGY TRANSITION CENTRE

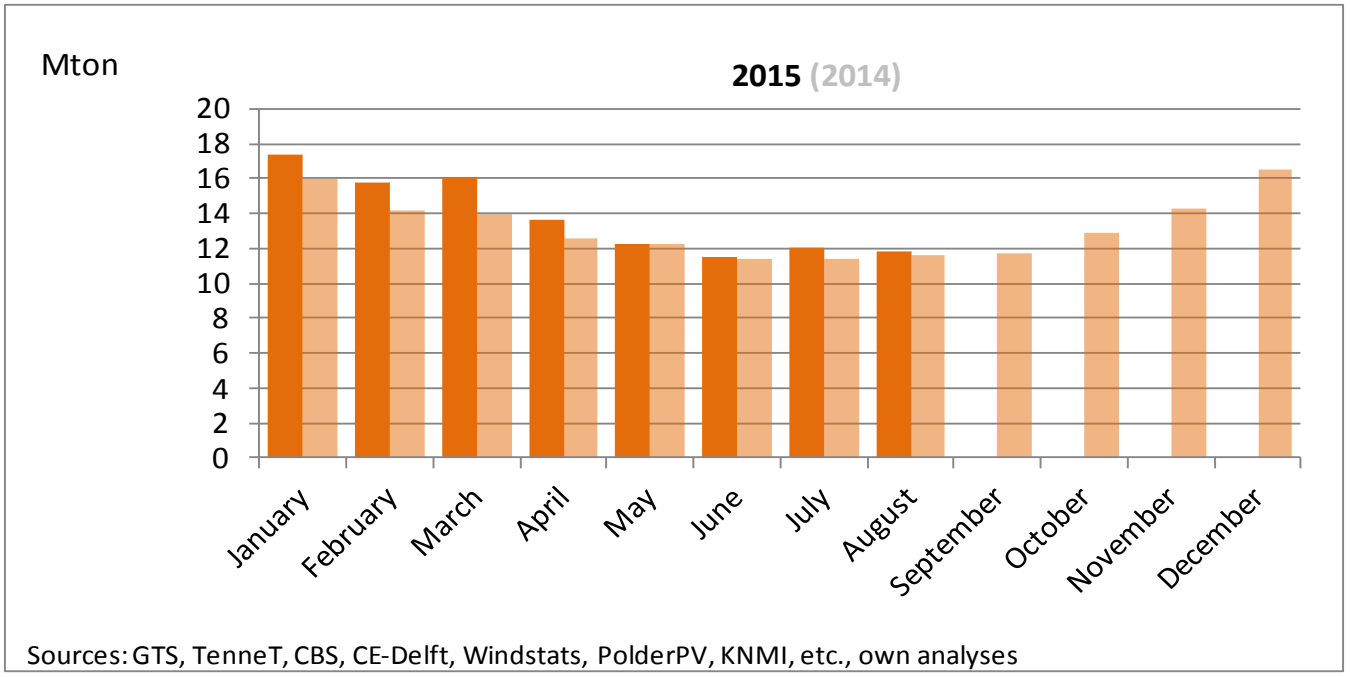


Sources: GTS, TenneT, CBS, Windstats, PolderPV, KNMI, etc., own analyses

Despite higher production of renewable energy, the percentage of renewable energy is slightly lower than previous year, due to a higher energy usage.

CO2 Emissions 2015 (and 2014)

EnTranCe
ENERGY TRANSITION CENTRE

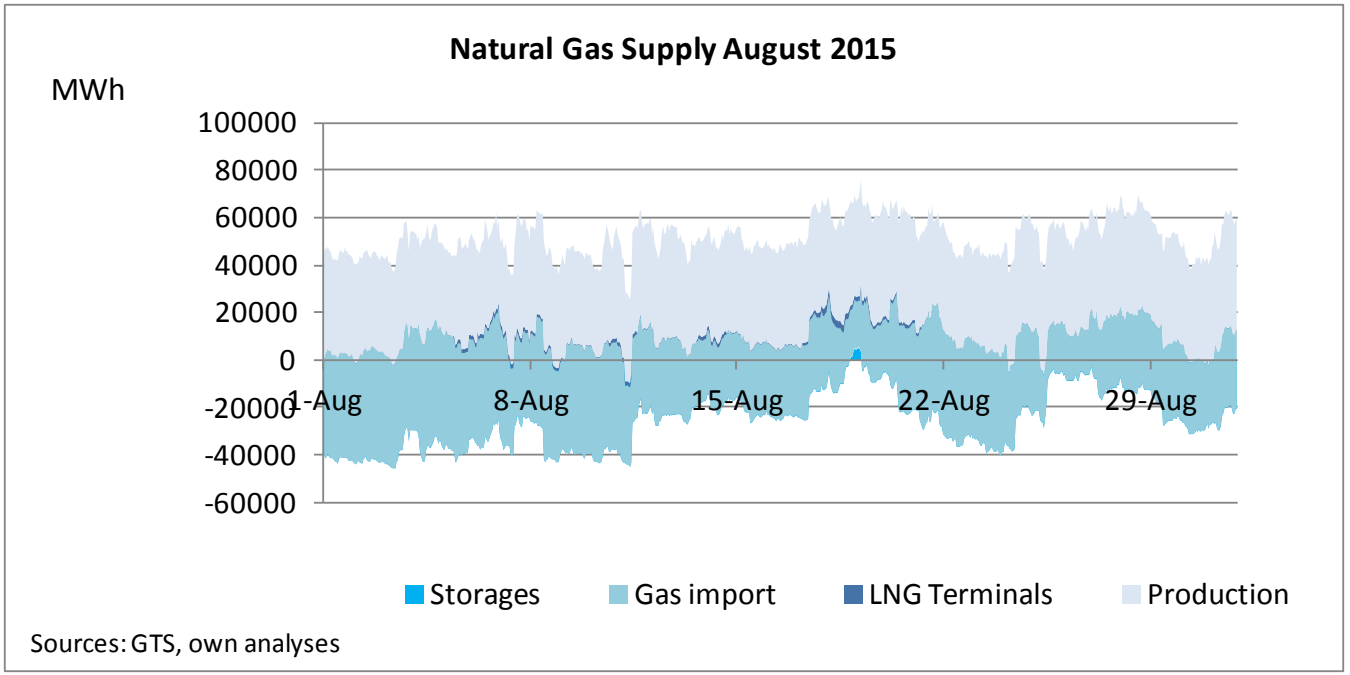


Sources: GTS, TenneT, CBS, CE-Delft, Windstats, PolderPV, KNMI, etc., own analyses

National CO2 emissions from the Netherland s are consistently higher than in 2014, mainly due high utilization of coal for Dutch power production.

SELECTED HOURLY ENERGY DATA

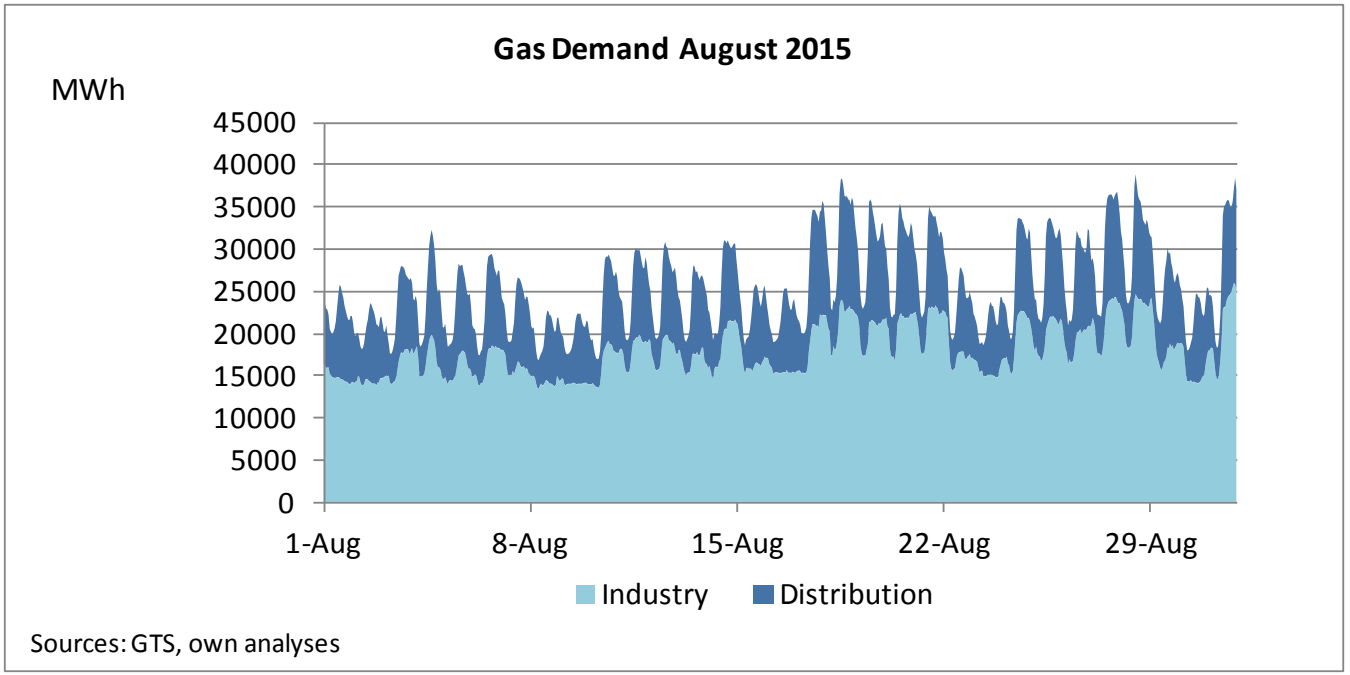
Gas Supply August 2015



In August 2015, substantial gas volumes were used to fill gas storages, depicted as negative values in the figure. This month, hardly any LNG was injected into the grid.

Gas Demand
Including Gas-to-Power
August 2015

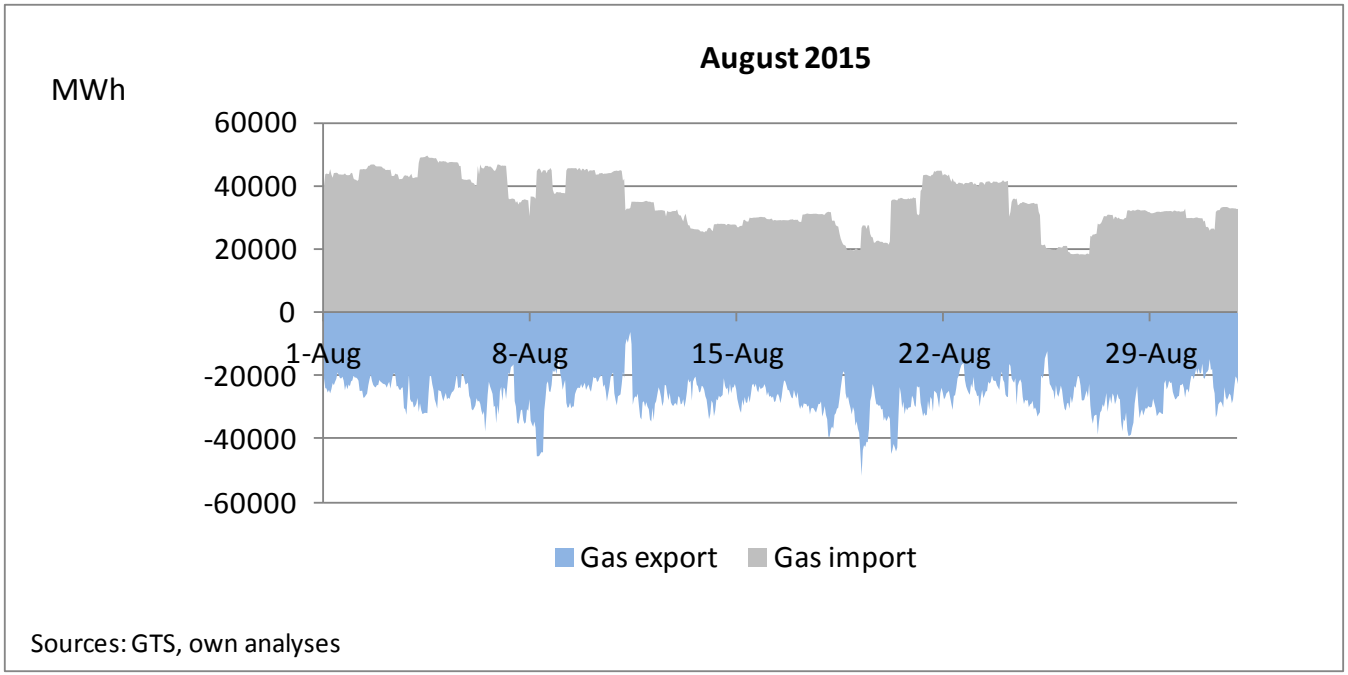
EnTranCe
ENERGY TRANSITION CENTRE



Sources: GTS, own analyses

In August, gas demand in The Netherlands peaked to 38000 MW. During summer, gas consumption is mainly by industry.

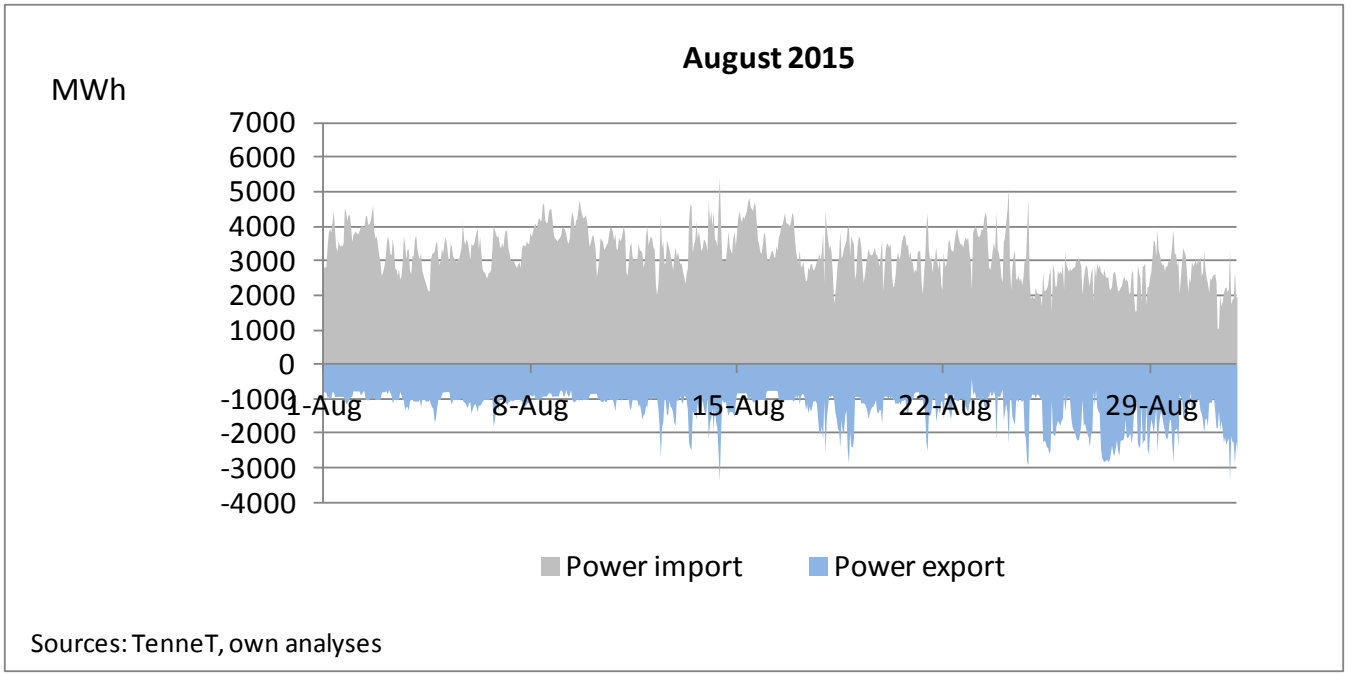
Gas Imports & Exports August 2015



Sources: GTS, own analyses

In August 2015, Dutch gas imports were 6 TWh higher than Dutch gas exports. This is the third month in 2015 that the Netherlands was a net importing country (on a monthly basis)

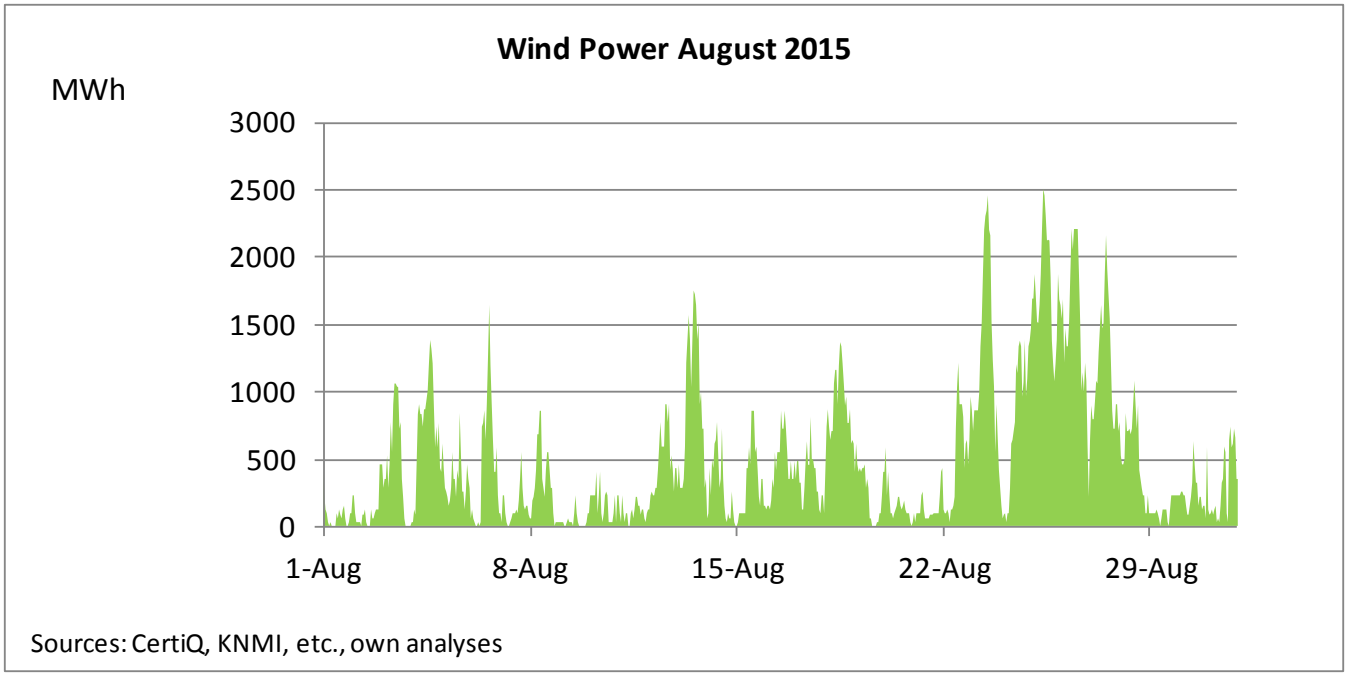
Power Imports & Exports August 2015



Sources: TenneT, own analyses

In August 2015, power imports were much higher than power exports.. Typically, the Netherlands imported about 3000 MW of power, while it exported about 1000 MW.

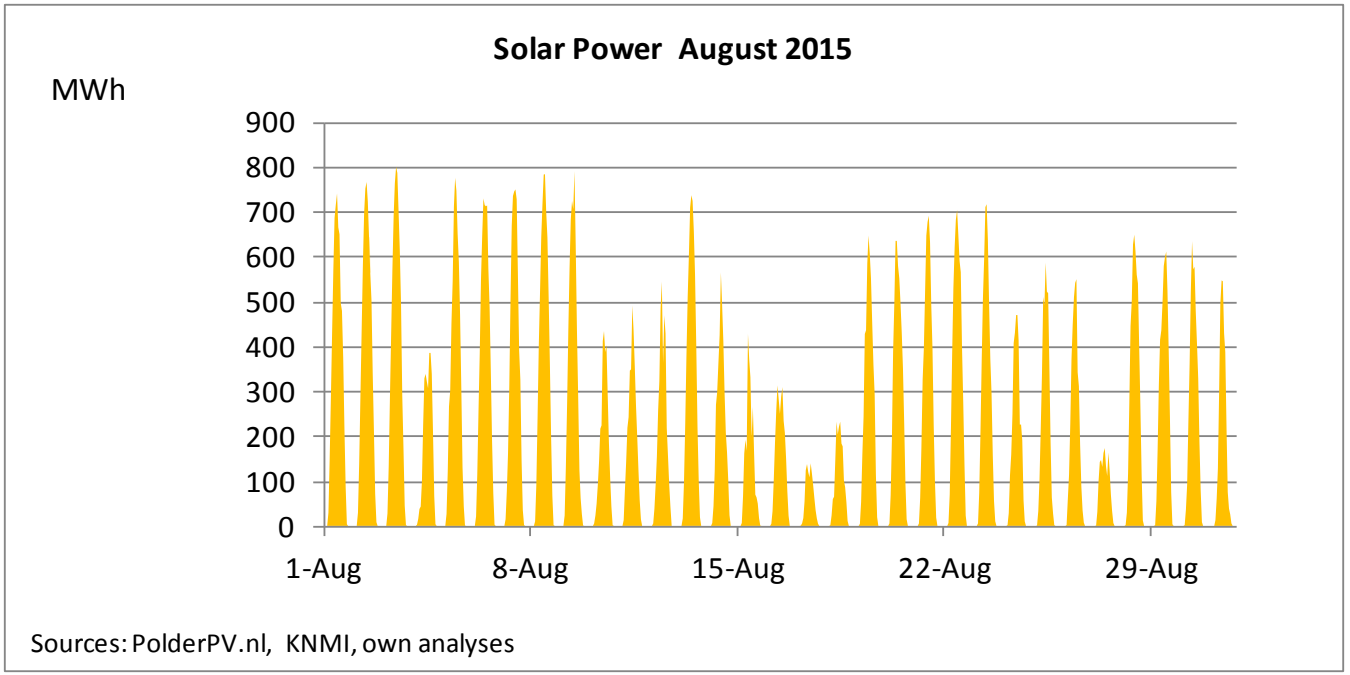
Wind Power August 2015



Sources: CertiQ, KNMI, etc., own analyses

In The Netherlands, summers are characterized by a low availability of wind. August 2015 has been no exception to this rule, with a utilization rate of the available wind capacity of 3250 MW by just 17%.

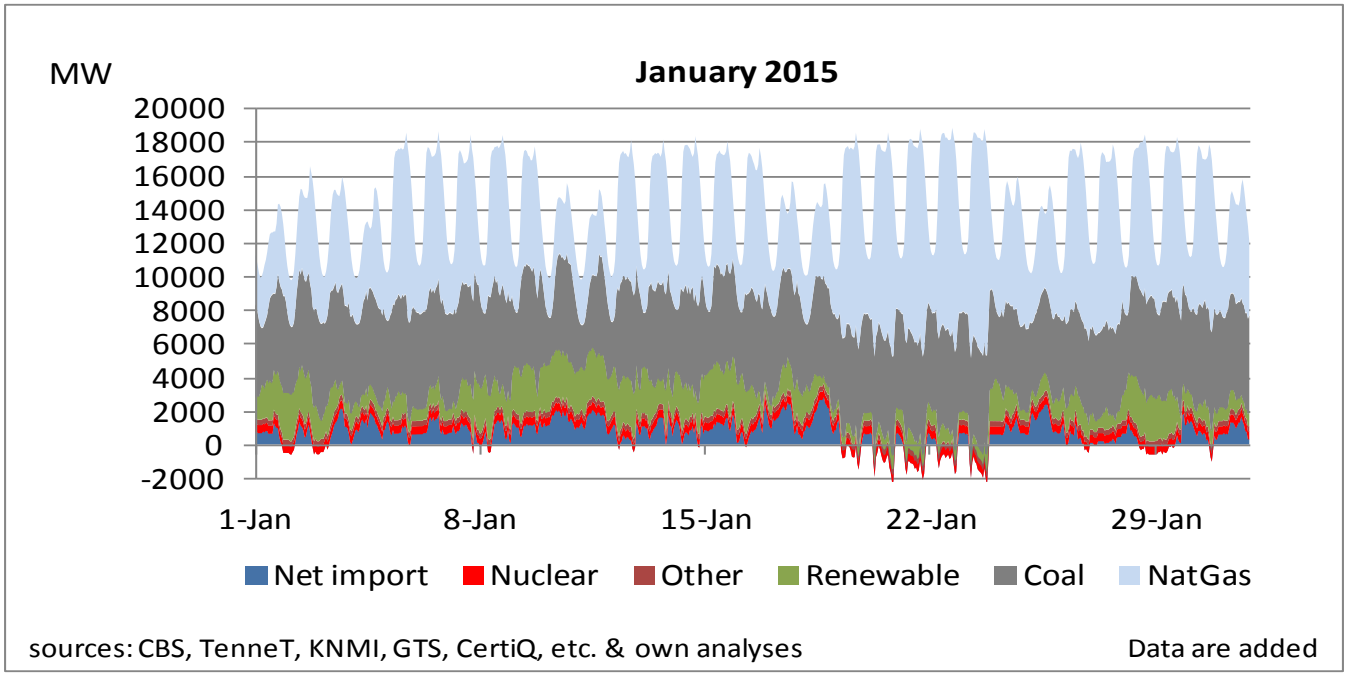
Solar PV Power August 2015



In August Solar-PV the amount of Solar-PV has been 140 GWh. The utilization rate of the solar PV installed was 16%.

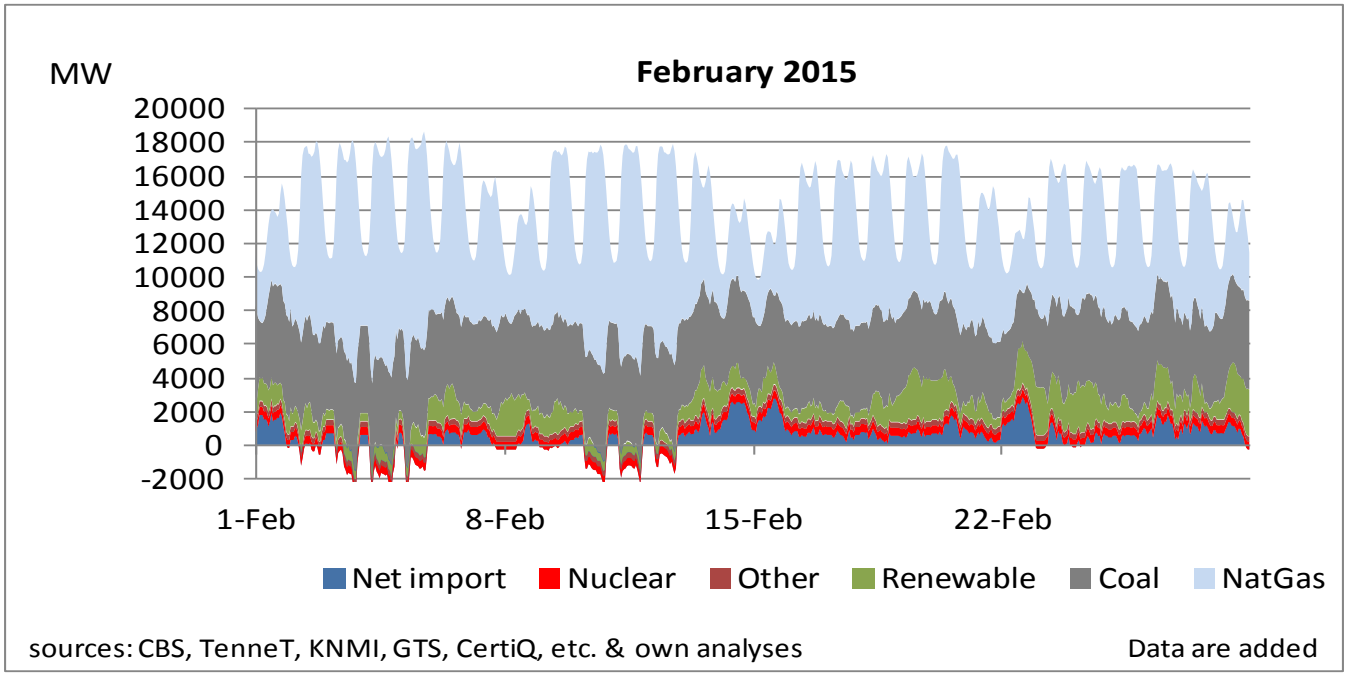
The following set of slides presents for each month in 2015 the hourly contributions of various energy sources to total power consumption in The Netherlands.

Power Generation January 2015



In the week of 20-24 January, power generation peaked, due to the net exports that occurred. The majority of the additional power generation has been generated by gas-fired installations.

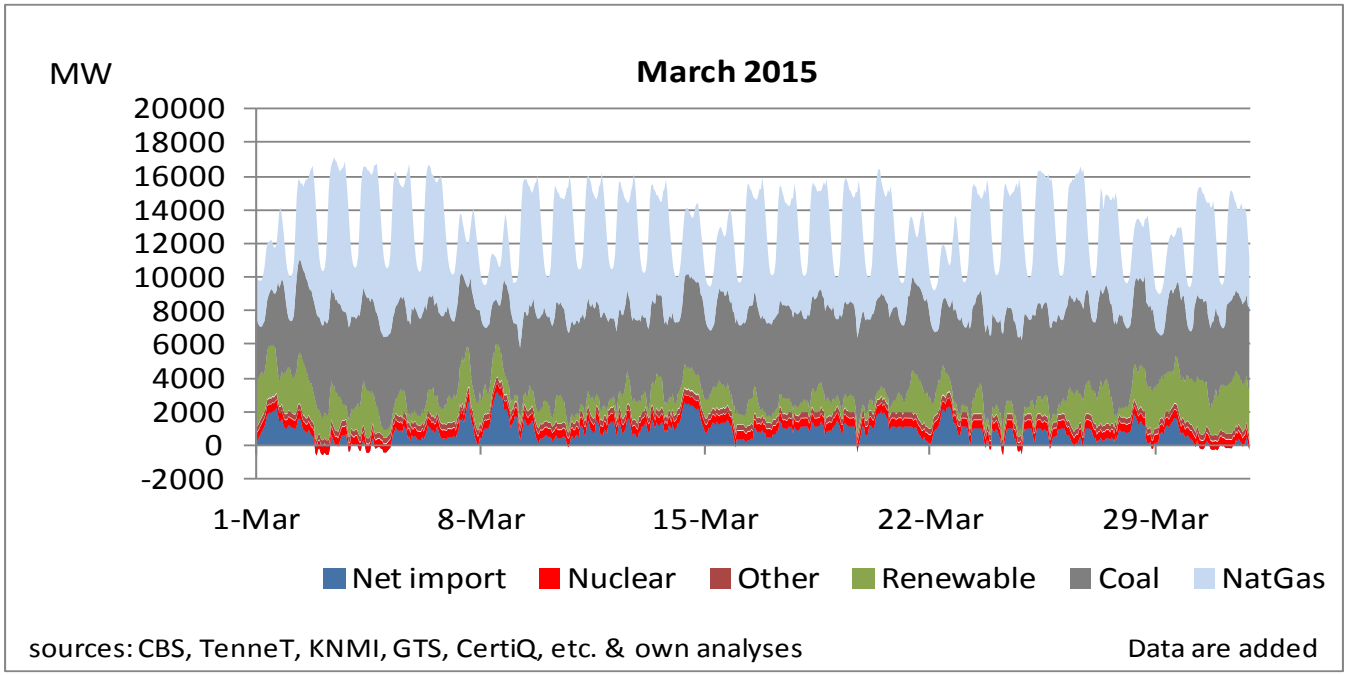
Power Generation February 2015



Like in January, low wind availability coincided with net exports of power.

Power Generation March 2015

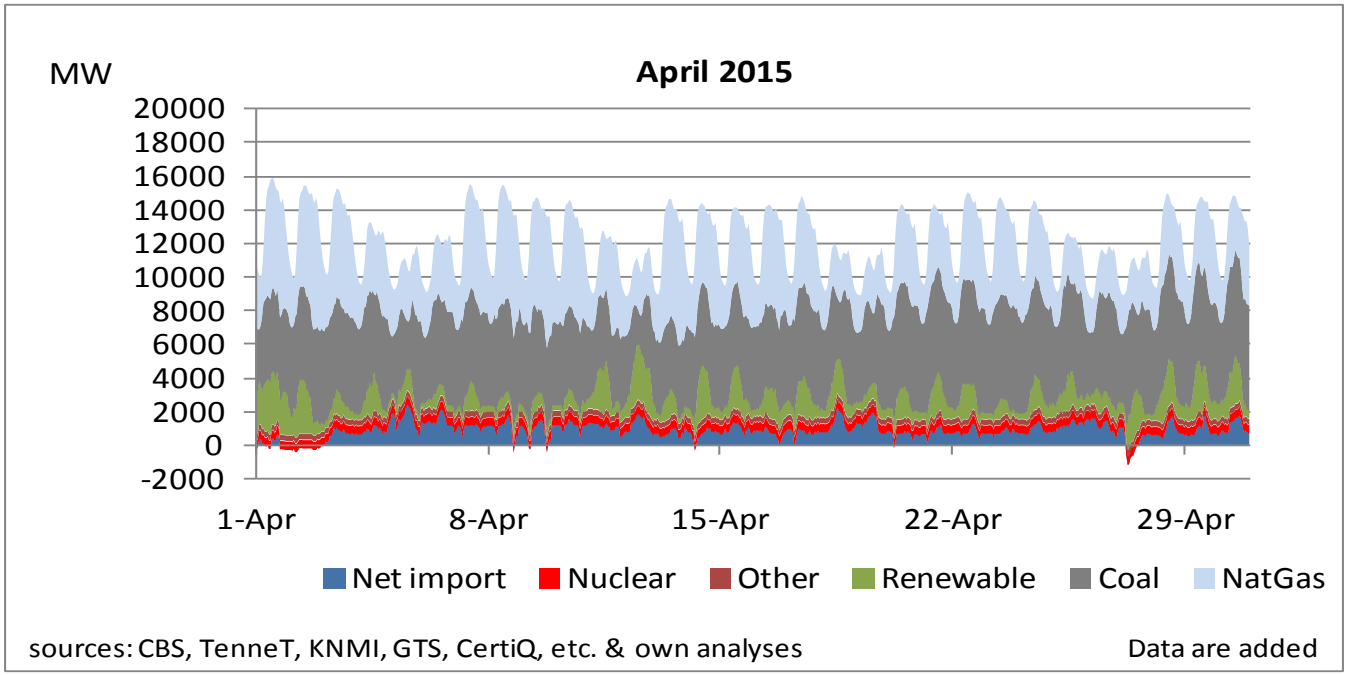
EnTranCe
ENERGY TRANSITION CENTRE



Relatively low imports of power occurred in March. On several Saturdays, some net exports were recorded.

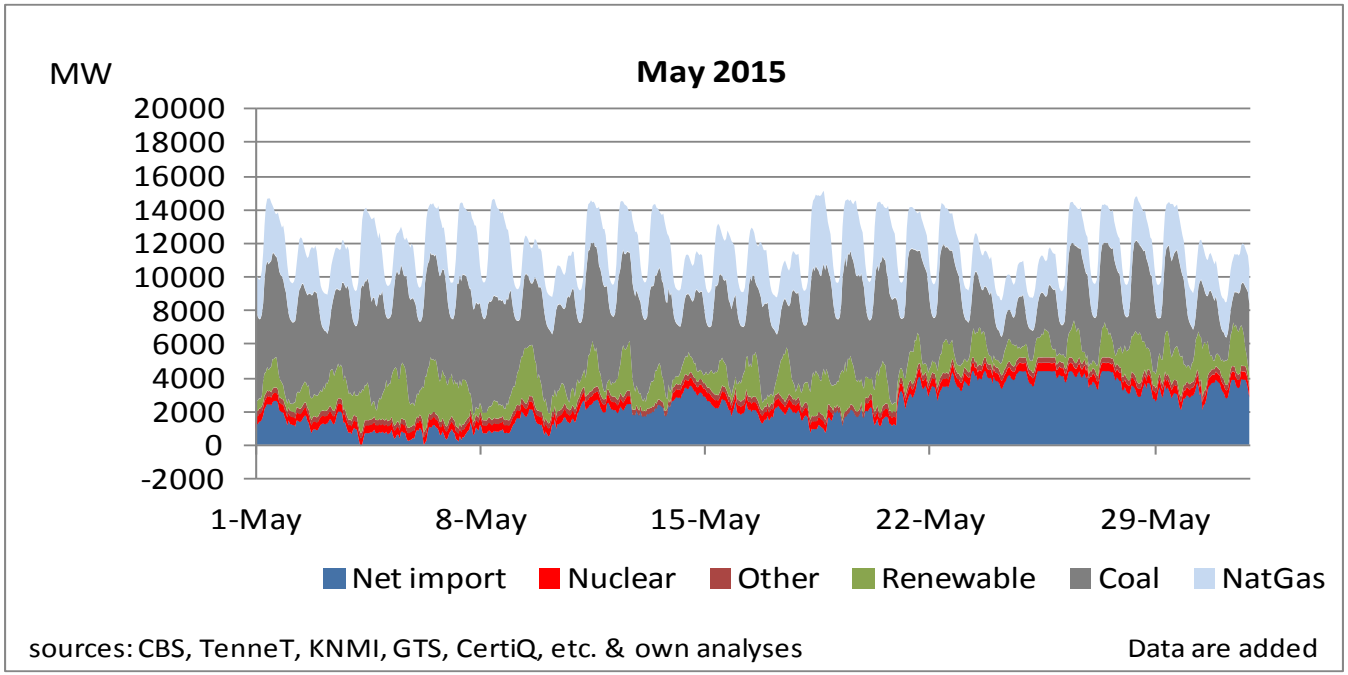
Power Generation
April 2015

EnTranCe
ENERGY TRANSITION CENTRE



Relatively low imports of power occurred in April. On several occasions, mainly on Saturdays, net exports were recorded. April showed several days with high coal-fired generation, while gas-fired generation was low.

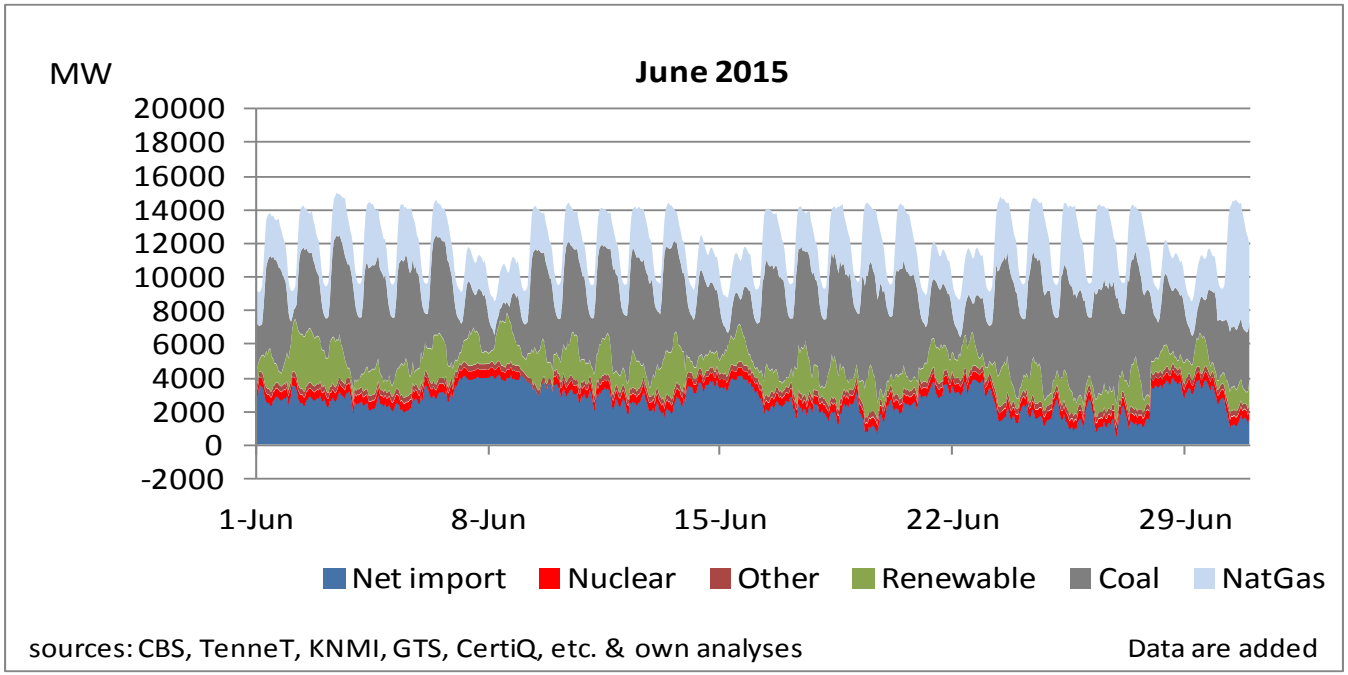
Power Generation May 2015



In May, high net imports and high coal utilization squeezed gas-fired power generation.

Power Generation
June 2015

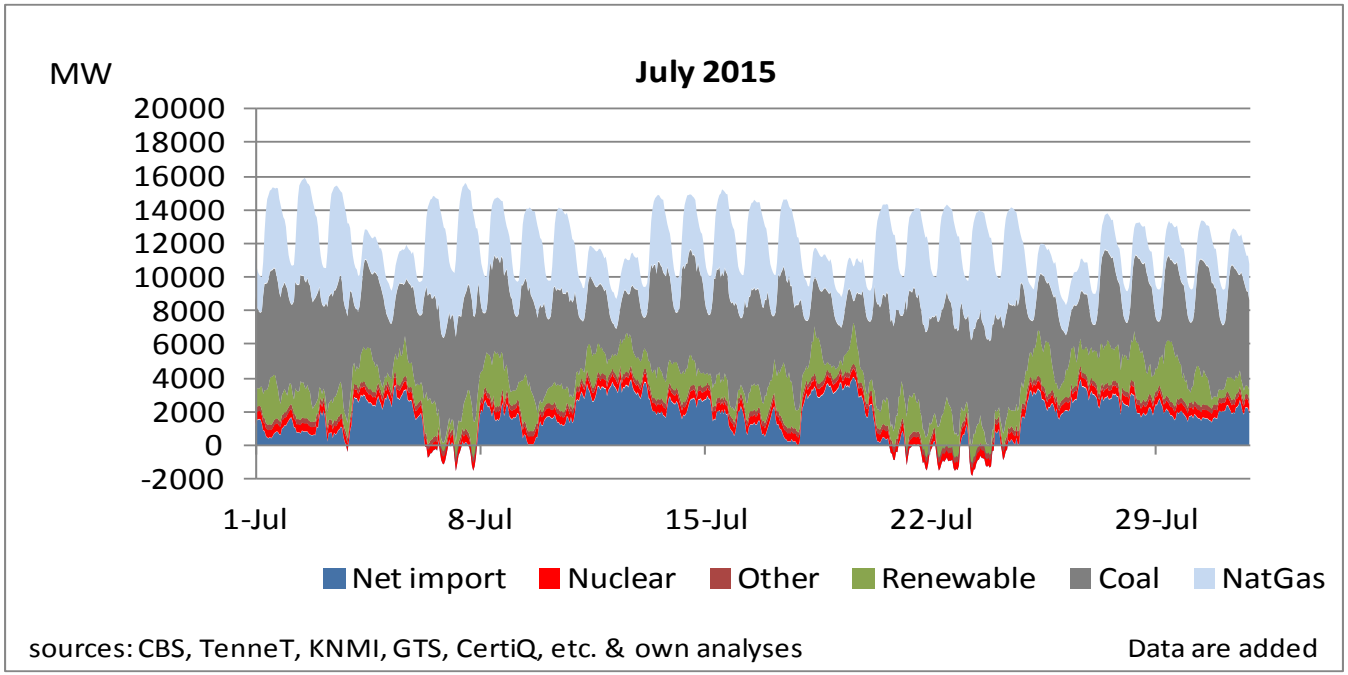
EnTranCe
ENERGY TRANSITION CENTRE



In June, high net imports and high coal utilization squeezed out gas-fired power generation.

Power Generation July2015

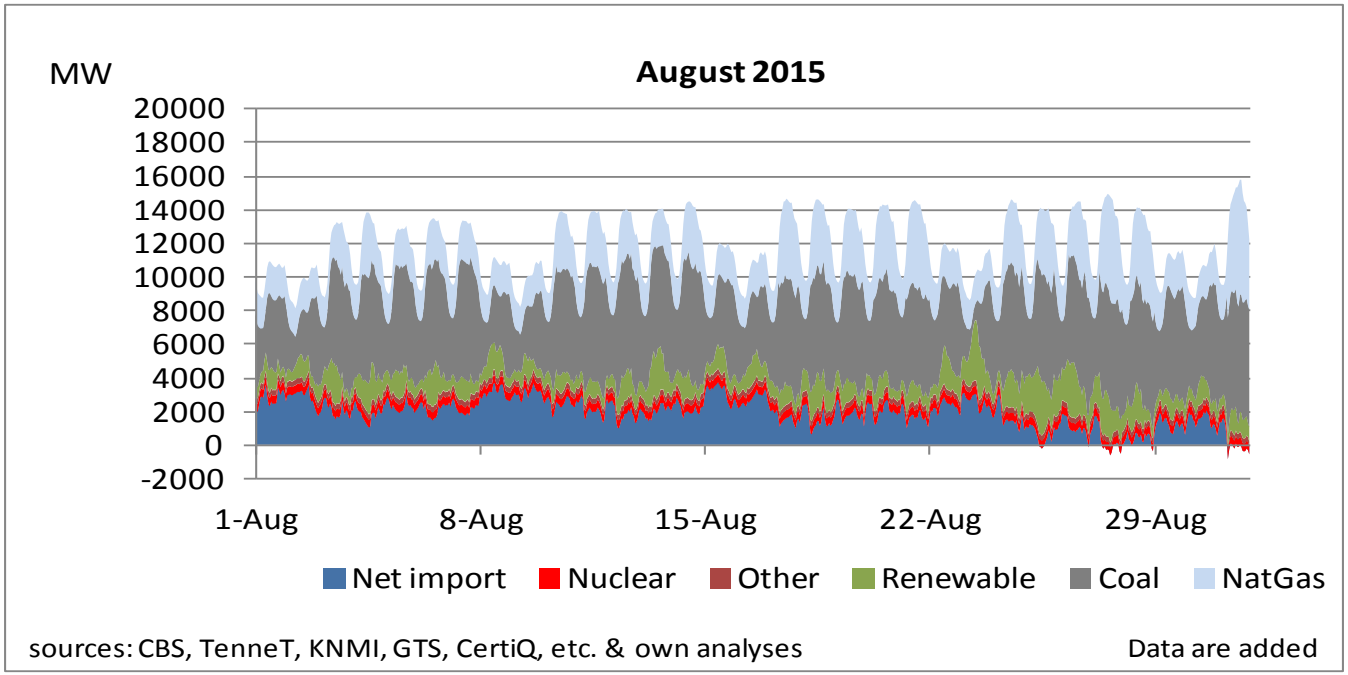
EnTranCe
ENERGY TRANSITION CENTRE



In July, imports were more moderate than in June; consequently, although coal utilization remained high, more gas-fired power generation was registered than in June.

Power Generation August 2015

EnTranCe
ENERGY TRANSITION CENTRE

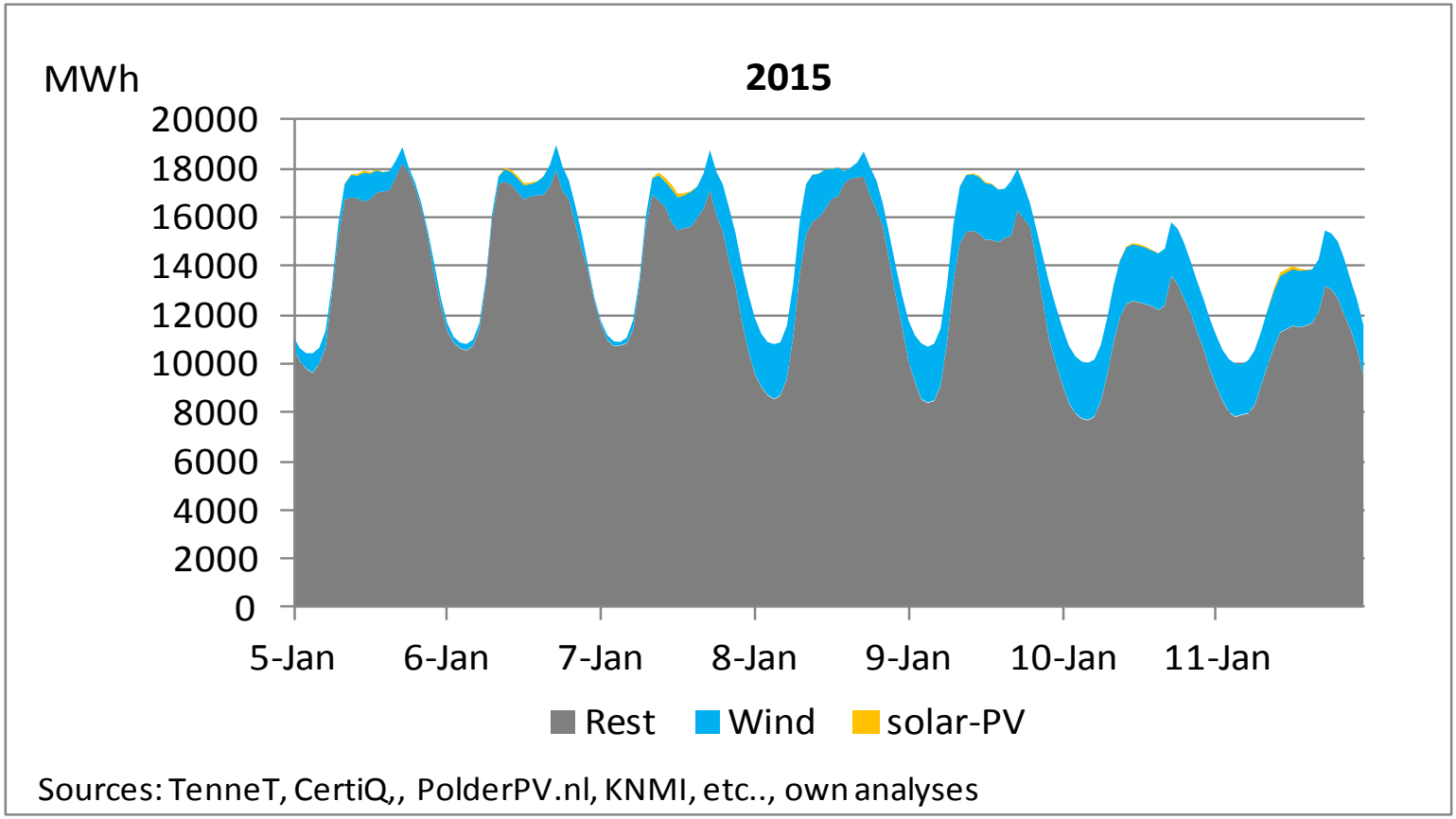


In August, there were a lot of power imports and consequently, not much gas-fired power generation was used.

The following set of slides presents for each week in 2015 the hourly contributions of wind and solar-PV to the total power consumption in The Netherlands.

Hourly Solar-PV and Wind Generation 2015

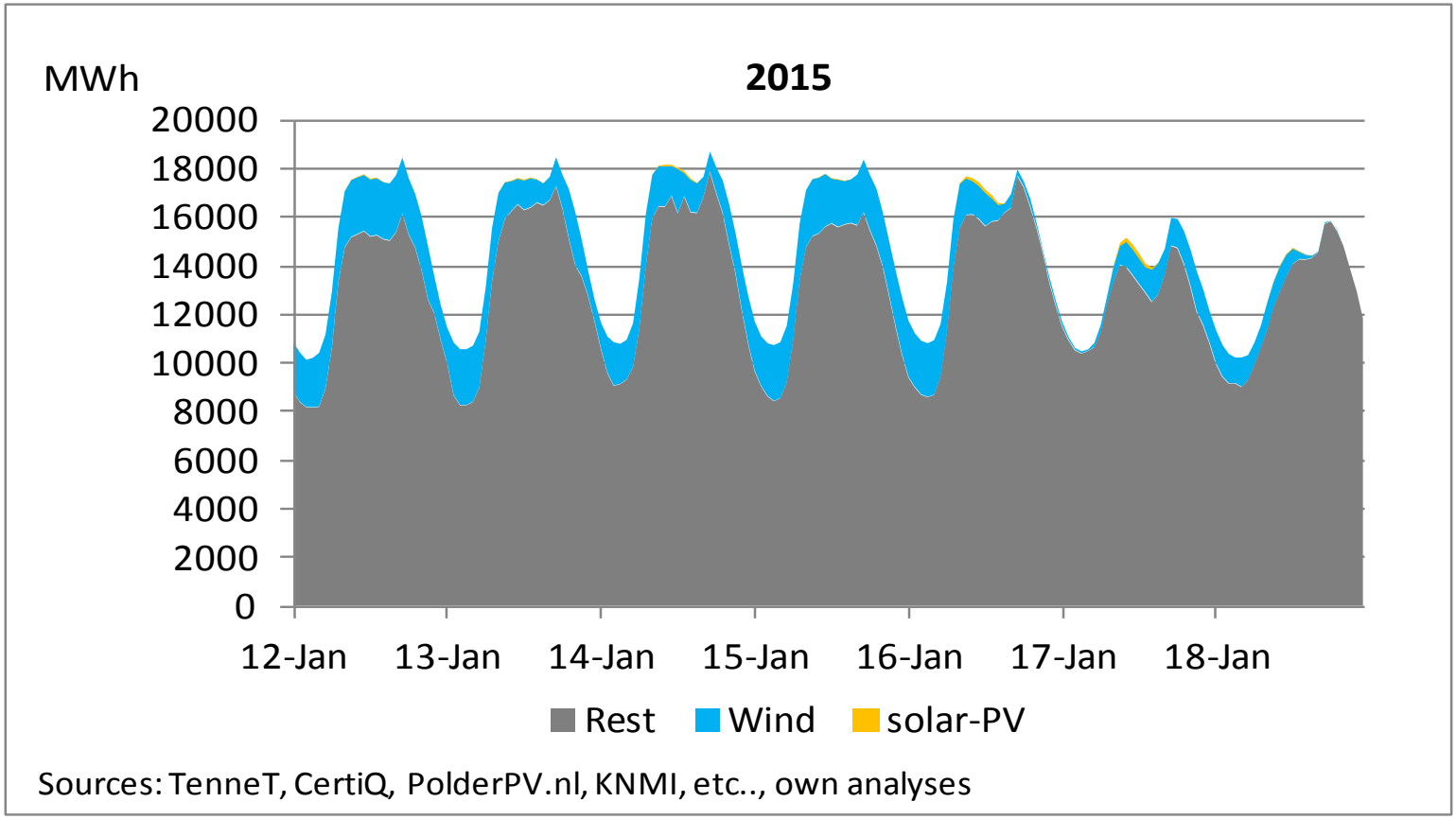
EnTranCe
ENERGY TRANSITION CENTRE



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

Hourly Solar-PV and Wind Generation 2015

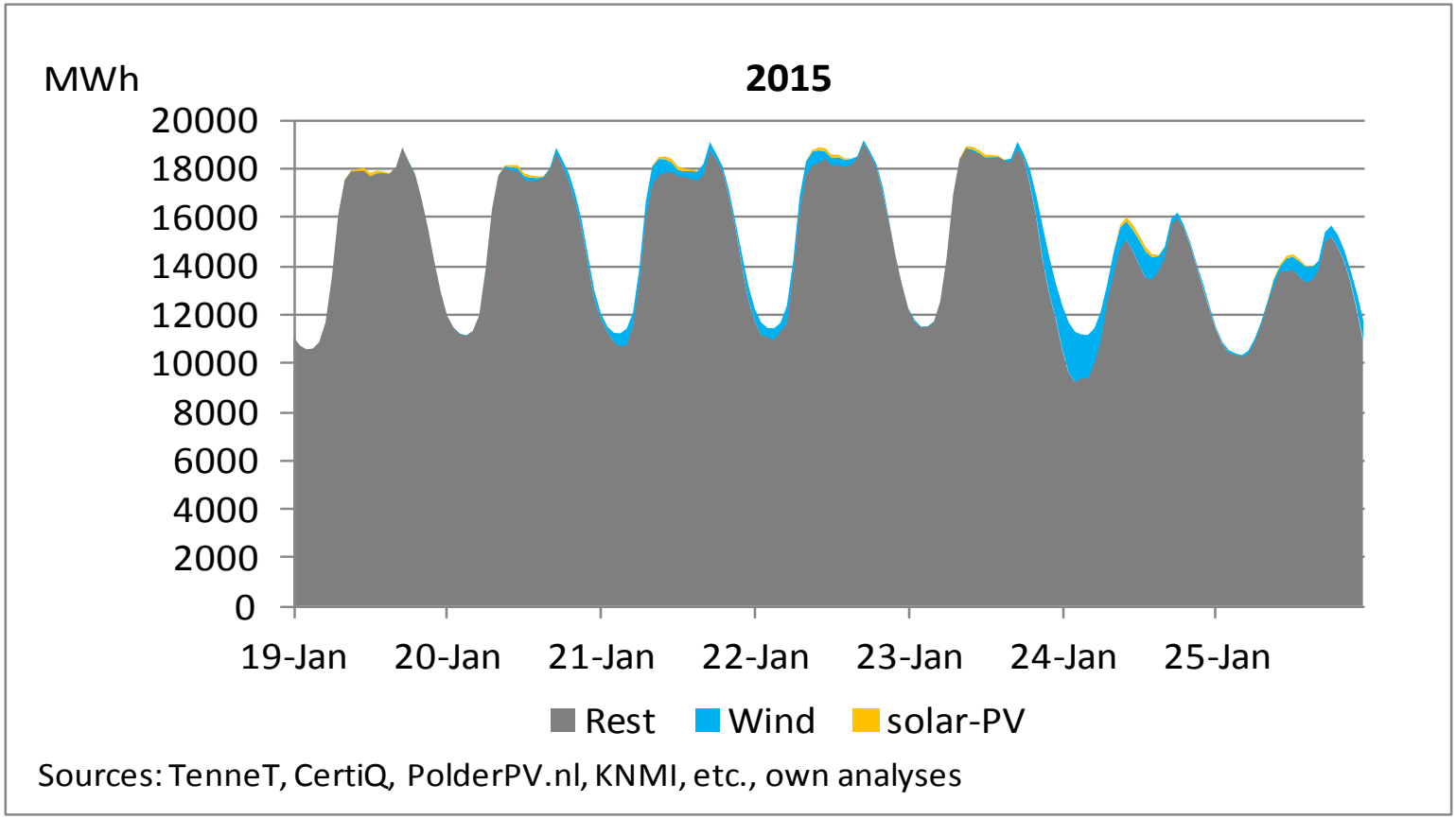
EnTranCe
ENERGY TRANSITION CENTRE



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

Hourly Solar-PV and Wind Generation 2015

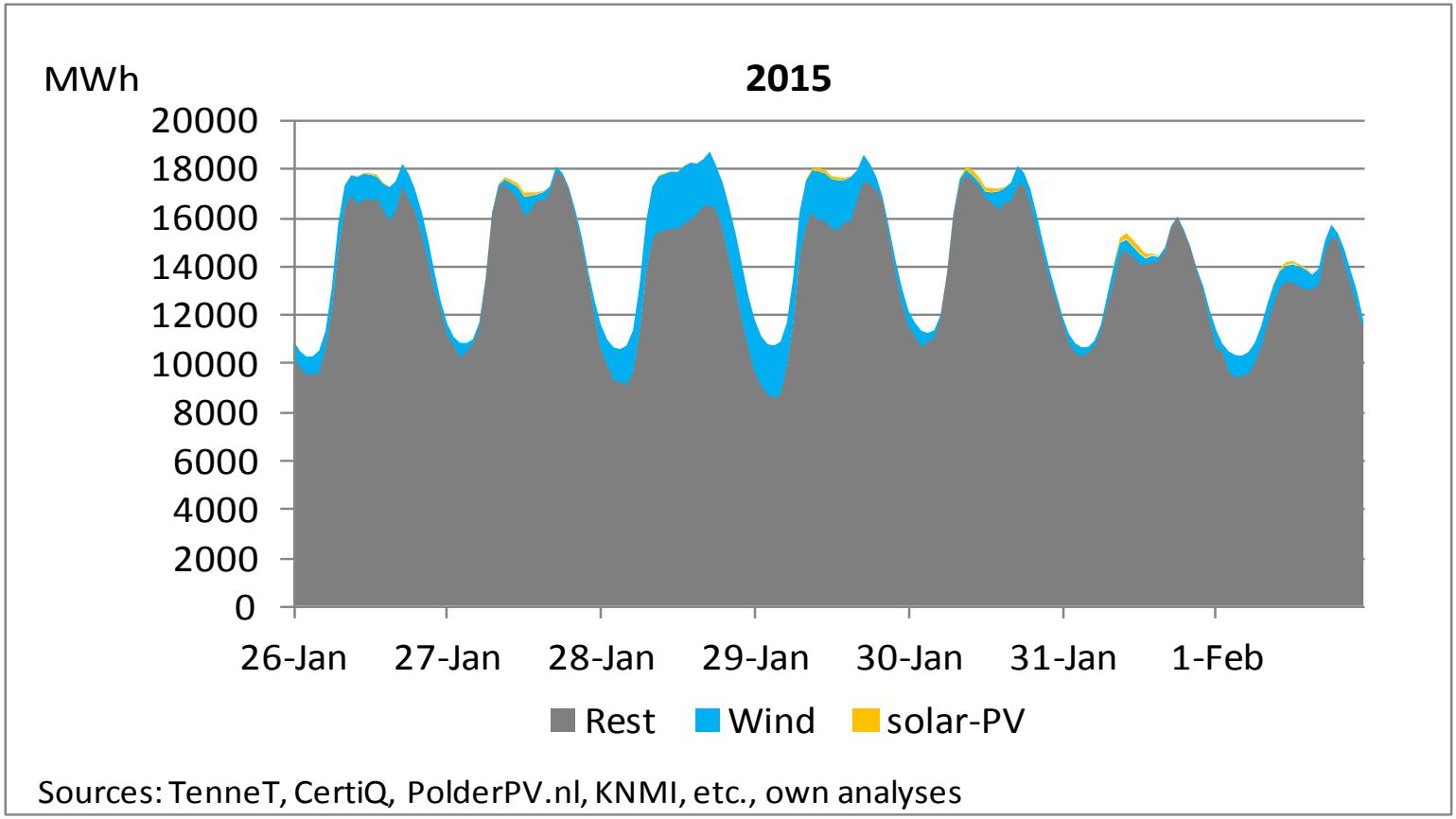
EnTranCe
ENERGY TRANSITION CENTRE



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

Hourly Solar-PV and Wind Generation 2015

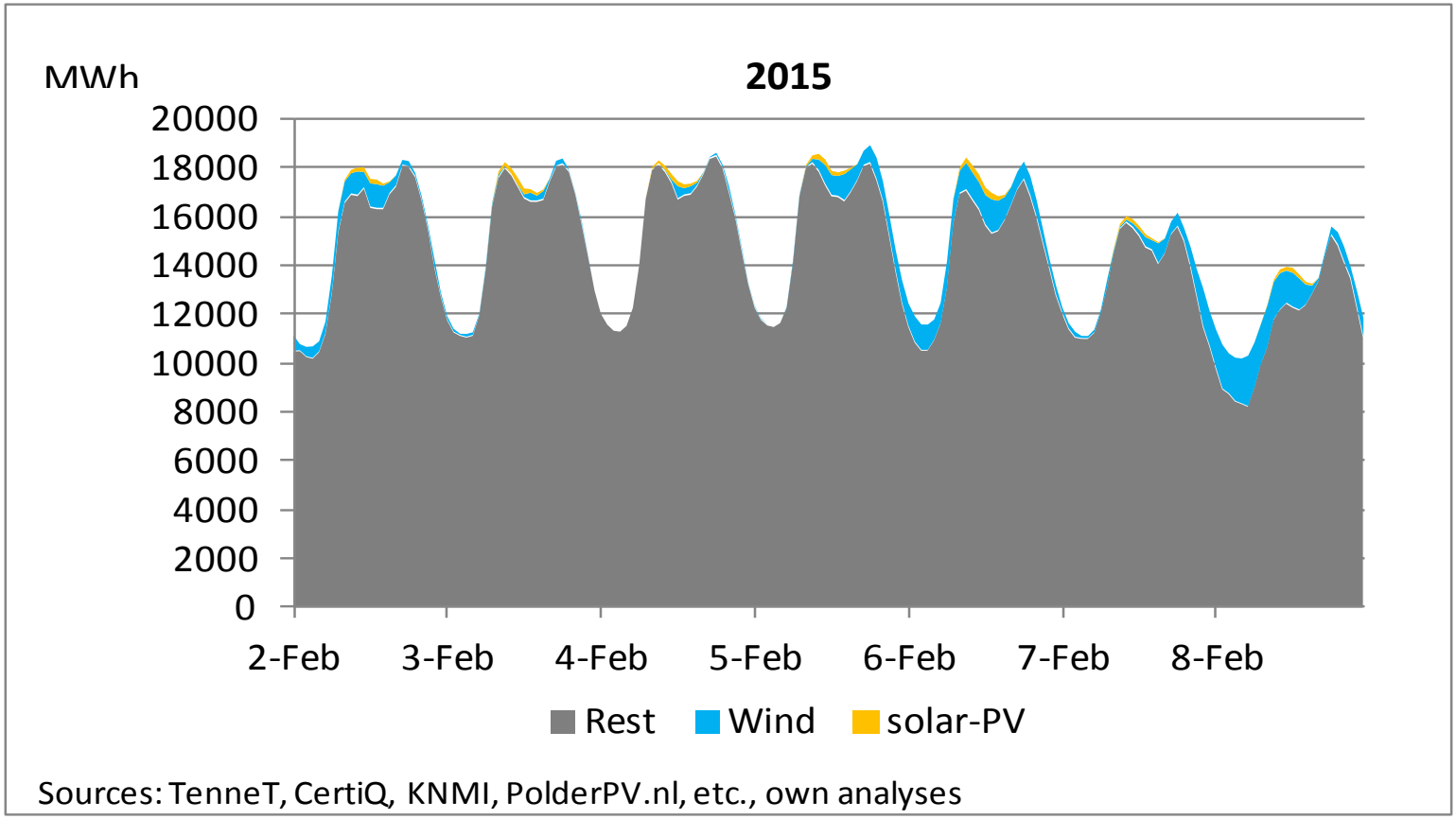
EnTranCe
ENERGY TRANSITION CENTRE



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

Hourly Solar-PV and Wind Generation 2015

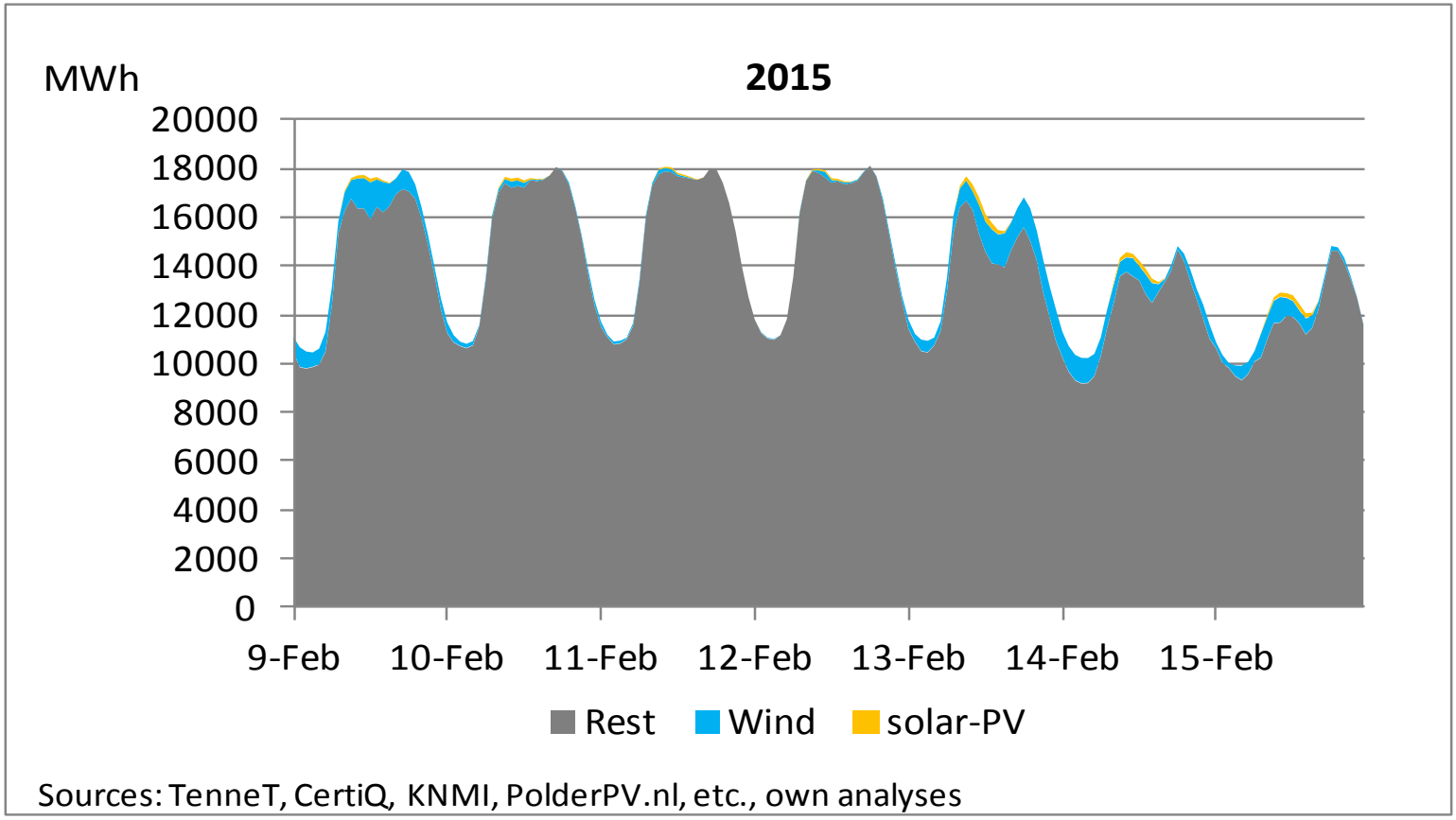
EnTranCe
ENERGY TRANSITION CENTRE



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

Hourly Solar-PV and Wind Generation 2015

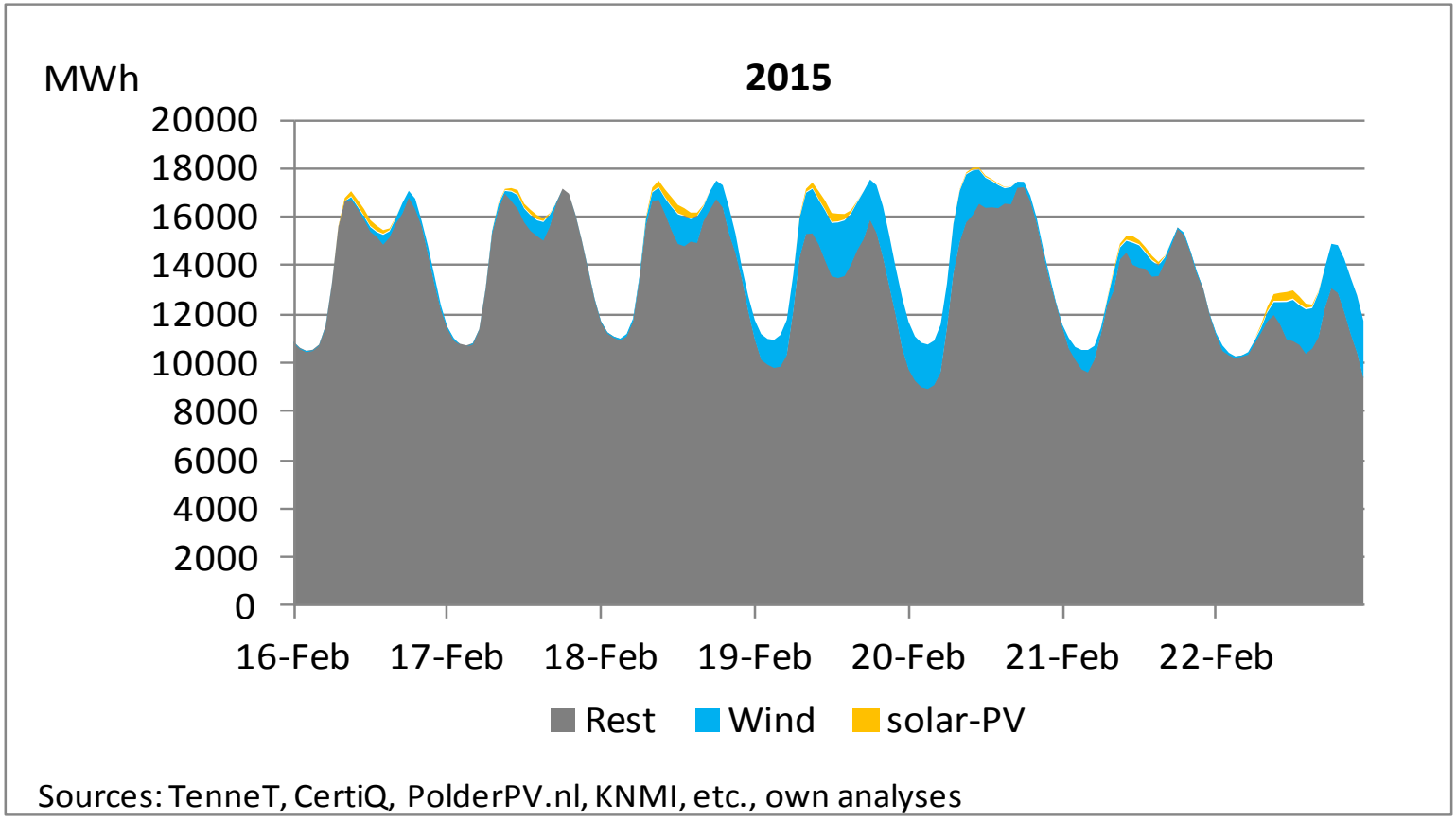
EnTranCe
ENERGY TRANSITION CENTRE



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

Hourly Solar-PV and Wind Generation 2015

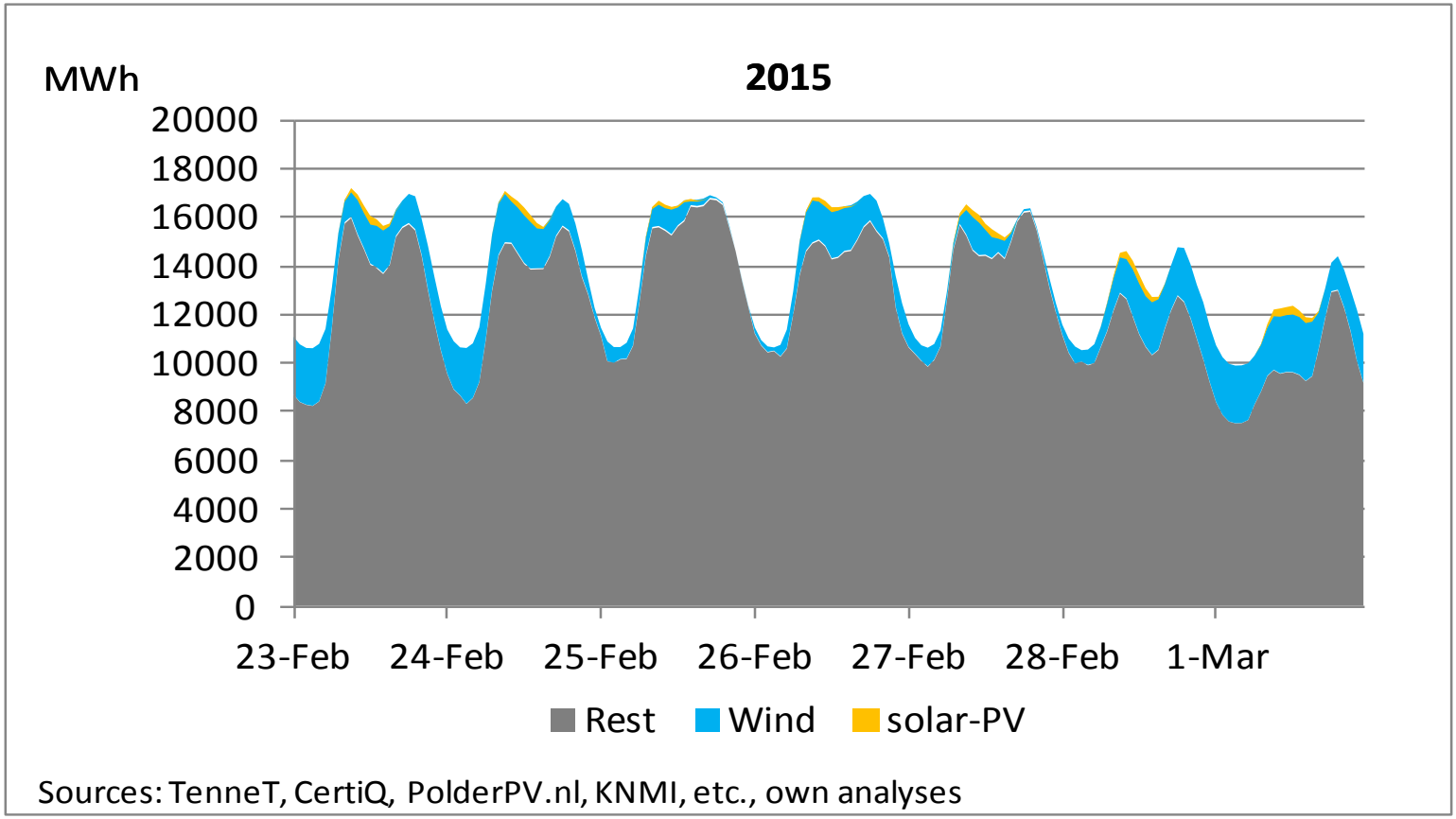
EnTranCe
ENERGY TRANSITION CENTRE



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

Hourly Solar-PV and Wind Generation 2015

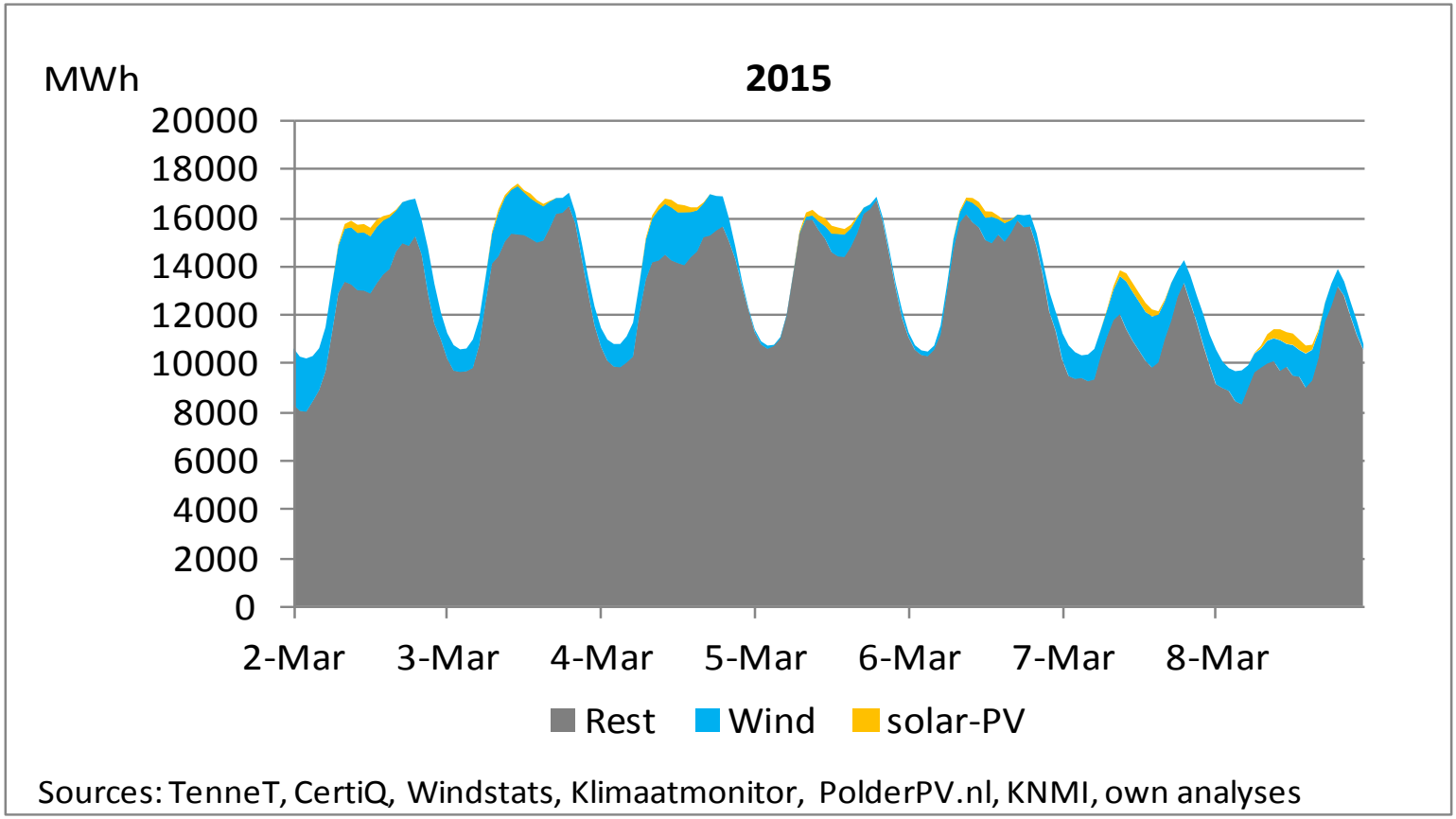
EnTranCe
ENERGY TRANSITION CENTRE



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

Hourly Solar-PV and Wind Generation 2015

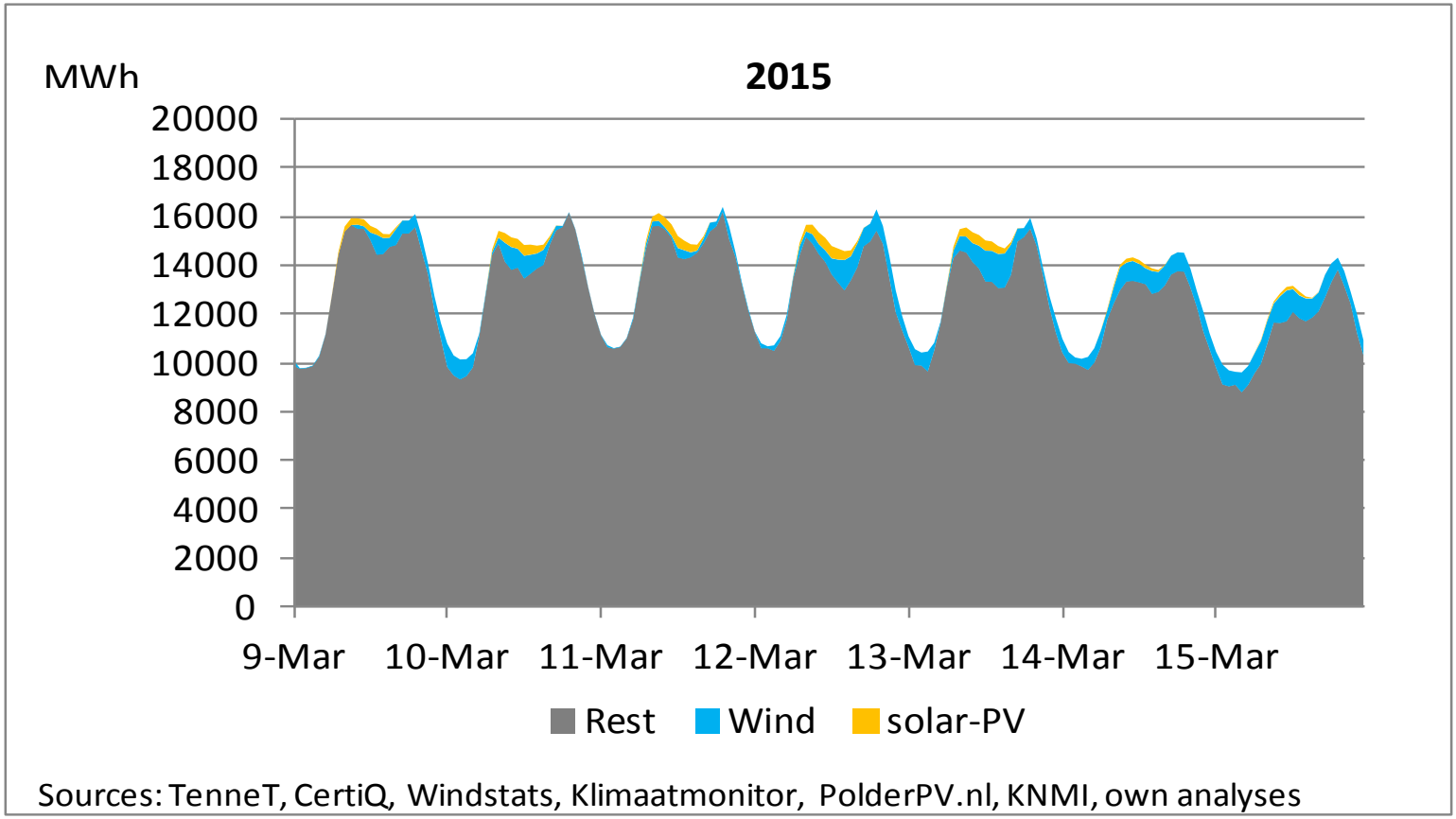
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

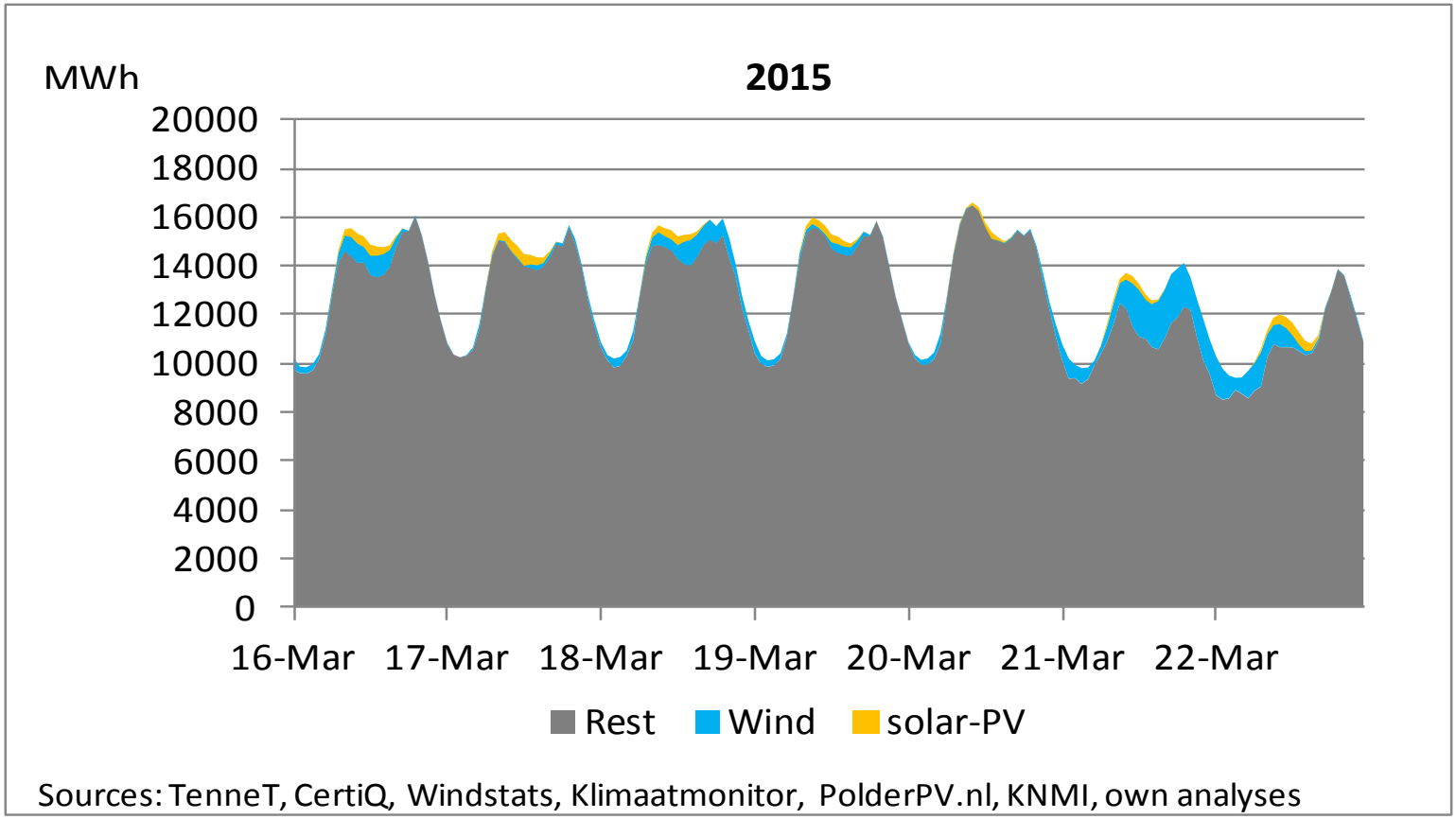
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

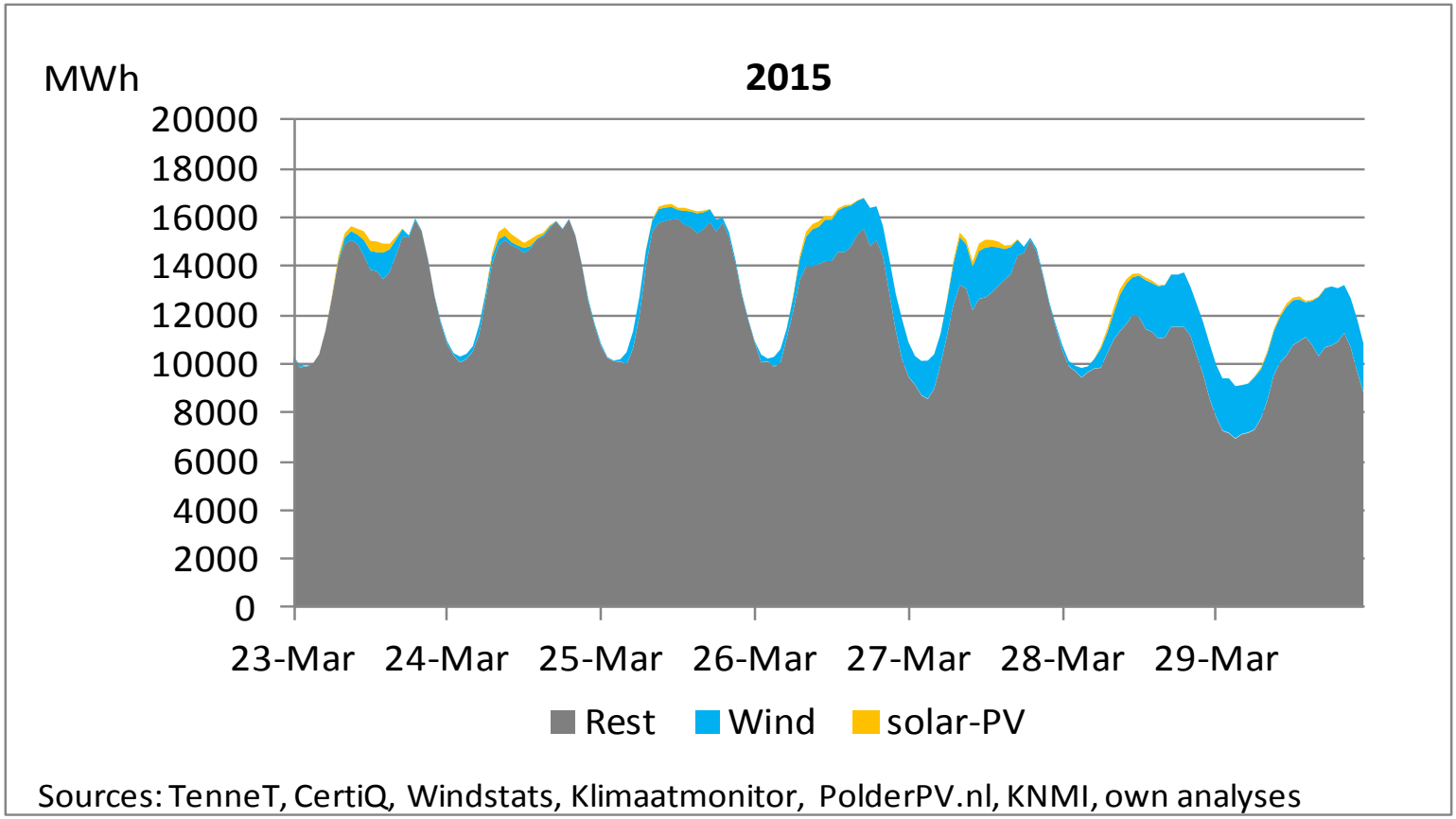
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

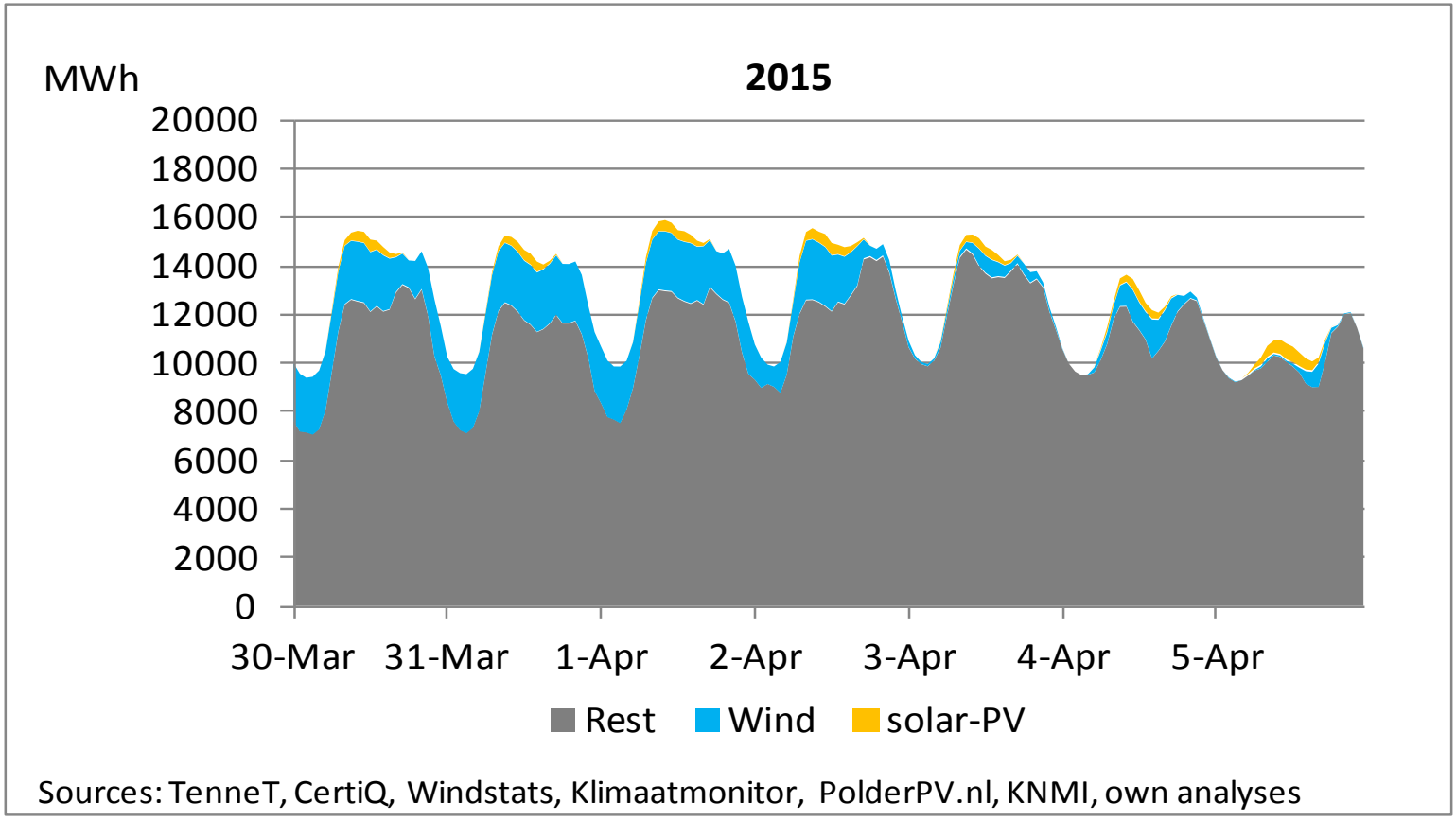
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

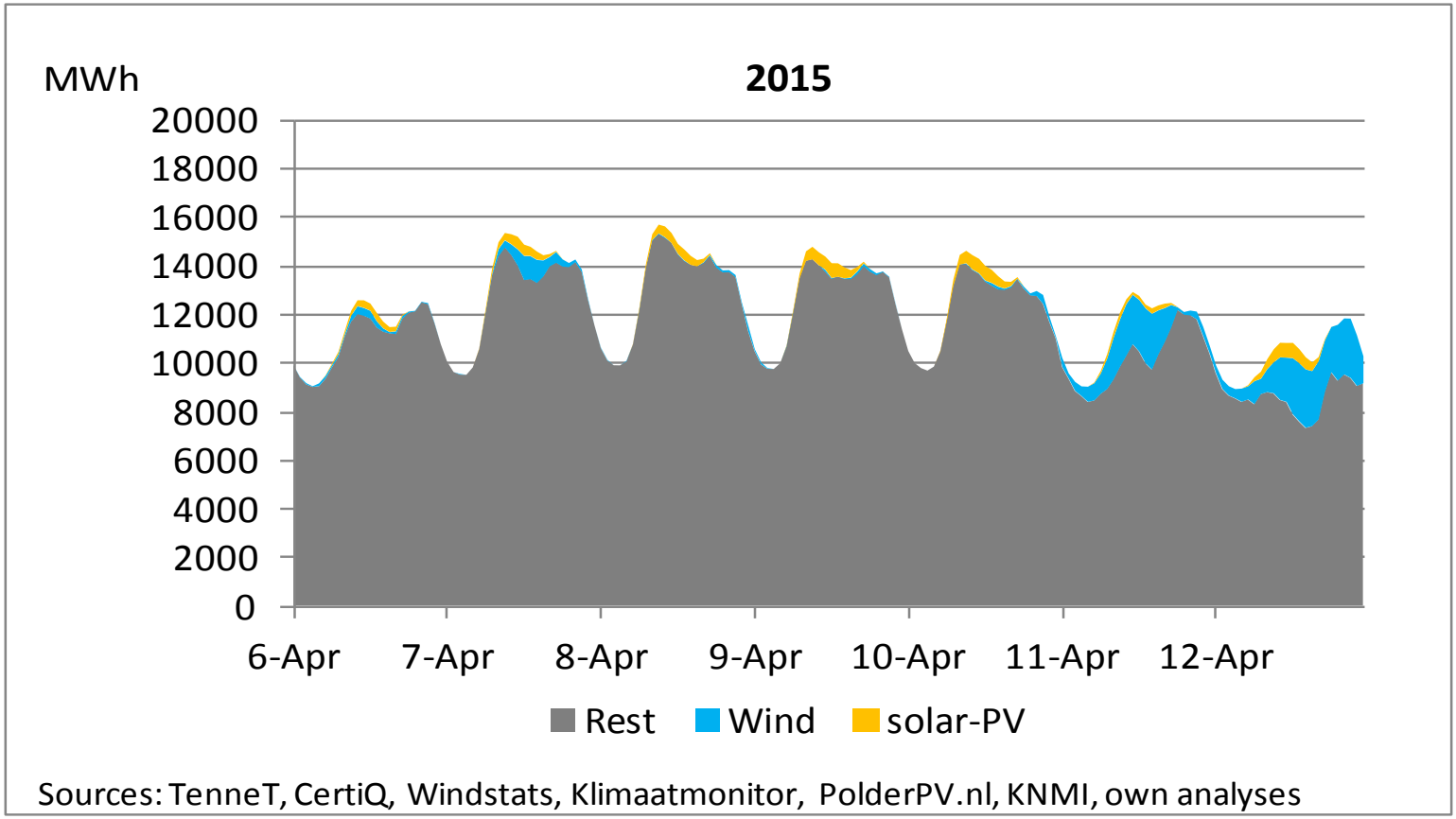
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

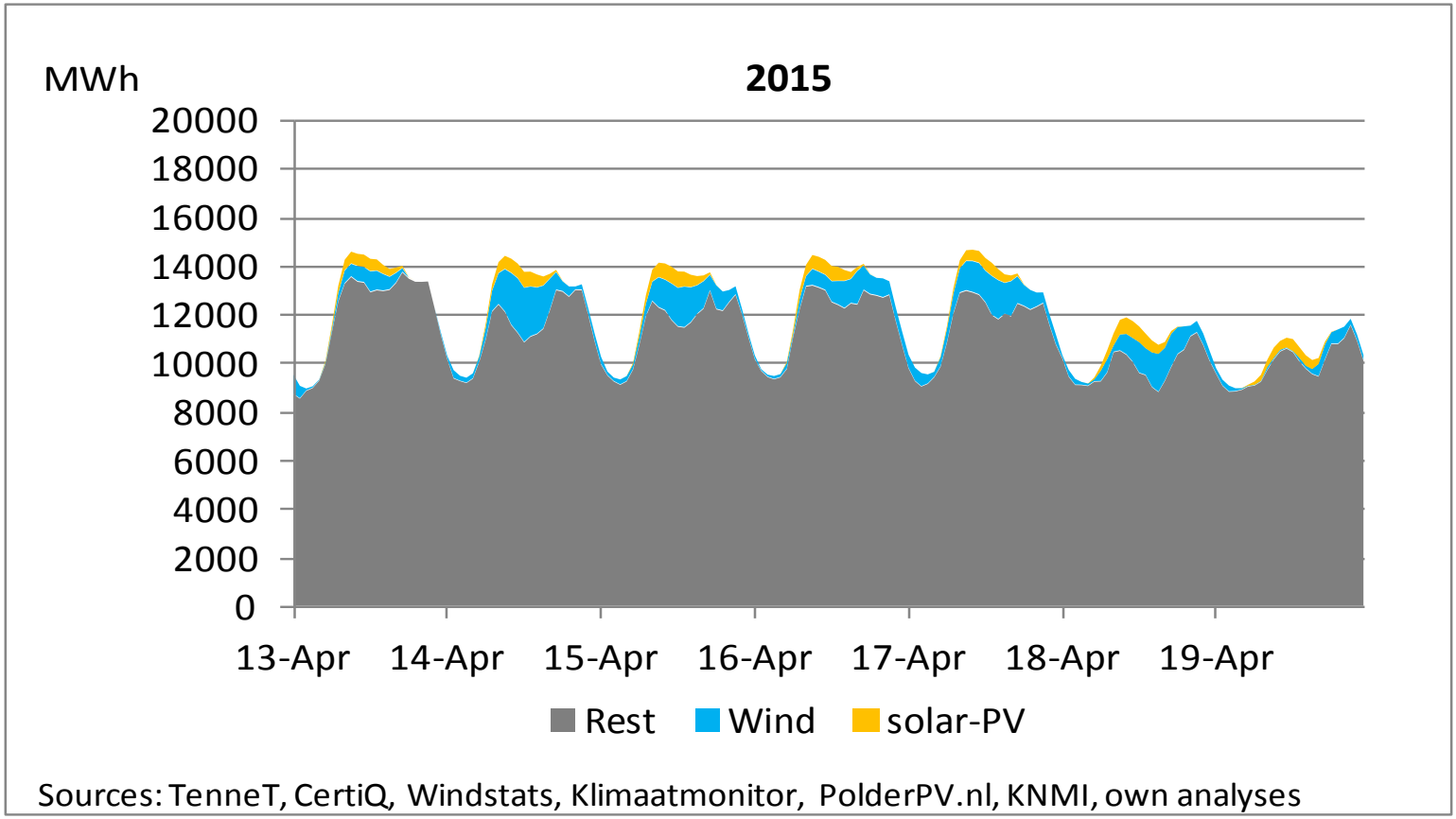
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

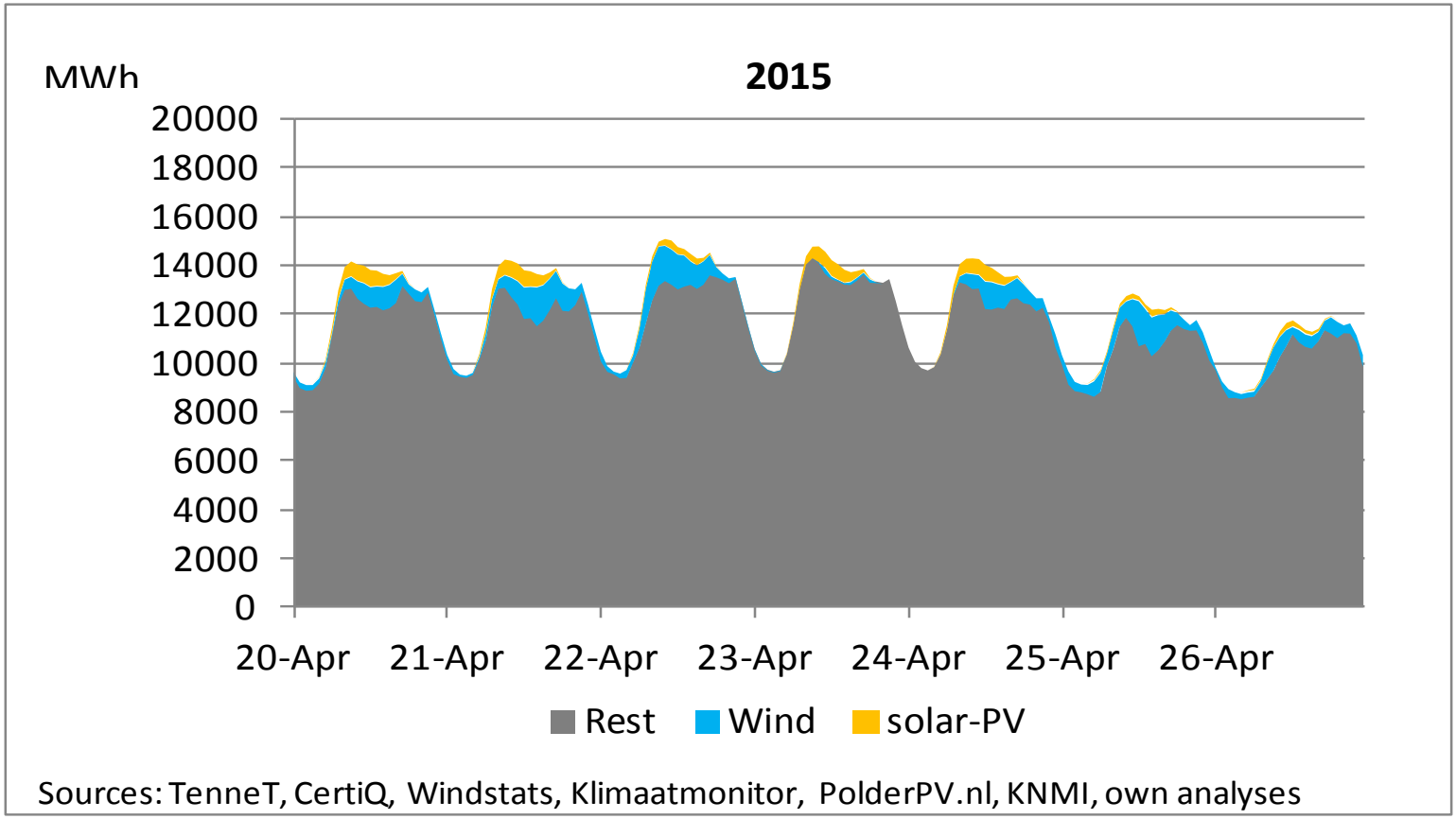
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

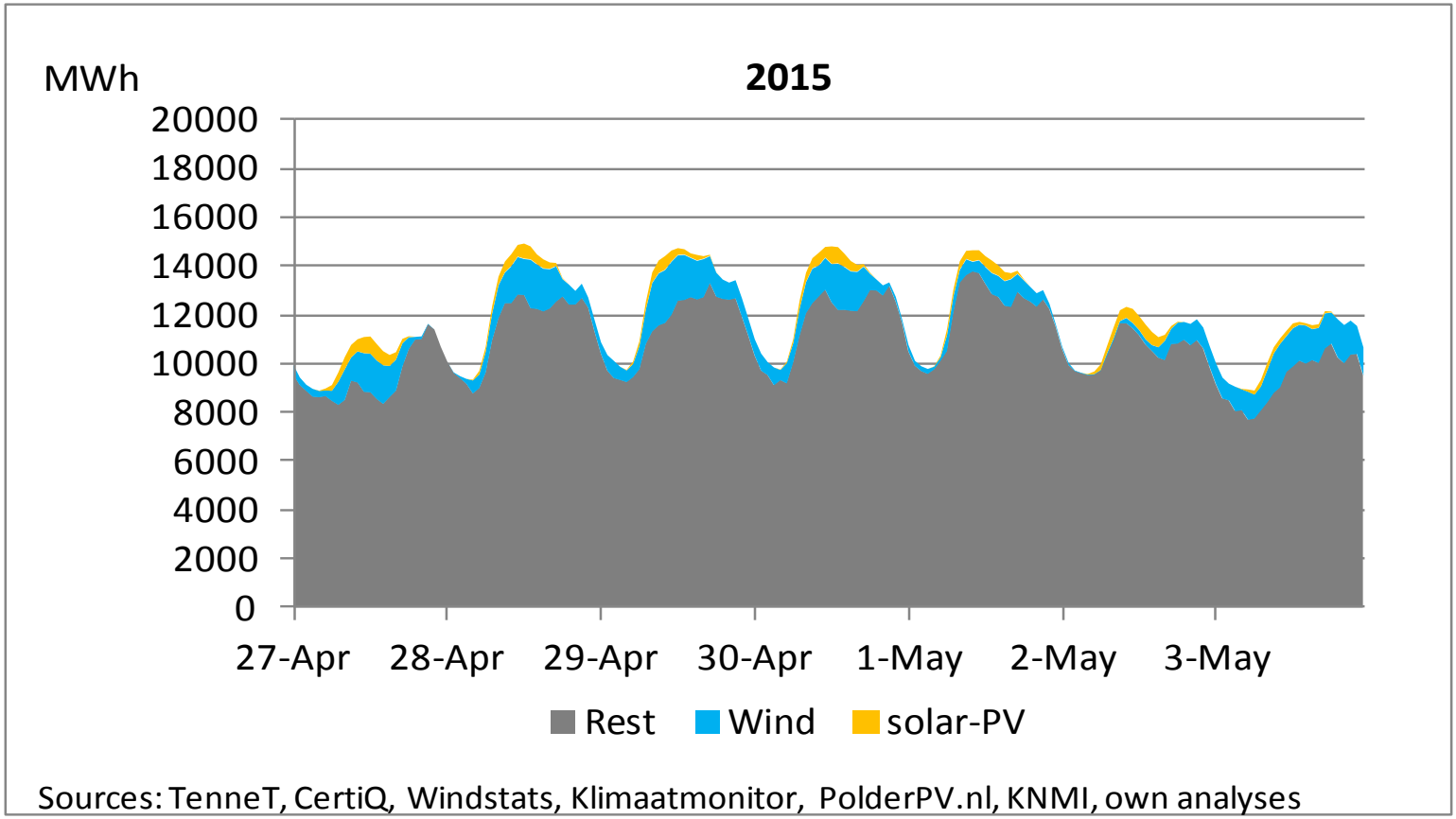
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

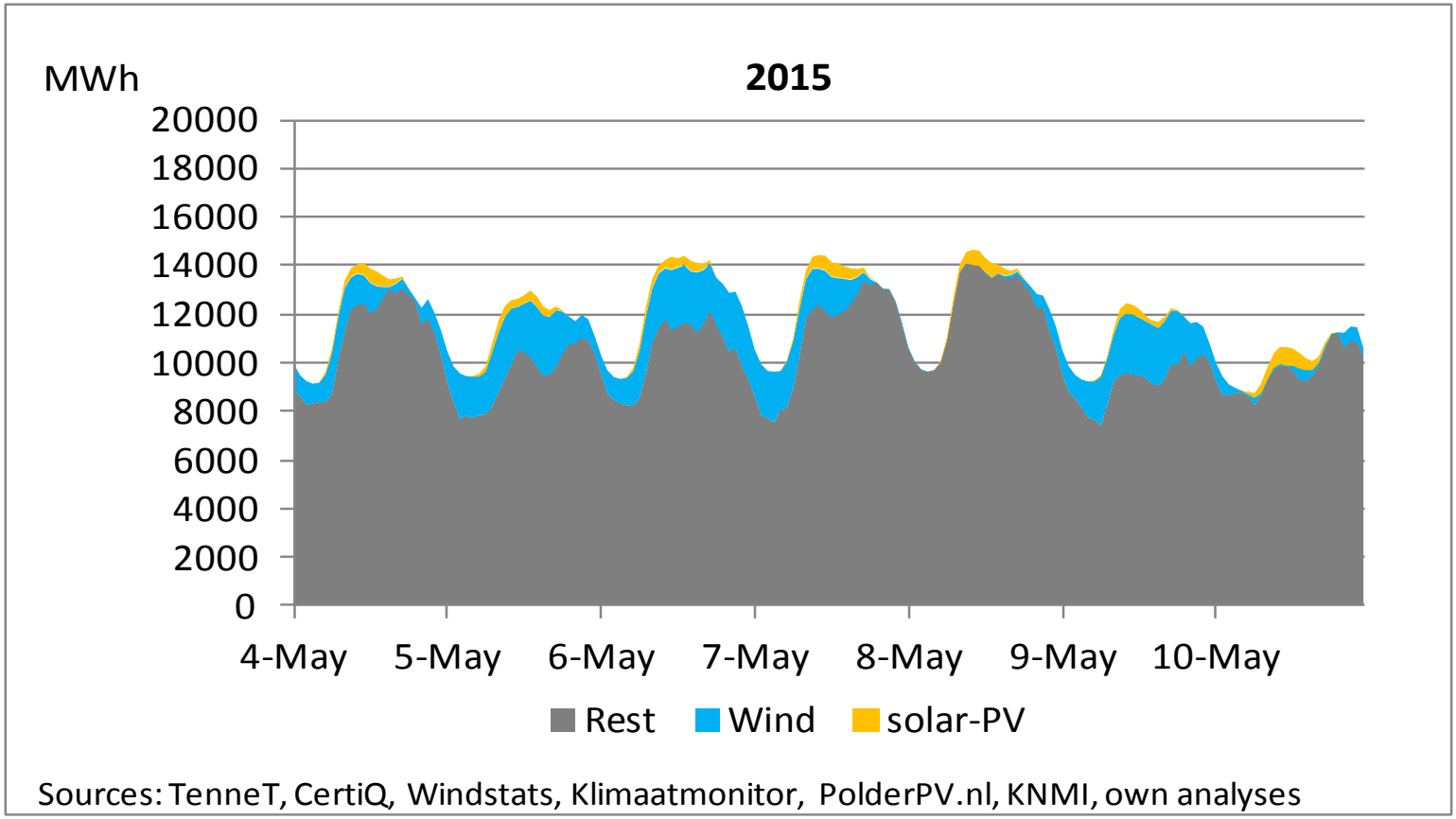
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

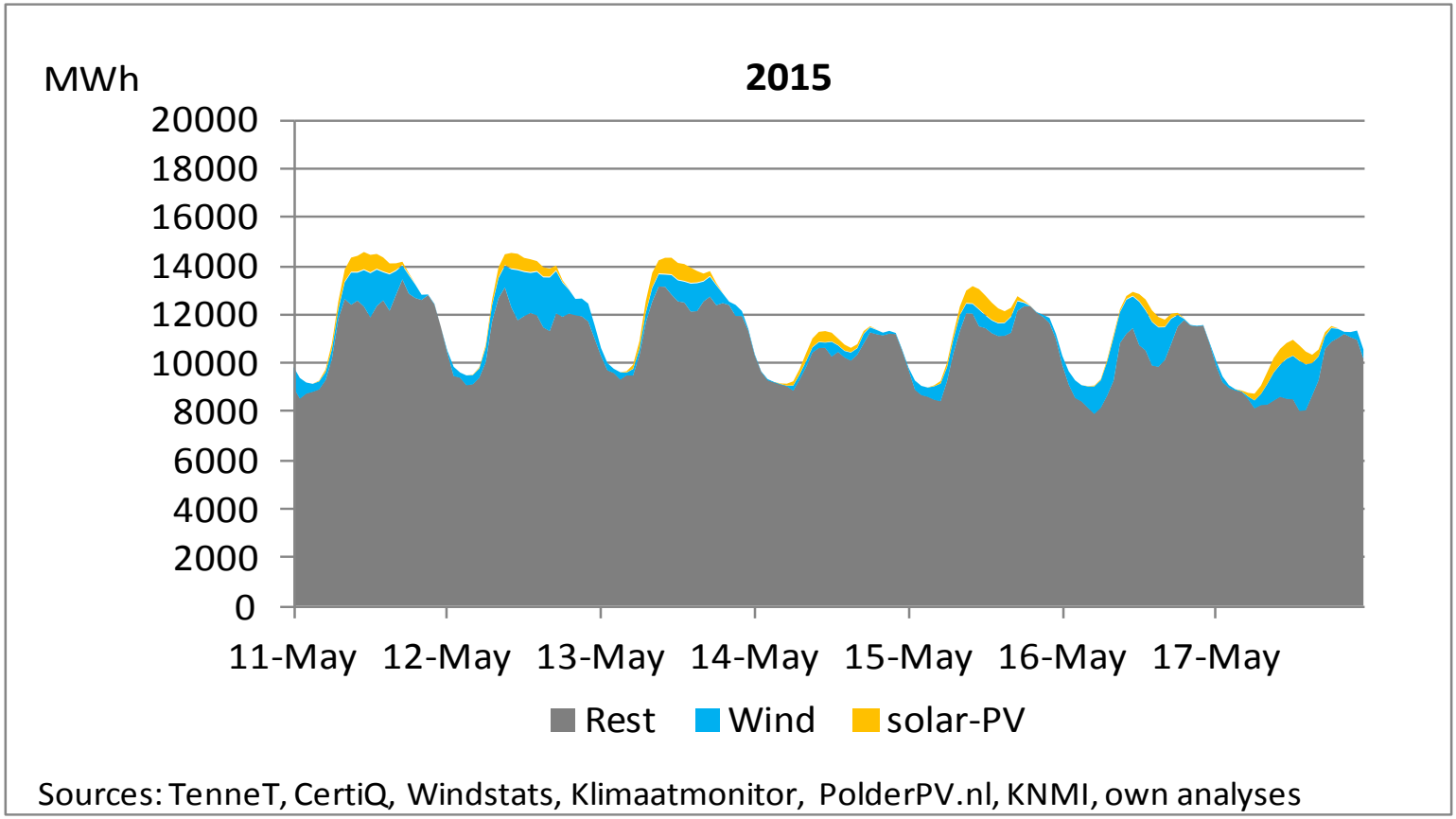
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

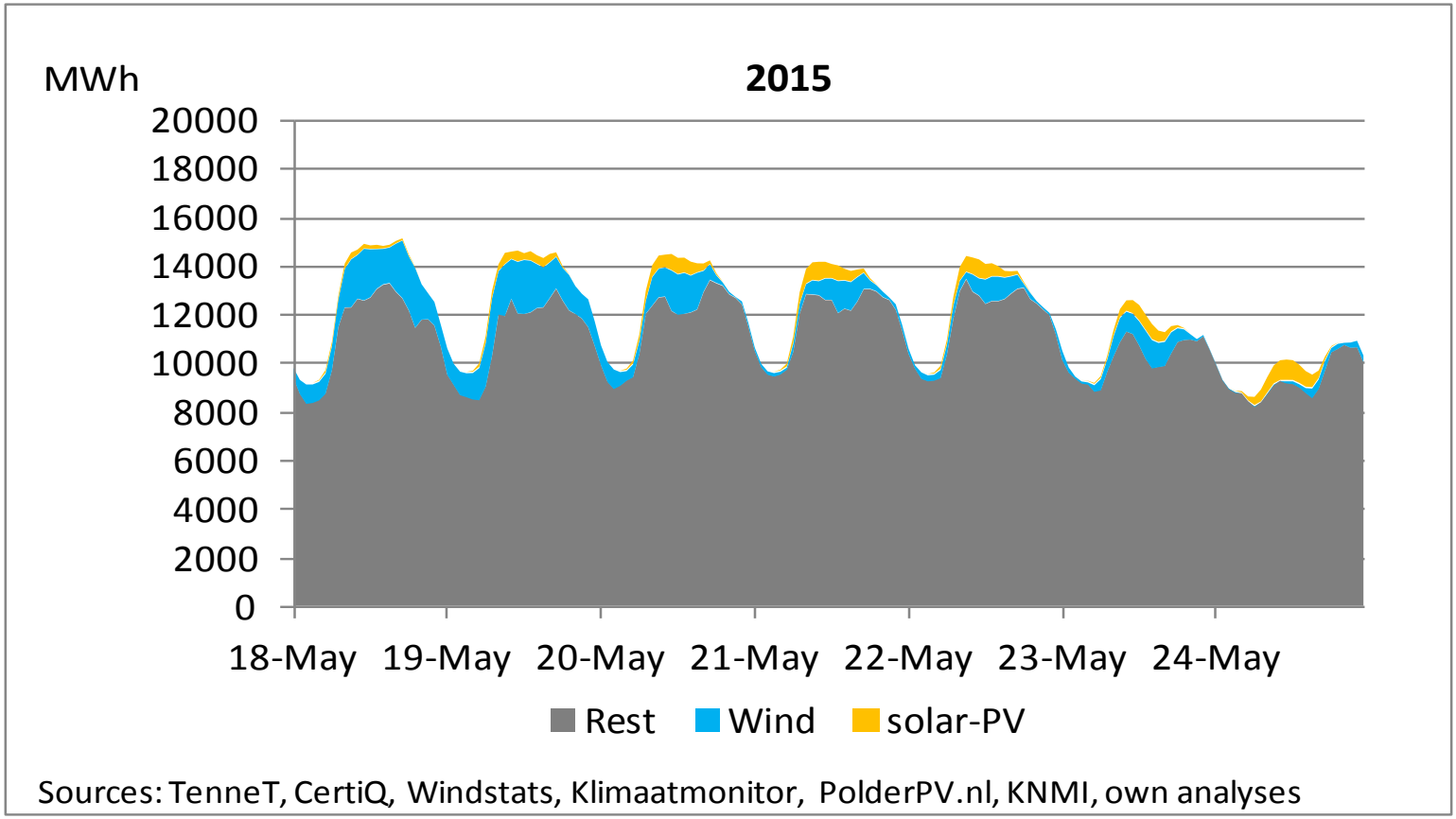
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

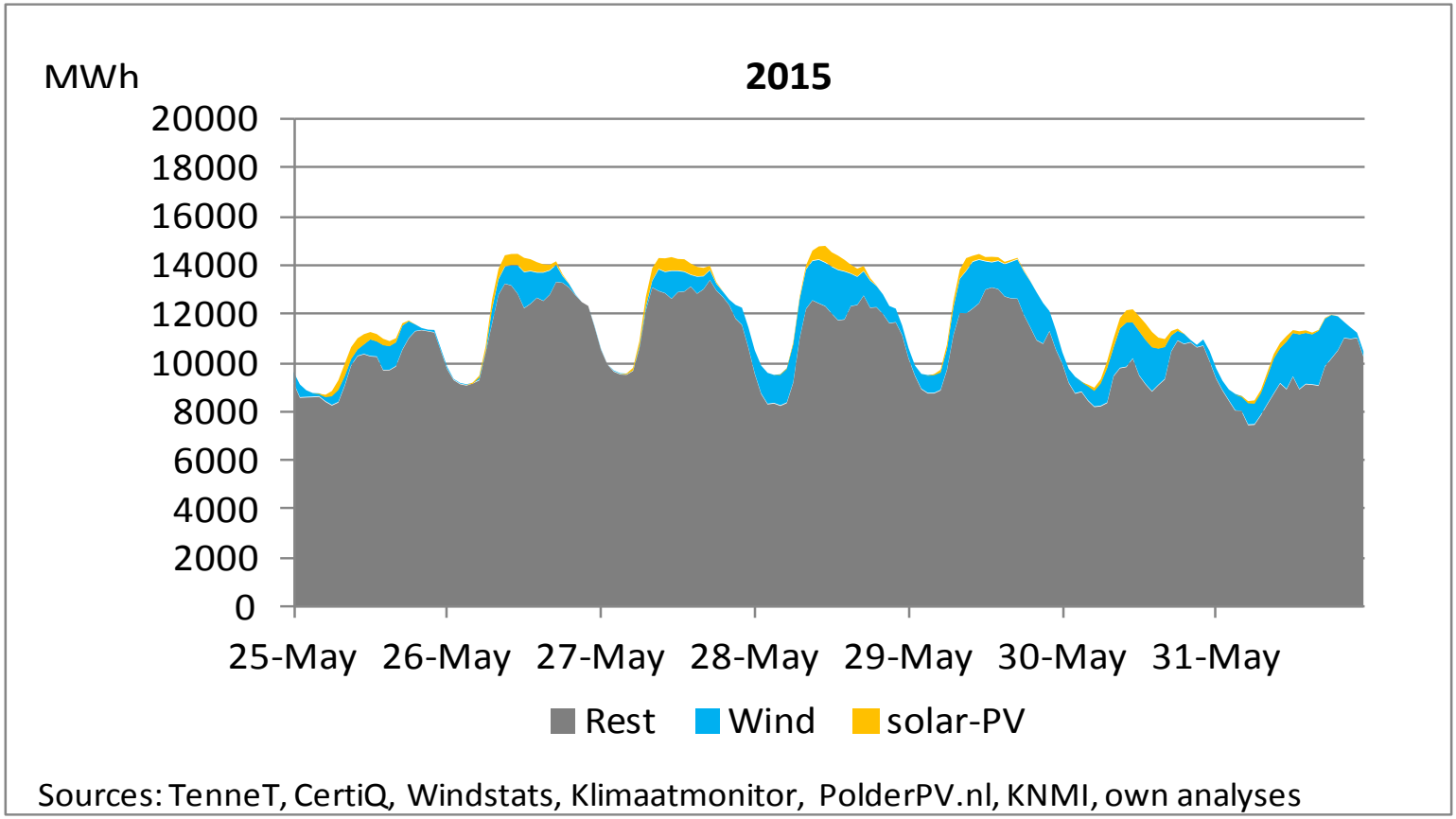
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

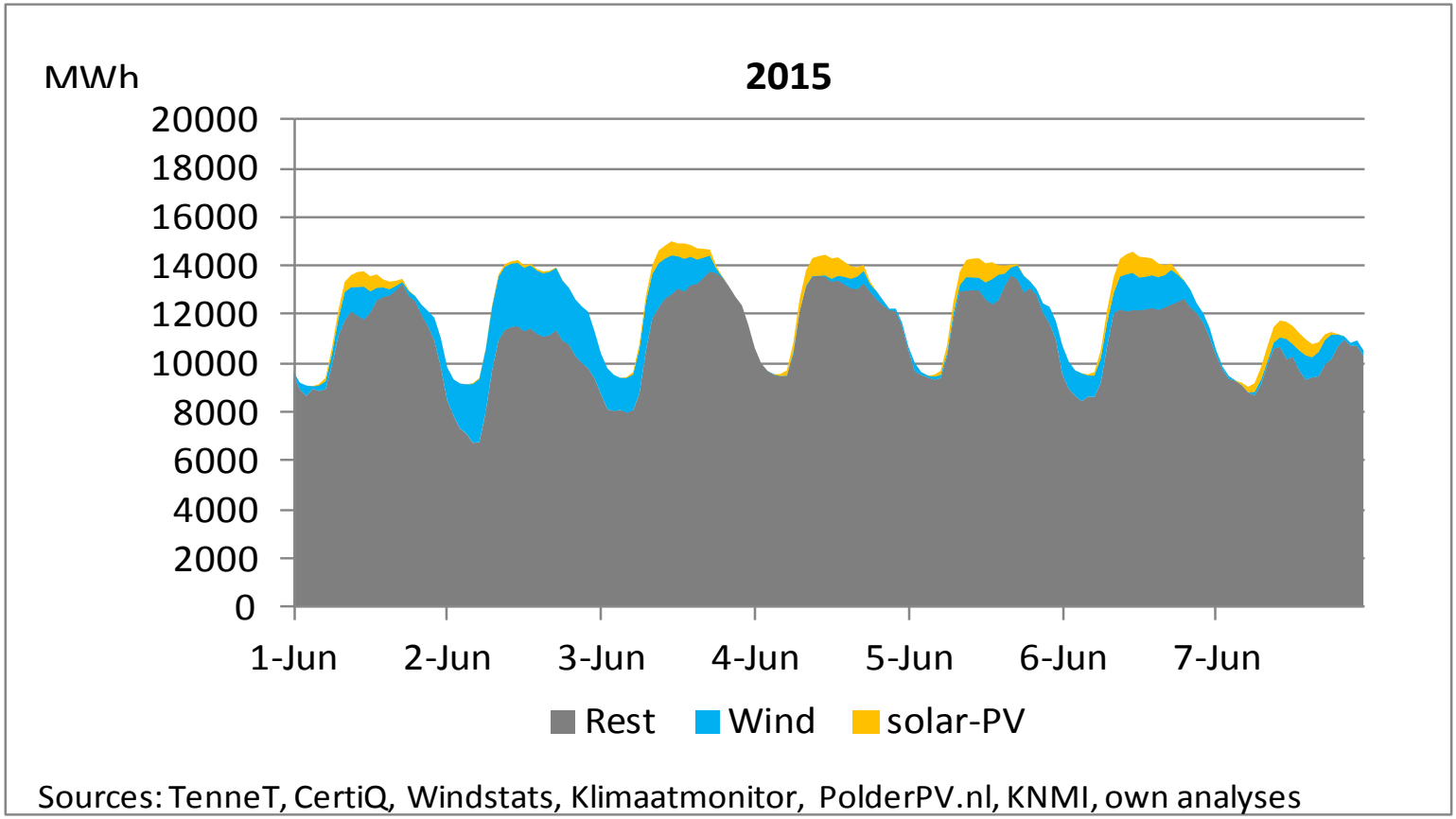
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

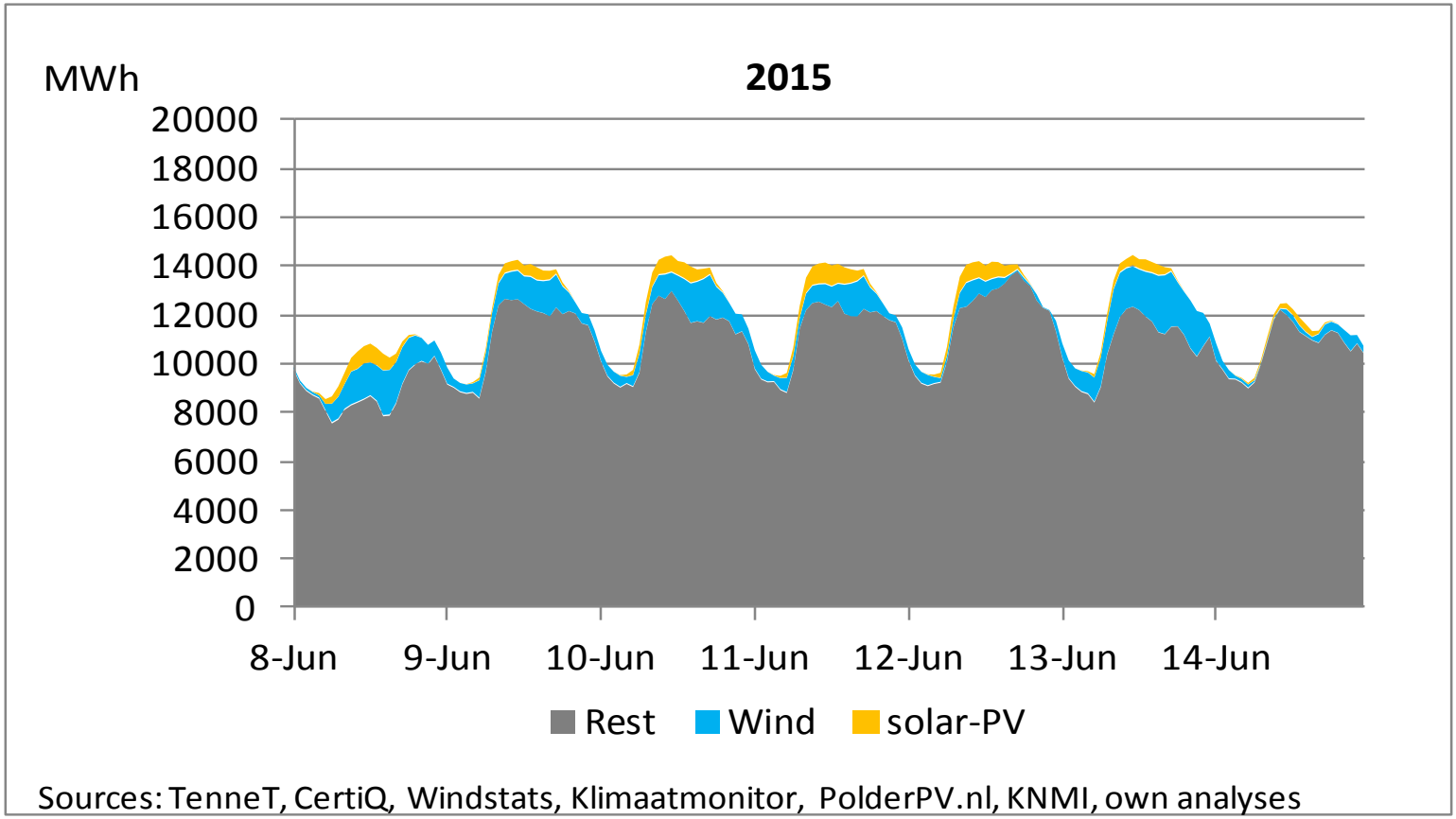
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

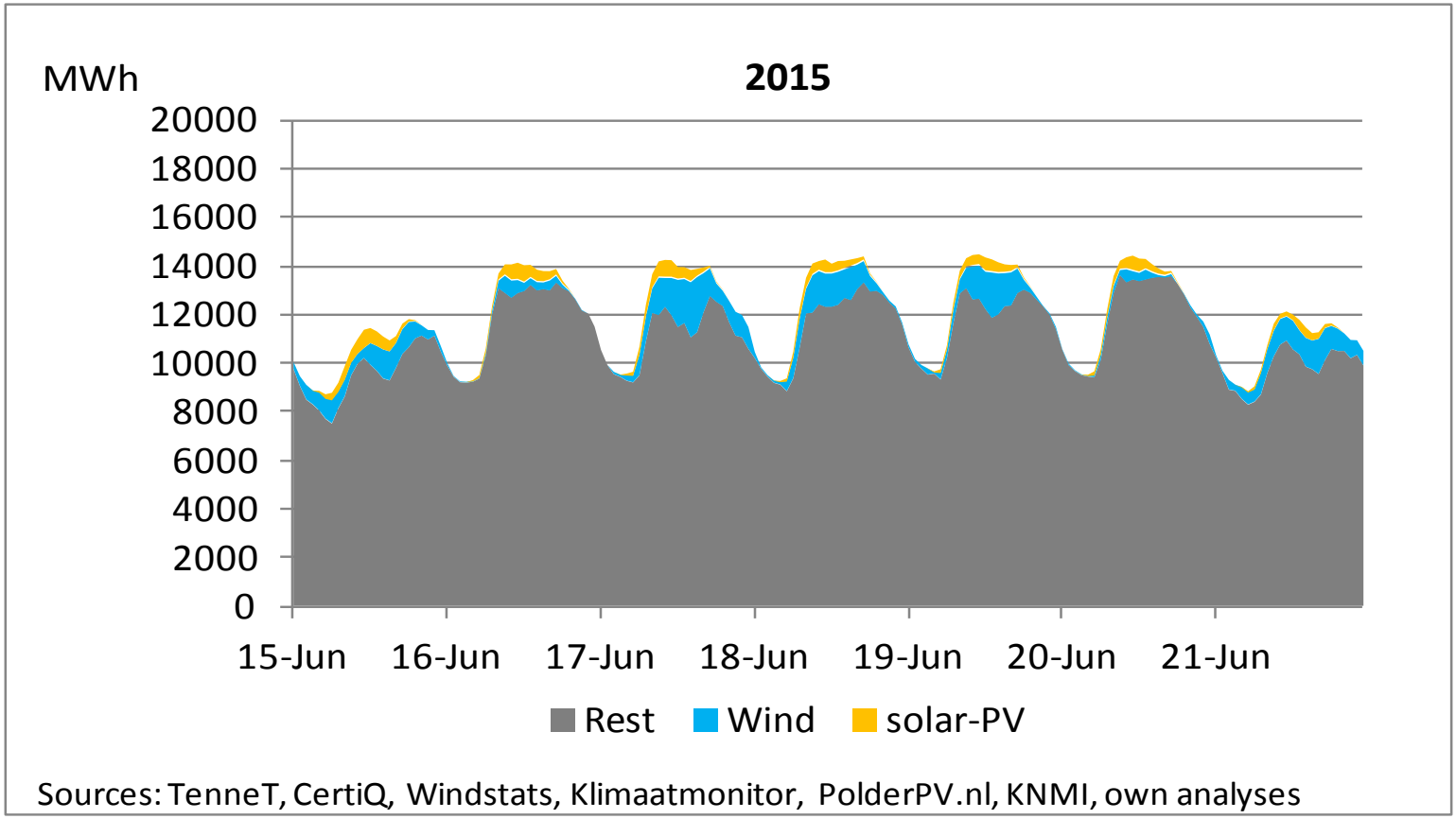
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

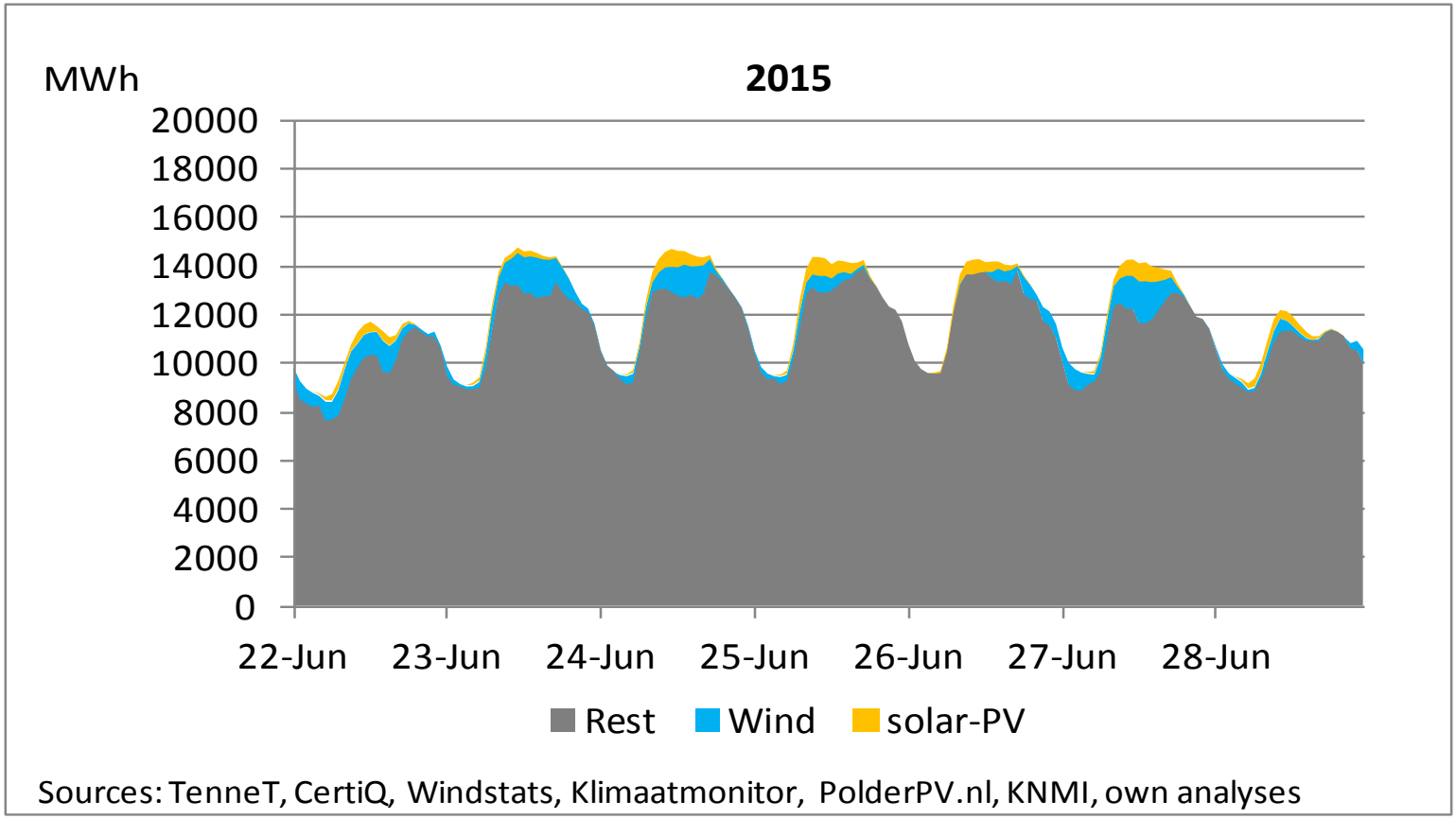
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

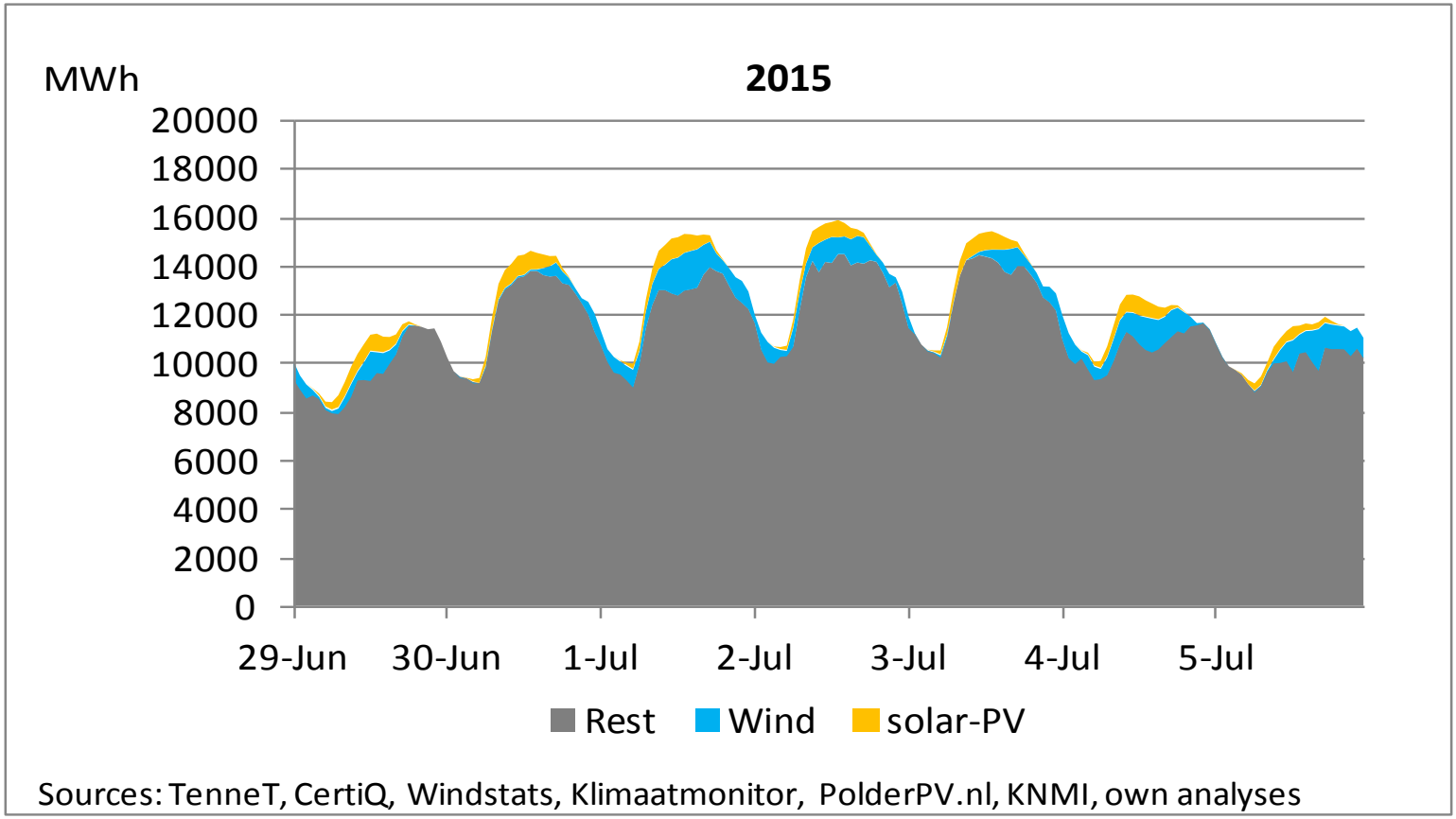
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

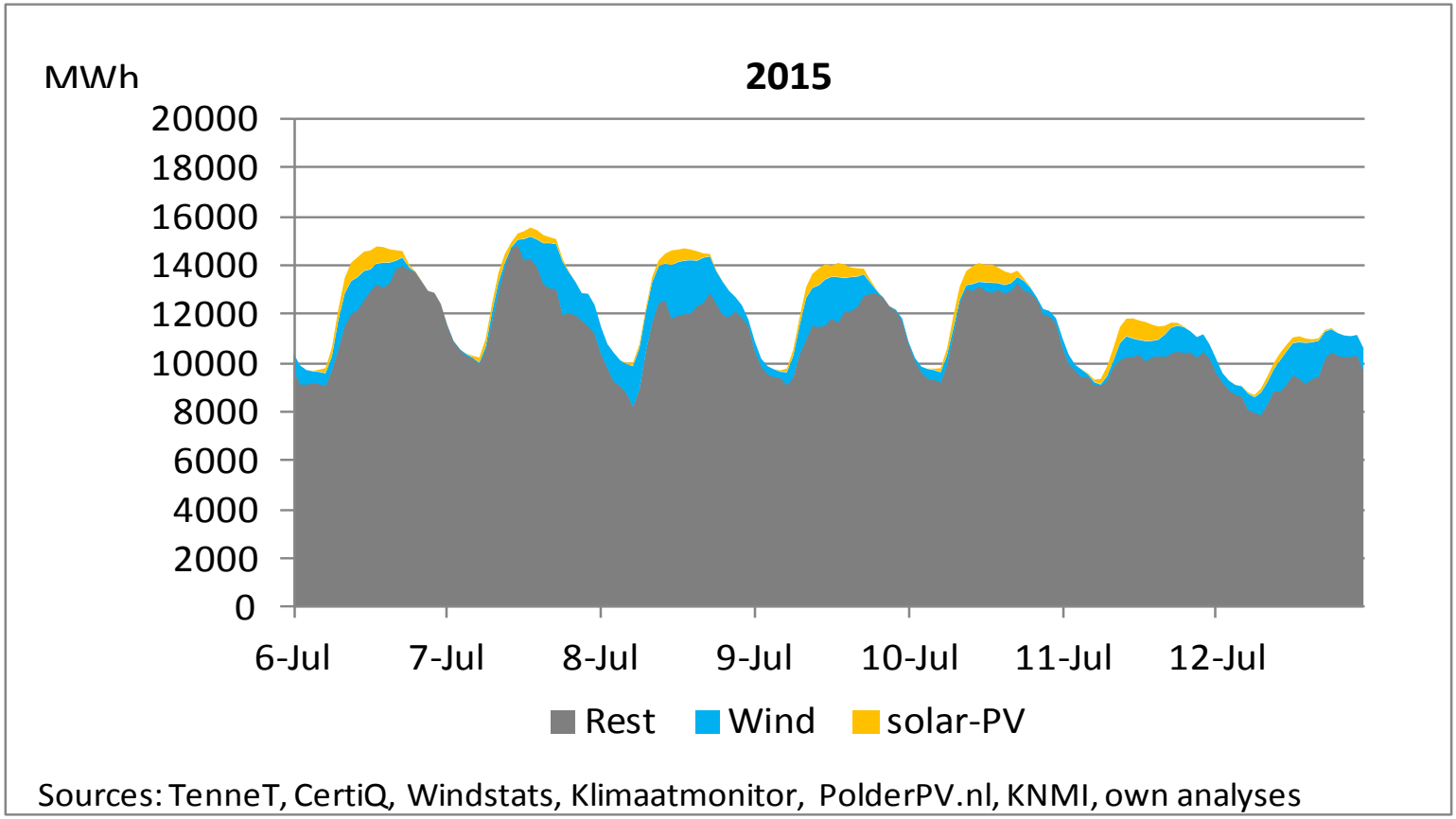
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

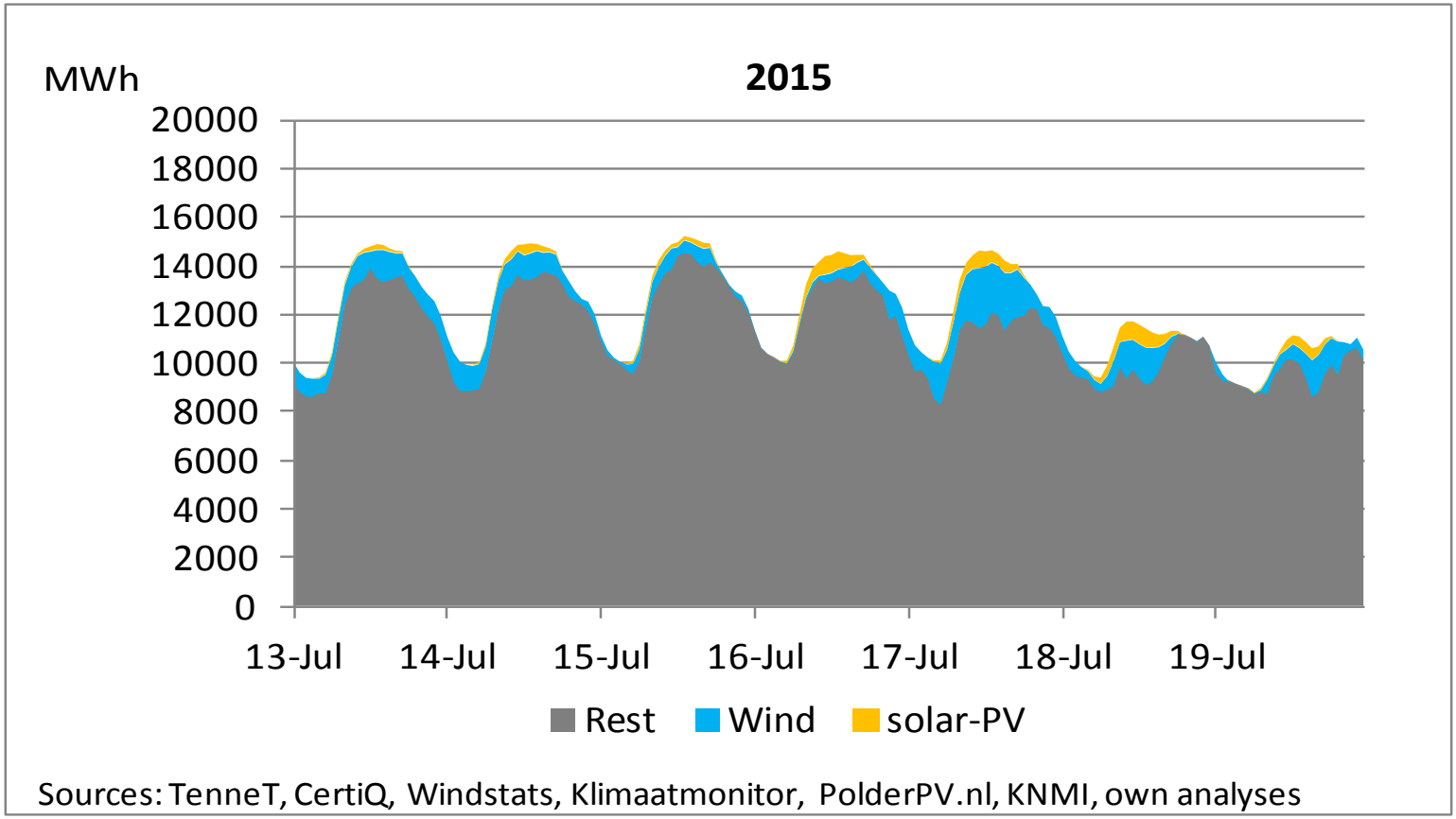
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

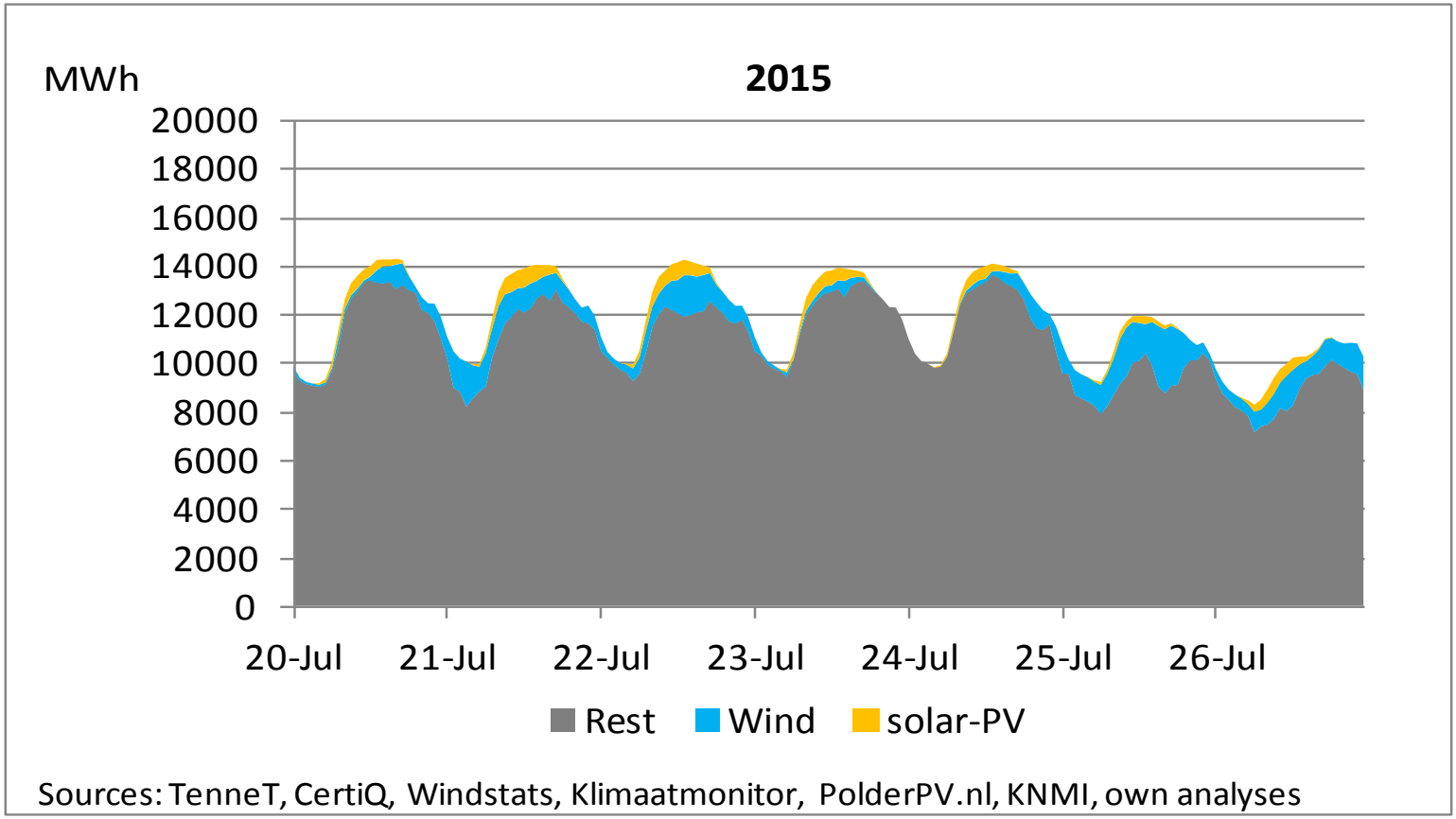
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

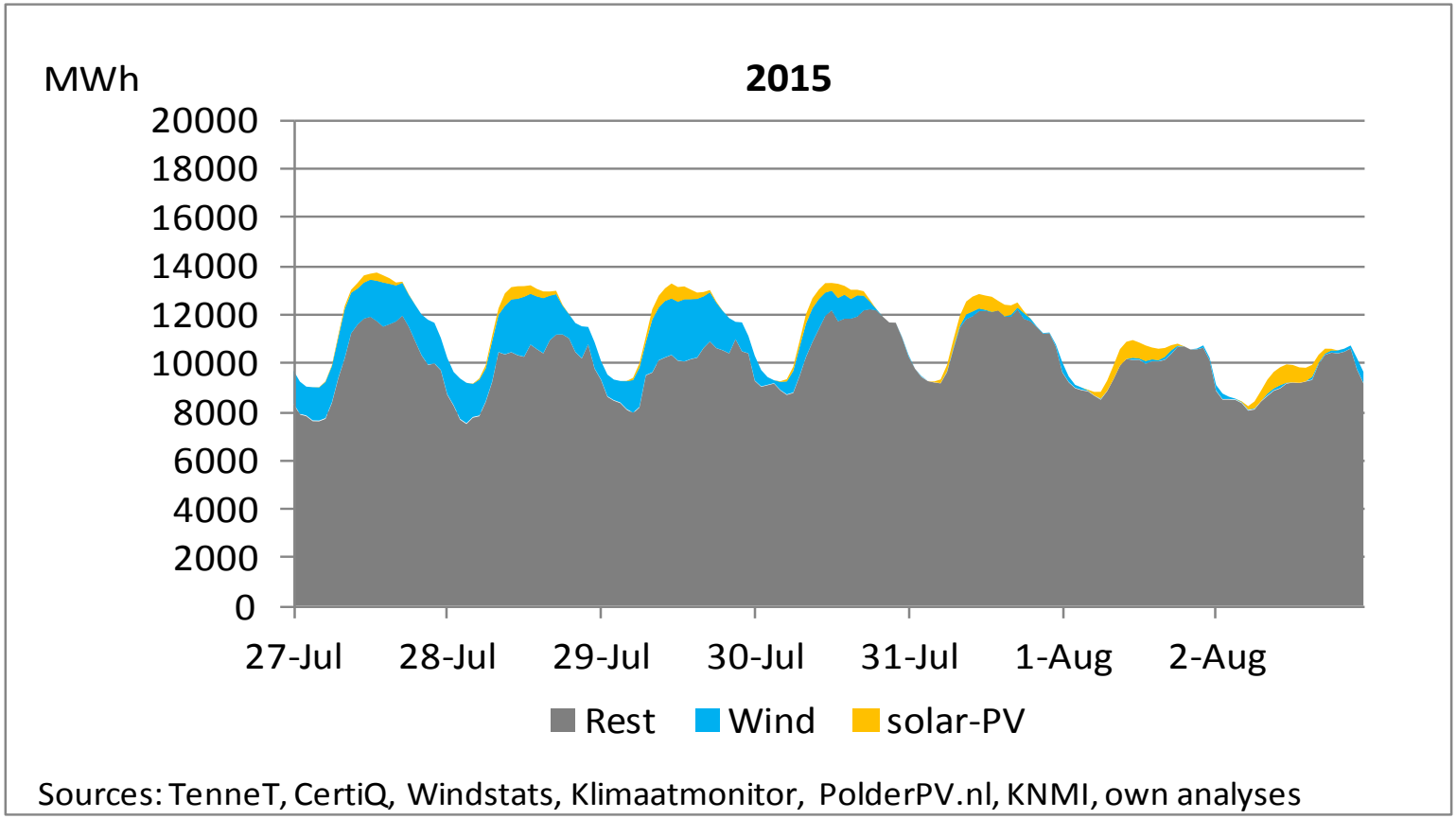
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

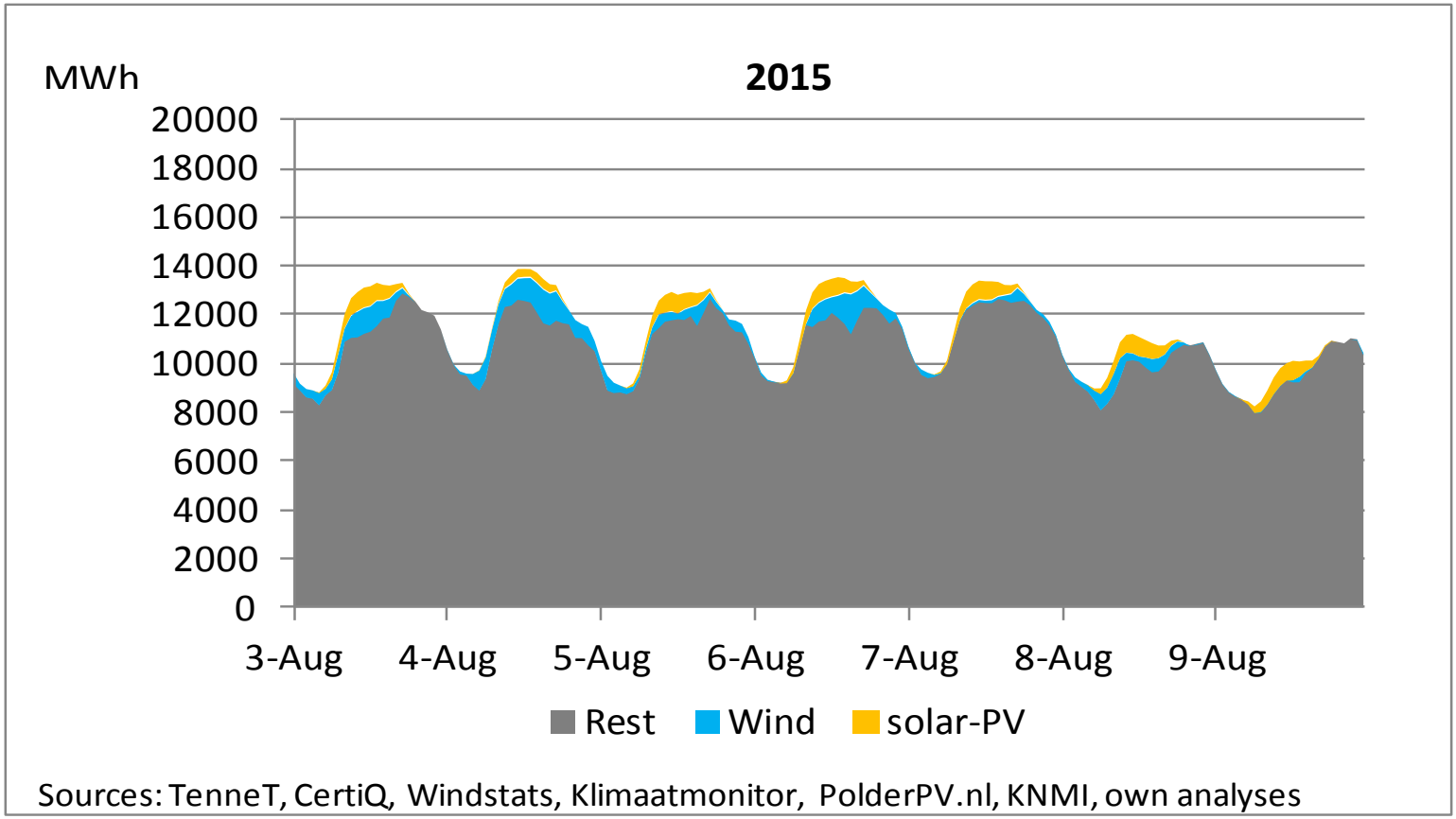
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

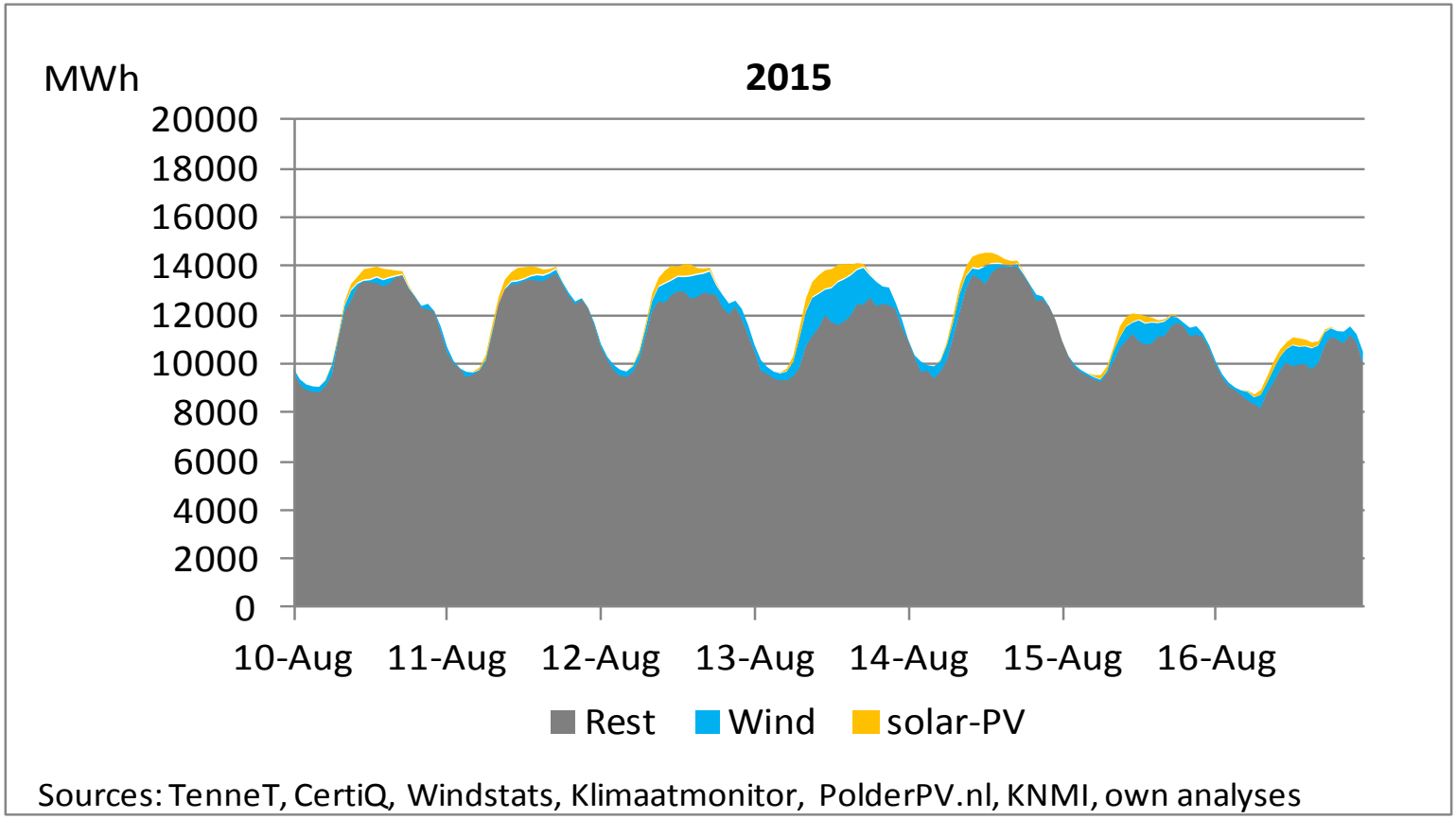
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

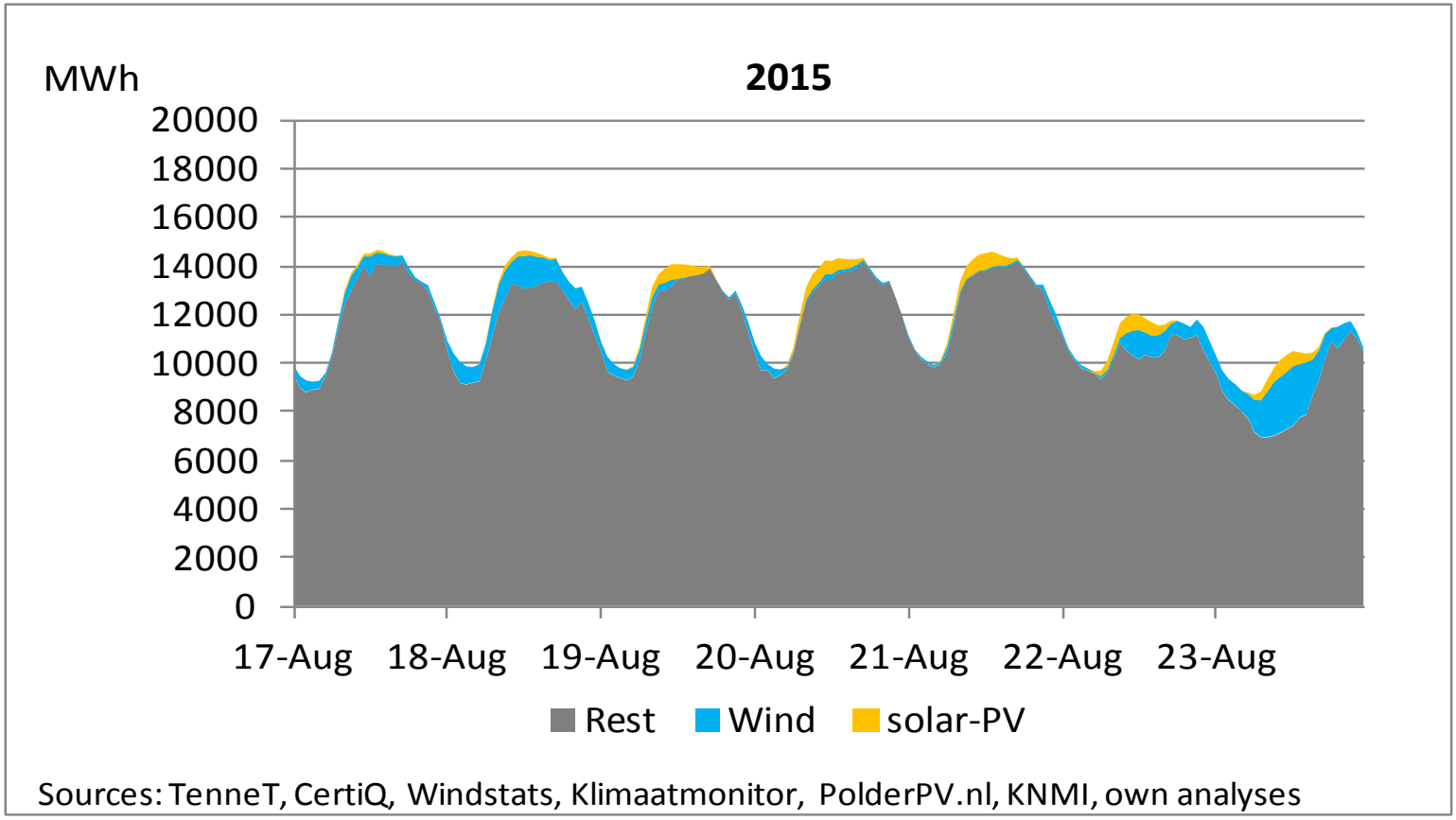
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

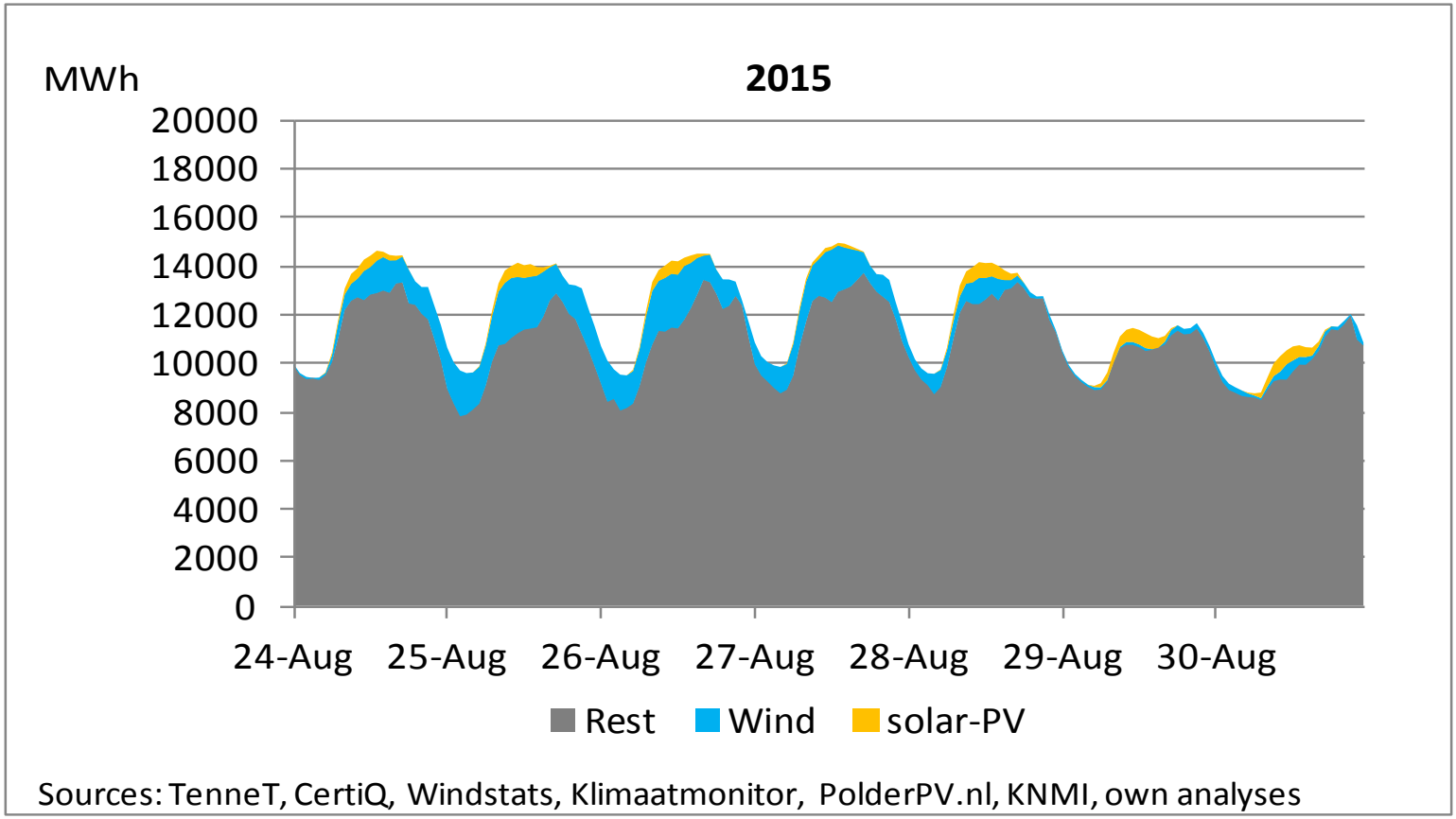
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

Hourly Solar-PV and Wind Generation 2015

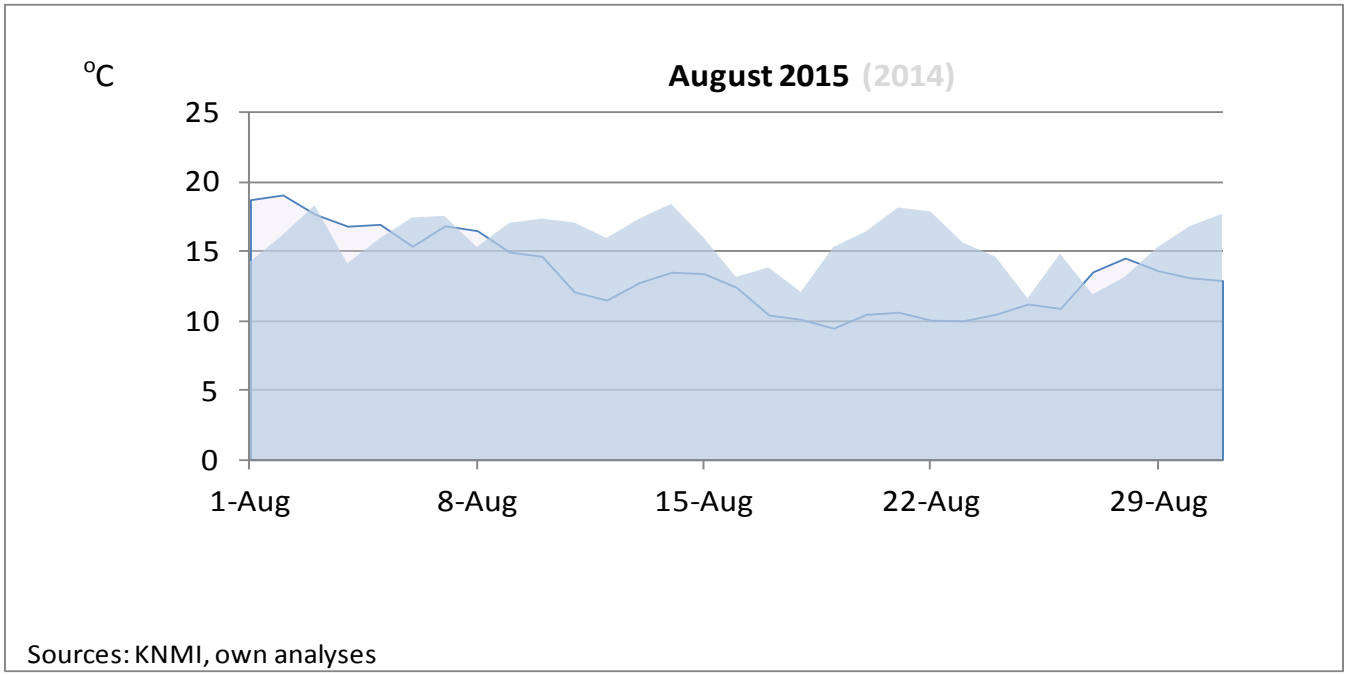
EnTranCe
ENERGY TRANSITION CENTRE



Sources: TenneT, CertiQ, Windstats, Klimaatmonitor, PolderPV.nl, KNMI, own analyses

MISCELLANEOUS

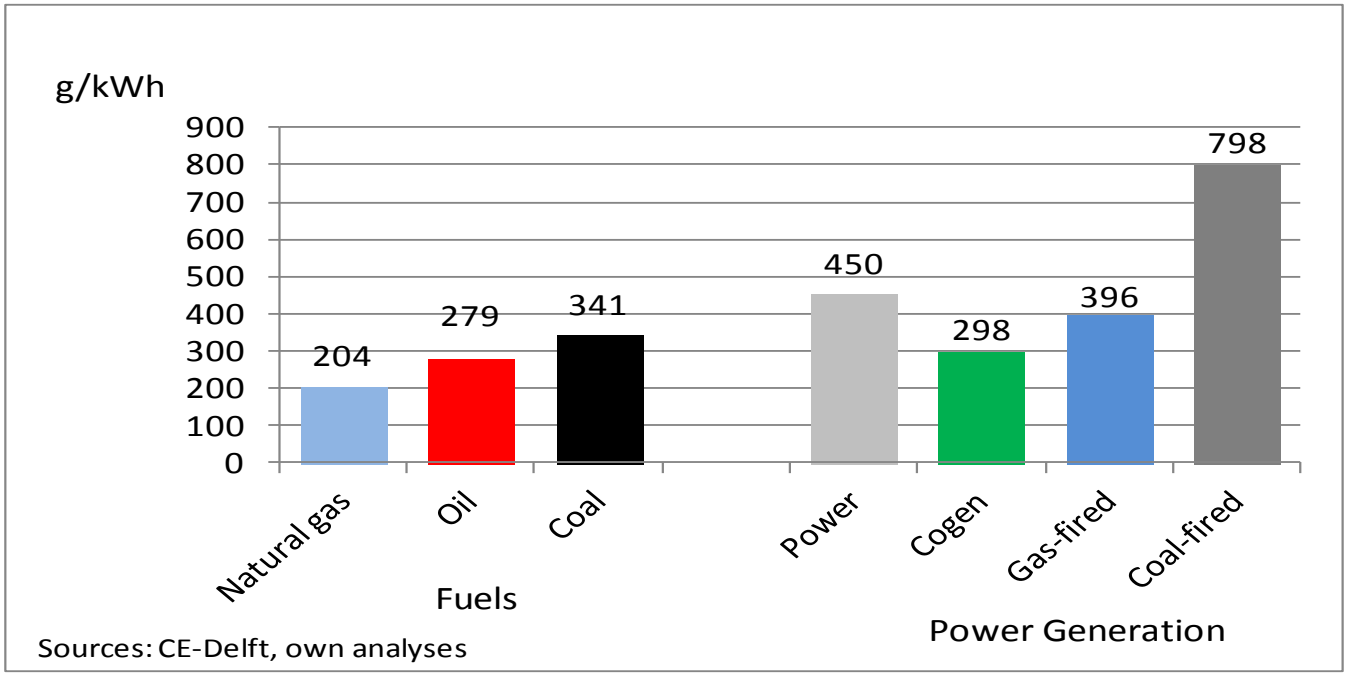
Effective Temperature August 2015



Sources: KNMI, own analyses

In Augusts 2015, the average daily effective temperature (temperature including wind shield factor) was about 15 °C. For comparison, the same temperatures of August 2014 are presented at the background.

Fuel Specific CO2 Emissions



Characteristic CO2 emissions used in this presentation.

Epilogue

b.m.visser@pl.hanze.nl

EnTranCe
ENERGY TRANSITION CENTRE

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.