Denmark in summer 2018:

Heat Wave and Increasing Cost of Electricity

The summer has been unusually hot and dry in Denmark in 2018 (table 1). Wind and solar power depend on weather. This note investigates if the weather in June and July has affected the performance of wind and solar power.

Denmark 2018	June	July
Average temperature C	16.5	19.2
Normal 1961-90	14.3	15.6
Total rainfall mm	31	17
Normal 1961-90	55	66
		Source: DMI

Table 1 - Temperature and rainfall

So far, we have only complete power system data from Energinet for June. Parts of the data for July have been estimated.

Table 2 is an overview of the electricity supply in Denmark in June and July 2018.

Denmark 2018	June	July	Change
	GWh	GWh	from 2017
Electricity consumption	2583	2546	+2%
of which			
Wind	36%	28%	-24%
Solar	6%	6%	+42%
Controllable production	14%	23%	-2%
Net import	43%	43%	+33%

Table 2 - Main electricity data for 2017 and 2018

The electricity consumption is practically unchanged from 2017 to 2018, but there are some significant deviations in the supply pattern.

Other factors than weather may have contributed to the changes, but for the first quarter of 2018, the wind energy production in Denmark decreased by 1% from 2017 to 2018, while the production of solar energy increased by 1%. These changes are rather small. Therefore, the dry summer is probably a main reason for the changes in table 2.

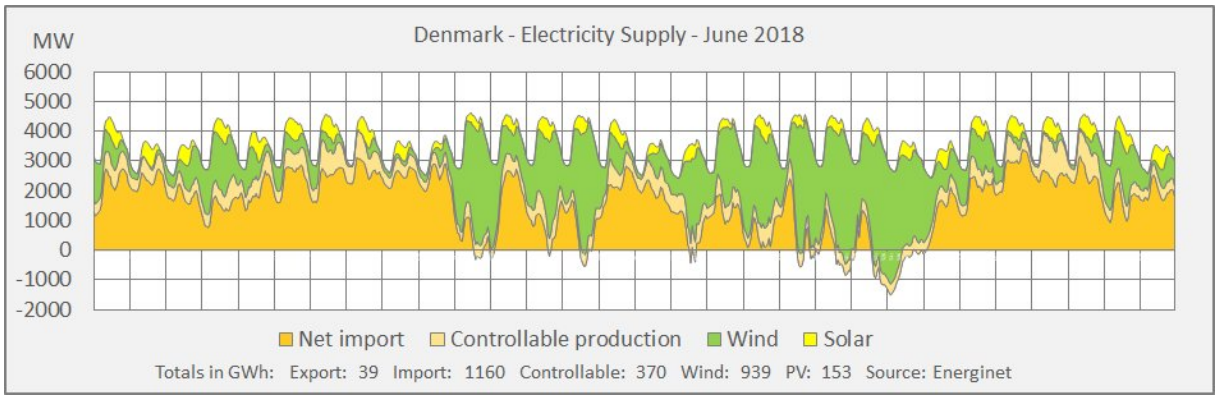

Fig. 1 – Import dominated electricity supply about half the days in June 2018

Fig. 1 shows the hourly distribution of production in June 2018. The heat demand was low and the thermal electricity production correspondingly low. There have been calm periods with a rather high share of import and some windy days. It is obvious that the production from photovoltaics (solar power) can “shave” the Daily demand peaks, at least during the summer season.

The hourly production distribution for June 2017 is shown on fig. 2.

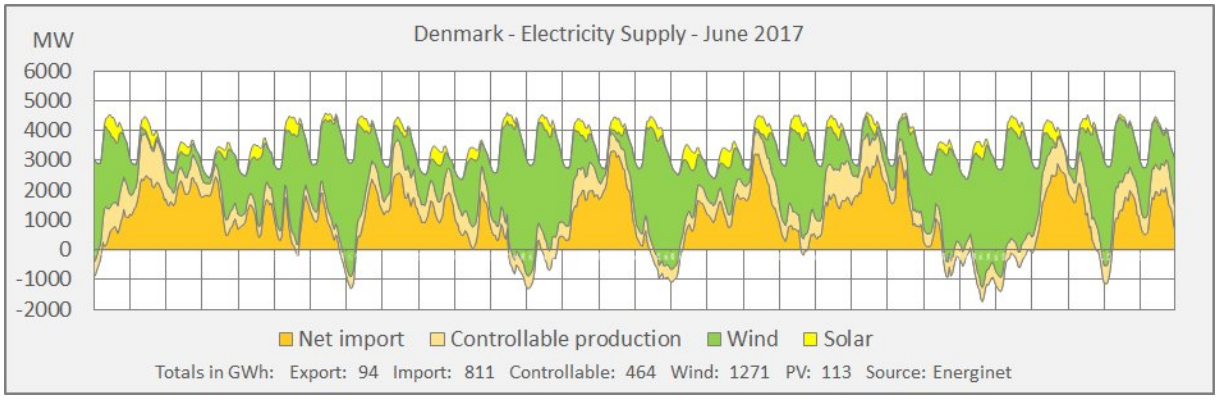

Fig. 2 – More wind energy than imported energy in June 2017

The calm periods were shorter and the wind energy contributions larger in June 2017. The wind energy production was 1271 GWh in 2017 and 939 GWh in 2018.

Market Response

The day-ahead spot prices were stable (about 30 €/MWh) throughout 2017. The prices were volatile from the beginning of 2018 and increased to over 50 €/MWh in July (fig. 3).

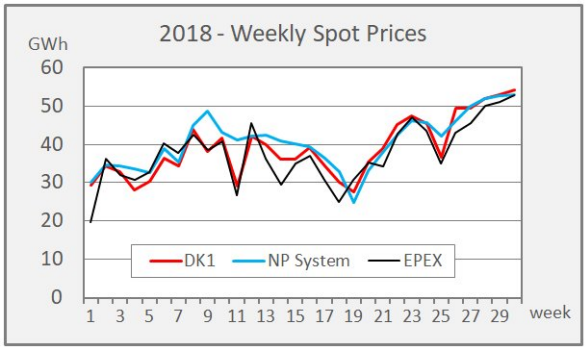

Fig. 3 - The day-ahead market fluctuated between pessimism and optimism during 2018

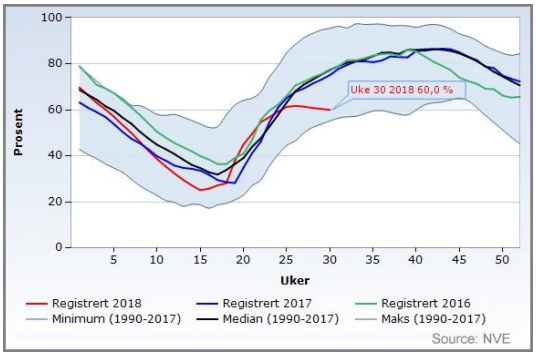

Fig. 4 – Norwegian energy level in the hydro reservoirs, alternating below and above median values

The water level in the Norwegian hydro reservoirs is a decisive factor (fig. 4). It was below the median value during the weeks 1 to 18, when the Nordpool system price varied between 30 and 50 €/MWh. From week 19, a high inflow of water from melting ice caused some optimism, until the drought reduced the inflow of water and caused spot prices exceeding 50 €/MWh.

The result was a turbulent exchange pattern (fig. 5). The net import to Denmark was (week 1 to 30 inclusive):

- 877 GWh from Norway,
- 131 GWh from Sweden and
- 1903 GWh from Germany

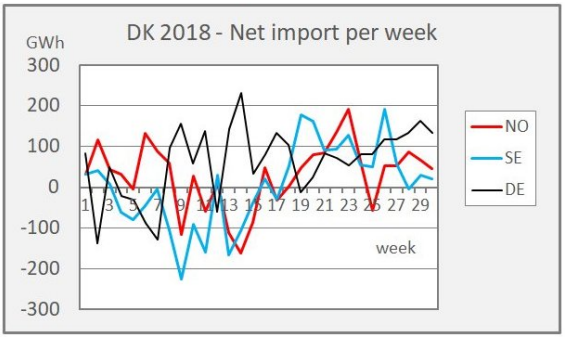

Fig. 5 - A confusing exchange pattern

This confirms the impression of Germany as a major supplier of electricity to Denmark in 2018.

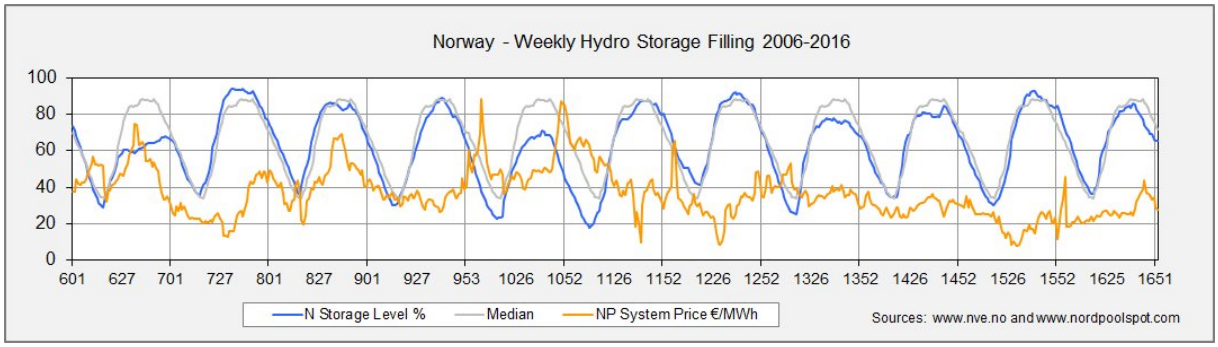

Fig. 6 – The same low water level in the Norwegian hydro reservoirs in July 2006, 2010 and 2018

A low energy content in Norwegian reservoirs in July will not necessarily have far-reaching consequences. In 2006, the energy level was also about 60% at this time of the year, but the inflow of water during the autumn of 2006 caused a good energy balance and low market prices already from the beginning of 2007. The year 2010 was a dry year from the beginning, and it took until the middle of 2011 to re-establish a normal energy balance.

In 2018, the European electricity market has been able to activate sufficient energy reserves, particularly in Germany. The return to a more normal price level may be fast (as in 2006) or slow (as in 2010).

A useful case

The power system structure is changing in most countries in the direction of more weather dependant production and less dispatchable production. There are significant differences from year to year in the production of both hydro energy and wind energy. The variations may be independent, but a simultaneous occurrence as in 2018 cannot be excluded.

It is obvious that this change will create new challenges for maintaining security of supply and for meeting the targets of the climate policy.

The Department of Energy (DOE) in USA has expressed some concern about the “wave of retiring baseload units” [1].

Therefore, the 2018 case can be an opportunity to examine the robustness (or resilience, as defined by DOE) of European electricity supply.

[1] “Reliability, Resilience and the Oncoming Wave of Retiring Baseload Units”, DOE March 2018, se http://pfbach.dk/firma_pfb/references/pfb_uk_running_out_of_gas_2018_04_12.pdf