

Markets Challenged by Wind and Hydro Variations

The electricity markets now seem to respond to the changing balance between dispatchable and fluctuating production of electricity. Several reports in Swedish media have worried about the consequences of high electricity prices for enterprises in the southern part of Sweden (fig. 1).



Fig. 1 - "Record high electricity prices - worst in southern Sweden"

Sweden had until 2020 a quite stable electricity spot market. The prices could go up and down in line with neighbouring markets, but the changes were at a leisurely pace, and the differences between the four Swedish price zones were insignificant (fig. 2). The traders felt safe in this environment.



Fig. 2 - New market behaviour from 2020 (weekly prices)

In 2020, a less stable period began. The price level in 2021 is high, but not extreme. Most people have noticed a growth since the spring of 2020, but the real news is the price volatility and the price variations from north to south in Sweden.

Probable reasons for the changes are:

- The balance between dispatchable and fluctuating generation is tipping. This is a challenge to the markets, because the demand response is poor. Continued decommissioning of traditional power plants will advance this development.
- The transmission systems are far too weak for serving the increasing imbalances.
- For 2020: A Norwegian energy surplus was trapped behind bottlenecks.
- First half of 2021: Wind conditions were poor in Denmark, Sweden and Germany.

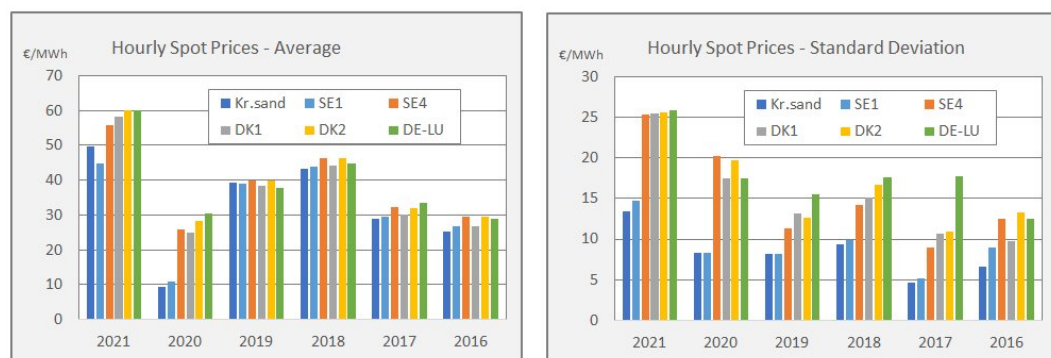


Fig. 3 - Average spot prices and standard deviation for six price zones 2016 to first half of 2021. The six zones are Norway south (Kr.sand), Sweden north (SE1), Sweden south (SE4), Denmark west (DK1), Denmark east (DK2) and Germany (DE-LU).

Fig. 3 demonstrates the influence of these conditions on hourly spot prices in Denmark and in three of its neighbouring countries.

For each year 2016 to 2019, the level of average hourly spot prices was the same for the six price zones. The price variations from year to year were quite normal.

The year 2020 was a year with energy surplus and low spot prices, particularly in the two hydro zones (Norway south and Sweden north). Such price differences between price zones are unusual. They are caused by the grid bottlenecks.

In the first half of 2021, shortage of energy gave increasing spot prices. One reason was the reduced wind energy output in both Denmark, Sweden and Germany (table 1)¹.

	DK	SE	DE
Onshore	23.2%	14.5%	21.3%
Offshore	4.2%	-	16.5%

Table 1 - Reductions in wind energy output in first half year from 2020 to 2021.

After a year 2020 with full Nordic hydro reservoirs, the inflow of water has been very low in 2021 (fig. 4).

Standard deviations for hourly spot prices were calculated in order to quantify the price volatility (fig. 3). The two hydro zones have significantly lower price variations than the other zones. It is not surprising, because hydropower systems with large storages can stabilize the electricity markets. The increasing price variations in 2020 and 2021 are clearly reflected in the standard deviations.

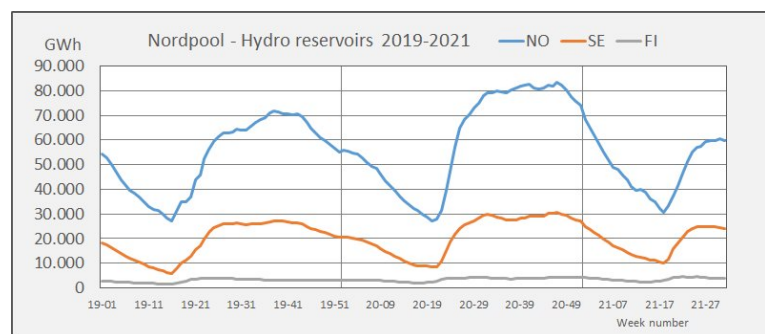


Fig. 4 - Norway has 25% less water than at the same time in 2020

Missing wind replaced by fossil generation in Denmark

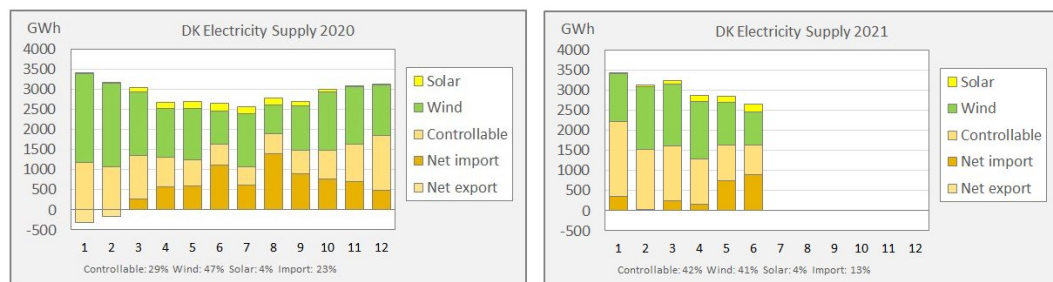


Fig. 5 - Less wind in 2021

Fossil reserve capacity filled the gaps during the first months of 2021 (fig. 4). High market prices were necessary for the mobilization of these reserves. The fossil generation less export was 41% higher in first half of 2021 than in 2020.

Wind power has like hydro systems rich and poor years. Therefore, it is natural that the market prices reflect the variations of both wind and inflow of water to the hydro systems. The

¹ The installed capacity has changed from 2020 to 2021. New Danish wind power January to April 2021: Onshore 36 MW. Offshore 344 MW. According to vindstat.dk, the reduction of energy content for wind in Denmark was 21.4% for large onshore turbines and 36.8% for small onshore turbines.

difference is that hydro systems with storages can smooth short-term variations, while the markets must absorb all variations for wind power.

Therefore, price variations as in 2020 and 2021 will probably be more frequent in a future with increasing shares of wind energy and a permanent lack of transmission capacity.