

# A Flipflop Electricity Market

## Dramatic drop in commercial value of wind energy

The Danish electricity market has changed significantly during 2023.

The primary indicator is the spot market price level (fig. 1). The market value of wind energy has been calculated as a weighted average of spot prices based on hourly volumes.

The average values of wind energy were halved from the beginning of the year to October.

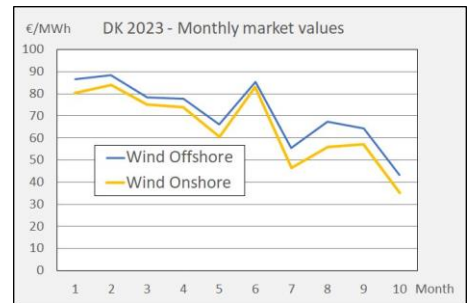


Fig. 1 - Decreasing spot market prices during 2023

### Danish hourly spot prices

The Danish hourly spot prices depend on operational conditions in Denmark and in the neighbouring countries. It may be difficult to identify reasons for trends and variations.

The weeks 11 and 40 have been selected for a comparison.

There are only a few hours with prices below 10 €/MWh in week 11. Half of the hours in week 40 have spot prices below 10 €/MWh.

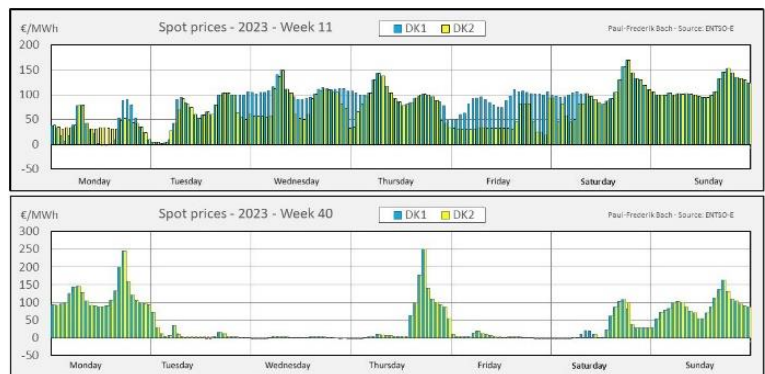


Fig. 2 - Very low spot prices in half of the hours in week no. 40

Is the difference accidental, or is there a systematic reason?

### Danish production patterns

Waves of wind power had a more direct influence on the spot prices in week 40 than in week 11 (fig. 2 and 3).

The wind power levels in Denmark are similar for the two weeks and cannot explain the increased sensitivity of the spot market in week no. 40.

The market value of wind energy will be significantly lower when wind power waves cause a price collapse.

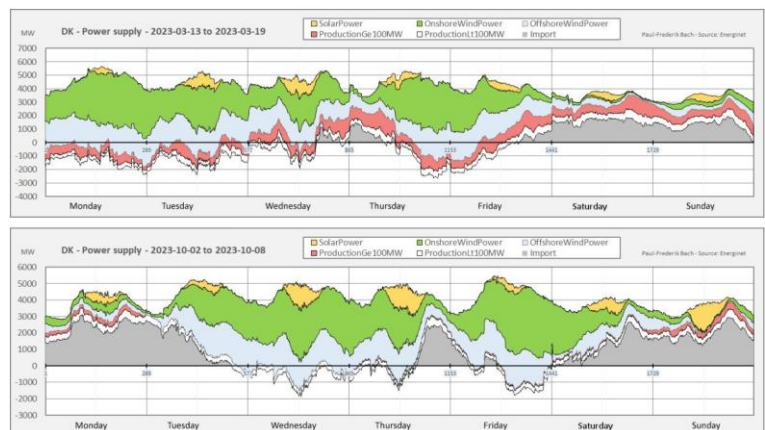


Fig. 3 - Similar wind power patterns in the two weeks

The volume of wind energy changes considerably from month to month. Strong winds in October may contribute to an explanation, but it is not the full explanation, because the wind energy output had the same level in January and in October.

In week no. 40 strong winds have spoiled the market for suppliers of wind energy. It is a paradox because the wind energy business depends on wind.



Fig. 4 - Wind energy output nearly doubled from September to October 2023

### Influence from neighbouring countries

There is a strong interdependence between the European electricity markets, and it can be difficult to analyse the creation of local spot prices. Grid bottlenecks play a decisive role.

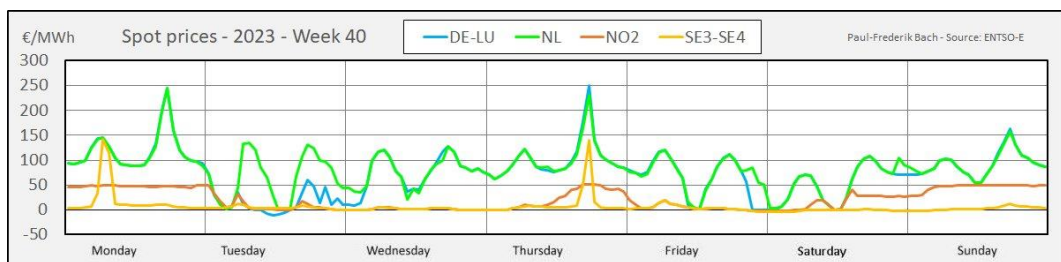


Fig. 5 - Spot prices in four neighbouring countries in week no. 40

For Wednesday, Norway and Sweden have prices about zero, while Germany and the Netherlands have "normal" prices (fig. 4). It indicates that the Nordic area has a surplus of power, and that all interconnections to Germany and the Netherlands may be fully loaded.

Swedish wind power did not change significantly from week 11 to week 40.

The flow of power can reveal bottlenecks. Exchanges change from hour to hour. Hour no. 16 on Wednesday has been selected as an example (fig. 6). The following four HVDC-links are fully loaded: SE-DK1, SE-DE, DK2-DE and DK1-NL. They move bulk power from the Nordic area towards the continent.

There were other exchanges from Norway and Sweden:

Export from		Export from	
Norway to	MW	Sweden to	MW
The Netherlands	422	Finland	1122
Germany	582	Poland	0
Great Britain	1400	Lithuania	734

The five active links are probably operated close to their capacity limits. Finland is a part of the Nordic area and exported 997 MW to Estonia. The total export from the Nordic area was 6167 MW in hour no. 16 on 4 October 2023.



Fig. 6 - Flow of power 4 October 2023 hour 16 UTC. Sources: Energinet and ENTSO-E.

### Did the market coupling system fail?

Only 39 MW were exported from DK1 to DE. According to Nordpool data, the transfer capability was 1650 MW. No special regulation was recorded in the Nordpool data. The initial Nordpool result was probably in fair balance with this additional export capacity.

My hypothesis is that the market coupling between Nordpool and the continental market systems blocked the export from DK1 due to internal German capacity limitations. Therefore, the Nordic prices collapsed in the subsequent Nordpool adjustments.

According to EU-requirements<sup>1</sup>, Germany must maintain a certain transfer capability from DK1 to DE, from 2019 at least 900 MW. However, the system operators cannot ignore the laws of nature. Formal requirements can be bypassed by countertrade or other complex arrangements, which are publicly inaccessible.

The AC-systems, the Nordic (incl. DK2) and the continental (incl. DK1), must be carefully operated in order to avoid local overloads. The clockwise circulation of power between DK1, NO and SE (fig. 6) suggests bottlenecks in Norwegian grids. Bottlenecks in Sweden would create a circulation in the opposite direction.



Fig. 7 - Expected reinforcement from 2024

Germany has more wind power in North Germany than the internal grid can transfer to the southern parts of Germany. Therefore, there is no room for additional power from Denmark. A new 380 kV line with two circuits from Brunsbüttel at the Elbe to the Danish border (the "Westcoast line", project P25, under construction for more than 10 years) is supposed to reach Klixbüll at Niebüll before the end of 2023. The continuation into Denmark will be the project Klixbüll-Endrup (fig. 7, expected commission in 2024).

### Decreasing market values in 2023

The declining price levels (fig. 1) are characteristic for all production and for consumption, but with the essential rule that dispatchable production has a higher market value than consumption, while non-dispatchable production (wind and solar power) has a lower value (fig. 8).

The low prices in October suggest that either power system or electricity market or both are out of balance.

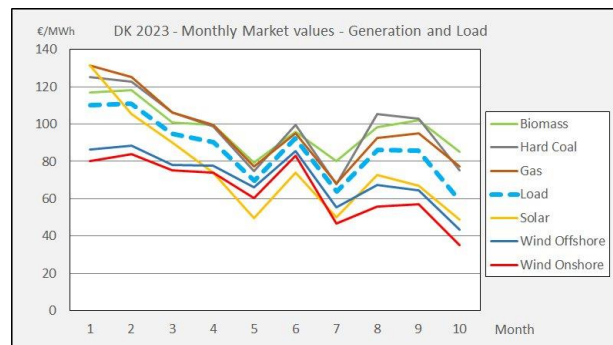


Fig. 8 - Value of wind energy dramatically reduced

2023		Biomass	Gas	Hard Coal	Oil	Solar	Waste	Wind Offshore	Wind Onshore	Load	Fossil	Prod.
Month	Hours	€/MWh	€/MWh	€/MWh	€/MWh	€/MWh	€/MWh	€/MWh	€/MWh	€/MWh	€/MWh	€/MWh
10	744	85,23	77,44	75,03	70,78	48,88	67,92	43,30	35,20	59,16	75,61	45,57

<sup>1</sup> COMMISSION DECISION of 7.12.2018 Case AT.40461 – DE/DK Interconnector

## **Increasing risk of flip-flop prices**

We did not find obvious reasons for the decreasing spot price levels in 2023. Uncertainty about the transfer capability from West Denmark (DK1) to Germany (DE) seems to play a role. We have known for more than 20 years that this capacity would decrease towards zero, but the planned reinforcements are – as always – too late.

Discrepancies between the formal transfer capabilities in the Nordpool data and the physical reality seem to disturb the convergence of the European market coupling process.

The amount of fluctuating power production in Germany and in the Nordic countries has reached a level, where minor imperfections in the market system cause price instabilities.

For the time being export of electricity is the only significant measure for absorbing the variations from wind and solar power. Stronger interconnections will not be a lasting solution because all countries are increasing their capacity of wind and solar power.

Other measures, such as batteries and Power-to-X (PTX) are supposed to solve the problems, but such measures are birds in the bush. They will be too late and too small.

The maximum export out of the Nordic area seems presently to be about 6 GW. Additional wind power would create more hours with spot price collapse. On the other hand, the new west coast line (Klxbüll-Endrup) and the new 1400 MW Viking Link between Denmark and England to be commissioned before the end of 2023 will bring some relief until overtaken by new wind power projects in Germany, Sweden and Denmark.

A flipflop electricity market is a risky environment for consumers and investors. Therefore, it is necessary to balance the amount of new wind power projects with efficient stabilising measures.