Dunkelflaute

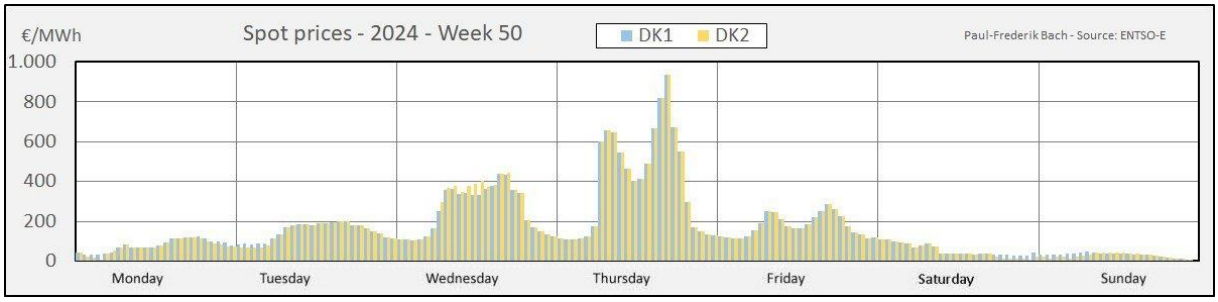

Fig. 1 - Three day's Dunkelflaute

I have been arguing for some time that the European electricity supply has become vulnerable. The volatile electricity market is one of the signs of this vulnerability.

"Dunkelflaute" is the German word for dark and still weather, when neither wind nor solar power can deliver anything.

In week 50 of 2024, the price spikes on Wednesday and Thursday gave rise to a number of public comments in Denmark. In some cases, the usual fronts of the energy debate were drawn up. Nuclear power was again mentioned as stable green energy, while nuclear power opponents claimed that the problems of weather-dependent production will soon be solved with PtX, i.e. by converting electricity to hydrogen and other green fuels.

Unfortunately, the realization of both of these options will take many years, but the rapidly growing balancing problems must be solved now and in the coming years.

An international problem

Due to international market coupling, spot prices are correlated from country to country in Europe. Strong interconnections provide close coherence, while weak interconnections create bottlenecks and price differences.

Denmark and Germany have the highest prices (Fig. 2), because the capacity shortage is found here.

Norway and Sweden experience large price differences between the northern and southern regions of the countries. Prices in Denmark and Germany are "contagious", so they have created high prices in southern Norway and southern Sweden.

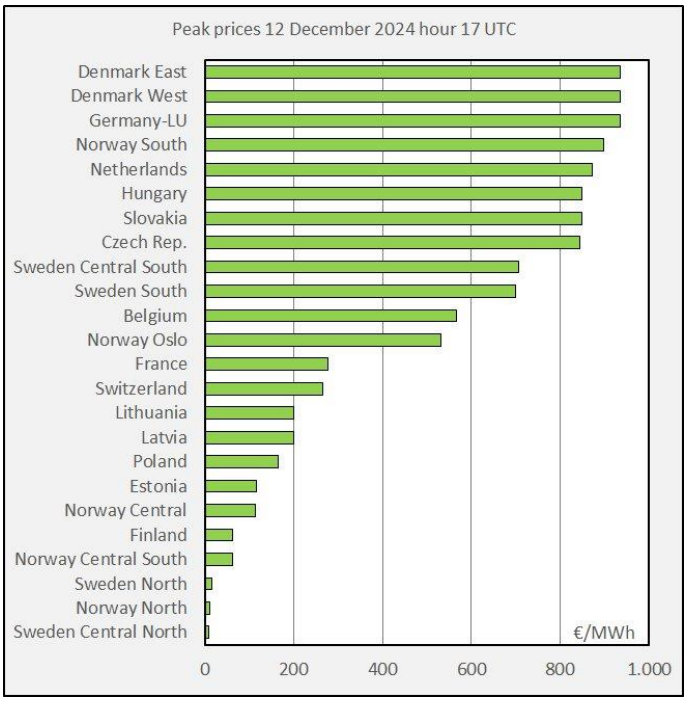

Fig. 2 - Price spikes due to capacity shortages in Denmark and Germany

Three days without wind power in Denmark

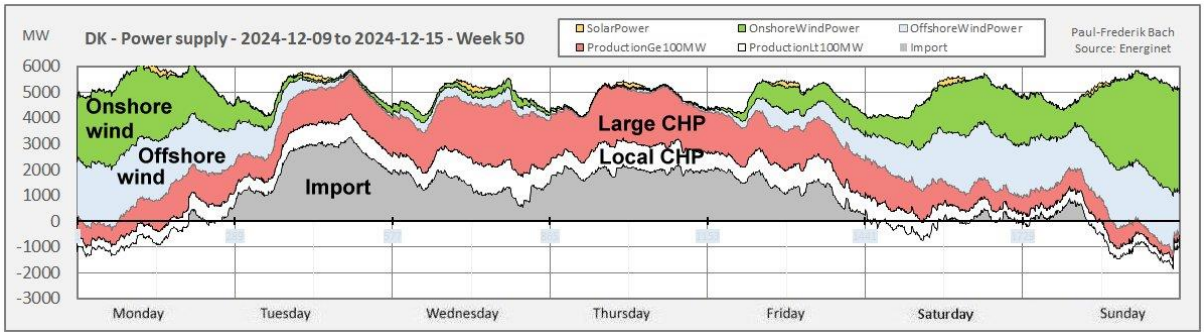

Fig. 3 - From 0% wind power Thursday to 126% wind power Sunday evening

The production profile for week 50 (fig. 3) shows that Denmark must rely on imported power for about half the daily peak demand.

Import to Germany and Denmark

It is a frequent argument in debates about wind power that it is always windy somewhere in Europe. This is possible, but the main problem is whether there is grid capacity for the necessary large-scale relocations.

Net imports to Germany and Denmark were 12 GW during the price peak in hour 17, but almost 17 GW during the morning price peak in hour 8. Of this, 2.3 GW was transited through Denmark from Sweden, Norway and England to Germany (Fig. 4 and 5).

New high-voltage lines have never been popular. Building a new transmission line can take one or two decades. The increasing need for transport must have refuted the argument of the past that wind power saves on the transport of electricity. Lack of transmission capacity seems to become a decisive obstacle to the Danish plans to expand new wind power for export and for conversion to hydrogen.

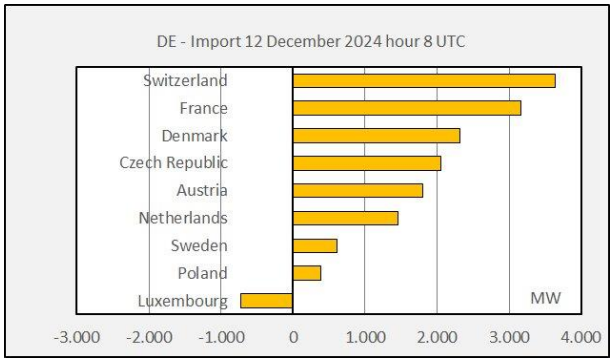

Fig. 4 - Germany's net import in hour 8 was 15 GW

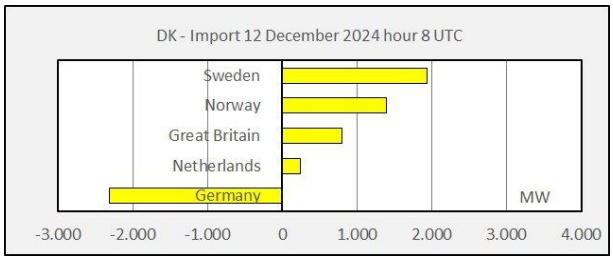

Fig. 5 - Denmark has become an important transit country for electricity

Conflict between German and Nordic electricity markets

Norway and Sweden were pioneers in the development of an international electricity market. Due to the division into price zones, they can handle and optimize the expansion and operation of systems with internal bottlenecks in the grid. However, they feel that the contagion from the south has led to price differences that are not acceptable to local consumers.

Both Norway and Sweden have decided to hold back on the expansion of interconnections. The Swedish parliament has not approved an application for the establishment of a new interconnection to Germany, the Hansa Power Bridge. Norway has similarly put a new link to Scotland on hold. Most recently, Norwegian politicians have announced that they do not

want to maintain the first almost 50-year-old sections of the interconnection to Denmark, the Skagerrak 1 and 2.

The reason is that the German electricity market is fundamentally structured differently from the Nordic one. There are also internal bottlenecks in the German grid, but nevertheless the aim has been to have the same spot price for the entire country and therefore price zones have not been introduced. Instead, bottlenecks are handled with redispatch and other economic instruments.

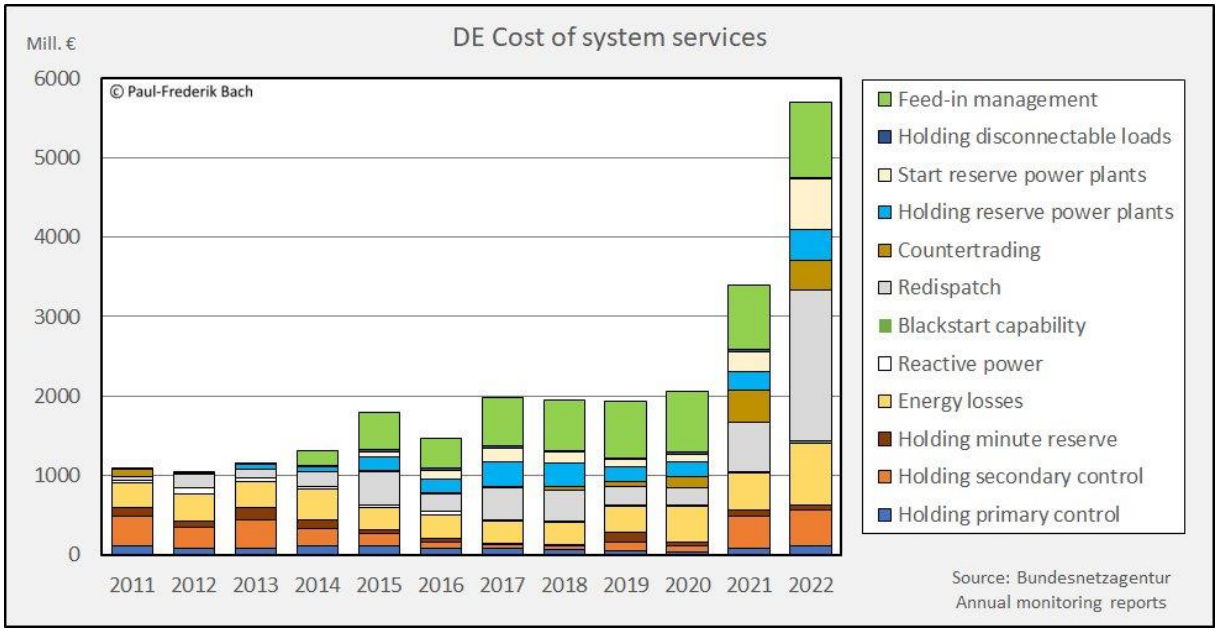

Fig. 6 - Rapid development in Germany's system service costs

This German policy has two significant consequences. Firstly, German system service costs are growing rapidly (fig. 6), partly due to strong growth in solar power. Secondly, it gives the wrong price signals at the borders and a less optimal utilisation of energy resources. This gives Norway and Sweden incentives to limit and reduce transmission capacity at the borders with Germany.

In this context, Denmark is more closely linked to Germany than to the other Nordic countries.

This is a regrettable break with the previous development of an increasingly closer interaction between European power systems with a highly developed electricity market as an intermediary.

The new trend could lead to both supply problems and economic losses in the long term, not least for Denmark, whose power system has been developed with strong dependence on neighbouring countries.