

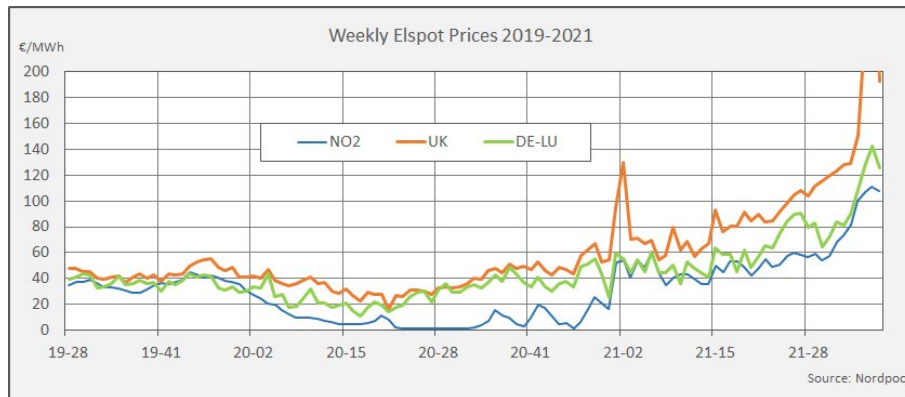
Unstable Energy Prices are here to stay

The year, 2021 was so far a poor energy year. Electricity supplies from wind and water were below normal, and stocks of gas and water are low. We have been told for years, that flexible energy demand must respond to price signals and absorb variations in energy supplies. The market has sent a signal. The price depends on the demand response.

This is not a crisis. The market works as intended. The change into a system with fluctuating supplies and without the former fuel storages must cause larger price variations.

Day-ahead wholesale prices for electricity since 2019 tell the story of a normal year (2019), a fat year (2020) and a poor year (2021). The interesting question is if the market and the power grid could handle these three types of year satisfactorily.

Norway, Germany and the UK: an important triangle in Europe



Nordpool has published spot prices for countries outside the original Nordpool market area since July 2019. Therefore, fig. 1 goes from week 28, 2019. A weekly resolution is used to eliminate noise from short-term variations.

Fig. 1 – Energy surplus in 2020 followed by shortage in 2021

The day-ahead prices in fig. 1 reflect the surplus of energy in Norway in 2020. The spot prices are decreasing during the first half of 2020, but with differences, causing a flow from Norway to Germany and further to the UK. Insufficient export capacity from Norway caused an increasing water level in the Norwegian hydro reservoirs and very low spot prices before and after week 28 in 2020. The spot prices in Germany and the UK increased during the same weeks to a more normal level. The result was an increasing price gap between the southern Norway (N2) and Germany.

Wind power has been developed to play an important role in the electricity supply in Sweden, Denmark and Germany. The wind power output was significantly lower than normal during the first half of 2021. The result was increasing and more volatile spot prices. A low inflow of water in Norway has accelerated the energy shortage. This is a coincidence, which will occur now and then. It must be considered as a normal condition in an energy system depending on fluctuating production and flexible consumer behaviour.

Market price differences are central in the evaluation of the profitability of new interconnectors. Table 1 shows large price variations from year to year. The year 2019 is the “most normal” year of the three. The table indicates interesting opportunities for trade with the UK. However, the investments in

€/MWh	2019	2020	2021
NO2	36,44	9,28	58,19
DE	37,30	30,30	69,57
UK	44,73	39,29	104,64

Table 1 - Average spot prices (2019 and 2021: part of year)

new interconnectors to the UK are huge, and unpredictable variations from year to year make it look like a risky business.

The zonal price system is challenged in Sweden

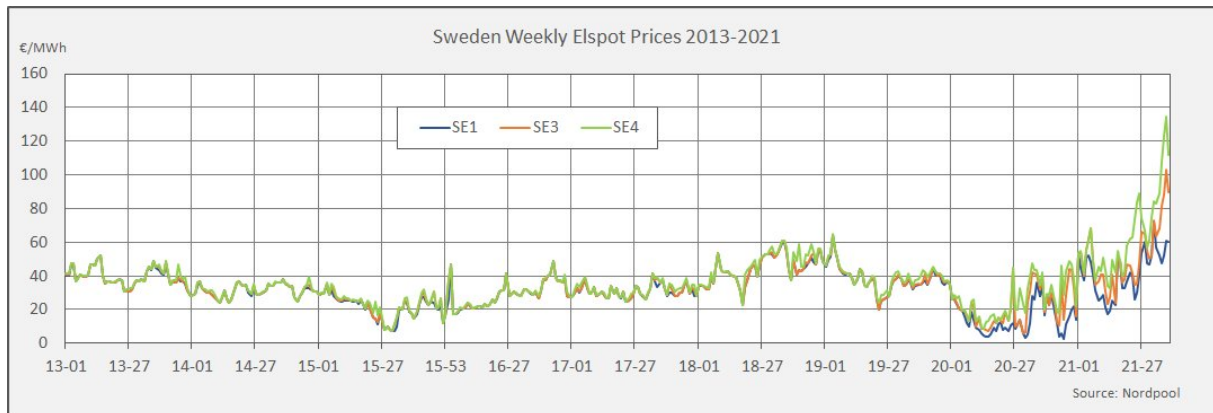


Fig. 2 - A different spot market from 2020

The Swedish electricity market has four price zones from SE1 in the north to SE4 in the south. The four zones had practically the same prices until 2020. The typical level was between € 30 and 40 per MWh with lower prices in “wet years” such as 2015 and 2020. In 2020, the four prices began to move apart with high prices in SE4 (table 2). Both price increases and the price differences from north to south have consequences for Swedish enterprises and for their choice of location for expanded and new activities.

€/MWh	2019	2020	2021
SE1	38,03	14,40	41,85
SE2	38,03	14,40	41,93
SE3	38,45	21,21	52,07
SE4	39,90	25,73	64,98

Table 2 - Swedish spot prices
(2021: part of year)

It is a matter of opinion if congestion problems should be prevented by price zones, or if a country should have one common spot price for its whole territory. Germany stands firm on maintaining one price zone for Germany, including Luxembourg. There are also people in Sweden, who would like to return to counter trade as replacement of the four price zones.

A price difference is a warning of a problem, which cannot be solved by changing the market system. The Swedish problem is that traditional production in south is being replaced with wind power in north. This action causes increased flow in the grid from north to south, but without the necessary grid reinforcements.

Many traditional power plants were located close to the demand centres, but this is not possible for wind power. A heavy commitment to wind power requires a transmission system reinforcement, which seems to be underestimated.

An electricity market replaces the traditional central optimization of investments and operations. The purpose of a zonal market system is to give proper incentives to both supply and demand side. High electricity prices in southern Sweden should encourage investments in local production, while the low prices in northern Sweden should stimulate large consumers to move north.

Ignoring the transmission problem will cause considerable losses in curtailed renewable production and disconnected consumption.

The difficult balance between production and transmission

Some people in Denmark observed very high spot prices on 7 October 2021, particularly for the hour 19 to 20 (CET).

Fig. 3 shows large variations in spot prices, even within the Nordpool area. The Nordpool system price was € 121 per MWh, which would have been a common price for all price zones if the transmission grid allowed flows without limitations.

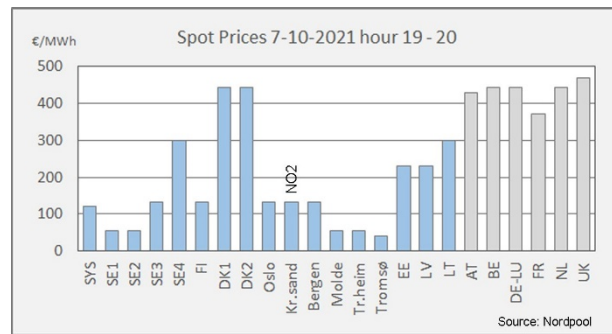


Fig. 3 - The blue columns are Nordpool Elspot Prices

However, production was trapped in the northernmost parts of Norway and Sweden, where the price level was around € 50 per MWh. The prices were slightly higher than the system price in the central parts of Norway and Sweden. The price in the southernmost part of Sweden (SE4) was about six times the price in North Sweden, while Denmark adopted the German price.

Nordpool's bid curves are publicly available (fig. 4). The market coupling procedure adds about 5 GW to the production in the Nordpool area and about 30 € to the system price. The Nordpool area could have provided another 5 GW production, but this capacity was trapped behind bottlenecks.

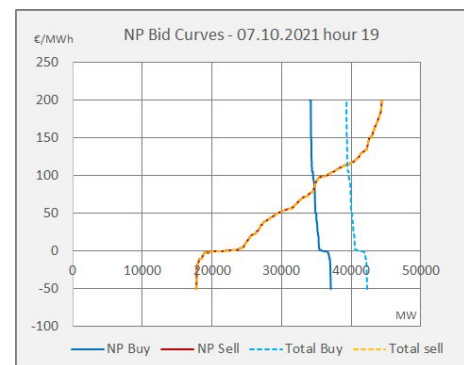


Fig. 4 - Market coupling adds about 5 GW export to the Nordic production

There will always be bottlenecks somewhere in the grid. It takes comprehensive analyses to find a fair capacity level. The construction of a large transmission line can take a decade or more. It seems to be a major problem in most countries, that grid expansions are lagging much behind the schedules. It is another problem that the green transition is changing production structures in a way, which has not been considered in the grid planning. This mismatch causes increasing cost due to curtailments of solar and wind power.

European energy markets will remain unstable in the years ahead

The price variations during the years 2019 to 2021 are common for all the countries in the Nordpool statistic.

€/MWh	EE	LV	LT	AT	BE	DE-LU	FR	NL	UK
2019	45,96	46,38	46,23	39,61	37,41	37,30	38,20	38,81	44,73
2020	33,57	33,93	33,92	33,00	31,73	30,30	32,05	32,08	39,29
2021	68,45	69,62	70,77	73,07	70,78	69,57	71,91	72,28	104,64

Table 3 - Average spot prices for nine countries. The prices for 2019 are based on only 25 weeks for the last six countries. For 2021, all prices are based on 39 weeks.

The explanations in previous sections are focused on variations in wind conditions and inflow of water to the hydro systems. The supplies of gas has also been a limitation in 2021. IEA

says in its Gas Market Report, Q4 2021, that "*the combination of recovering economic activity, lower liquefied natural gas (LNG) availability and a succession of severe weather events has put the global gas system under strong pressure and sent market prices to new highs.*"

The lesson of the energy crises in 1973 and 1979 was that dependence on imported energy could be a threat to normal life in Europe. In the following years, the aim of energy policy was to develop more robust energy systems. The present instability of the European energy markets suggests that this experience has been forgotten or ignored. The instability will be characteristic for European energy markets for many years to come.