Electricity Supply without Large Units in Denmark

The large Danish power plants have had other purposes than producing electricity and heat. They were necessary for the security of supply by providing short circuit capacity, rotational inertia and reserves of reactive power.

New synchronous compensators can now provide essential security functions together with reserve capacities abroad. Five synchronous compensators commissioned between 1965 and 2014 have a total capacity at 930 MVA. After decommissioning of two power plants, the generators with a total capacity at 1210 MVA were left as synchronous compensators.

When heat demand is low and electricity spot prices are low, the large thermal power plants must stop for economic reasons. The local CHP units must follow soon because their subsidy arrangements are expiring.

Several people have noticed the low electricity production from large Danish CHP units on 7 June 2017. This note is an attempt to characterize the situation with a few simple charts.

Fig. 1 - High price volatility in Germany

Fig. 1 shows the spot prices in the day-ahead-market.

One reason for the interesting conditions on 7th June can be found in Germany. The German spot prices oscillated from less than two €/MWh to more than 25 €/MWh. The Danish price zones had throughout the day the same prices as the adjacent price zones in Norway and Sweden.

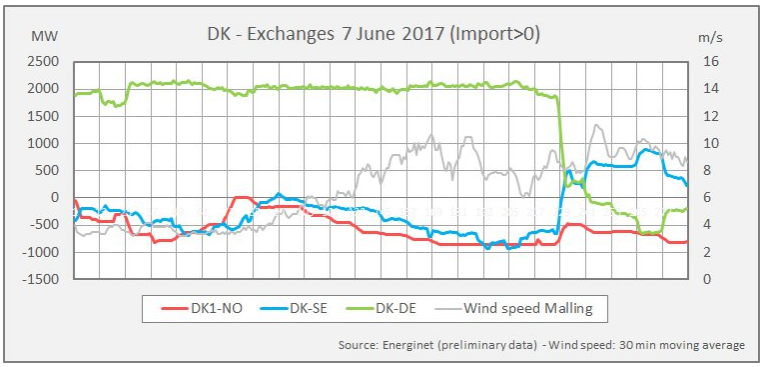

Fig. 2 - Transit from Germany to Norway and Sweden until 19:00.

This price profile corresponds to full loaded interconnections from Germany and some available capacity left on interconnections between Denmark and the other Nordic countries.

Fig. 2 confirms this expectation. The total Danish import from Germany was about 2,000 MW until 19:00.

Fig. 2 also shows the wind speed, recorded onshore in Denmark. The wind conditions were not extreme and the Danish

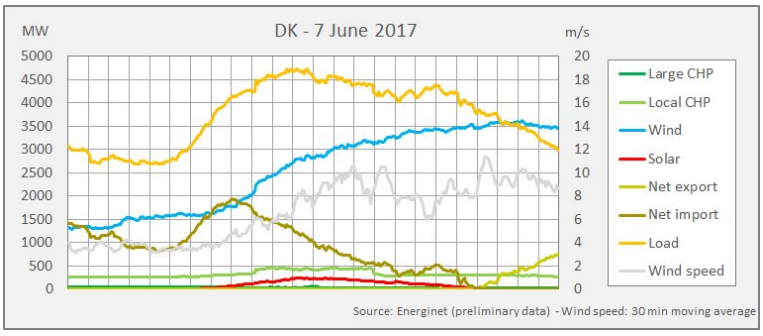

Fig. 3 - Average output from large CHP: 36 MW

wind observation does not explain the sudden change in Germany at 19:00.

The overview in fig. 3 shows the insignificant thermal generation in Denmark on 7th June. Fig. 4 is a magnification. Most "Large CHP" is output from the straw-fired 35 MW unit at Odense (heat 84 MJ/s). It is classified as Large CHP because there are large units at the same site.

No large units were connected to the grid in Denmark on 7 June 2017.

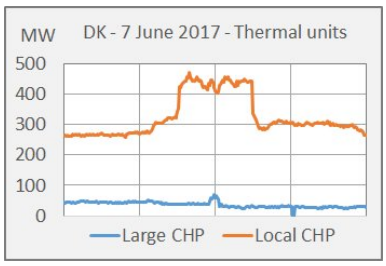

Fig. 4 - Low CHP output in June

A net import up to 2000 MW at 08:00 and a net export up to 700 MW at the end of the day balanced the Danish power systems.

The original idea of a power system, dominated by fluctuating and non-controllable generation, was to activate flexible demand for balancing and to organize an interaction between electricity and heat supply. So far, the demand side has contributed very little, and the CHP-systems are on the decline, so this option will be less important.

Other developments have contributed much more to a successful integration of wind power in Denmark. Most important are the international electricity markets and the reinforced interconnections.

However, the trees do not grow up to the sky. The volatile German spot prices show that Germany cannot balance its own power system either. Therefore, the development in Germany is much more interesting than the Danish achievements.

Fig. 5 has been downloaded from agorameter.de in order to give an idea of the situation in Germany.

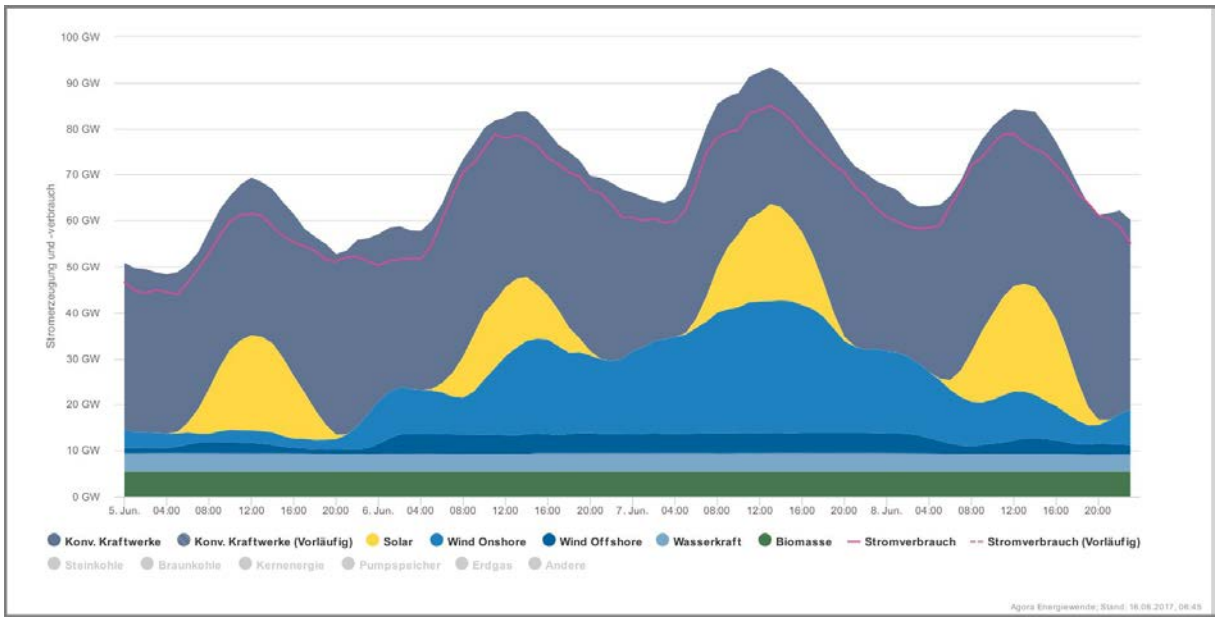

Fig. 5 - The German surplus of power exceeded 8 GW at noon on 7 June

Agorameter.de also specifies net export per neighbouring country and per hour (fig. 6).

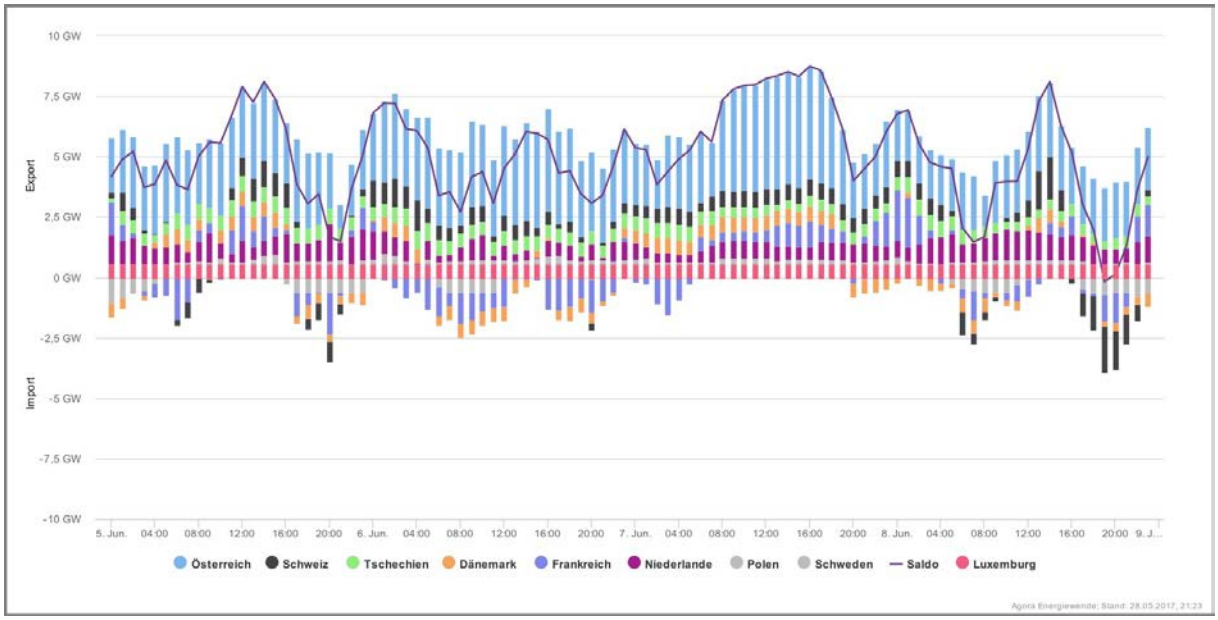

Fig. 6 - Most of the German electricity surplus was exported to Austria.

The massive German export suggests that the planned German transmission links may have other purposes than supplying electricity from Northern Germany to industrial consumers in Southern Germany. They will also serve the conveyance of electricity to countries in Southern Europe.

Austria has an important role as distributor of electricity from Germany and the Czech Republic. Austria consumes a share of the import. The rest is passed on to Italy, Hungary, Slovenia and Switzerland.

Austria GWh	Resulting import	From Germany	From Czech	To Italy	To Hungary	To Slovenia	To Switzerland
05.06.2017	12,4	48,9	18,5	4,7	13,4	25,2	11,7
06.06.2017	19,9	47,3	18,2	-0,1	20,9	20,5	4,3
07.06.2017	21,1	57,1	20,6	3,4	21,1	19,4	12,7
08.06.2017	12,0	38,6	22,8	2,9	17,5	20,3	8,7

Table 1 – Electricity from Germany and the Czech Republic re-exported from Austria (Source: ENTSO-E)