

Increasing Curtailed Production in West Denmark

An article in the Danish engineer's magazine "Ingeniøren" (46 2019) discusses the increasing curtailment of Danish wind power. The curtailment is a result of 'special regulation', a tool, which will be explained and discussed in this note.

The Regulating Power Market

The day-ahead market defines preliminary balances for the two Danish market zones, hour by hour. The system operator, Energinet, must be able to adjust the preliminary plans in real time, when unpredicted changes occur. Market participants can make bids for regulation up and down in the 'Regulating Power Market'. Energinet can any time select the cheapest bid for the next regulation up or down in order to maintain the planned system balance.

Regulating-power bids are submitted to Energinet, who in turn enters the bids on the common IT platform for the Nordic regulating power market, NOIS (Nordic Operational Information System).

Energinet has explained the Regulating Power Market in [1].

Any change of production or consumption will change the flow of power in the grid. Changes may cause overloads, particularly during wind power peaks. In such cases, Energinet must be able to use alternative bids that are more expensive. This option is called 'special regulation'. See Energinet's explanation in annex 1.

As an exception, special regulation can be used in West Denmark (DK1) for relieving German grid problems. Helping Germany can be profitable for Danish market participants.

The Increasing Curtailment of Production in West Denmark

The volume of special regulation is available from Nordpool¹.

The Nordpool data specifies up- and down-regulation, hour by hour, but it does not tell if the curtailed production is wind or thermal power or if the curtailment was caused by German or Danish grid problems.

However, it is clear from the data that special regulation down in West Denmark (DK1) is increasing and much larger than the three other categories of Danish special regulation (fig. 1). The 1.2 TWh curtailment in 2018 is 5.7% of the electricity consumption in West Denmark in 2018.

It remains to be seen if the new Cobra cable to the Netherlands will break the trend. The new link was commissioned in September 2019.

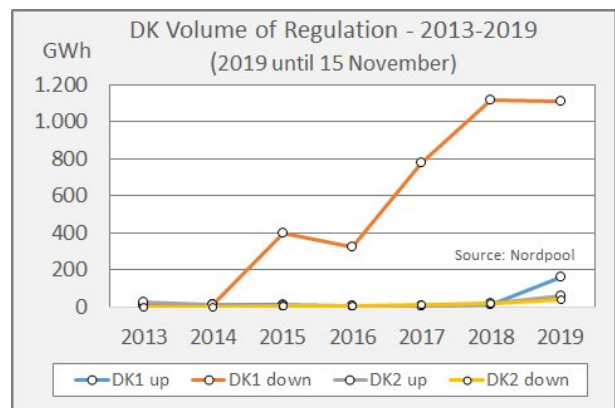


Fig. 1 - Curtailments of power in West Denmark exceed by far other Danish special regulations

¹ <https://www.nordpoolgroup.com/historical-market-data/>

The next question is if the curtailment is related to wind power.

I have selected September 2019 for a comparison between wind power and special regulation down (fig. 2).

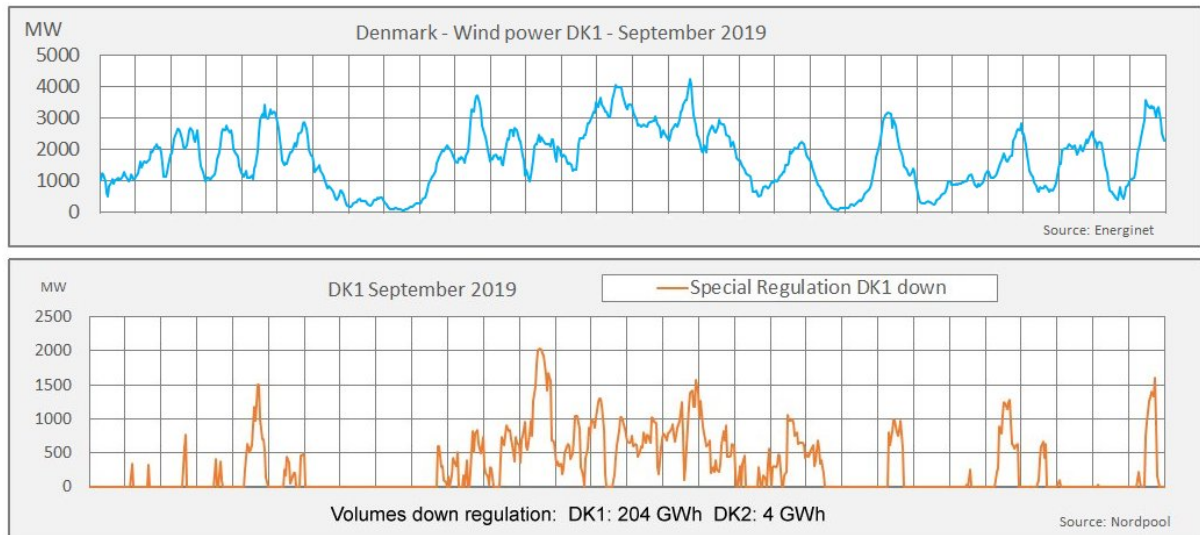


Fig. 2 - Special regulation seems to be related to wind power output

Fig. 2 suggests some interrelation between local wind power and special regulation, but other factors may also play a role. The correlation coefficient is 0.50.

Based on the observations we assume that increasing penetration of wind power will cause increasing curtailment of production, unless targeted measures can counteract congestions in the grids.

The race between additional wind power and new measures for absorbing wind power oscillations has begun.

For the time being, the volume of special regulation seems to be the best indicator of congestion.

Side Effects of the Green Transition turned up as a Surprise

Bulk transports beyond the capacity of existing power grids and curtailment of wind power are predictable effects of the green transition. Nevertheless, these consequences seem to have come as a surprise to Danish decision makers and experts.

Unfortunately, available time series on curtailment are incomplete. Further details are desirable in order to obtain a broader understanding of the challenges and a well-informed debate on possible solutions.

The Danish system operator, Energinet, has an *Energy Data Service*², covering the following categories:

- Production and consumption

² <https://www.energidataservice.dk/en/>

- Wholesale market
- Ancillary services
- Transmission lines
- Emissions
- Gas

Due to the increasing importance of congestion and special regulation, Energinet is preparing publication of time series with thorough information on special regulation. The new datasets are expected to be available sometime next year.

Energinet has kindly informed me that annual statistics on special regulation have been published [2]. I have deduced the following table:

Denmark, Special Regulation	2015	2016	2017	2018
Received from TenneT, Germany (GWh)	653	554	1.210	1.598
of which downregulated by Danish participants (GWh)	402	337	781	1.114
of which				
- Stop/reduction of thermal production (GWh)	101	172	500	590
- Start electric boilers (GWh)	141	94	172	234
- Stop wind power (GWh)	161	71	109	290

References

1. Energinet: Regulation C2, The balancing market and balance settlement, December 2017. 13/91893-80
2. Energinet: [Specialregulering 2015-2018](#)

Special Regulation

Energinet has the following explanation in [1]:

2.6 Special regulation

Special regulation is applied when Energinet makes a specific selection of regulating-power bids for upward or downward regulation disregarding the usual price order. This may occur either as a consequence of bottlenecks in Energinet's grid, bottlenecks/restrictions in the transmission grids of neighbouring areas or in case of announced or unannounced testing of reserve plants. Regulating-power bids used for special regulation are settled at the bid price (pay-as-bid).

A footnote explains pay-as-bid:

The pay-as-bid rule in connection with special regulation only applies if it has been necessary to bypass bids on the NOIS list in order to carry out the necessary regulation. If it turns out after the delivery hour that no bids on the list ranked according to price, NOIS, have been bypassed, the special regulation made is settled at the RP price of the area.