Monitoring Report

Date:
March 29, 2019

DK1-DE COUNTERTRADE FOLLOWING JOINT DECLARATION 2018

1. Introduction

The Danish Ministry of Energy, Utilities and Climate and the Federal Ministry of Economic Affairs and Energy of the Federal Republic of Germany together with the Danish Utility Regulator (DUR) and Bundesnetzagentur have agreed on a Joint Declaration.

The Joint Declaration aims to gradually increase the capacity between Denmark West (DK1) and Germany (DE) available to the day-ahead market by securing a minimum of available hour-ly import and export capacity (referred to as minimum capacities) in each hour on the inter-con-nector.

The Joint Declaration was launched on 3rd of July 2017 with a pilot phase lasting until the end of November 2017, and will until 2020 increase the minimum capacities in a stepwise approach, as Figure 1 shows.

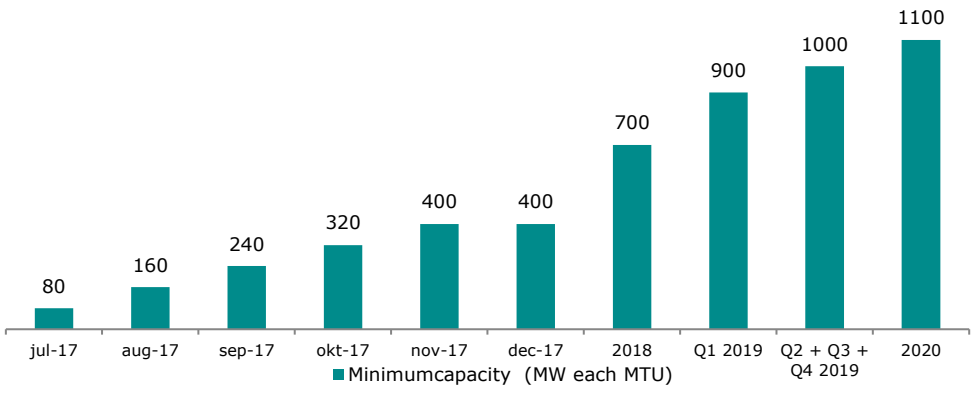


Figure 1 Minimum capacities (MW in every hour) following the Joint Declaration.

Following the Joint Declaration, the TSOs Energinet and TenneT have sent their collected figures of the previous months every quarter to the National Regulatory Authorities (NRAs) DUR and Bundesnetzagentur. The scope of this yearly monitoring report is to give an overview on the

total costs incurred, deviations from the Joint Declaration, reasons for deviations, challenges during the operations and opportunities for improving the execution of this Agreement.
The report follows the outline used for the pilot phase monitoring report, supplemented with additional information requested by the NRAs in their joint opinion on the first monitoring report in the following way:

- *Monitor and assess the impact on the Nordic mFFR market including possible spill-over effects between the Nordic regulating power market and the market for special regulation.*

  => Included as Appendix 1.

- *Include statistics on ordinary special regulation in DK1 and assess the interplay between ordinary special regulation and special regulation according to the Joint Declaration.*

  => Included in Chapter 3 and Chapter 6.

- *Include impact of countertrading on the German intraday market.*

  => Included in Chapter 5.

- *Monitor and assess the liquidity of the special regulation market.*

  => Included in Chapter 6.

- *Report on the status on grid development on both sides.*

  => Included in Chapter 7.

- *Include best estimates for future costs (already to include this in the monthly reports from august 2018 to the NRAs).*

  => Included in Chapter 4 based on the methodology accepted by NRAs at TSO-NRA workshop on 6th November 2018.

- *Include information on how the activated downward regulation is provided (consumption, thermal production, RES curtailment or by other means).*

  => Included in Chapter 6 for all special regulation.

In December 2018 TenneT made a commitment towards the European Commission[1] to implement additional demands that go beyond the Joint Declaration. From February 2019 on the minimum available capacities for the day-ahead market will be a combination of both obligations. However, for this monitoring report TenneTs commitment will be out of scope.

[1] See press release: https://www.tennet.eu/de/news/news/tennet-begruesst-entscheidung-der-eu-kommission-fuer-stromhandel-an-deutsch-daenischer-grenze/

2. Scope of countertrade

For each hour TenneT and Energinet separately calculate the available Net Transfer Capacity (NTC) in both directions for the DK1-DE border. The capacity offered to the market is determined by whichever TSO calculates the lowest transmission capacity on its side. The TSOs have to respect a limitation set on capacity by each other, as the method is used to restrict the flow on the interconnector to a volume that does not endanger the other TSO's system security.

With the implementation of the minimum capacity requirements, the TSOs have to secure a day-ahead NTC of at least the currently applicable minimum capacity in each hour as specified in the Joint Declaration. The capacity offered to the day-ahead market is defined as the highest value of either the aligned day-ahead NTC or the minimum capacity:

Day-ahead capacity = MAX(day-ahead NTC; minimum capacity)

Following this methodology, if one of the TSOs calculate the NTC on the border for a given hour, which is lower than the level of minimum capacity specified in the Joint Declaration, the TSOs are obliged to disregard the calculated NTC value for the day-ahead market, and instead increase the capacity to the level specified in the Joint Declaration.
On the other hand, if the calculated NTC is higher than the level of minimum capacities, the Joint Declaration is disregarded, and the calculated higher NTC is released to the market.

The Joint Declaration covers both directions at the border, which implies that TenneT and Energinet will have to secure the minimum capacities in both the import and export direction.

The minimum capacity requirement applies only to the day-ahead market. The Joint Declaration's intention is to secure day-ahead prices that reflect a capacity situation at the DK1-DE border without limitations imposed by internal grid elements. Given the fact that minimum capacities are applied in situations where the internal grid cannot sustain the actual physical flow resulting from the day-ahead market, the minimum capacity flow cannot result in actual physical flow, but needs to be countertraded by the TSOs. The minimum capacities apply when the reductions are caused by internal congestions, however, in hours with direct outages of the exact interconnectors between DK1-DE, the TSOs can disregard the minimum capacities.

Current measures used for countertrade are special regulation on the Danish side and trading on the continuous intraday market on the German side. These measures are described in detail in the report 'DK1-DE Countertrade Models Impact Assessment'[2]. The decision of Energinet to continue the use of special regulation beyond the pilot phase of the Joint Declaration has been based on a substantial stakeholder process and answers received as part of a public consultation in February/ March 2018.[3]

[2] Available at: https://www.tennet.eu/news/detail/publication-of-dk1-de-countertrade-models-impact-assessment/ and https://en.energinet.dk/About-our-news/News/2017/12/01/Energinet-and-TenneT-publish-final-impact-assessment-of-different-countertrade-models-for-DK1-DE

[3] Available at: https://en.energinet.dk/About-our-news/News/2018/04/23/Published-consultation-report

3. Amount of countertrade

The following figure shows the day-ahead capacity and day-ahead flow at the DK1-DE border.

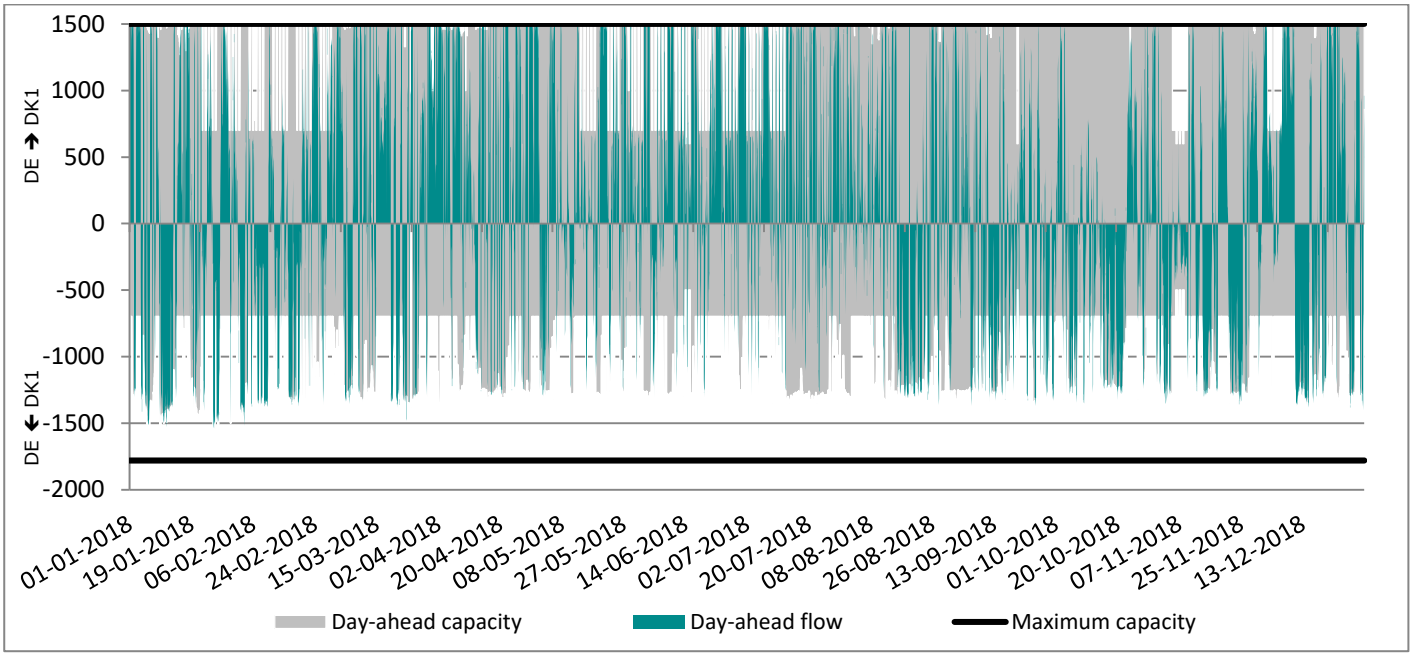


Figure 2 Day-ahead capacity and flow between Denmark West and Germany, MWh/h.

As can be seen in the figure there were a few hours where day-ahead capacity has been below the minimum capacity. This was due to maintenance on the exact interconnectors between DK1-DE:

- In 9 hours on the 24th of April 2018 and in 9 hours on the 14th of June 2018, day-ahead capacity was reduced below the minimum capacity, respectively to 500 and 600 MW, in the import and export direction on the DK1-DE border, due to maintenance on the 400 kV station Jardelund, which is an integral part of the cross-border interconnector Kassø-Jardelund[4].
- In 10 hours on the 20th of September 2018, day-ahead capacity was reduced below the minimum capacity, respectively to 500 and 600 MW, in the import and export direction on the DK1-DE border due to maintenance on the overhead line between the station Jardelund and the station Kassø, which is an integral part of the cross-border interconnector Kassø-Jardelund [5].
- In 9 hours on each the 6th, 7th and 8th of November 2018, day-ahead capacity was reduced below the minimum capacity, respectively to 500 and 600 MW, in the import and export direction on the DK1-DE border, due to maintenance on the overhead line between the station Jardelund and the station Kassoe, which is an integral part of the cross-border interconnector Kassø-Jardelund [6].

[4] https://umm.nordpoolgroup.com/#/messages/95a99206-db9b-4464-ba47-a5b057c715b0/2

[5] https://umm.nordpoolgroup.com/#/messages/0e5c0787-570f-46be-9bde-f6f2a66ca4d0/1

[6] https://umm.nordpoolgroup.com/#/messages/205bdb18-b712-4771-af40-b3ed17e78fa7/2
https://umm.nordpoolgroup.com/#/messages/205bdb18-b712-4771-af40-b3ed17e78fa7/1

The following table shows the general overview of the use countertrade according to the Joint Declaration in 2018.

2018	Hours with counter-trade	Countertrade as of total hours per month	Countertrade (MWh)
Jan	99	13%	41.103
Feb	161	24%	57.584
Mar	104	14%	41.170
Apr	14	2%	2.479
May	196	26%	61.382
Jun	154	21%	24.986
Jul	74	10%	5.036
Aug	46	6%	22.736
Sep	159	22%	60.030
Oct	221	30%	115.669
Nov	188	26%	69.788
Dec	121	16%	50.621

Table 1 Overview of countertrade following Joint Declaration.

The following table shows the costs by Energinet and TenneT for 2018.

2018	Costs in Den-mark West (EUR)	Costs in Ten-neT area (EUR)	Average costs Ener-ginet (EUR/MWh)	Average costs TenneT (EUR/MWh)	Total costs (EUR)	Acc. Costs (EUR)
Jan	-214.481	1.711.724	-5,22	41,64	1.497.243	1.497.243
Feb	-1.191.505	2.604.572	-20,69	45,23	1.413.067	2.910.310
Mar	533.362	1.811.373	12,96	44,00	2.344.735	5.255.045
Apr	-50.838	86.017	-20,51	34,70	35.179	5.290.224
May	83.453	2.298.580	1,36	37,45	2.382.033	7.672.257
Jun	-76.662	1.224.163	-3,07	48,99	1.147.501	8.819.758
Jul	-9.331	303.558	-1,85	60,28	294.226	9.113.984
Aug	-468.472	1.350.195	-20,6	59,39	881.723	9.995.707
Sep	-172.133	3.084.342	-2,87	51,38	2.912.209	12.907.916
Oct	435.094	6.703.237	3,76	57,95	7.138.331	20.046.247
Nov	-964.081	3.848.134	-13,81	55,14	2.884.053	22.930.300
Dec	-569.952	2.907.513	-11,26	57,44	2.337.561	25.267.861

Table 2 Total countertrade costs for Energinet and TenneT (negative numbers indicate revenues).

The above tables reflect the volumes and prices for special regulation and intraday trade used for Joint Declaration countertrade. The following figure shows the total volumes of requested special regulation from TenneT, split according to countertrade following Joint Declaration and regular countertrade.

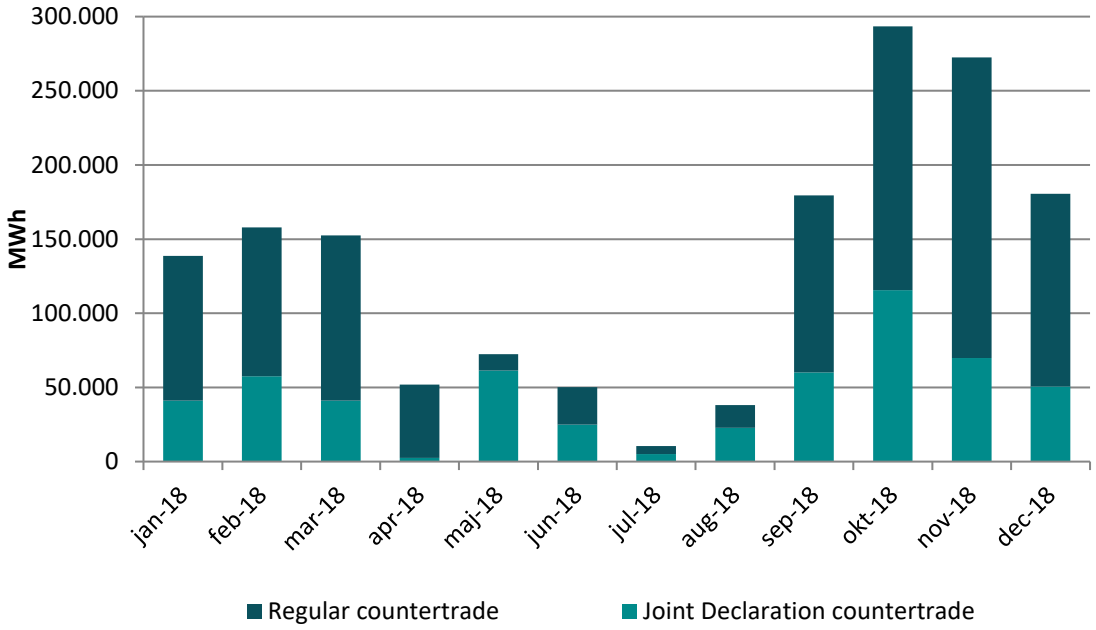


Figure 3 Total requested countertrade and share of Joint Declaration countertrade.

4. Forecast of countertrade costs

During a joint workshop between DUR, Bundesnetzagentur, Energinet and TenneT in November 2018, a method to estimate the future costs from the Joint Declaration was agreed.

In order to estimate the costs of countertrades induced by the Joint Declaration Energinet and TenneT developed a tool which forecasts the costs based on historical data. For forecasting costs for 2019 and 2020 historical data from 2018 is used.

The forecast has to consider the following elements:

1) Forecast of countertrade volume, based on:
- Hours with countertrade
- Countertrade volume in hours with countertrade

2) Forecast of northbound and southbound flow as minimum capacities apply for both the northbound and southbound direction at the border. Therefore, the forecast has to consider the direction of the countertrade.

3) Forecast of prices for upward and downward regulation

Out of all hours in 2019 and 2020, TSOs will only apply minimum capacities in a fraction of these hours. Further, even though the minimum capacities apply in some hours, this will not always result in countertrade, as this dependents on the day-ahead flow. Lastly, in hours with countertrade due to the minimum capacities, the countertraded capacities could be lower than the minimum capacities. These assumptions will result in a projected volume of countertrade in 2019 and 2020.

As a starting point the countertrade volume (MWh) is estimated as the product of estimated number of hours with countertrade and the respective countertrade volume per hour. The estimation of the number of hours with countertrade is based on the assumption that the share of hours with countertrade will equal the share of hours with countertrade observed in 2018. Therefore, the number of hours with countertrade in 2018 is devided by the number of hours of 2018 (8.760). The resulting ratio could be applied to the duration (number of hours) of any projection period to estimate the number of hours with countertrade in that period.
The estimation of the countertrade volume per hours is based on the assumption that the average countertrade per hour with countertrade per megawatt minimum capacity will equal the average observed in 2018. Therefore, the hourly countertrades are divided by the respective level of minimum capacity (i.e. 700 MW throughout 2018) and the number of hours with countertrade in 2018. The resulting ratio could be applied to the level of minimum capacities of any projection period to estimate the average hourly countertrade volume.

In a second step the volume is allocated to the directions based on the historical distribution of the flow.

In the third and last step the volumes are priced at the historical average price spreads for north- and sourthbound countertrades based on the respective historical upward and downward regulation prices in Denmark West and Germany. The costs where estimated for three different cases. In the normal case the estimated price spreads equal the histrorical price spreads from 2018. The best case scenario assumes that the price spreads for 2019 and 2020 will be 25%

below the level of 2018 while the worst case scenario is based on 25% higher price spreads compared to 2018. The table below shows the assumptions upon which the estimations are made.

	Normal Case	Best Case	Worst Case
CT hours	18%	18%	18%
Average price upward ENDK (EUR)	50,67	.49,67	51,68
Average price downward ENDK (EUR)	-6,07	-11,60	-0,54
Average price upward TTG (EUR)	50,32	44,79	55,86
Average price downward TTG (EUR)	-42,63	-43,64	-41,63

Table 3 Assumptions for cost estimation.

The respective results of the forecasts are shown in the table below.

	Jan – Mar 2019	Apr – Dec 2019	Sum 2019	Sum 2020
MinCap according to Joint Declaration (MW)	900	1.000	-	1.100
CT hours	379	1.137	1.516	1.516
Total costs Normal Case (EUR)	8.010.585	26.701.948	34.712.533	39.162.858
Total costs Best Case (EUR)	6.007.938	20.026.461	26.034.400	29.372.143
Total costs Worst Case (EUR)	10.013.231	33.377.436	43.390.666	48.953.572

Table 4 Forecast of Joint Declaration costs.

5. Countertrade in Germany

The following figure shows information on the countertrade prices for TenneT on the German intraday market. It reflects the minimum and maximum price for countertrading on a monthly basis. In 21 hours in 2018 the price for countertrading in the German intraday market was negative.

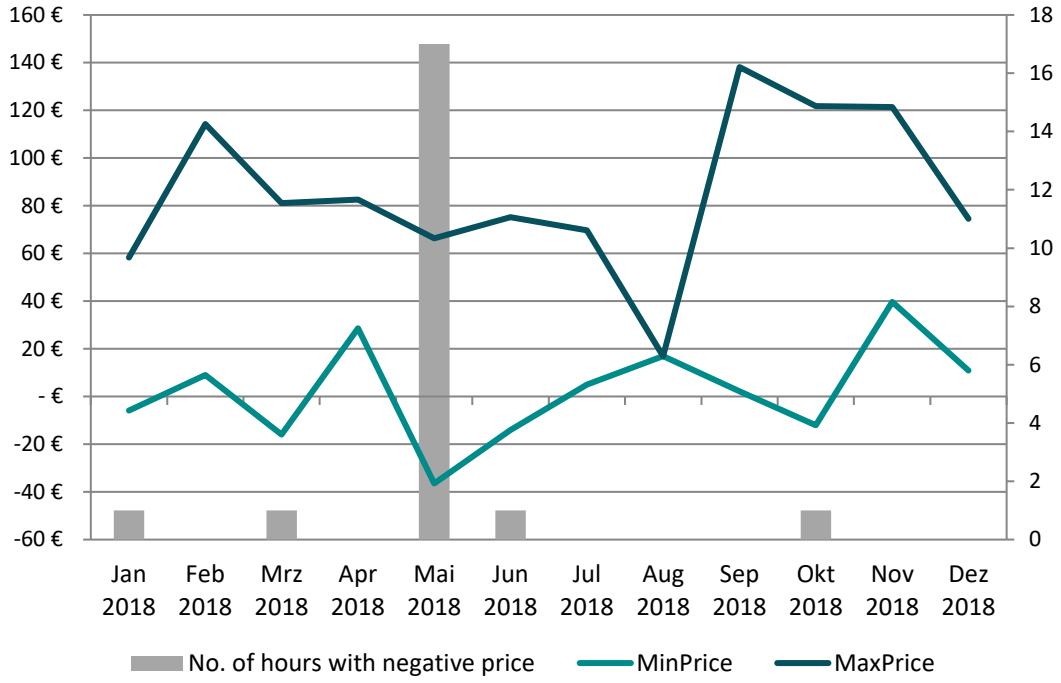


Figure 4 Prices on the German intraday market.

5.1 Impact of countertrading on the German intraday market

5.1.1 General

The German intraday market consists of two sub-markets, the opening auction and the subsequent continuous trading session. In the opening auction, all bids entered before gate closure are cleared in a single step. By contrast, continuous trading is a first come, first served market where, during a period of several hours, trades are executed as soon as a bid matching an existing bid is entered by a market participant. As TenneT performs countertrading exclusively in the continuous trading session, and in order to avoid an underestimation of its impact on the intraday market, the present monitoring focuses on the continuous trading. Theoretically, it would be appealing to analyse the impact of countertrading on the intraday market by comparing the actual historical market outcome with a fictitious alternative outcome that would have occurred without the countertrading activities. However, it is not feasible in practice to determine this counterfactual outcome, for reasons set out in the following.

Firstly, removing TenneT's activities from the continuous intraday market and simulating the then different fictitious market result would not be enough to describe the counterfactual situation. This is because market participants may have anticipated the need for countertrading and consequently adjusted their bidding behaviour on the earlier market stages, i.e. day-ahead and/or intraday opening auction. Yet it is not feasible to separate such potential adjustment activity from the overall bidding behaviour on these market stages.

Secondly, even the isolated (and thus incomplete) simulation of the alternative outcome of the continuous intraday market without TenneT's countertrading is infeasible. This is not only be-

cause also in this market stage the bidding behaviour of other participants may have been influenced by their anticipation of the countertrading. Even more generally, the nature of continuous trading prevents such simulation: Since each pair of matching bids is cleared separately and instantly, the market situation and price evolve in the course of the trading session, as market participants learn about executed trades and about the evolution of the "external" situation (materialising of renewable injection forecast errors, unplanned power plant outages, etc.). There are neither sufficient data nor models available to simulate how the multitude of individual actions and decisions throughout the remaining trading session would have been altered if some bid (by TenneT) had not been placed.

On the backdrop of the above considerations, the following analysis is exclusively based on actual historical market data and abstains from simulating fictitious counterfactuals.

5.1.2 Results

The following figure shows the volume of countertrading by TenneT in relation to the total continuous intraday trading volume in the German[7] bidding zone in hourly resolution. Countertrading was conducted in 17,5 % of all hours, with a maximum share in total volume of 22 %. The average volume share of the intraday market during hours with countertrading was 6,5 %, while the average volume share across all hours of the year was 1,1 %.

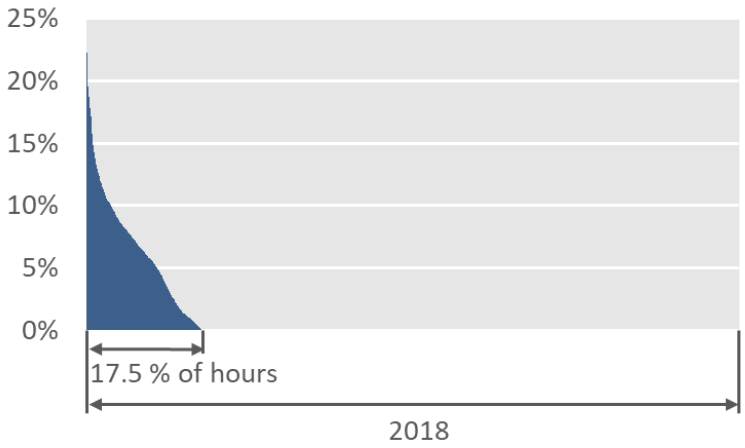


Figure 5 Hourly share of countertrading volume in continous intraday trading volume (sorted)

The impact of countertrading on the market prices is analysed by comparing day-ahead to intraday[8] prices and setting the difference between these in relation to the volume of countertrading. The analysis yields a positive correlation with a correlation coefficient of 0,25 across all hours with countertrading. This finding is underpinned by the – albeit moderate – positive slope of the red regression straight in the following figure: The more countertrading was conducted in direction from DE to DK1, i.e. the more energy TenneT bought in the German bidding zone, the higher the intraday price was relative to the day-ahead price for the same delivery hour.

7 Until 30/09/2018: Joint German-Austrian bidding zone

8 Volume weighted prices of all successful trades per delivery hour; trades for 15 and 30 minutes periods weighted by ¼ and ½, respectively.

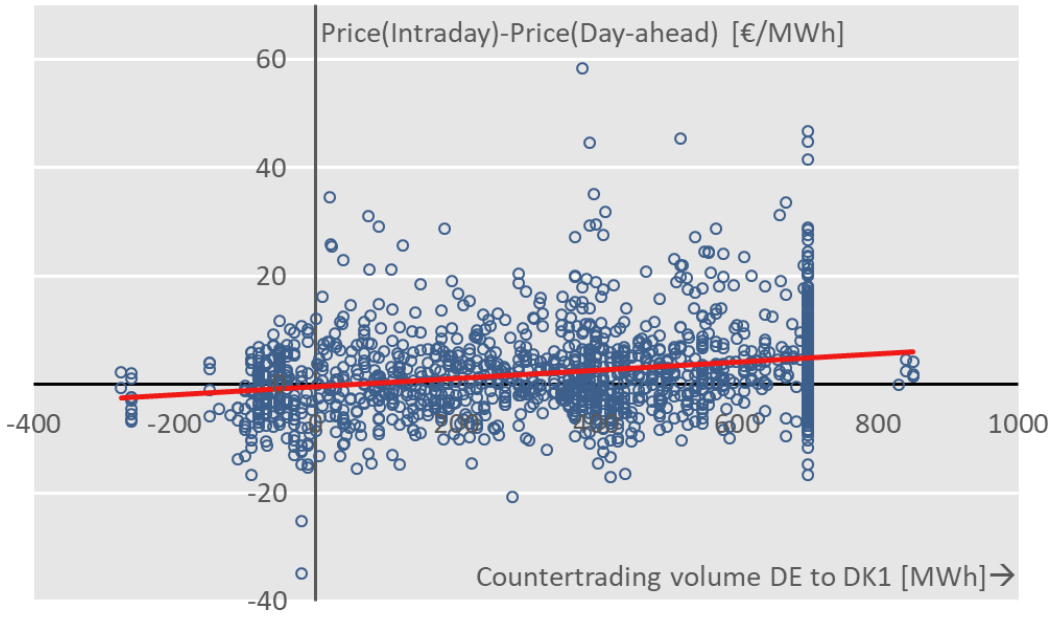


Figure 6 Relation between price difference (intraday vs. day-ahead) and countertrading volume for hours with countertrading. Positive volume denotes buying in DE and selling in DK1.

6. Special regulation in Denmark West

The following table provides an overview of the total volume of bids in the regulating power market in Denmark West. Please note, that the following volumes are not split according to countertrade conducted due to the Joint Declaration, regular countertrade towards TenneT or use of special regulation towards the Nordic, as Energinet is not able to make this split in the data at this given point.[9]

2018	Offered bids of upward regulation (MWh)	Offered bids of downward regulation (MWh)	Activated bids of upward regulation for balancing (MWh)	Activated bids of downward regulation for balancing (MWh)	Requested volumes of downward regulation for special regulation towards TenneT (MWh)	Requested volumes for upward regulation for special regulation towards TenneT (MWh)
Jan	776.968	1.170.578	12.301	6.619	138.753	0
Feb	592.737	1.197.540	8.708	8.346	157.824	2.210
Mar	717.175	1.331.392	25.912	17.358	152.512	4.242
Apr	701.642	1.035.771	8.702	14.980	52.011	10.420
May	591.250	605.266	13.030	6.092	72.336	7.764
Jun	426.435	630.224	3.330	3.015	50.182	6.447
Jul	454.242	630.103	5.570	513	10.460	2684
Aug	510.482	793.828	9.597	2.483	38.076	785
Sep	558.330	1.066.190	11.701	8.289	179.561	450
Oct	687.216	1.226.966	13.839	9.397	293.510	2.740
Nov	629.013	1.203.111	9.853	2.670	272.381	0
Dec	682.455	1.396.178	17.773	6.642	180.643	130

Table 5 Volume of offered and activated bids in the regulating power market in Denmark West. Note: Special regulation is total request MWh from TenneT.

The volume of bids is higher during the winter and spring season, as the demand for regulating power is higher these months, and more capacity is available due to higher heat production. The regulating volume bids are first and foremost reserved for balancing of the Nordic system, however if there are additional bids available, these can be used for special regulation towards TenneT.

[9] In the joint opinion of DUR and Bundesnetzagentur on the implemention of the Joint Declaration for DK1-DE monitoring report, NRAs asked for information on how the activated downward regulation is provided (consumption, thermal production, RES curtailment or by other means). At Energinet, the necessary IT changes to split the countertrade from the Joint Declaration and regular countertrade are still on-going. Due to the prioritization of among others essential infrastructure projects (COBRA Cable (DK1-NL) and Kriegers Flak (DK2-DE)), Energinet cannot meet this requirement of the NRAs and cannot, at present, indicate a timeframe for when the IT development will be made. Energinet will of course follow the IT resource problem closely and provide updates if and when the resource outlook changes.

The following duration curve shows the liquidity of the regulating power market in DK1, and the percentage use of offered upward and downward regulation. The curve is not split according to the use for special regulation or balancing.

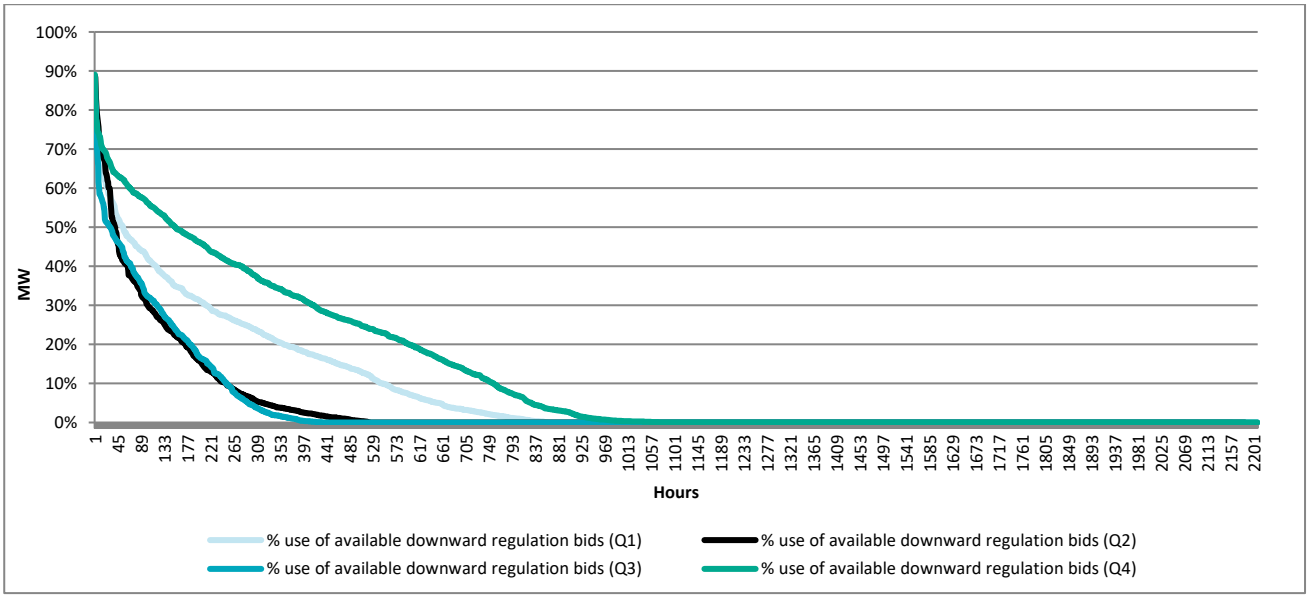


Figure 7 Duration curve of % use of offered downward regulation in DK1.

The figure shows that in three hours in Q1, four hours in Q2, three hours in Q3 and two hours in Q4, Energinet activated over 80 % of all offered downward regulation in DK1, however the highest use of activated bids was 89 % in a single hour. The figure also shows that in more than 1300 hours in Q1, 1600 hours in Q2, 1700 hours in Q3 and 1100 hours in Q4, none of the offered downward regulation in DK1 was used.

The following figure shows the duration curve for upward regulation in DK1.

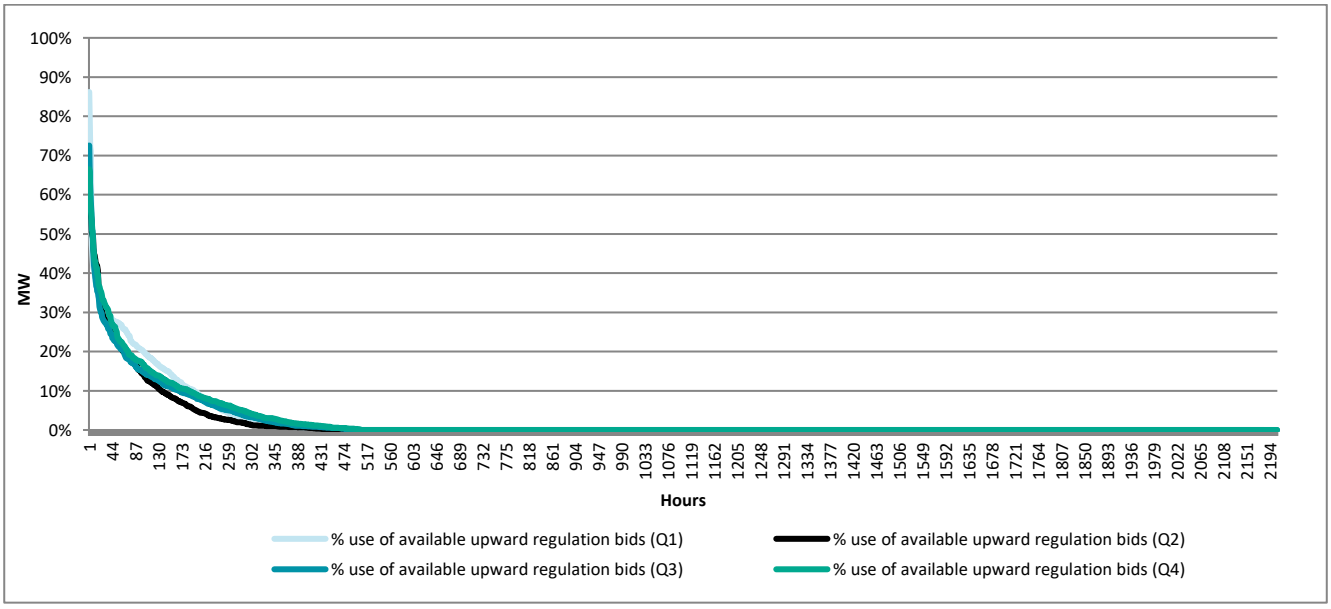


Figure 8 Duration curve of % use of offered upward regulation in DK1.

The requested volumes of down- and upward regulation towards TenneT reflect the amount requested from TenneT, whereas the activated volumes might differ. This is due to the imbalance netting procedure. Imbalance netting is the process agreed between TSOs that allow for the avoidance of simultaneous activation of balancing power, i.e. mFRR, in opposite directions

by taking the respective and adjacent area control imbalances into account, in order to maximize social economic welfare[10].

The following table shows the activated volumes of special regulation in Denmark West, and specifies the source of the downward regulation, i.e. if the downward regulation is delivered by production, wind or consumption. Please note, that the following volumes are not split according to countertrade conducted due to the Joint Declaration, regular countertrade towards Tennet or use of special regulation towards the Nordic, as Energinet is not able to make this split in the data at this given point.

	Activated volumes of downward regulation for special regulation (MWh)	Delivered by wind	Delivered by consumption	Delivered by production	Activated volumes of upward regulation for special regulation (MWh)	Delivered by wind	Delivered by consumption	Delivered by production
Jan	111.980	12%	25%	63%	44	0%	0%	100%
Feb	102.075	3%	16%	81%	202	0%	0%	100%
Mar	121.790	33%	25%	42%	413	0%	0%	100%
Apr	25.923	8%	24%	69%	2.850	0%	0%	100%
May	39.586	39%	30%	31%	2.203	0%	0%	100%
Jun	25.350	64%	26%	10%	1.914	0%	0%	100%
Jul	5.616	39%	10%	51%	1.855	0%	0%	100%
Aug	17.455	25%	23%	52%	2.159	0%	0%	100%
Sep	123.469	51%	19%	30%	1.136	0%	0%	100%
Oct	228.948	33%	20%	47%	1.023	0%	0%	100%
Nov	196.604	18%	20%	62%	19	0%	0%	100%
Dec	135.261	15%	20%	65%	105	0%	0%	100%

Table 6 Activated volumes for special regulation, split by source.

[10] See description in Energinet and TenneT common Impact Assessment

7. Status on grid development

7.1 Status grid development directly related to the DK1-DE border

Grid extensions related to the DK1-DE border include the Kassø-Dollern project (on Energinet's side called "Eastcoast Line" and on TenneT's side called "Middle Axis") and the Endrup-Brunsbüttel extension (called "West Coast Line"). The following two sections include a short description and progress for both projects.

7.1.1 Kassø-Dollern (Energinet: Eastcoast Line; TenneT: Middle Axis):

The table below shows the different project sections, their size and status.

Section	Responsible TSO	Total route length [km]	Realised rout length [km]	Status/Planned commissioning
Dollern - Elbekreuzung	TenneT	10	0	2019
Elbekreuzung – Hamburg/Nord	TenneT	35	30	2019
Hamburg/Nord – Audorf	TenneT	70	70	In commission
Audorf - Flensburg-Handewitt	TenneT	70	0	2020
Flensburg-Handewitt – DK/GER border	TenneT	10	0	2020
DK/GER border – Kassø	Energinet	30	0	2020

Table 7 Status of the project Kassø-Dollern.

For the Handewitt-Kassø part, substations construction work is progressing according to plan. Overhead line construction work started in Denmark March 2019 and in Germany from August 2019. It is expected that commissioning will be in second half of 2020 (originally planned to end of 2020).

7.1.2 Endrup-Brunsbüttel (West Coast Line):

The table below shows the different project sections, their size and status.

Section	Responsible TSO	Total route length [km]	Realised rout length [km]	Status/Planned commissioning
Brunsbüttel - Süderdonn	TenneT	14	14	In commission
Süderdonn – Heide	TenneT	23	17	2019
Heide – Husum	TenneT	46	2	2021
Husum – Klixbüll	TenneT	38	0	2022
Klixbüll – DK/GER border	TenneT	16	0	2021
DK/GER border – Endrup	Energinet	75	0	2023

Table 8 Status of the project Endrup-Brunsbüttel.

The project is in the permitting phase in both Germany and Denmark. The Danish part of the project has been postponed one year due to postponement of the Viking Link project. Commissioning was planned end of 2022 which in 2018 was postponed to end of 2023.

Approval from Danish authorities is expected for Q2 2020. Final agreements with landowners in Denmark are expected to be reached in Q1 2022. Approval from German authorities is planned for Q1 2021.

Overhead line construction work in Germany will commence from Q2 2021, while overhead line and underground cable construction work in Denmark will start in Q2 2022. Commissioning is planned for end of 2023.

8. Appendix 1: Report on special regulation in 2018

8.1 Summary

In connection with the adoption of the Joint Declaration in spring 2017 and its ongoing implementation, the Danish Utility Regulator has requested an analysis of the interaction between the special regulation market and the ordinary regulating power and balance market. More specifically, the analysis must investigate:

- Whether special regulation affects the price of upward and downward regulation in the balance market
- The interaction between the special regulation/pay-as-bid and balance regulation/pay-as-clear
- Possible spill-over effects from one market to the other

This memorandum contains the results of the analysis based on data from 2018. The Danish Utility Regulator will decide at a later date whether the analysis is only required for 2018, or must be updated annually.

Conclusion

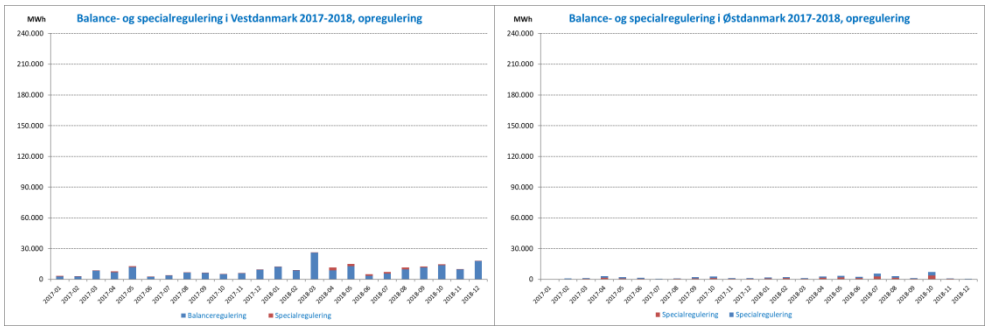
Special regulation reached new heights in 2018 with the delivery of 1.6 TWh from Germany to Denmark. The selected countertrade model – special regulation – has functioned satisfactorily throughout the entire period and provided the desired volume. The volume of available regulating power bids has gradually increased in step with the increase in demand.

Handling the extraordinary imports has significantly reduced the scope and price of upward regulation in the Danish balance market. However, handling special regulation in the form of Danish downward regulation has not noticeably affected the price for downward regulation in the Danish balance market. Finally, it has been noted that certain players are using their knowledge of special regulation to reduce their purchases in the spot market at certain times ('under scheduling').

8.2 Scope of special regulation

The figures below show the scope of special regulation in Eastern and Western Denmark. It is very clear from the figures that apart from sporadic deliveries of upward regulation as special regulation, it is downward regulation in Western Denmark that stands out with extensive special regulation.

Given the concentration of special regulation in the context of downward regulation in Western Denmark, all subsequent analyses and illustrations focus solely on downward regulation in Western Denmark from 1 January to 31 December 2018, and no distinction is made between special regulation with reference to the Joint Declaration and other special regulation across the Jutland-German border.



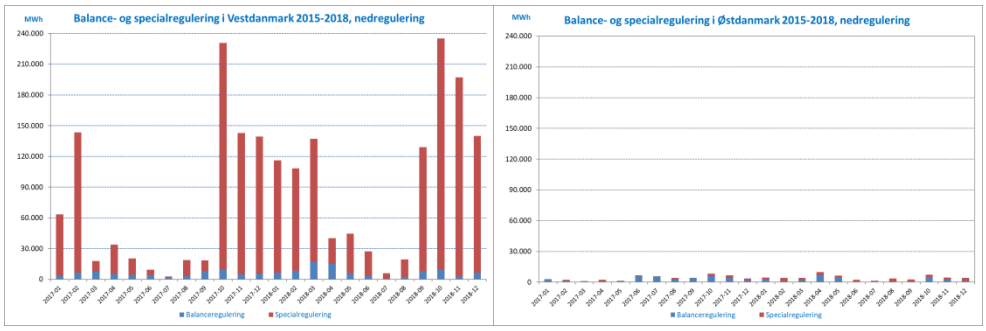


Figure 9: The scope of special regulation in 2017-18 in Eastern and Western Denmark

8.2.1 Key figures for 2018

TenneT has sent 1,598 GWh across the Jutland-German border as part of the countertrade arrangement on the German side in 2018. Approx. 70% of these energy deliveries were downward regulated by Energinet at Danish players (1,114 GWh), while 30% were used to equalise the upward regulation requirement in the Nordic region (484 GWh).

The cost of downward regulation at Danish players was DKK 79 million, while the set-off in the Nordic regulating power market resulted in an income of DKK 150 million. Overall, the energy volume gave Energinet a net income of DKK 71 million (150 - 79), and this amount has been credited to TenneT.

Equalisation of the upward regulation requirement is often called 'netting', as the method involves using surplus energy from Germany to cover any upward regulation requirement among Danish players or in the Nordic region, prior to activating downward regulation bids with Danish players. When surplus energy is used to cover an upward regulation requirement, the price paid for the delivery is at least the spot price for the given hour. The price for netting in connection with equalising the upward regulation requirement in 2018 was DKK 280/MWh on average.

It is apparent that netting, as part of the special regulation countertrade model, significantly contributes to giving TenneT an attractive price for the sale of surplus power in Denmark.

8.2.2 Technology-specific downward regulation prices

As mentioned in the previous section, 1,114 GWh of TenneT's total delivery was eliminated by means of downward regulation at Danish players. Players in the other Nordic countries do not participate in this arrangement[11].

The Danish downward regulation in 2018 was delivered by three technologies:

[11] See the 'DK1-DE Countertrade Models – Impact Assessment' report, doc. no. 17/09862-37.

- Thermal units that lower production (53% of the total amount)
- Electric boilers that raise consumption (21% of the total amount)
- Wind turbines that stop or reduce production (26% of the total amount)

The three technologies have significantly different cost structures. The CHP units save fuel when production is reduced. Electric boilers have to pay for the power, including grid tariffs for the DSO and TSO and electricity taxes, and replace heat production at the same time. Wind turbines have very limited operating costs, but they lose their subsidy when production is reduced.

The weighted average price across all technologies for 2018 was calculated to be DKK -69/MWh, resulting in a total cost of DKK 79 million in connection with downward regulation (special regulation).

8.2.3 Supply of downward regulation resources

It is a condition of the agreement between Energinet and TenneT linked to the Joint Declaration, that Energinet has to always be able to eliminate the surplus power that arises as a result of TenneT setting minimum capacities for the Jutland-German border.

Figure 10 below shows the supply of downward regulation resources, hour-by-hour, from Danish players over the past three years.

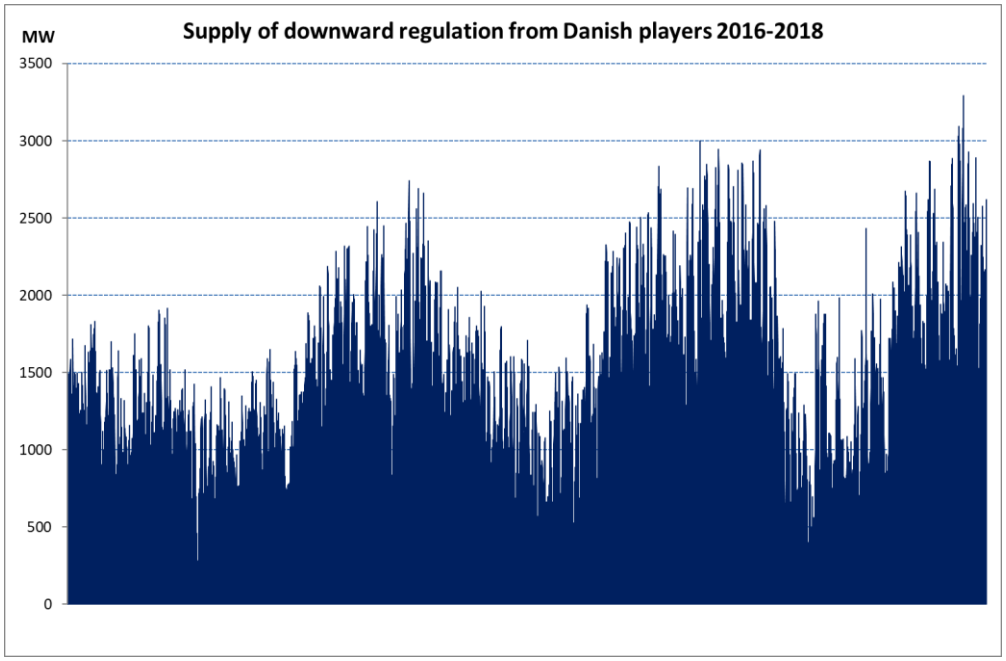


Figure 10: Supply of downward regulation resources in 2016-2018

It is apparent that the supply has grown considerably over the past three years as demand has increased. From a market perspective this is a very satisfactory trend, and competition has increased at the same time. However, there is also a clear seasonal variation in supply, such that the volume of downward regulation bids is lowest in summer, where there is limited heat demand and light winds are predominant.

Generally speaking, it is not critical that there is seasonal variation in supply, as the demand also varies throughout the year. This is partly because the need for special regulation is greatest at times of high wind power production, and this occurs primarily during the winter months.

In reality, the critical factor is whether Energinet has always been able to provide the volume of downward regulation that TenneT has requested under the Joint Declaration. This factor is illustrated in Figure 11 below, showing the residual downward regulation bids on the day with the highest delivery of special regulation (28 November 2018), and on the day where the surplus available downward regulation was at its lowest (17 May 2018).

Please note that the figure includes both downward regulation requested by TenneT under the Joint Declaration, and any ad-hoc downward regulation in response to TenneT's expressed requirements.

Given that Energinet has never been under pressure with the deliveries beyond the downward regulation volume that has been directly available (as shown in Figure 11), it can be concluded that Energinet has been able to meet the agreed obligations throughout 2018.

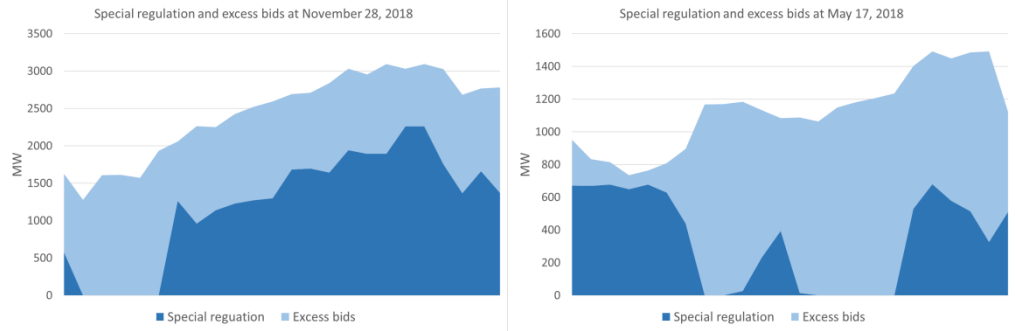


Figure 11: Supply of downward regulation resources and actual downward regulation on 28/11 and 17/5

8.3 Interaction between special regulation and prices for balancing power

This section examines the extent to which the extensive volume of special regulation affects the upward and downward regulation prices for balancing power.

Special regulation is normally settled according to pay-as-bid, and only Danish players and plants contribute downward regulation in this context. Balance regulation is settled according to pay-as-clear (marginal price), and all players and plants in the Nordic region contribute. Finally, Energinet handles all surplus electricity from Germany by first investigating whether part of the energy can be used to equalise an upward regulation requirement, either in Denmark or the other Nordic countries, and only after this is any downward regulation activated.

Against this background, the table below shows the price premium for upward regulation and price reduction for downward regulation, in hours with and without special regulation[12].

[12] Price premium and price discount refer to the difference between the balancing power price and spot price. The upward regulation price will always be the spot price or higher, while the downward regulation price will always be the spot price or lower. The gap between the spot price and balancing power price is a direct measure of how expensive it would be to cover the imbalances in the balance market rather than the spot market.

	Price premium/reduction (DKK/MWh)		Number of hours (h)	
Regulation direction	Special – YES	Special – NO	Special – YES	Special – NO
Upward regulation	26.3	64.3	321	3121
Downward regulation	76.1	62.3	992	2183
No regulation	-	-	648	1495

Table 9: Price premium/discount for balancing power, with and without special regulation

The first interesting observation in Table 9 is the exceptionally low number of hours with upward regulation (321 hours) coinciding with special regulation. This is linked to the fact that special regulation largely neutralises the need for upward regulation, due to netting. The next observation is that even in hours with residual upward regulation, the price premium for upward regulation in hours with special regulation (26.3 DKK/MWh) is significantly lower than the premium in hours without special regulation (64.3 DKK/MWh). Special regulation thus reduces both the scope and price of upward regulation in the Danish balance market. The relationship is further illustrated in Figure 12 below.

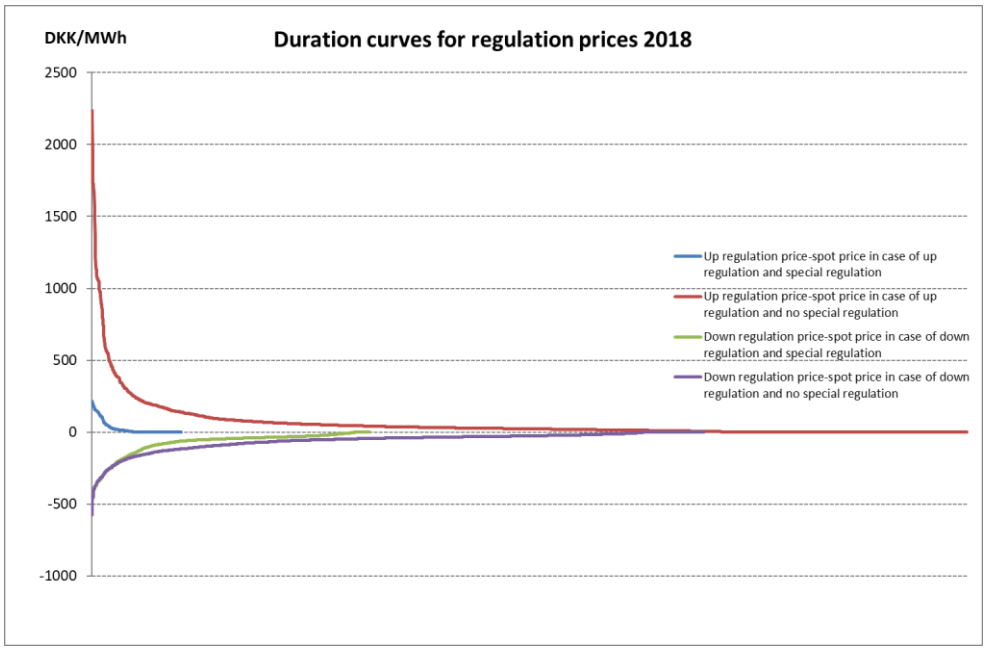


Figure 12: Duration curves for upward and downward regulation prices in 2018

Figure 12 shows that special regulation eliminates all expensive hours with upward regulation (the blue curve is much lower than the red curve). In the short term, this effect means that balance responsible parties end up paying less for their imbalances (upward regulation). In the slightly longer term, the absence of high prices for upward regulation may mean that fewer players and plants will offer upward regulation on a voluntary basis, i.e. the supply of upward regulation resources will decline.

Looking next at downward regulation in Table 9 and Figure 12, the conclusion is almost as clear. Special regulation has only a minimal impact on the scope and price of downward regulation. This outcome may seem surprising, since special regulation has dramatically increased the demand for downward regulation.

The surprising outcome is linked to the fact that downward regulation for special regulation purposes is only supplied by Danish players and plants, while downward regulation for balancing purpose is supplied by Danish and Nordic players and plants in direct competition. Hydroelectric power stations in the Nordic region are also extremely efficient at delivering downward regulation services.

8.3.1 MARI platform could change competitive situation for special regulation

Under the current plans, a common European regulating power market will become a reality in late 2021 with the launch of the MARI platform. When this platform is put into operation, and activation and settlement of regulating power for various purposes is automated, it can be assumed that Norwegian and Swedish players and plants will participate in special regulation on equal terms with Danish players and plants.

This change to market conditions can be expected to increase competition for special regulation and thereby reduce the costs of deliveries.

8.4 Marginal price rather than pay-as-bid

Special regulation is used in the event of grid restrictions and settled as pay-as-bid, while balance regulation is settled at the marginal price. This principle has been in force in the common Nordic regulating power market since 2002, and the reason for keeping the two types of regulation separately priced is to avoid players having to pay a higher price for their imbalances in the case of grid congestion.

Some players have expressed on several occasions that the two different settlement methods make it difficult to plan their bidding. Under marginal price settlement, the plant's own marginal cost is reported, and the plant owner then receives either this price or a higher price corresponding to the marginal bid that has been activated. Under pay-as-bid, players change their bidding strategy and try to estimate what the final marginal price might be, and then 'deftly' place their bids accordingly. In particular, the fact that players do not know which market they are bidding in when they place their bids is seen as problematic. This adds to the problem that the players do not have access to public information about prices for special regulation.

Several alternative solutions have been proposed by players, such as a fixed price mark-up if a regulating power bid is used for special regulation. However, the most persistent proposal is the introduction of two marginal prices – one for balance regulation and one for special regulation. This proposal was also put forward during ENTSO-E's consultation process regarding proposals for pricing balancing energy in autumn 2018[13].

During discussions with market players regarding pricing principles, Energinet stated that the argument about not knowing the relevant market in advance is weaker today than when special regulation commenced at the start of 2015. Looking at downward regulation in DK1 alone,

[13] ENTSO-E public consultation on the Activation Purpose Proposal and the Pricing Proposal, cf. "All TSOs' proposal on methodologies for pricing balancing energy and cross-zonal capacity used for the exchange of balancing energy or operating the imbalance netting process pursuant to Article 30(1) and Article 30(3) of the Commission Regulation (EU) 2017/2195 of 23 November 2017 establishing a guideline on electricity balancing".

special regulation accounted for 93% of the total volume of downward regulation in 2018 in MWh, i.e. there is essentially only one market.

In addition, the introduction of two marginal prices per hour – one for balance regulation and one for special regulation – could lead to new uncertainty/speculation. The player does not know at the time of bidding whether his bid will be used for balance regulation or special regulation, but the payment for otherwise almost identical bids can end up being very different, depending on where the bid ends up (see Figure 6)[14]. It is therefore possible that the introduction of two marginal prices could start a new 'battle for position' among players and plant owners, to find the price that places their bid in the most profitable category (balance regulation or special regulation).

Aside from the above discussions, Energinet has informed market players that the issue of future pricing principles for regulating power will be decided at an international level, cf. 'All TSOs proposal on methodologies for pricing balancing energy ...'. The proposal is currently being considered by regulators. It is also Energinet's opinion that more public information on prices for special regulation might alleviate some of the players' difficulties and improve competition in the area[15].

8.5 Spill-over effects

This section on 'spill-over effects' includes an analysis of whether certain players do arbitrage between different markets, i.e. whether players consciously buy or sell in the spot market in order to gain certain advantages in the regulating power market.

With reference to section 4.3 of the 'DK1-DE Countertrade models – Impact Assessment' report, two types of possible arbitrage have been identified:

- BRPs for generation report extra production to the spot market, possibly by reducing the price below the marginal costs for the plant, so they can offer downward regulation (special regulation) at attractive prices. In principle, this action could result in the given player earning money on plants they never intended to operate.
- BRPs for consumption purchase less power on the spot market than their expected requirement, thereby reducing the spot price (all else being equal). The player then meets the shortfall at attractive prices for balancing power, as the upward regulation is covered by netting in connection with special regulation.

Both actions involve risk. In order to achieve the desired effect they also require that the player is able to predict when – and in what volumes – special regulation will occur.

Energinet has no way of determining whether the first arbitrage option is being exploited. This would require access to the player's reporting to Nord Pool Spot. However, Energinet sees no indications that it is occurring. Thermal units have supplied an increasing volume of downward regulation (special regulation) over the past three years, but looking at the scope of supply over the year etc., it is not possible to identify any atypical operations.

[14] The marginal price for balance regulation ended up at DKK 321/MWh on 23 November 2018, while the marginal price of special regulation on the same day ended up at DKK -151/MWh (see Figure 6).

[15] The Danish Utility Regulator set the framework for which price information Energinet can publicise in connection with special regulation in a letter dated 6 July 2018.

Regarding the possibility that certain players buy less than their expected consumption in certain situations ('under scheduling'), Energinet established a tool two years ago that makes it possible to continuously monitor the scope of special regulation hour-by-hour, in parallel with the players total purchases/sales and final imbalances.

From this monitoring it has been found that certain players actually do buy much less than their requirements during certain periods of special regulation. However, they do not exhibit consistent and systematic behaviour, and this is probably because it can be difficult to predict the scope of special regulation with sufficient precision. Any attempt to calculate the scope of under scheduling on an annual basis is therefore subject to great uncertainty.

To provide an indication of the possible scope, all consumption imbalances for the most significant BRPs for consumption were summed for the hours during which special regulation accounted for more than 750 MW. According to this calculation, the total amount of under scheduling was estimated at 30-50 GWh in 2018. Compared to the total volume of energy used for netting (484 GWh), under scheduling only represents about 10% of this amount.

In light of the above calculations, under scheduling can be viewed as a relatively low-key activity that only occurs in special circumstances among certain players.