Monitoring Report

Date:
June 19, 2020

DK1-DE COUNTERTRADE FOLLOWING JOINT DECLARATION 2019

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 hourly import and export capacity (referred to as minimum capacities) in each hour on the interconnector.

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.

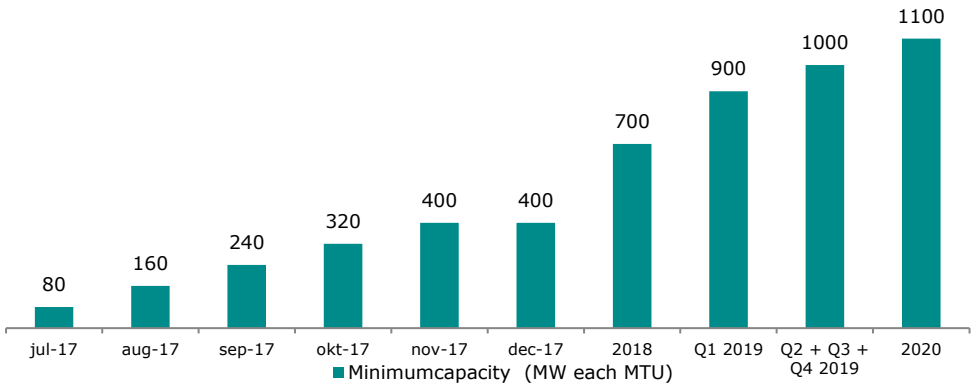

Figure 1 Minimum capacity (MW in every hour) following the Joint Declaration

Following the Joint Declaration, the TSOs Energinet and TenneT have sent their collected figures 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 of the 2018 monitoring report supplemented with additional information requested by the NRAs in their joint opinion on the 2018 monitoring report:

- Explain effect of net developments on expected ability to transport physical power on the DK1-DE border.
  ⇨ Included in chapter 7.

- State clearly in all text, graphs and figures, which TSO is the requesting party.
  ⇨ Included in chapter 3

- Describe how special regulation will be provided in the light of the upcoming European-balancing platforms, grid enforcements and increasing countertrade volumes (future target model for counter-trading).
  ⇨ Every TSO publishes a yearly report on transmission infrastructure on the ENTSO-E Transparency Platform according to Art. 9.1 of Regulation (EU) 543/2013. This report shows all planned infrastructure projects with a completion date expected in the next three years including the estimated impact on cross-border capacities.

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 at the same or at a higher level than the minimum capacity in each hour for both import and export capacities as specified in the Joint Declaration. The capacity to the day-ahead market is defined as the highest value of either the 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 an import and/or export 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'[1]. 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.[2]

3. Amount of countertrade

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

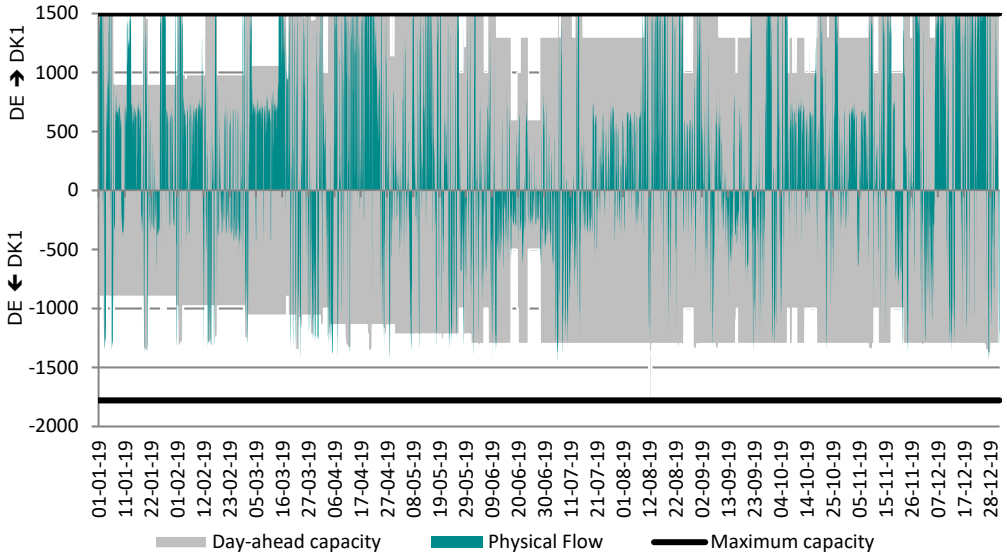

Figure 2 Day-ahead capacity and flow between Denmark West and Germany, MWh/h.

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 53 hours from the 17th of June to the 19th of June and 108 hours from the 24th of June to the 28th of June, Energinet reduced the day-ahead capacity below the minimum capacity, respectively to 500 and 600 MW in the import and export direction on the DK1-DE border. By approval of DUR, Energinet can limit the capacity below the minimum capacities specified in the Joint Declaration if the cross-border interconnectors on DK1-DE are out for maintenance, as decided by the Danish Energy Agency and Danish Utility Regulator. In both periods with reduced capacity, Energinet was doing construction work on the 400 kV station in Kassoe.

The following table shows the general overview of the use countertrade according to the Joint Declaration in 2019.

[1] 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

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

2019	Hours with countertrade	Countertrade as of total hours per month	Countertrade (MWh)
Jan	358	48%	145.086
Feb	304	45%	125.296
Mar	238	32%	55.540
Apr	111	15%	68.563
May	173	23%	95.984
Jun	471	65%	223.475
Jul	399	54%	218.576
Aug	126	17%	48.048
Sep	292	41%	176.894
Oct	252	34%	91.399
Nov	237	33%	115.892
Dec	122	16%	63.373

Table 1 Overview of countertrade following Joint Declaration.

The following table shows the costs by Energinet and TenneT for 2019.

2019	Costs in Denmark West (EUR)	Costs in TenneT area (EUR)	Average costs ENDK (EUR/MWh)	Average costs TTG (EUR/MWh)	Total costs (EUR)	Acc. Costs (EUR)
Jan	-2.376.595	7.070.536	-16,38	48,73	4.693.941	4.693.941
Feb	-879.797	4.379.237	-7,02	34,95	3.499.440	8.193.382
Mar	1.634.146	-99.842	29,42	-1,80	1.534.304	9.727.686
Apr	-33.117	2.777.037	-0,48	40,50	2.743.920	12.471.606
May	-956.048	4.076.361	-9,96	42,47	3.120.312	15.591.919
Jun	-1.237.546	8.238.908	-5,54	36,87	7.001.362	22.593.281
Jul	2.188.690	7.580.162	10,01	34,68	9.768.852	32.362.133
Aug	3.086.588	-797.011	64,24	-16,59	2.289.576	34.651.709
Sep	1.430.253	7.054.731	8,09	39,88	8.484.984	43.136.694
Oct	2.963.057	245.152	32,42	2,68	3.208.209	46.344.904
Nov	1.508.293	2.770.436	13,01	23,91	4.278.729	50.623.633
Dec	61.400	2.681.543	0,97	42,31	2.742.943	53.366.577

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.

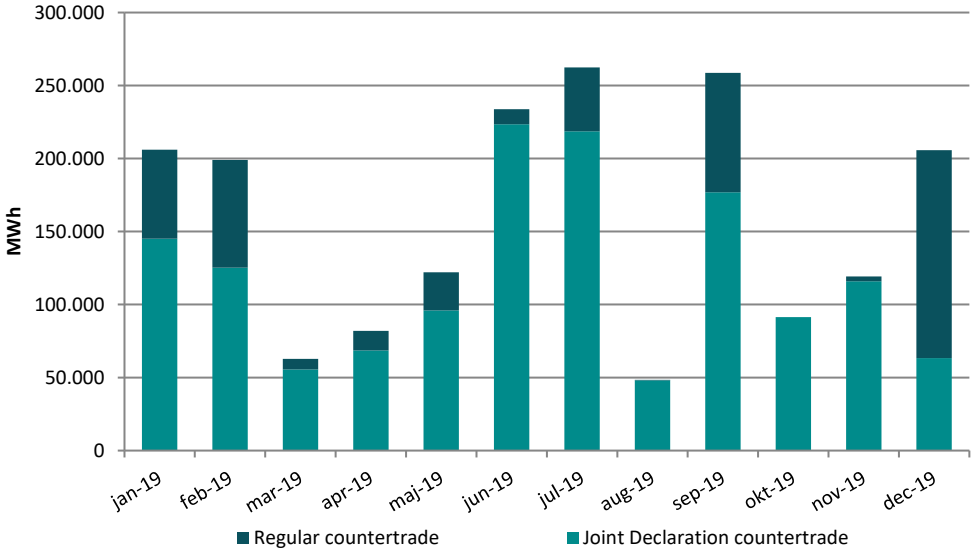

Figure 3 Total requested countertrade and share of Joint Declaration countertrade.

4. Forecast of countertrade costs

In order to estimate the costs of countertrades induced by the Joint Declaration Energinet and TenneT developed a forecast based on historic data. The costs for 2020 are forecasted based on 2019 data.

The forecast has to consider the following elements on a monthly basis:

1) Number of hours requiring countertrading in the respective month:
- Hours with countertrade in the respective month of 2019
- Multiplied by a factor of Joint Declaration capacity in the respective month of 2020 devided by the Joint Declaration capacity in the respective month of 2019

2) Average amount of countertrading per hour in the respective month:
- Average amount of countertrading per hour in the respective month of 2019
- Multiplied by a factor of Joint Declaration capacity in the respective month of 2020 devided by the Joint Declaration capacity in the respective month of 2019

3) Average price of countertrading in the respective month:
- Average price of countertrading in the respective monthof 2019
- Multiplied by a factor of Joint Declaration capacity in the respective month of 2020 devided by the Joint Declaration capacity in the respective month of 2019

The product of these three elements constitutes the base case estimate of costs of countertrading for 2020:
- Number of hours requiring countertrading * Average amount of countertrading per hour * Average price of countertrading

The best and worst cases are 75 and 125 percent of the base case respectively.

2020	Hours of Counter-trade [h]	Average Counter-trade [MW]	Average price [EUR/MWh]	Estimated costs [€]
Jan	438	495	39,54	8.570.000
Feb	372	504	34,14	6.389.000
Mar	291	285	33,76	2.801.000
Apr	122	679	44,02	3.652.000
May	190	610	35,76	4.153.000
Jun	518	522	34,46	9.319.000
Jul	439	603	49,16	13.002.000
Aug	139	419	52,42	3.047.000
Sep	321	666	52,76	11.294.000
Oct	277	399	38,61	4.270.000
Nov	261	538	40,61	5.695.000
Dec	134	571	47,61	3.651.000

Table 3 Monthly estimation of frequency, mangnitude, price and costs of Joint Declaration

	Sum 2020
Base case [0 %]	75.800.000
Best case [75 %]	56.900.000
Worst case [125 %]	94.800.000

Table 4 Estimation of annual Joint Declaration Costs.

5. Impact of countertrading on the German intraday market

5.1 General

The German intraday market of EPEX Spot 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 at EPEX Spot 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 because 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 of EPEX Spot and TenneT, and abstains from simulating fictitious counterfactuals.

5.2 Observations for 2019

The following figure shows the volume of countertrading by TTG in relation to the total continuous intraday trading volume in the German bidding zone in hourly resolution. Countertrading was conducted in 35 % of all hours, with a maximum share in total volume of 39 %. The average share during hours with countertrading was 8.4 %, while the average share across all hours of the year was 3.0 %.

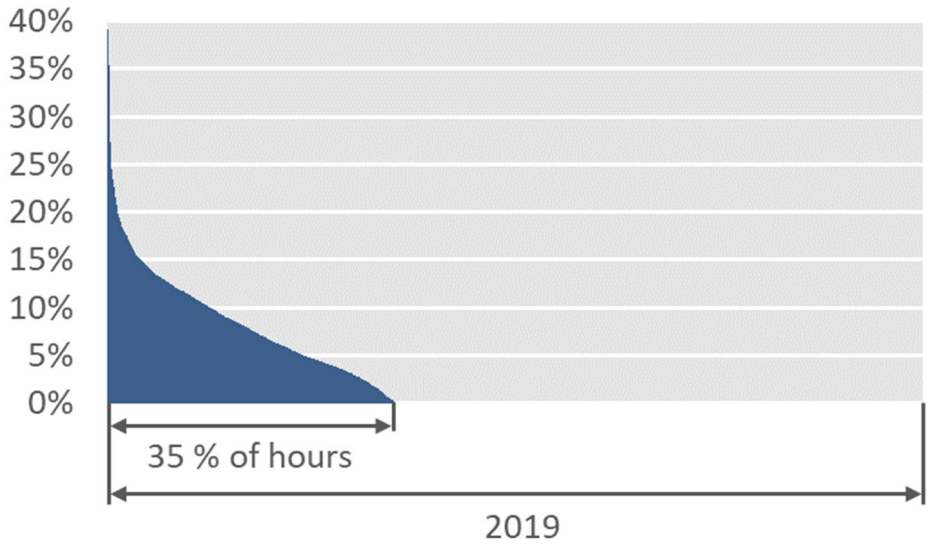

Figure 4 Hourly share of countertrading volume in continuous intraday trading volume (sorted)

The impact of countertrading on the market prices is analysed by comparing day-ahead to intraday[3] 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 0.12 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 TTG bought in the German bidding

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

zone, the higher the intraday price was relative to the day-ahead price for the same delivery hour.

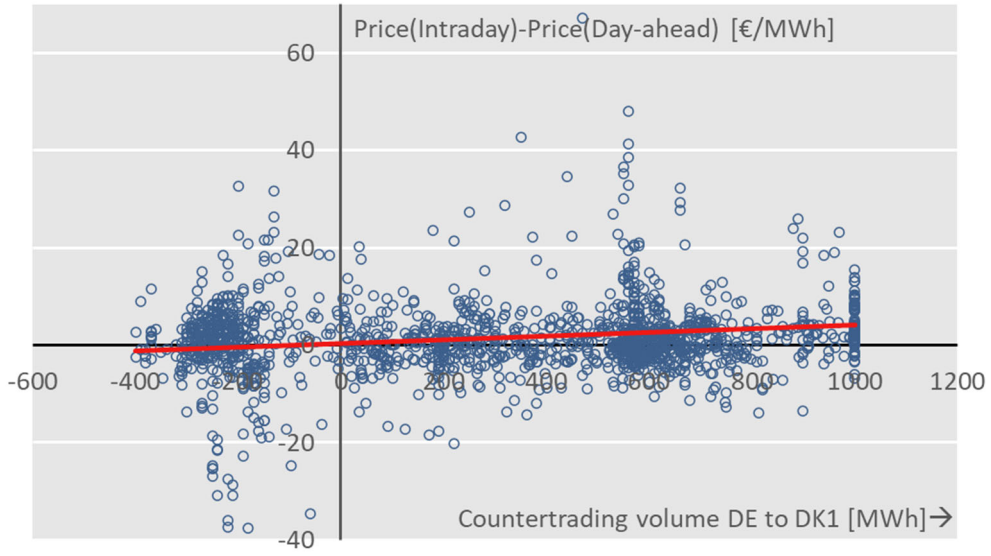

Figure 5 Relation between price difference (intraday vs. day-ahead) and countertrading volume for hours with countertrading. Positive volume denotes buying in DE and selling in DK1.

5.3 Comparison with 2018

Compared to 2018, the frequency and relative volume share of countertrading have significantly increased in 2019 (cf. table 1). At the same time the correlation coefficient between countertrading volume and the difference between day-ahead (DA) and intraday (ID) prices has decreased.

	2018	2019
Frequency of countertrading	17.5 % of hours	35 % of hours
Average share of countertrading in continuous intraday trading volume	6.5 % during hours with countertrading	8.4 % during hours with countertrading
Correlation coefficient between countertrading volume and DA-ID price difference	0.25	0.12

Table 5 Comparison of frequency and volume of countertrading between 2018 and 2019

Considering only static market conditions, one would tend to expect that a larger volume share of countertrading would yield an increase in the market price differences. However, the observed development is contrary to this. A possible explanation is that market participants in 2019 have been more successful in their attempts to anticipate the TSOs' countertrading behaviour. This would support the rational expectation that market participants forecast the need for countertrade and make use of arbitrage between the day-ahead and intraday time frames. As a consequence, the day-ahead price spread between DK1 and DE would not be (solely) based on the transmission capacity available in the day-ahead market, but already tend to be related to the physical transmission capacity. The more this is the case, the less "surprising" the occurrence of countertrading is on any given day, and the less the intraday price differs from the day-ahead price.

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 notice, that the volumes in the following table 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.[4]

2019	Offered bids of up-ward reg-ulation (MWh)	Offered bids of downward regulation (MWh)	Activated bids of up-ward reg-ulation for balancing (MWh)	Activated bids of downward regulation for bal-ancing (MWh)	Requested volumes of down-ward regulation for special regulation towards Ten-neT (MWh)	Requested volumes for up-ward reg-ulation for special regu-lation to-wards Ten-neT (MWh)
Jan	629.661	1.491.457	7.760	5.357	206.039	29.198
Feb	620.361	1.237.517	6.787	13.000	198.962	20.449
Mar	730.608	1.319.723	8.837	19.015	62.733	56.960
Apr	632.241	931.068	8.496	6.525	81.916	2.130
May	613.151	1.056.654	10.955	15.007	122.050	2.034
Jun	441.189	715.509	5.753	4.541	233.792	22.370
Jul	480.727	806.729	4.640	1.753	262.295	35.987
Aug	442.476	698.108	5.201	3.731	48.386	60.922
Sep	491.130	962.416	1.872	408	258.639	3.260
Oct	654.429	923.254	7.011	8.363	89.755	58.443
Nov	664.919	1.093.759	4.138	5.363	119.199	64.667
Dec	706.806	1.355.794	4.590	8.437	205.704	0

Table 6 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.

[4] In their 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). In 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 from 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.

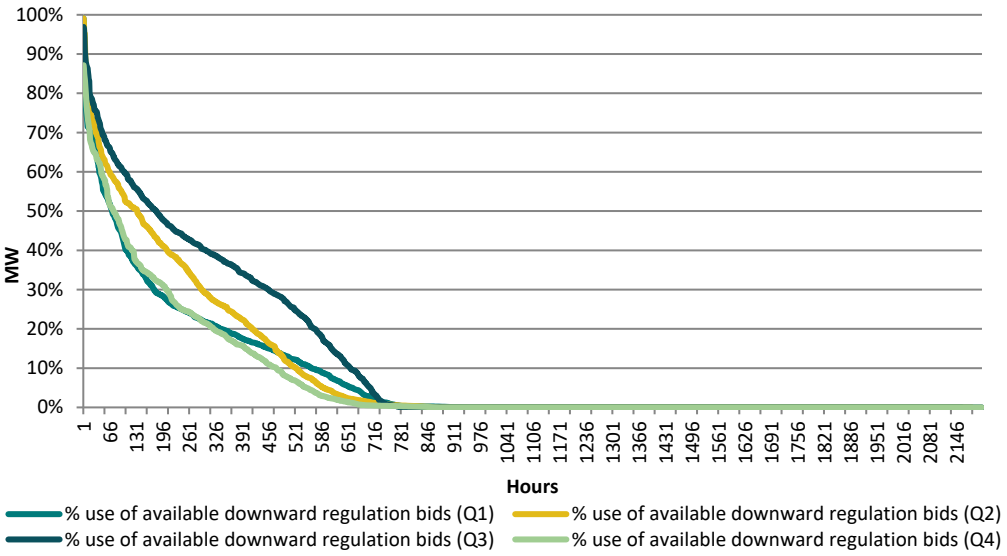

Figure 6 Duration curve of % use of offered downward regulation in DK1

The figure shows that in 5 hours in Q1, in 14 hours in Q2, in 16 hours in Q3 and 7 hours in Q4 Energinet activated over 80 % of all offered downward regulation in DK1, however the highest use of activated bids was 99,1 % in a single hour. The figure also shows that in more than 1200 hours in Q1, 1300 hours in Q2, 1400 hours in Q3 and 1300 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.

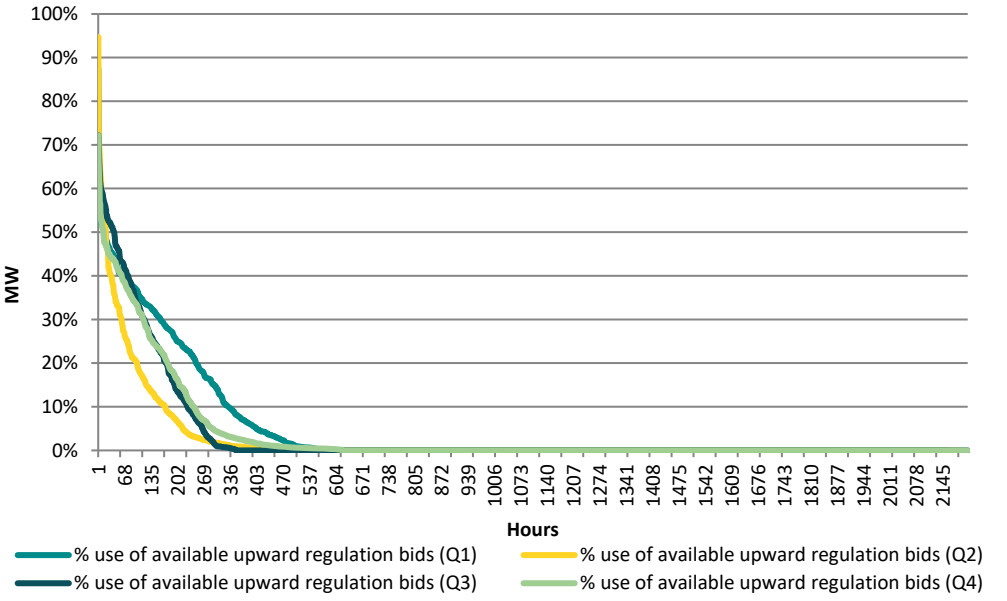

Figure 7 Duration curve of % use of offered upward regulation in DK1

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[5].

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 notice, 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	128.099	13%	15%	72%	13.609	0%	0%	100%
Feb	147.380	26%	21%	53%	6.724	0%	0%	100%
Mar	49.965	31%	36%	33%	27.025	2%	0,2%	97,8%
Apr	80.680	30%	25%	45%	1.290	0%	0%	100%
May	74.624	22%	30%	48%	3.769	0%	0%	100%
Jun	121.394	43%	27%	30%	8.628	0%	0%	100%
Jul	182.231	46%	17%	37%	13.302	0%	0%	100%
Aug	37.260	59%	29%	12%	23.444	0%	0%	100%
Sep	206.932	42%	18%	40%	7.087	16,8%	0,3%	82,9%
Oct	67.284	38%	22%	40%	30.357	0,3%	0%	99,7%
Nov	78.631	8%	22%	69%	33.302	0%	0%	100%
Dec	159.399	27%	24%	49%	195	0%	0%	100%

Table 7 Activated volumes for special regulation, split by source.

7. Status on grid development

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 project.

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

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

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

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

*Table 8 Status of the project Kassø-Dollern. *Commission planned in July 2020*

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).

7.2 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 operation
Süderdonn – Heide	TenneT	23	23	In operation
Heide – Husum	TenneT	46	13	2021
Husum – Klixbüll	TenneT	38	0	2022
Klixbüll – DK/GER border	TenneT	16	0	2023
DK/GER border – Endrup	Energinet	75	0	2023

Table 9 StatusA 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 2021. Final agreements with landowners in Demark are expected to be reached in Q2 2022. Approval from German authorities is planned for Q1 2021.

Overhead line construction work in Germany will commence from Q1 2022, while overhead line and underground cable construction work in Denmark will start in Q2 2022. Commissioning is planned for end of 2023.