

Nordic Capacity Calculation Methodology Project (Nordic CCM)

Nordic CCM

External Parallel Run Market Report for Week 9

05.04.2023













Abbreviations

- CCM Capacity Calculation Methodology
- CGM Common Grid Model
- ENDK Energinet
- EPR External Parallel Run
- FB Flow-based
- FG Fingrid
- IGM Individual Grid Model
- IVA Individual Validation Adjustment
- JAO Joint Allocation Office
- LHF Last Hour Flow
- MTU Market Time Unit
- MAS Modelling Authority Set
- NP Net Position
- NTC Net Transfer Capacity
- PTC Power Transfer Corridor
- RCC Nordic Regional Coordination Centre
- SA WG Simulation & Analysis Working Group
- SEW Socio-economic Welfare
- SF Simulation Facility
- SN-Statnett
- Svk Svenska kraftnät



Svenska Kraftnät





Contents

Abbreviations	3
Introduction	5
Data quality	6
Data quality remarks	6
Disclaimer	7
Market outcome NTC vs. simulated FB for week 9	7
Aggregated price results	7
Socio-economic welfare results	9
Price difference duration curve	13
Nordic net position	14







Introduction

This market report presents the comparison of the market results between the current Net Transfer Capacity (NTC) calculation method and the simulated Flow-Based (FB) capacity calculation method of the day-ahead market timeframe. NEMO Simulations has produced the simulated FB market results by using Euphemia test environment.

The analysis presented in the market reports focuses on the socio-economic welfare (SEW) outcome of the Nordic power systems. During the external parallel run (EPR) weekly reports are published along with supplementary data and additional documents.

Chapter 1, "Data quality", gives an overview of the input data and TSO remarks regarding the FB domains.

Chapter 2, "Market outcome NTC vs. simulated FB for week", elaborates on the overall comparison of NTC vs. simulated FB market results of week 9.

The capacity calculation tool and the data used for the capacity calculation are under development and continuously being improved by the Nordic TSOs. The outcome of the FB calculations is considered valid for comparison with NTC even with some known disclaimers that are being continuously evaluated and improved by the TSOs.

Please refer to the phenomena report found on the RCC website for in-depth descriptions of known issues with input data, modelling, and methodology that could potentially influence the simulation results.

In the Appendix detailed market results of each Nordic country are presented.

The Nordic TSOs welcome comments and questions from the stakeholders. Please send an email to CCM@nordic-rcc.net.







Data quality

The following table provides information about the data quality during the TSO operator domain validation process, such as substituted domains and IVA provision. More details regarding the quality of the FB domains for this report are presented in the Appendix.

Energy Delivery Day:	Mon. 27/2.	Tue. 28/2.	Wed. 1/3.	Thu. 2/3.	Fri. 3/3.	Sat. 4/3.	Sun. 5/3•
Substituted IGMs	0	0	0	2	о	о	о
IVA provision	0	0	2	2	1	1	2
Final domain acceptance (1 TSO =25%)	100%	100%	100%	100%	100%	100%	100%

Table 1. Data from Norcap reporting. Note: IGM refer to hourly national power systemmodels, and the IVA refer to manual adjustments of the domain capacities. Thefinal domain acceptance must be 100% for the data to be published.

Data quality remarks

As seen in Table 1 after adjustments the final FB domain was accepted by all TSOs for 7 out of 7 days for week 9.

For the 2nd of March there were 2 substituted IGMs from Fingrid due to an internal IT update. Svk provided IVAs on several constraints from the 1st until the 4th of March. This was done to adjust the input data to reflect that some series capacitors were bypassed. On the 1st of March Fingrid provided IVA for a PTC. Energinet provided an IVA on the 2nd of March due to a failure on SK4. On the 5th of March, Statnett provided an IVA due to a mistake in the input data and Svk provided IVA due to an inaccurate Fmax value.

During the EPR, the Nordic CCM will ensure necessary improvements of our input data, modelling and processes in general. Please use the EPR as a learning by doing experience. After go-live, the Nordic TSOs and Nordic RCC will continue to improve the flow-based process as and when needed.







Disclaimer

In previous reports it has been explained that there was a difference between NTC and FB as the topology of the series capacitors on lines connecting SE2 and SE3 was accounted for in NTC but not in FB, which could allow more flow on SE2-SE3 in NTC than in FB. From the 1st of March, a prognosis of the most likely topology expected for the day of delivery is included also in the FB capacity calculation which makes the FB input more aligned with the handling of the series capacitors in NTC. Additional notes and observations related to this is detailed further down in this document.

Reoccurring disclaimers can be found in the phenomena report on the Nordic RCC website.

Market outcome NTC vs. simulated FB for week 9

This chapter presents a comparison of the market results for week 9 (February 27-March 5 2023) between NTC and simulated FB with regards to changes in socioeconomic welfare along with individual bidding zone price changes.

Bidding zone	Price FB [€/MWh]	Price NTC [€/MWh]	Price FB-NTC [€/MWh]	Price diff (FB- NTC)*100/NTC [%]
DK1	128.94	131.66	-2.72	-2.07
DK2	129.46	125.85	3.61	2.87
FI	78.19	70.33	7.86	11.18
NO1	106.49	111.18	-4.69	-4.22
NO2	106.94	111.18	-4.24	-3.81
NO3	44.25	30.55	13.7	44.84
NO4	24.32	23.8	0.52	2.18
NO5	102.34	111.18	-8.84	-7.95
SE1	32.35	29.31	3.04	10.37
SE2	27.86	29.31	-1.45	-4.95
SE3	95.71	66.16	29.55	44.66
SE4	118.15	113.15	5.0	4.42

Aggregated price results

Table 2. Average price per bidding zone with NTC and flow based, week 9.







As evident from Table 2 above, DK1, NO1, NO2, NO5 and SE2 has a decrease in price for the FB simulations compared to the prices from the market using NTC. These areas, except for SE2, are the four most expensive areas in NTC so it is expected that a decrease in price is seen with FB. This trend has been observed during the previous weeks as well. However from the 1st of March this changes slightly. See Figure 1 below. From the 1st of March prices in SE2 are higher with FB than NTC although previously, the price in SE2 was lower with FB than NTC.



Figure 1 - Day-ahead price in SE2 on hourly level for both FB and NTC.

The change in price for SE2 in Figure 1 above can be attributed to a change in the topology used in FB for the series capacitors on several lines between SE2 and SE3. As stated in previous reports, this topology was previously accounted for in NTC, but not in FB. From the 1st of March a prognosis of the most probable topology expected for the day of delivery is also included in the models used in the FB capacity calculation. An additional note is that on the 27th and 28th of March there were even some negative prices recorded in SE2 for a few hours.

Additionally, the change in the management of series capacitors also have effects on the prices for NO1, NO2, and NO5. Prices in NO1 are shown in Figure 2 below. After the 1st of March prices with FB is generally a little lower than with NTC. There are also three spikes in price that primarily affect NTC but can also be noted in the FB results. These seem to be related to the morning peak hours associated with low wind infeed into the system, particularly in bidding zones SE3 and SE4.









Figure 2 - Day-ahead price in NO1 on hourly level for both FB and NTC.

Socio-economic welfare results

In Table 3, the SEW gain per country for the Nordic CCR can be seen. The biggest change is noted in Sweden where the consumer surplus decreases by 47,63 M€ and the producer surplus increases by 40,88 M€ in FB. The SEW change is positive for Norway, Sweden and Finland, whilst Denmark sees a negative SEW change. For week 9, the overall SEW in the Nordics CCR change amounts to 11,62M€.

	Denmark	Norway	Sweden	Finland	Sum
Congestion income	-0.79 M€	14.86 M€	9.20 M€	0.59 M€	23.87 M€
Consumer surplus	-0.40 M€	3.37 M€	-47.63 M€	-9.21 M€	-53.88 M€
Producer surplus	-0.93 M€	-7.37 M€	40.88 M€	9.06 M€	41.63 M€
Sum	-2.12 M€	10.86 M€	2.44 M€	0.44 M€	11.62 M€

Table 3. SEW gain per country for the Nordic CCR. The values represent the difference in SEW between FB and NTC. Positive numbers indicate higher SEW in FB than NTC.

The Nordic SEW change per stakeholder type and day can be seen in Figure 3 below. There is a positive SEW gain for all days except for the first days of the week. The consumer surplus in the Nordic CCR is lower for FB than NTC all days, except on Sunday the 5th of March when it is higher instead. The opposite is true for the producer surplus. A clear change in SEW between the 28th of February and the 1st of March can be noted in Figure 3. One explanation to this is that the change in modelling of the series capacitors FB that was implemented by Svk on the 1st of March 2023.









Nordics socio-economic welfare per stakeholder and day

Figure 3 - Daily SEW change for the Nordic CCR.

Over the course of the week the change in congestion income on the Hansa and Baltic borders is equal to -0.59 M€. The SEW change in the rest of SDAC is -0.2 M€ giving a weekly total of 10.84 M€.

In Figure 4, the change in Nordic socio-economic welfare between NTC and FB is shown per bidding zone. SE2 is the bidding zone in the Nordics which sees the greatest increase in welfare. This is due to an increase in producer surplus from that area. The bidding zone which sees the largest drop in SEW is SE4.

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Socio economic welfaregain FB-NTC per BZ - Total_sew

Figure 4 - Change in Nordic socio-economic welfare per bidding zone. CI from the Hansa/Baltic region is included in this graph.

In Figure 5, the change in Nordic SEW between NTC and FB is shown specifically for NO1. The clear increase can also be attributed to the change in modelling of series capacitors that was implemented on the 1st of March.









Socio economic welfaregain FB-NTC per BZ - Total_sew

An additional note should also be made of the fact that during week 9, Svk provided IVA values for the CNECs associated with the lines with series capacitors. Later other limitations were noted and this practise was ceased. However, with the correct modelling of the series capacitors, the relevant CNECs are expected to be less limiting even without IVA included. Therefore the change in trends related to SEW observed in week 9 are expected to continue in coming weeks.





Figure 5 – Change in SEW in FB-NTC for NO1.



Price difference duration curve

Figure 6 shows the duration curve for the difference in area price between the bidding zone with the highest and lowest price within the Nordic CCR. For this week, NTC had smaller spread between the highest and the lowest priced bidding zone for roughly 80 percent of the hours.



Duration curve for Nordic bidding zones

Figure 6 - Duration curve showing the difference in area price between the area with the highest and lowest price within the Nordic CCR.

If the same duration curve as shown in Figure 6 is plotted for only the first two days of the week, i.e. before the change in the FB domain according to the modelling of series capacitors, we obtain the duration curve shown in Figure 7. The graphs show that NTC results have a smaller price difference between the two bidding zones with highest and lowest price for all hours, compared to FB.

The change in pattern can be partly explained by looking at the bidding zone with lowest prices during week 9: SE2 (prices shown in Figure 1). For the first two days of the week, the prices from the FB simulations are low, we even see some negative prices. On 1st of March we see a clear increase in prices which is due to the increased permissible flow between SE2-SE3 because of the change in the handling of the series compensators.

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FINGRID Statnett

ENERGINET

FB



Duration curve for Nordic bidding zones



Figure 7 - Duration curve showing the difference in area price between the area with the highest and lowest price within the Nordic CCR for the 27th and 28th of February.

Nordic net position

In Figure 8 and 9, the net position and cumulative net position for the Nordics can be seen. The cumulative net position difference between FB-NTC is positive in week 9 which means that with FB, the Nordics export more power out of the region than in NTC. In the FB simulations, approx. 15 000 MWh more has been exported in the end of the week compared to the NTC result.







Total Net Position Nordics



Figure 8 - Total Net Position for the Nordics, per hour

Cumulative Net Position Difference FB-NTC, Nordics



Figure 9 - Overall net position for the Nordic CCR, showcases either import or export.



