External parallel run evaluation report - For assessment by the NRAs of the Nordic CCR, as required by the Nordic DA/ID CCM

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

Table of content:

Abbreviations:

AAC	Already allocated capacity
AAF	Additional aggregated flow (computed from the NPs and the FB parameters)
AC	Alternating current
ACER	Agency for the Cooperation of Energy Regulators
ATC	Available transmission capacity
ATCE	ATC extraction
BZ	Bidding zone
CACM GL	Capacity Allocation and Congestion Management Guideline
CC	Capacity calculation
CCC	Coordinated capacity calculator
CCM	Capacity calculation methodology
CCR	Capacity calculation region
CET	Central European time
CGM	Common grid model
CI	Congestion income
CID	Congestion income distribution
CNE	Critical network element
CNEC	Critical network element monitored under a contingency
CNTC	Coordinated net transmission capacity
CS	Consumer surplus
DA	Day ahead
DC	Direct current
EPR	External parallel run
F_0 or F_0	Linear approximation of a flow in the reference net position on a CNEC or combined dynamic constraint in a situation without any cross-zonal exchanges
F_0' or F_0'	Real flow on a CNEC or combined dynamic constraint in a situation without any cross-zonal exchanges
F_{AAC} or F_{AAC}	Flows resulting from previously allocated cross-zonal capacities for all CNECs and combined dynamic constraints
F_{max} or F_{max}	Maximum flow on all CNECs and combined dynamic constraints
F_{ref} or F_{ref}	Reference flows on all CNECs and combined dynamic constraints
F_{RA} or F_{RA}	Flow for increasing the RAM on a CNEC or combined dynamic constraint due to RAs taken into account in capacity calculation
F_{RM} or F_{RM}	Flow for reliability margin for all CNECs and combined dynamic constraints
FB	Flowbased
FRM	Flow reliability margin
GSK	Generation shift key
HVDC	High-voltage direct current
ID	Intraday

IGM	Individual grid model
IVA	Individual validation adjustment
KPI	Key performance indicators
MC	Market coupling
MTU	Market time unit
NEMO	Nominated electricity market operator
NP	Net position
NRA	National Regulatory Authority
NRCC	Nordic RCC
NTC	Net transfer capacity
PS	Producer surplus
PTDF or *PTDF*	Power transfer distribution factor
RA	Remedial action
RAM or *RAM*	Remaining available margin
RM	Reliability margin
RCC	Regional coordination centre
SDAC	Single day-ahead coupling
SEW	Social economic welfare
SIDC	Single intraday coupling
TRM	Transmission reliability margin
TSO	Transmission system operator
XBID	Cross-border intraday

What has changed?

The Nordic TSOs issued a version of this document as input for the public consultation during the timeframe April 17 – May 17, 2023.

The document has been updated, and this final version of the document has been submitted to NRAs on June 12, 2023. In this section of the document it is explained what changes have been made compared to the earlier version.

- Congestion income distribution (CID) and SEW figures
    - Change in distribution of congestion income:
        - It has come to our attention that the congestion income distribution used in our analysis tools wasn't properly aligned with the methodology for congestion income distribution approved by ACER.
        - This has been corrected for and the congestion income distribution has been recomputed for all the weeks. Those new values are now embedded in this updated version of the report, and correspond to how the congestion income would be distributed between the Nordic TSOs after go-live.
        - A bit more of detail on the actual change made: the congestion income distribution was based on the scheduled exchanges, whereas it needs to be (and is now) based on the flow-based allocated flow. The change should only impact the distribution of the congestion income and not the total sum of the congestion income.
    - Correction of CI mistakes:
      In the process of adjusting the CID, two other mistakes in the congestion income distribution calculation were identified:
        - Erroneous handling of borders that were out of service (e.g. a DC link having the "status out" on the JAO platform). This had an impact of -0,085 MEUR in SEW change (the SEW difference between FB and NTC).
        - The CID calculation has been improved in January 2023 for the weeks 50-52 (2022), but this improvement had not been applied for the weeks 1 and 2 (2023). The error was related to the handling of DK1A and NO2A in NTC. This has now been corrected for and shows an impact of roughly -8 MEUR in SEW change (the SEW difference between FB and NTC).
    - In total, the correction of the CID reduces the total SEW change with roughly 8 MEUR (the SEW difference between FB and NTC).
    - All relevant graphs and numbers in the 3-months EPR evaluation report have been updated.
- Stakeholder responses provided in the public consultation, and the TSOs' reflections, have been added in the Annex I

- A short summary of the public consultation responses is provided in the Chapter 6
- While the 3-months evaluation report served as the vehicle for the public consultation, no clarifications were asked by stakeholders with regard to the 3-months evaluation report. As such, no content-related changes have been made to the report, that were triggered by stakeholders' comments, compared to the version that was submitted for the public consultation. Some minor changes have been made based on the stakeholders' inputs:
    - The abbreviation "AAF" is better described in the list of abbreviations;
    - The use of the word "flow" is explained in the introduction;
    - The example in the Box 4 has been corrected.

The Nordic TSOs,

June 12, 2023

Executive summary

The Nordic flowbased project has been working on the coordinated capacity calculation method for the Nordic Capacity Calculation Region covering Denmark, Finland, Norway and Sweden. The Nordic development of a flowbased market approach was initiated in 2012 due to the increasing complexity of the Nordic power system. The complexity makes it increasingly difficult to provide market capacities by the NTC approach that ensures efficient grid utilization and operational security. This is amongst others driven by the rapidly increasing amounts of wind and solar and new large-scale electricity consumption. To manage the congestions in the grid, the flowbased method will provide tools to consider the grid elements and their contribution and limitations to host power flows. This is acknowledged in the legislation as well, as the flowbased approach is the default method in the European legislation. The Nordic capacity calculation methodology (CCM) has been approved by the regulatory decisions.

To get confidence in the calculation, first an internal parallel run was undertaken from May 2021 until March 2022. Thereafter an external parallel run was launched where the aim has also been to give the market participants the opportunity to learn how the flowbased method works and to allow a comparison of its market results with those of the current net transfer capacity method.

The external parallel run period has now encompassed a 3-month continuous reporting period, for which the stability of the capacity calculation process has been monitored and the market results have been simulated.

This report is the reporting of the KPIs put forward by the Nordic NRAs at the time of the approval of the latest version of the Nordic CCM in October 2020. The KPIs reflect the functionality of the flowbased operation and should be monitored in a 3-month period followed by a report showing the result of the monitoring. All KPIs have been met as there are no fallbacks or delays being observed related to the DA capacity calculation process for the 3-month period. Moreover, the external parallel run shows that flowbased provides a higher social economic welfare (SEW), which reflects that the flowbased parameters are a result of a calculation that is in line with the legal methodology; thus the Nordic TSOs asses that the quality of the flowbased parameter calculation has proven to be of a sufficient quality.

The welfare gain is mainly driven by a better utilization of the Nordic power system. Flowbased can increase the amount of electricity that can be moved through the grid and thereby decrease the price differences in the Nordic area. Flowbased allows for a higher production in the northern Nordic areas, where the prices are lower, as the electricity can be transported to the southern Nordic areas with higher prices. Through the 3-months period, flowbased allows to transport 1.5 TWh of electricity more through the Nordic grid. This is possible because flowbased allows the TSOs to represent the grid in the market in a better way. The increased flow through Norway is a clear example.

One element that has caught some focus among stakeholders is the loss in consumer surplus experienced in parts of the Nordics, and in the SE3 bidding zone (BZ) in particular. It is natural that in case of increased exports from the Nordics, the price level will increase. Yet, without any change in

exchange from/to the Nordics, one may expect that flowbased (= increased grid capacity) would lower the overall generation cost and thereby the overall consumer cost of electricity. Flowbased will lower the overall cost, but due to the nature of NTC it is difficult to provide capacity to SE3 borders in order to maximize the utilization of the power system. Thus the better market integration in flowbased causes the consumers in that bidding zone to face higher prices due to the closer connection to high-price areas, yet some consumers will face lower prices in adjacent bidding zones. This is basically not a speciality of flowbased, but would also be the case if the capacity was increased by massive grid investments or defining the Nordics as one bidding zone. Some analysis and calculations are included to illustrate this issue.

For the ID market, the Nordic TSOs have calculated the left-over capacity after the day-ahead flowbased market coupling as the gate-opening capacity. As the intraday allocation mechanisms are not yet able to operate with flowbased parameters, the left-over capacity has been translated into NTC capacities. The assessment of the left-over capacities shows that all BZs have capacity in at least one border direction.

In short, during the three-months evaluation period, the flowbased approach has demonstrated the following features:

- The flowbased capacity calculation process is stable and functions as planned
- The utilization of the Nordic power system has been improved by the flowbased approach
- The total social economic welfare has increased in the Nordic CCR

When looking at the absolute values, and distribution, of the social economic welfare gain, one should bear in mind that the flowbased market simulations are assessed by using the real-world order books, that are based on the operational NTC capacities. Indeed, bidding strategies might be different, e.g. in hydro-dominated bidding zones, when flowbased is the applied approach.

The flowbased capacity calculation is still in its project phase, and it is a huge learning process. We Nordic TSOs are working to improve the underlying grid models based on the analyses of the calculations and market simulations. To move towards the deployment of the new coordinated capacity calculation method requires a good dialogue among us all – TSOs, NEMOs, market actors, other stakeholders, and NRAs. There is still work to be done to make sure that the method is mature enough and its functioning understandable to the market actors. On the way towards go-live, the last 6-month of the external period will provide the sound comparison basis that will be of high importance to the market actors as no major changes or developments will take place. This period is foreseen to start after the regulatory assessment of the 3-month period, which was first subject to a public consultation.

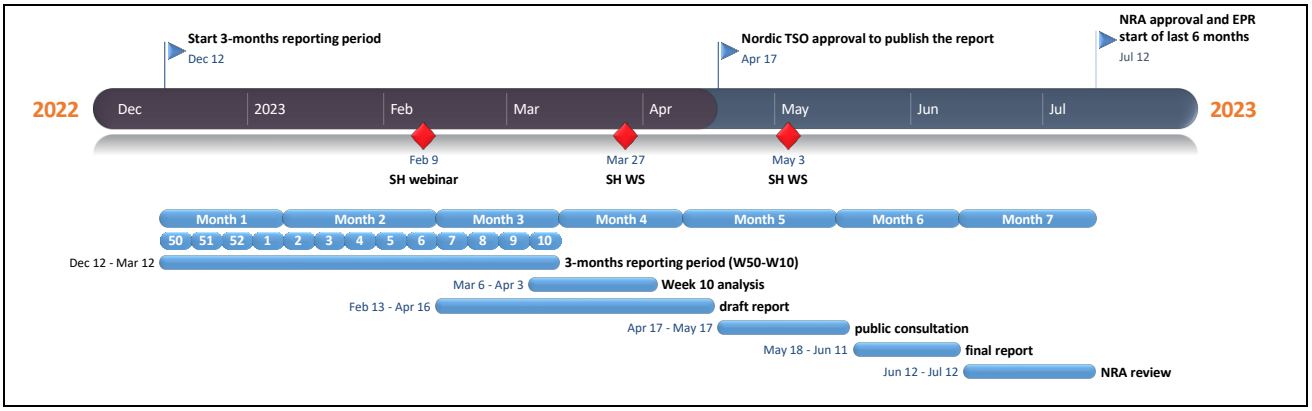
1. Introduction

The Nordic development of a flowbased market approach was initiated in 2012 due to the increasing complexity of the Nordic power system. The complexity makes it increasingly difficult to provide market capacities by the NTC-system that secures efficient grid utilization and operational security. With the introduction of flowbased, a simplified grid model is introduced directly in the market algorithm making the algorithm able to monitor how production and consumption are influencing electricity flows in the grid, and by that, being able to maintain all flows within the physical limits. The change to flowbased will optimize the utilization of the power grid and the production system in general, generate welfare economic benefits, while the TSO operators are provided with a better tool to plan for real-time operations.

The TSOs of the Nordic CCR have, since the CACM GL went into force in 2015, been working on firstly a common formalised methodology for capacity calculation and secondly the implementation of the NRA-approved flowbased (FB) methodology. Part of the implementation is the parallel run, where the processes related to the operation of the CCM have been performed with the attempt to mimic a real-life operation. The main purpose of the parallel run is two-fold. *Firstly*, the Nordic TSOs and the Nordic RCC together with NEMOs have to make sure that the quality and functionality of the process is at a sufficient quality to move from the current NTC and governance structure into an operational mode where flowbased parameters are the input into the market operation and subsequent settlement of market players. *Secondly*, it is to secure a smooth and gradual transition from the current NTC into flowbased for the market players. The parallel run offers the possibility to obtain some learnings of the flowbased market coupling before market players will have to take flowbased into account in their submission of bids in the day-ahead and intraday market.

This report is the external parallel run (EPR) evaluation report for assessment by the NRAs of the Nordic CCR, as required by the Nordic DA/ID CCM that was approved by the NRAs of the Nordic CCR on October 14th, 2020. The report is based on data for a period of 3 months out of a total amount of months of at least 12. The external parallel run period is illustrated in Figure 1. The three-months evaluation period started on Dec 12, 2022 and ended on March 12, 2023, and covers the weeks 50 (2022) until 10 (2023). As the grace period of the order books needs to be respected when performing the flowbased market simulations, the market analyses can only be completed several weeks after the actual day of the capacity calculation – this has been indicated by the “week 10 analysis” in the Figure 1; the market results of the last week of the three-months evaluation period are only available several weeks later. This dictated the timeline to complete this evaluation report, and the one-month public consultation. After the consultation, the comments received from the stakeholders will be addressed and a final version of the report will be submitted to the Nordic NRAs before Summer.

Figure 1: Timeline for the external parallel run period.



The report starts off with an introduction of the Nordic CCM project and the overall motivation for introducing flowbased in the Nordics. This is followed by a presentation of the KPIs put forward by the NRAs. The KPIs and the requirement to report on the monitoring of these, are the very reason for this report. The chapters 3 - 5 present the computation of the KPIs. This is structured in a way where each main category of KPIs has its own chapter. Chapter 3 reports on the KPIs capturing the quality of the capacity calculation process, where chapter 4 and 5 report on the KPIs capturing the quality of the parameter calculation. In chapter 4 the welfare computation for the DA market is presented. The overall approach has been to firstly present the total results on the welfare numbers and net positions for the Nordics, and hereafter to present disaggregated results to obtain a better understanding. In order to understand how flowbased improves the grid management, a zoom on a few individual hours is provided. Within the chapter some explanatory boxes are provided. These can be skipped by the expert reader, but are included as a service in case some background understanding is needed. For the ID market in chapter 5 there is no welfare computation as this is not possible. The chapter starts off with and explanation of the ATC extraction (ATCE) methodology, followed by the computational results applying the left-over DA capacity as a point of departure. In chapter 6, a summary of the stakeholder feedback is included. Chapter 7 is an attempt to put perspectives on the results of mainly chapter 4, being the social economic welfare results from the external parallel run in the DA market. The complete overview of stakeholder responses received and the TSOs' reflections to those can be found in the Annex I.

Please note that when the word flow is used in this report, we refer to the flow computed from the NPs and the FB parameters. When referring to commercials flows, the word "scheduled exchange" will be used.

The point of departure for a common Nordic methodology for capacity calculation.

The external parallel run can be described as an operational test phase where the flowbased parameters are applied in the DA market alongside with the current NTC method. However, it is important to bear in mind that even though flowbased is compared to NTC, the point of departure for a common Nordic methodology for capacity calculation, is not to stay with the current method, including the current design of operational processes, during the daily calculation of NTCs. This is the case for three reasons, as explained below.

Firstly, the CACM GL lays down that flowbased is the default CC methodology to be applied in all CCRs, including Nordic CCR and only if it can be demonstrated by TSOs that the application of the capacity calculation methodology using the flowbased approach would not yet be more efficient compared to the CNTC approach at the same level of operational security, CNTC can be applied. Mainly due to the meshed grid characteristics of the Nordic grid, this has not been demonstrated.

Secondly, the current NTC method is not an option. It is required by the CACM that the capacity calculation, whether NTC or flowbased, shall be based on the common grid model (CGM). The current Nordic NTC-approach, however, is not based on the CGM. Thus, the relation between limiting grid-components and offered capacity is not all the time precise in the current market design. Sometimes it's too low, constraining the market more than necessary, and sometimes it's too high, increasing the risk of having overloads which may cause redispatch during operation. This makes it difficult to compare between the current NTC-approach and the new flowbased-approach. A true comparison between NTC and flowbased can only be made when both approaches would be based on the same CGM, thus on the same level of operational security. This is also what makes the current Nordic NTC-approach non-compliant to the European regulation. And due to the more efficient features of the flowbased approach, this approach has been chosen by the Nordic TSOs and NRAs as the future of the Nordic power market.

Thirdly, due to the increased complexity of the power system, including more meshed grids, more distributed and variable generation and more flexible consumption, it is increasingly difficult to operate the grid in a secure and efficient manner applying the current NTC. Due to the excess simplicity of grid representation in the market coupling process, the NTC involves that TSO operators take ex-ante decisions about the location of generation and consumption before submitting capacities to NEMOs / the market coupling process. Implementation of the flowbased approach is a step forward from the current NTC approach towards taking better into account the locational information within a bidding zone as the flowbased approach models better the congestions induced by fluctuating power flows in the meshed transmission grids during the market coupling phase. The locational information is essential to ensure operational security for the on-going energy transition.

2. The criteria to be fulfilled for the CCM to be implemented.

Prior to the implementation phase of the Nordic CCM, the CCM went through an NRA approval phase. Among other elements, the Nordic NRAs amended the legal CCM, and included an evaluation phase of the operational functioning of the CCM during the external parallel run, cf. Box 1, to take place before the last 6 month of external parallel can be conducted and finally the CCM is implemented.

Box 1: Requirement of evaluation report cf. The Nordic CCM as of October 2020

In the Nordic DA/ID CCM it is stated that:

An evaluation report is written by the TSOs and delivered to the NRAs for assessment. Before submitting the report, the TSOs shall organize a stakeholder meeting based on the draft evaluation report.

- *The report shall be submitted to the NRAs earliest 5 months after parallel runs with continuous publications of results have started.*
- *The report shall cover at least a consecutive 3-month period of parallel runs, as close in time as possible to the publication of the report. All data presented in the report should be made available to NRAs, on a per MTU level of granularity.*
- *The report shall include at least the following, based on a per MTU level of granularity:*
    - *A calculation of DA socio-economic effects (as measured by delta in consumers' surplus, producers' surplus and congestion income) from flow-based capacity calculation compared to the current capacity calculation method in use. The geographical area for this calculation shall be the Nordic market area plus neighboring countries if possible.*
    - *If the accumulated DA socio-economic effect of flow-based is negative over any two-week period, the TSOs shall provide analysis and explain why this occurred.*
    - *Percentage and number of MTUs where fallback measures (in accordance with Article 22) have been used. TSOs should also analyse the reasons for the use of fallback measures and include this analysis in the report.*
    - *Percentage and number of MTUs where delays in having FB parameters ready for delivery in time for the allocation mechanism by CCC have occurred. Each occurrence of a delay should be explicitly reported along with the reasons for the delay.*
    - *Percentage and number of MTUs where the availability of FB parameters for publication as required by the Transparency Regulation ((EU) 543/2013) has been delayed. Each occurrence of a delay should be explicitly reported along with the reasons for the delay.*
    - *Information on how the capacities available for trade in the intraday-market are affected by the implementation of this methodology for the day-ahead timeframe.*
        - *Quantitative data on the expected opening capacities for ID should be provided on MTU level. The calculations shall be performed using either a prototype tool or the industrialised tool.*
        - *A qualitative assessment and explanation should be provided.*

- *Stakeholder feedback received in written form during the parallel runs. The feedback should be complemented with TSOs response to the comments received from stakeholders.*
- *If the NRAs' common assessment of the first or any subsequent report comes to the conclusion that FB is not operating at a sufficient level, the TSOs will be given further time to develop the operational implementation of the methodology. In this case, the TSOs are required to send a new report covering at least 3 consecutive months of additional parallel runs. The second or any subsequent report after that shall have the same requirements as the first report.*

The concrete criteria were developed along two dimensions. The first set of criteria is aimed at capturing the **quality of the process** from the delivery of input data from TSOs to CCC, calculation of flowbased parameters by the CCC, to the publication of parameters at relevant platforms (e.g. ENTSO-E transparency platform), and the actual application of the parameters in the market coupling process in the NEMO algorithm Euphemia. In case the KPIs for these criteria were violated, the 3-month period would have to start all over again. The second set of criteria are aimed at capturing the **quality of the flowbased parameters**, which is captured in the welfare economic assessment of the DA market and computation of ATCs for the intraday market. The reason why the welfare economics might act as a proxy for the practical functioning of the method is that the theoretical result unambiguously proves that flowbased is superior to NTC in terms of social economic welfare. Thus, if this is not the case in the parallel run, this is an indication of a potential for improvement of the flowbased parameters, thereby bearing in mind that the NTCs might be outside the secure operation of the power system. The concrete KPIs including thresholds are presented in Box 2.

Box 2: The KPIs monitored during the 3-month period of the external parallel run (and for the last 6 months)

Use of fallback measures. This KPI captures the quality of the process. Quality is measured as the ability of process to deliver a flow based domain based on the most recent input data. In case this is not possible, the CCC has to deliver a fallback domain, which by the very nature, is not the best available domain given the intended CC process.

NRAs' criteria: Fallback measures (as described in art 22 of the methodology) should be used in less than 3 % of MTU covered in the report to consider the methodology to operate sufficiently well concerning this criterion. NRAs shall assess the reasons for TSOs use of fallback measures based on the analysis and explanations received from the TSOs.

Structural delays. This KPI is also an attempt to capture the quality of the process. In this case the quality is captured in the daily delivery of flow based domains within the deadline of 9:30 AM CET and publication of the parameters by 11:00 AM CET. This is important as the daily timelines in the market coupling process are tight, and as the inputs are needed for the market analysis of the market players. Moreover, CACM GL requires that the RCC shall ensure that the flowbased parameters shall be

provided to relevant NEMOs in time to ensure the publication of flowbased parameters in time (legal requirement).

NRAs' criteria: The delivery of FB parameters by the CCC to the ENTSO-E transparency platform in accordance with Transparency Regulation ((EU) 543/2013)) is delayed for 2-10 minutes in less than 5 % of the MTUs in the time period covered in the TSOs' report. Any delay exceeding 10 minutes is not acceptable.

NRAs' criteria: The publication of FB parameters to stakeholders is delayed for 2-10 minutes in less than 5 % of the MTUs in the time period covered in the TSOs' report. Any delay exceeding 10 minutes is not acceptable.

Social economic welfare. The change in social economic welfare is computed by observing the impact of substituting the NTC by the flowbased domain in the market coupling process. The expected impact is positive in the favour of flowbased. In case not, this might (or might not) be due to the quality of the flowbased parameters. See Box 3 on the motivation and explanation of computation of social economic welfare.

NRAs' criteria: NRAs acknowledge that one of the purposes of introducing a new methodology for capacity calculation, according to CACM Regulation, is to provide welfare benefits to society. Thus, comparing the socioeconomic welfare of the current NTC methodology to the estimated results from using the new methodology, is an indicator to capture potential shortcomings in the implementation of the new methodology. However, NRAs note that this comparison cannot be performed with perfect precision, partly due to the two methodologies operating at different levels of operational security. NRAs will therefore need to broaden their analysis to include more parameters than just the net difference in socioeconomic welfare. If deviations to the expected outcome of improved socioeconomic welfare with the new methodology compared to NTC occur in the period covered in the TSOs report, the NRAs shall analyse the reasons for the outcome not being in line with expectations based on the analysis and explanations received from the TSOs.

Effect on intraday market. Contrary to the day ahead market, social economic welfare cannot be computed for the intraday market. This is due to the fact that the intraday market is a continuous market, where individual bids are matched in XBID, including individual settlement prices. For the computation of social economic welfare, unique supply and demand curves and marginal settlement prices are needed. Instead the focus is on the effect in terms of available gate-opening cross-zonal capacity for the intraday market.

NRAs' criteria: The transition to the FB calculation methodology for the day-ahead timeframe will have impacts also on the intraday timeframe and trading. It is clear that if more capacity is used in the day-ahead market in one direction, then less capacity will usually be available in the same direction in the intraday market. However, the impact of allocated flows in the day-ahead market on the available capacities in intraday needs to be looked at. The worrying point for NRAs would be if there were less intraday capacity in both directions on a bidding zone border, when FB is used in the day-ahead market. NRAs will assess the effect to ID markets based on the available data and TSOs' report.

Stakeholder feedback.

NRAs' criteria: The TSOs' report will include stakeholder input and/or comments on the time period and data covered and analysed in the report, which should be taken into account when NRAs assess the report.

TSOs will apply the criteria set by the NRAs to assess the functionality and the efficiency of the flowbased methodology during the full EPR-period. The NRA-criteria will be used also during the final 6 months of external parallel run after NRAs have found that the approved methodology and the operational implementation of the flowbased methodology are working well enough without further changes before go-live.

3. Results of the KPIs covering fallback and calculation process delays

This section reports on the percentage and number of MTUs where fallback measures (in accordance with Article 22 of the CCM) have been used and delays has been encountered.

In terms of fallback, article 22 of the CCM reads:

- *When day-ahead or intraday capacity calculation fails to provide the FB parameters for two or less consecutive market time units, the CCC shall calculate the missing FB parameters as being the minimum of the FB parameters, which have been successfully calculated for adjoining market time units.*
- *When day-ahead or intraday capacity calculation fails to provide the FB parameters for three or more consecutive hours, the CCC shall apply the default FB parameters. These default FB parameters shall be based on latest calculated FB parameters for the same market time unit and market time frame taken from daily, weekly, monthly or yearly capacity calculation.*

The flowbased capacity calculation process has stabilized since the beginning of the external parallel run in March 2022, and the start of the internal parallel run in May 2021.

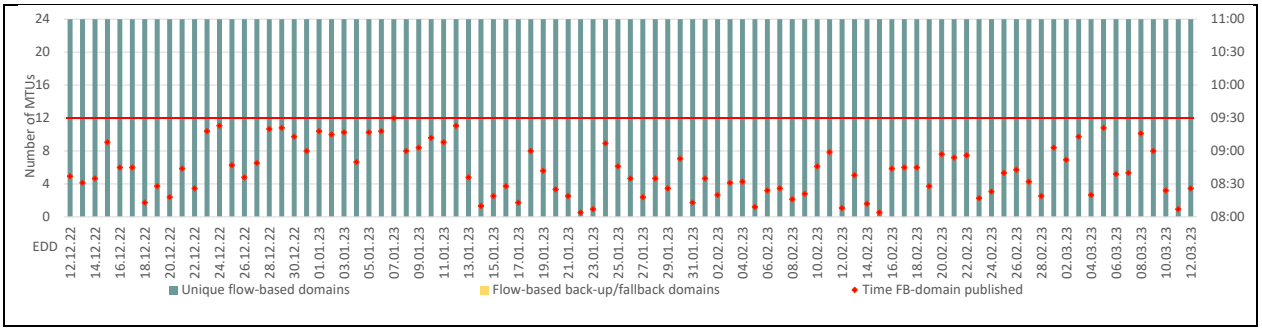
During the 3-months reporting period, covering Dec 12, 2022 up to and including March 12, 2023, no fallback measures (in accordance with Article 22 of the CCM) had to be used in the DA flowbased capacity calculation process.

For the percentage and number of MTUs where delays in having flowbased parameters ready for delivery in time for the allocation mechanism by CCC have occurred, the flowbased capacity calculation process has stabilized since the beginning of the external parallel run in May 2022. During the 3-months reporting period, no delays to provide the capacity calculation results to the allocation mechanism have occurred.

Also, for the percentage and number of MTUs where the availability of flowbased parameters for publication as required by the Transparency Regulation ((EU) 543/2013) has been delayed, the flowbased capacity calculation process has stabilized since the beginning of the external parallel run in May 2022. During the 3-months reporting period no delays to publish the capacity calculation results have occurred.

The capacity calculation performance is depicted graphically in Figure 2. The KPIs, as described in the Box 2, have been monitored throughout the three-months evaluation period. The green bars – and the absence of yellow bars – indicate that for each MTU during the three-months evaluation period a flowbased domain could be created, without the application of fallbacks in the capacity calculation process. The red diamonds indicate the time that the flowbased domain was available from the capacity calculation process, and ready for market simulation runs and publication to the stakeholders. All were managed before the 9.30 deadline.

Figure 2: The fallback and delay KPI during the 3-month period



4. Results of the social economic welfare computation

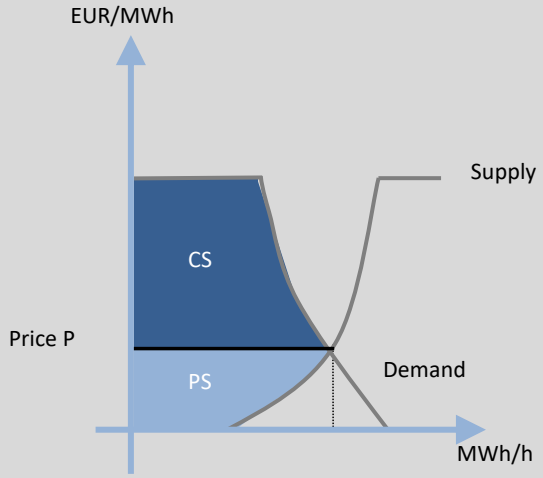
This section reports on the social economic welfare computation of the external parallel run in the day-ahead market applying the flowbased parameters for 3-months reporting period. During the flowbased external parallel run, a flowbased capacity calculation is performed by the TSOs and NRCC, alongside the operational NTC capacity calculation applied in the DA market currently. Where the operational NTC values are used in the single day-ahead market coupling (SDAC), the flowbased parameters are used in a flowbased market coupling simulation, by using the order books submitted in the SDAC. Therefore the only difference between the two, is the parameters applied in the DA market; thus it is possible to compute the isolated (static) impact of applying flowbased parameters instead of NTC.

The computation of social economic welfare draws upon the standard approach from applied microeconomic and cost-benefit analysis. In the Single Price Coupling Algorithm, Euphemia, the pan-EU welfare is the objective function that is maximized; the concept of consumer and producer surplus, but also congestion income, and impact on the exchange of electricity between BZs are part of the picture. The approach and motivation are explained in Box 3.

Box 3: The approach to social economic welfare computations

Impact assessment done through social economic welfare computation applies the concept of consumer and producer surplus in order to quantify the impact of a certain market design change or in this case, a change of capacity calculation methodology. Moreover, the same concept is applied when a NEMO does the daily calculation of equilibrium prices and volumes for the 24 hours in the day-ahead market, applying the Single Price Coupling algorithm, Euphemia.

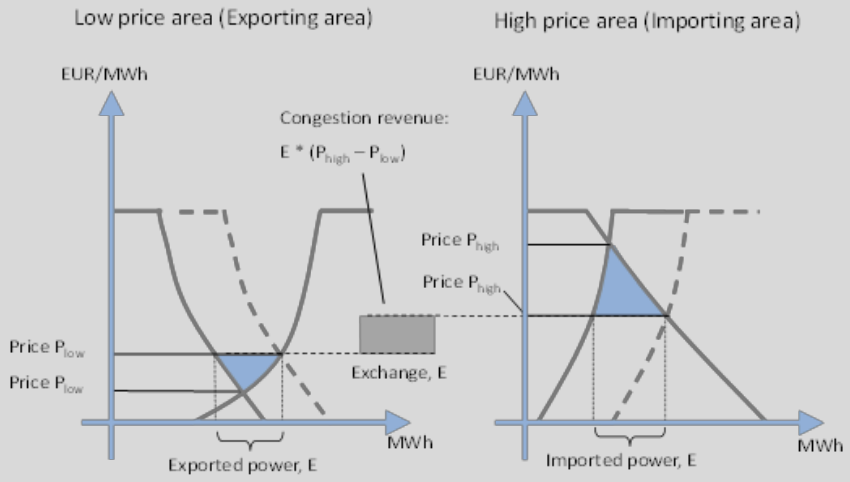
The social economic welfare computation can be illustrated by applying the standard supply and demand diagram, shown below. This diagram illustrates the value for society of a given activity. The supply curve assumes to illustrate the cost for society as the assumption of perfect competition ensures that the supply curve reflects the cost for society of providing the good. The demand curve assumes to illustrate the value for society as the curve reflects the willingness to pay and, thus, can be "translated" into a proxy of utility for individuals by consuming the good. The idea is, that individuals are only willing to pay the prices, reflected in the demand curve, if the good provide as least the same level of utility as they could obtain by alternatively purchasing another good. Based on this reasoning, the logic deduction is that the area between the two curves can be defined as social economic welfare, SEW. SEW can be split into consumer and producer surplus, thus SEW = CS+PS. CS is defined as the area below the demand curve and the equilibrium price, P, where PS is the area above the supply curve and the equilibrium price, P.



What the Single Price Coupling algorithm, Euphemia, does is that DA prices and quantities are computed with the goal of maximising the SEW subject to the constraints in the system, NTC or flowbased. For the external parallel run, the TSOs have applied flowbased parameters in the Euphemia algorithm and computed the impact on PS and CS, with the NTC PS and CS as the reference.

However, in this setting some of the social gain, SEW will materialise as congestion income, CI to the cable owners, the TSOs. This is the standard approach of computing the social impact when the market contains constraints that materialise in two or more local market areas. Seen from the market player perspective, the congestion income is a cost of transportation, but materialises as a gain at the TSO, making this an element of focus in the computation.

Turning to the approach for computing the impact of flowbased, the two-zone model below can be applied. The point of departure is little or no interconnector capacity. Then the capacity is increased (e.g. by substituting the NTC capacities with the flow based parameters), which will lead to new price and volume equilibria and thus having an impact on the three components, CS, PS and CI.



Gains has three elements:

1. Low price area:
   - Price increase:
   - →ΔCS <ΔPS
   - Net-effect: gain for low price area (blue area)
2. High price area:
   - Price decrease:
   - →ΔCS >ΔPS
   - Net-effect: gain for high price area (blue area)
3. Income for TSO (grey area)

In the low price area, price increase → consumers will loose and producers will gain, thus ΔCS<ΔPS, with a net gain equal to the blue triangle. In the high price area the producers will loose and consumers will gain, thus ΔCS>ΔPS, with a net gain equal to the blue triangle. In addition the net gain, the TSO will gain the grey area equal to the CI.

Please observe that a social economic welfare assessment does not imply that a loss or gain for any party has particular weight in the total net SEW computation, meaning that no particular weight are attached to a gain for e.g. consumers

It is important to emphasize that the reason for performing the social economic impact assessment is not to provide material for a decision between (C)NTC and flowbased. The decision to implement flowbased was prepared already around the time the European target model for electricity was developed by European stakeholders, regulators and Commission and subsequently laid down in the CACM GL as a legal requirement. The flowbased is the default methodology, as flowbased provides a better grid representation compared to NTC, thus more electricity can be exchanged in the power system. More exchanges induce an improved cost-efficient electricity generation and allocation to consumers with a higher willingness to pay. This is elaborated in Box 4.

Box 4 Why flowbased is expected to provide higher social economic welfare compared to CNTC - The relation between NTC and flowbased using the same CGM for both approaches.

Whenever a common the CGM is applied, the formal relation between NTC and flowbased becomes clear. We can illustrate this by applying a simplified grid model for an electricity grid containing three bidding zones and three lines connecting them. Each line is regarded a Critical Network Element (CNE) limiting how much electricity can be transferred between the bidding zones.

In this simple example, each CNE is equal in terms of electric resistance, with a capacity of 1000 MW, and we do not consider any contingencies. The capacity is the physical capacity adjusted for internal flows and loop-flows (F_0), Reliability Margins (RM), Remedial Actions (RA) and the Individual Validation Assessment (IVA). This simplified grid model is illustrated in figure x1.

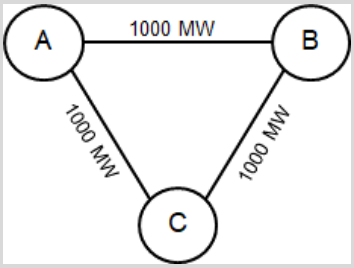


Figure x1. Simplified grid model

Due to the physical features, if electricity is injected in bidding zone A, and extracted in bidding zone C, the flow of electricity will fan out in the grid. Because the electric distance from A to B to C is twice that of A to C, 2/3 of the electricity will flow directly from A to C, and 1/3 will flow from A to B to C. This flow-pattern will emerge for electricity exchanged between any two bidding zones in this simplified grid model.

In an AC-flow model, we always assign one node as a slack-node. The purpose of the slack-node is to absorb all imbalances between supply and demand of electricity in the model. Which node is assigned as the slack-node is of no consequence for the results, and in our simplified model, we have assigned bidding zone C as the slack-node. By assigning a slack-node, we can define the "Zone-to-Slack" Power Transfer Distribution Factors (PTDFs).

A Zone-to-slack PTDF is a percentage-number showing how much of one MW injected in a bidding zone and extracted in the Slack-node will flow on each CNE. As such, there will be one PTDF for each bidding zone and each CNE. In our simplified model we will have 3 PTDFs for each bidding zone to each of the CNEs. The zone to slack PTDFs is already introduced above for an exchange between bidding zone A and bidding zone C, and the numbers are 2/3 for line A>C, 1/3 for line A > B and 1/3 for line B>C. The full PTDF matrix is illustrated in table x1. The first column in the table is the capacity of each CNE which is called the remaining available margin (RAM).

	RAM	BZ A	BZ B	BZ C
A>B	1000	1/3	-1/3	0
B>C	1000	1/3	2/3	0
C>A	1000	-2/3	-1/3	0

Table x1. PTDF matrix – flowbased/security domain

The flowbased approach

The PTDF-matrix together with the RAMs provides the market capacity for the flowbased approach, which is what will be provided to the market algorithm. The matrix, including the RAMs, is also what we refer to as the flowbased domain, or the security domain, mapping all possible combinations of net-positions (supply minus demand) for the bidding zones in the electricity system that is possible to obtain without overloads on any CNE. The way the market algorithm applies this information in the flowbased approach, is to add a market constraint for each CNE in the form:

$$\sum_{BZ} NP_{BZ} * PTDF_{BZ}^{CNE} \leq RAM_{CNE}$$

The constraint says that the flow on any CNE, provided by the left side of the equation, must be lower or equal to the RAM. The flow is computed as the sum-product of the net-positions for each bidding zone and PTDF.

The flowbased domain can also be illustrated in two dimensions as in figure x2. The first point (1) we can observe is the max export/NP for bidding zone A which is 2000 MW. This can be obtained if, and only if, both of bidding zone B and C are importing 1000 MW each. In that case we will have a maximum flow of 1000 MW on A>B, and 1000 MW on A>C. The flow from B>C will be zero. The next point (2) of interest is where C imports 2000 MW. This is possible if and only if both A and B export 1000 MW each. In this situation, the flow A>B is zero, A>C is 1000 MW and B>C is also 1000 MW. Any points on a straight line connecting these two points are also possible. The third (3) point of interest is the maximum export for bidding zone B at 2000 MW. In this situation A is importing 1000 MW and C is also importing 1000 MW. This will provide a flow of 1000 MW B>A, 1000 MW B>C and zero for A>C. Any points on the line connecting (3) and (2) are also possible market solutions. Similar reasoning can be done for import situations for A, B and C, providing points (4), (5) and (6). The blue lines are now enveloping all possible net positions for the bidding zones A and B that are allowed in the market algorithm, provided the capacity information in table x1.

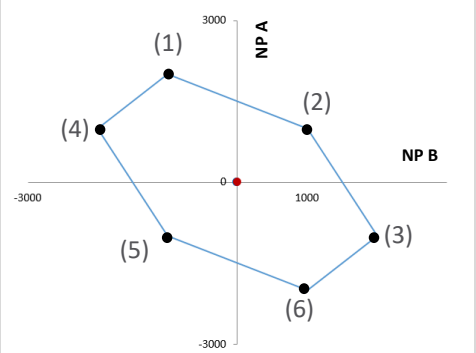


Figure x2. The flowbased domain

The NTC approach

In NTC, the capacities are provided for the market algorithm in a different form, as NTC-capacities on each commercial border. To be compliant to the regulation, the NTC capacities have to be extracted from the same common grid model as the flowbased capacities, which is exemplified by the simple model in figure x1. The way the market algorithm applies the NTC-information, is to add market constraints in the form:

$$NP_{BZA} \leq \sum_n NTC_{BZA->BZn}$$

$$NP_{BZA} \geq \sum_n NTC_{BZn->BZA}$$

As the constraints illustrate, the only requirement is that the net position of each bidding zone is above the total import capacity, and below the total export capacity. There is no information of flows in this solution, thus, transit flows will have to be managed by reducing the offered capacity below the RAM. We can illustrate this by reviewing the NTC domain in the same picture as the flowbased domain in figure x2, giving us figure x3.

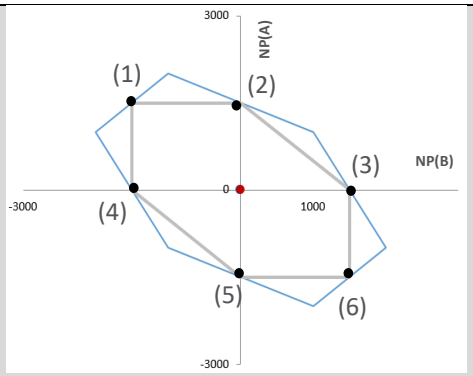


Figure x3. The flowbased & NTC domains

The first point of interest here is the maximum export that can be allowed for bidding zone A. If we imagine allowing 2000 MW, as in flowbased, a worst-case scenario is that C absorbs the whole quantity. In that situation, the flow will still fan out according to the PTDFs, with 1/3 through A>B>C, and 2/3 directly from A>C which causes a flow of 2000*2/3 on A>C. This is above the limit of 1000 MW. This can happen because the NTC market algorithm does not consider flows on each individual CNE, only minimum and maximum net positions. Thus, due to the asymmetric flows caused by the electrical resistance, the NTC capacities for the borders A>B and A>C must limit the net position of A to a total of 1500 MW, which in the worst case will give a flow A>C of 1000 MW and A>B>C of 500 MW. The maximum net position of 1500 MW for A is reflected in (1) and (2) in figure x3, where point (1) is the situation where 1500 MWs are absorbed in bidding zone B, and (2) is a situation where the power is absorbed in bidding zone C. All points along a straight line connecting (1) and (2) are also possible in the NTC-approach.

A similar reasoning is made for bidding zone B, providing us with point (3) and (6). And similarly, all points on a straight line connecting the two points are also possible market solutions. The same is true for all points on a straight line connecting (2) and (3). When the same reasoning is applied for maximum imports for bidding zone A and B, we can derive points (4) and (5) as well, thus giving us the grey area in figure x3 which is all possible market outcomes allowed in NTC based on the same CGM as the blue flowbased domain.

Assessing figure x3, it should be clear that, provided that the same CGM is used, the flowbased market domain covers all possible NTC market outcomes and then some more. If the optimal market outcome is located outside the grey area, but inside the blue area, the flowbased approach will allow for the better solution that is not possible in NTC. If the optimal market solution is inside the grey area, both approaches will find the same optimum. Thus, the flowbased approach cannot provide inferior market solutions to NTC, while it can provide better. The current Nordic NTC approach, however, is not based on the same CGM as the flowbased approach. Thus, we cannot infer that this relation holds for the current EPR. What we do know is that the current NTC is not compliant to the regulation and must be changed in a way to apply the same CGM as is applied in the flowbased EPR. Provided this, we do know that the flowbased approach will be the most efficient choice providing more trading opportunities than the NTC approach.

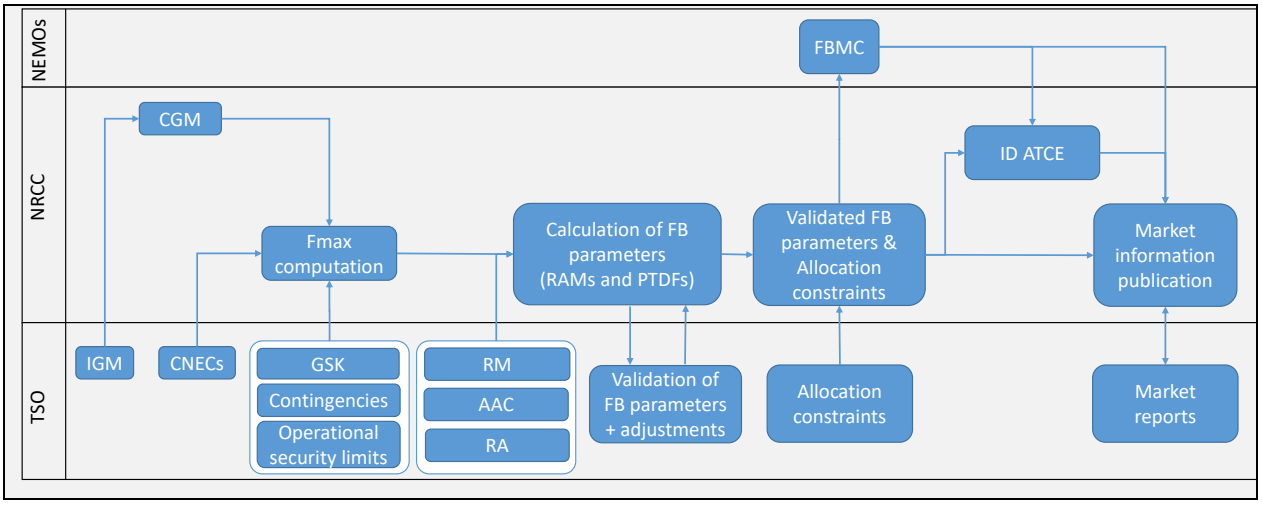
Description of the external parallel run set-up

For the external parallel run, the following setup is applied.

- The four Nordic TSOs provide the flowbased input data to the NRCC, including D-2 IGMs.
- The NRCC performs the merging of the D-2 IGMs into a D-2 CGM.
- The NRCC performs the flowbased capacity calculation process.
- The TSOs validate the resulting DA flowbased parameters, to be used in the DA market coupling.
- The Nordic NEMOs perform the DA flowbased market coupling simulation.
    - The NEMOs use a "local copy" of the market coupling system Euphemia to perform the flowbased market coupling. In these simulations the same geographical area is covered as in the operational market coupling.
- The NRCC performs the ATCE (ATC Extraction), by using the DA flowbased parameters and the DA flowbased market outcome, to provide the gate opening capacity for the ID timeframe.
- The TSOs validate the resulting ID capacities.

A graphical overview of the EPR process is depicted in the Box 5.

Box 5: Graphical overview of the EPR process



When the flowbased market coupling simulation results are available, DA left-over capacity can be assessed and provided to the ID market in the form of ATC-capacities. These are presented in chapter 5.

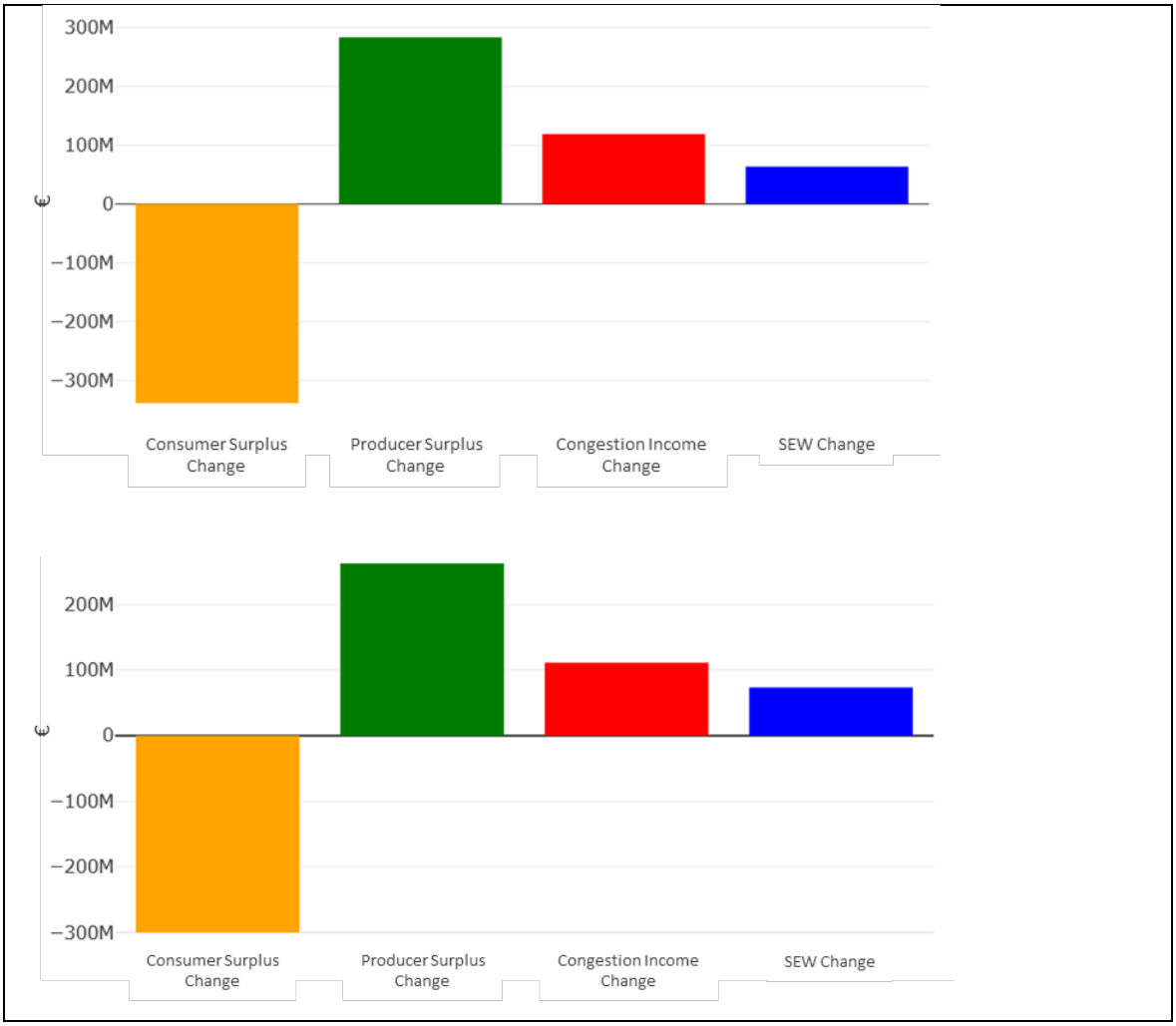
DA social economic welfare comparison

This section presents the DA welfare comparison between the operational NTC system and the simulated flowbased system. The DA results contain simulations from the three-months reporting period

12.12.2022-12.3.2023 (week 52 – week 10). See Chapter 7 for further elaboration on different perspectives of the results.

The total change in social economic welfare (SEW) and the distribution of its components is shown in Figure 3. For the 3-month EPR period, the total SEW gain is 63.3 M€ in the total single day-ahead coupling (SDAC) region and 73.4 M€ in the Nordic CCR. This comprises of increases in congestion income and producer surplus and a decrease in consumer surplus.

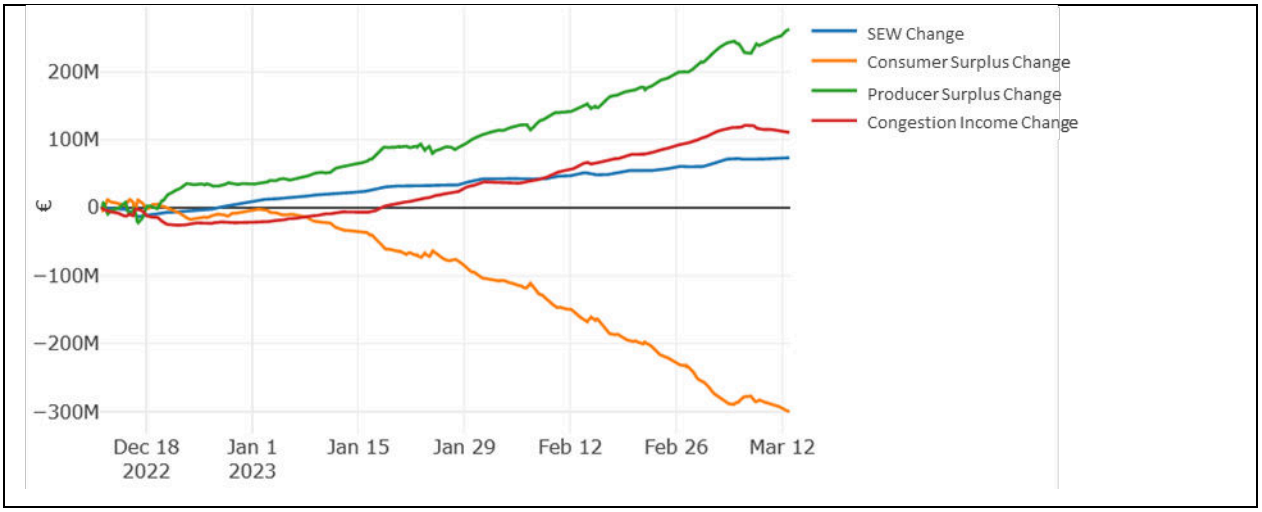
Figure 3: Welfare change for the total SDAC (top) and the Nordic CCR (bottom). Total social economic welfare change (SEW) consists of changes in consumer surplus, producer surplus, and the congestion income.



The same result is illustrated in Figure 4 as a cumulative social economic welfare difference between the SEW results in NTC and flowbased in CCR Nordic. The consistent rise in SEW gain over the period illustrates that the positive result for flowbased comes from general positive results and not from single

days with large results. It can also be seen that the positive results come from a consistent increase in producer surplus and decrease in consumer surplus. Figure 4 also shows that flowbased did not provide higher welfare for all hours. During the first week (week 50) there is more variation in all components of SEW. Flowbased congestion incomes were lower compared to NTC during the first week.

Figure 4: Cumulative SEW line chart (Nordic CCR only).



The NRA criteria requests that *If the accumulated DA socio-economic effect of flow-based is negative over any two-week period, the TSOs shall provide analysis and explain why this occurred*. Figure 5 shows the SEW for any two-week period within the 3 months, e.g. week 50-51, 51-52, 52-01 etc.; it can be observed that no two-week period has a negative SEW.

Figure 5: Sum of SDAC SEW for any two-weeks period.

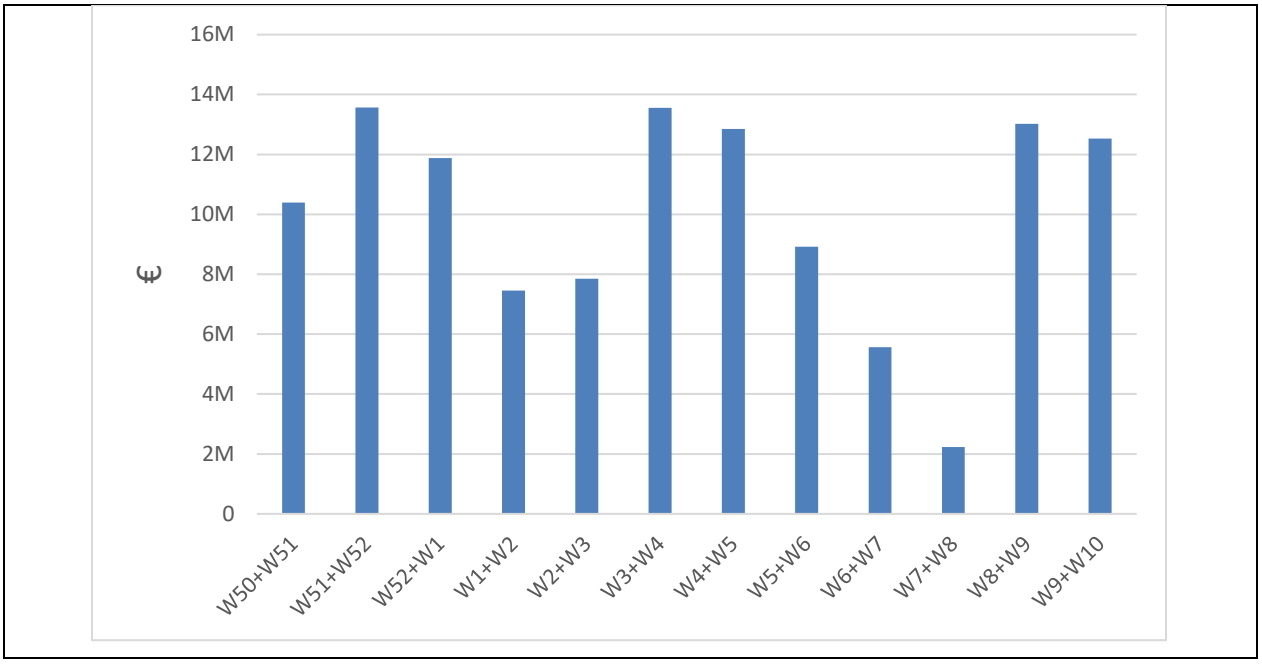
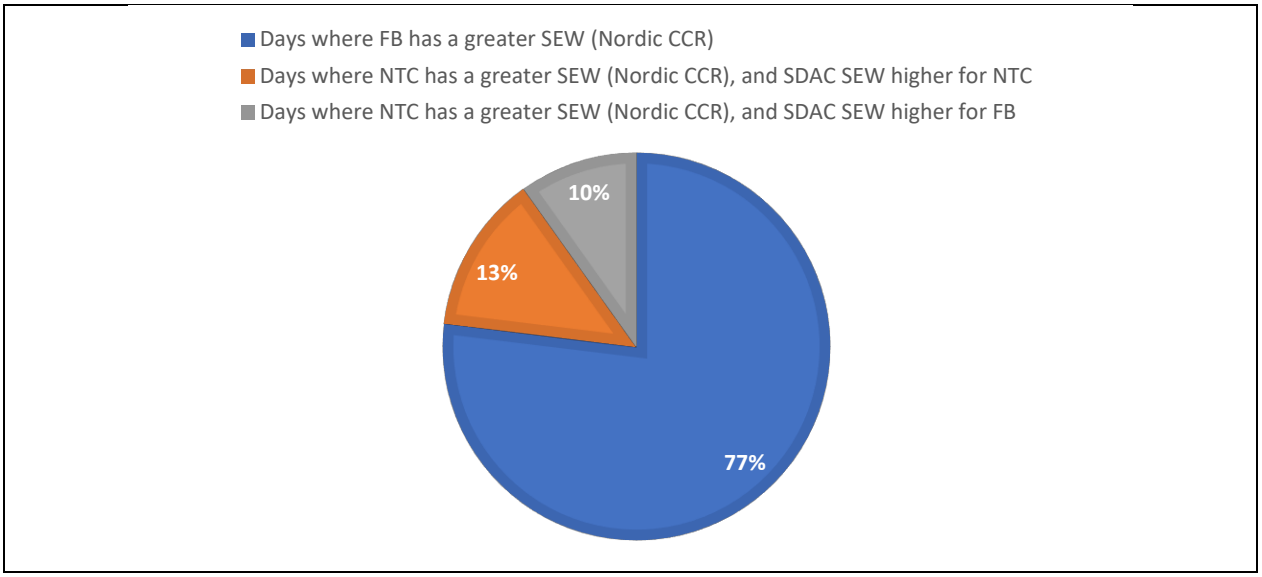


Figure 6 shows the percentage of days where the flowbased SEW outperforms the NTC SEW, and vice versa. As shown, 77% of the simulated days during this parallel run have a higher SEW in flowbased than NTC when comparing the outcome for the Nordic CCR. This means that for 23% of the days, NTC provides more welfare in the Nordics, yet for 10% of these days the total SDAC SEW has a higher SEW with flowbased than with NTC.

Figure 6: Percentage of days where the flowbased SEW outperforms the NTC SEW.



While the appearance of days where NTC achieves a higher SEW than flowbased may at a first seem unintuitive, it can nonetheless be explained on closer inspection. Overall, when NTC yields a better result, it is mainly due to one of the following factors.

1. **Reporting area vs. Total area:** The reporting area for this report is limited to the Nordic CCR. Therefore, any gain in the rest of SDAC is not by default included in these graphs. If the whole SDAC region is considered, for roughly half of the days (43%) when NTC has a higher SEW for the Nordic CCR is compensated in the rest of the SDAC. In total, 13% of the days have a negative impact from flowbased for both the Nordic CCR and the whole SDAC region (see Figure 6).

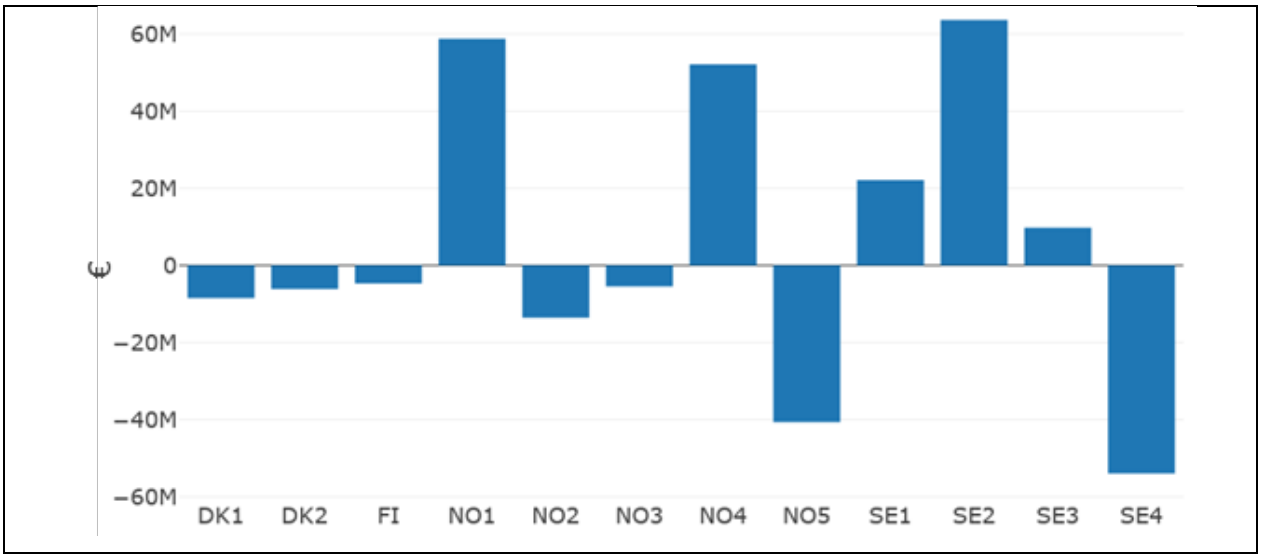
2. **Learning by doing:** One of the objectives in the 3-month period is to gain experience with the flowbased and exploring ways to improve IGMs (and thereby CGMs). Some errors are noticed afterwards based on the results of the parallel runs. When errors are spotted in the process they are corrected. As the EPR results comparison is based on the capacities provided by the operators in an operation process, the historical flowbased domains cannot be corrected. This must be kept in mind when assessing the SEW results.

   One example of an important take-away from the learning process during the past three months of EPR is how the series compensators on the SE2-SE3 border should be handled. This is further explained in the section *Modelling between SE2 and SE3*.

In addition to the total Nordic SEW, it has also been monitored how flowbased affects individual bidding zones (BZs) within the Nordic CCR. Even though the overall SEW impact for the Nordic CCR is positive, the results among the BZs vary (Figure 7). BZs with the highest gains during the reporting period are

NO1, NO4 and SE2, while NO5 and SE4 experience the largest losses in total welfare. On the other hand, the overall SEW impacts on the Danish bidding zones (DK1, DK2), Finland, and NO2 can be deemed as relatively minor.

Figure 7: Net SEW impact for each BZ in the Nordic CCR.

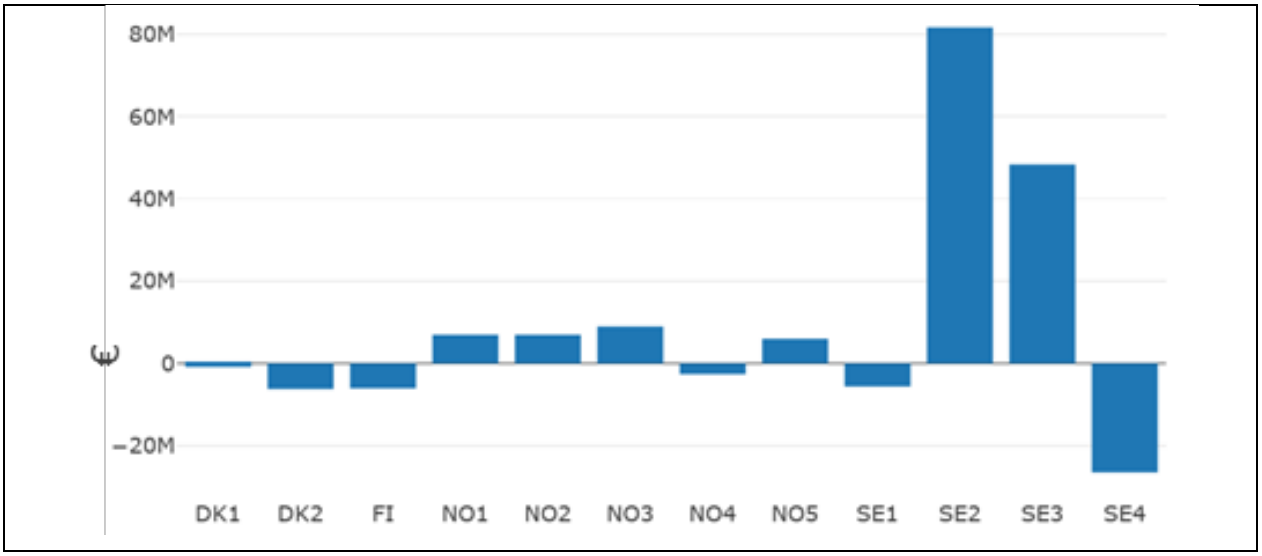


Looking at the congestion income (CI) changes in Figure 8, the overall increase of congestion income is mainly driven by the results for bidding zones SE2, SE3, while SE4 has the largest decrease. Congestion income is distributed following the ACER decision No 38/2020 [1] and split equally between the BZs related to the border.

The largest change in CI relates to SE2-SE3 where the increase in both the SE3 price and the flow has increased the income on this border. This increase in price for SE3 can also explain the change in CI for SE3 and SE4 as it makes the CI for border SE3-NO1 and SE3-SE4 decrease.

[1] Decision no 38/2020 of the European union agency for the cooperation of energy regulators of 23 December 2020 on the methodology for the use of congestion income for the purposes referred to in article 19(2) of regulation (EU) 2019/943 in accordance with article 19(4) of regulation (EU) 2019/943

Figure 8: Net impact on congestion income obtained at the CCR Nordic BZ borders



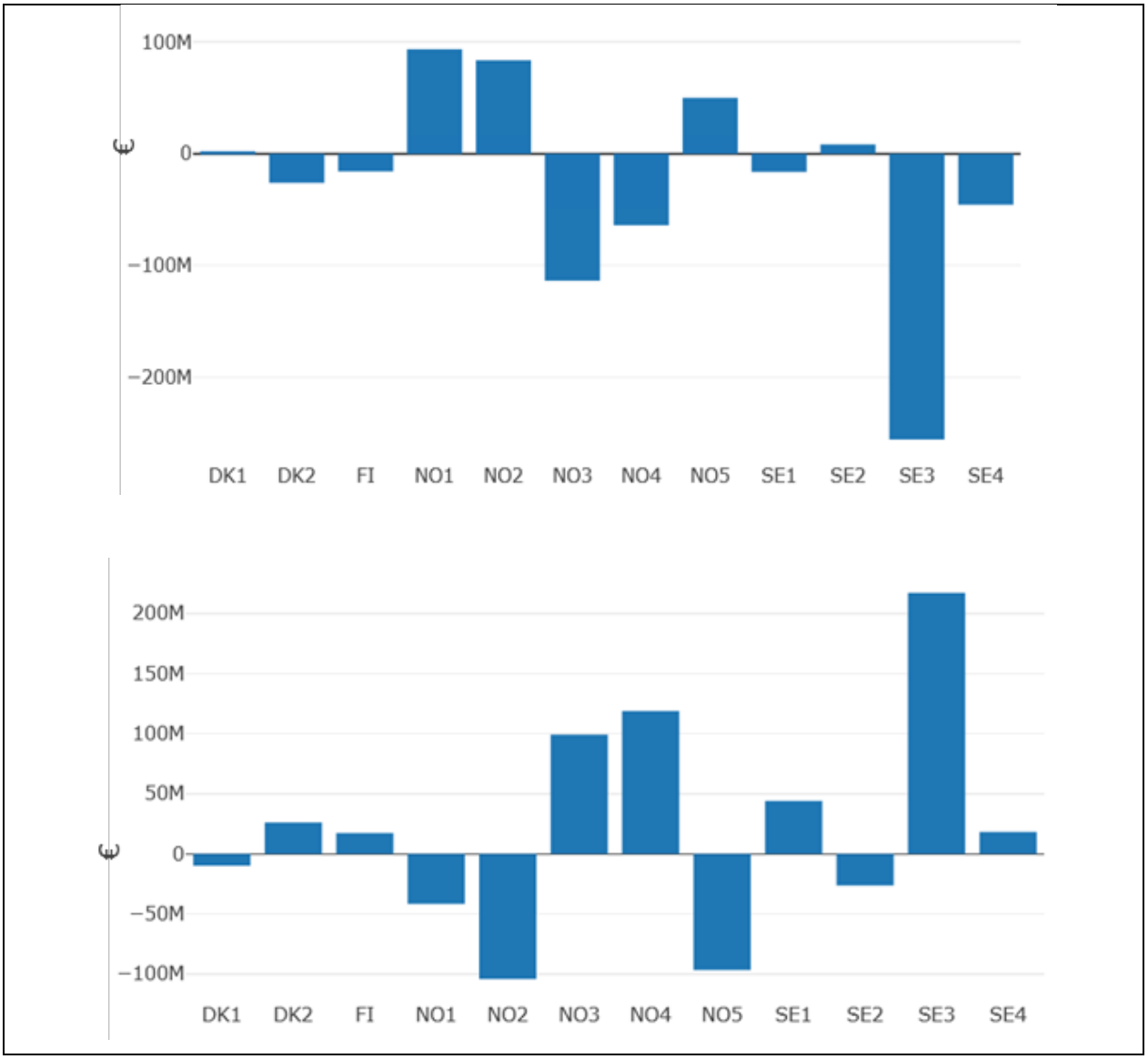
When a BZ price increases/decreases due to flowbased, it means that power is imported or exported differently than with NTC and that there is a redistribution of welfare between consumers and producers. This is also shown in Figure 9 where the changes in consumer surplus (CS) and producer surplus (PS) are split per BZ.

The BZs obtaining an increase in CS and a decrease in PS are mainly areas that in NTC had high prices, such as southern Norway (NO1, NO2, and NO5), as these areas had a decrease in prices with flowbased.

The opposite occurs for northern Norway (NO3, NO4) and SE3 that obtained an increase in PS and a decrease in CS as these areas had an increase in prices with flowbased.

Again, the impacts for Denmark (DK1, DK2), Finland, but also Northern Sweden (SE1, SE2) and the southernmost Swedish bidding zone SE4 are smaller in magnitude.

Figure 9: Change in consumer (top) and producer (bottom) surplus in the Nordic BZs



Deep dive on the flowbased simulation results on different elements

As a point of departure, one has to acknowledge, that the reason for changes in SEW can basically be due to two main reasons:

- Elements **not related** to the difference in the two methodologies, but due to e.g. flowbased applying a CGM while NTC is not, NTC applying planned countertrade or special line settings,

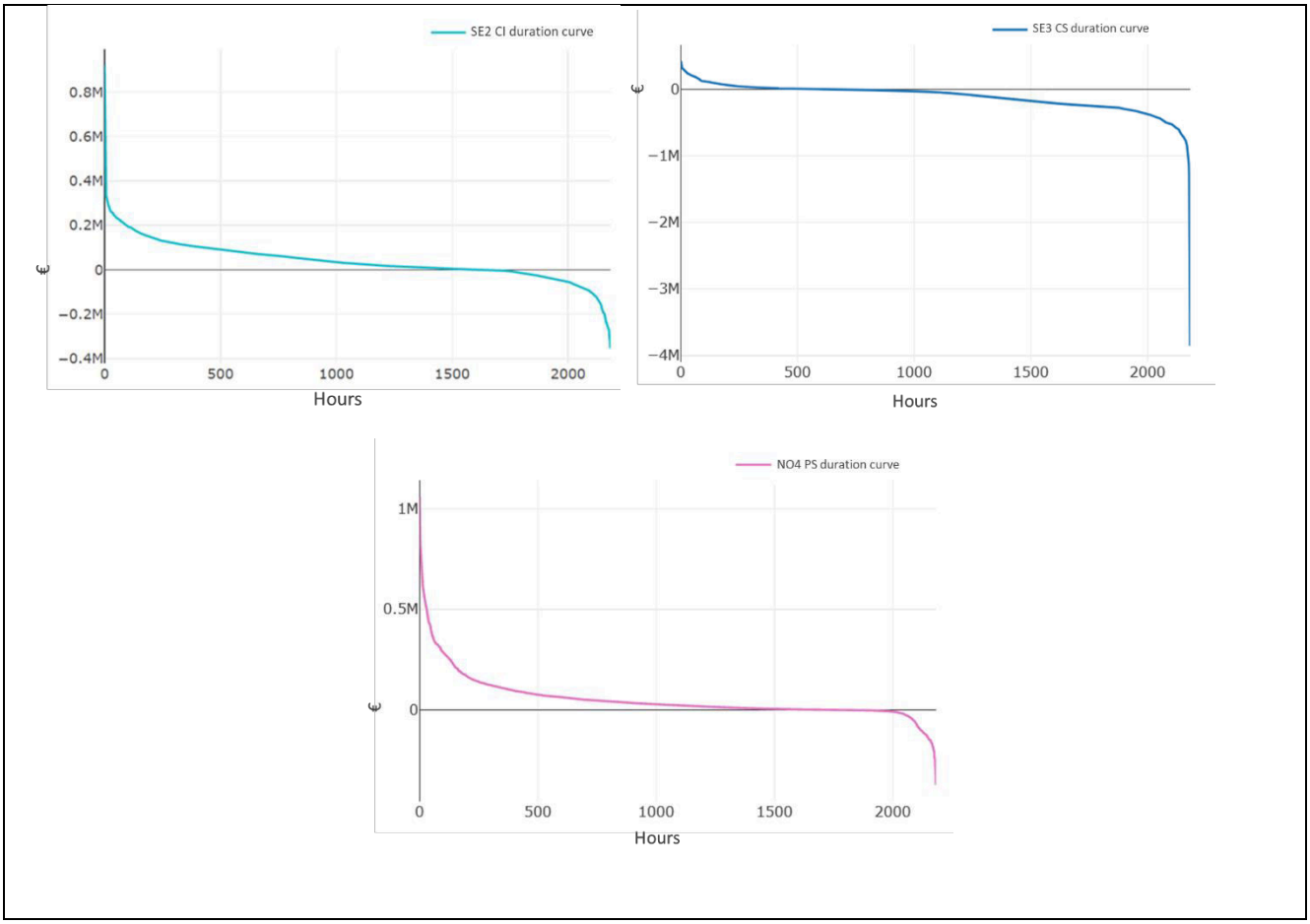
while flowbased is not. One such element is the modelling of the SE2-SE3 border, which is elaborated upon later in this chapter.

- Elements **related to** differences in the methodologies of flowbased and NTC, where flowbased can offer improved grid representation in Euphemia, thereby leading to e.g. non-intuitive flows and relatively different impact on pricing but also differences in definition e.g. of FRM and TRM.

It is important to bear this in mind, as parallel run results will reflect both reasons. Therefore it is important not to draw conclusions on the functioning of flowbased if the reason for different behaviour is related to reasons within the first category.

Below we have provided a more disaggregated picture of the BZs with the largest impact in one of the three welfare components; net positive congestion income in SE2, net negative consumer surplus in SE3 and net producer surplus in SE4; this is done in the form of duration curves, where the welfare values on an hourly level are illustrated. The purpose is to identify if the total sum of each welfare component (CI in SE2, CS in SE3, and PS in SE4) are driven by a few hours of extreme values or provide a more generic picture. It can be concluded that it is a result of a more general picture of the market situation for the period of focus. In Figure 10 it can be seen that approximately 50% of the MTUs adds to the sum of positive CI for SE2, negative CS for SE3, and positive PS for SE4.

Figure 10: Duration curves of hourly values of CI in SE2, CS in SE3 and PS in SE4



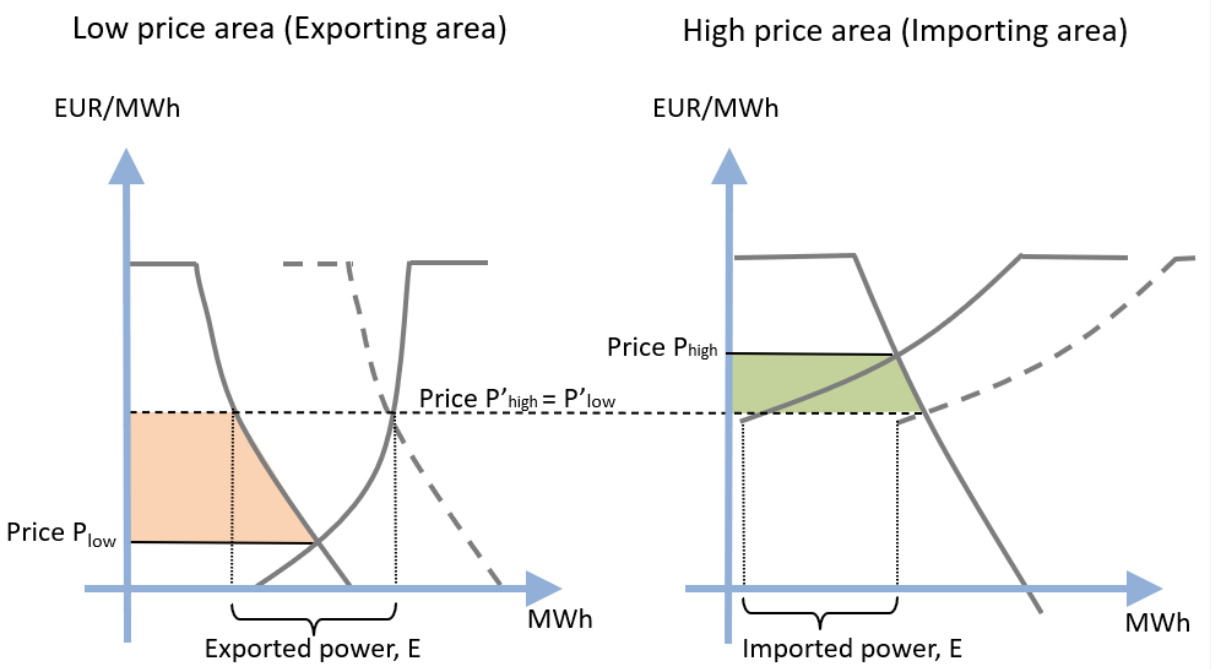
Why the consumer surplus may decrease despite more efficient use of the grid

For the period covered by this report there is an overall positive SEW impact for the Nordic CCR, but a decrease in consumer surplus. However, as shown in Figure 9, some BZs have an increase in the CS, while the others have a decrease. The BZs with the initially highest prices typically show a decrease in prices, and thereby an increase in CS, with flowbased. However, these increases have not been enough to cover the decreases of CS in other BZs. This section aims to explain why this may happen even if flowbased, by definition, should be able to use the transmission capacities more efficiently to maximize the overall gain from the power market.

Box 6 illustrates an example of two bidding zones on how the slopes of the demand and supply curves can impact the consumers. The slope of the curves is one of the reasons for the welfare which is of significant importance for the impact assessment result when more power is exchanged between, initially, low-price and high-price BZs.

SE3 is an area with relatively steep supply order curves, while areas in the south of Norway have a lot of flexible hydro production resulting in flatter bid curves on the supply side. When flowbased increases the capacity between these areas, and the south of Norway is a more expensive area than SE3, a consequence can be that the increase in CS in the south of Norway is not enough to cover the consumer loss in SE3. Yet, as the example in Box 6 shows, this will still increase the overall SEW for the system.

Box 6: Theoretical example with a total SEW increase, but an overall loss in CS.



In this theoretical example, based on the approach explained in Box 3, there is a total SEW gain from the move of cheap power from a low-price area to the high-price area, but the change in total CS is negative. In this example, the change in surplus for the consumers in the low-price area (red area) is larger than the gain for the consumers in the high-price area (green area).

The changes in CS and PS depend on the slope of the bid and ask curves and the bought and sold volumes in each area. The imported and exported power is equal, but how much this amount affects the prices is different in the two areas. If the bidding curve is steep, a change in produced power has a large impact on the price, and if the bidding curve is flat a change in produced power has a small impact on the price.

In this example the capacity between the low-price area and the high-price area allows a full convergence of the prices, but the example holds also if the capacity had been limited.

One will see that the conclusions do not change if more bidding zones were included in the model, because the key outcome from the analysis does not depend on the number of BZs, but the impact of increasing exchange possibilities (= capacity) in the power system. In order to show this, a simulation of an "extreme" situation which supports that the finding on the impact on consumers is not fundamentally related to the flowbased methodology, is provided below. Flowbased is a methodology that should by default provide more grid capacity by offering a better utilisation of the existing grid. This way of thinking has been taken to an extreme by simulating the impact of having infinite capacity in the Nordic DA market.

The SEW results for an illustrative example of a one-day simulation are shown in Box 7. As expected, a system without constraints increases the overall SEW in the system. The results also show that the consumers in the BZs in the south of the Nordic area have a growth in welfare due to utilizing the cheapest possible production located in the North. However, this is not enough to make up for the loss for the consumers in the rest of the Nordic area. The results also show that the overall increase in welfare comes from the producers.

Box 7: Result of a one-day simulation of the Nordic DA market with infinite capacity in the Nordic CCR.

A one-day simulation of the Nordic area with infinite capacities in the Nordic CCR has been done for the 7th of February. This corresponds to a scenario with one Nordic bidding zone without any constraints.

This infinite situation could either be achieved through massive investments in the grid or by defining the Nordic market as one bidding zone and to manage the constraints with countertrade and redispatch.

Comparing the SEW of this simulation to the SEW from the DA NTC shows that for this day an increase of capacity in the CCR Nordic would provide the consumers in the Nordic area with a loss of 9 MEUR, while the Nordic producers gain 31 MEUR.

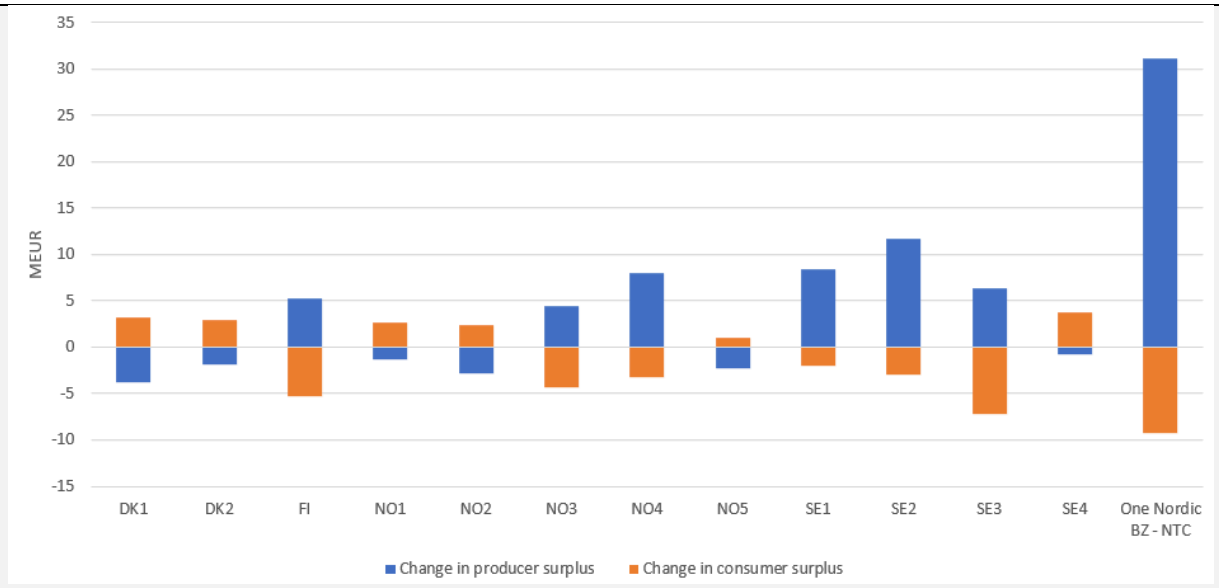


Figure – Change in CS and PS when comparing the simulation with one BZ in the Nordic area to the NTC DA results on a bidding-zone level. The 'One Nordic BZ – NTC' shows the total change in the Nordic system and 'FB-NTC' shows the change between flowbased and NTC.

As stated in Box 6, the distribution between CS and PS depends on the slopes of the supply and demand curves, the bought and sold volumes, and thereby on the initial price spreads in the system. These are factors that change over time depending on the market situation, for example, due to changes in fuel prices, water values, and the season. This indicates that the loss for consumers is not a deterministic outcome of the flowbased capacity calculation (or an increase of transmission capacity) over a longer time horizon. Rather, on the one hand, the loss for consumers is possible and explicable, but on the other hand, it is subject to the overall market situation. From this 3-month reporting period it can therefore not be concluded that the consumers will be the overall loser of introducing flowbased (or introducing an increased transmission capacity).

Better management of the NO1-SE3-DK1 flow through Sweden

In NTC, the East-West flows through SE3 are handled by a sum allocation between NO1-SE3-DK1. In hours where power is exchanged from SE3 to NO1 and DK1, internal CNEs in SE3 are congested. In NTC this is handled by applying a reflection of the internal CNE in bidding-zone border capacities. With flowbased, the East-West flows are handled better as all available capacity is submitted to the market and allocated in the most optimal way with respect to the flowbased domain and the market situation. Flowbased allows for larger flows, mainly between NO1-SE3, which will decrease the price spread between these two areas. In Figure 11 the price difference between NO1 and SE3 is positive for the

period of the reporting, which indicates that SE3 had lower prices than NO1 in NTC. A consequence of having more capacity between NO1-SE3 is therefore a price increase in SE3.

The picture is the same when comparing the SE3 to the system price calculation by Nord Pool. The system price reflects a situation of infinite capacity in the Nordic grid. The price in SE3 was in NTC lower than the overall price of electricity in the Nordic system for 59% of the time captured in this evaluation

report. Increased capacity will increase the SE3 price. This is the case throughout the period of the 3-month reporting.

As mentioned before the slope of the bid curve in SE3 is steep, so higher exports will increase the price a lot.

Figure 11: Rolling average weekly price for NO1 and SE3 in NTC and the system price calculated by Nordpool in NTC.

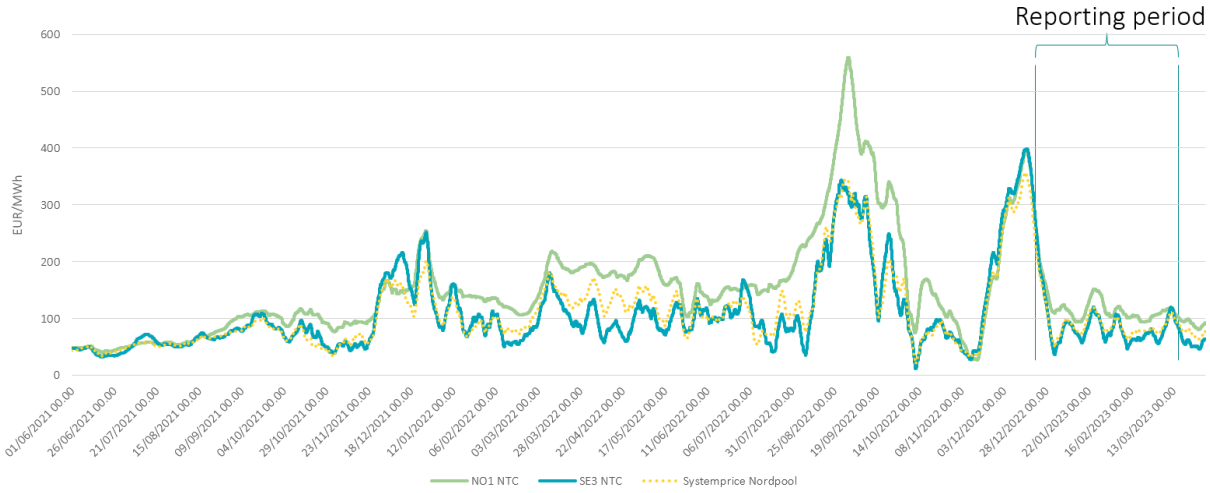
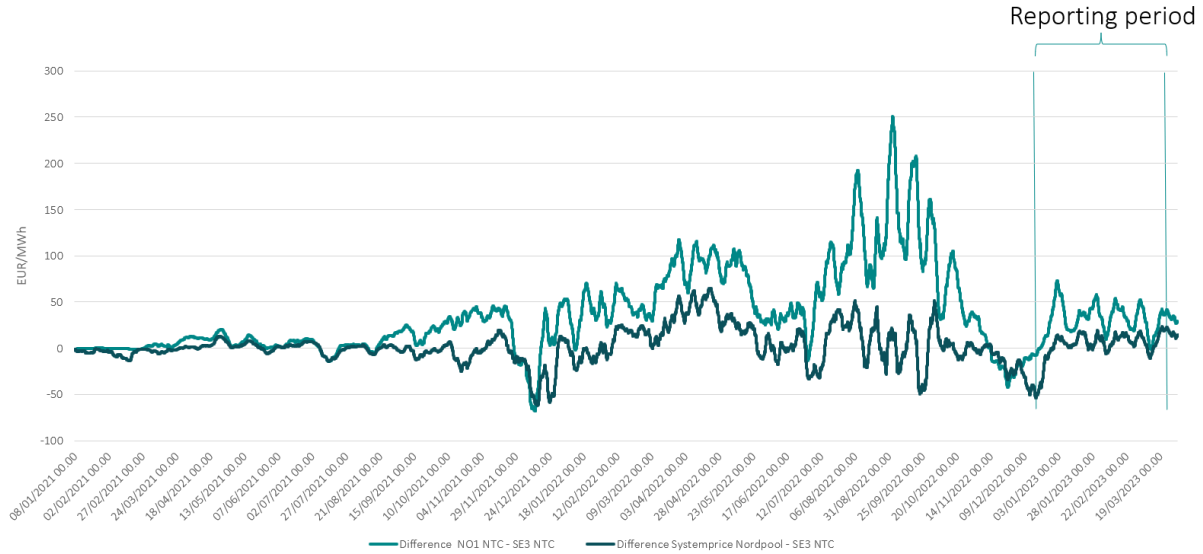
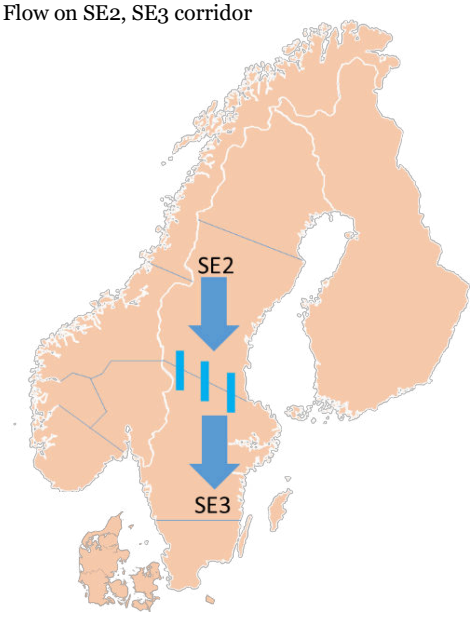


Figure 12: Difference of the rolling average weekly price for SE3 in NTC and respectively NO1 in NTC and the system price in NTC. Positive numbers mean that the SE3 price was lower than the compared price.



Modelling between SE2 and SE3

Figure 13: Flow on SE2, SE3 corridor



The border between SE2 and SE3 is the largest corridor in the Nordic CCR for transporting electricity from North to South. When the grid topology and countertrade modelling in flowbased does not match the one in NTC, this has an impact on the cross-border capacity and henceforth on the comparison of prices, congestion income, and welfare distribution between flowbased and NTC.

Between the 12th of December and the 28th of February, the modelling of series compensators on the SE2-SE3 border had another set-up in flowbased than in NTC. The practice in flowbased was to have an even distribution of the capacitors. In NTC, the operational status of them was adjusted to the expected situation in operation. This resulted in the maximum permissible flow in NTC being higher than in flowbased, which led to some network elements situated on the SE2-SE3 border being the most constraining network elements in the Nordic CCR. On the 1st of March, the management of the series compensators was changed in flowbased to fit the expected operational status. This has resulted in a better alignment of the maximum allowed flow between NTC and flowbased.

Planned countertrade in the south of Sweden is another aspect that has an impact on the flow between SE2-SE3. The planned countertrade is taken into account in the NTC capacity calculation and is not taken into account in flowbased. This leads to NTC having an increased capacity on the SE2-SE3 border compared to flowbased as the solution domain in NTC is enlarged.

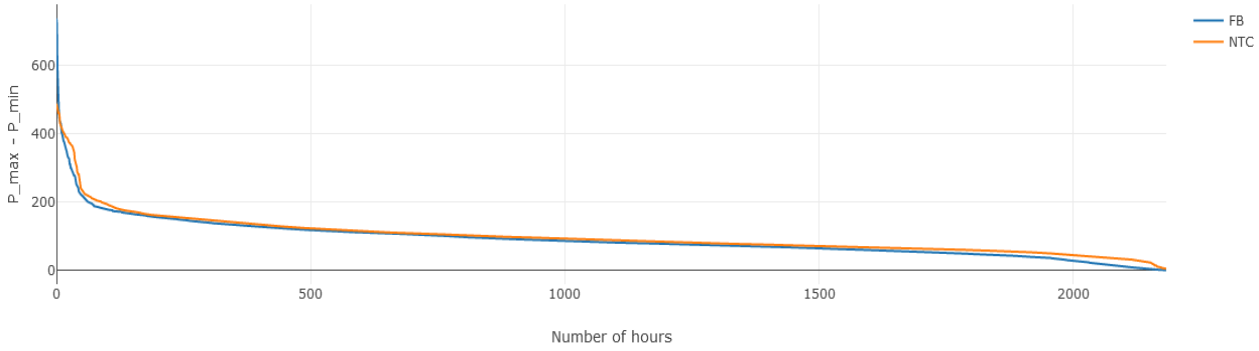
DA price comparison

The three-month EPR reporting period covers 12.12.2022 - 12.3.2023. Hence, the power market situation of the winter 2022-2023 is reflected in the results for this reporting period. This can be seen especially for the first week of the EPR (12–18.12, week 50, 2022), when power prices both in NTC but also in flowbased were exceptionally high for all Nordic bidding zones. This week had days with high load in combination with outage of a nuclear reactor in Sweden. Furthermore, the water levels in the reservoirs in the Nordic areas were under the median values for this period which could have an impact on the pricing of hydro power. This first week stands out compared to the rest of the weeks in terms of prices, which is reflected in the price graphs. The rest of the reporting period this winter has had more consistent prices.

Figure 14 shows a duration curve for the price differences between the highest and lowest bidding-zone price for each hour in the EPR period for both NTC and flowbased. It gives a high-level comparison of prices in flowbased and NTC. The hours on the x-axis do not correspond to chronological hours, as the hourly price differences are sorted from highest to lowest for both NTC and flowbased. The duration curve shows that the difference between the highest- and lowest-priced bidding zone in general is smaller with flowbased than with NTC for almost all hours, except for 7 out of the total 2184 hours in the EPR. What this demonstrates, is that flowbased is better than NTC at achieving a price convergence across the Nordic system over time, indicating that flowbased utilises the grid better. This is in line with the expected outcome from flowbased, as it is expected that with flowbased the available transmission capacity can be allocated in a more optimal way than with NTC.

The 7 hours to the far left in the chart, where flowbased has a higher min-max price difference than NTC, are all found during the 15th and 16th of December 2022. These days were days with high load; December 16th was the day with highest load in Sweden for this winter. At this point in time, the change in management of the series capacitors was not implemented. This contributed to less capacity on SE2-SE3 in flowbased compared to NTC and thereby to a larger price difference between the highest- and the lowest-priced bidding zone with flowbased than NTC for a few hours these days.

Figure 14: Duration curve for the price difference between the highest and lowest bidding zone price for each hour, for both flowbased and NTC



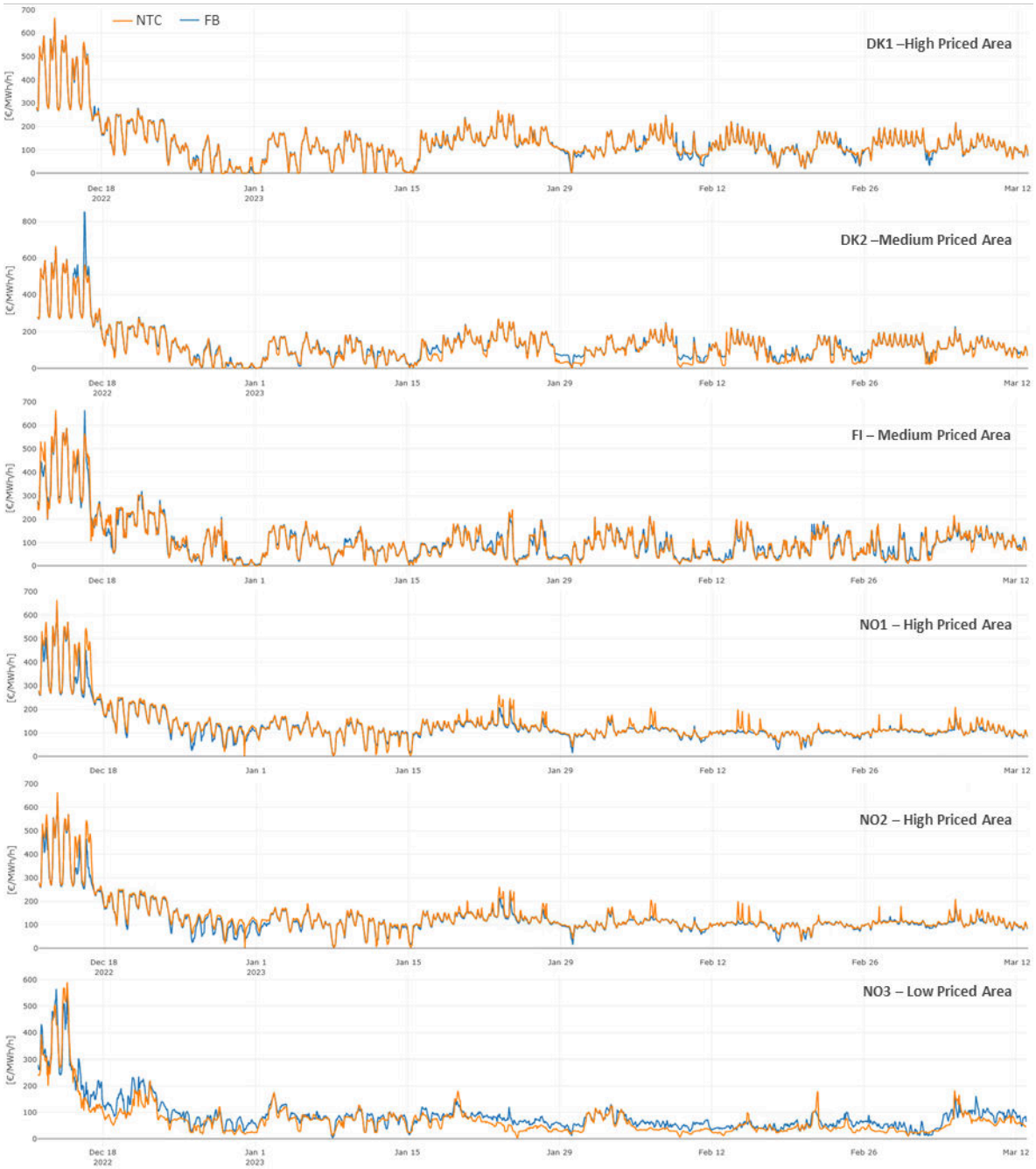
Looking at hourly DA prices for each of the Nordic BZ, the prices for some bidding zones are in general lower in the flowbased simulations compared to the prices with NTC, while for some bidding zones the prices with flowbased are generally higher. From the graphs in Figure 15**,** it can be seen that the most notable changes in prices are seen for NO3 and NO4, which get a higher price with flowbased for the majority of the hours. This relates to the increased net position that is reached with flowbased as the grid is utilized to a larger extent and more power can be exported from these areas which increases the price.

Furthermore, the SE3 price graph shows an increase in price for a rather large share of the hours but this pattern ceases on the 1st of March. The increased price in SE3 relates to larger export to NO1 and the management of the series capacitors on the SE2-SE3 border.

The main reason for the decrease in average prices for NO1, NO3, NO5 is that flowbased decreases the hours with price spikes together with the size of them once still occurring. The opposite is happening for DK2, SE3 and SE4 where flowbased increases the prices for hours where the prices in NTC are low. Both being the consequence of flowbased utilizing the grid better and thereby decreasing the price spread.

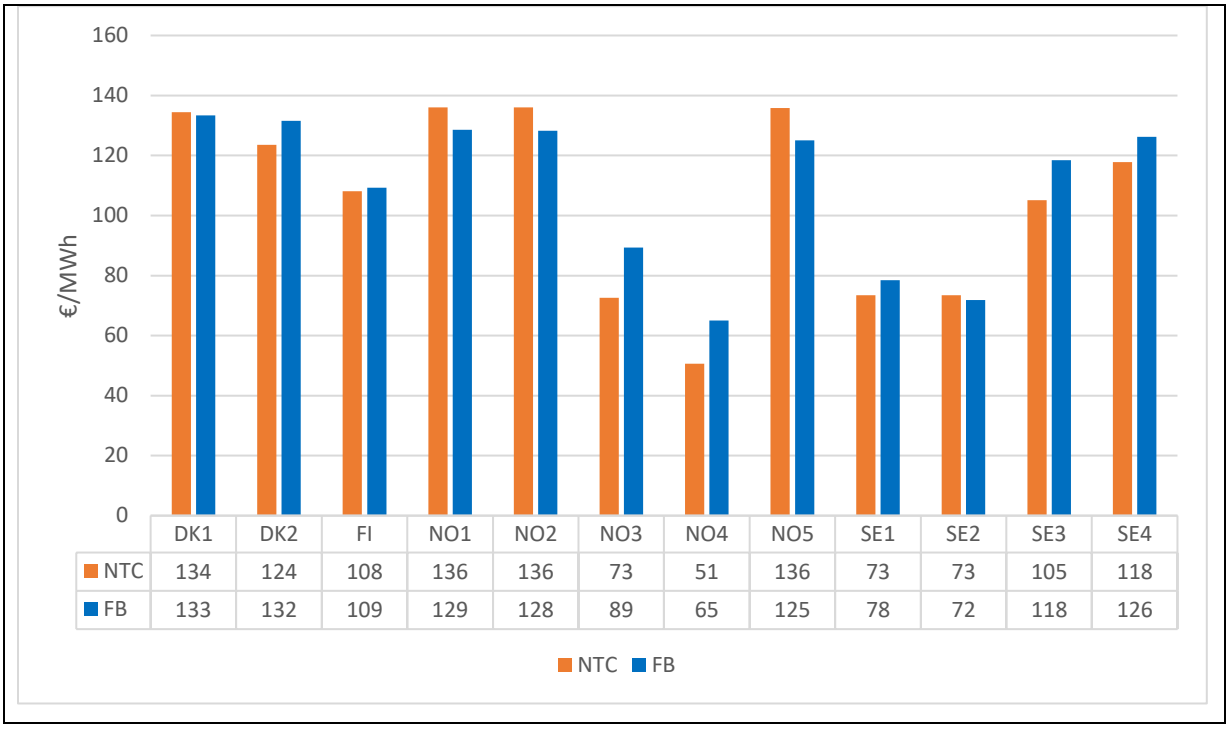
In the first week, prices in all bidding zones were high. These days were impacted by high load, outage of nuclear power production in Sweden and relatively small wind power production for some days.

Figure 15: Hourly DA prices for all bidding zones.




NTC
FB
NO4 – Low Priced Area
NO5 – High Priced Area
SE1 –Low Priced Area
SE2 –Low Priced Area
SE3 – Medium Priced Area
SE4 –Medium Priced Area
[€/MWh/h]
Dec 18 2022
Jan 1 2023
Jan 15
Jan 29
Feb 12
Feb 26
Mar 12

Figure 16: Average area price per bidding zone for NTC and flowbased



	DK1	DK2	FI	NO1	NO2	NO3	NO4	NO5	SE1	SE2	SE3	SE4
NTC	134	124	108	136	136	73	51	136	73	73	105	118
FB	133	132	109	129	128	89	65	125	78	72	118	126

DA net position comparison

When assessing the exchanged volumes with flowbased compared to NTC, the focus has firstly been on the impact on the net position (NP). The NP is the netted sum of electricity exports and imports for each Market Time Unit for a given geographical area (in this case, bidding zones). Figure 17 shows the NPs in the Nordics on the left axis, as well as the cumulative NP difference between NTC and flowbased on the right axis. Based on the cumulative NP the graph can be divided into two parts.

The first part before February the 14th shows that flowbased increased the export out of the Nordics and in the second part, after the 14th, flowbased establishes an increased import to the Nordics from the external areas compared to NTC. What can be gained from this is that flowbased does not lead to the Nordics having a definitive change towards constantly more import or export, but instead more structural changes are taking place.

Figure 17: Nordic net position and cumulative net position

To evaluate this structural change further, the change in NP on the bidding-zone level can be examined (Figure 18). If the number here is positive, then the bidding zone's NP is higher with flowbased and vice versa if lower, the NP is higher with NTC.

From Figure 18, the biggest changes are in Norway and Sweden. From these changes three points become interesting.

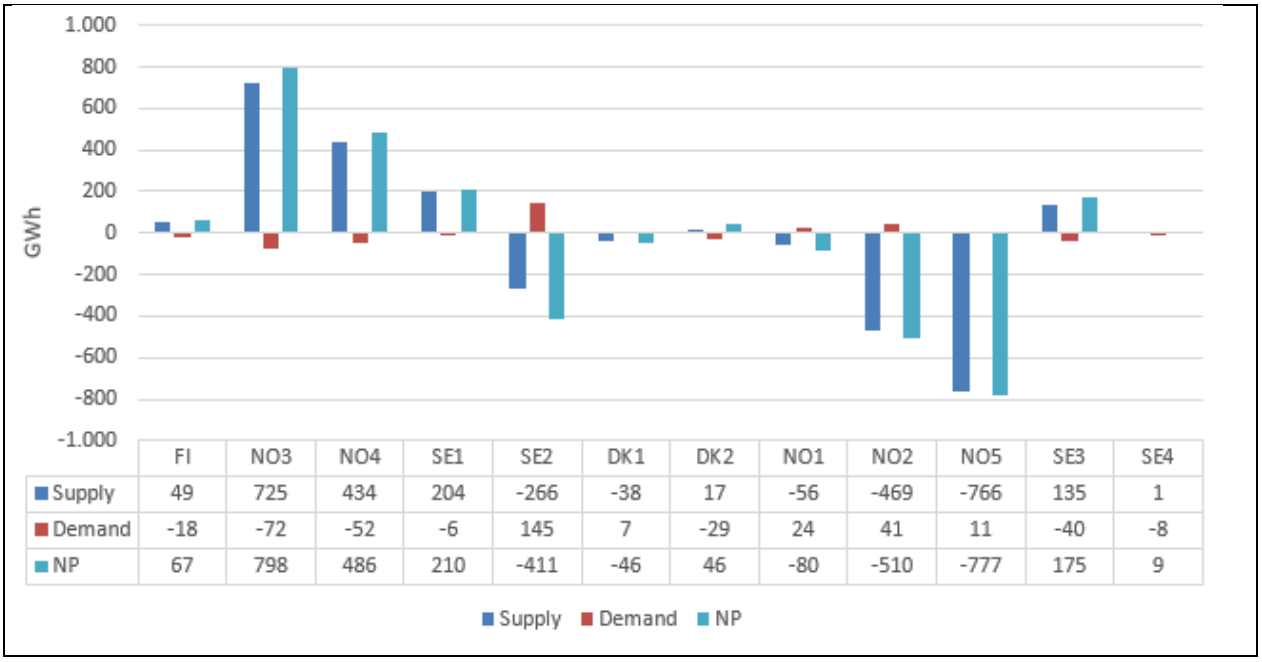
The first is the very large decrease in the southern Norwegian bidding zones and the increase in the northern bidding zones. This is one of the reasons for the positive SEW when introducing flowbased as it is possible to utilize more of the cheaper production in the north and save the more expensive production in the south.

The second thing is that with a flowbased capacity calculation SE2 has a lower NP despite being considered a low-priced area (cf. Figure 15 and Figure 16).

Third and last is that SE3 is a medium-priced area that has the highest NP increase with flowbased. The reasoning behind this is mainly due to how the east-west flow through Sweden is handled as discussed in the section *Better management of the NO1-SE3-DK1 flow through Sweden* and *modelling of SE2-SE3.*

Figure 18 also illustrates the change in demand and supply in each area. Most of the change in NP comes from changes in supply, but in SE2 - where the price is increased - 1/3 of the change comes from changes in demand.

Figure 18: Difference between flowbased and NTC for NP, demand and surplus in each area.

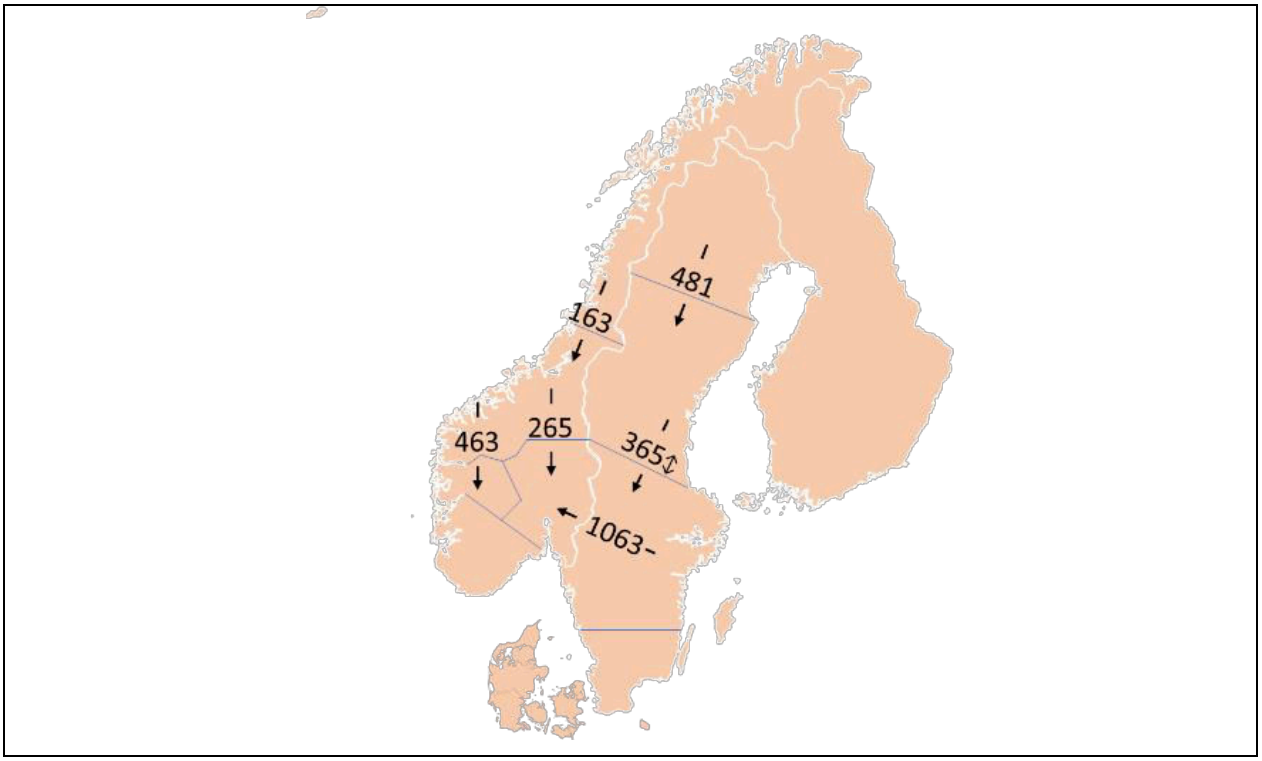


	FI	NO3	NO4	SE1	SE2	DK1	DK2	NO1	NO2	NO5	SE3	SE4
Supply	49	725	434	204	-266	-38	17	-56	-469	-766	135	1
Demand	-18	-72	-52	-6	145	7	-29	24	41	11	-40	-8
NP	67	798	486	210	-411	-46	46	-80	-510	-777	175	9

What is observed from flowbased is that it changes the way power moves from North to South. With flowbased the power is moved quite a lot more over Norway, power through Sweden in hours with low load and high wind is increased, and the Finland corridor is only slightly affected as it helps with congestions management.

Overall, there are three possible ways to move power from north to south within the Nordic CCR. These are through Norway, through Sweden, and through Finland. To evaluate the Norwegian and Swedish corridors, Figure 19 can be examined. Here the accumulated increases in flow in GWh across the borders with a flowbased capacity calculation can be seen. The important thing to note about the increased flowbased flows on Figure 19 is that all appear as a constant increase in flow. This means that for close-to-all hours the capacity on these borders is increased with flowbased by a somewhat constant amount. For the SE2-SE3 border this does not hold true. Though flowbased does yield an overall increase in flow it is not constant and instead changes from period to period whether flowbased or NTC gives a higher flow. The ↕ on Figure 19 is used to represent this non-constant trend.

Figure 19: Accumulated change in flows in GWh, when using flowbased compared to NTC for the entire EPR period. The ↕ arrow on the SE2-SE3 border is there to indicate that this increase in flow does not appear as a constant for flowbased but changes more throughout the simulation period based on other factors.



About 66% of this increase in flow on the SE2-SE3 border, that is seen with flowbased, comes between the beginning of the EPR on the 12th of December and the 1st of January, after which countertrade in NTC was applied, giving NTC a higher capacity on the border. After this period, it is more on a period-by-period case whether NTC or flowbased has the highest flow.

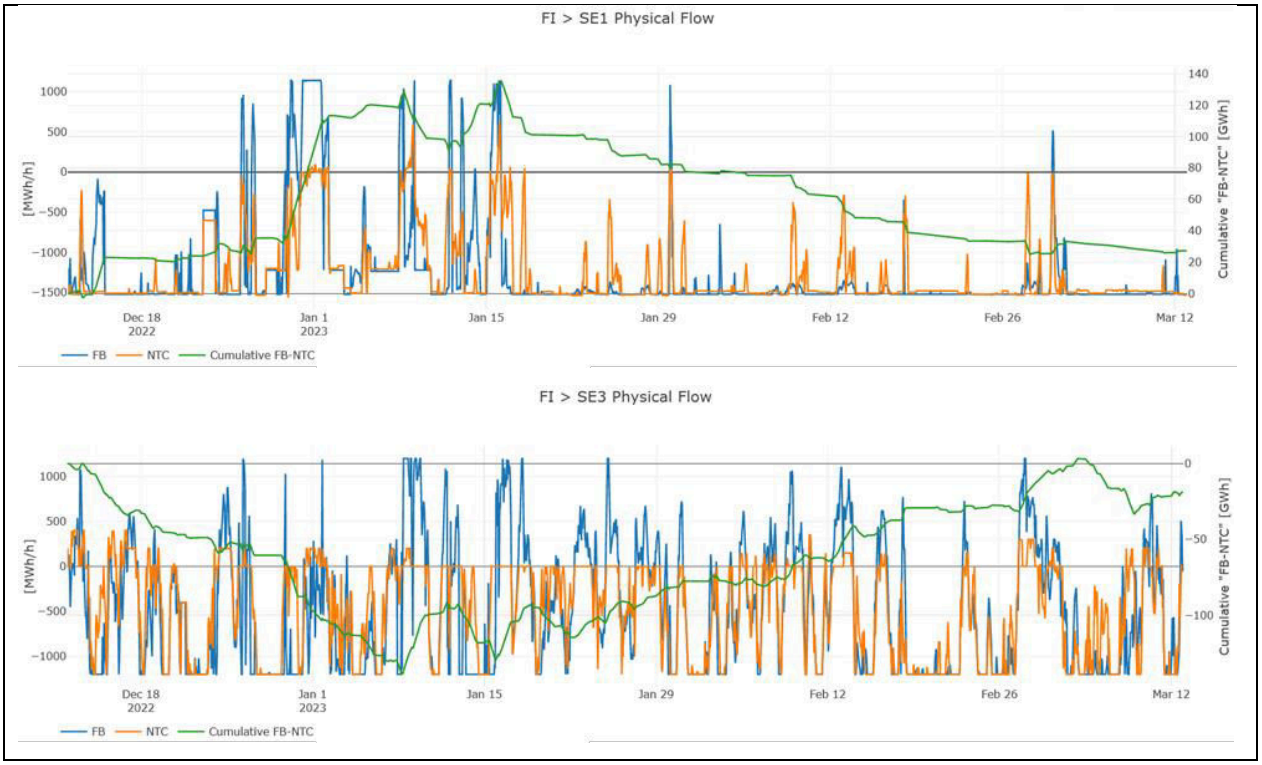
Whether flowbased or NTC gives the highest flow correlates closely to two factors. These are the overall demand and the wind production. When demand is high this naturally increases the need for production and particularly the demand for cheap northern production. This increases the strain on the SE2-SE3 border, and since NTC has a higher border capacity, NTC is in these hours able to flow more than flowbased. On the other hand, when there is high wind production, it helps ease the strain on this SE2-SE3 border. Flowbased, unlike NTC, can capture this in its optimization and increase the SE2-SE3 border flow giving hours where flowbased has a higher border flows. Whether flowbased or NTC gives a higher flow on the SE2-SE3 border after the 1st of January is therefore largely dependent on the state of the system and with the current modelling it is difficult to say whether a larger structural change takes place on this border. With a more correct modelling of the SE2-SE3 border, it would be expected that the trend present before the 1st of January - where flowbased had a higher flow - will be observed.

The last north-south corridor goes from SE1-FI-SE3 and does not have a clear increase in one direction as the corridors discussed in Figure 19. Looking at Figure 20, in the majority of hours Finland is importing on both borders (SE1-FI and SE3-FI).

Flowbased however leads to both borders having more frequent export towards Sweden from Finland compared to NTC. These hours with export often correspond with hours where the SE2-SE3 border becomes congested, and power is instead moved over Finland. This is however not a large phenomenon which can also be seen from the cumulative difference in border flows between flowbased and NTC that lands at close to zero.

A clear advantage of flowbased is that the currently-used export restriction in NTC from FI to SE3 (Fennoskan) can be better represented via flowbased domains. This means that the network elements that affect allowed Fennoskan flows are now better represented by individual CNECs, without needing to constrain Fennoskan. Better representation can be seen from the bottom graph of Figure 20, where the flowbased flows from FI to SE3 are allowed to reach much higher values than the NTC flows. For NTC the maximum allowed export from FI to SE3 during the EPR period has varied between 0-400 MW/h (on average 156 MW/h), whereas the flowbased flows towards SE3 can be over 1000 MW/h.

Figure 20: Flow on the FI→SE1 (top) and FI→SE3 (bottom) borders for both flowbased and NTC, together with the accumulated difference.

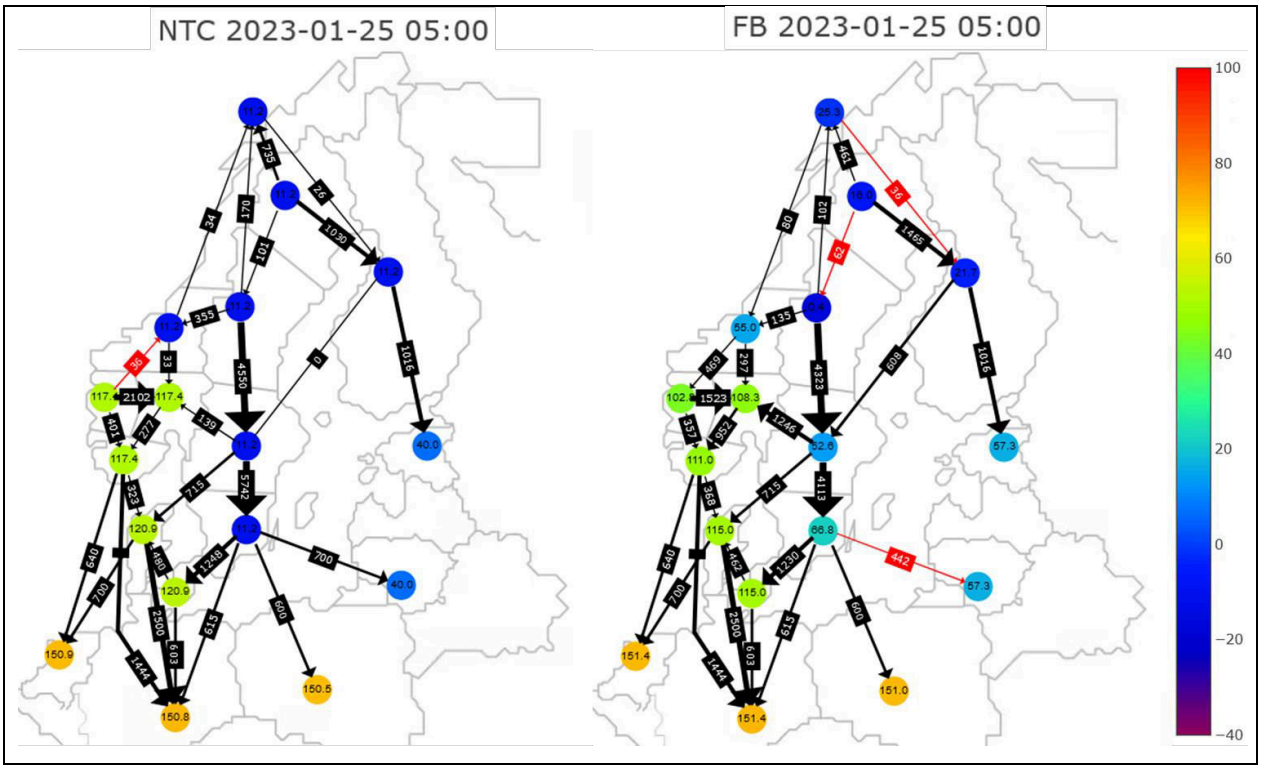


Example flowbased optimizes the use of the grid.

As mentioned, the flow over the SE2-SE3 border is higher in NTC than in flowbased often in hours with low southern wind production and high load. This is in one part due to the difference in how NTC and flowbased model the border (as mentioned in the section *Modelling between SE2 and SE3*) but it also happens as a result of how flowbased optimises the flows using the PTDFs.

This can be illustrated by looking closer into a specific hour, which in this example will be 01-25-2023 05:00 (the flows and area prices can be seen below in Figure 21). The way flowbased handles this leads to a lower NP in SE2. In this hour the NP for SE2 is 478 MWh lower in flowbased compared to NTC but the overall southward flow is higher. From Figure 21 it can be seen that the flow through Norway increases from -3 MWh (-36+33) to 766 MWh (469+297) and the flow through Finland increases from 0 MWh to 608 MWh, while the flow through Sweden decreses from 4550 MWh to 4323 MWh. Overall, the flow towards the south increased with 1150 MWh.

Figure 21: Example of the flows and area prices in NTC and flowbased for January 25th, 2023, hour 05:00.



To understand what is happening, the PTDF for the most limiting critical network element (CNEC) must be evaluated. This can be seen below in Table 1; the PTDF values represent how much the CNEC will be loaded by an increase of 1 MWh/h extra production in the different bidding areas. So, if the NP in e.g.

NO3 is increased by 1 MWh/h then the CNEC represented in Table 1 will be affected by 0,05 of that increase.

Table 1: Z2S PTDF values for the most limiting CNEC for the timestamp 2023-01-25 05:00

	DK1	DK2	NO1	NO2	NO3	NO4	NO5	SE1	SE2	SE3	SE4	FI
PTDF values	0	0	-0.09	-0.09	0.05	0.12	-0.07	0.14	0.18	0.05	0.02	0.14

The highest PTDF value is for SE2, which is highlighted in orange. This means that increasing the NP in SE2 will have the highest impact on this CNEC, and the system as a whole will quickly become constrained. Due to this, when the market coupling optimization applies the flowbased domains and thereby the PTDFs, production may be more optimal to be located elsewhere, because that would not put as much of a strain on this limiting CNEC.

Thus from Table 1 it can be seen that increasing the NP in SE2 by 1 MWh/h puts an equivalent amount of strain on this CNEC as a 3.5 MWh/h increase in NO3 or a 1.5 MWh/h increase in NO4. Since much of the cheap hydro production is located in these Nothern areas, flowbased is able to activate more than in NTC as it considers how the cheap hydro affects the overall grid. This leads to a different result for the NPs in flowbased which can be seen from Figure 21. Here the flow from especially NO3 has increased while the flow from SE2 has decreased due to the changes in NPs. Overall the reason for many of the different NPs that are observed between NTC and flowbased can be boiled down to how flowbased increases the utilization of the grid as shown above.

Non-intuitive flows

Non-intuitive flows are flows from the market coupling that go from a higher-priced bidding zone to a bidding zone with a lower price. Non-intuitive flows are a well-known phenomenon from the theory of nodal prices as well of the practical implementation of nodal pricing globally. The flow occurs as a result of a combined effect of the physical laws in power systems and the locations of generation, consumption, and constraints in the system. These flows generally occur when the loss of social economic welfare from a flow from a higher-price bidding zone to a lower-price bidding zone is smaller than the social economic benefit of relieving a congestion. This allows for an overall market efficiency gain as the Euphemia algorithm maximizes the pan-European welfare in the market coupling[2].

Figure 22 illustrates the share of non-intuitive flows for each BZ border within the Nordic CCR and for the external borders (i.e. the Hansa and Baltic cables). The SE1-SE2 border has the highest share of non-

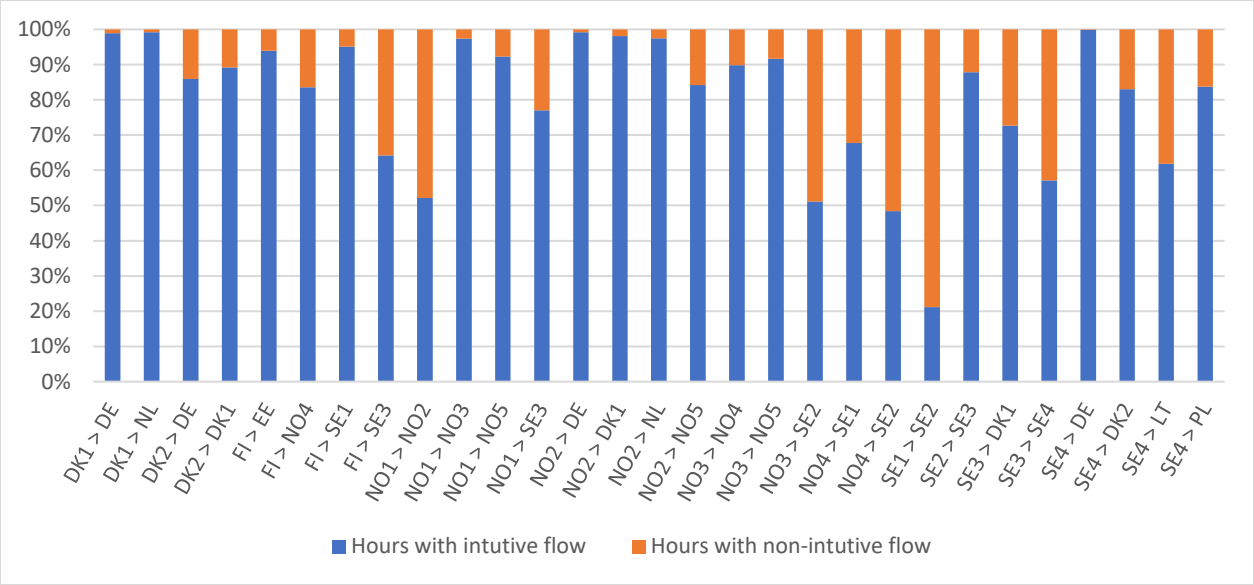
[2] See the phenomena report on the Nordic RCC website for more information about why non-intuitive flows occur.

intuitive flows, 79% of the hours during the reporting period, followed by NO3-SE2 and NO4-SE2 where the share is around 50%.

The non-intuitive flows on these borders are to a large extent due to the fact that SE2 has the highest PTDF (high impact) on the most-limiting CNEs/CNECs for the flow from north to south for most hours. The market algorithm identifies that the maximum SEW within the flowbased domain is obtained by increasing the net position in SE1, NO3, NO4, and reducing the net position in SE2 compared to the NTC result. The net position changes result in higher prices in SE1, NO3, and NO4 than in SE2, although the flow is still southbound.

The price difference when there is a non-intuitive flow, is not necessarily high. For the border DK1-DK2 there is a non-intuitive flow in 9% of the hours, but the negative CI is only 0,06% of the positive CI. For SE3-DK1 there is a non-intuitive flow in 28% of the hours, but the share of negative CI is 6% of the positive CI.

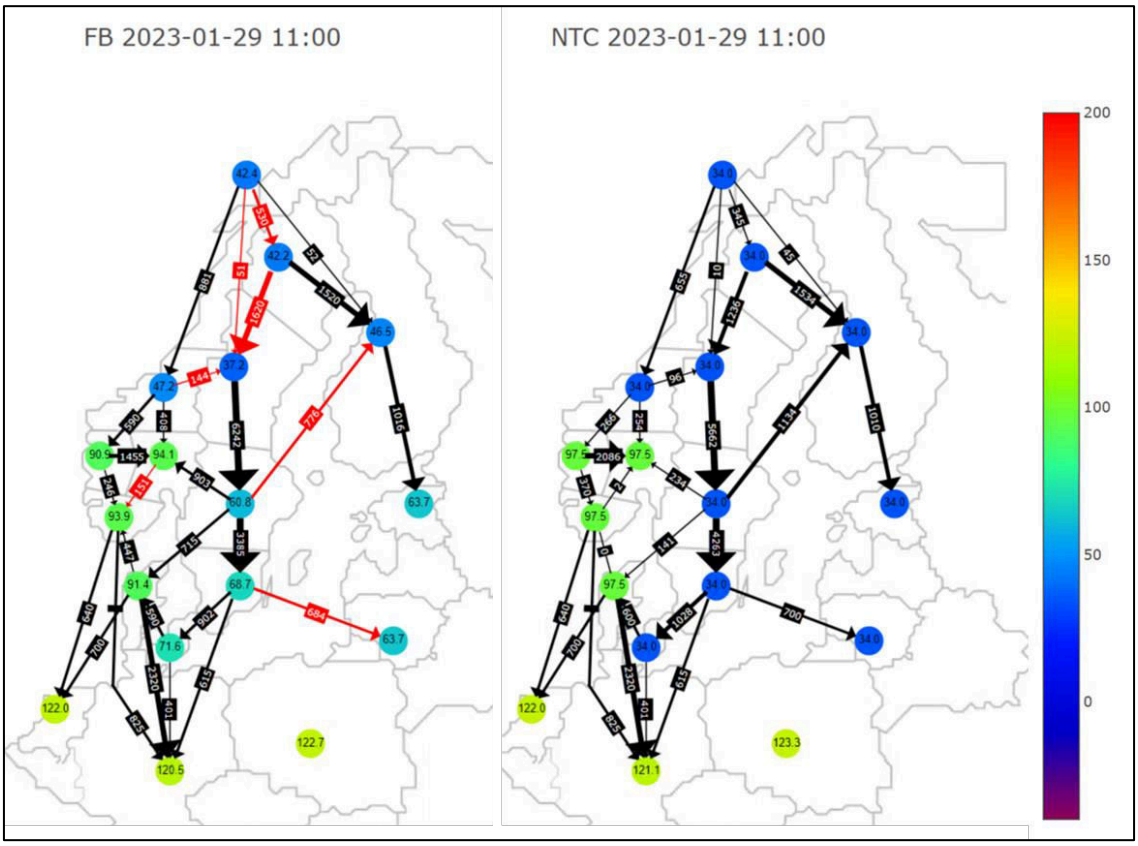
Figure 22: Percentage of non-intuitive flows on each Nordic BZ border during the reporting period.



Example of a non-intuitive flow

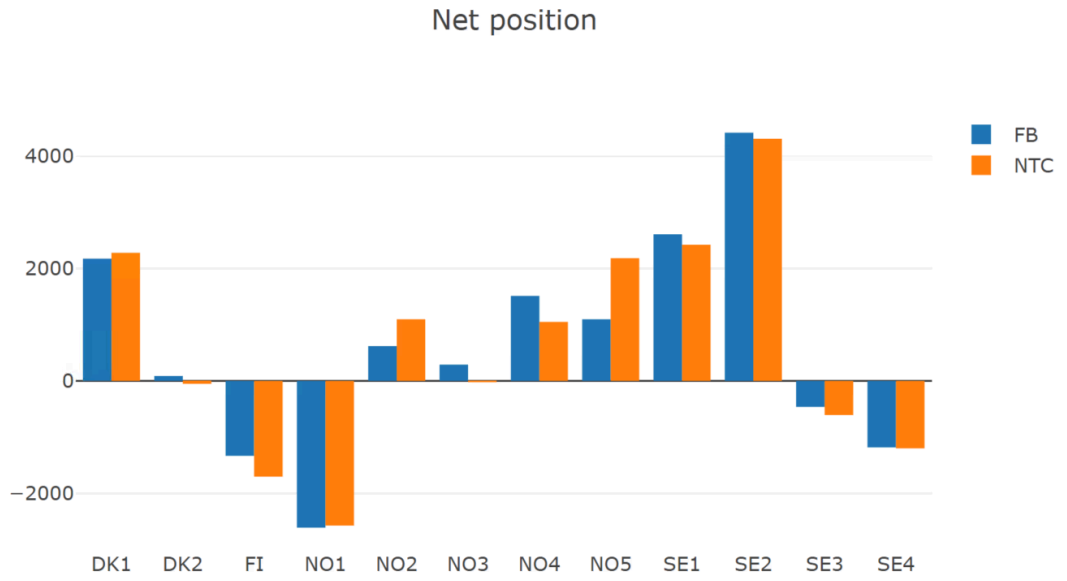
In this section, an example is provided for one hour that describes the non-intuitive flow in relation to shadow prices and PTDFs for the relevant CNEs. The example is based on MTU 11 on the 29th of January 2023, and the bidding zone prices and flows for both the flowbased and NTC market outcome are shown in Figure 23. As can be seen in the figure, there are four non-intuitive flows in the flowbased outcome. In this section, the reason why the non-intuitive flow between NO4 and SE1 occurs, will be explained.

Figure 23: Example of flows and area prices for flowbased and NTC with non-intuitive flows (marked as red) for January 29th, 2023, 11:00



The zonal net positions are different in the flowbased and NTC market outcomes, as can be observed from Figure 24. In the flowbased outcome, the net position increases the most in NO4, FI, SE1, and SE2, thus leading to a higher export from the northern part of the Nordics to the southern part. The bidding zone which sees the highest increased net position in flowbased is NO4.

Figure 24: Net positions for both flowbased and NTC for MTU 11 on the 29th of January 2023.



The day-ahead market prices in NO4 and SE1 are 42.4 EUR/MWh and 42.2 EUR/MWh respectively. This amounts to a price difference of 0,2 EUR/MWh. There are 13 CNEs/CNECs which constrain the market for MTU 11 on the 29th of January, but only 3 of them were affected by a net position change in NO4 and SE1. For these 3 constraints, the shadow price, zone-to-slack PTDF, and the zone-to-zone PTDF values for NO4 and SE1 are shown in Table 2.

Table 2: CNEs with the largest shadow prices and their PTDF values for MTU 11 on the 29th of January 2023.

CNE	Shadow price	PTDF Z2S NO4	PTDF Z2S SE1	PTDF Z2Z NO4-SE1	PTDF Z2Z SE1-NO4
CNE 1	184,596689	0.11992	0.14248	-0.02256	0.02256
CNE 2	56,7844	0.12627	0.05541	0.07086	-0.07086
CNE 3	4,347498	-0.01445	0	-0.01445	0.01445

Table 3 shows the product of the shadow price and PTDF values corresponding to the marginal value of relaxing the flow limitation (RAM) for each CNE and the corresponding net positions of NO4, SE1, and on the border NO4-SE1.

Table 3: Product of the shadow price and PTDFs for CNEs with a shadow price for MTU 11 on the 29th of January 2023.

CNE	Shadow price * PTDF Z2S NO4	Shadow price * PTDF Z2S SE1	Shadow price * PTDF Z2Z NO4-SE1
CNE 1	22.13683494	26.30133625	-4.164501304
CNE 2	7.170166188	3.146423604	4.023742584
CNE 3	-0.062821346	0	-0.062821346
Total	29.24417979	29.44775985	-0.203580066

The marginal cost of transmission is more expensive in SE1 than in NO4, which explains why the market algorithm with flowbased increases the net position more in NO4 than in SE1, resulting in a non-intuitive flow. It is also evident that the price difference between NO4 and SE1 is equal to the transportation cost in the power grid (-0,2035) which was derived earlier.

This explains why there is a non-intuitive flow between the NO4-SE1 border for MTU 11 on the 29th of January. The principles explained here are also valid for other instances of non-intuitive flows.

5. DA left-over capacity for the ID market

This chapter reports on the assessment of the left-over capacity after the DA flowbased market coupling, that is to be released as initial capacity to the ID market, in the form of an ATC value. All graphs contain the comparison between ID ATC capacities computed by the ATCE method and the current NTC method for the ID gate opening.

Description of the ATC extraction

Article 20 of the Nordic DA CCM describes a transitional solution for the calculation and allocation of cross-zonal capacities for the intraday timeframe. Article 20(1) states the need of calculating ATC values based on the flowbased domain for the intraday market until the single intraday coupling can support flowbased parameters. Article 20(2) prescribes an optimization approach to facilitate this calculation.

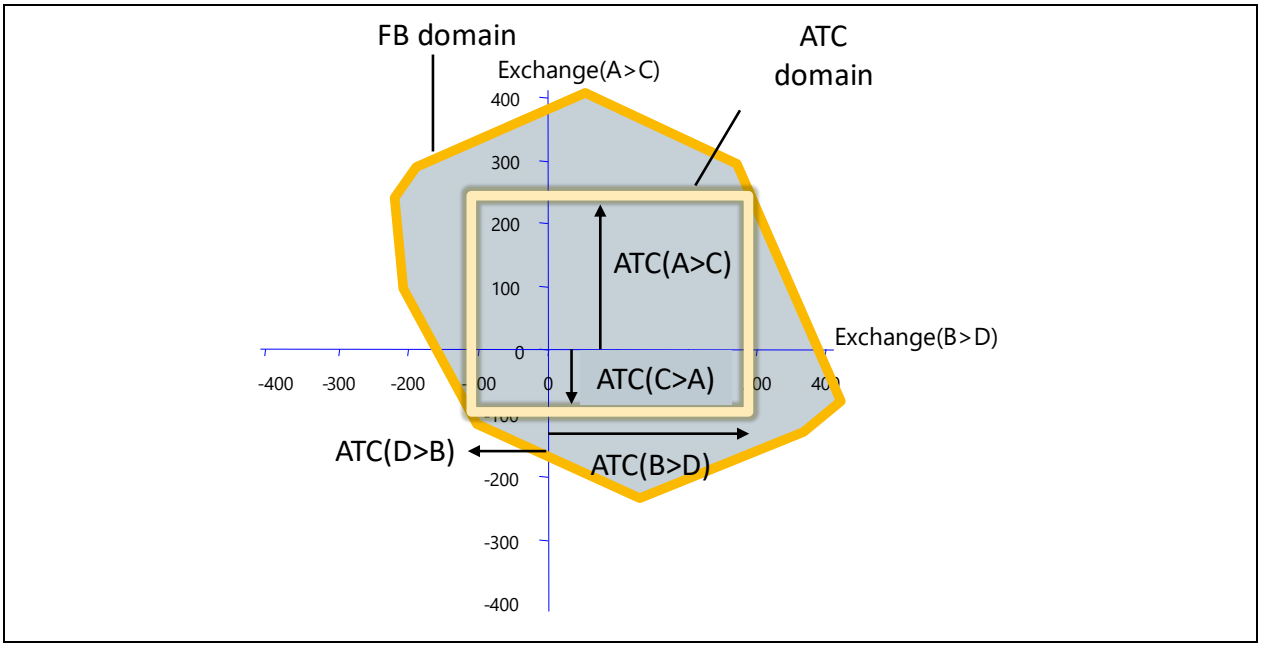
To fulfil the legal requirements in the Nordic DA CCM, the Nordic TSOs developed a so-called 'ATC extraction' methodology. In this section a short description of the methodology is provided; for a more detailed description please refer to the note on the Nordic RCC website[3].

In general, the ATCE methodology does two things: it determines the left-over capacity after the DA stage, and it translates the flowbased capacity domain into an ATC domain.

The translation from a flowbased domain to an ATC domain is not straightforward. A simple example is shown in the Figure 25. Indeed, in this figure, only one possible ATC domain – that fits within the flowbased domain – is depicted; many other ATC domains can be extracted without violating the flowbased domain. Therefore, the Nordic TSOs developed an optimization-based approach to extract a single set of optimal ATC values.

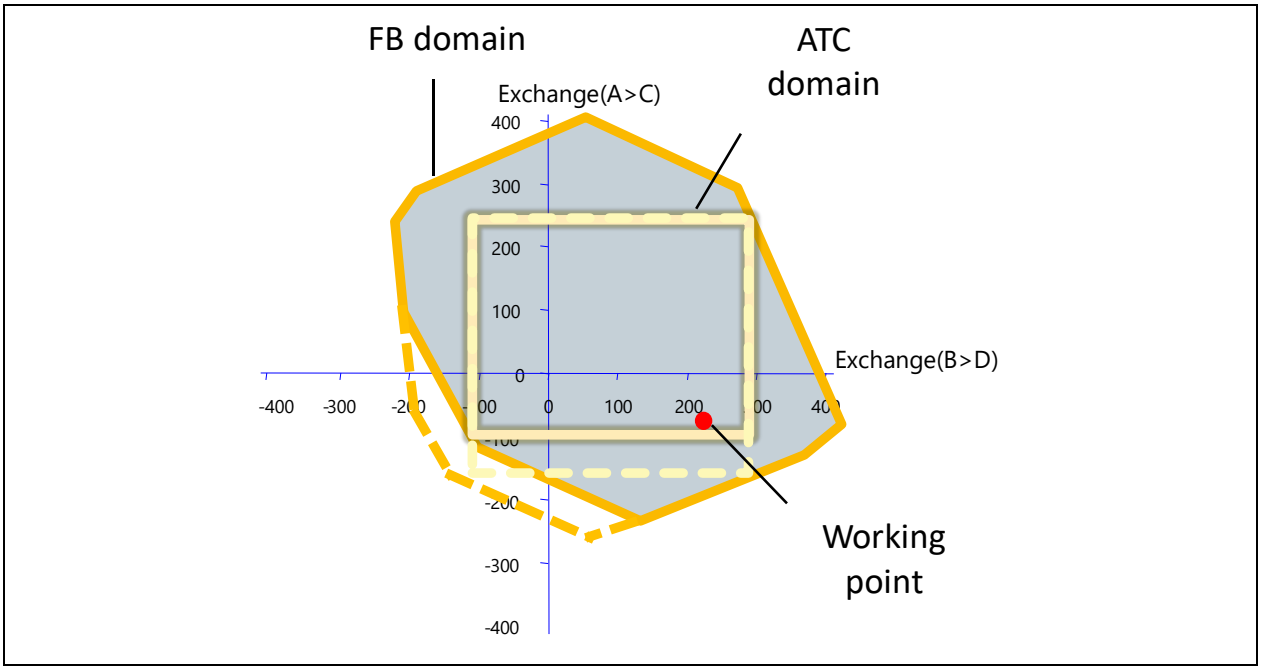
[3] ATCE methodology description (updated April 2022): https://nordic-rcc.net/wp-content/uploads/2022/05/ATC_Extraction_Description_20220413.pdf

Figure 25 ATC extraction from a flowbased domain



As stated before, the translation from a flowbased domain to an ATC domain is not straightforward. Indeed, the ATC concept describes the grid limitations on a higher and less-detailed level than flowbased does. As an example: the ATC capacity is an option – it can be used, but is not guaranteed to be used. As such, only the loading effect of the use of the ATC capacities can be accounted for on the flowbased CNECs; the relieving effect cannot be considered. This consideration, together with the DA being optimized by Euphemia, may lead to a situation where the ID gate opening capacity may be very limited. Therefore the Nordic TSOs have designed the ID ATCE methodology such, that relaxations are applied in the ATCE process in order to provide as much ID capacity to the market participants as possible – from an operational security point of view. This is schematically depicted in Figure 26.

Figure 26 Relaxation of the flowbased domain around the DA market clearing point (working point)



As a result of this, the resulting ID ATC values for the ID gate opening trades are always larger than or equal to zero, and capacity may be released on CNECs that was not available at the DA stage.

Like in any coordinated capacity calculation process, a TSO domain validation is applied where capacities may have to be reduced – in case potential overloads resulting from the ID ATCE cannot be coped with.

Quantitative analysis

The quantitative analysis in this section compares the bidding-zone level ID capacities between the ATCE method and the ID initial capacity offered by the current NTC method.

Bidding zone trading space

The total trading space of a bidding zone for a given MTU is the sum of export capacity and import capacity on all borders of that bidding zone for that MTU.

The TSOs recommend to compare the bidding-zone level comparison instead of the border-level comparison. Please consider the following conceptual example of a bidding zone A having 3 borders with other bidding zones. Under the current NTC method, the operator of the bidding zone A may decide that each border should be offered 200 MW as its NTC, respectively. (i.e. the total bidding-zone level capacity is 600 MW). Using the ATCE method, it is possible that the extracted NTC of this bidding zone is 650 MW. However, the 'per border' capacity may be very different, e.g. the first border yields 450 MW and the

other two borders yield 100 MW each. In this case, the comparison on a bidding-zone level clearly shows that the ATCE method offers more capacity (i.e. 650 MW vs. 600 MW). The 'per-border' comparison becomes non-conclusive (i.e. 450 MW vs. 200 MW, 100 MW vs. 200 MW, and 100 MW vs. 200 MW).

Table 4 and Table 5 explain how the ID import and export trading spaces are computed, using the bidding zone SE2 as an example. The export trading space of SE2 is the sum of the ID capacities of all its borders from SE2 to NO3, NO4, SE1, and SE3, being 306 + 484.5 + 3701.9 + 0 = 4492.4 MW. Similarly, the import trading space is computed by 262.9 + 184.1 + 709.8 + 11261.4 = 12418.2 MW. The total SE2 bidding-zone trading space is 4492.4 + 12418.2 = 16910.6 MW.

Table 4 Example of SE2 exporting direction of MTU: 20230213 first hour

SE2 export direction	SE2→NO3	SE2→NO4	SE2→SE1	SE2→SE3	Export trading space
ATCE ID in MW	306	484.5	3701.9	0	4492.4

Table 5 Example of SE2 importing direction of MTU: 20230213 first hour

SE2 import direction	NO3→SE2	NO4→SE2	SE1→SE2	SE3→SE2	Import trading space
ATCE ID in MW	262.9	184.1	709.8	11261.4	12418.2

Figure 27 - Figure 29 depict the difference of the ATC ID capacities between the current NTC method and the ATCE method[4].

[4] Trading space computed by the reference method (i.e. the current method used in production) are calculated from intra-day offered ATCs collected from ENTSO-e transparency platform. Note that the capacities collected from the transparency platform include ramping constraints for some HVDCs connecting the Nordics and external CCRs, whereas the ID ATC results from the ATCE method do not include the ramping restrictions.

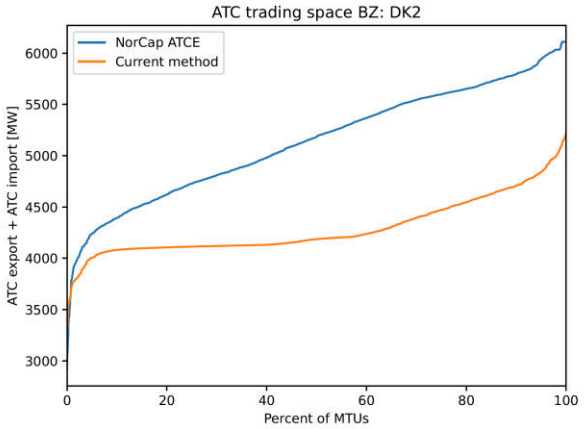


Figure 27 Example of ATCE that structurally provides more ID capacities than the current method for a BZ

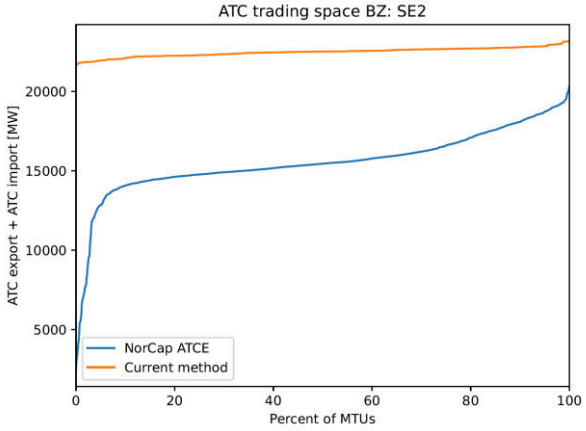


Figure 28 Example of the current method that structurally provides more ID capacities than the ATCE method for a BZ

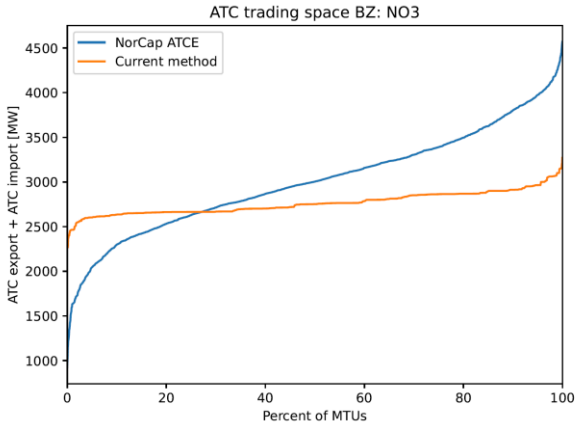


Figure 29 Example of a mixed outcome for a BZ

The duration curves show the proportion of time (in terms of percentage) for which the measured quantity is lower than a certain value. Figure 27 shows that the ATCE structurally provides more ID capacities than the current NTC method for a bidding zone. Figure 28 shows the opposite behaviour, where the current NTC method offers more capacity in a structural manner. Figure 29 shows that both methods have their performing moments according to the 3-month period.

Bidding zone with no ID trading (lock-in situations)

Some fears were expressed by stakeholders, in an early stage, that the left-over capacity from the DA as starting point for the ID market may lead to situations were BZs are not able to export nor import one

single MW. This bidding zone is considered being stuck at a 'lock-in' situation at the ID gate opening. Though this is not by definition perceived as being an issue – given the fact the ID continuous trading may actually release capacity for the BZ 5 minutes later – this is what we investigate in this section.

Before investigating the bidding zone level lock-in, we first investigate where the lock-in situation occurs on the export or import direction. The export direction lock-in refers to a BZ operating at its maximum export when the sum of ATC on all exporting directions of that BZ is less than 1MW. On the opposite direction, the import direction lock-in refers to a BZ operating at its maximum import when the sum of ATC on all importing directions of that BZ is less than 1MW. Consequently, a BZ level (bi-directional) lock-in refers to a BZ that it is operating at both its maximum export and maximum import during the same MTU. The table below summarizes the lock-in statistics.

Table 6 BZ lock-in statistics

Bidding zone	#MTUs at max Export	#MTUs at max Import	#MTUs at lock-in
DK1	1	0	0
DK2	0	0	0
SE1	14	0	0
SE2	197	0	0
SE3	0	0	0
SE4	0	0	0
NO1	0	26	0
NO2	0	0	0
NO3	1	1	0
NO4	1363	0	0
NO5	2	25	0
FI	0	0	0

The NO4 bidding zone has the highest number of MTUs being in a structural lock-in situation in the exporting direction. The reason is that most of the time, the DA FB MC allocates capacities of NO4 in the exporting position via its 3 borders. For the ID gate opening, the ATCE engine decides that its exporting capacities should not be further used in the ID timeframe, to ensure the overall Nordic capacities in the ATCE objective function is at its maximum.

Qualitative assessment

In this section we provide an elaboration of elements to bear in mind when reviewing the comparison between the two methods:

- The ID ATC of the current NTC method, being the leftover of the current NTC DA capacities, i.e. the ATC ID = NTC – AAC, where the NTC is the current NTC for DA and the AAC is the scheduled exchange (note: scheduled exchange is computed by the NEMOs using Flow Determination).

- The ATCE, where the ATCE ID = extracted NTC – AAF. The extracted NTC is an extracted value from the DA flowbased domain, and the AAF is the FB MC induced 'physical' border flow from the DA timeframe, computed by PTDF * NP (note: PTDF comes from the DA flowbased domain and NP comes from the SDAC algorithm).

The current NTC for DA is different from the extracted NTC. The current NTC for DA is heavily dependent on the TSO modelling and operational experience. The extracted NTC is computed based on the DA flowbased domain, which is further dependent on the common grid model, GSK, amongst others. In other words, the current NTC values and the extracted NTC values are the results of two different methods. Also, the AAC term in the current NTC method refers to the scheduled exchange, whereas the AAF term in the ATCE methodology refers to the 'physical' border flow computed by the z2sPTDF * NP of the DA market outcome. Consequently, the resulting ATC ID and ATCE ID results are different and not comparable by default.

From the operational security perspective, the ATC ID capacities from the ATCE method respect the security domain to the extent possible[5], as seen in the BZ SE2 trading space (Figure 28). On the contrary, the SE2 ID ATC, e.g. SE2-SE1 direction, from the current NTC method does not necessarily fulfil the N-1 security criteria for all MTUs today. Re-evaluation of this capacity in this direction has not been prioritized since this level of south-to-north flows never occurs.

It is also important to take into account that the data collected from the ENTSO-E Transparency platform contains the HVDC ramping constraints and the capacity reduction from the neighbouring non-Nordic TSOs, whereas the ATCE outcome of the ID capacities does not include such constraints.

[5] Please refer to the ATCE methodology description about the application of the positive PTDF filter and z2zPTDF threshold, amongst others.

6. Stakeholder feedback

The TSOs organized a one-month public consultation to collect stakeholder inputs to the evaluation report. During the public consultation period, a stakeholder event has been organized to answer questions from the stakeholders.

This section presents a short summary of the stakeholder feedback that TSOs received from the public consultation. The complete overview of stakeholder responses received and the TSOs' reflections to those can be found in the Annex I.

In total 19 stakeholders filled in the public consultation at the ENTSO-E consultation hub; one stakeholder requested its inputs not to be published. Most of the responses have been received from Swedish and Finnish stakeholders. Three responses from Norwegian stakeholders, and no Danish responses were received.

While the 3-months evaluation report served as the vehicle for the public consultation, no clarifications were asked by stakeholders with regard to the 3-months evaluation report. As such, no content-related changes have been made to the report, that were triggered by stakeholders' comments, compared to the version that was submitted for the public consultation.

There are different views among the various stakeholders. The Swedish and the Finnish stakeholders were more critical on flowbased in general, where the Norwegian stakeholders are more supportive. As the Danish stakeholders did not provide any comments, this can be interpreted that there are no concerns on their side.

The major concerns from the Swedish and the Finnish stakeholders are captured here below:

- The legality of flowbased is challenged
- Concerns whether the three-months reporting period is representative, and doubts on the quality of the flowbased parameters
- Concerns on non-intuitive flows in relation to the left-over capacity for the ID timeframe are expressed
- The transparency of flowbased, mainly due to the obfuscation of the Swedish CNECs, is deemed non acceptable
- General concerns on the overall market design, from LT, DA to ID and balancing are touched upon

The 3-months evaluation period is only one portion of the overall (at least) 12-months EPR period. The 12-months EPR period is there to allow stakeholders to get acquainted to the new methodology as required by the CACM regulation. Thus the EPR is providing a learning-by-doing possibility both for the stakeholders and the TSOs.

As requested by the Nordic NRAs, the Nordic TSOs have prepared this report, and organized the public consultation, to demonstrate that the Nordic FB implementation is ready for a final six months of EPR

before go-live. By ticking off the KPIs that were set by the NRAs, the Nordic TSOs have provided the necessary proof of the FB implementation readiness.

The Nordic TSOs acknowledge the concerns expressed by the stakeholders, but also recognize that most of them are not linked to the scope of the report – despite the quality concerns that have been expressed. The Nordic TSOs are working on a continuous quality improvement.

The Nordic TSOs conclude that the Nordic FB implementation has been demonstrated to meet the NRA KPIs and to function as expected.

7. Different perspectives of results

This section gathers some elements the reader may consider when reading the report. During the EPR, the Nordic CCM will ensure necessary improvements of our input data, modelling, implementation, and processes in general. After go-live, the Nordic TSOs and Nordic RCC will continue to improve the flowbased process as and when needed.

Quality improvements moving forward

The following items focus on the key assumptions and limitations of the models to be considered when assessing the EPR simulation results. In addition to this section, some of the key elements are discussed within the most relevant results in chapter 4. They have also already been presented during the external parallel run in the weekly simulation reports published at the Nordic RCC website.

- Flowbased simulations use order books from the current NTC operational setup. This means that the simulations do not consider any other changes in the market, such as adaptions in the market participants' bidding behaviour. Flowbased may allow for higher flows than NTC as it allows for a more efficient grid usage. If this occurs in bidding zones that have a high share of hydro production, the external parallel runs may overestimate the use of hydro power in the long run. In reality, it is expected that the water value of hydro power reservoirs would change accordingly. This would be reflected in the supply curves, net positions, and use of hydro power in the long run.
- For some hours during EPR, the export capacity in NO4 was above the physical limitations due to inaccurate forecasting of wind power in NO3 and hydro generation in SE1 and SE2. This comes from the modelling of production close to the bidding-zone borders NO4-NO3, NO4-SE1, and NO4-SE2. The modelling and GSK strategies on these power plants can make the capacity in flowbased more varying and sometimes higher than NTC. Svenska kraftnät and Statnett are continuously working on a better representation of this power production.
- The planned countertrade by Svenska kraftnät has not been included in flowbased but it is included in NTC. This impacts the flows between bidding zones.
- The modelling of series compensators on the SE2-SE3 border had a different set-up in flowbased and NTC from the start of the EPR until the 1st of March. During that period, the practice in flowbased was to have an even distribution of the capacitors. In NTC, the operational status of them was adjusted to the expected situation in operation. This resulted in the maximum permissible flow in NTC being higher than in flowbased which led to some network elements situated on the SE2-SE3 border being the most constraining network elements in the Nordic CCR. On the 1st of March, the management of the series compensators was changed in flowbased to fit the expected operational status. This has resulted in better alignment of the maximum allowed flow between NTC and flowbased.

- aFRR capacities were not included in the flowbased domain but were included in NTC due to data processing errors on the following days: 25.12. – 27.12. and 14.1. This resulted in slightly larger flowbased domains, thereby skewing the results towards a more positive flowbased outcome.
- There are two different deadlines for providing NTC and flowbased capacities to the market, and this can result in different transmission capacities if an interconnector trips between those deadlines. Both capacities are correct, but the different timings led to different transmission capacities and results. An example of this was observed on 8.1. on the LT-SE4 border.
- In the current implementation of the flowbased approach, the FRM is a fixed number (5% of Fmax) and not resulting from a computational process, and the AC load flow is not applied when assessing contingency scenarios, as it is agreed to be implemented after the flowbased go-live.

Economic efficiency & operational security in NTC and flowbased

The flow of electricity in any power grid, as in the Nordic power grid, is guided by the physical laws of electricity, and limited by the physical capability of the components that constitute the grid. These physical laws and limitations must be represented in the transfer capacities provided to the power market to maintain operational security and prevent critical outages. However, not all physical limitations are relevant for the market, and only the most limiting grid elements will typically be represented in the transfer capacity offered to the market.

Bidding zones should, according to legislation, be constructed to reflect structural bottlenecks in the grid. In practice, the relevant physical limitations are rarely located at the border between bidding zones but rather scattered around, at different locations in the grid. Thus, bidding zones are not perfectly matched to structural bottlenecks, but are constructed to reflect the physical limitations in the best possible way.

However, in the NTC-based approach, the market algorithm doesn't allow us to reflect physical flows (in meshed AC grids). Thus, only the physical limitations of each grid component can be managed by the transfer capacity (NTCs) offered for each border surrounding a particular bidding zone, and regardless of where the actual limiting component/bottleneck is physically located inside the bidding zone.

Because each limiting grid component can only be used up to its maximum capacity, the physical capacity of each relevant limiting grid component will have to be split towards all the borders of that bidding zone. This process is done manually by the TSO operators before the capacities are provided for the electricity markets, and there is no guarantee that all capacity is offered to the most valuable border. This process is often referred to as "moving internal bottlenecks to the border". However, it's not possible to avoid this in NTC. In NTC, the inefficiency can only be reduced by increasing the number of bidding zones.

Another inefficiency that follows along from the inability of NTC to reflect flows in meshed AC grids, is transit flows. Whenever a flow is allowed from one bidding zone to another, a part of that flow will fan

out and traverse one or several other bidding zones on its way to the destination. When providing capacity to the market, the operators will have to take this into consideration, and the only way to do so, is by manually reducing capacity below the physical limit. Thus, NTC has three inherent limitations:

1. Internal bottlenecks are moved to the borders
2. Capacity is not necessarily offered at the most valuable borders
3. Transit flows cause capacity to be reduced below its physical limit

Flowbased uses an hourly CGM

A common feature of the power grid is changes introduced by both planned and unplanned outages. An outage will change the topology of the grid and thus the way electricity will flow in the grid. Planned and unplanned outages happen regularly, from day to day and hour to hour. Thus, whenever an outage happens, other physical grid components become relevant for the transfer capacity offered to the market. This will change, either reduce or increase, the NTC capacities in the current market approach, and the CNECs in the coming flowbased approach. Due to planned outages, both NTC-capacities and CNECs will change from hour to hour and day to day, both during external parallel runs and later in real operation. The outages will be captured in the Common Grid Model (CGM), causing differences in the model from day to day and hour to hour.

The CGM itself is "a picture" of the grid at a specific moment in time and inside the relevant hour it represents. Thus, there are 24 unique CGMs per day, and each of them contains specific information of the topology, electric features of each component, and forecasted state of each generation and consumption node. With the challenges ahead, linked to the energy transition, the availability of an hourly and high-quality CGM, and the use of it in the capacity calculation process, will be key.

8. Annex I: Results from the public consultation

This document contains the responses from the stakeholder consultation, that was open from April 17 to May 17 2023. The consultation concerned an external parallel run evaluation report for assessment by the NRAs of the Nordic CCR, as required by the Nordic DA/ID CCM that was approved by the NRAs of the Nordic CCR on October 14th, 2020. The document provides an overview on the content of the responses and names of stakeholders who has submitted a response.

Name of stakeholders

Stakeholder #	Name of stakeholder	I want my answer to remain anonymous, i.e. we will publish your comments but we will not publish your name and organization	I do not want my answer to be published, i.e. we will not publish your answer to this consultation but your answer may be shared with national authorities involved in the consulted document
1	shadow analysis ab	No	No
2	Association of Energy Users in Finland (ELFi)	No	No
3	Renewables Norway	No	No
4	UPM	No	No
5	VOLUE	No	No
6	Statkraft Energi AS	No	No
7	Baltic Cable AB	No	No
8	RISE Research Institutes of Sweden	No	No
9	SKGS	No	No

10	Northvolt AB	No	No
11	Fortum Oyj	No	No
12	Nord Pool	No	No
13	Swedenergy	No	No
14	EPEX SPOT	No	No
15	Finnish Energy	No	No
16	This stakeholder requested its inputs not to be published	Yes	Yes
17	E,ON Sverige AB	No	No
18	H2GS AB	No	No
19	Vattenfall AB	No	No

Individual responses to the questions raised in the consultation and TSO answer

The questions raised by the TSOs, have been answered by nineteen stakeholders; one stakeholder requested its inputs not to be published. The responses are listed in the first column of the table in the following section, whereas the stakeholder mentioning it has been mentioned in column 2. Column 3 mentions the TSOs' comment to the responses provided.

Question and answer

What is your view on chapter 1?

Stakeholder response:

Stakeholder response		Stake-holder (s)	TSO comment
1	"As there are major differences made to the model (as reported) the time period considered is not representative for the expected results. Thus, the report is disqualified and should for this reason not be considered as having valid results. We look forward to new results with the finished mature model with a report of the KPI for that run. The Nordic transmission system operators insist that flow based will be implemented as this is the only legal avenue forward. However, the EU legislation does not require an implementation that obviously leads to less total overall welfare in the combined markets that constitute the electricity markets, (balancing, intraday, day-ahead, and forward) or higher prices for the end consumers. The latter is hard to misinterpret as EU is looking for a different set of market rules to protect customers from abuse, be it from producers or system operators. Given the many question marks concerning the early results it is important that the regulators' ensure that the implementation of flow based leads to an improvement of the Nordic market. An improvement must mean that the overall trade flows are increasing, the impact on other markets (intraday, financial market) is acceptable, and the model should lead to legitimate distribution of the welfare. As the current model, as it stands, does not produce such a legitimate outcome it is very important that the Nordic Transmission System Operators moves beyond theoretical reasoning and using empirical data describes why the Swedish and Danish consumers lose in all reported week. Normally we would expect that the gains of trade should be more balanced between producers and consumers. In the end, the Nordic System Operators must be able to explain the outcome, using real data, concerning the redistribution when implementing the flow based capacity calculation."	1	The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains. The NTC system does not fit anymore to the Nordic power grid today and with the future changes coming up. Based on this, the work in the Nordics on FB started in 2012 to cope with the scarce capacities in the grid. This approach is also supported by the CACM that came into force in 2015. The Nordic CCMs have been approved by the Nordic NRAs and ACER. Impact on welfare distribution is a common feature when making changes in the power system and power market. Redistribution of welfare can happen between different stakeholders and over multiple timeframes.
2	It is mentioned that the current NTC cannot be used as it's not based on the CGM, and flowbased has been chosen as the approach as it's more efficient. However, flowbased risks the forecastability of the market prices, and that risk hasn't been assessed at least in this report. So has there been any testing and development of NTC with CGM?	4	NTC has not been tested for CGM by the TSOs as Nordic capacity calculation methodology approved by NRAs requires TSOs to implement FB approach. The NTC method does not inherently consider internal congestions, that may have effect to cross-zonal capacities, especially in meshed transmission grids.

3	This introduction chapter provides a satisfactory overview of the background for the Nordic flowbased market approach and important issues related to the external parallel run period.	6	
4	The features and impact of advanced hybrid coupling on market results are not mentioned. It is essential to add that this is an important feature of the implementation, which will have repercussions on bidding zone borders beyond the Nordic CCR region (Hansa for example).	7	Advanced hybrid coupling is a technical construction that secures that DC cables can be operated with highest efficiency in a FB set up. Applying standard hybrid coupling would lower the efficiency of the market. From the comment it is not clear what is meant by "impact", as no reference is mentioned. If SHC is the reference we cannot provide an impact as no simulations has been done with SHC
5	It is a good introduction.	8	
6	"In general, a three-month evaluation period does not provide enough data to generate sufficiently valid conclusions. Especially since the flow-based model has been developed and improved during the evaluation period. As already stated, we question the statement given that flow-based is the only way forward unless the evaluation shows a negative SEW-gain. However, the EU-legislation does not require an implementation that obviously leads to less total overall welfare considering the combined markets that constitute the electricity markets, (balancing, intraday, day-ahead, and forward) or higher prices for the end consumers. The option to develop and improve the current NTC-methodology has not been properly evaluated. It is important that the Nordic regulators ensure that the implementation of the flow-based methodology leads to an improvement of the total Nordic power market design. As the current model, as it stands, does not produce such a legitimate outcome, it is very important that the Nordic TSOs move beyond theoretical reasoning and using empirical data describes why the Swedish and Danish consumers lose in all reported week. Normally, one would expect that the gains of trade should be more balanced between	9, 10, 18	During this 3-months EPR evaluation period, the FB process has been demonstrated to function in a stable way, and to provide the expected results. The EPR is not completed though, as it will continue until at least a period of 12 months has been covered (i.e. all the seasons of the year). The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains. The NTC system does not fit anymore to the Nordic power grid today and with the future changes coming up. Based on this, the work in the Nordics on FB started in 2012 to cope with the scarce capacities in the grid. This approach is also supported by the CACM that came into force in 2015. The Nordic CCMs have been approved by the Nordic NRAs and ACER. Impact on welfare distribution is a common feature when making changes in the power system and power market. Redistribution of welfare can happen between different stakeholders and over multiple timeframes.

	producers and consumers. In the end, the Nordic TSOs must be able to explain the outcome, using real data, concerning the redistribution when implementing the flow-based capacity calculation."		
8	"Our comments relates to the content in the executive summary and Introduction: In Executive summary it is stated that the main reason for the switch to flow-based (FB) is the increasing complexity of the Nordic power system. Could this increase in complexity be elaborated? Would this complexity not be contained medium-term via TSO/DSO grid investments and continuous remedial actions by TSOs in operation also in an (C)NTC setup? It is also stated that FB manages the grid-congestions more efficiently. Can some comparison of congestion between FB and NTC be provided in the report? How can the congestion be measured in FB? In NTC we have congestion of lines. But how can it be compared against limiting CNECs? Also; to what extent is that statement substantiated also for the Intraday (SIDC) timeframe given the big impact SDAC FB results can have on the ATC(E) computed initial Cross Zonal capacity allocated for SIDC and subsequently on when SIDC gets congested across subsections (BZs) of the Nordic (+) grid? It would have been useful to have a list of all the defined KPIs for Nordic Flow Based defined by the Nordic NRAs in year 2020 and then clear indications of which KPIs have been met and with what "margin". It is stated that "the external parallel run shows that FB provides a higher social economic welfare (SEW), which reflects that the FB parameters are a result of a calculation that is in line with the legal methodology". It (parameters being in line with the legal methodology) cannot necessarily be inferred from a higher SEW. The question is whether the single KPI of (higher) SEW is sufficient to conclude that quality of FB parameters is of good quality or even sufficient? It is stated that FB decreases the price difference in the Nordic area Please add this in the form of a clear measure to the report. We observe though that it does not seem to be the case for the observed (e.g. average) price differences between for example SE1, SE2 and SE3. Additionally, given that the share of time (MTUs) when prices in especially SE1 and SE2 have become different is much, much bigger in the FB EPR then in NTC production. How can this be explained?	12	Explained in the last paragraph in chapter 1. In FB, congestions are monitored on the individually limiting grid components rather than being moved to the borders. Thus, directly comparing congestions in NTC and FB is not correct or relevant. Improvements in flows, as seen in figure 19, illustrate the improved efficiency in congestion management by FB. See chapter 3 of the 3-months evaluation report. The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains. The highest and the lowest prices are coming closer. However, due to all FB-prices being unique whenever there is congestion, there will be price differences between all BZs in congested situations unlike the NTC-approach.

	As stated in the report "Indeed, bidding strategies might be different, e.g. in hydro-dominated bidding zones, when FB is the applied approach", it is important to include expected future scenarios in simulations and not rely on historical orders. It is stated that FB will lower the overall cost. How is this cost calculated and what aspects and timeframes are included in what is defined as costs (and equally benefits or opportunity costs)? Can it be added to the report? We think it would be correct to include the full data disclaimers in this report as they are far from perfect and the simulations and methodology chosen creates issues, now some part of them can be found in Phenomena report, 11 April 2023 (nordic-rcc.net) page 10->. This approach gives a bit of not complete background and does not show all issues encountered. Page 51, on the topic of starting capacities we take note of following sentence: As a result of this, the resulting ID ATC values for the ID gate opening trades are always larger than or equal to zero, and capacity may be released on CNECs that was not available at the DA stage. TSOs should bring this message back as the outcome of ATCE will be starting capacity for both IDAs and continuous implicit intraday trading in the Nordics. Also it is not clear what CNEs were not available at the time of SDAC capacity allocation but would become available for the SIDC capacity allocation process, can it be explained and based on some example? In the early stages of the EPRs, TSOs started an Issue log that should be up to date following the issues encountered as part of EPRs. This was published on RCC webpages for a while, Unfortunately, we can observe that this log hasn't been updated as part of the EPRs. As an example, 8th of May, last entry is 4 of March. The TSO communication of the starting date of the EPRs happened long after the actual starting point Communicated at 20th Jan-23 compared to 12th –22nd of Dec. Immediate and timely communication with the target audience can create better commitment to the process from them. The data publication during the period has improved however it is far from perfect Anyhow TSOs are saying that they still plan to increase the data been published. We also observe clear regional approaches adopted by the different TSOs on how active they are in trying to explain and reply to questions from local stakeholders. Sadly, not all key questions in SHG-meetings have been answered in a timely manner.		Indeed, the bidding behaviour may be impacted by the introduction of FB in the Nordics. TSOs will not take any position on this matter, nor is it possible for the TSOs to simulate this. Euphemia is doing a welfare economic optimization which is the dual problem to cost minimization. From the higher SEW follows a lower cost for society. The cost is defined as the short-run marginal cost, based on the order books provided. Both NTC and FB may be impacted by mistakes, also in operation. The D-1 CGM will be updated to reflect any changes in the grid after the SDAC. Outages happening after the MC could potentially induce new CNEs to become limiting in the SIDC. The issue log is up to date and can be found here: https://nordic-rcc.net/flow-based/simulation-results/epr_issue_list_for_stake_holders/ Indeed, the communication was elevated over the Christmas break, in order to be certain on the stability (especially with the Xmas period being special) and to be able to share the market reports as close to this notification as possible (as also explained in the Feb 9 stakeholder meeting).

	In our understanding the objective for the EPRS is to learn, educate and let stakeholders adapt their systems to the new processes, this have been hindered due to TSO still having their own internal issues and describe this process as also a learning process on their side. An example of this is the frequent questions from market participants on long-term capacities and changes to both (REMIT) transparency ("UMM/NUCS") related publication of impact on "Cross Zonal Capacity" from planned and unplanned outages, and FB parameter input data publications as a result of FB implementation in the Nordics. In our understanding this is something that should be clear and ready to test a real live version at this stage of the process if there are changes related to this, but this is not yet clarified by TSOs . The fact that most of the 3-month period is operated with a FB CCM model that in some key aspects has been amended at the end of the period is a real concern in terms of it being possible to properly evaluate the results since the CCM model applied is not consistent across the EPR period subject for the report and this consultation. It is unclear how TSOs will inform the market in future on details in relation to these changes.		The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains.
	Regarding the fact that the modelling of SE2-SE3 border has changed in the course of the 3-months period EPR, it seems that the referred to 2021-2022 IPR was not sufficient to finalize the modelling approach. Are TSOs using the EPR as an extension to the previous internal parallel run period?		See above.
	In the report a couple of problematic cases during the 3-month EPR period are explianed and with 1-2 reasons for them given, but is not explaining the whole situation and reasoning behind the situations in details. Individual TSOs input parameters, IGMs, has the largest impact on the flow based capacity calculation and therefore to the EPR results. As TSOs also state in the report, they are using the EPR period for exploring ways to improve IGMs. Thus, the EPR results aren't comparible with production NTC results until TSOs have learned to set the IGMs in sufficient level.		See above.
	Does EPR report in general refer to the scheduled exchanges (SDAC results) or to physical flows (TSO post-process PDTF*NP) when mentioning specific flow results?		The flowbased results refer to physical flows. We added a clarifying comment in the report on this.
	Can one expect physical flows to be closer to scheduled exchanges under FB? Can it be compared against NTC as a KPI?		The scheduled exchanges are not physical flows and should not be mixed or compared.
	What are the KPIs to measure level of operational security and efficiency of operation?		There are no NRA KPIs on this element
	It is stated that "the application of the capacity calculation methodology using the FB approach would not yet be more efficient compared to the CNTC approach at the same level of operational security, CNTC can be applied. Mainly due to the meshed grid		Please refer to the explanation in Box 4 in the 3-months evaluation report.

	characteristics of the Nordic grid, this has not been demonstrated." Does it mean that it is not possible (CNTC outperforms FB in efficiency)? Can the potential decrease in redispatch cost via FB versus (C)NTC model be shown using EPR results? Also, the effect of the by TSOs indicated lack of usage of Redispatch & Countertrade in the FB EPR CCM while it was used in production in NTC, would be valuable to make visible. It is stated that "FB approach is a step forward from the current NTC approach towards taking better into account the locational information within a bidding zone". But it is not locational as long as the resolution of published price and buy/sell settlement is on BZ level, portfolio bidding is applied per BZ, and flows are calculated between BZs. As a consequence, flows can be non-intuitive, which impacts CI, and also incentives for generation/consumption. Under Section "Better management of the NO1-SE3-DK1 is not fully clear what the purpose of the comparison to the to NTC based Nordic System Price is. Would it be possible to improve the example and explain why it is put forward? We would like to see a detailed example between NTC and FB of north-bound flows having real impact on the west coast corridor in Sweden. For example, a deep dive in an example like the real case on 7th of May -23 (if none can be found in the EPR 3-month period)."		The application of remedial actions in capacity calculation is based on an operational security assessment, which is applied in both NTC and FB. Remedial actions will indeed impact the capacity and thereby the welfare distribution. NTC does not take into account the individual BZ influence on individual congestions Examples are meant to provide some general insight to specificities of capacity calculation We are happy to see an interest in the results! The date proposed is outside of the 3-months evaluation reporting period; yet, we are more than interested to deep-dive into interesting cases / days. Please do reach out to us if you see any specific date / case that is of interest, so that we can also see the need for doing so.
9	"As there are major differences made to the model (as reported), we do not see the time-period considered as representative for the expected results. Thus, the report should be disqualified and not be considered as having valid results. We look forward to new results with the finished mature model with a report of the KPI for that run. The Nordic TSOs insist that flowbased must be implemented as this is the only legal avenue forward. However, the EU-legislation does not require an implementation that obviously leads to less total overall welfare considering the combined markets that constitute the electricity markets, (balancing, intraday, day-ahead, and forward) or higher prices for the end consumers. Given the many question marks concerning the early results, it is important that the Nordic regulators ensure that the implementation of flowbased leads to an improvement of the Nordic market. An improvement must mean that the overall trade flows are increasing, the impact on other markets is acceptable, and the model should lead to legitimate distribution of the welfare. As the current model, as it stands, does not	13, 17	The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains. The NTC system does not fit anymore to the Nordic power grid today and with the future changes coming up. Based on this, the work in the Nordics on FB started in 2012 to cope with the scarce capacities in the grid. This approach is also supported by the CACM that came into force in 2015. The Nordic CCMs have been approved by the Nordic NRAs and ACER. Impact on welfare distribution is a common feature when making changes in the power system and power market.

	produce such a legitimate outcome, it is very important that the Nordic TSOs moves beyond theoretical reasoning and using empirical data describes why the Swedish and Danish consumers lose in all reported weeks. Normally, one would expect that the gains of trade should be more balanced between producers and consumers. In the end, the Nordic TSOs must be able to explain the outcome, using real data, concerning the redistribution when implementing the flowbased capacity calculation. Given the results presented, we find it important to have an explanation why CNTC is disqualified."		Redistribution of welfare can happen between different stakeholders and over multiple timeframes.
10	"Finnish Energy welcomes the possibility to give feedback on the Nordic TSOs' CCM external parallel run evaluation report. Finnish Energy is concerned about the lack of evidence on clear benefits of flow based, quality of the inputs and results published during the parallel run, negative impacts on the intraday market and lack of transparency in the Nordic flow-based approach. Moreover, as there are major adjustments made to the model, we do not see the time-period considered as representative for the expected results. Thus, the report should be disqualified and not be considered as having valid results. We look forward to new results with the finished mature model with a report of the KPI for that run. The Nordic TSOs insist that flow-based must be implemented as this is the only legal avenue forward. However, the EU-legislation does not require an implementation that obviously leads to less total overall welfare considering the combined markets that constitute the electricity markets, (balancing, intraday, day-ahead, and forward) or higher prices for the end consumers. Given the many uncertainties concerning the early results, it is important that the Nordic regulators ensure that the implementation of flow-based leads to an improvement of the Nordic market. An improvement must mean that the overall trade flows are increasing, the impact on other markets is acceptable, and the model should lead to legitimate distribution of the welfare."	15	The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains. The NTC system does not fit anymore to the Nordic power grid today and with the future changes coming up. Based on this, the work in the Nordics on FB started in 2012 to cope with the scarce capacities in the grid. This approach is also supported by the CACM that came into force in 2015. The Nordic CCMs have been approved by the Nordic NRAs and ACER.
11	"General remarks: Vattenfall remains concerned, that the decision about such a fundamental change is taken without first having done a solid analysis and evaluation of the pros and cons. Both the TSOs and the NRAs repeatedly refer to The NRA decision taken in 2016 and with this excuse abstains from a full to evaluation of the performance of the model in the external parallel runs (EPR) and focus too narrowly on KPIs that in principle only cover technical functionality.	19	The Nordic TSOs went a long way in the choice for, and the development of, the FB methodology. This has been reported and shared with stakeholders along the way. In the same way, FB as the European target has been discussed and consulted upon before being captured in the CACM regulation.

	Our overall conclusion is that the EPR process is not ready. The purpose of the EPR and this process is described as to allow the market participants to learn how the Flowbased Market Coupling (FBMC) works and to allow a comparison of its market results with the NTC method. Given the degree of modelling errors and significant changes to the model that has taken place during the period, we question that this purpose is fulfilled. We do recognise improvements to the process and simulation during the parallel runs, however we have experienced persistent errors (since March 2022) and communications from the TSOs in market regular market reports with the message "The TSOs are aware of the comment/issue. We are working on fixing it. In total we do not regarded this as sufficient for a process that will imply significant transfer of wealth from and between different user groups. We are concerned that the model for this far reaching change of the electricity market is still under development this close to a planned go-live date.		During this 3-months EPR evaluation period, the FB process has been demonstrated to function in a stable way, and to provide the expected results. The EPR is not completed though, as it will continue until at least a period of 12 months has been covered (i.e. all the seasons of the year).
	The most important example of this is that due to modelling errors until week 10 (at the very end of the 12 week period), it is not possible to fully compare the EPR results with the current NTC method (as stated by the TSOs as the purpose of the process). To conclude: We have data for the 3-month period that we know is wrong, and we advise against drawing conclusions what regards socioeconomic implications from it.		The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains.
	Three months is not enough to cover all aspects of system operation and implication for market participants and customers. A full analysis should cover at least a full year with a stable methodology. Only covering 3 months implies that we lose the opportunity to stress test methodology and transparently discuss with stakeholders on the performance of the method under different demand supply situations. Conditions change with season, and the impact on price formation from one season to another is highly diverse.		The EPR will continue until at least a period of 12 months has been covered (i.e. all the seasons of the year).
	Not sufficient discussion and analysis of the impact from using real-world order books. The issue of using real-world order books is mentioned in the report, however, the impact of this is not described sufficiently. The report should have included a description that clearly explained that the volumes would be different and as a consequence of this, different valuation and different strategies, which in the long run would cause a different SEW.		As mentioned in the report, the bid curves are based on the NTC capacities (i.e. operational order books).
	The weekly reports have strictly focused on analysing the changes in the SEW-value, but other key elements have been left behind. The bought and sold volumes are published, however analysis have not been done by Nordic RCC to verify if these volumes are possible to realize. Using the NTC orderbooks for FB analysis could eventually result in production volumes exceeding the existing energy volumes in the reservoirs. The EPR approach for areas with dominating thermal production provides a fairer comparison,		

	however, it should be questioned if the SEW-value is truly representative a hydro dominated area such as the Nordics. The interpretation of socioeconomic figures is not complete. It is noted in the report that "The total social economic welfare has increased in the Nordic CCR" but it is not really set in perspective (i.e how much in percentage has the Socioeconomic welfare (SEW) has increased compared to NTC?"), nor is it sufficiently discussed how the known shortcomings of the model impact the results. The requirement of a common grid model does not rule out other potential design options. TSOs refer to that the current Nordic NTC-approach does not fulfil the requirement as it is not based on a common grid model, but here we would like to point out that requirement does not require the capacity allocation methodology to be based on FBMC using non-intuitive flows. Current challenges are acknowledged but consequences of choosing a FBMC approach are still not problematised. It is mentioned as a reference that "Flowbased is not an option it is a requirement". The TSOs acknowledge that" due to the increased complexity of the power system, including more meshed grids, more distributed and variable generation and more flexible consumption." But given that FBMC use D-2 wind forecasts it is difficult to understand how this really solves a problem D-1 without creating a another problem later in the operational phase. It is widely known that wind forecast quality is not good enough on a D-2 level, which means we are moving towards a technology that could reduce the quality given the wind forecasts used to calculate the domain. The change to FBMC will impact the intraday market and utilisation of flexibility negatively. This has been Vattenfall's core concern throughout this stakeholder process. We genuinely believe that the intraday market could and should be the key realise a well-functioning market with intermittent renewable generation. And the impact on the intraday market has still not been fully analysed. We cannot accept the TSO explanation: "For the ID market in chapter 5 there is no welfare computation as this is not possible". We understand that the locational information will help, but more efforts must be done to understand the real impact on the intraday and analyse the impact of using D-2 wind forecasts. It is further claimed that "FB will optimize the utilization of the power grid and the production system in general, generate welfare economic benefits". To achieve this, the analysis must cover the whole process of planning and operating a power system, from the forward planning, spot market bidding, through the intraday adjustments and		It is not a common practice to compare the welfare change with the overall market welfare. The welfare gain with FB has been demonstrated. FB is the target solution for Europe, as stated in the CACM regulation. The use of the intuitive patch has been discarded by ACER in its decision on the Algorithm Methodology. The D-2 CGM is used as a basis for the capacity calculation – to use the latest information available as input to the capacity calculation process. In the hypothetical case that NTC could remain, it would have to be based on the same D-2 CGM as well. Maximizing welfare (SEW) entails that the DA market outcome is in line with all available information at that point in time – including the amount of scarce capacity in the grid. The sequence of trading on the various timeframes (DA, ID) is based on a maximum amount of capacity provided per timeframe. Increased efficiency on the DA stage, will lead to a potential low left-over capacity for the ID gate opening. For the ID timeframe, dedicated CGMs and capacity calculations will be performed, to provide the maximum amount of capacity available at that moment in time. TSOs will provide a maximum amount of capacity as DA left-over capacity for the ID gate opening, within the

	the balancing market and real time operation of the system. For further detail we refer to our answer on question 8 covering the intraday market."		operation security limits as explained in the report. An ID welfare computation is not feasible with the current continuous trading schemes.

What is your view on chapter 2?

Stakeholder response:

Stakeholder response		Stake-holder (s)	TSO comment
1	Chapter 2 describes the purpose of the report and what KPIs that will be evaluated. We have one statement. It is important that the regulators respect the data set underlying the submitted report. To clarify, if data and analysis are missing in the EPR-document, the regulators need to conduct their own analysis. Ultimately, missing data or missing analysis should lead to a disqualification of the submitted report.	1, 13	Comment to the NRAs; all data has been provided.
2	"The theoretical result unambiguously proves that flowbased is superior to NTC in terms of social economic welfare." We assume that the rationale for this result is presented in this report in box 4. Please provide another source if that's not the case. In the KPI presentation (box 2), it's stated clearly that the NRAs note that the comparison between flowbased and NTC cannot be done perfectly, partly due to the different operational security. This may be interpreted to include also the other uncertainty factors, including the use of realized NTC order books with reservoir hydro power and lack of analysis on the forecastability of prices."	4	Box 4 present the theoretical background, why flowbased is expected to provide higher social economic welfare compared to NTC. Simulation results for 3-month EPR show that the flowbased method result in a higher overall SEW compared to SEW from NTC.
3	Chapter 2 accounts in a satisfactory way for criteria to be fulfilled for the Capacity Calculation Methodology (CCM) to be implemented.	6	
4	"The evaluation of the flow-based methodology must consider the whole and complete functioning of the Nordic power market. It is not fair nor correct to assess the SEW-gains based on only a comparison between the flow-based and NTC methodologies applied DA. Regarding the ongoing decarbonization of society, there are predictions announced that Sweden will need to double its electricity consumption until the end of 2030´s. Further	9, 10, 18	The sequence of trading on the various timeframes (DA, ID) is based on a maximum amount of capacity provided per timeframe. Increased efficiency on the DA stage, will lead to a potential low left-over capacity for the ID gate opening. For the ID timeframe, dedicated CGMs and

	buildout of renewable and volatile generation is the main response to how to secure supply for those massive investments. The importance of a well-functioning ID-market will grow in tandem with the continuous buildout of wind and solar generation. In this situation, when preparing for a paramount change of the Nordic power market function, the assessment of the implication of flow based for the ID-market is a must. The non-intuitive flows are a big concern and might have a vital impact on the functioning of the ID-market, allowing traders to utilize arbitrage opportunities. The arbitrage opportunities give incentives to turn the scheduled flow over that boarder in the opposite direction. We need to understand what impact such extensive ID-trading,, would have for the operation of the Nordic power system. This is barely mentioned in the report, and even less addressed as a concern. The guidance to the report states a minimum requirement of analysis and KPIs to present but does not exclude further analysis to be performed. The implication of flow-based on the functioning of the ID-market have to be included in the evaluation."		capacity calculations will be performed, to provide the maximum amount of capacity available at that moment in time. TSOs will provide a maximum amount of capacity as DA left-over capacity for the ID gate opening, within the operation security limits as explained in the report. An ID welfare computation is not feasible with the current continuous trading schemes. Arbitrage possibilities between the DA and ID markets may arise because of how the ATCE is implemented, applying a relaxation of the FB parameters. Thus, arbitrage between DA and ID is not a necessary consequence of implementing a FB method in DA. It is rather linked to the fact that the TSOs have chosen to relax the FB domain in order to release non-zero capacities for the ID gate opening, when possible from an operational security point of view.
5	"NRAs asked TSOs to report SEW effects of FB in the neighboring countries. Could this be added to the report? It is stated that “The second set of criteria are aimed at capturing the quality of the FB parameters, which is captured in the welfare economic assessment of the DA market and computation of ATCs for the intraday market.” The question is; how can an increase/decrease of ATC for ID be a result of good/bad quality of FB parameters?"	12	The overall SDAC welfare figures are a part of the report (see e.g. Figure 3). As the ATC depends on the DA-domain and the DA market result, any quality issues of the FB domain will be translated into the ATC results.
6	"We stand behind the comments given by SwedEnergy. To give market participants and decision makers the possibility to evaluate and to adapt to the change in capacity calculation, the updated report also needs to include - Optimized countertrade to increase social welfare both during the calculation period and long-term to mitigate negative impact even higher prices have on consumer investments in affected areas - Calculations of impact of social economic welfare for the intraday market. In chapter 2, it is stated that “Contrary to the day ahead market, social economic welfare cannot be computed for the intraday market”. It is strongly advised that the definition of “economic surplus for the single day-ahead or intraday coupling”, as stated in the CAGM	17	Countertrade comes at a cost as well. Please note that FB establishes a welfare gain compared to the current NTC system for all weeks covered in the 3-months period. The sequence of trading on the various timeframes (DA, ID) is based on a maximum amount of capacity provided per timeframe. Increased efficiency on the DA stage, will

	GL, is studied and that the intraday impact is calculated accordingly, e.g. by using and presenting allocated intraday capacities for each hour during the parallel run in the direction from the lower price area to the higher price area when comparing flowbased with NTC"		lead to a potential low left-over capacity for the ID gate opening. For the ID timeframe, dedicated CGMs and capacity calculations will be performed, to provide the maximum amount of capacity available at that moment in time. TSOs will provide a maximum amount of capacity as DA left-over capacity for the ID gate opening, within the operation security limits as explained in the report. An ID welfare computation is not feasible with the current continuous trading schemes.
7	"In general the criteria focus too narrowly on technical functionality to analyze the socioeconomic implication of this change. For example implications for credibility and trade with flexibility are not covered. The NRA decision in 2016 is not sufficient to guarantee positive customer value. On the requirements on the evaluation report we note (Box 1, page 8) that refers to information on ID-capacities, qualitative assessment and explanation etc., we do not regard that this is provided at a satisfactory level. Not by the process nor in the report."	19	As the evaluation criteria are defined in the NRA approved Nordic CCM, an evaluation of the appropriateness of the criteria themselves lays outside the scope of this report. The EPR provides data for the ATCE for each MTU and bidding zone border, and this data has been summarized and analyzed in the report. The amount of available capacity for imports or exports will vary depending on bidding zone and MTU, as shown in the analysis in chapter 5. However the amount of trading possibilities is dependent on MP interests and not the sole function of cross border capacity.

What is your view on chapter 3?

Stakeholder response:

Stakeholder response		Stake-holder (s)	TSO comment
1	The KPI for fallback measures seems fulfilled. This is an IT-issue and it is needs to be more or less perfect.	1, 13, 17	TSOs agree with this conclusion.

2	"In chapter 3 results of the KPIs covering fallback and calculation process delays is accounted for. It is satisfactory that no fallback measures had to be used, nor any delays to provide capacity calculation process and neither have any delays to publish the capacity calculation results occurred. Accordingly, the requirements from the Nordic NRA regarding KPI goals are fulfilled. However, we register with some concern that after the model updates for SE2-SE3 there have actually been cases of fallback solutions and other issues in the simulations."	6	TSOs agree. The fallbacks occurred after the 3-months evaluation report period. Yet, fallbacks may occur once in a while. This is unfortunate and we are working on mitigating such situations.
3	The model appears to deliver output as required for operating the DA-market calculation.	9, 10, 18	TSOs agree with this conclusion.
4	Quality of the FB parameters and results is not taken into account in the analysis. TSOs seem to consider that it is sufficient if they manage to calculate some parameters and get some results. We consider that more analysis on the quality of the inputs and outputs is needed. We would also like to see how many and how large adjustments (if any) TSOs have done manually to the FB parameters and other inputs and outputs during the parallel run.	11	The FB parameters are the output of a coordinated capacity calculation process; they are not altered by the TSOs. If a TSOs, based on more recent insights or information, is able to increase the margin on one of its CNECs, or needs to lower it, the TSO will apply an Individual Validation Adjustment (IVA). The IVA values are published on the JAO website and need to be justified by the TSOs.
5	"The chosen KPIs in general are not the best in terms of e.g. evaluating increase or decrease of market and power system efficiency as a result of shift to FB Plain instead of (C)NTC as CCM for SDAC in the Nordics and we have expressed our views on this in the past. But also, we see that TSOs need to adhere to fallback domains both before and after the EPR period. More details and associated market impact is something we have asked TSO to clarify in several public SHGs during this project and this topic has never been fully explained, we are still waiting for more feedback on this. Also, TSOs should run a few days with back-up domains to be able to demonstrate and educate MPs on both the handling and impact on results. This is important as now no impact from this part of the process is known to MPs. To fulfil the KPIs (as FB capacity calculation takes long time) TSOs are calculating and publishing the FB domain early in the morning. Publishing too early is a problem itself – capacity data will be based on earlier information, thus not reflecting the grid situation as closely as it is possible in NTC model where capacities can be (re)calculated and published closer to deadline. TSOs are also using only the FB domain to limit the HVDC links (modelled as NTC lines). Therefore, the comparison between production and EPR data is not necessarily based on same information either."	12	The KPIs have been defined by the Nordic NRAs. Please refer to the explanation in Box 4 in the 3-months evaluation report. The application of fallbacks is unfortunate and may have a negative impact on the market results. Like any fallback, it is designed to guarantee a continuity of the DA market clearing process. It is of course the objective to keep the amount of fallbacks applied to the absolute minimum (as reflected by the NRA KPI). The capacity calculation process is based on forecasts indeed. The target model for the consecutive process of DA, ID, and balancing timeframe capacity calculation is designed to take into account the latest (forecast) information available, through updated D-2, D-1, and ID CGMs.

6	The KPIs for fallback measures seems to be fulfilled. However, we are concerned that the quality of the flow-based parameters and results are not taken into account in the analysis. We consider that more analysis on the quality of the inputs and outputs would be needed. We would also like to see if TSOs have done any adjustments to the flow-based parameters and other inputs during the parallel run.	15	The FB parameters are the output of a coordinated capacity calculation process; they are not altered by the TSOs. If a TSOs, based on more recent insights or information, is able to increase the margin on one of its CNECs, or needs to lower it, the TSO will apply an IVA. The IVA values are published on the JAO website and need to be justified by the TSOs.
7	"Vattenfall has no major concerns, but we object to following conclusion "The flow-based capacity calculation process stabilized since the beginning of the external parallel run in March 2022, and the start of the internal parallel run in May 2021". Motivation: There is no available data for weeks 17-45 (2022), which means that it is not possible to evaluate the stability of the process during this time. Another example is a quote from the simulations results web page "Earlier published data for week 44-45 has been removed due to data error. There is no plan to re-simulate them." That is not the characteristic of a stable and transparent process. In the week 52 report, data processing error of the aFRR capacities is mentioned: "For the 26th and 27th of December the capacities for aFRR were not been included in the FB domain due to a data processing error but were included in the NTC domain." In the Q&A webpage, it is mentioned that the aFRR CM process timing does not constraint. It would be good if the TSOs could elaborate more on how this data processing error occurs, and if it is part of your learn-by-doing process, please share what measurements have been taken to avoid this kind of data processing error once FB goes live."	19	Over the course of the internal and external parallel runs, the calculation process has gradually become more stable. As shown in this report, the stability over the 3-month reporting period has satisfied the KPI criteria. The quality of the process, as for any, will continuously improve going forward. It is expected that more improvements are identified in the beginning of the implementation of a process.

What is your view on chapter 4?

Stakeholder response:

Stakeholder response		Stake-holder (s)	TSO comment
1	"The results for the socioeconomic welfare, needs to help ensure that we implement flow based in a version and manner that secure a better functioning of the electricity market. Currently the welfare gains are small, and very lopsided towards producer rents. Thus an	1	TSOs don't have access to the bid curves per bidding zone, but can use them in the market simulations. However, all the results in the EPR are driven by

	in-depth investigation into the socioeconomic redistribution from consumers to producers should be conducted. Figure 3 shows negative consumer surpluses both within the Nordics and on the outside. The analysis need to move from the theoretical reasoning about slopes of demand curves to a real case study exploring how this consistent redistribution from Swedish and Danish consumers to producers can be explained. We need to be ensured with examples from the model to be implemented that these results are a result of the circumstances these 10 weeks, rather than a feature of the model, or the parameter calculations. Another important point to clarify is whether this redistribution is a consequence of the Transmission system operators taking far less remedial actions in flow based than in NTC. This could lead to such a redistribution as this would decrease overall commercial trade (from low price to high price area) and in conjunction with buying in a high price area and selling in a low price area (creating non-intuitive flows) it could be a possible explanation to the lopsided distribution of surplus. It is also valuable to note that water in northern Norway is used several times. That is, when more hydropower is produced in flow based than in NTC, the water doesn't disappear. Thus the next hour you are back at the same reservoir level as with NTC and can sell the same hydropower once more. It is difficult to do the parallel runs in a different way. However, it would be possible to compare the hydropower produced in the two models and thus use this as an indication of how much this inflates the welfare measures. In the end, the proof that flow based is better than NTC would depend on the ability to create more trade (from low to high price areas). This is an empirical issue that should be measurable. Thus it is insufficient to just claim that this seems to be the case in Norway. The negative impacts on intraday market is not accounted for. When this has been pointed out to the system operators they have rather flippantly argued that their project is for the day-ahead. It is however the case that the regulatory setting consists of a whole, where the intraday market and the day-ahead market are clearly connected. Thus losses in the intraday market must be counterbalanced by gains in the day-ahead market. Concerning the last paragraph, the system operators are obliged to auction instruments to safeguard the liquidity in the financial market. This needs to be part of the oveerall analysis.		empirical data. The findings on the consumer and producer surplus are supported by an infinite capacity simulation, as referred to in the report. The application of remedial actions in capacity calculation is based on an operational security assessment, which is applied in both NTC and FB. Remedial actions will indeed impact the capacity and thereby the welfare distribution. As mentioned in the report, the bid curves are based on the NTC capacities (i.e. operational order books). FB outperforms NTC as demonstrated by the increased SEW figures. The sequence of trading on the various timeframes (DA, ID) is based on a maximum amount of capacity provided per timeframe. Increased efficiency on the DA stage, will lead to a potential low left-over capacity for the ID gate opening. For the ID timeframe, dedicated CGMs and capacity calculations will be performed, to provide the maximum amount of capacity available at that moment in time. TSOs will provide a maximum amount of capacity as DA left-over capacity for the ID gate opening, within the operation security limits as explained in the report. An ID welfare computation is not feasible with the current continuous trading schemes.

	If you use the convergence of prices as a measure of success, it is important to make a note at what level the convergence is. Usually, the convergence of prices as measured empirically can be a good indicator whether markets are integrating. However, data presented at the RCC's on the 27th of March 2023 indicates that the price convergence happens at a higher level in flow based than with the current methodology. Thus, we urge the regulators to ask for more in-depth explanations and empirical data on the level of which prices are converging. Prices converging at higheer levels does not help the consumers, and it would often be considered a sign of monopoly rents being created."		The price convergence has been shared and depicted as being the difference between maximum and minimum Nordic bidding zone prices. From the figure 14 it can be observed that the price convergence for FB is better than for NTC over the 3-months period. Impact on welfare distribution is a common feature when making changes in the power system and power market. Redistribution of welfare can happen between different stakeholders and over multiple timeframes.
2	"In box 4, a reasoning is provided that flow-based cannot provide inferior market solutions to NTC, but it can provide better. The reasoning is sound for a single MTU. However, there are major dependencies between MTUs that affect the market solution and SEW via the production planning of market actors based on price forecasts. As the parallel run uses the realized NTC order books, these are not considered in the parallel run. Amid the large share of reservoir hydro power and large and increasing share of wind power, the importance of the forecastability of the market to allocate the reservoir hydro power for creating SEW is accentuated in the Nordics. And risking the forecastability of the prices, particularly beyond day-ahead, is a key risk of flowbased. Due to the errors in the flowbased process during the parallel run (learning by doing on p. 23), the results of the parallel run are not consistent with the theoretical result. It is mentioned in chapter 2 that the NRAs note that the comparison in the parallel run cannot be perfect, but it remains to the NRAs to decide if the uncertainty due to the learning by doing and other factors is acceptable. It has also to be kept in mind that only a 3-month period covering the market situation during that period has been considered. We understand the need to elaborate on the decrease in consumer surplus, but it's quite clear that as the total SEW is maximized, one side may gain and one may lose."	4	The results in the parallel run are based on the realized production plans of a NTC based system and may not be completely comparable. However, flowbased has shown higher SEW to NTC during the 3-month EPR. Both the FB and the current NTC process are subject to unknown situations arising, and thereby developing over time. The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains. Maximizing SEW means that in the optimal domain, bidding zone prices will converge and either producers or consumers will gain and the other will lose.
3	"In the EPR report, it is stated that the purpose of the parallel run is also to give market players the possibility to obtain learnings of the flowbased market coupling before they have to take flowbased into account in their submission of bids. In our opinion this is especially important in the Nordics, as optimal dispatch of the large hydro resources is highly dependent on price and production forecasts of sufficient quality up to five years ahead. If market players in the Nordics are not able to adapt to FBMC in the best possible way this would have a large cost for the society.	6	Indeed, the learning-by-doing is an important phase for all stakeholders involved!

	In the EPR weekly runs there has been several issues and disclaimers stated in the various reports throughout the whole 3-month period – as is also described in the EPR report. The most important one seems to be the issue with management of the series compensators on the SE2-SE3 border, but there are also other issues like the bugs in NO4 for week 11-13. On March 1st the management of series compensators was changed in flowbased to fit the expected operational status, which resulted in better alignment of the maximum allowed flow between NTC and flowbased on the SE2-SE3 border. It seems to us as the change mentioned above gives quite large changes to the outcome and what learnings one can take from this parallel run. The problem is of course that the issue is only fixed for the last full week of the EPR, and it is hard for market players to say what the first 10-11 weeks would look like with this fix implemented. We can only guess but based on the weekly reports it seems to have changed substantially the dynamics between the Swedish price areas and also in the north of Norway. This makes it hard for us to use 3-month period for any learning at all, as we don't know what trends are still valid and what are not. In general, a lot of analysis and conclusions are made in the EPR report based on the full 3-month period without commenting or reflecting on how this SE2-SE3 issue (and other mentioned issues/disclaimers) would possibly change the results. Thus, we find the results from the 3-month period hard to use for learning purposes, and it does not fulfill the intention of giving market players the possibility to learn and prepare for flowbased market coupling as it stands now. We will underline that for the planned next 6 months EPR period the quality of data needs to be substantial improved so that we can use it for analytical purposes."		No comment. Both the FB and the current NTC process are subject to unknown situations arising, and thereby developing over time. The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains Please see the response above. TSOs will continue to work on improving the data quality.
4	"In Box 4 the description for the situations for the numbered points seems incorrect. The graphs show the changed NPs per BZs as well as the changes in congestion income on Nordic bidding zone borders. What is missing is an evaluation of the effect of advanced hybrid coupling on the neighbouring interconnectors for example with regards to flows and congestion income. By definition AHC expands the scope of the Nordic FB project implementation beyond the Nordic CCR borders. Interestingly, this idea has been implemented in the report, but just for one indicator, namely the non-intuitive flows where non-Nordic BZ borders have been covered."	7	The purpose of the box is to illustrate why FB provides higher welfare compared to NTC. Adding AHC to the box will not add any new information in this regard and not change the main message, only complicate the presentation. See also answer to Q4 under ch. 1.
5	"It should be noted that the current NTC model has a larger SEW-gain in 10 % of the hours during the parallel run, despite the fact that the flow-based method in theory outperform the NTC-method in every given situation (or provides same results). It would have been	9, 10, 18	Evaluating several capacity calculation methodologies are not in the scope of the EPR, it is performed according

	interesting and valuable to have an improved NTC-method as comparison, since the result might have been much different in that case. This we believe indicates that also the flow-based method has its limitations. Currently, the welfare gains are small, and very lopsided towards producer rents. Thus, an in-depth investigation into the socioeconomic redistribution from consumers to producers should be conducted. As stated earlier, the importance of increasing congestion rent and producers surplus at the cost of decreasing consumer surplus can also be questioned. As stated in the report, the SEW-gain distribution depends on the current situation represented by bidding curves, and the result can look very different at another point in time. This is also one of the main reasons why a 3-month parallel run is too short for providing any sustainable result. As mentioned earlier the non-intuitive flows are of high concern. For 18 out of 29 Nordic bidding zone borders the non-intuitive flows appears more than 10 % of the time. For 3 more than 50 % of the time. This will have a vital impact on the functioning of the ID-market, allowing traders to utilize arbitrage opportunities. The implication of non-intuitive flows for the functioning of the Nordic power market needs extensive analysis. It is likely that with larger price areas the problem with non-intuitive flows would decrease. The current setup with many price areas in Sweden and Norway might not be fit for purpose if the flow-based methodology is introduced. The topic of price areas configuration should be linked to the flow-based methodology evaluation, in order to address the non-intuitive flow issue. Therefore, the parallel run needs to be extended, and the alternative way forward of improving the NTC-methodology should be introduced to the project."		to the provisions set in the methodology approved by NRAs. Impact on welfare distribution is a common feature when making changes in the power system and power market. Redistribution of welfare can happen between different stakeholders and over multiple timeframes. Arbitrage possibilities between the DA and ID markets may arise because of how the ATCE is implemented, applying a relaxation of the FB parameters. Thus, arbitrage between DA and ID is not a necessary consequence of implementing a FB method in DA. It is rather linked to the fact that the TSOs have chosen to relax the FB domain in order to release non-zero capacities for the ID gate opening, when possible from an operational security point of view. As laid out in Article 20(3) of the CCM, the Nordic TSOs shall, two months before go-live, publish a detailed description of the ATCE methodology. The NRAs and stakeholders shall be informed along the development process, and they may provide comments duly to be taken into account in development work. The bidding zone delineation is not in the scope of the CCM project (part of the bidding zone review that is currently performed).
6	"• Fortum disagrees with the statement of the TSOs: “It is important to emphasize that the reason for performing the social economic impact assessment is not to provide material for a decision between (C)NTC and flowbased. The decision to implement flowbased was prepared already around the time the European target model for electricity was developed by European stakeholders, regulators and Commission and subsequently laid down in the CACM GL as a legal requirement.”	11	

	o Original target of the EU legislation is for example to increase efficiency and transparency. Also the NRAs requested the TSOs to present the welfare comparison between current NTC and FB and explain possible negative changes. o We consider that TSOs have to be able to show that flow based will contribute to achieving the general objectives of CACM, for example increasing transparency and efficiency without endangering the functioning of other market time frames (e.g. intraday) before implementing it. • During the parallel run period consumer surplus in SDAC level is decreasing. This is very strange, one could assume that in SDAC level consumers would gain when a capacity calculation method, that should be at least in theory more efficient, is being introduced. Based on the results published, Fortum considers that it is not possible to draw a conclusion that flow based would be reliable and more efficient compared to the current method. o Increasing congestion income turns the total SEW to positive (Nordics and SDAC). o Only minor total SEW improvements shown during the parallel run period, especially when comparing to the total SEW in the Nordics / SDAC. o Introducing flow based in DA will decrease the possibilities for market based balancing in ID market due to decreases in ID capacities. This in turn will increase the need for balancing done by the TSOs, and most probably increase the need for transmission capacity reservations for capacity before the DA market (this is stated at least by Svk). Negative ID market impacts, cost for reserving more capacity before spot and it's impacts on the DA prices are not taken into account in the analysis. • Percentage of the non-intuitive flows in several borders is very high, indicating large impacts on ID trading possibilities and making it harder to forecast and explain market outcomes."		In the whereas of the "Nordic Capacity Calculation Region capacity calculation methodology in accordance with Article 20(2) of Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management" de dato 14 October 2020, it is explained how the proposed capacity calculation methodology contributes to the objectives of the CACM. As demonstrated in the Figure 3 in the report, the introduction of FB in the Nordics brings about a SEW gain in the SDAC and the Nordic area. Maximizing SEW means that in the optimal domain, bidding zone prices will converge and either producers or consumers will gain and the other will lose. TSOs take note that Fortum considers the welfare gain of 73,4 MEUR for the three-months period in the Nordic region to be minor. The sequence of trading on the various timeframes (DA, ID) is based on a maximum amount of capacity provided per timeframe. Increased efficiency on the DA stage, will lead to a potential low left-over capacity for the ID gate opening. For the ID timeframe, dedicated CGMs and capacity calculations will be performed, to provide the maximum amount of capacity available at that moment in time. TSOs will provide a maximum amount of capacity as DA left-over capacity for the ID gate opening, within the operation security limits as explained in the report. The analysis on the DA left-over capacity for the ID market is captured in the chapter 5 of the 3-months report and results of ATCE calculations can be found at NRCC website.

7	"It is stated that “The computation of social economic welfare draws upon the standard approach from applied microeconomic and cost-benefit analysis”. What is meant by cost-benefit analysis and microeconomics (if not meant to say macroeconomics) in this context? For example, it would be valuable to understand the scope of aspects and timeframes for trading and balancing that supposedly has been taken into account in such a CBA. It is stated that “the concept of consumer and producer surplus, but also congestion income, and impact on the exchange of electricity between BZs are part of the picture.” What is meant by the impact on the exchanges between BZs (as part of SEW)? In the description of supply curve, what is meant by cost for society? Is the assumption of perfect competition relevant? Explanation for Figure 6 is not clear. What is the actual impact on SDAC level throughout the 3-month reporting period? In the report TSOs raise a couple of examples of problematic situations. Are these the only ones throughout 3-month reporting period? It is stated that “The FB is the default methodology, as FB provides a better grid representation compared to NTC, thus more electricity can be exchanged in the power system. More exchanges induce an improved cost-efficient electricity generation and allocation to consumers with a higher willingness to pay.”. Does it mean that today with NTC consumers with a higher willingness to pay are not getting their electricity needs allocated? Box 4 intends to visualize Why FB is expected to provide higher social economic welfare compared to CNTC. But in practice this is only provided that the CNE selection and FB parameters calculation are done correctly. What is meant by “electric distance” (Box 4)? It is stated that “What we do know is that the current NTC is not compliant to the regulation and must be changed in a way to apply the same CGM ”. That is not correct since ELE REG 2019/943 and preceding regulations, also including CACM GL, allows for also (C)NTC CCM models to be applied, as is still done in several multi-country regions in Europe, as long as FB is not proven to be superior in terms of market efficency, overall	12	The welfare economic assessment is based on calculation of congestion income, consumer- and producer surplus for the DA-market. Exchanges between BZs, or trade, is fundamental to the efficiency and SEW generated in a market. Euphemia is doing a welfare economic optimization which is the dual problem to cost minimization Indeed, the main focus is on the Nordic region. Where e.g. the Figure 3 also provides numbers on an SDAC level. The issues mentioned in the report are the ones where the comparison between NTC and FB may be impacted. It means that consumers with higher willingness to pay have better access to cheaper electricity The comparison between NTC and FB may be impacted by a mistake in FB or NTC Electricity travels the path of least electric impedance. See CACM Art 29, paragraph 7 & 8

	welfare, etc. In that context it appears like changing NTC to apply the same CGM could be an option		
	The comparison (of SEW) is not correct as long as the two methods don't use same CGM.		Correct, it is a proxy
	It is stated that “For the 3-month EPR period, the total SEW gain is 71.3 M€ in the total single day-ahead coupling (SDAC) region and 87.2 M€ in the Nordic CCR”. So it means that there is gain in Nordic CCR and loss (87.2 - 71.3 M€) in rest of SDAC. Is this acceptable outcome of Nordic FB?		This implies that both in Nordics and for the overall SDAC region (including the Nordics) there is a welfare gain.
	In Figure 4, it can be seen “a consistent increase in producer surplus and decrease in consumer surplus”. Why is the change increasing (why isn’t it fixed/stable)? Is it because of the improvement in FB parameters calculation?		The welfare economic results depends on both provided capacity and submitted bids
	It is stated that “for 23% of the days, NTC provides more welfare in the Nordics”. Has the root cause been investigated?		The comparison between NTC and FB is not straightforward, as one is an operational process based on operational experience while the other is a fully coordinated methodology. Thus, the root cause is related to a different level of operational security between NTC and FB.
	It is stated that “The reporting area for this report is limited to the Nordic CCR. Therefore, any gain in the rest of SDAC is not by default included in these graphs.” But there is not necessarily gain in the rest of SDAC as a result of Nordic FB. Based on the theoretical explanation, FB (provided that both are using same CGM) should improve SEW for the region the change is applied (Nordic). How can FB improve SEW outside Nordic CCR?		FB influences the trades by the interconnectors
	It is stated that “Some errors are noticed afterwards based on the results of the parallel runs”. Are these explained in the report? Shouldn't those days be re-simulated or excluded from the report?		The comparison between NTC and FB may be impacted by a mistake in FB or NTC; this does not disqualify the FB domain or the FB market results computed with that FB domain.
	One can see “NO5 and SE4 experience the largest losses in total welfare”. This can impact bidding behavior in these areas (short- and mid-term), and more long-term changes in incentives for investments in supply/demand and flexibility.		Indeed, the bidding behaviour may be impacted by the introduction of FB in the Nordics.
	Regarding calculation of CI per BZ (instead of per border), it is more important to know on which borders CI is increasing, and whether it is a result of higher price difference and/or flow on the border.		The congestion income distribution under a FB system follows the methodology approved by ACER, and deviates from the current NTC practices.
	The impact of presence of planned countertrade in NTC is very important. Is the information of planned countertrade and its costs available? Does it mean that all that		

	countertrade cost is dropped under FB while it is a requirement to consider it based on ELE REG 2019/943?		The application of remedial actions in capacity calculation is based on an operational security assessment, which is applied in both NTC and FB.
	What is meant by special line setting in NTC, which are not included in FB simulations?		This relates to the NTC capacities provided to the market clearing algorithm, where the operators consider specific elements, such as series compensators applied in operation in the Swedish grid, but were not similarly applied during the first weeks during the FB EPR.
	It is stated that "it is important not to draw conclusions on the functioning of FB if the reason for different behaviour is related to reasons within the first category". But how can the stakeholders be sure about the functioning of FB if the comparison is irrelevant?		For the stakeholders, we assume it is important to (in itself) understand the relation between CNECs and prices/market results.
	It is stated that "SE3 is an area with relatively steep supply order curves, while areas in the south of Norway have a lot of flexible hydro production resulting in flatter bid curves on the supply side. " The slope of the curves are not always same, and Nord Pool can see that around market clearing pricethe slope of aggregated bidding zone supply/demand curves in different countries/BZs varies a lot.		TSOs take note of this comment.
	In our view the impact of change in utilization of cross border capacities given by the FB model applied in the Nordic EPR can also explain consumer loss in e.g. SE3 (with SE3 today being a deficit area, therefore with consumer loss typically being higher than producer surplus when the BZ price goes up). Therefore, it is key to also analyze if and then why there possibly is less import capacity utilization towards SE3 in the Nordic FB EPR versus in NTC production and if that in truth is welfare optimizing.		Please refer to the explanation in the sections "Why the consumer surplus may decrease despite more efficient use of the grid" and "Better management of the NO1-SE3-DK1 flow through Sweden" in Chapter 4 in the 3-months evaluation report.
	It is stated that "the increase in CS in the south of Norway is not enough to cover the consumer loss in SE3.". But an increase in CS of south of Norway will not be transferred to SE3 (to compensate its loss of CS), and besides what is the basis for increase in CS in South of Norway (presumably NO1+NO2+NO5) that makes it welfare and grid technical optimizing for the Nordics as a whole?		The market algorithm optimizes the economic welfare for the total power system. FB allows for more welfare-efficient trades.
	Is "a sum allocation between NO1-SE3-DK1" the current lineset implementation on SE3 borders towards DK1 and NO1?		Yes
	It is stated that "The picture is the same when comparing the SE3 to the system price calculation". Comparison with system price cannot be relevant, since in Nordic System Price calculation non-Nordic BZs are excluded, meaning that their impact on formation of		This calculation refers to the outcome of introducing infinite capacity in the Nordics and how this affects CS and PS in the same way as increased capacity in FB

	price is missing (apart from the fact that consideration taken to the SDAC flow in/out Nordics in the Nordic SP calculation). It is stated that “the management of the series compensators was changed in FB to fit the expected operational status.”. Does it mean the results before March 1 are not comparable with NTC (since NTC domain was bigger than FB)? Is the change in line with adding planned countertrade in calculation of FB parameters? Can ""decrease in the SEW gain from FB"" change (reverse?) if one reduces cost of planned countertrade from NTC's SEW? It is stated that “The duration curve shows that the difference between the highest- and lowest-priced bidding zone in general is smaller with FB than with NTC for almost all hours”. It is not visible from the curve (Fig. 14). It is stated that “FB is better than NTC at achieving a price convergence across the Nordic system over time, indicating”. At the same time it is noted that CI increases. This doesn't seem to be intuitive. Moreover, this indicator (difference between the highest- and lowest-priced bidding zone) is too aggregate and cannot necessarily be representative of a better utilization of grid, and in addition the Nordic FB EPR period part of this report shows significant price differences between some adjacent BZs that was not the case in NTC production in the given period and rarely has been the case in the past (e.g. for SE1 vs. SE2), and that further puts in question the validity of the statement on price convergence. Is the ""change in management of the series capacitors"" now permanent (giving more capacity on SE2-SE3)? General comment on Fig. 15: These time series graphs are difficult to read; not showing the message given in the text. It is stated that “Most of the change in NP comes from changes in supply, but in SE2 - where the price is increased - 1/3 of the change comes from changes in demand.”. It is worth to simulate a future scenario based on expected change in bidding as a result of FB.		The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains. Sorry, the comment/question is not clear to the TSOs. No comment. CI depends on both price differences and flows. Until further notice, this is what will be applied. Indeed, it is challenging to have a lot of information gathered in one overview. We have provided all the data to the stakeholders as well, allowing them to create the relevant overviews and graphs when needed. Indeed, the bidding behavior may be impacted by the introduction of FB in the Nordics. TSOs will not take any position on this matter, nor is it possible for the TSOs to simulate this.

	It is stated that “FB, unlike NTC, can capture this in its optimization and increase the SE2-SE3 border flow giving hours where FB has a higher border flows.” What is meant to be captured in optimization by FB, but not by NTC? High wind production?		In a FB system you allow for a fair competition for scarce capacity, taking into account all the loading and relieving effects from the cross-border trades that would like to make use of that scarce capacity.
	It is stated that “With a more correct modelling of the SE2-SE3 border, it would be expected that the trend present before the 1st of January - where FB had a higher flow - will be observed.” Please elaborate on this. Which element in modeling needs to be corrected? When can it be done?		Please refer to the section “Modelling between SE2 and SE3” in the 3-months evaluation report for more details.
	It's important to clarify in the whole report that all flows are physical not commercial (scheduled exchange calculated by clearing algorithm and published by NEMOs). Can the figure in page 47 be also presented based on scheduled exchanges?		The TSOs refer to physical flows in this report, and will clarify this in the update of the report. The scheduled exchanges are not physical flows and should not be mixed or compared.
	It is stated that “the flow over the SE2-SE3 border is higher in NTC than in FB often in hours with low southern wind production and high load”. Can it be verified by looking at load/wind data? Also is it by the TSOs suggested that such added Southbound flow to SE3 when there is a relatively speaking increased “supply shortage” in SE3 would be wrong in terms of welfare and power system balancing when it on the record has been shown to work and deliver lower prices in the deficit BZ of SE3 (and as a consequence often also in SE4)?		The question is not completely clear, and it might involve the use of bid curves to answer – the TSOs do not have access to the bid curves. We invite you to – with all the data that has been shared – to investigate this.
	Is there a plan to publish the list of limiting CNECs (and their corresponding shadow prices) to help the market understand where in the grid the congestion is happening?		All CNECs, unless Swedish, are listed in the result files
	There is a difference between non-intuitive flows where the final destination (when zooming out) has indeed a higher price than price of the source. It is important to do the reporting by also looking at the Nordic (+) grid as a whole, rather than only counting occurrence of non-intuitive flows between adjacent pairs of BZs.		Please do share some more details, as the question is not quite clear to the TSOs.
	Please provide the link in the footnote of page 45 (information about non-intuitive flows).		https://nordic-rcc.net/wp-content/uploads/2023/04/Phenomena-report-revised-11-April.pdf
	When it comes to non-intuitive flows, one need to keep in mind that settlement and clearing between NEMOs is done based on scheduled exchanges (so called commercial flow). Can Figure 22 be reproduced based on SEC? Is there a big change in the whole picture? Also, it is important to include “depth” of non-intuitive flows (price difference		Please do share some more details, as the question(s) is(/are) not quite clear to the TSOs.

	and volume) to (a) evaluate negative congestion income, and also to consider the impact it will have on (b) market bidding behaviour and physical portfolio optimization in both SDAC and subsequent SIDC, and (c) the allocation of initial ATC capacity for SIDC Continuous and IDA trading, and (d) the ability to in the SIDC market adjust for big fundamental differences in fundamentals between the SDAC GCT and until SIDC GCT (max 1 hour before delivery). How many CNEs are normally binding in EPR simulations? Where are they located? Do TSOs use this information to revise CNE selection? Isn't there any potential for improvement in selection of CNEs?"		Can be viewed at: https://test-publicationtool.jao.eu/nordic/marketGraph
8	"The result of the socioeconomic welfare is fundamental to ensure that we implement flowbased in a version and manner that secure a better functioning of the electricity market. Currently, the welfare gains are small, and very lopsided towards producer rents. Thus, an in-depth investigation into the socioeconomic redistribution from consumers to producers should be conducted. Figure 3 shows negative consumer surpluses both within the Nordics and on the outside. The analysis needs to move from the theoretical reasoning about slopes of demand curves to a real case study exploring how this consistent redistribution from Swedish and Danish consumers to producers can be explained. We need to be ensured with examples from the model to be implemented that these results are a result of the circumstances these 10 weeks, rather than a feature of the model, or the parameter calculations. Another important point to clarify, is whether this redistribution is a consequence of the TSOs taking far less remedial actions in flowbased than in NTC. This could lead to such a redistribution as this would decrease overall commercial trade (from low-price to high-price area) and in conjunction with buying in a high-price area and selling in a low-price area (creating non-intuitive flows), it could be a possible explanation to the lopsided distribution of surplus. It is also valuable to note that water in northern Norway is used several times. That is, when more hydropower is produced in flowbased than in NTC, the water doesn't disappear. Thus, the next hour you are back at the same reservoir level as with NTC and can sell the same hydropower once more. It is difficult to do the parallel runs in a different way. However, it would be possible to compare the hydropower produced in the two models and thus use this as an indication of how much this inflates the welfare measures.	13, 17	TSOs don't have access to the bid curves per bidding zone, but can use them in the market simulations. However, all the results in the EPR are driven by empirical data. The findings on the consumer and producer surplus are supported by an infinite capacity simulation, as referred to in the report. The application of remedial actions in capacity calculation is based on an operational security assessment, which is applied in both NTC and FB. Remedial actions will indeed impact the capacity and thereby the welfare distribution. As mentioned in the report, the bid curves are based on the NTC capacities (i.e. operational order books).

	In the end, the proof that flowbased is better than NTC would depend on the ability to create more trade (from low to high price areas). This is an empirical issue that should be measurable. Thus, it is insufficient to just claim that this seems to be the case in Norway. If you use the convergence of prices as a measure, it is important to make a note at what level the convergence is. Usually, the convergence of prices as measured empirically can be a good indicator whether markets are integrating. However, data presented at the RCC's on the 27th of March 2023, indicates that the price convergence happens at a higher level in flow based than with the current methodology. Thus, we urge the regulators to ask for more in-depth explanations and empirical data on the level of which prices are converging. When it comes to SEW, the description is just partial. Firstly, the consequences of income redistribution are not analysed. Secondly, the potentially negative impacts on both the intraday and the financial markets must be taken into account. This especially as intraday will be increasingly important to accommodate intermittent generation and incentivise flexibility. The negative SEW from decreasing possibilities for intraday trade must be put in relation to the after all relatively small gains of SEW in the day-ahead market as shown in the report."		FB outperforms NTC as demonstrated by the increased SEW figures. The price convergence has been shared and depicted as being the difference between maximum and minimum Nordic bidding zone prices. From the figure 14 it can be observed that the price convergence for FB is better than for NTC over the 3-months period. Impact on welfare distribution is a common feature when making changes in the power system and power market. Redistribution of welfare can happen between different stakeholders and over multiple timeframes.
9	"Original target of the EU legislation is, for example, to increase efficiency and transparency. Also, the NRAs requested the TSOs to present the welfare comparison between current NTC and FB and explain possible negative changes. We consider that TSOs have to be able to show that flow-based will contribute to achieving the general objectives of CACM, for example increasing transparency and efficiency without endangering the functioning of other market time frames (e.g. intraday and balancing) before implementing it. The result of the socioeconomic welfare is fundamental to ensure that we implement flow-based in a version and manner that secure a better functioning of the electricity market. Currently, during the parallel run period the welfare gains are small, mostly due to increase in the congestion income, and consumer surplus in SDAC level is decreasing. It could be assumed that when the capacity calculation method is, at least in theory, more efficient the consumer surplus should increase. As this is not the case based on the published results, we consider that it is not possible to draw a conclusion that flow based would be reliable and more efficient compared to the current method. It is also valuable to note that water in hydropower plants is used several times. That is, when more hydropower is produced in flow-based than in NTC, the water doesn't disappear. Thus, the next hour you are back at the same reservoir level as with NTC and	15	In the whereas of the "Nordic Capacity Calculation Region capacity calculation methodology in accordance with Article 20(2) of Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management" de dato 14 October 2020, it is explained how the proposed capacity calculation methodology contributes to the objectives of the CACM. FB outperforms NTC as demonstrated by the increased SEW figures in the section "DA social economic welfare comparison" in chapter 4. As mentioned in the report, the bid curves are based on the NTC capacities (i.e. operational order books).

	can sell the same hydropower once more. It is difficult to do the parallel runs in a different way. However, it would be possible to compare the hydropower produced in the two models and thus use this as an indication of how much this inflates the welfare measures. When it comes to SEW, the description is just partial. Firstly, the consequences of income redistribution are not analysed. Secondly, the potentially negative impacts on both the intraday and the financial markets must be taken into account. Introducing flow based in DA will decrease the possibilities for market-based balancing in ID market due to decreases in ID capacities. This in turn will increase the need for balancing done by the TSOs, and most probably increase the need for transmission capacity reservations for capacity before the DA market (this is stated at least by Svk). Negative ID market impacts, cost for reserving more capacity before spot and it's impacts on the DA prices are not taken into account in the analysis. Transitional ATC solution for intraday was not included in the parallel run from the beginning and in the evaluation report the ID analysis is missing, although intraday impact evaluation is one of the NRA KPIs and listed in CCM under the requirements for parallel run. There is a large amount of non-intuitive flows on certain borders, which indicates negative impacts on the ID capacities and trading possibilities."		The sequence of trading on the various timeframes (DA, ID) is based on a maximum amount of capacity provided per timeframe. Increased efficiency on the DA stage, will lead to a potential low left-over capacity for the ID gate opening. For the ID timeframe, dedicated CGMs and capacity calculations will be performed, to provide the maximum amount of capacity available at that moment in time. TSOs will provide a maximum amount of capacity as DA left-over capacity for the ID gate opening, within the operation security limits as explained in the report. The analysis on the DA left-over capacity for the ID market is captured in the chapter 5 of the 3-months report.
10	"We stand behind the comments given by SwedEnergy. In addition, one of the defined objectives of CAGM GL is "respecting the need for a fair and orderly market and fair and orderly price formation". Based on what is written in the report, the proposed implementation will work against this objective and create major imbalances in the distribution of welfare across the different segments. Price increases of more than 10% cannot be justified by classifying South of Sweden as "medium-price areas", based on average spot prices of around 120€/MWh. It is both desirable and expected of the TSOs to mitigate the negative impact by using e.g. countertrade, both in the evaluation of flow-based and in real operations."	17	The welfare distribution with FB will be closer to what can be established when an infinite capacity would be available in the Nordic area. Impact on welfare distribution is a common feature when making changes in the power system and power market. Redistribution of welfare can happen between different stakeholders and over multiple timeframes.
11	"Given the shortcomings of the simulation results as described above, we argue that no reliable welfare computation is possible. Not even a full 3 month period would have constituted a sufficient basis for this assessment as the electricity system change with seasons and weather.	19	The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains.

	Increased congestion income can be achieved by increased capacity at lower price spread, but also with reduced capacity causing higher price spread. We see a risk that the model could achieve increased SEW from tightening bottlenecks rather than improving them. Regarding the objective of the EPR we note that it is described differently throughout the report. In the section "DA social economic welfare comparison" we note: "Learning by doing: One of the objectives in the 3-month period is to gain experience with the flowbased and exploring ways to improve IGMs (and thereby CGMs). Some errors are noticed afterwards based on the results of the parallel runs. When errors are spotted in the process they are corrected." Furthermore, from the Executive Summary: "To get confidence in the calculation, first an internal parallel run was undertaken from May 2021 until March 2022. Thereafter an external parallel run was launched where the aim has also been to give the market participants the opportunity to learn how the flowbased method works and to allow a comparison of its market results with those of the current net transfer capacity method." Thus, in the Executive Summary, implementation of FBMC in the Nordics is presented as a ready process, whereas it in the EPR is described as a learning process. For the keen reader, this can be interpreted as a convenient twist of the EPR objective, used effectively to suit as an explanation for the data errors and as a shield against further questioning. "One example of an important take-away from the learning process during the past three months of EPR is how the series compensators on the SE2-SE3 border should be handled." This is the perfect example of lack of operational readiness, the internal parallel runs was active from May 2021 until March 2022, and then the external process started in March 2022. We do not find it acceptable that the external parallel runs where started before this was addressed. Additionally, the report does not address the stakeholders need to forecast the DA prices to support an efficient production planning. This topic is more or less completely left out from the report, and it is one of the recurring topics that worry the stakeholders. It is true that the transparency about the spot flows will increase for DA at the point in time when the domain is published. However, since the LT CC will start to be published one year after go-live and the value of the information from that process is uncertain, market participants will need to base the their optimization of flexible assets on UMMs for NTC. Thus, the market participants will themselves need to forecast the FB-domain based on the NTC UMMs and the dataset of historical FB-domains for days after DA. How to convert		TSOs do not see this risk; TSOs apply the capacity calculation methodology approved by the Nordic NRAs in order to maximize the capacity for the cross-border trade (with a minimum of 70%, see EL REG. 943) The EPR does indeed serve multiple purposes. As with any capacity calculation methodology, the application of the FB methodology will continue to evolve and be improved upon continuously, also after go-live. As such, the fact that improvements are made and errors corrected does not contradict that market participants can use the EPR to have the opportunity to learn how the flowbased method works and to allow a comparison of its market results with those of the current NTC method. Please refer to the last paragraph of the executive summary, where we state "The flowbased capacity calculation is still in its project phase, and it is a huge learning process. We Nordic TSOs are working to improve the underlying grid models based on the analyses of the calculations and market simulations." The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains. TSOs understand that the transition to a new CC method implies that market participants will have to adapt or replace their current forecasting tools. However, in a longer-run perspective, it is not clear that it would be fundamentally more difficult to predict DA prices in the longer term with the FB methodology.

	data about the network into an FB-domain is regarded as well known, however, the practical implementation in this case is not transparent. Our concern is that the forecasting uncertainty will increase (compared to today) when we need to forecast the FB-domain for days after DA. In most cases, more uncertainty will lead to less optimal utilization of flexible assets. The loss of SEW due to increased uncertainty is not considered in the calculation and it is unclear if this loss is in the magnitude of the theoretical win according to the current calculation of the SEW. We encourage TSOs to share as much information as possible related to their FB-domain calculations in order for market participants to be able to catch as large share as possible of the theoretical SEW. This could for example different kind of forecast used, as wind or demand, or modeling of capacitors. Furthermore, we find strict formal arguments and statements such as “It is important to emphasize that the reason for performing the social economic impact assessment is not to provide material for a decision between (C)NTC and flowbased.” as strange in the context of design changes that will transfer very significant values between producers and consumers. We refer back to our more general comments under question 4. A proper analysis and evaluation of the socioeconomic consequences on the entire physical electricity market and system (including ID + and regulation power market) has never been carried out. It is, a big responsibility for this decision to carry."		The Nordic TSOs conducted several in depth analysis of different choice for, a new CC methodology. This has been reported and shared with stakeholders along the way. In the same way, FB as the European target has been discussed and consulted upon before being captured in the CACM regulation.

What is your view on chapter 5?

Stakeholder response:

Stakeholder response		Stake-holder (s)	TSO comment
1	"The treatment of the intraday market has generally been a weakness of this implementation. The current version opens up for all kind of trading messes that it is hard to take it seriously. It is also very bad that the regulators did not even at the stakeholdeer meeting the 3rd of may have an inkling of how they would evaluate this.	1	

	There is some consensus that alongside a development of wind and solar an intraday market will have an increasingly important role to play. This is hardly reflected in either the system operators treatment of this, nor the regulators' treatment of how to evaluate this market's possibilities in flow based"		The sequence of trading on the various timeframes (DA, ID) is based on a maximum amount of capacity provided per timeframe. Increased efficiency on the DA stage, will lead to a potential low left-over capacity for the ID gate opening. For the ID timeframe, dedicated CGMs and capacity calculations will be performed, to provide the maximum amount of capacity available at that moment in time. TSOs will provide a maximum amount of capacity as DA left-over capacity for the ID gate opening, within the operation security limits as explained in the report. An ID welfare computation is not feasible with the current continuous trading schemes.
2	"We are missing a clarification on ID-capacity from low to high price areas in situations with non-intuitive flows. Further, we also miss an account of how the balancing markets will be affected. Our understanding is, based on the report describing the methodology, that the ATCE methodology has an object function that maximizes total Nordic capacity (regardless of price) for IDM. The ATCE methodology therefore does not optimize for SEW."	6	A (high) DA price difference illustrates that the border is congested, thus more capacity cannot be allocated in this direction. In general; all welfare gains from trade have been exploited in the FB outcome, thus no such thing as idle economically advantageous borders (with a higher price spread) exist. Yet, the flow (from ID trade) can still reverse. Moreover, a high DA price difference might not be the right criteria for capacity allocation. The purpose of the ID market is to handle imbalances, thus the location of economically advantageous borders might not coincide with the location of imbalances.
3	"This section explains that ID ATC values will always be larger than or equal to zero, and that relaxations are applied in order to maximise the capacity. It remains unclear though whether these relaxations refer to the so-called z2zPTDF threshold only or whether other mechanism will be used by TSO for that purpose. The methodology used for determining the ID capacity is in our view inconsistent with the model applied in day-ahead where capacity is used in an optimal way to maximise social welfare. The intraday method treats all borders equally and does not differentiate based on the value of capacity for the market. Taking into account the price differences on bidding zones borders from the day-ahead market and providing more capacity on economically advantageous borders (with a higher price spread) could be a way to distribute the remaining XB-capacity in a better way.	7	The z2zPTDF threshold and the compensation on the DA RAM are the relaxations being applied, described in the published ATCE methodology https://nordic-rcc.net/wp-content/uploads/2022/05/ATC_Extraction_Description_20220413.pdf A (high) DA price difference illustrates that the border is congested, thus more capacity cannot be allocated in this direction. In general; all welfare gains from trade have been exploited in the FB outcome, thus no such thing as idle economically advantageous borders (with a higher price spread) exist. Yet, the flow (from ID trade) can still reverse. Moreover, a high DA price difference might not be the right criteria for capacity allocation. The

	In line with our comment in chapter 1 the impact of AHC on neighbouring bidding zone borders is also not explained in this chapter. These bidding zone borders do not belong to Nordic CCR, but by implementing AHC the scope of capacity calculation by definition becomes larger than the CCR only. How are Hansa borders affected when non-intuitive flows are induced by flow-based in day-ahead? We assume the resulting intraday capacity would then be day-ahead NTC + scheduled exchanges of the non-intuitive flow."		purpose of the ID market is to handle imbalances, thus the location of economically advantageous borders might not coincide with the location of imbalances. The methodology for determining ID capacity cannot be changed, only by amending the CCM including a NRA approval process. AHC is not implemented as such in the ID ATC market. However, by considering the virtual bidding zones and their related FB parameters, we do include the impact of the HVDC links to the AC grid in the final set of ATCE values.
4	"Overall comment: My impression after analysis the data from the // runs is that a lot of the differences between current and new ATC come from the ATCE methodology, not from using FB on DA. ATC are NTC - AAC. My point here is that the differences in NTC are as important as the differences in AAC. From the results from the // runs, the differences in NTC have at least as much impact as the differences in AAC (for examples for borders where ID ATC decrease in both directions). I think it is important to emphasize this point. First comment: on ATC vs NTC. A general remark is that ID NTC and ID ATC are sometimes mixed up. My understanding is that the algorithm determines NTC capacities (and, indirectly ATC), not ATC capacities, with the constraints that NTC-AAC should be positive (i.e. ATC should be positive). In Figure 25, shoudn't it for example be NTC instead of ATC? I think it would be good to make the point that the ATC extraction is really a CNTC methodology (with the added constraints that NTC-AAC>=0). Related to this, the following sentence is a bit misleading: ""In general, the ATCE methodology does two things: it determines the left-over capacity after the DA stage, and it translates the flowbased capacity domain into an ATC domain"" Aren't these two things the same thing? Once you have translated the FB domain to an ATC (or NTC) domain, then you have determined left-over capacities. ATC are left-over capacities.	8	Feedback to overall comment: The comment is reflected in details in the published ATCE methodology in chapter 3.1 and 3.3. Link: https://nordic-rcc.net/wp-content/uploads/2022/05/ATC_Extraction_Description_20220413.pdf Feedback to comment 1: More elaboration on Figure 25: it is a generalized graph to visualize the FB method and the ATC extraction method together. It illustrates that the extracted outcome should not go beyond the FB domain that bounds it. The FB domain in this case is not necessarily a DA FB domain, but any FB domain regarded as the boundary of the extraction. Consequently, it is not necessarily a (DA)NTC domain being extracted. Additional feedback to comment 1: the methodological content of the so-called CNTC methodology is not officially defined. For the ID gateopening in the Nordic CCR, the ATCE methodology is considered a more descriptive name, covering the essential elements of the methodology, i.e. in the ATC format and extracted (from the FB domain). Regarding the comment on the misleading sentence, indeed, the comment is correct, especially for experts

	Second comment: on relaxation. Figure 26: I don't understand why we need a relaxation in this case, since the working point is already inside the FB domain. Also, what is the consequence of the delta values (p 14 of the ACTE document) on the security? It would be good to publish delta values to get an understanding of how much relaxation is needed to ensure the feasibility of the DA AAC. Third point: on the involvment of operators It is stated in the consultation document that ""Like in any coordinated capacity calculation process, a TSO domain validation is applied where capacities may have to be reduced"". There is no adjustment value in the data from external parallel runs so far, thus making it difficult to evaluate how operators would react to the automatically computed ID ATC. Fourth point: on the chosen metric of BZ trading space It is stated that ""The TSOs recommend to compare the bidding-zone level comparison instead of the border-level comparison."" Why is that? Today, it is very much so that ID trades are more important on some borders rather than others. I think the border-level comparison is much more relevant. A simple example is the Swedish internal borders. These are important for ID trades today. So, for example, if the ID ATC for SE2->SE3 is reduced but the trading space around SE2 is increased, it doesn't mean that it will be beneficial for ID trading, quite the opposite. Also, and more importantly, this statement goes directly against the NRAs whose statement farther up in the consultation document reads: ""The worrying point for NRAs would be if there were less intraday capacity in both directions on a bidding zone border, when FB is used in the day-ahead market"" Fifth point: missing a discussion on how changes in ATC correlate with the actual ID trading patterns An analysis of today's intraday trading flows would be very valuable to shed some lights on the consequences of the changes in ID ATC. In the end, increase ID ATC in one border/direction is not relevant if there is no ID trading need in that border/direction. While the trading needs change hour by hour, there are some trends and some bidding zone borders are much more important than others.		that possess good mathematical knowledge. For general public, we believe that it is more intuitive to emphasize the two features separately, but within one sentence. Feedback to comment 2**:** For illustration purposes, Figure 26 depicts a more generalized situation that the day-ahead market clearing point is within the FB domain, especially not end up at the corner of the FB domain. The purpose of Figure 26 is to show the readers how to 'imagine/visualize' the relaxation in a graphical way, not to emphasize the necessity of the relaxation. In reality, it is likely that the FB MCP touches the edge of the FB domain or ends up at the corner where the relaxation becomes essential for the TSOs to provide some ID capacities. Regarding the security consequence of the delta, the consequence of the delta is part of the overall ID validation. It is not separately assessed as it is used to ensure the mathematical feasibility of the ATCE optimization. These deltas on the CNECs does not have physical meaning or practical use for the stakeholders (on the border level). Feedback to comment 3: the TSOs are working on the ID validation methodology and the associated business processes. Before the ID validation is in place, the published ATC ID final should be regarded as final. Feedback to comment 4: please refer to the explanation in 'Bidding zone trading space' section. Indeed, it is not trivial to compare the ID capacity between the ATCE outcome and the ID initial capacity offered by the current NTC method. Additionally, the TSOs do not explicitly prioritize the ID borders, as there is no fair way of doing so. Feedback to comment 5: this comment or request belongs to a wider discussion of the EPR setup and purpose. In the DA SEW comparison, it is acknowledged

	Sixth point: on ID ATC being within the FB domain It is stated that: ""From the operational security perspective, the ATC ID capacities from the ATCE method respect the security domain to the extent possible5 , as seen in the BZ SE2 trading space (Figure 28). On the contrary, the SE2 ID ATC, e.g. SE2-SE1 direction, from the current NTC method does not necessarily fulfil the N-1 security criteria for all MTUs today. Re-evaluation of this capacity in this direction has not been prioritized since this level of south-to-north flows never occurs."" It would interesting to look at how often it happens that the current ID ATC are outside of the FB domain. No need to recompute the NTC for that. Seventh point: missing discussion on FRM One of the possibilities of not having zero capacity on ID due to full usage of the capacity in DA is that reliability margins should decrease in ID. In the Core methodology, it is proposed that the ID FRM are half of that for DA. I am missing a discussion on this point in the document. Eight point: missing discussion on the analysis by the TSOs of the changes in ID ATCs What do the TSOs think of the differences between current and new ID ATCs? For example, ID ATC decrease on almost all Swedish borders (in both directions most of the time). More detailed analysis and observations of the ID results are needed."		that the TSOs use the NTC orderbook to simulate the 'trading patterns' of the FB bids. The ATCE is the leftover of the DA FB CC MC outcome. It is not practical to draw any conclusion of the ID trading patterns based on the EPR DA FB MC outcome which comes from the assumption that the FB DA trading patterns is the same as the current NTC. Also, please acknowledge that the TSOs do not have the intention to prioritize ID borders or directions, even they may appear to be more favorable in the DA timeframe. Feedback to comment 6: The TSOs did not add this topic to their priority list, but with the numbers published, the stakeholders are able to evaluate this when needed, Feedback to comment 7: The DA left-over capacity, being the ID gate-opening capacity, is still based on the D-2 CGM. The FRM considered at the DA stage is linked a.o. to the uncertainties captured in the D-2 CGM. This does not change for the ID gate-opening capacity. Only when new D-1 and ID CGMs are available, lower FRM values are expected. Feedback to comment 8: the NRAs are responsible for the overall EPR evaluation based on the TSO reporting and inputs. To the observation of the SE borders having less ID capacity, please refer to the ''Qualitative assessment' of chapter 5 and the mathematical implication of the ATCE objective function in relation to the large installed capacity and DA AAF (e.g. the SE grids). To be more specific, without applying explicit weighting factors that the TSOs do not intend to do, the current ATCE optimization formulation, being the maximization of the total Nordic capacities, is implicitly in favour of smaller borders.
5	The impact of the flow-based methodology on the functioning of the ID-market is barely mentioned in the report, and even less addressed as a concern. This aspect have to be included in the evaluation. And it is not an acceptable explanation that it is difficult to find	9, 10, 18	The sequence of trading on the various timeframes (DA, ID) is based on a maximum amount of capacity provided per timeframe. Increased efficiency on the DA stage, will lead to a potential low left-over capacity for the ID gate

	a method for how to evaluate and include the ID-market impact into the SEW-gain evaluation.		opening. For the ID timeframe, dedicated CGMs and capacity calculations will be performed, to provide the maximum amount of capacity available at that moment in time. TSOs will provide a maximum amount of capacity as DA left-over capacity for the ID gate opening, within the operation security limits as explained in the report. An ID welfare computation is not feasible with the current continuous trading schemes.
6	"• Requirement for parallel run according to approved CCM: ""Information on how the capacities available for trade in the intraday-market are affected by the implementation of this methodology for the day-ahead timeframe. o Quantitative data on the expected opening capacities for ID should be provided on MTU level. The calculations shall be performed using either a prototype tool or the industrialised tool. o A qualitative assessment and explanation should be provided"" • Above requirement is not fulfilled, as ID ATC solution for intraday was not included in the parallel run from the beginning and ID impact analysis is missing from the parallel run report. As we see, TSOs should have calculated and published intraday capacities using the new method for each day during the parallel run period starting from day one. Additionally, stakeholders have requested a proper comparison of the intraday capacities calculated using the new method versus the old. This is completely missing from the report. Functioning intraday market is getting more and more important due to the increasing volumes of wind and solar power generation, but based on the data published so far, we cannot properly evaluate the implications of DA flow based to intraday. o Large amount of non-intuitive flows on several borders, indicating big impacts on the ID market. o In the stakeholder meeting in Oslo May 3rd, it became obvious that there is still a lot of uncertainty on how the ID capacities will actually be calculated. This applies especially to the situations where there is a non-intuitive flow in the DA market. TSOs indicated that the ID CCM needs to be re-evaluated. Without knowing the details of the ID	11	The results are available on the NRCC website: https://nordic-rcc.net/flow-based/simulation-results/ Please refer to the Chapter 5 for a summary of the results in the 3-months evaluation period. ID calculation needs as input already allocated capacities (AAC) from DA timeframe. For EPR DA market coupling results will be calculated after grace period (which is 2 weeks). This grace period introduces around 3 weeks delay for publication of ID ATCE values for ID gate-opening. Calculated ID gate-opening capacities are available at Nordic RCC website for whole EPR period (for each day and MTU). SHs can find cross-zonal capacities for all bidding zone borders. In addition, SHs can find duration curves for capabilities of each bidding zone with ATCE method and comparison to current ID method. Flows originating from the DA stage (either intuitive or non-intuitive), and that are not available for ID, have an impact on the ID. For clarity: at this stage ID CCM will not be re-evaluated, but parameters applied for transitional method (ATCE) are currently being evaluated. This evaluation may lead

	CCM, it is hard to evaluate the ID market impacts. Additionally, if TSOs are planning to fix the flow direction (i.e. set the capacity to opposite direction to zero) if there is a non-intuitive flow in the DA market, this will make the ID impacts even worse and is likely to lead to lock-in situations in several bidding zones. o More focus on ID impacts is needed, as intraday market is getting more and more important. So far the requirements for the parallel run have not been fulfilled, as TSOs have published ID capacities only afterwards, method seems to be still unclear and ID impact analysis is missing from the report."		to changes in parameters. These changes are possible until two months before application of transitional solution, when TSOs shall publish exact values and parameters for transitional solution. It should be noted that this transitional solution will be replaced by FB approach as soon as FB is implemented in ID timeframe.
7	"We find it unfortunate that the welfare loss/gain for ID is not considered by TSOs. ATCE should have a higher focus in this report from TSOs as this segment is increasingly important, this is one of the topics really highlighted as problematic. There are learnings from CORE FB go-live in this direction. Nord Pool is looking forward to more information on ATCE from TSOs as promised in stakeholder group meetings. The question is whether the quality of results (calculated ATCs for ID) is acceptable. Is it certain that the chosen formulation in ATCE methodology (where all individual Nordic bidding zones are multiplied and then the model attempts to find capacities maximizing this value) outperforms a sum (weighted) averaged ATCs or minimum ATCs across all borders (or a combination similar to what is done in CORE region)? There is an implicit failure in the methodology where product of capacities is maximized that it can favor the smaller borders. Knowing that not all borders are as important in ID trading, there is a risk that this approach can have large consequences on ID trading. It is stated that “relaxations are applied in the ATCE process in order to provide as much ID capacity to the market participants as possible”. Is there a reason to believe that relaxations applied in the ATCE process (z2zPTDF threshold parameter) indeed increase ID capacity? It is stated that “TSO domain validation is applied where capacities may have to be reduced – in case potential overloads resulting from the ID ATCE cannot be coped with.”. The question is based on which information the reduction may be justified. Why do TSOs recommend to compare ID capacities at BZ level rather than border level?	12	No comment Please refer to the detailed ATCE methodology description (updated April 2022): https://nordic-rcc.net/wp-content/uploads/2022/05/ATC_Extraction_Description_20220413.pdf The objective function has been selected based on elaborate numerical exercises and aspects like neutrality, convergence properties, and robustness. Yes This may include forced outages, updated forecasts. Several paths exists between BZs, thus BZ net positions is better to reveal the full trading space for each BZ.

	Knowing that “the data collected from the ENTSO-E Transparency platform contains the HVDC ramping constraints and the capacity reduction from the neighboring non-Nordic TSOs, whereas the ATCE outcome of the ID capacities does not include such constraints”, can one conclude that by including those constraints the ID capacity will be even lower than the ones reported here? Page 51, on the topic of starting capacities we take note of following sentence: As a result of this, the resulting ID ATC values for the ID gate opening trades are always larger than or equal to zero, and capacity may be released on CNECs that was not available at the DA stage. TSOs should bring this message back as the outcome of ATCE will be starting capacity for both IDAs and continuous implicit intraday trading in the Nordics. Also it is not clear what CNEs were not available at the time of SDAC capacity allocation but would become available for the SIDC capacity allocation process, can it be explained and based on some example?"		Like in the current NTC system, the ID market needs to respect allocation constraints like ramping. Additional ID capacity may arise because of how the ATCE is implemented, applying a relaxation of the FB parameters. The TSOs have chosen to relax the FB domain in order to release non-zero capacities for the ID gate opening, when possible from an operational security point of view.
8	"The data given is worrisome as it can be shown that the ID-capacities proposed to be given to the market would lead to large trades in directions opposite to the day-ahead flows. It is not clear to us how this will be managed. We trust the NRAs to thoroughly assess the effect to ID markets. As the power system will be increasingly weather dependent, the value of ID-trade will also increase."	13	Arbitrage possibilities between the DA and ID markets may arise because of how the ATCE is implemented, applying a relaxation of the FB parameters. Thus, arbitrage between DA and ID is not a necessary consequence of implementing a FB method in DA. It is rather linked to the fact that the TSOs have chosen to relax the FB domain in order to release non-zero capacities for the ID gate opening, when possible from an operational security point of view. As laid out in Article 20(3) of the CCM, the Nordic TSOs shall, two months before go-live, publish a detailed description of the ATCE methodology. The NRAs and stakeholders shall be informed along the development process, and they may provide comments duly to be taken into account in development work.
9	"One of the requirements for parallel run according to approved CCM is to give information on how the capacities available for trade in the intraday-market are affected by the implementation of this methodology for the day-ahead timeframe. This is not fulfilled as ID ATC solution for intraday was not included in the parallel run from the beginning. As we see, TSOs should have calculated and published intraday capacities using the new method for each day during the parallel run period starting from day one and ID impact analysis is missing from the parallel run report. Additionally, stakeholders have requested a proper comparison of the intraday capacities calculated using the new	15	

	method versus the old. This is completely missing in the report. Functioning intraday market is getting more and more important due to the increasing volumes of wind and solar power generation, but based on the data published so far, it cannot be evaluated what kind of implications DA flow based have on intraday. In the meetings between stakeholders, it has become obvious that there is still a lot of uncertainty on how the ID capacities will be calculated. This applies especially to the situations where there is a non-intuitive flow in the DA market. TSOs indicated that the ID CCM needs to be re-evaluated. Without knowing the details of the ID CCM, it is hard to evaluate the ID market impacts. Additionally, if TSOs are planning to fix the flow direction (i.e. set the capacity to opposite direction to zero) if there is a non-intuitive flow in the DA market, this will make the ID impacts even worse and is likely to lead to lock-in situations in several bidding zones. More focus on ID impacts is needed, as intraday market is getting more and more important. So far, the requirements for the parallel run have not been fulfilled, as TSOs have published ID capacities only afterwards, method seems to be still unclear and ID impact analysis is missing from the report."		The analysis on the DA left-over capacity for the ID market is captured in the chapter 5 of the 3-months report. Arbitrage possibilities between the DA and ID markets may arise because of how the ATCE is implemented, applying a relaxation of the FB parameters. Thus, arbitrage between DA and ID is not a necessary consequence of implementing a FB method in DA. It is rather linked to the fact that the TSOs have chosen to relax the FB domain in order to release non-zero capacities for the ID gate opening, when possible from an operational security point of view. As laid out in Article 20(3) of the CCM, the Nordic TSOs shall, two months before go-live, publish a detailed description of the ATCE methodology. The NRAs and stakeholders shall be informed along the development process, and they may provide comments duly to be taken into account in development work. The sequence of trading on the various timeframes (DA, ID) is based on a maximum amount of capacity provided per timeframe. Increased efficiency on the DA stage, will lead to a potential low left-over capacity for the ID gate opening. For the ID timeframe, dedicated CGMs and capacity calculations will be performed, to provide the maximum amount of capacity available at that moment in time. TSOs will provide a maximum amount of capacity as DA left-over capacity for the ID gate opening, within the operation security limits as explained in the report.
10	"Vattenfall's view is that the open questions regarding the intraday market are still not clarified. We do not consider that Chapter 5 lives up to the requirements for a quantitative and qualitative analysis of the effects on the ID market. We still lack an analysis of the direct and potentially substantial effects on the regulation power market and the operational	19	

	reliability if we do not have a functioning and efficient ID market to use for balance management, especially with the growing share of renewables and concerns already today with from time to time a lack of mFRR bids in some bidding zones and already today.		This is outside the scope of the three-months evaluation report.
	In chapter 2, and on the NRAs' criteria for SEW we make note of the following: "However, NRAs note that this comparison cannot be performed with perfect precision, partly due to the two methodologies operating at different levels of operational security. NRAs will therefore need to broaden their analysis to include more parameters than just the net difference in socioeconomic welfare." This reference is a good example of why a deeper analysis of the implications for the ID market is absolutely necessary. Here is also the mandate for the NRAs to really require such an analysis irrespective of decision schedule as it looks today. In box 2 it is also states that "NRAs will assess the effect to ID markets based on the available data and TSOs' report" .		No comment.
	A further comment on the quantitative analysis is that even if it is not possible to make the exact same SEW calculation as DA, it is still possible to make quantitative evaluations of consequences on the ID market and, for example, calculate value transfers, eg. the Arbitrage values. These will also have indirect consequences on the SEW calculations/results that the project has calculated for DA as market participants will adapt their bidding strategies to realize arbitrage values. It is also a topic for credibility and trust of the market framework, that could be at least discussed qualitatively (reference to Question 7).		An ID welfare computation is not feasible with the current continuous trading schemes.
	The report refers to the fears expressed by stakeholders "in an early stage, that the left-over capacity from the DA as starting point for the ID market may lead to situations were BZs are not able to export nor import one single MW". If the TSOs release capacity in the direction of non-intuitive flows (according to the report), then we will have less problems in the opening of ID. However, the arbitrage trade ID will completely change the ""optimized flow from the FB algorithm"" and these ID capacities (arbitrage capacities) will most likely be traded away immediately when the ID market opens. Consequently, they will not be available at a later stage (closer to the delivery hour) when they are needed for balance management. NOTE: this is a direct consequence of FB and especially non-intuitive flows, as these incentives do not exist in today's ID market.		Arbitrage possibilities between the DA and ID markets may arise because of how the ATCE is implemented, applying a relaxation of the FB parameters. Thus, arbitrage between DA and ID is not a necessary consequence of implementing a FB method in DA. It is rather linked to the fact that the TSOs have chosen to relax the FB domain in order to release non-zero capacities for the ID gate opening, when possible from an operational security point of view. As laid out in Article 20(3) of the CCM, the Nordic TSOs shall, two months before go-live, publish a detailed description of
	To put this in perspective Vattenfall has calculated the "max theoretical arbitrage value"" of 87.9 MEUR for the 3 month period. This should be seen in relation to the calculated SEW value from the DA market that amounts to 87.2 MEUR for the Nordic Capacity Calculation Region. Rational market participants will over time adjust their DA strategies to access this arbitrage value, leading to other results/flows/prices also in DA. In summary		

	this means that both SEW value and Arbitrage value will be lower in reality (presumably, however, the relationship between SEW DA and Arbitrage value ID is relatively constant). But above all, the use of arbitrage value ID will lead to a watering down of the ""optimal flow planning"" that FBMC gives to the day-ahead market. These effects and consequences are not sufficiently studied nor discussed. If such phenomena as described above will result in lower allocated capacity for the cross border intraday trading, a knock-on effect for the balancing market must also been taken into account. Our tentative conclusion is that this risk both a more expensive and less robust balancing of the Nordic bidding zones as market based flexibility not suitable for the balancing markets We would also like to add that ID-trading/liquidity on some borders are much more important than others in relation to the operation of the Nordic power system. We note that several borders around Sweden are very important for the overall functioning of the power system. It is unfortunate that these effects and risks are not properly assessed as it can have an impact on the increasingly weather dependent electricity system in the Nordics. Decreased efficiency and lock-in effects on ID-market will have a direct impact on the ability for BRPs to do balance management, implying that a larger share of imbalances needs to be managed in the delivery hour using mFRR and aFRR. Balancing resources which regularly are scarce already today. This risk has to be further analyzed by both TSOs and NRAs, for instance by evaluating different concrete balancing scenarios both today and for future markets. We would like to provide an example to highlight the importance of the intraday market to be able to trade into balance during winter in northern Sweden. In the north of Sweden there is a lot of hydro production today in combination with wind, which is growing rapidly. In recent years the negative correlation between imbalance prices and wind has increased drastically. It is clear that increasing wind is the main driver for the mFRR activations in this area. The coming years the buildout will increase and then the need to be able to trade oneself into balance is expected to increase accordingly. The main risk for the producers as well as the TSO's are during winter when the hydro power is already running at max (or when laying ice on the rivers) there will be no available power for up-regulation. This time during the year is also the most sensitive for the wind assets as they are exposed to icing. The icing is really hard to predict both in terms of the amount and for how long time it will be present. As it is hard to forecast it will suddenly hit some or very often almost all wind farms in the same price area. When this occurs there will be a significant need to be able to buy power in the intraday market. If the non-intuitive flows are restricted this will not be possible, hence a higher share of this imbalance have to be		the ATCE methodology. The NRAs and stakeholders shall be informed along the development process, and they may provide comments duly to be taken into account in development work. Vattenfall is providing an example that shows how the available "import space" (i.e. the initial ATC from the FB ATCE in the import direction) can be small, and how this might lead to situations where there might not be enough capacity to enable BRPs to trade themselves into balance in the ID market. The example focuses on SE2 on 2023-01-04. On this day, Vattenfall estimates a negative imbalance of about 600-1000 MW in SE2 due to icing on wind generation. They also note that, during these conditions, most

	managed in the delivery hour by activating FRR. To illustrate the issue we have made an example from the EPR data from the 2023-01-04 PH1-PH12 where we based on our own imbalance have scaled it up to the future expected volume based on build out predictions (see table below) and compared with the possible trading space given that non-intuitive trades will be set to zero. Extrapolating VF's wind imbalances to all of the wind assets in SE2 indicates deficits of between 600 and 900 MW for the given hours. The same extrapolation for the expected installed wind capacity in SE2 for 2030 and 2040 results in imbalances of up to 1400 and 1900 MW respectively. During some of these hours the total ID import capacity was less than 100 MW and would clearly not have been sufficient for actors to handle these imbalances. Columns from left to right: Hour/market time unit Extrapolated SE2 imbalance 2023*** Extrapolated SE2 imbalance 2030*** Extrapolated SE2 imbalance 2040*** Total FB ID import space** Total NTC ID import space Available regulation volume SE2 Available regulation volume in connected areas PH01 -987 -1480 -1973 615 14630 1053 3784 PH02 -818 -1227 -1636 12798 14033 1202 3444 PH03 -922 -1383 -1844 12303 13634 1318 4148 PH04 -924 -1386 -1848 12176 13490 1320 4142 PH05 -864 -1295 -1727 11914 13513 1322 3947 PH06 -881 -1321 -1761 219 13766 1019 2751		hydropower within SE2 will already have been sold in DA, and therefore there are not likely to be any significant sales bids in ID from within SE2. They further claim that with FB, for some of the hours on this day, there would be close to zero MW initial ATC in the import direction to SE2. This would effectively mean that BRPs would not be able to trade themselves into balance in ID during these conditions. However, looking at the data from the ATCE results from this day, the ATCE data does not directly match the data provided by Vattenfall in the example. In the ATCE data, there is plenty of import capacity from SE3 to SE2 for all hours of the day (more than 10 000 MW). In order to match the data in the Vattenfall example, one needs consider that Vattenfall has done this analysis, as they mention in the text, “given that non-intuitive trades will be set to zero”. On this day, there were non-intuitive flows from SE2 to SE3 for several hours, where the price in SE3 was slightly lower than the price in SE2 in combination with a large flow from SE2 to SE3. The data from the Vattenfall example matches the ATCE results if the SE2-SE3 ATC is set to zero whenever there was a non-intuitive flow. One additional factor to keep in mind, which is relevant to the example provided, is that with the introduction of D-1 and ID CGM updates for the ID market, changes in forecasts (for example of wind production) would also influence the amount of capacity available in the ID time frame.

	PH07	-786	-1179	-1572	0	14636	701	2306		
	PH08	-658	-988	-1317	1	14973	636	2088		
	PH09	-618	-926	-1235	1	15109	532	1956		
	PH10	-543	-814	-1085	57	15174	532	1955		
	PH11	-684	-1025	-1367	82	15019	764	2543		

To illustrate that this is not only an issue in areas with a high share of renewables we would also like to bring attention to the potential impact on the balancing market in the case that one or more nuclear reactors shut down unexpectedly. A recent example of this is 2023-04-26 when the two reactors at Forsmark caused large imbalances in the system. While this day falls outside of the EPR period and the relevant FB data has not been published yet, considering what happened in the NTC case gives an idea of how the same day might have played out in a FB scenario.

From PH10 and onwards over 1700 MW were imported in SE3 intraday. As a result only some of the hours were upregulated and those that required regulation volumes considerably smaller than the nuclear imbalances. This would not have been possible had there not been plenty of ID capacity available, particularly on the SE2-SE3 and NO1-SE3 borders. Given that the ID capacities provided for these borders during the FB EPR have been restricted considerably - regardless of whether or not nonintuitive flows are allowed - it is not unlikely that the majority of these trades would not have been possible in a FB setup. The situation would instead have had to be handled on the imbalance market. On this day the available volumes for up regulation in SE3 ranged from 700 to 1000 MW and would not have been enough to compensate for the nuclear failures. Although the joint available up regulation volumes of two to three GW in the connected areas was sufficient in this case, limitations in capacity would clearly pose a risk for the imbalance market as well.

Table Available ID capacity

Columns from left to right:

Hour/market time unit

SE3 ID import

	SE2-> SE3									
	FI-> SE3									
	NO1-> SE3									
	DK1 -> SE3									
	Total SE3 import space									
	Available regulation volume SE3									
	Available regulation volume in connected areas									
	PH09	1062	693	200	2788	0	3681	1003	2914	
	PH10	2001	1490	200	2870	0	4560	971	2825	
	PH11	2198	2011	200	2916	0	5127	849	2497	
	PH12	2208	2741	301	2918	0	5960	911	2726	
	PH13	2082	3131	208	2918	0	6257	836	2834	
	PH14	2061	3317	340	2926	0	6583	804	2829	
	PH15	1850	3348	537	2926	0	6811	754	2761	
	PH16	1751	3329	549	2918	0	6796	713	2842	
	PH17	2158	3273	384	2928	0	6585	697	2852	
	PH18	2101	2541	200	2938	0	5679	759	3045	
	PH19	2157	1936	200	2837	0	4973	899	2877	
	PH20	1981	1230	96	2501	0	3827	919	2849	
	PH21	1897	883	200	2242	0	3325	1062	2968	
	PH22	1889	1048	200	2238	0	3486	976	3068	
	PH23	1900	1673	90	2209	0	3972	1010	3191	
	PH24	1922	2472	23	2218	0	4713	1009	3392	

Table Available ID capacity

Columns from left to right:

Hour/market time unit

SE3 ID import

SE2-> SE3

FI-> SE3

NO1-> SE3

DK1 -> SE3

Total SE3 import space

PH09	1062	693	200	2788	0	3681
PH10	2001	1490	200	2870	0	4560
PH11	2198	2011	200	2916	0	5127
PH12	2208	2741	301	2918	0	5960
PH13	2082	3131	208	2918	0	6257
PH14	2061	3317	340	2926	0	6583
PH15	1850	3348	537	2926	0	6811
PH16	1751	3329	549	2918	0	6796
PH17	2158	3273	384	2928	0	6585
PH18	2101	2541	200	2938	0	5679
PH19	2157	1936	200	2837	0	4973
PH20	1981	1230	96	2501	0	3827
PH21	1897	883	200	2242	0	3325

	PH22	1889	1048	200	2238	0	3486		
	PH23	1900	1673	90	2209	0	3972		
	PH24	1922	2472	23	2218	0	4713"		

What is your view on chapter 6?

Stakeholder response:

Stakeholder response		Stake-holder (s)	TSO comment
1	"The Stakeholder feedback chapter is hard to give any feedback upon. On the one hand, the project group representing the RCC Nordic project divides comments about flow based from stakeholders into valid and non-valid comments (this was done on the 27th of March, stakeholder meeting at Arlanda). Without defining what is valid comments from the stakeholders it is hard to evaluate whether this will work as expected. On the other hand, both in the document and during the presentation on the 3rd it was clarified to the stakeholders that a main object of this whole exercise is to educate the stakeholders of how flow based works. As a stakeholder, I would like to point out that for me this exercise should be part of an evaluation process ensuring that the implementation of flow based improves the functioning of the Nordic electricity market. Given the above concerns I would rate this stakeholder process a complete failure!"	1	Sorry to hear that.
2	This chapter will in the final evaluation report include stakeholders' feedback and TSOs' comments to the stakeholders' feedback. We expect that stakeholders' feedbacks are communicated in a comprehensive way.	6	
3	"A stakeholder event was organized, as stipulated in the evaluation process. The event did answer questions, but only related to the evaluation process and not to the functioning of the methodology or how to interpret the results. This left unclarity about the intention of this process checkpoint.	9, 10, 18	The EPR and its reporting is a part of the implementation of the legal requirements for calculating cross boarder capacity defined by Nordic NRAs.

	We urge the project, the TSOs and the Regulators to listen to the concerns raised by market participants, and carefully consider the proposals presented. The complete implications for the Nordic power market of an implementation of the flow-based methodology need to be extensively analysed and completely understood before taking the final go-ahead decision."		For further questions related to the functioning of the methodology or how to interpret the results, please contact your TSO or Nordic RCC. You may also find answers to your questions in the Questions & Answers section on the Nordic RCC website: https://nordic-rcc.net/flow-based/questions-answers/
4	We hope that the stakeholder feedback is properly taken into account by the TSOs and NRAs. Several concerns and questions related to flow based have been raised already several years ago, but TSOs have not been properly addressing them so far.	11	
5	It could have been valuable to in this report, at least as an appendix or link, already now refer to Stakeholder questions and expectations expressed during at least the last 3 years of Market Stakeholder Group meetings and the given responses, when the case, by Nordic TSOs and RCC.	12	
6	"The chapter is difficult to give any feedback upon. On the one hand, the project group representing the RCC Nordic project divides comments about flowbased from stakeholders into valid and non-valid comments (this was done on the 27th of March stakeholder meeting at Arlanda). Without defining what is valid comments from the stakeholders it is hard to evaluate whether this will work as expected. On the other hand, both in the document and during the presentation on the 3rd of May, it was clarified to the stakeholders that a main object of the exercise is to educate the stakeholders of how flowbased works. As stakeholders, we would like to point out that the exercise should be part of an evaluation process ensuring that the implementation of flowbased improves the functioning of the Nordic electricity market."	13, 17	

What is your view on chapter 7?

Stakeholder response:

Stakeholder response	Stake-holder (s)	TSO comment

1	"The secrecy of the critical network elements is a problem. However, the stakeholders must be ensured that these are of the kind that are not structural bottlenecks or that they are continued to be solved with remedial actions if possible. As the trust in the TSOs are very low in this regard we need to find ways of independent monitoring of this. In addition, we need a full analysis of non-intuitive flows and their consequences. First of all, how often and where do we experience non-intuitive flows in flow based. On which borders do this happen? We should also consider either one Swedish price area, or the use of an intuitive patch."	1	The obfuscation of Swedish CNECs is due to the Swedish Nation security legislation, as recognized by ACER and the Nordic NRAs, and cannot be overruled by this project. How often and where do we experience non-intuitive flows in flow based is illustrated in Figure 22 of the report. The bidding zone delineation is not in the scope of the CCM project (part of the bidding zone review that is currently performed). The use of the intuitive patch has been discarded by ACER in its decision on the Algorithm Methodology.
2	Limitations of the EPR have duly been presented. However, forecastability of prices is not discussed here either. It's not a part of EPR, given that EPR uses NTC order books, but it's a key risk of flowbased and hence is an important perspective to keep in mind.	4	Without a full end-to-end test and simulated system operation utilizing all producers and consumers, forecastability remains theoretical until the actual methodology can be tested and applied in production. Stability of the FB parameters can already be looked into today from the numbers published on the JAO website.
3	"Chapter 7 account inter alia for quality improvements both during the rest of the EPR period and after go-live. As stated in our views on previous chapter there needs to be substantial improvements, both in the quality of data used in the FBMC but also more stable model-setup. We miss the modelling and calculation of the system price. We perceive that this is not the FB-project responsibility, but for the financial power market and for us as market participants this is highly important. We perceive that the FB-project has been of the opinion that the system price calculation will not be affected by the FB-project; we have a different view, and this issue needs to be addressed soon"	6	The TSOs is engaged in a continuous effort to improve the process, and the capacity calculation results. The system price may change, when the bidding behaviour changes at the introduction of FB.
4	"The secrecy of the critical network elements is a problem. However, the stakeholders must be ensured that these are of the kind that are not structural bottlenecks or that they are continued to be solved with remedial actions if possible. As the trust in the TSOs are very low in this regard, there is a need to find ways of independent monitoring of this.	13, 17	The obfuscation of Swedish CNECs is due to the Swedish Nation security legislation, as recognized by ACER and the Nordic NRAs, and cannot be overruled by this project.

	In addition, we need a full analysis of non-intuitive flows and their consequences. First of all, how often and where do we experience non-intuitive flows in flowbased. On which borders do this happen? Furthermore, we must stress that the goal must be socio-economic efficiency and not partial technical optimality."		How often and where do we experience non-intuitive flows in flow based is illustrated in Figure 22 of the report. FB outperforms NTC as demonstrated by the increased SEW figures.
5	"Nordic TSOs have so far published flow-based simulation results only for some weeks / months and based on the results the benefits of implementing flow based can be questioned. We consider that more parallel runs are needed in order to evaluate the impacts of flow based in DA market in general, including also the impacts on the intraday market. There are lot of uncertainties in the parallel run results, e.g. due to the inputs and assumptions taken by the TSOs. Significant uncertainty coming also due to the characteristics of a hydro dominated system, as in parallel run NTC bids are applied also in FB analysis. This is easily leading to overestimated benefits. In general, we see the lack of transparency as a challenge. If there are one or more countries in the Nordics that do not publish sufficient data (e.g. permanent identifiers, location of critical network elements), it is very challenging for all market participants to understand, explain and forecast the market results – only TSOs have the necessary data to do this. TSOs might introduce new grid limitations to Euphemia by adding new CNEs, but market participants cannot identify those new limitations or forecast their impacts on the market outcome based on the limited data available. Also, flow-based is having negative impact on predictability and transparency on market results in general (SDAC, SIDC, reserves, price and volumes) the ability of market participants to allocate their capacity to market in optimal way is reduced. As Nordic TSOs have not been able to show that flow based will contribute to achieving the general objectives of CACM, for example increasing transparency and efficiency without endangering the functioning of other market time frames (e.g. intraday), according to our understanding it is not ready to be implemented."	15	During this 3-months EPR evaluation period, the FB process has been demonstrated to function in a stable way, and to provide the expected results. The EPR is not completed though, as it will continue until at least a period of 12 months has been covered (i.e. all the seasons of the year). The obfuscation of Swedish CNECs is due to the Swedish Nation security legislation, as recognized by ACER and the Nordic NRAs, and cannot be overruled by this project. In the whereas of the “Nordic Capacity Calculation Region capacity calculation methodology in accordance with Article 20(2) of Commission Regulation (EU) 2015/1222 of 24 July 2015 establishing a guideline on capacity allocation and congestion management” de dato 14 October 2020, it is explained how the proposed capacity calculation methodology contributes to the objectives of the CACM.
6	During the stakeholder meetings, the topic of the NTC orderbooks has been brought up on multiple occasions. The response from the Nordic RCC team and TSO had been that no further actions are to be taken regarding this. Quote from the Q&A section on the webpage “The Nordic TSOs do not plan to create an opinionated FB orderbook and draw	19	TSO have taken this comment into consideration and decided that the text in the section describes the intention sufficiently even if the heading could have been different.

	conclusion upon the opinionated FB orderbook." The question is, why is this topic then included in the section "Quality improvements moving forward"? Are there real intentions to do something about it? If not, then we strongly recommend removing this bullet point from this section. Alternatively, find a more suitable subtitle.		

Any additional views on the EPR report?

Stakeholder response:

Stakeholder response		Stake-holder (s)	TSO comment
1	The reported period needs to be based on a version of the flow based methodology that is going to be implemented. The information given tells us that this is not the case. Thus we do not think this report fulfils the reporting requirement. A new report should be submitted when the correct version is implemented and the results from that is reported: (from page 5) "There is still work to be done to make sure that the method is mature enough and its functioning understandable to the market actors." It is the mature version that we think should be evaluated.	1, 13, 17	The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains. .
2	"All costs of the electricity market and related infrastructure will be borne by electricity end-users. The rules of the game in the electricity market play a major role in how effectively the market players use resources. It was mentioned that the Nordic development of a flowbased market approach was initiated in 2012 due to the increasing complexity of the Nordic power system. From ELFi's (Association of Energy Users in Finland) point of view the flow-based calculation currently being developed and with currect rules does not improve things from the point of view of market players, end customers or political decision-makers, but reduces the transparency of all markets and even the acceptability of the EOM market model. Flow-based calculation contains two major flaws, which in the view of Association of Energy Users in Finland should be fixed.	2	

	Firstly: There should be no danger of electricity flowing from an expensive area to a cheap one when calculating daily SPOT-prices. We understand if the final physical transfer direction during the operational hour is in some hours from an expensive areas to a cheap ones, but not in the calculations which based demand and supply forecast of the day before. Second flaw will touch social wellface calculations. When calculating market benefits based on flow-based market approach, only the benefits for electricity buyers and electricity sellers should be calculated. Nowadays, bottleneck revenues of TSOs are listed as market benefits in the calculation. From a market point of view, bottleneck revenues arise in situations where the physical limitations of the market prevent efficient market trades and operations. These bottlenecks or incomes are not in the market player's best interest. Thus, it should not be results the positive inside flow-based calculations. Association of Energy Users in Finland's task is to improve position of the large electricity users in the electricity market. By promoting better understanding for authorities and policy makers about cost efficient electricity market solutions that contribute competitiveness to the industry and the services."		Non-intuitive flows are an outcome of the optimal SEW domain where net positions of bidding zones and capacities force flow to be in the "wrong" direction. Adjusting the domain to reduce non-intuitive flows would lead to lower SEW. ACER has decided not to prevent non-intuitive flows in their algorithm decision. Congestion income is part of optimisation within the SDAC algorithm, so it will be taken into account when SEW for FB approach is compared with SEW for current NTC method
3	"Renewables Norway welcomes the Nordic TSOs' external parallel run evaluation report. The transition from the current Net Transfer Capacity (NTC) approach to the flowbased method is a significant change for market participants, and it is important that they are offered the possibility to gain insight in how the flowbased method will work before it is implemented in practice. The current report is important in this regard. In our view, the rationale for introducing the flowbased method has been demonstrated through previous reports and the Nordic NRA approval phase of the Nordic capacity calculation methodology. The power grid is the backbone of the energy transition. New grid investments entail large investment costs as well as negative consequences for nature, society and other area interests. More efficient use of the current Nordic grid is key to enable the energy transition in a cost-efficient and sound manner. The NTC approach is in our view no longer adequate given the increasing complexity of the Nordic power system, with more intermittent power production, consumption, flexibility and more integration. As explained previously by the Nordic TSOs, this development with increasing complexity and interdependencies has made it increasingly difficult to decide how to share exchange capacity for different bidding zone borders within the current NTC approach. We are therefore supportive of the introduction of the flowbased method, which allows for better representation of the grid and thus enables a more optimal utilization of the scarce transmission capacity. This will give more accurate	3	

	price signals and increased socio-economic welfare. During the three months period with external parallel runs, the flowbased method allowed to transport 1,5 TWh more electricity than the NTC method. We are glad to see that the external parallel runs demonstrate that the flowbased capacity calculation process has been stable and worked as planned. No fallback measures had to be used in the Day Ahead flowbased capacity calculation process during the three months reporting period. However, the TSOs stress that they are still in a learning process when it comes to creating IGMs and other input to the process. Improvements have been made during the three months evaluation period, for instance regarding modelling of power production in the north of Norway and grid capacity between SE2 and SE3. This demonstrates that the process is still at an early stage, and that the following period of six months of external parallel runs, in which no major changes or developments will take place, will be very important. The flowbased capacity calculation relies on a more complex representation of the grid than the NTC method. This increases the complexity in information given to market participants regarding CNECs, capacities, unavailability messages and so on. For this reason, it is important that the TSOs continue a thorough stakeholder involvement in particular with regards to information and strengthen their work to be transparent. The report from the three months evaluation period shows an overall increase in socio-economic welfare in the Nordic CCR, with increased producer surplus and reduced consumer surplus. This could be specific for this period of EPRs and need not to be exactly the situation over time and in other time periods. A shift in the socio-economic surpluses is to be expected when price differentials are reduced, and it is important that these effects are sufficiently understood. We encourage TSOs to monitor that the flowbased market coupling continues to deliver increased socio-economic benefits. The results in the evaluation report are based on bids and water values reflecting NTC capacities and should therefore be interpreted with some caution. We encourage the TSOs to find a method to overcome this limitation, in order to have a more correct calculation of socio-economic welfare gain with the flowbased method over time. It would also be preferrable to see comparisons between the NTC and flowbased methodologies for future situations."		TSOs will continue to monitor the NRA KPIs during the remainder of the EPR period. This comment or request belongs to a wider discussion of the EPR setup and purpose. In the DA SEW comparison, it is acknowledged that the TSOs use the NTC orderbook to simulate the 'trading patterns' of the FB bids. Indeed, the bidding behavior may be impacted by the introduction of FB in the Nordics. TSOs will not take any position on this matter, nor is it possible for the TSOs to simulate this.

4	"In general, the report presents clearly the EPR results and describes well the challenging topic of flowbased market coupling. Improving the use of the Nordic power transmission system is an important area of development. A comment to the executive summary: the 1.5 TWh increased electricity transport through the Nordic grid is attributed to the better representation of the grid by flowbased, highlighting the increased flow through Norway. This figure may also include unrealistically high hydro power production due to the use of NTC order books throughout the EPR, as discussed in chapter 7. In relation to the SEW in the executive summary, this issue is duly mentioned, but not in relation to the increased transport."	4	Renewable production does indeed highlight the capabilities of flowbased in improving transmission through the Nordics but does not completely account for the availability of hydro reserves or other renewables.
5	"The comment below is written on behalf of Volue Insight the company of the Volue group in charge of data and analytics. We presented in Copenhagen in June_22 the main take away of the activities done in the continent to extend the FBMC forecast and optimization from the area of CWE to CORE into our short-term model Plexos (https://nordic-rcc.net/wp-content/uploads/2022/06/6.-Stakeholder-experience-on-Core-FB-parallel-run.pdf). We have just started to put in place the IT processes to integrate the Nordic FBMC optimization as well. We write here below a generical comment, not necessarily related to the report, but more generically related to our (and our customers) difficulties in forecasting FB domain/s for mid and long-term horizon. "" In general, we are happy of the results shown by the parallel run data published since December 2022 and of the effort made by the experts and all Nordic TSOs to explain the results of the simulations, often deep diving in the complex theory behind the algorithm of the XB optimization. As mentioned during the Stakeholders Meeting in Copenhagen in June 2022, Insight gained experience over the past 10 years on forecasting both the PTDF and the prices of continental markets optimized with both implicit and explicit auctions as well as flow-based market coupling mechanism in the so-called CORE area. Our analysis mainly serves market players in exploiting trading opportunities and assessing the risk associated to their financial and physical exposures. The main issues that we have lately discussed with several customers active in the Nordics is about the prognosis of the PTDF for mid- and long-term horizon. A simplification of the PTDFs or families of clusters, could be of help for us and our customers to run model simulations for the coming months and years. For the Nordics we – as most of the market players –	5	If the comment is understood correctly, the implementation of the long term CCM might support in this regard.

	perform analysis on mid- and long-term horizon using the model called EMPS which offers an understanding of the evolution in each bidding zone of statistical distribution of prices – dominated by hydro production – depending on scenarios which reproduce weather years. The FB domain shape is very much correlated with residual load, consumption and wind output and therefor, in order to perform meaningful analysis, one should run the EMPS with weather years associating a correct PTDF to the windy/ not windy/ cold/ warm… days/ hours. For the time being this is the major obstacle that we experience in our analysis: we need a set of realistic domains to play out with in our model not only for a short-term horizon, but also for the next months and years. The nature of the Nordic markets, where the prices are dominated by hydro power, imposes to calculate with accuracy the water values which will define not only the appetite of the plants to offer in the spot exchange, but also the outcome in terms of dispatch and the correct optimization of the powerplants and the usage of the resource (the water). Any help at this stage to create meaningful clusters would be very much appreciated. “ Greetings :) Silvia Messa"		
6	"The transition from the current Net Transfer Capacity (NTC) approach to the flowbased method is a significant change for market participants, and it is important that they are offered the possibility to gain insight in how the flowbased method will work before its implemented in practice. The current report is important in this regard but as stated earlier we need to see improvements going forward. The flow-based method implies that physical characteristics for the electricity is taken into consideration, which is not the case for today’s NTC methodology. Thus, one should expect a more efficient and better utilization of the Nordic transmission grid. The power grid is the backbone of the energy transition. New grid investments entail large investments costs as well as negative consequences for nature, society and other area interests. More efficient use of the current Nordic grid is a low-hanging fruit and is key to enable the energy transition in a cost-efficient and sound manner. In today’s use of the NTC methodology TSO needs to cope with the limitation of the NTC approach through negative transmission capacity between bidding areas and requirements towards sum transmission capacity limitations for bidding zones. With more	6	

	intermittent power production, consumption, flexibility and increased integration, the complexity of the Nordic power system will increase. Thus, making it more difficult to decide how to share exchange capacity for different bidding zone borders within the current NTC approach. We are therefore supportive of the introduction of the flowbased method, which allows for better representation of the grid as it enables a more optimal utilization of the scarce transmission capacity, which should give more efficient price signals and increased socio-economic welfare. However, if the flow-based method shall be beneficial for society the basis for optimizing flexible power plants, such as hydro reservoirs, needs to be in place both for short-, medium- and long term. This relates to information as a basis for estimating future production scheduling. For this estimated future transmission capacity between bidding areas, included consequences of temporary and lasting changes in the power system, are needed. When it comes to information about future transmission capacity between bid areas, it must be clarified what type of information the players will receive. The information must be useful as a basis for calculating water values in the future. For us, it seems unrealistic that the actors themselves should build their own PDTFs, not least because it is not transparent what the critical network elements are in Sweden. This needs to be improved and clarified before the flow-based methodology can go-live. For this reason, it is important that the TSOs continue a thorough stakeholder involvement with regards to information and strengthen their work to be transparent. The report shows an overall increase in socio-economic welfare in the Nordic CCR, with increased producer surplus and reduced consumer surplus. This is probably specific for this period of EPRs and will likely become different for other time periods. Thus, the important is that socio-economic welfare for the Nordic increases, not the distribution between the producer and the consumer side in the different bidding areas. A shift in the socio-economic surpluses is to be expected when price differentials are reduced, and we encourage TSOs to monitor that the flowbased market coupling continues to deliver increased socio-economic benefits."		
7	"For further analysis of non-intuitive flows the calculated TSO data (as depicted in chapter 4 in figure 22) as for example in which MTU on which border non-intuitive flows occurred and an aggregation like in figure 22 would be helpful. In the weekly reports (CCM EPR Market report Appendix) the data on non-intuitive flows (number of hours, percentage of hours, and negative congestion income) is not available for weeks 50-6 and week 8, it would be helpful to add these."	7	It is not clear from the comment what is meant by further analysis of non-intuitive flows and not clear what value this would add to the report showing these flows on MTU level for all 10 weeks. Data can be accessed by stakeholders themselves for further analysis.

8	"To begin with, we would like to highlight our concerns with the flow-based methodology and especially the impact on the Nordic power market in general. This response should therefore be received as remarks and suggestions for the implementation project rather than commenting on the report itself. General comments 1. It appears from the parallel run that the flow-based methodology in general generates higher prices in the Nordic region. The positive SEW gains are mainly distributed between producer surplus and congestion income. Considering the current situation with several years of high energy prices and large industry investments going into sustainable technology shifts it can be questioned if the distribution of SEW gains should be equally weighted between generation, congestion income and consumption. 2. The parallel runs clearly demonstrate the occurrence of non-intuitive flows. This will have an impact on the ID-market, offering arbitrage opportunities for traders. An extensive utilization of the arbitrage opportunity might have a significant impact on the planned flows and potentially also impacting the way the Nordic power system is operated. This impact could be severe and must be included into the evaluation of the flow-based methodology. 3. The reason behind non-intuitive flows is complex to explain and understand. If non-intuitive flows become a reoccurring element of the power market design this might have a negative impact on the transparency and confidence for the price formation. This can hurt the overall trust for the market design and the current functioning of the market. 4. As an energy intensive consumer, we have concerns regarding the potential negative impacts linked to the flow-based methodology implementation. In dialogue with other market participants, it appears as if other participants share this concern, consumers and producers alike. Therefore, we see reasons to questions the motives behind a fundamental market design change that market participants in general do not support. 5. The flow-based methodology is evaluated against the current NTC model, however it is clearly stated that there is not an option to continue with the current approach since it is not compliant with regulation. Therefore, a comparison with the	9, 10, 18	Impact on welfare distribution is a common feature when making changes in the power system and power market. Redistribution of welfare can happen between different stakeholders and over multiple timeframes. Arbitrage possibilities between the DA and ID markets may arise because of how the ATCE is implemented, applying a relaxation of the FB parameters. Thus, arbitrage between DA and ID is not a necessary consequence of implementing a FB method in DA. It is rather linked to the fact that the TSOs have chosen to relax the FB domain in order to release non-zero capacities for the ID gate opening, when possible from an operational security point of view. As laid out in Article 20(3) of the CCM, the Nordic TSOs shall, two months before go-live, publish a detailed description of the ATCE methodology. The NRAs and stakeholders shall be informed along the development process, and they may provide comments duly to be taken into account in development work. The occurrence of non-intuitive flows is a natural consequence of the FB capacity calculation method, and reflects the ability of FB to more accurately represent and value the actual physical flows that occur in the power system. As requested by the Nordic NRAs, the TSOs compare the FB with what is applied today: NTC. The purpose of the

	current model does not provide a fair result. Instead, the flow-based methodology should be evaluated against the relevant alternative, an improved NTC methodology."		EPR is to compare the new methodology to what is in operation.
9	"Fortum is concerned about the missing intraday impact analysis, lack of evidence on clear benefits of flow based, quality of the inputs and results published during the parallel run, negative impacts on the intraday market and lack of transparency in the Nordic flow based approach. Some considerations based on the report and parallel run results published are listed below. • Fortum does not agree with the statement of the TSOs in the executive summary of the report: "All KPIs have been met as there are no fallbacks or delays being observed related to the DA capacity calculation process for the 3-month period. Moreover, the external parallel run shows that flowbased provides a higher social economic welfare (SEW), which reflects that the flowbased parameters are a result of a calculation that is in line with the legal methodology; thus the Nordic TSOs asses that the quality of the flowbased parameter calculation has proven to be of a sufficient quality." o Nordic TSOs have so far published flow based simulation results only for some weeks / months, and based on the results the benefits of implementing flow based can be questioned. We consider that more parallel runs are needed in order to evaluate the impacts of introducing flow based in DA market in general, including also the impacts on the intraday market. o Transitional ATC solution for intraday was not included in the parallel run from the beginning and in the evaluation report the ID impact analysis is missing, although intraday impact evaluation is one of the NRA KPIs and also listed in CCM under the requirements for parallel run. There is a large amount of non-intuitive flows on certain borders, which indicates negative impacts on the ID capacities and trading possibilities. Also based on the ID capacities published so far, it is clear that impacts on ID trading possibilities will be negative. • There are lot of uncertainties in the parallel run results, e.g. due to the inputs and assumptions taken by the TSOs. Significant uncertainty coming also due to the characteristics of a hydro dominated system, as in parallel run NTC bids are applied also in FB analysis. This is easily leading to overestimated benefits. Also different assumptions	11	In total, at a minimum 12 months parallel runs are requested by Nordic CCM. 3-month EPR has been requirement from the NRAs within the decision on Nordic CCM ID calculation needs as input already allocated capacities (AAC) from DA timeframe. For EPR DA market coupling results will be calculated after grace period (which is 2 weeks). This grace period introduces around 3 weeks delay for publication of ID ATCE values for ID gate-opening. Calculated ID gate-opening capacities are available at Nordic RCC website for whole EPR period (for each day and MTU). SHs can find cross-zonal capacities for all bidding zone borders. In addition, SHs can find duration curves for capabilities of each bidding zone with ATCE method and comparison to current ID method. Please refer to our earlier reflections at your responses.

	taken by the TSOs in NTC and FB calculations (e.g. related to counter trade and redispatch). o Very limited benefits in DA so far (mainly due to the fact that same bids are applied for FB as in NTC) compared to the negative impacts in ID and decreased transparency and complexity and their impacts on the market => total benefit of introducing flow based can be questioned, minor benefits in DA market turning into negative when taking into account the negative impacts on other markets and transparency. o DA welfare change in comparison to the total DA welfare is very low based on our assumptions (TSOs have not presented the actual numbers (change compared to the total DA welfare) even if they have been requested to do so.) o Introducing flow based in DA will decrease the possibilities for market based balancing in ID market due to decreases in ID capacities. This in turn will increase the need for balancing done by the TSOs, and most probably increase the need for transmission capacity reservations for capacity before the DA market (this is stated at least by Svk). The cost for reserving more capacity before spot and it's impacts on the DA prices and welfare are not taken into account in the analysis either. • In general, transparency with the Nordic CCM is significantly lower compared to the CORE region. We consider that the minimum level for transparency in the Nordic countries should be the same as in CWE region today. o If there are one or more countries in the Nordics that do not publish sufficient data (e.g. permanent identifiers, location of critical network elements), it is very challenging for all market participants to understand, explain and forecast the market results – only TSOs have the necessary data to do this. TSOs might introduce new grid limitations to Euphemia by adding new CNEs, but market participants cannot identify those new limitations or forecast their impacts on the market outcome based on the limited data available. Additionally, non-intuitive flows in general might be hard to explain to the consumers, who are on a high price area with export to lower price area. Lack of transparency will make it even harder to understand and explain them. We consider that		Please refer to our earlier reflections at your responses. Please refer to our earlier reflections at your responses The sequence of trading on the various timeframes (DA, ID) is based on a maximum amount of capacity provided per timeframe. Increased efficiency on the DA stage, will lead to a potential low left-over capacity for the ID gate opening. For the ID timeframe, dedicated CGMs and capacity calculations will be performed, to provide the maximum amount of capacity available at that moment in time. TSOs will provide a maximum amount of capacity as DA left-over capacity for the ID gate opening, within the operation security limits as explained in the report. The obfuscation of Swedish CNECs is due to the Swedish Nation security legislation, as recognized by ACER and the Nordic NRAs, and cannot be overruled by this project.

	the Swedish limitations in publishing the data should be re-evaluated and transparency needs to be improved. o FB is having negative impact on predictability and transparency on market results in general (SDAC, SIDC, reserves, price and volumes) and the ability of market participants to allocate their capacity to market in optimal way is reduced. • As Nordic TSOs have not been able to show that flow based will contribute to achieving the general objectives of CACM, for example increasing transparency and efficiency without endangering the functioning of other market time frames (e.g. intraday), according to Fortum's understanding it is not ready to be implemented."		TSOs understand that the transition to a new CC method implies that market participants will have to adapt or replace their current forecasting tools. However, in a longer-run perspective, it is not clear that it would be fundamentally more difficult to predict DA prices with the FB methodology. Please refer to our earlier reflections at your responses.
10	"In CORE FB it has been applied NRA monitoring of 20% RAM. This would have been useful if (A) any such target RAM values have been set by TSOs for Nordic FB , and (b) if NRAs plan to monitor it in simular way as done in CORE region. We suggest that TSOs also include statistics on the most limiting CNECs in an overview for the EPR period also in this report and continue to report on this during the full EPR period. In our opinion the Non-intuitive flows analysis is too brief. The broad perspective is more important than focus on the single interconnectors. TSOs should clearly elaborate on the longer-term effects from high frequency from non-intuitive flows on individual borders (as we have seen 80 % on individual borders), including the impact on neighboring regions and bidding zones and impact on the clear incentives to change the bidding behavior, impact on the overall acceptance on the market model. From previous debates in the public and in academia, for examples related to the very frequent non-intuitive flows. Need to provide proper information for the market. NUCS, net positions. Today it is not possible to understand the future data publication and result publication as this will be once FB goes live, the future go-live solution should be able for markets participants to test for at least 6 months without any changes. Allocation of CZC for ID Market participants are concerned about the way ID CZCs will be allocated and how much in both directions, especially in cases with observed BZ-to-BZ "non-intuitive flows" in SDAC. Some preliminary assessments show interesting results, and also puts in question how allocation of remaining capacity for SIDC is distributed between BZ-to-BZ borders	12	No comment. All information is available to the stakeholders to perform this kind of analysis. A change of bidding behavior (if any) is a consequence of FB, and not linked to the existence of non-intuitive flows. This report is an assessment of the 3-month KPI-period from the required 12-month EPR for the DA-market timeframe. NUCS are outside the scope of this report. Indeed, the current ATCE optimization formulation, being the maximization of the total Nordic capacities, is implicitly in favor of smaller borders.

	since it appears to somewhat favor CZ Borders with smaller max NTC then those with bigger max NTC. Transparency regarding CNECs. The Swedish TSO is not responding to all the questions from MPs in SHGs in relation to their decision NOT to disclose individual names on CNECs. There should be clear written communication from SvK on how SvK is working with these questions, what actions are taken to increase the transparency level in Sweden to a level comparable with therest of SDAC/SIDC- areas having implemented FB. Afterall Swedish CNECs are often the most limiting ones in Nordics and a lot of TSO claimed transparency gains is lost given this decision. There has however been some oral mentioning from SvK that full secret information will be disclosed only to the Swedish NRA, however this is not creating any visible transparency for market monitoring purposes outside the Swedish NRA. SvK should adopt an approach allowing daily monitoring."		The obfuscation of Swedish CNECs is due to the Swedish Nation security legislation, as recognized by ACER and the Nordic NRAs, and cannot be overruled by this project.
11	The parallel run is a necessary exercise. One important caveat in the methodology is that order books from Market Participants remain unchanged in the two scenarii (historical NTC-based and simulated FB). Those simulations are however the closest way to anticipate future operations The capacity calculation process is deemed stable: the FB domain has been calculated without fallback measure or delay for 3 months in a row. It would be helpful to include a map with the bidding zones including the changes made to the Nordic topology (virtual bibbing zones) The results are sometimes showed for Nordics only, sometimes compared for the whole SDAC. The criteria in fine remains an increased welfare for SDAC, this should be made clearer. Notwithstanding the above comment, a further elaboration on the differences between the internal Nordics bidding zones would be appreciated. The 3 months report has been made over a winter period, it could be interesting to factor in seasonal effects. The conclusions on left-over capacity for IDA are not clear and shall be further elaborated. This is a golive criteria to make sure that the improvement measures in Day-Ahead framework are not detrimental to Intraday market.	14	The topology is included in the EPR handbook: https://nordic-rcc.net/wp-content/uploads/2023/03/CCM-EPR-handbook_V3.pdf We have the differences between the Nordic bidding zones shown in various graphs, e.g. the figure 9 which shows the consumer and producer surplus. This report is an assessment of the 3-month KPI-period from the required 12-month EPR. The other seasons are covered and explored in this 12 months period. The NRA KPIs are only related to the ID gate-opening capacities (DA left-over capacities). ID capacities will be

	Is it possible to include Euphemia's computational time (time to first solution?)		updated as soon as the D-1 and ID CGMs are available for this purpose. As this is related to Euphemia performance and not so much to the FB methodology, these numbers are not considered to be relevant for sharing with the stakeholders. The NEMOs have access to those numbers.
	Is it possible to comment on the FB parameters, such as the ones listed below, to ensure that there is no discrepancy between the methodologies or no error in the FB parameters: • capacities being underestimated or overestimated with FB compared to ATC/NTC; • flowbased applying a CGM while NTC is not; • spikes in prices spread being accentuated; • comparison with NTC and not with CNTC; • number of time the ATC domain exceeded the FB one; • number of times the ATC flows would have breached the PTDF domain) A more detailed analysis on flows would be welcome (notably on non-intuitive flows) Is it possible to comment on market effects (such as steepest curves for exporting areas compared to importing ones, increase of welfare but loss of consumer surplus) In Box 3, the low-price area and high price area figures are not clear. It could help if the CS and the PS in each bidding area were highlighted. Furthermore, there are two Price "Plow" and two Price "Phigh" to indicate different price points on the curves. In Box 4: it seems there is a mistake, either interchange A with B bidding zones in the description, or change the axes in the graph. In Box 4: there is no mention of the opposite direction limitation for each CNEC (please clearly indicate if it is considered the same). The figure x2 can be obtained only considering limitation in both direction of the CNEC. The fact that the PTDF matrix is given for directional CNEC does not help understanding the graph.		It is not clear to the TSOs what it is that you are requesting the TSOs to do here… Please do look into the different reports and documents published at the NRCC website, and all the numbers that have been shared with the stakeholders, to check whether you can find your answers there. Please do indicate what you have in mind; more of what? Please refer e.g. to the boxes 6 and 7 in the 3-months evaluation report. In the boxes we try to explain some features in an easy way… and that implies that some details need to be left out, in order for others to get the spotlight. Well-spotted; corrected in the updated report Well-spotted; you are correct. The other direction needs to be considered as well: same RAM, and opposite signs for the PTDFs.
13	"Summary of Vattenfall's views: The studied 3-month period has not provided satisfactory answers or evidence of a capacity allocation design that will benefit the electricity system and its different user	19	

	groups. We recommend that process from here on is guided by more non-process oriented criteria that among other things mentioned include a thorough analysis of the risks and implications of negative effects for the intraday market and balancing market. We not that FBMC has been successful in the CORE area, however but the structural differences from the Nordic suggest that this evidence is of limited relevance, and at least need to studied broader and more in-depth to prove its relevance: • Model incomplete or wrong before March 1st 2023 Regardless of the views expressed below, the 3-month report should have started from week 10 as it is the first complete week with Cut 2 series capacitors properly modeled. • Calculations of SEW include hydro resources beyond reasonable limits The effect on hydro-dominated areas should be analyzed more in-depth. DA results with increased hydro generation are accumulated with no connection to water valuation. Must be addressed to have realistic SEW development over time. • Intraday Market at risk The Nordic system operate with 12 bidding zones and a multiple of bidding zone borders. This implies a much more intricate trade with flexibility, of which the intraday market is key. Vattenfall has followed the immense development of predictability and dynamics that have occurred during the last decade. We are convinced that the market participants need to step up and improve their ability to manage the increased volatility during the ID-timeframe. We remain concerned that this is a proposal that will restrict the free market's ability to actively offer flexibility, and rely more heavily on a reactive system operation, where only flexibility that meet the requirement of the balancing market can participate. A well-functioning Intraday market will also help the TSOs to run a robust and cost efficient system. • Reduced Forecastability Small bidding zones are more sensitive to changes in line capacities. Therefore, it is problematic for the Nordics to not have a domain for a longer horizon. Using NTC:s for D+2 may lead to larger planning errors. Swedish anonymous CNE is further adding to the		The comparison between NTC and FB may be impacted by inaccuracies and uncertainties both in FB and NTC; this does not disqualify any of the domains or the market results computed with those domains. As mentioned in the report, the bid curves are based on the NTC capacities (i.e. operational order books). The sequence of trading on the various timeframes (DA, ID) is based on a maximum amount of capacity provided per timeframe. Increased efficiency on the DA stage, will lead to a potential low left-over capacity for the ID gate opening. For the ID timeframe, dedicated CGMs and capacity calculations will be performed, to provide the maximum amount of capacity available at that moment in time. TSOs will provide a maximum amount of capacity as DA left-over capacity for the ID gate opening, within the operation security limits as explained in the report. TSOs understand that the transition to a new CC method implies that market participants will have to adapt or

	difficulty to forecasting the domain for D+2 and onward. Consequently this could lead to bad management of hydro resources and reduced transparency. • Reduced transparency and trust in the market outcome. The FB method implies an increasing complexity that will make it harder to forecast prices. It will be a challenge to explain non-intuitive power flows (flow from high to low price areas), and there is an obvious risk that this will cause reduced confidence in the market outcome. • Potential risk for negative impact on liquidity not studied sufficiently The increased complexity could affect the financial market negatively, which would imply increased cost for risk mitigation and providing fixed prices to consumers. We perceive a risk that EPADs are not a sufficient hedging instrument after introducing non-intuitive version of FB. It remains to be seen how long-term transmission rights work in combination with non-intuitive flows in the DA market. Impacts to the financial market and hedging possibilities are not covered in the studies performed by the TSOs despite repeated requests from stakeholders. There is no straightforward solution to all of the challenges mentioned above. However, there are simple actions that can help increase confidence in the flowbased method and process: • Firstly with, we recommend redoing the 3-month report using data from week 10 and onwards, this will at least provide better-modelled data. • Secondly, the TSO and Nordic RCC should align on the rules that will apply to the intraday market, together with further in-depth analysis of the impact on this market. • Thirdly, the forecastability of the D+2 prices should be a vital part of the analysis, even if there are no specific KPIs for this, a real proposal for the LTCC should be in place. This proposal should clearly include how the UMMs will be published once flowbased is implemented, how the UMMs will be structured and most importantly, how these impact the domain so that stakeholders can actually use and interpret this data correctly."		replace their current forecasting tools. However, in a longer-run perspective, it is not clear that it would be fundamentally more difficult to predict DA prices in the longer term with the FB methodology. Non-intuitive flows can be perfectly well explained. Please refer to the phenomena report: https://nordic-rcc.net/wp-content/uploads/2023/04/Phenomena-report-revised-11-April.pdf The financial markets in the Nordics make use of price derivatives. Though the prices will change when applying FB, the principles of bidding zones and bidding zones prices remain unaltered. No comment.