DA results from the external parallel run (EPR) of Nordic flow-based

SH bi-weekly meeting

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Upcoming events

- Hybrid meeting 26 October
  - **The bi-weekly EPR result elaboration will be part of the agenda.**
    - (It has previously been communicated that the EPR elaboration would be cancelled.)
  - Place: Radisson Blu Terminal Hotel, Stockholm Arlanda Airport, Sweden.
  - Please register for onsite participation on the RCC website.
  - No registration necessary if you participate by Teams.

- Next event containing only bi-weekly EPR results will be 9 November

Agenda

1. Introduction
2. Updates since last meeting
3. Flow-based impacts on
   - Socio-economic welfare (SEW)
   - Prices
   - Net position
   - Border flows
4. Constraining CNECs in FB
5. Non-intuitive flows
6. Specific hour walk through: consumer surplus increase
7. Consumer surplus impacts in the Nordic CCR

External parallel run (EPR)

- In EPR, the capacity calculation process for both FB and NTC is performed in parallel
- Market results are simulated with FB constraints by NEMOs
- Same market coupling algorithm, same order books, different capacity calculation method
- The NTC results are the actual DA market coupling results, while FB is simulated
- The simulated FB-results are compared with the results from the DA market, where the Nordics currently still use NTC
- This period is intended for the TSO and market participants to become familiar with FB capacity calculation and the impacts flow-based has on the market outcome.

Important to note!

The EPR market data comparison does not serve as:

- A complete forecast of the future market results, or
- A complete assessment of the consequences of the flow-based.

Please remember; market results for FB are simulated using NTC order books. Simulations does not consider diverse effects of FB could potentially have on water values in the Nordic region.

In short, market results **does not consider** the following:

- The *effect of unused* water resources (which could have been used in the NTC world) in the southern part of the Nordic region
- The *effect of increased* water utilization in the northern part of the Nordic region

Updates since last SH meeting

Open questions from the last bi-weekly meeting:

- **Average shadow price has been added to CNEC information**
- **The impact of "too high capacity NO1-NO2"**

  →After further analyses, from week 34, capacity is much more realistic as initially thought. We are still looking into this.
- **NTC flows are incorrect for W31-35 in published data.**

  →This mainly affects SE4-DK2 and will be fixed soon.
- **Topics to be discussed in the 26 October Hybrid meeting:**
  - ID/ATCE
  - How are outages communicated to the market (=unavailability information) in FB

Other changes since last meeting:

- New visualizations

Social welfare change W35-W36

- Flow-based results in a higher SEW compared to NTC for both the Nordic region and the whole market coupling region.
  - Total Nordic SEW change 20 M€
  - CI change on borders out of the Nordic region 5 M€
  - Total SEW change in the SDAC region 24 M€
- Flow-based provides a gain for the producers in the Nordic region and in the continent.

Figure: SEW change in Nordic

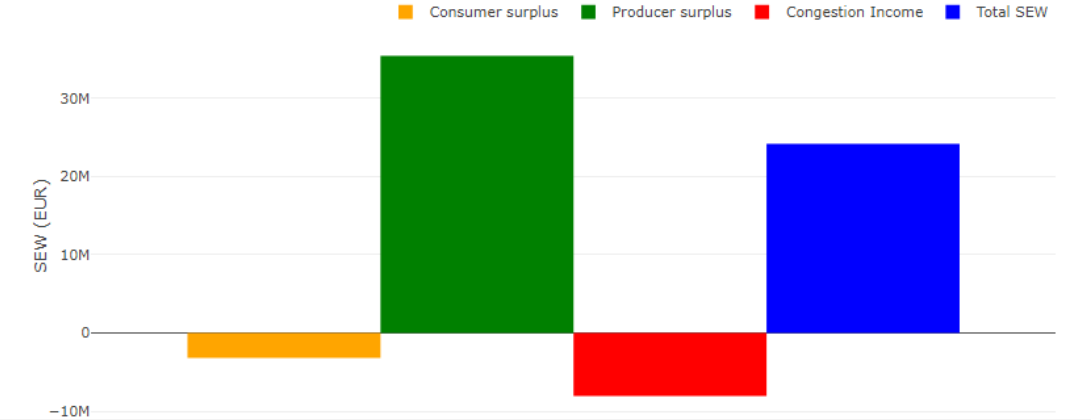

Figure: SEW change in the whole SDAC region

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SEW Impact on country level
W35-W36

- Flow-based results in total in a gain for producers, while consumers experiences a loss.
- In Denmark and Finland, there is a small gain for the consumers, while Norway and Sweden have a bigger gain for the producers.
- Total SEW is positive for all countries

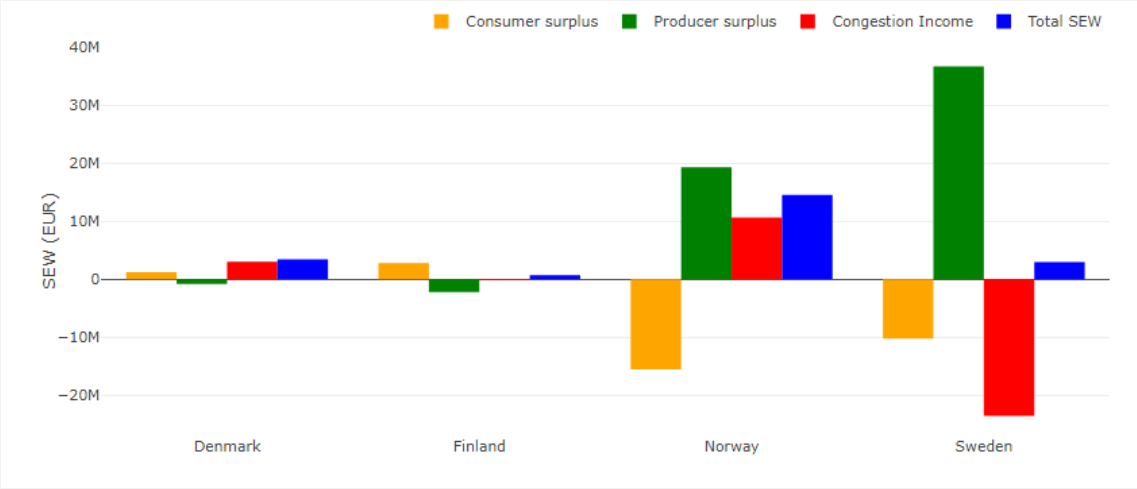

Figure: SEW change on stakeholder level in CCR Nordic per country

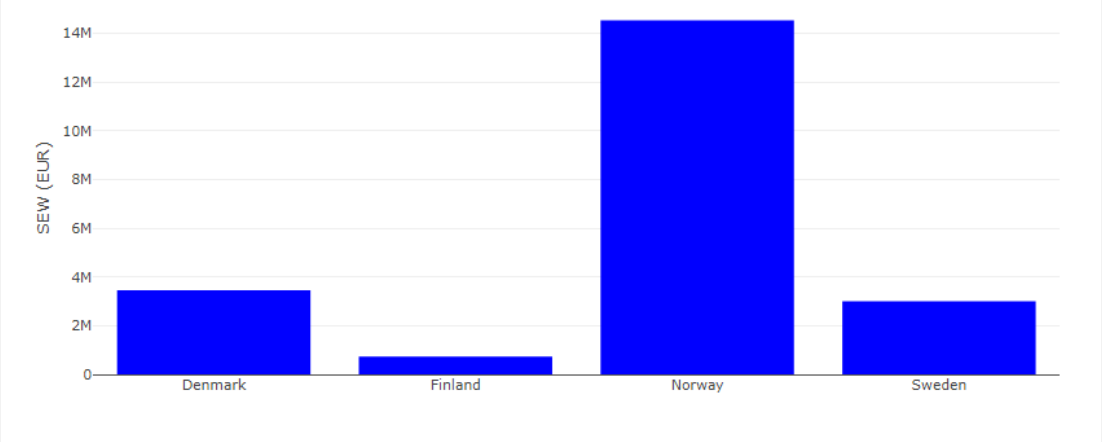

Figure: Total SEW change in CCR Nordic per country

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SEW Impact on bidding zone level W35-W36

The distribution of the effect of FB is very different from BZ to BZ.
Largest total SEW changes in BZs NO5(+), SE1(+), SE2(+) and SE3(-).
Flow-based results in a gain for the consumers in DK, FI, Southern NO and SE4, while the consumers in SE1, SE2, SE3, NO4 and NO1 have the largest loss.

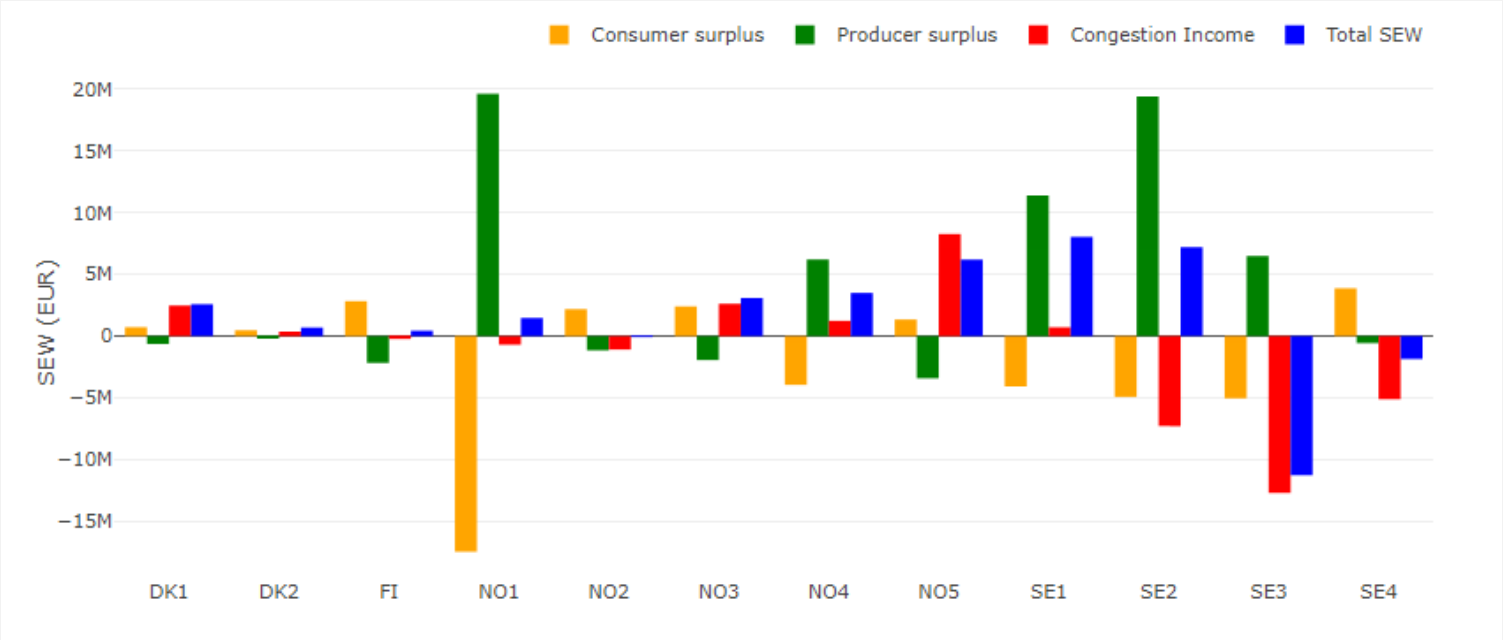

Figure: SEW change per stakeholder in CCR Nordic per BZ

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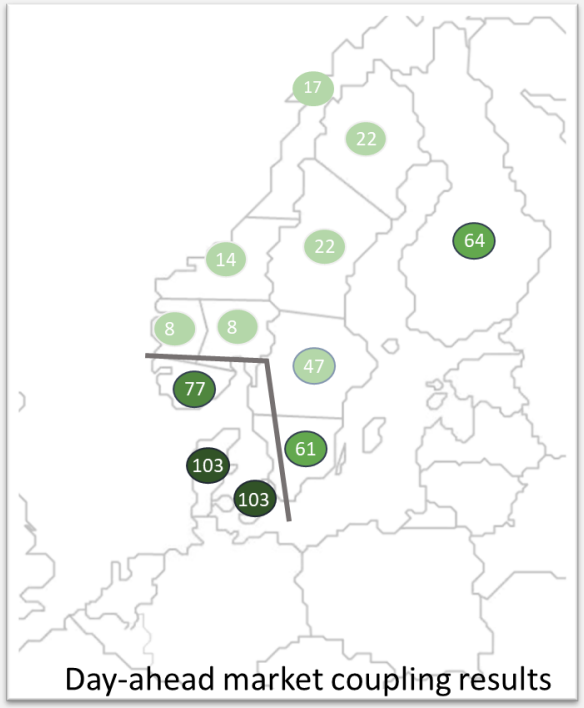
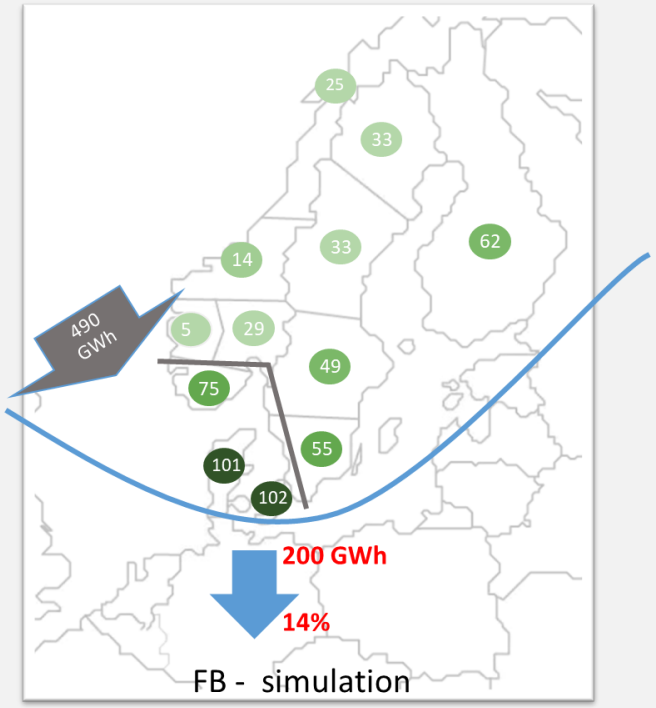
Average prices in the Nordic region
W35-W36

- High prices seen in DK and NO2 in both FB and NTC
- Lower FB average prices in FI, SE4, DK and NO2. Higher average prices for other bidding zones.
- FB increases the flow to the continent through southern parts of Nordics
- But the energy transferred to NO2 and DK is even higher than the increased Nordic net position



Day-ahead market coupling results



FB - simulation

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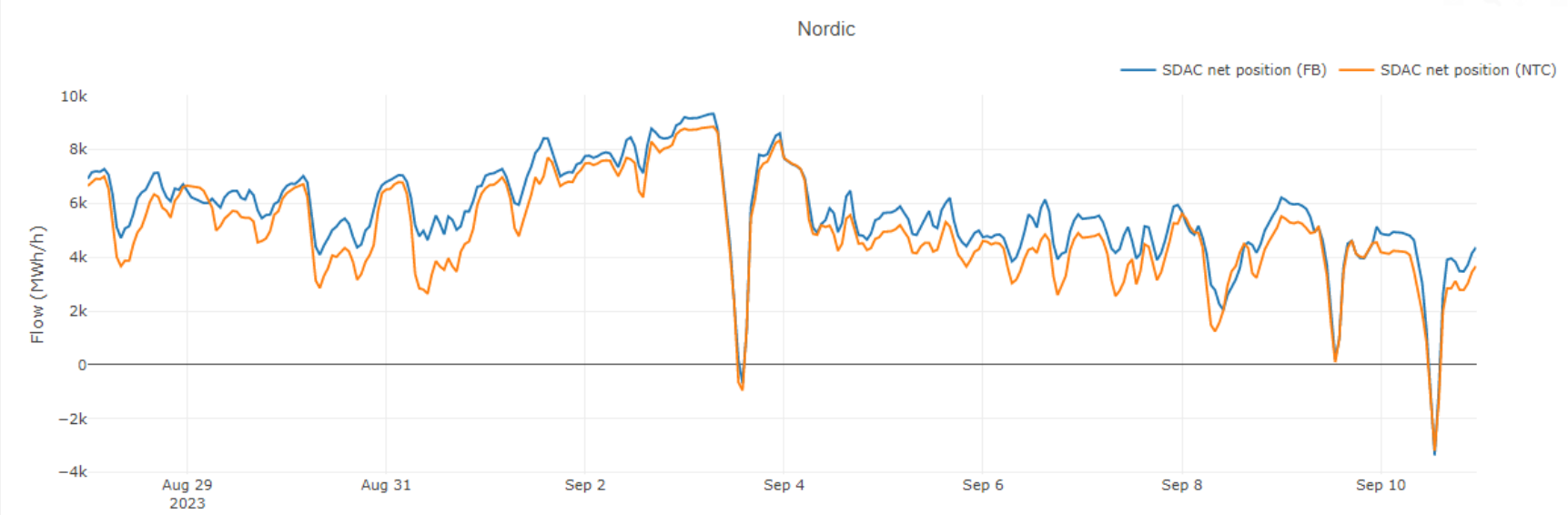
Net position impacts
W35-W36

- FB allows for more export to the continent, clear trend seen since beginning of April
- Generally net position increases in northern areas and decreases in southern areas

Top 5 largest changes in NP

BZs	Net position change FB-NTC (GWh)
SE1	196
SE2	154
NO2	-150
NO5	-89
NO4	73



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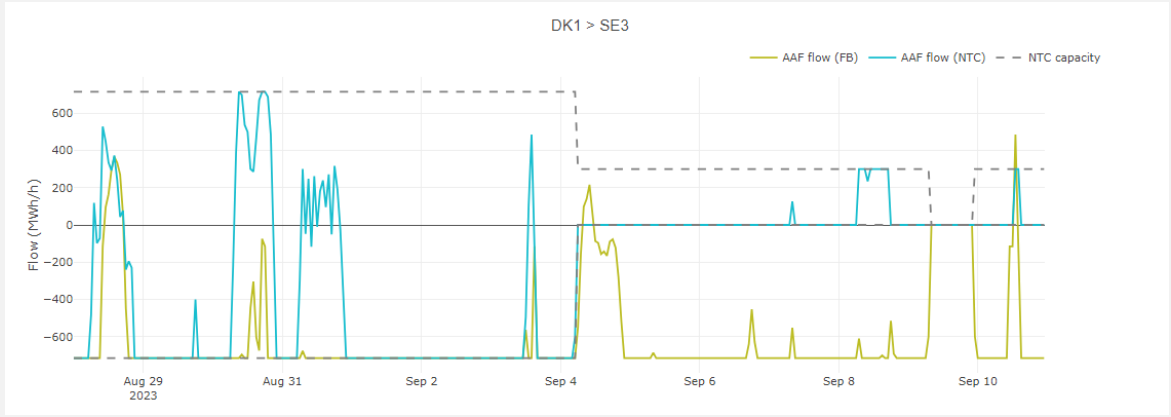
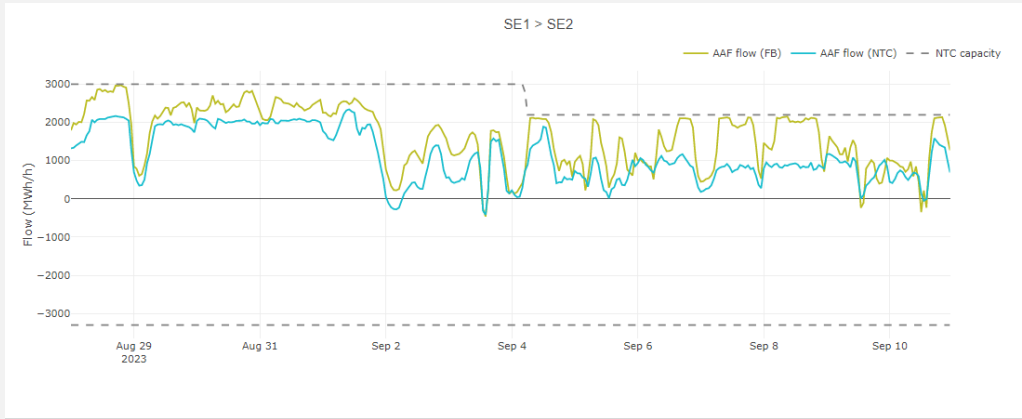
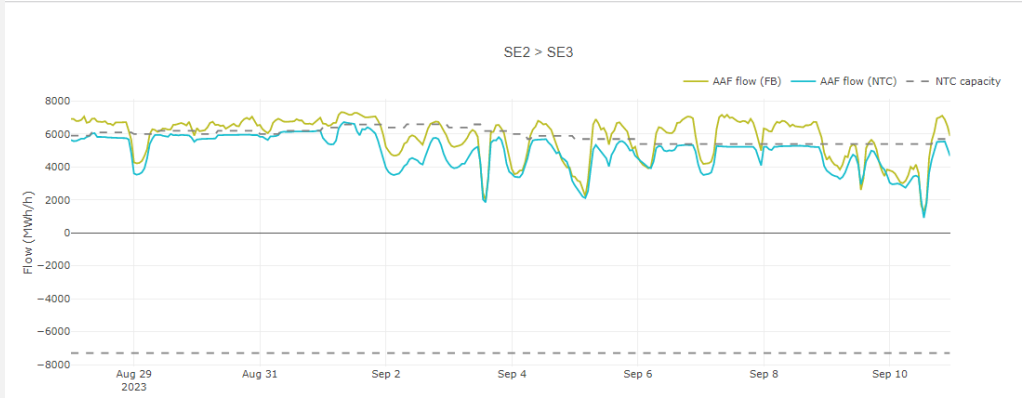
Flow impacts
W35-W36

- Biggest/most interesting changes in flows for internal and external borders
- DK1-SE3: FB enables a higher flow. In NTC internal maintenances limit the border flows.*







* https://www.nucs.net/outage-domain/unavailability-messages/show?ummId=23ffb6f569444856b89bab19194aae96%7C10X1001A1001A418

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Constraining CNECs in FB
W35-W36

CNEC	Count of hours	Average shadowprice	Total shadowprice	Internal CNEC	From area	To Area
13792_325 300 Mauranger-Blåfalli	259	167.7	43435.47	No	NO5	NO2
Swedish CNEC 1	97	237.34	23022.25	No	SE2	SE3
AC_Minimum_FI_EL	217	83.52	18122.87	No	FI	EE
DK2_SV_IMP	290	53.65	15557.29	No	DK2	SE3
Swedish CNEC 2	260	56.3	14638.97	No	SE4	PL
AC_Minimum_SE3_KS	271	53.43	14479.59	No	SE3	DK2
15316_11 40% 300 Minne-Frogner + 300 Roa-Ulven	50	229.56	11477.88	Yes	NO1	NO1
L5_11 40% 420 Tegneby-Hasle + 300 Røykås-Tegneby	56	182.71	10231.53	Yes	NO1	NO1
AC_Minimum_SE4_BC	138	56.05	7735.22	No	SE4	LT

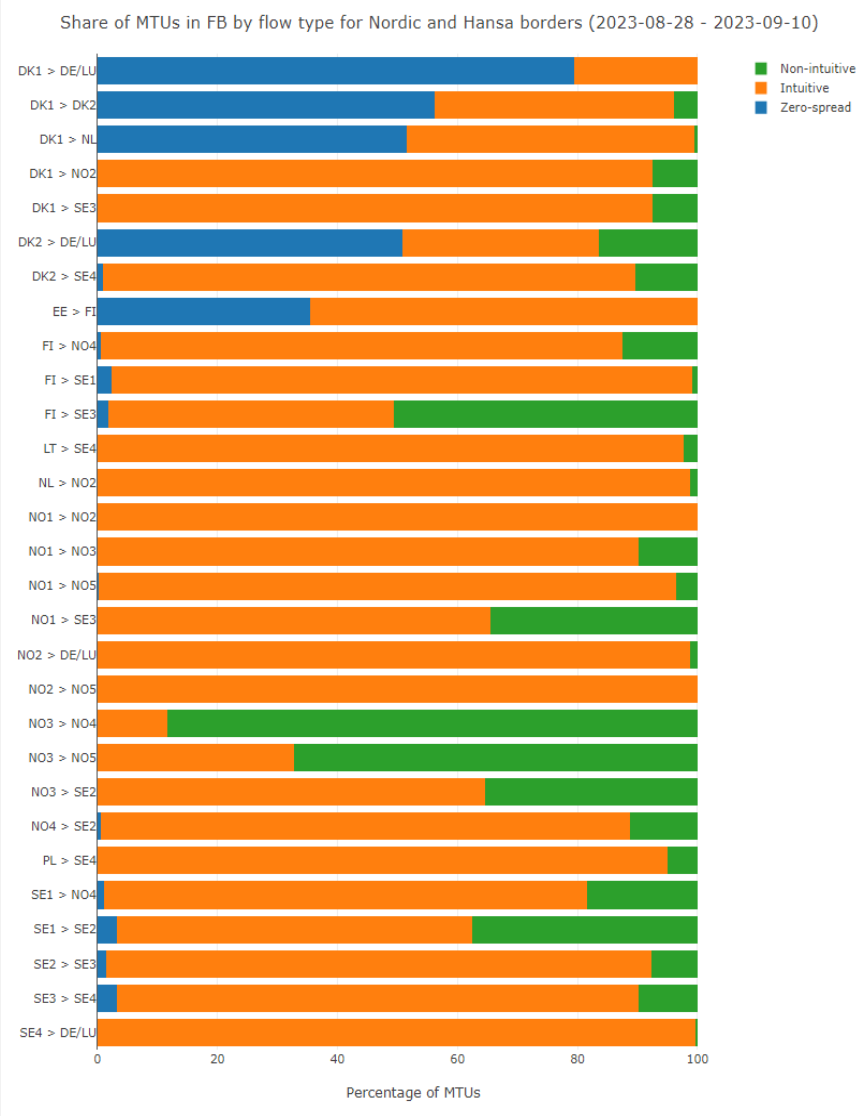
Non-intuitive flows
W35-W36

General remarks:

- Certain borders have high percentage of non-intuitive flows
- Price spreads between the areas are not high, when non-intuitive flows happen

<u>Highest percentage of non-intuitive flows and avg. price spread when flow in non-intuitive</u>

Border	Percentage	Avg. price spread
NO3 > NO4	88 %	12
NO3 > NO5	67 %	-10
FI > SE3	50 %	6
SE1 > SE2	37 %	-4
NO3 > SE2	35 %	14
NO1 > SE3	35 %	19
SE1 > NO4	18 %	-5



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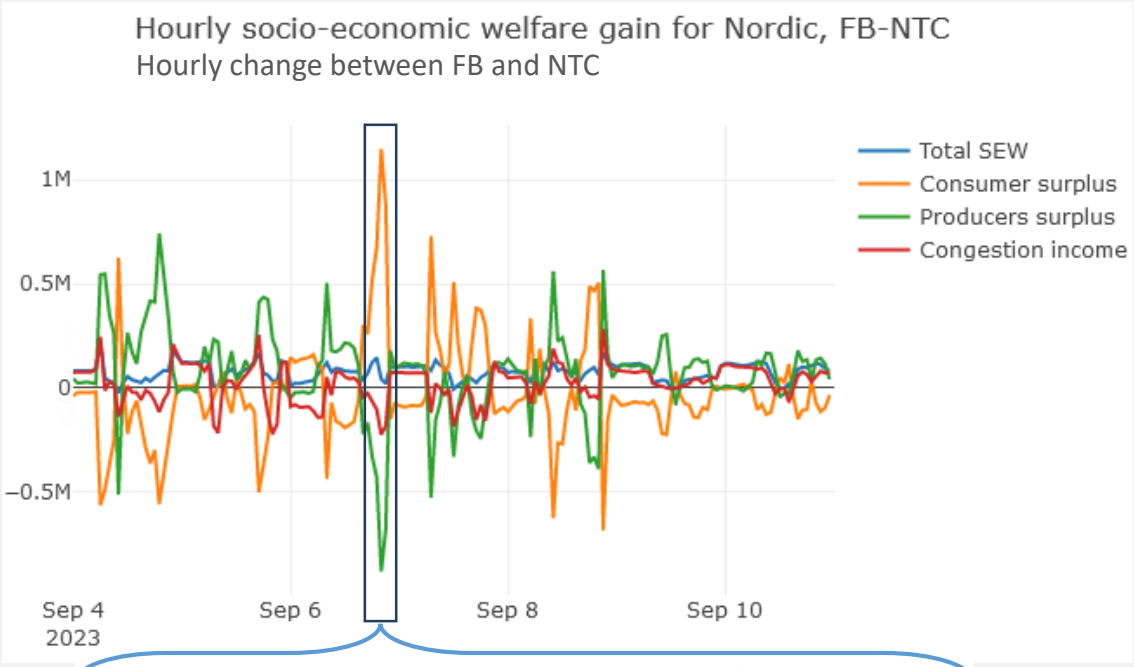
Specific hour walk through September 6th 20:00

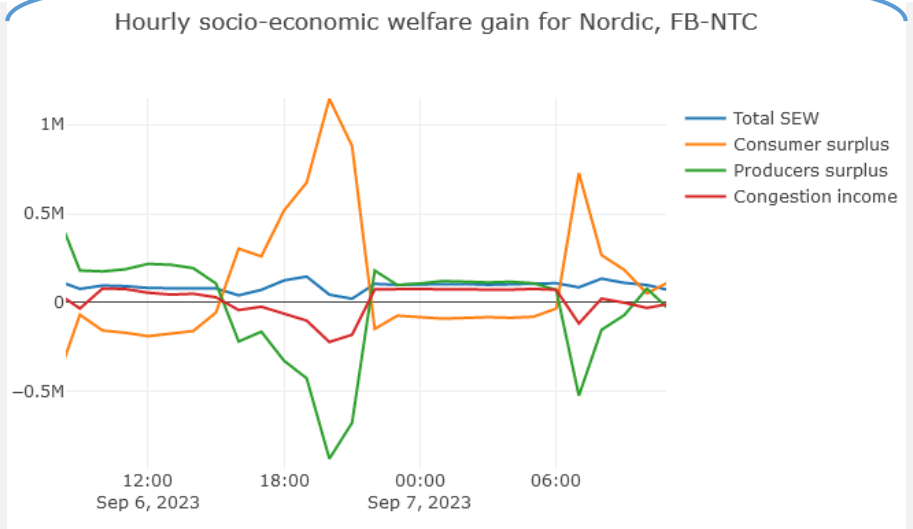
High consumer gain in the Nordics while electricity is exported to Continent.

- Price decreased in consumer dominated BZs. Especially in SE3, SE4 and FI

	Consumer	Producer	Congestion income	Sum
6.9.2023 at 20:00	+1,15M€	-0,88€M	-0,22M€	+0,04M€

- Total SEW below hourly average (W35-W36) due to less congestion incomes with FB





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Specific hours walk through September 6th 20:00

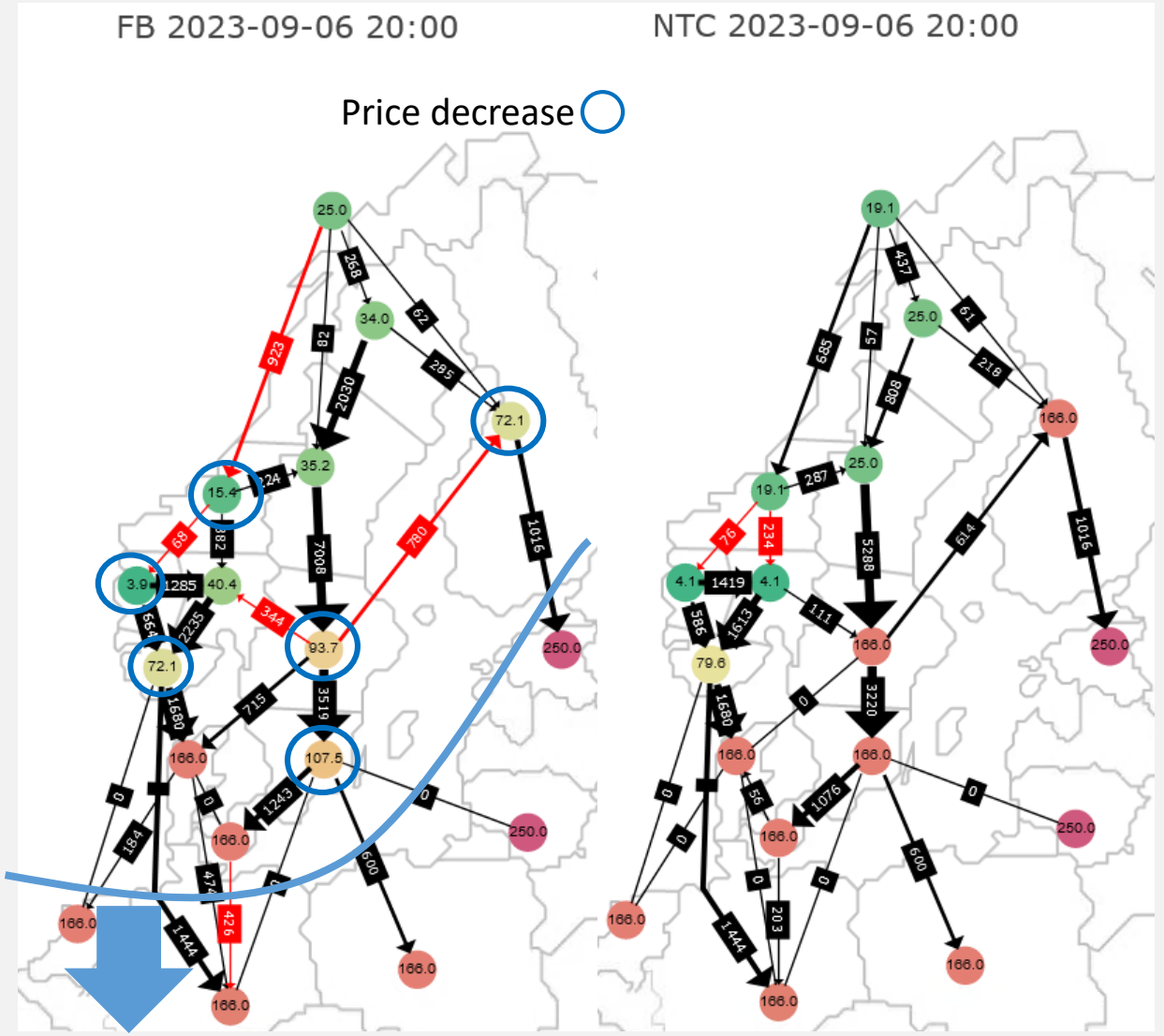
- High production essentially from SE1 and SE2.

BZ	Net position	*Price change%
SE1	+1457MW	+36%
SE2	+537 MW	+41%
NO4	+ 96 MW	+31%
NO1	+ 152 MW	+892%
FI	-234 MW	-57%
SE3	-83MW	-44%
SE4	-134MW	-35%

- Small change in net positions influence greatly to price change during this hour

  → This suggest very steep bidding curves (to be investigated more)

*Absolute change is not necessarily large



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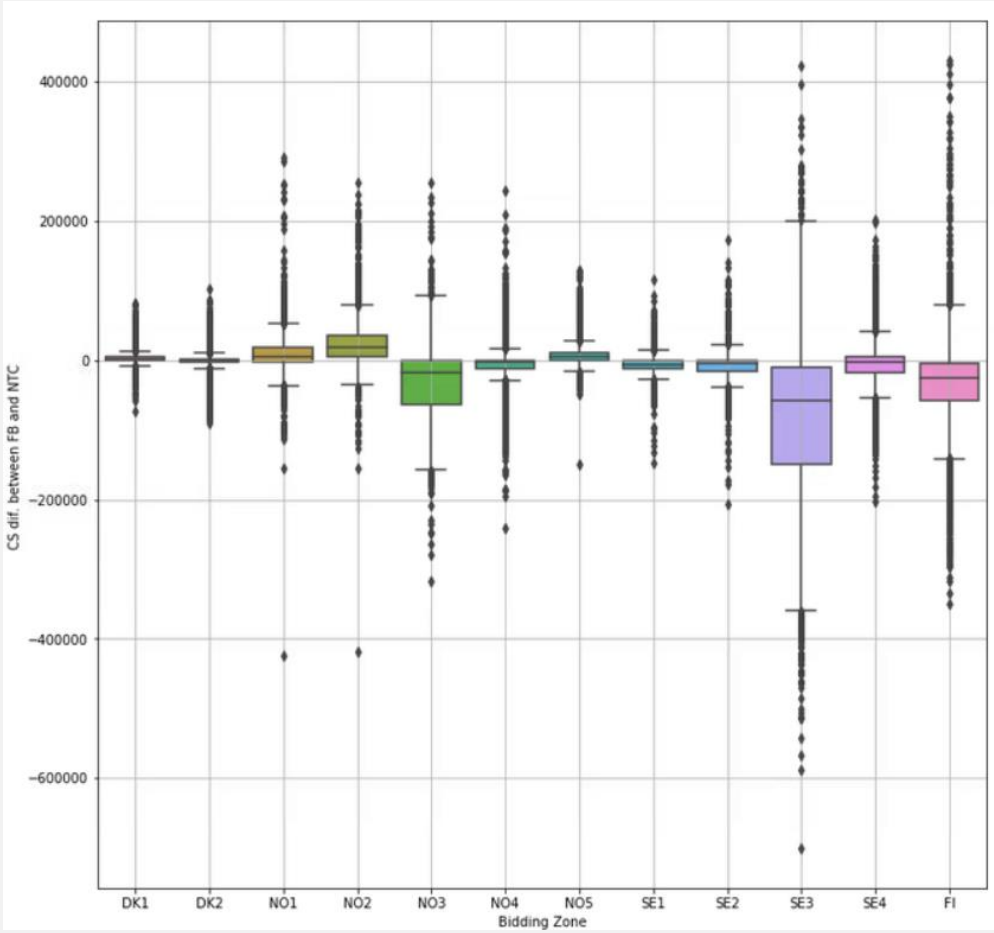
Consumer surplus impacts in the Nordic CCR

- Stakeholder requests for empirical analysis based on the 3-months NRA report.
- FB capacity calculation changes the market flows from NTC. For example:
  - FB allows for higher flows where economically most valuable (cf. SH meeting 28 Sep, East-West flows in SE3)
  - Non-intuitive flows
- This will have a redistribution effect between producers and consumers in the affected bidding zones.
- Positive total SEW
  - W10-W30: +113 M€ (Nordic) and +141 M€ (SDAC)
- Total consumer surplus typically decreases. This cumulates mainly from certain bidding zones: SE3, also FI and NO3.

Consumer surplus impact from FB (W10-W30, 2023)



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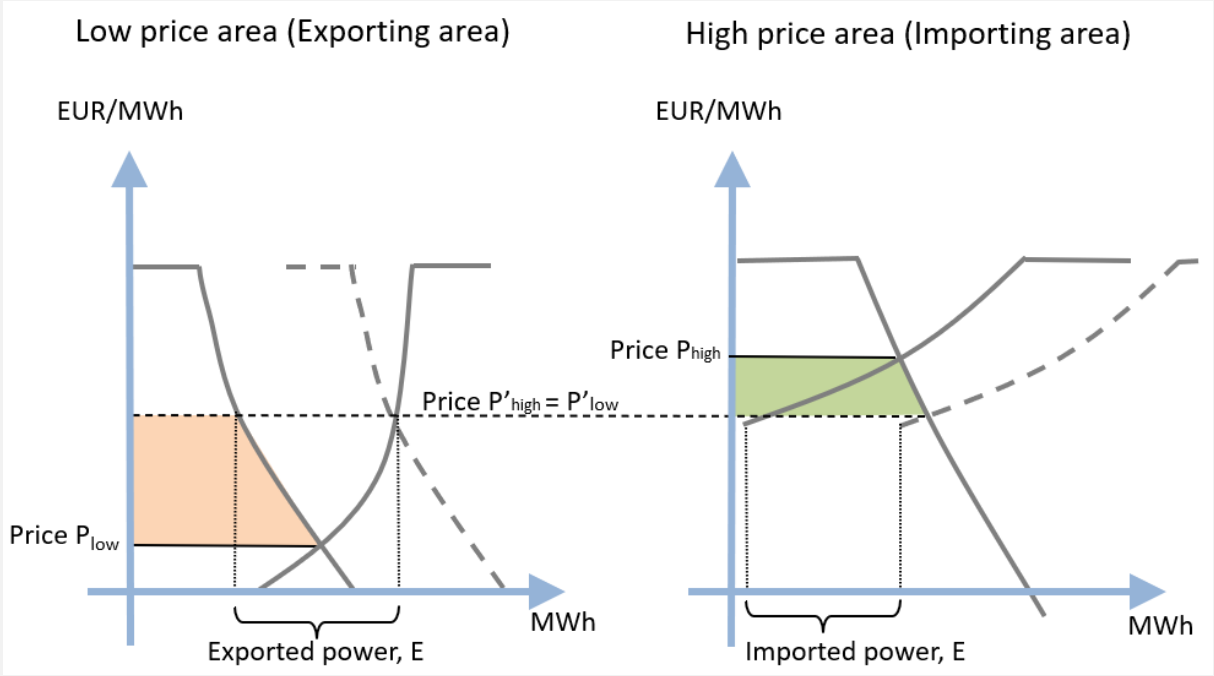
Consumer surplus impacts: theoretical perspective

- Exporting bidding zone: higher price + decrease in consumer surplus
- Importing bidding zone: lower price + increase in consumer surplus
- If the consumer loss in the export area is higher than the created consumer benefit in the import area, consumers lose in total. Total SEW still increases.*
- The slope of the supply and demand curves affects the results – but we as TSOs do not have access to this data.



*Unless FB domain is smaller, or SDAC algorithm Euphemia finds worse or fewer solutions.

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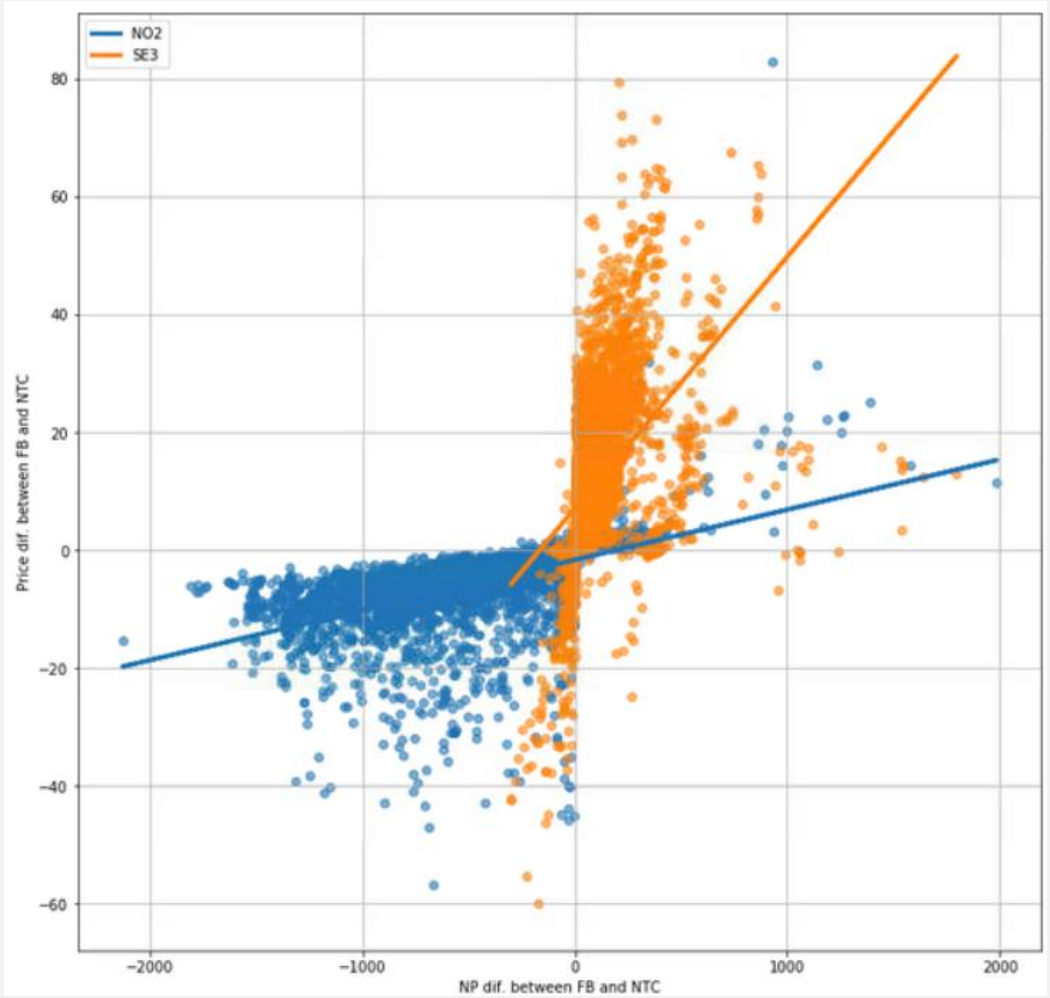
Consumer surplus impacts: empirical perspective

- Case SE3-NO2:
  - SE3 and NO2 are the two extremes in the consumer surplus impacts.
  - South of Norway has been more expensive than SE3. FB allows for higher flows from SE3 than NTC.
- Net position and prices typically increase in SE3 and decrease in NO2 with FB.
- SE3 price impacts are high with moderate net position changes, and vice versa for NO2. For example, on average, a change of 100 MW in net position results in
  - 4.3 €/MWh price impact in SE3
  - 0.9 €/MWh price impact in NO2

Price and net position impact from FB (W10-W30, 2023)



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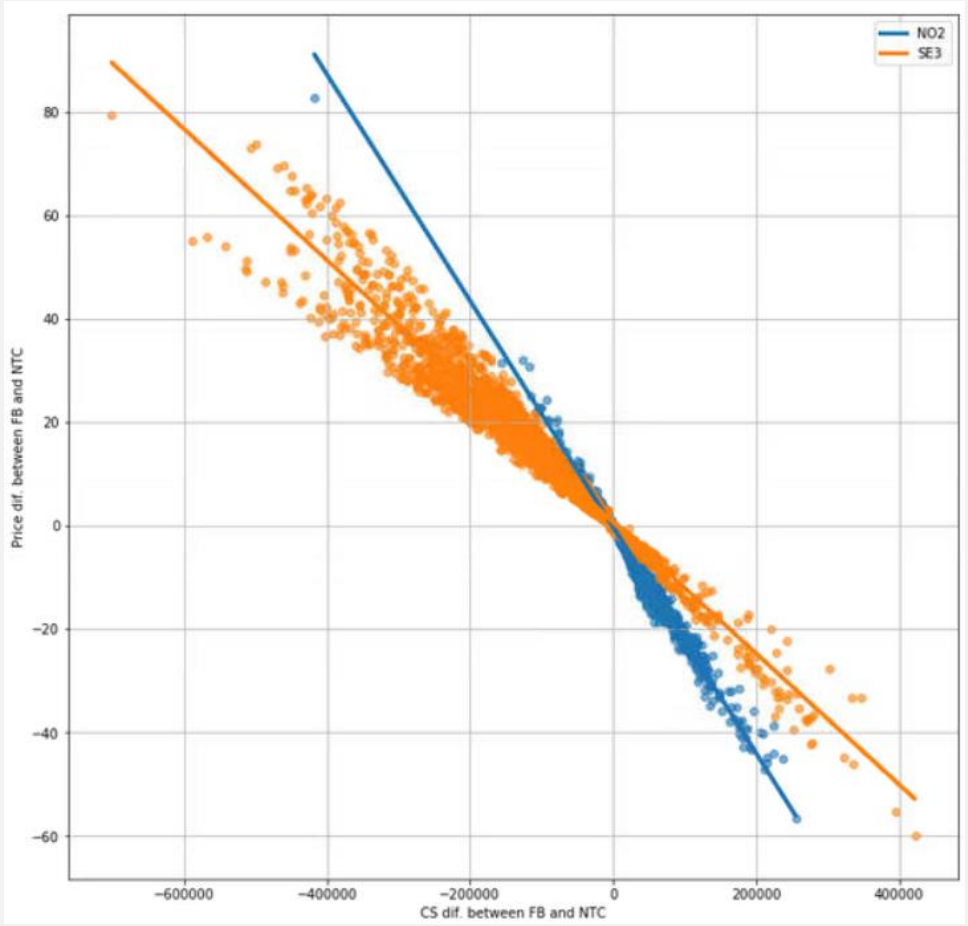
Consumer surplus impacts: empirical perspective

- A similar price change in SE3 impacts consumer surplus more than it does in NO2.
- For example, on average, a change of 20 €/MWh in price results in
  - 157 k€ change in SE3 consumer surplus
  - 91 k€ change in NO2 consumer surplus
- For these two bidding zones, the total consumer surplus decreases.
- For the Nordic CCR and SDAC the total consumer surplus decreases, although total SEW increases.

Price and consumer surplus impact from FB (W10-W30, 2023)



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Consumer surplus impacts: conclusions

- This analysis will be published soon in the phenomena report that is published on RCC website.
- The result is not a deterministic outcome of FB over a longer time horizon but depends, for example, on
  - Changes in flows
  - Bidding (supply and demand) curves
  - Market situation and price spreads
- We will continue to monitor and report on the findings related to this topic.

Thank you!

- Questions, comments?
- Contact: ccm@nordic-rcc.net

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