3. Biweekly EPR result presentation

Nordic CCM Stakeholder Meeting

26 October 2023

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Agenda

1. Introduction
2. Updates since last meeting
3. Flow-based impacts on
   - Socio-economic welfare (SEW)
   - Prices
   - Net position
   - Bid/sell volumes
   - Border flows
4. Constraining CNECs in FB
5. Specific hour walk through:
   1. Price convergence in the Nordics (SE3 & SE4)
   2. NO1->NO2

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

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

Updates since last Bi-weekly SH meeting

- The impact of “too high capacity NO1-NO2” (Will be elaborated on in this presentation)
- Mauranger-Blåfalli impact on East-West and North-South flow (Will be included in the presentation)
- Inclusion of Bid/Sell curves in the Bi-weekly presentations (Will be included in this presentation)
- FAAC NTC flows were incorrect for W31-35 in the published data.
  - Appendices for week 31-35 have been updated to show the correct FAAC flow in NTC.
  - The error stems from applying the estimated flow on South West Link incorrectly in NTC.
- FAAC NTC flows has been incorrect in the market simulation results file published on the RCC website since week 31
  - Error caused by the same error as mentioned above but was applied for the entire EPR period
- Water value discussion
  - The focus of the EPR is to compare the two capacity calculation methodologies and if flow-based can create more SEW using the same market bids, hence the TSOs will not try to estimate the value of the extra water usage or try to alter the bids.
  - The goal with implementing flow-based is to increase the grid utilization and increase the total SEW.

Social welfare change week 37-38

- Flow-based results in a higher SEW compared to NTC for both the Nordic region and the whole market coupling region (SDAC).
  - Total Nordic SEW change 10 M€
  - Total SEW change in the SDAC region 19 M€
- Flow-based provides a gain for both consumers and producers in the Nordic region, and a gain for consumers when looking at the whole SDAC

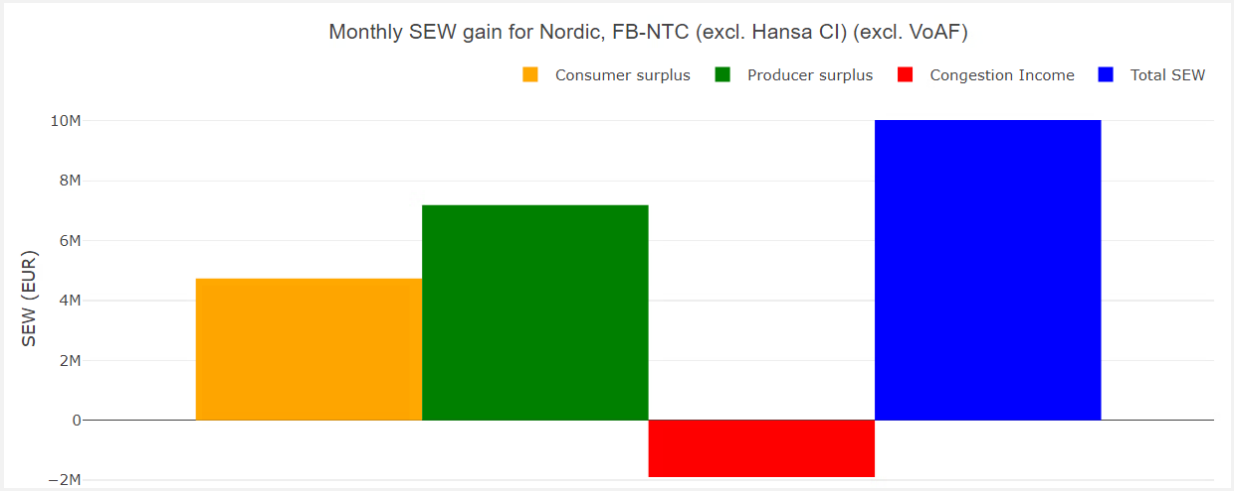

Figure: SEW change in Nordic

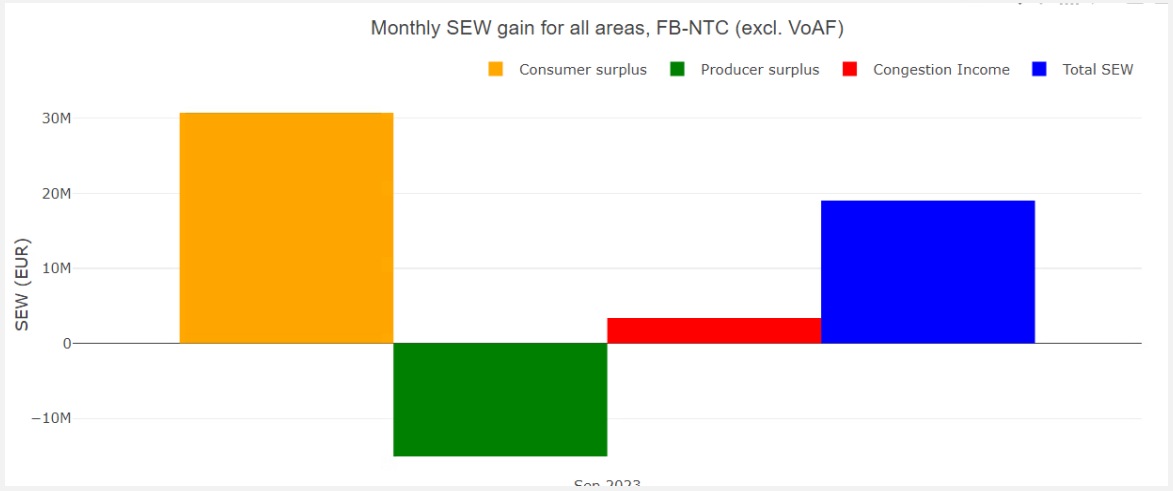

Figure: SEW change in the whole SDAC region

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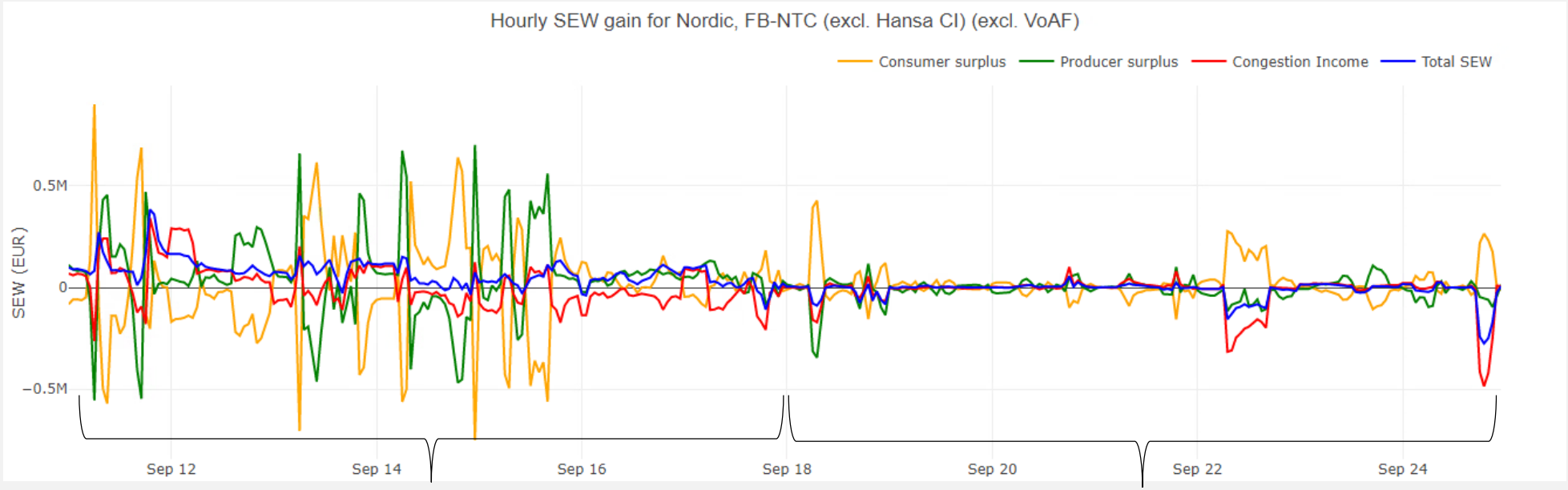
Socio economic welfare on hourly level week 37-38

- Large gains of consumer surplus and producer surplus in FB outweigh the hours with losses
- The volatility of welfare change is larger in week 37 than in 38
- Large amount of wind and relatively low load due to mild weather during both weeks
- Very few internal constrains in the Nordic grid causing the welfare changes being smaller during week 38



Week 37

Week 38

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SEW Impact on country level week 37-38

- The total SEW for all Nordic countries is positive this period
- In Denmark, and Finland the consumer surplus is higher with FB than NTC, while the opposite is true for Norway. For Sweden, both consumer and producer surplus is positive.
- More CI with FB than NTC in Denmark and Norway, and less in Sweden. Small difference in Finland

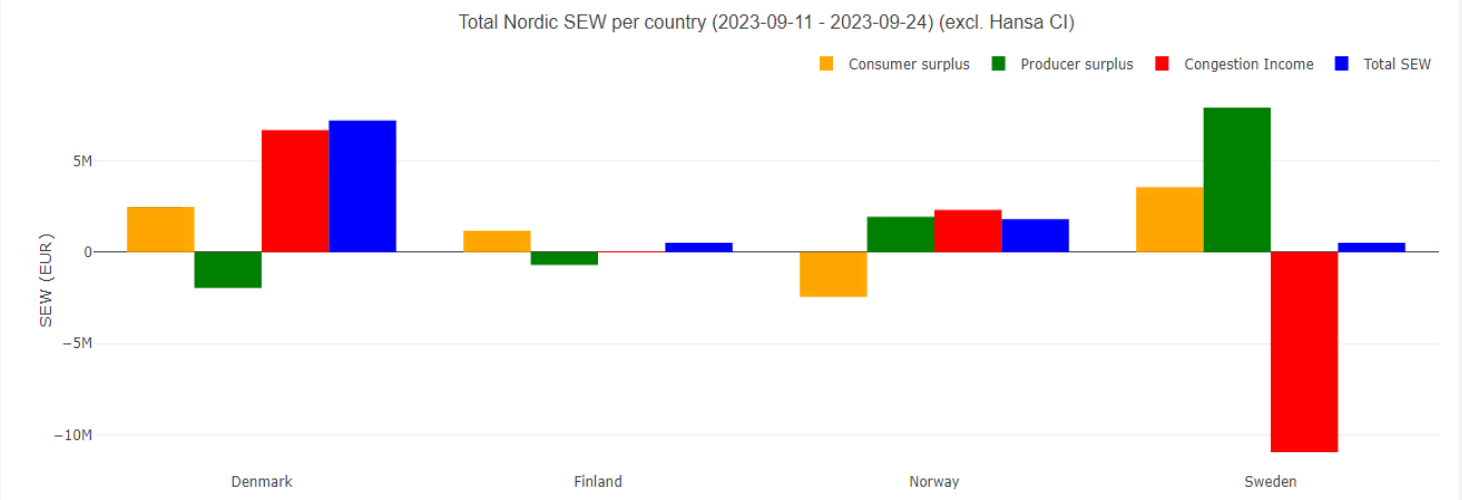

Figure: SEW change on stakeholder level in CCR Nordic per country

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SEW Impact on bidding zone level week 37-38

- The impact on the different parts of the SEW from FB differs significantly between the Nordic bidding zones.
- Largest positive total SEW change in DK1, DK2, NO5 and SE2. Largest negative difference in SEW is observed in NO2 and SE3.
- FB results in a large gain for consumers in NO2, SE4, while the consumers in NO1 experience the biggest loss with FB compared to NTC.

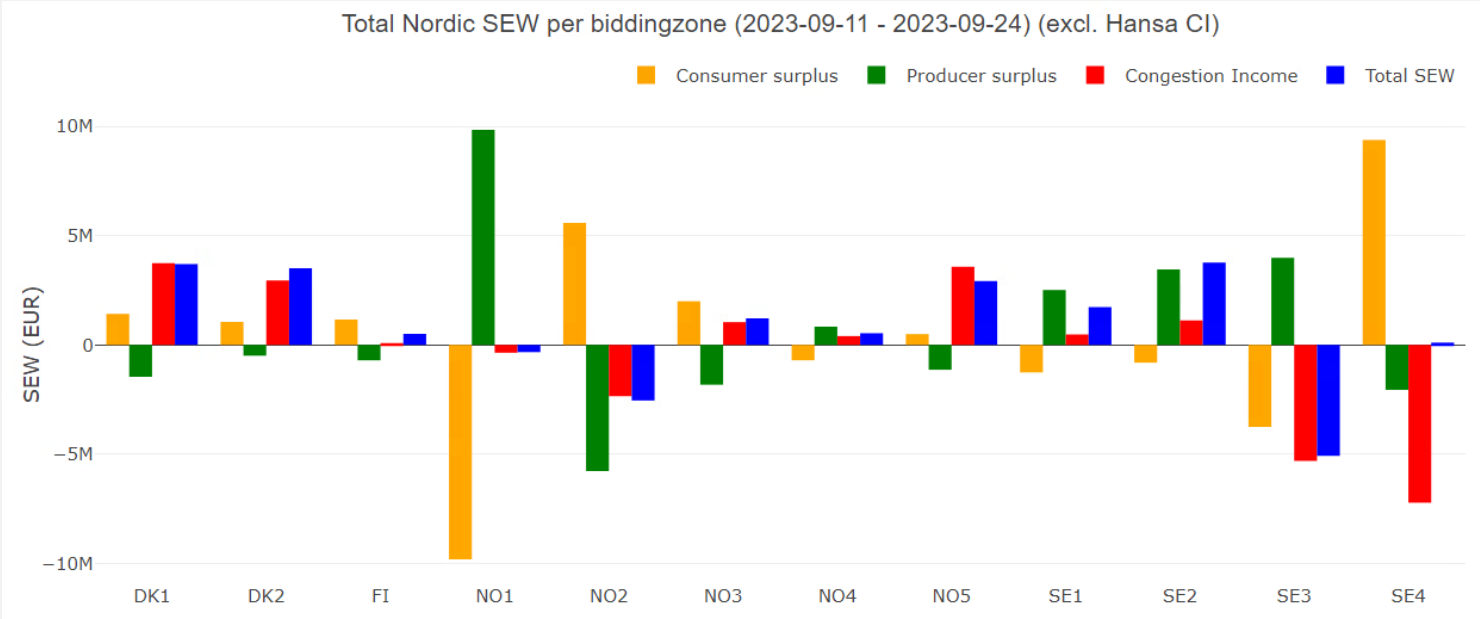

Figure: SEW change per stakeholder in CCR Nordic per BZ

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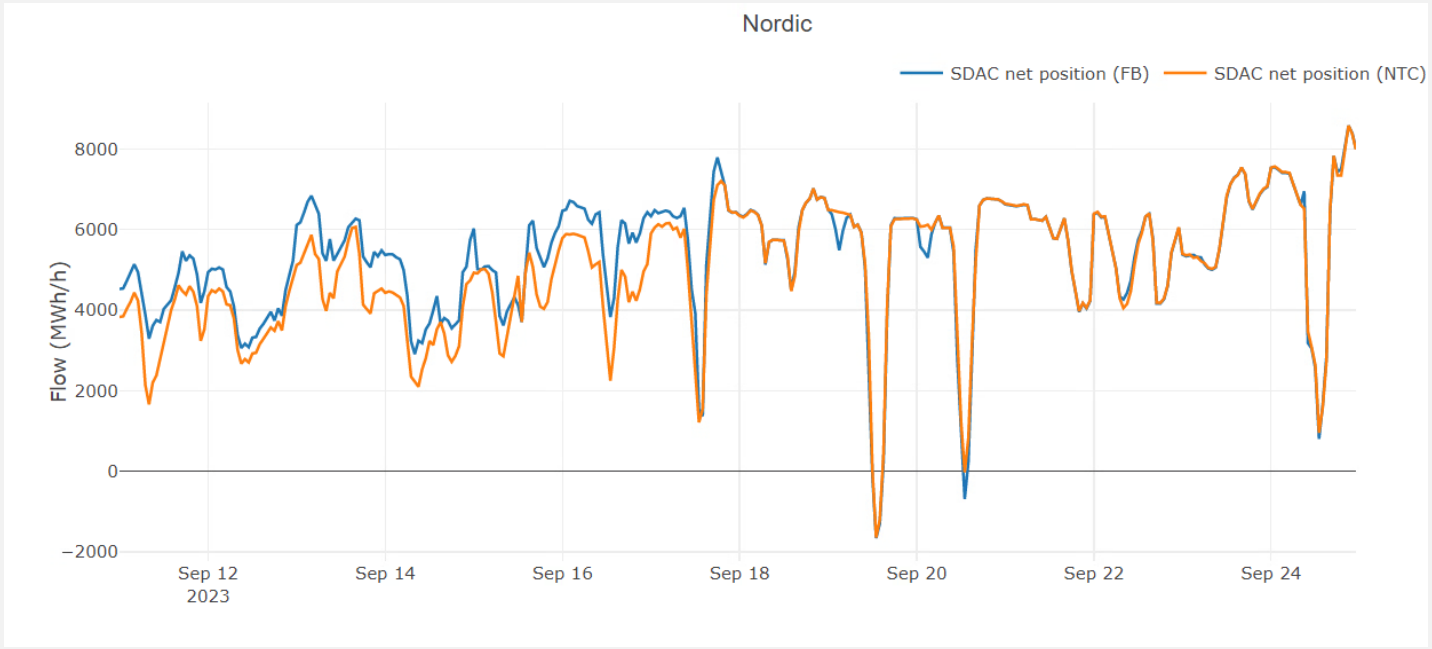
Net position impacts week 37-38

- FB allows for more export to the Continent also for this week, 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)
NO2	-126
SE1	126
SE2	106
NO5	-89
NO1	60

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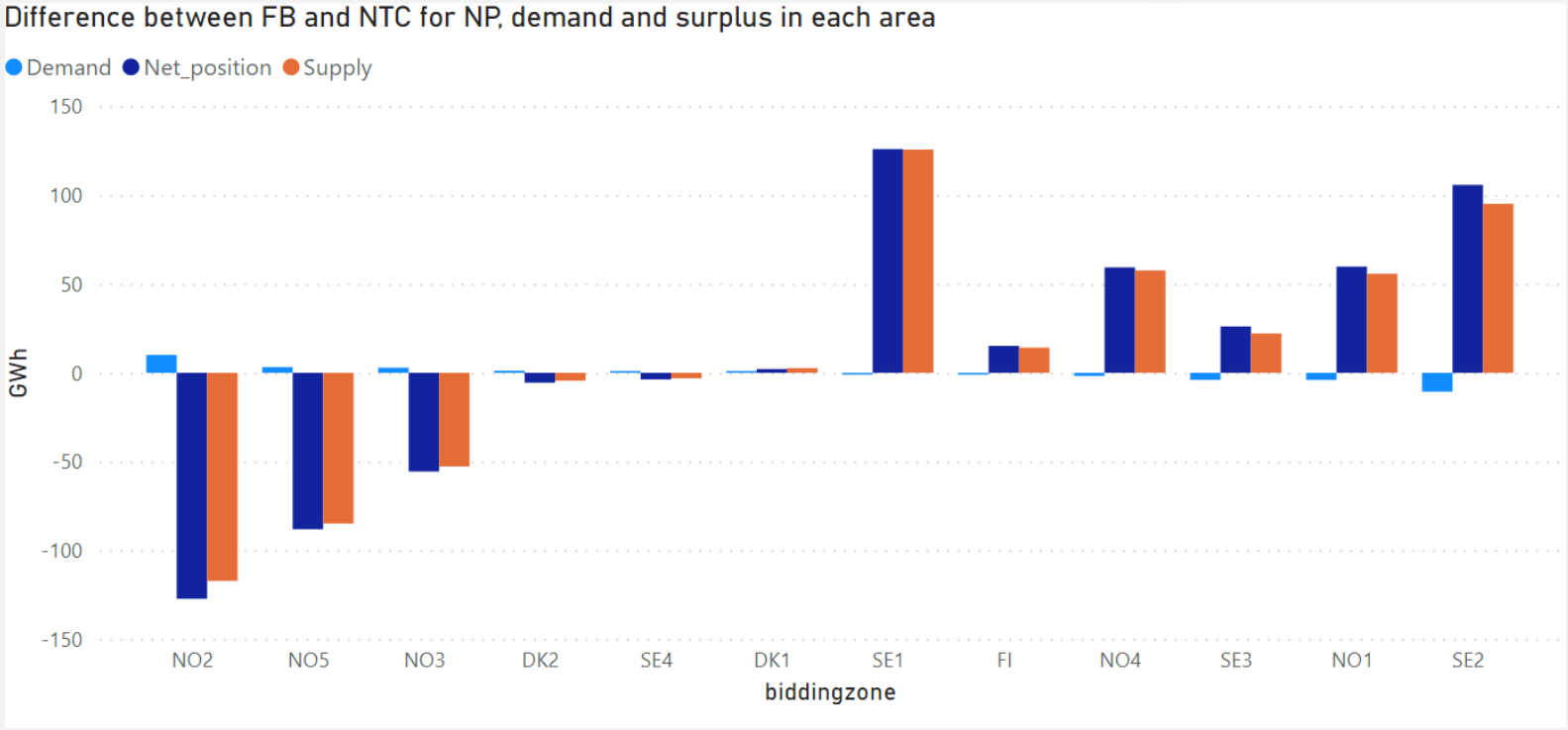
Change in bid/sell volumes

- Biggest difference is noted in NO2, NO5, SE1, and SE2
- Mostly the change in supply volumes that are impacting the changing net positions in the bidding zones



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Prices week 37-38

- 6 out of 12 bidding zones in the Nordics get lower average prices with FB than NTC
- Low prices for many hours the Nordics during the period, in particular during week 38
- SE4 sees a drop in price of 16 Euro/MWh and NO1 an increase with 11 Euro/MWh

Bidding zone	Min. price		Max. price		Avg. price		
	FB	NTC	FB	NTC	FB	NTC	FB-NTC
DK1	-5	-6	440	524	77	79	-2
DK2	-4	-3	440	524	78	80	-2
FI	-5	-4	406	300	33	34	0
NO1	-6	-5	45	5	11	0	11
NO2	-5	-5	90	87	39	43	-4
NO3	-5	-4	17	18	5	7	-2
NO4	-5	-4	27	18	9	7	1
NO5	-5	-5	5	5	-1	0	-1
SE1	-5	-4	42	27	11	8	4
SE2	-5	-4	37	27	9	8	2
SE3	-5	-4	198	230	22	20	2
SE4	-5	-4	264	277	34	50	-16

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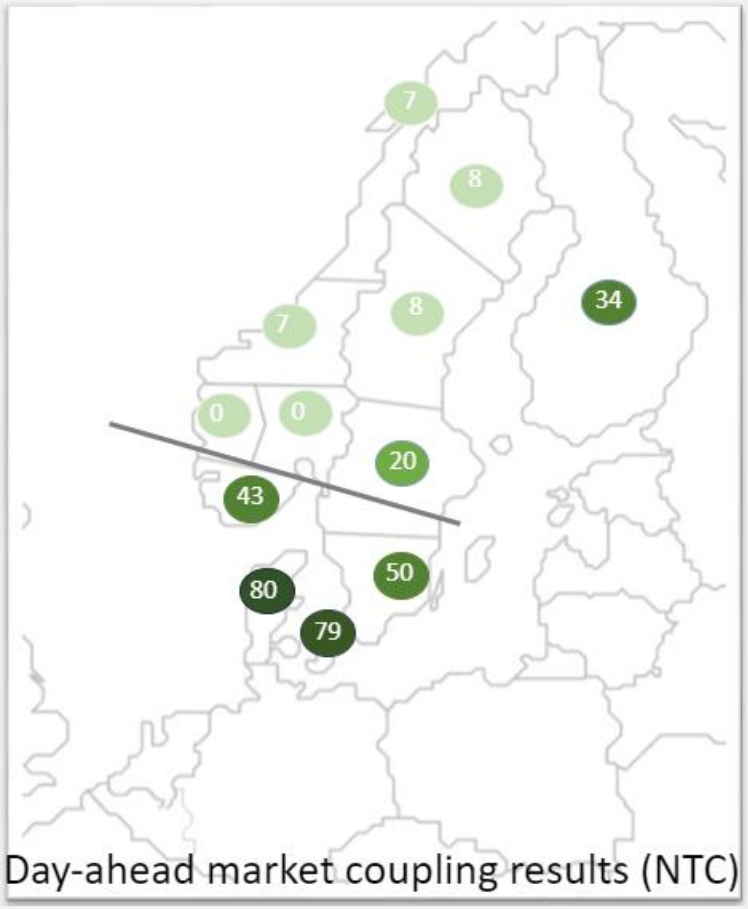
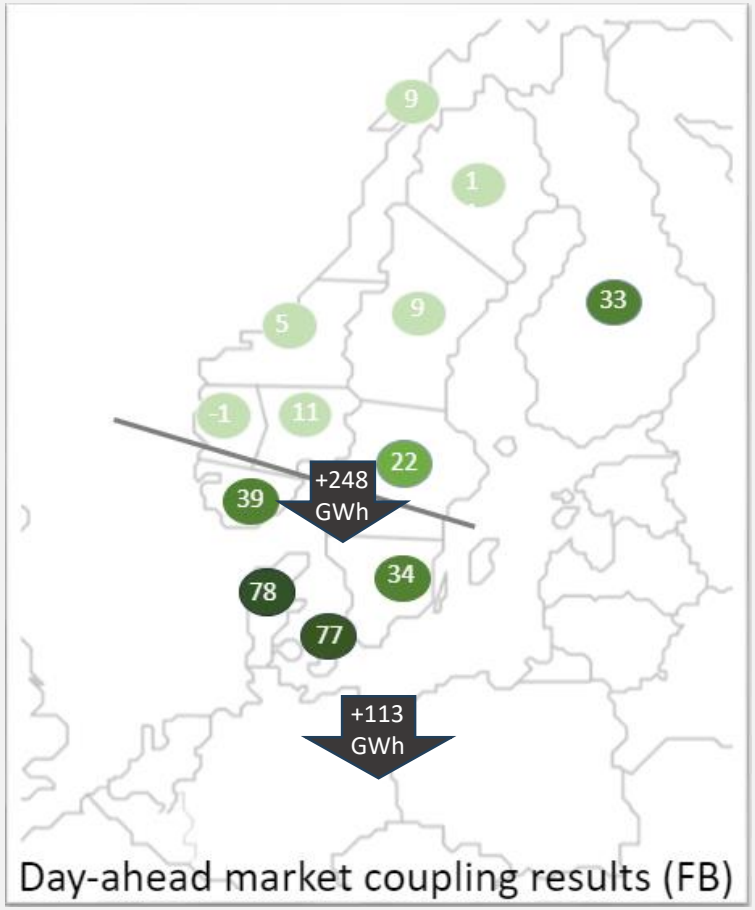
Average prices in the Nordic region week 37-38

- On average, low prices
- Split between northern Nordics and southern Nordics
- Highest prices bidding zones (NO2, DK1, DK2 and SE4) gets lower prices with FB
- 113 GWh (7%) more export from the Nordics with FB than NTC
- 248 GWh (15%) more to the Nordic high price areas from the Nordic BZs with lower price*

*NO1-NO2, NO5-NO2, SE3-DK1, SE3-SE4



Day-ahead market coupling results (NTC)



Day-ahead market coupling results (FB)

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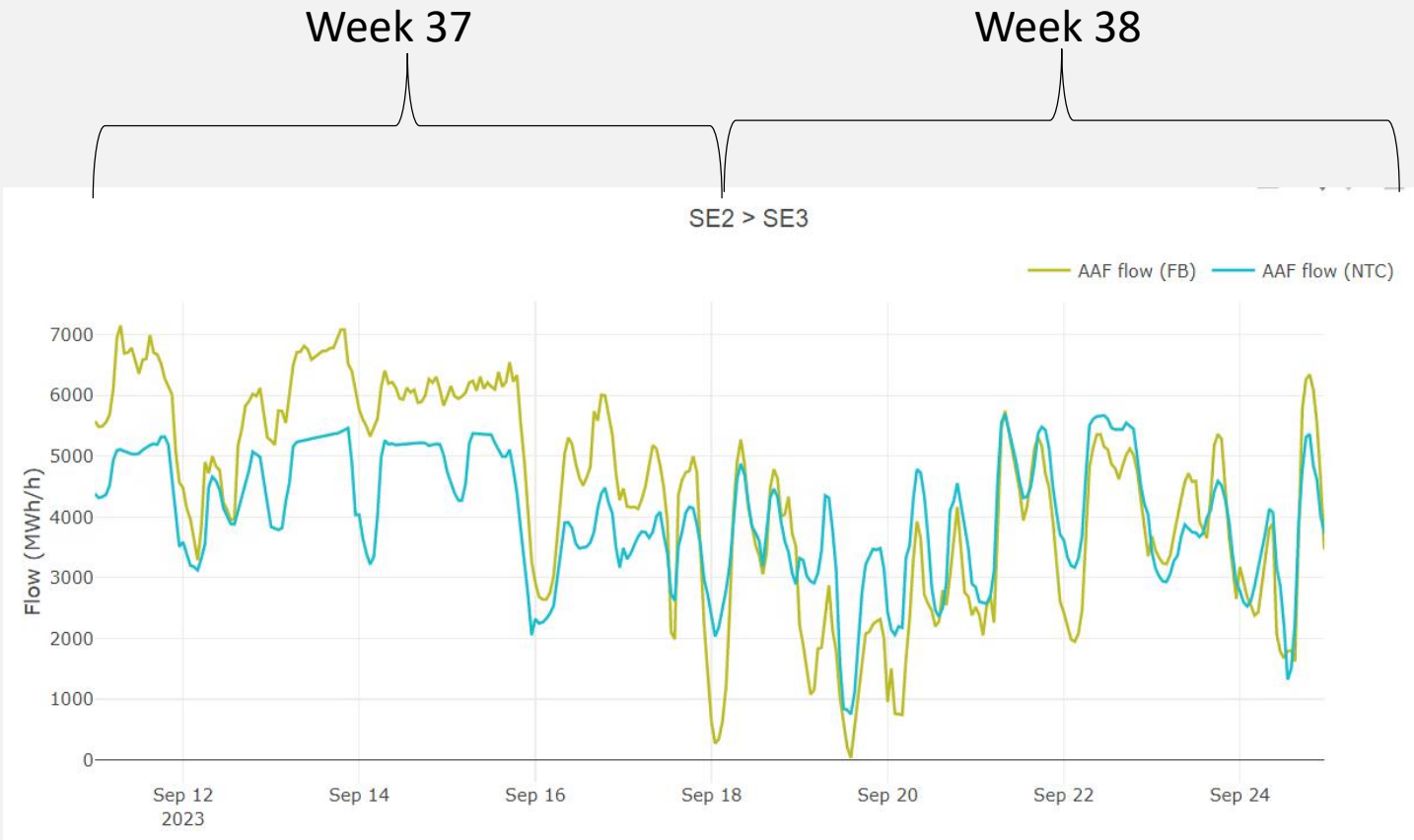
Flow impacts SE2-SE3 week 37-38

- More flow between SE2-SE3 during week 37, same trend as previous weeks.
- For week 38, less flow between SE2-SE3 is needed due to large amounts of renewables in the southern Nordics



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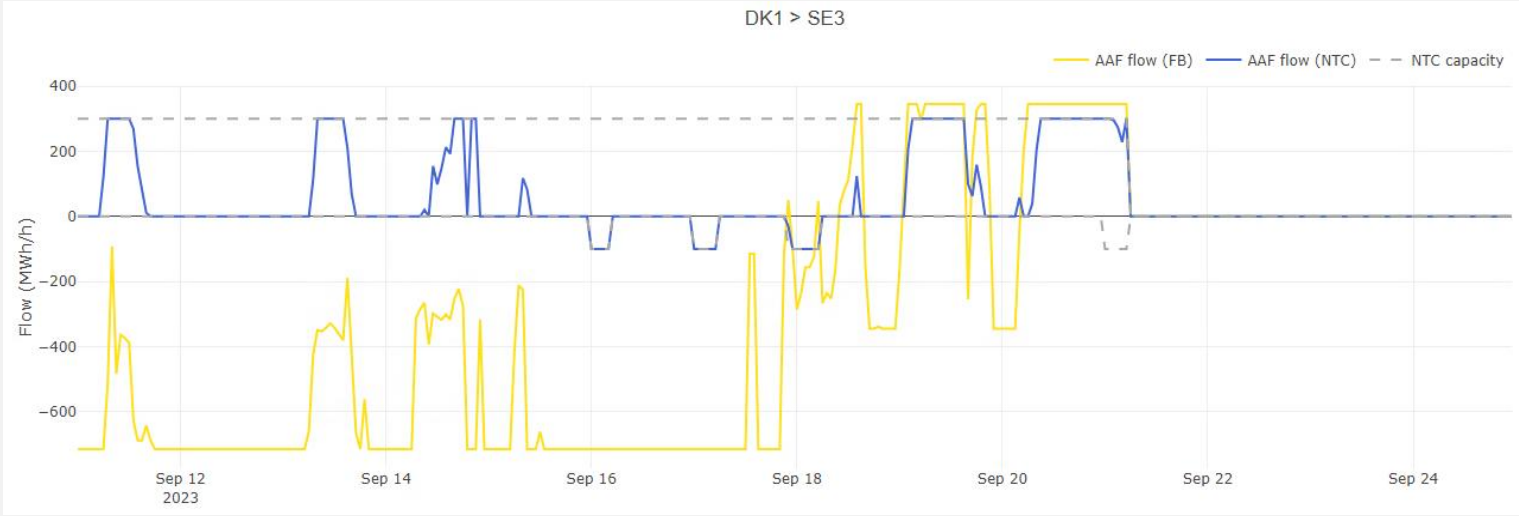
Flow impacts DK1-SE3

- The capacity on DK1-SE3 in NTC was reduced during week 37 and large parts of week 38*
- FB manages to find a solution outside the NTC domain for the flow between DK1 and SE3



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

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Constraining CNECs in FB week 37-38

- The CNECs with highest shadow prices are mostly HVDC interconnectors connecting the Nordics to the continent
- Higher shadow prices indicate that more flow to the continent would have increase the total SDAC welfare

CNEC	Count of hours	Average shadowprice	Total shadowprice	Internal CNEC	From area	To Area
AC_Minimum_FI_EL	282	103.07	29065.47	No	FI	EL
Swedish CNEC 1	76	265.54	20180.88	No	SE2	SE3
AC_minimum_SE4_NB	207	86.25	17854.69	No	SE4	LT
Swedish CNEC 2	198	85.64	16955.75	No	SE4	PL
AC_Minimum_NO2_ND	276	56.72	15653.85	No	NO2	NL
DK2_SV_IMP	224	66.46	14886.94	No	DK2	SE4
AC_minimum_SE4_BC	279	51.46	14357.23	No	SE4	DE
Swedish CNEC 3	79	175.78	13886.97	Yes	SE3	SE3
13792_325 300 Mauranger-Blåfalli	197	67.31	13260.72	No	NO5	NO2
AC_minimum_NO2_SK	172	56.89	9784.44	No	NO2	DK1

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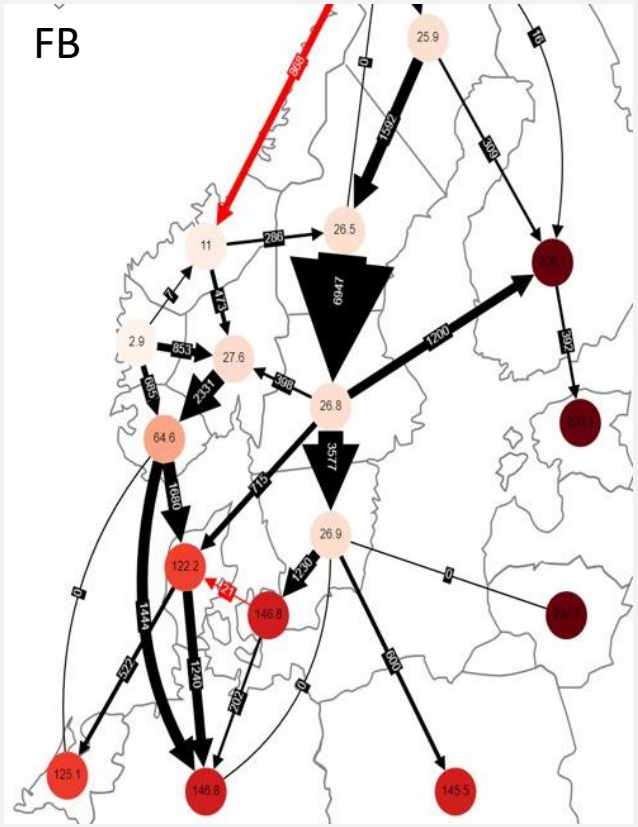
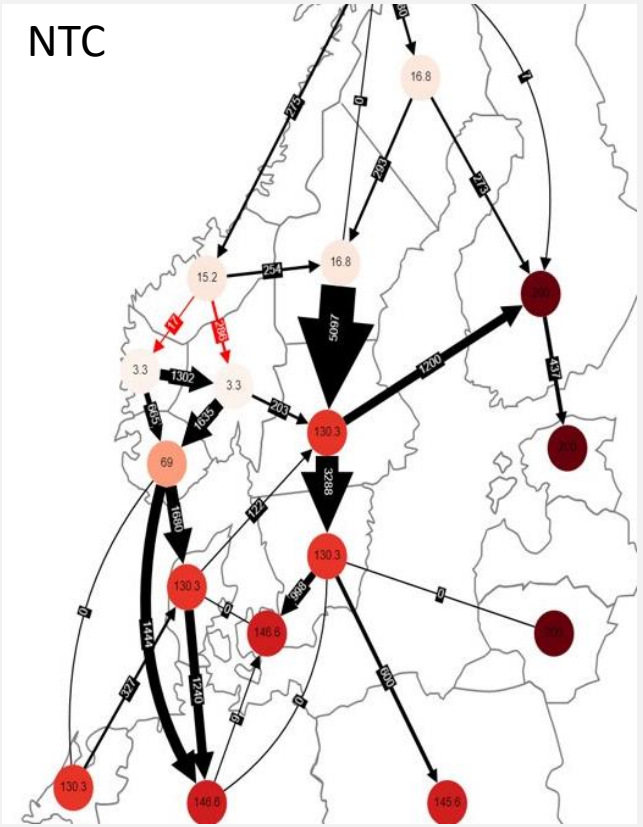
In-depth walk-through of market situations

- Price convergence in the Nordics (SE3 and SE4)
- NO1-NO2 flows

Price convergence in the Nordics in FB
11 September 6:00-7:00

- Lower prices in SE3 and SE4
- Higher prices in NO1 and SE2
- Change in NP of 420 MW in SE3 and SE4
- Price change of 103 EUR/MWh.
- Also decreases prices in DK1 and NO2





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Deep-dive 11/9 hour 6-7

- Maintenance on internal CNEs in SE3 limited the capacity in NTC between NO1->SE3 and SE3->DK1.
- In FB this was possible in a more efficient way that allowed a much higher flow from SE2 -> SE3. That decreased the price in SE3 and SE4.
- Total SEW is positive for both the Nordics and SDAC, with a positive consumer surplus

Deep-dive 11/9 hour 6-7

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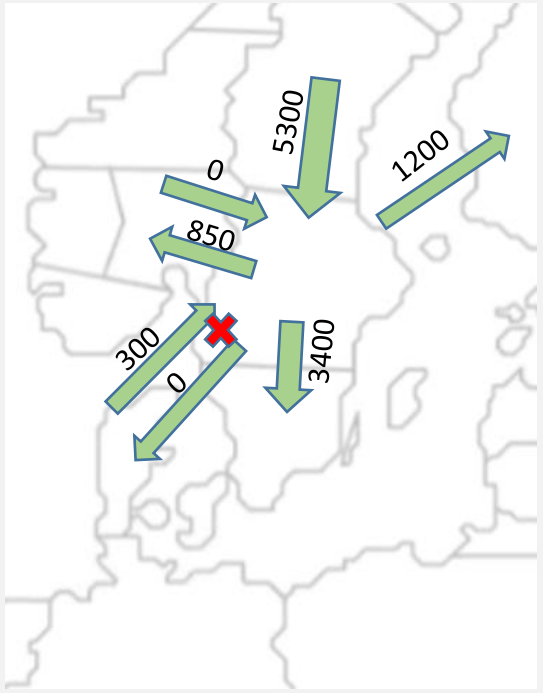
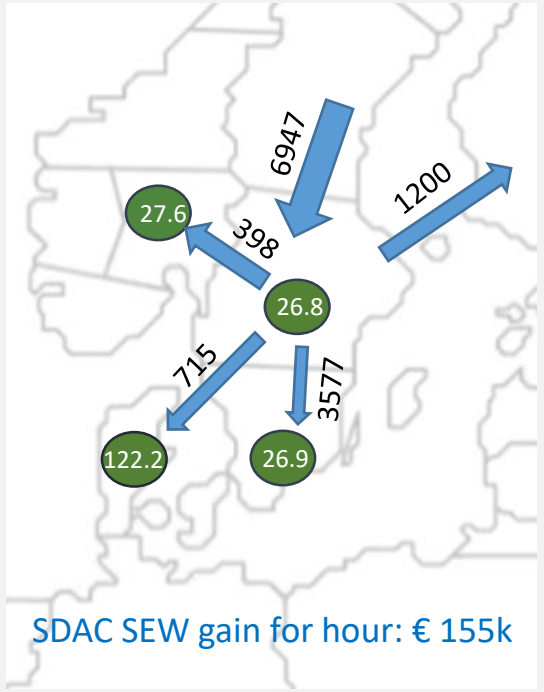
NTC capacities

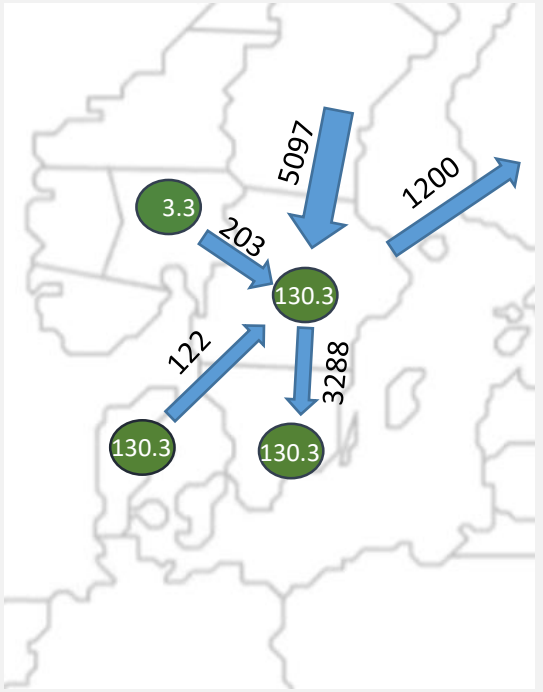


FB flow (AAF)



SDAC SEW gain for hour: € 155k

NTC flow (AAF)



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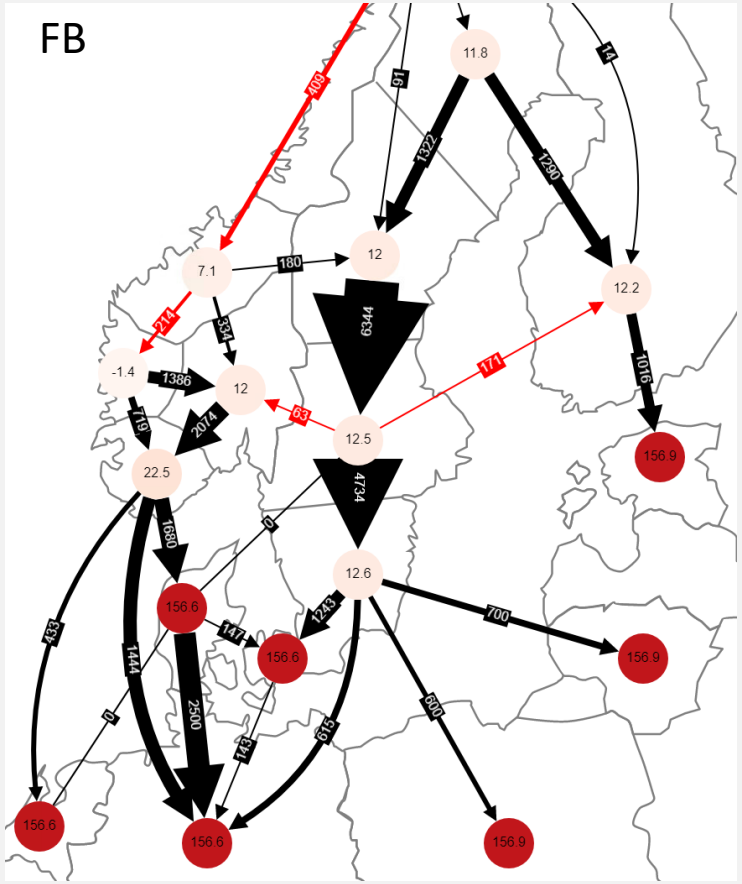
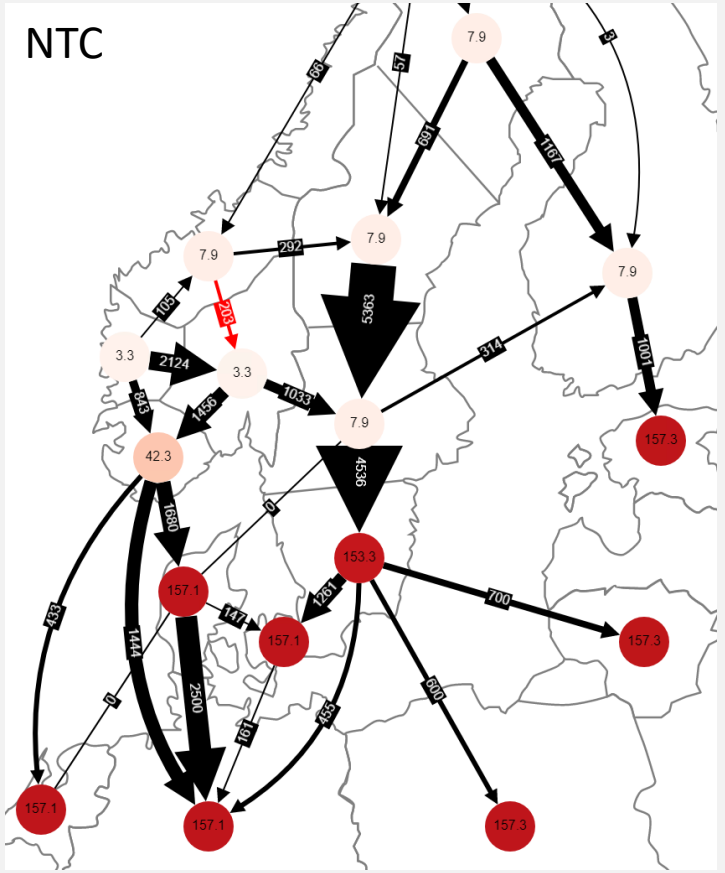
Price convergence in the Nordics in FB
24 September 19:00-20:00

- Reduced prices in SE4 – consumer gain
- Slight increase in SE3 prices
- 20 MW change in NP on SE4
- Price change of 140.7 €/MWh





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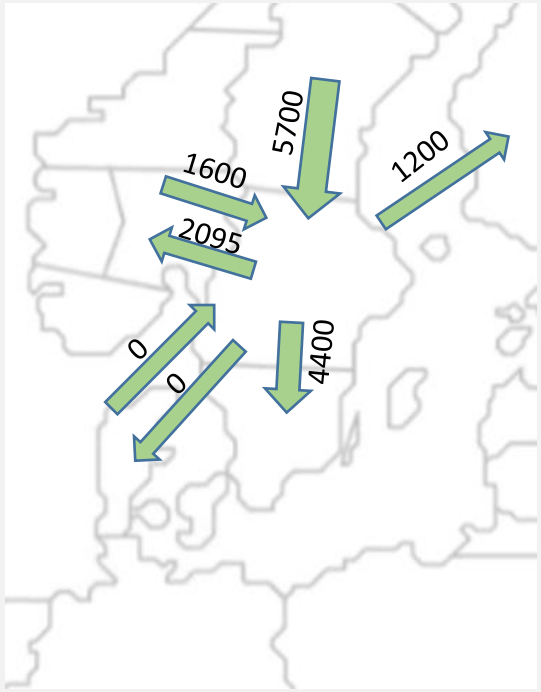
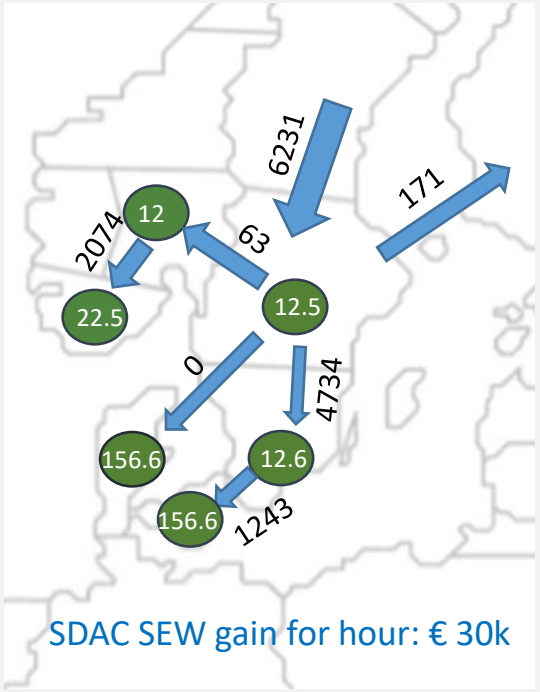
Deep-dive 24/9 hour 19-20

- Maintenance on internal CNEs limited the capacity in NTC between SE3 and DK1.
- Since prices in NTC is lower in NO1 than SE3, export goes in that direction
- FB sees a way to import from SE3 to NO1 to send further to NO2, thus increasing the prices in SE3 and creating a price convergence
- Positive SEW for SDAC, negative for Nordics
  - Consumer surplus is positive, most comes from negative congestion income

NTC capacities

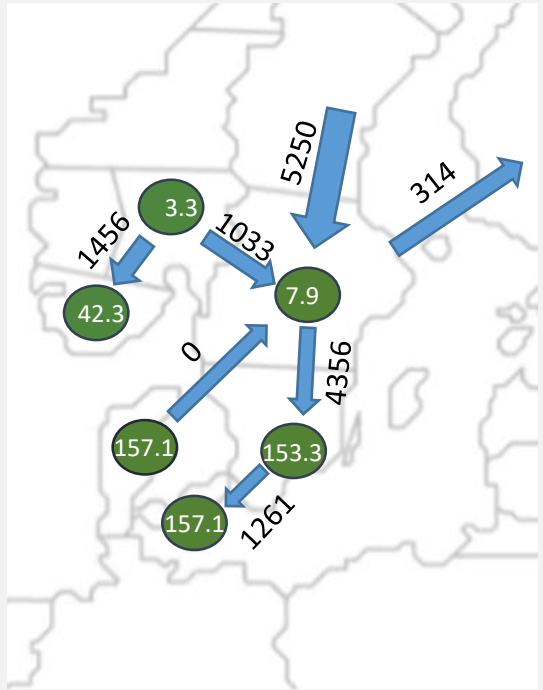


FB flow (AAF)



SDAC SEW gain for hour: € 30k

NTC flow (AAF)



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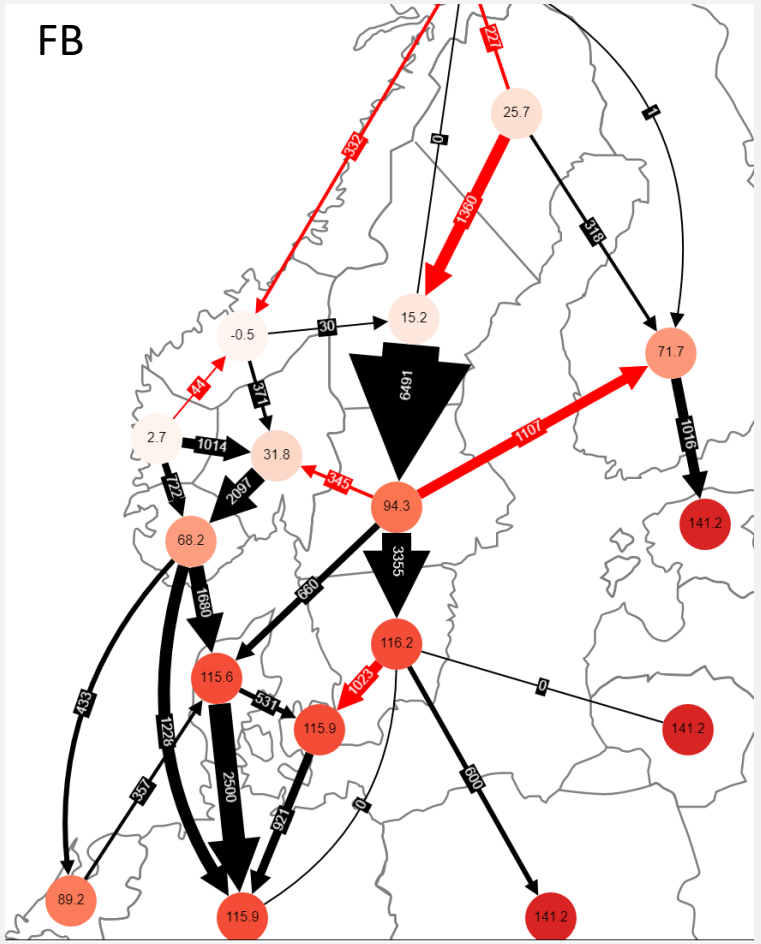
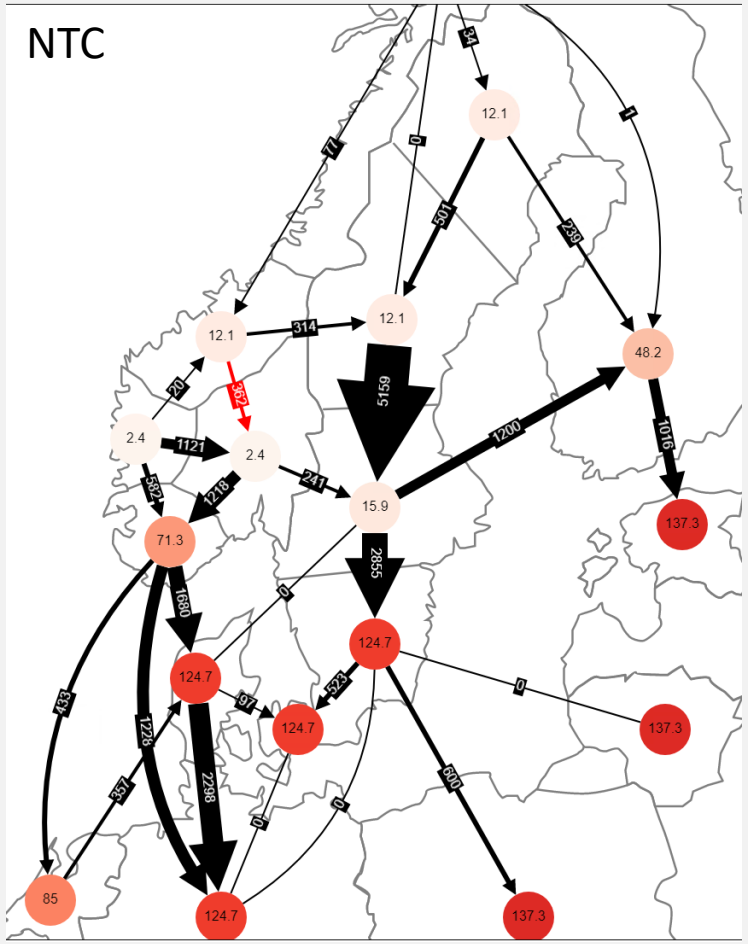
Price convergence in the Nordics in FB
13 September 06:00-07:00

- Higher prices in SE3 – consumer loss
- Lower prices in SE4 – consumer gain
- 322MW change in NP in SE3
- Price change of 78€/MWh
- Similar NP in SE4





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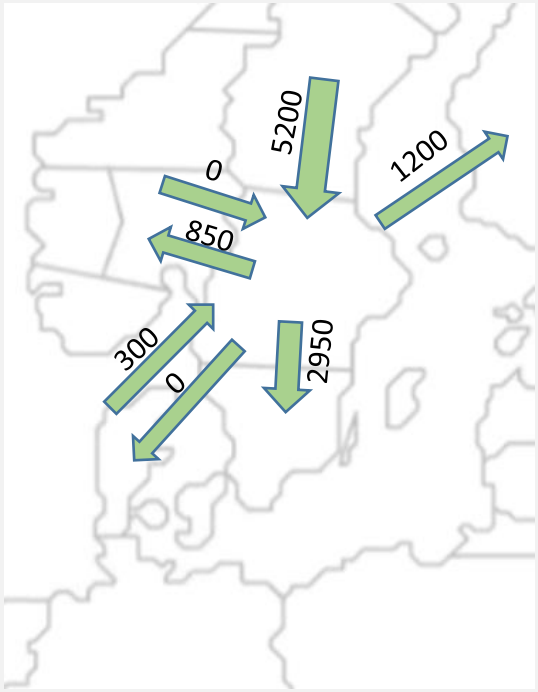
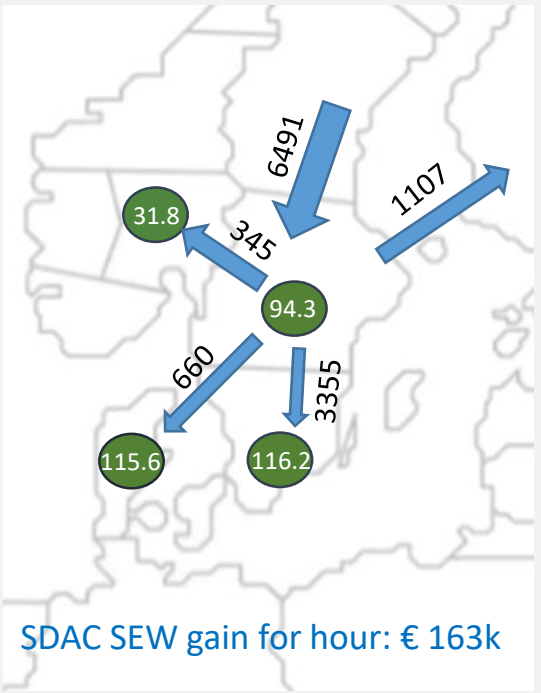
Deep-dive 13/9 hour 6-7

- Maintenance on internal CNEs limited the capacity in NTC between NO1->SE3 and SE3->DK1.
- Limitations in NTC gives a reduced domain compared to FB.
- Positive SEW for Nordics and SDAC, but negative consumer surplus

NTC capacities

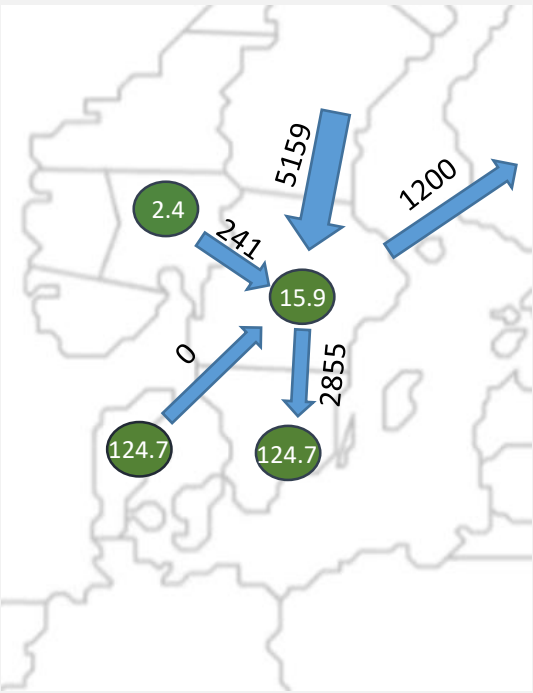


FB flow (AAF)



SDAC SEW gain for hour: € 163k

NTC flow (AAF)



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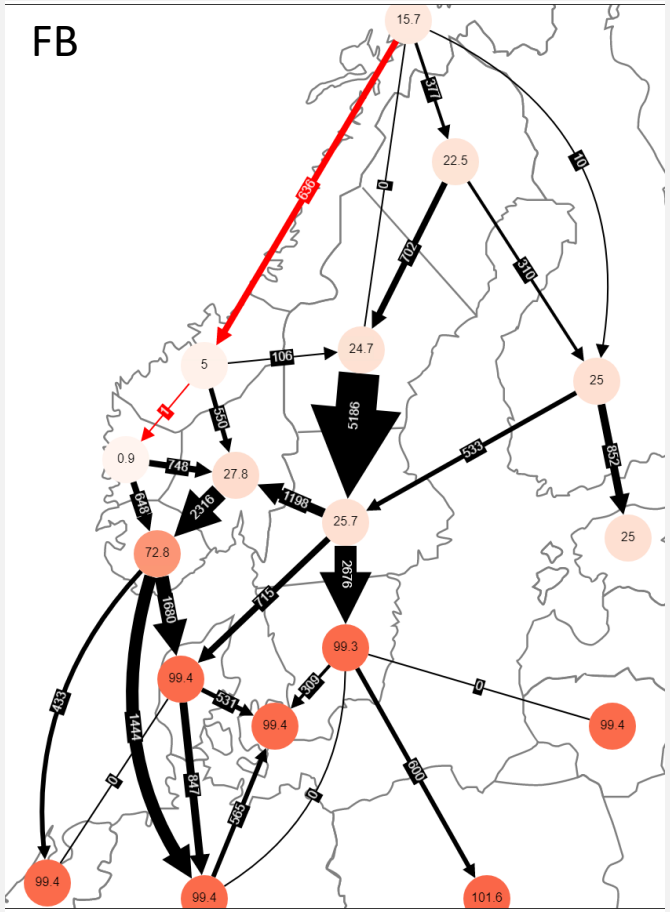
Flow-based increases flow on NO1-NO2

Background

- FB has showed much higher flows on NO1-NO2 compared to NTC
- Initially, we thought this flow was unrealistically high due to experience in real-time operations
  - Was mentioned in the Operational Learning Points
- After thorough analyses, we see that the flows given by FB is realistic and does not create overloads



NO1-NO2 analysis 12/09 15:00-16:00

- Much higher flow on NO1-NO2
- Import from Sweden in FB
- Price increase in NO1, decrease in NO2

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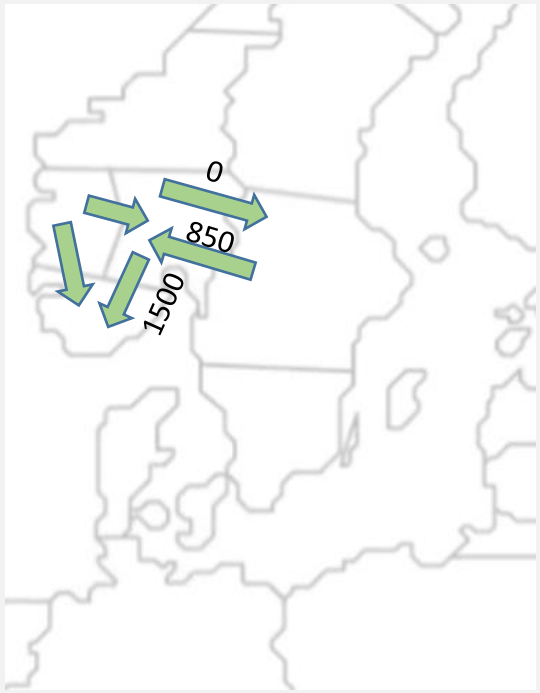
Deep-dive 12/9 hour 15-16

- Most constraining is NO5-NO2, NO1-NO2 and SE3-SE4
- Lower flow on NO5-NO2 in FB due to assumption of too high flow
- NO5-NO2 capacity will increase in FB from week 46
- Positive SEW, negative consumer surplus in the Nordics, positive for SDAC

NTC capacities



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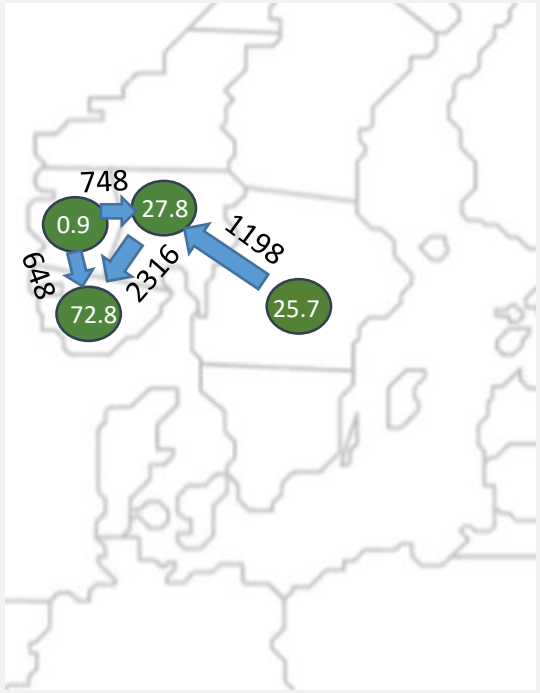
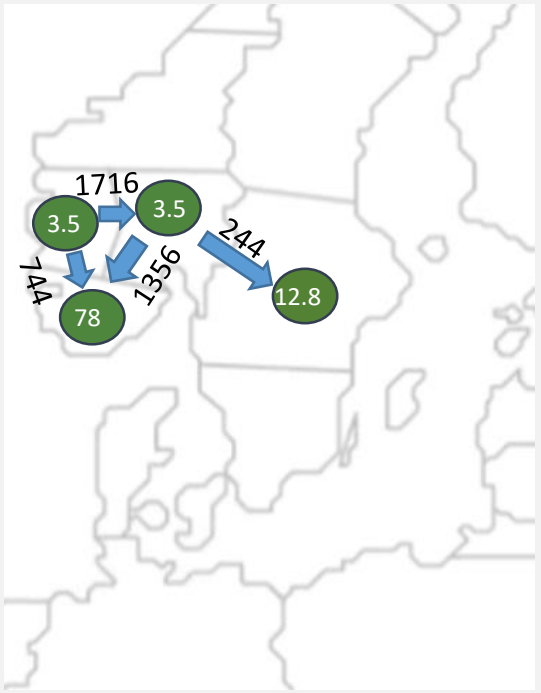


NTC flow (AAF)



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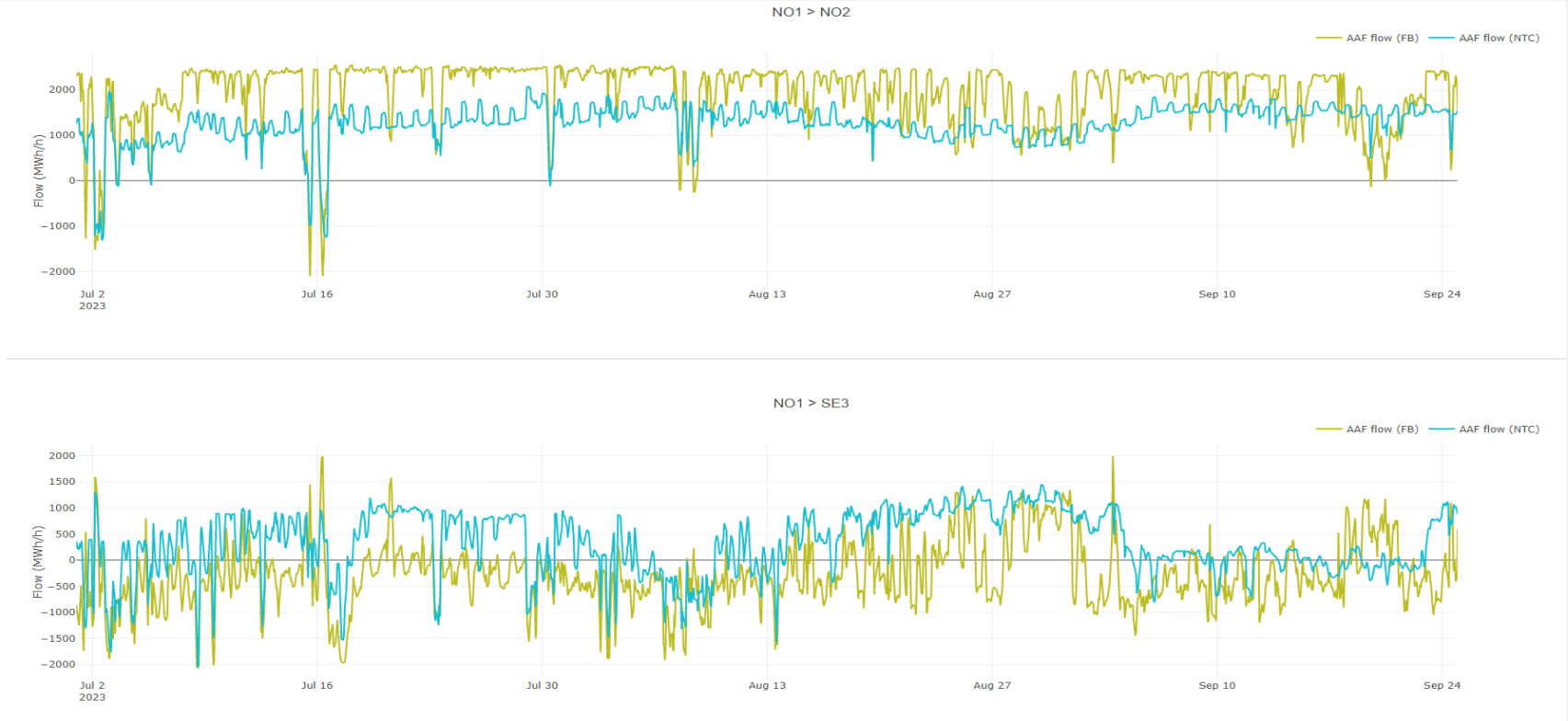
NO1-NO2 flow

- Higher flow on NO1-NO2 since before summer
- ~2400 MW vs 1800 MW
- More import from SE3 allows higher flow to NO2
- Not a "possible" solution in NTC due to limitations



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Prices in NO1 and NO2

- Increased NO1 price, especially since mid-August
- Slightly lower prices in NO2
- Indicates steep bid-curves for NO1, flatter for NO2

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Net positions in NO1 and NO2

- Increased NP in NO1 of 700-800 MW in many cases
- Similar NP change in opposite direction for NO2

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NO1-NO2 capacity - conclusion

- The flows indicated by FB is realistic
- Illustrates the FB methodology's ability to find domains outside the NTC domain and increase the flow between NO1 and NO2
- The Operational Learning Points document will be updated

Thank you!

Questions or comments?

Contact: ccm@nordic-rcc.net

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