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

SH Monthly meeting

13 June 2024

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Agenda

1. Upcoming events and news
2. Background information on the EPR
3. EPR results, weeks 15-18
   - Impacts on SEW, prices, flows, net positions, constraining CNECs
4. Specific hours walkthrough

Upcoming events and news

- **ID ATCE update**
  - The relaxation parameters of the ATCE method are 2 % PTDF relaxation, 0.01 MW on allocation constraints and 10 MW on CNECs (https://nordic-rcc.net/flow-based/methodology/, updated 25 April 2024)
  - The 6-month EPR period started on Monday 25 March, i.e., energy delivery week 13.
  - Historical re-runs for weeks 26/2023 – 12/2024 have been published at the RCC website. Week 13 to week 19 has also been uploaded, and the TSOs plan to continue publishing weekly results.

- **Hybrid stakeholder meeting (focusing on ATCE) was held on Monday June 10, 09:30 - 16:00 CET**
  - Presentation material is available at the Nordic RCC website.
- **Next monthly EPR meeting on Thursday July 4, 9:00 – 11:00 CET**
  - This and the following monthly EPR events will cover an evaluation of the ID ATCE in addition to the day-ahead results as usual
- **Links to the recordings from the "FB for beginners" event (March 13) have been published at the RCC website**

External parallel run (EPR)

- **In EPR, the capacity calculation process for both FB and NTC is performed in parallel. Market results are available for:**
  - NTC = actual day-ahead market coupling results, “production”
  - FB = simulated market coupling results with flow-based constraints
- **Simulations are done on a weekly basis after a 2-week grace period, and the market report is published ~4 weeks after production.**
- **Goals of the EPR:**
  1) Ensure that the capacity calculation process works
  2) Show the differences between FB and NTC capacity calculation methods
  3) Intended for market participants to become familiar with FB capacity calculation and the impacts FB may have on the market outcome
  4) “Learning by doing” for TSOs

The role of TSOs and EPR

- **Flow-based capacity calculation aims to enhance the use of current transmission capacities.**
  - The role of TSOs is to provide as much transmission capacity to the markets, as operationally secure, to ensure efficiency.
  - Other market participants are responsible for other segments of the day-ahead market; TSOs should not intervene or speculate in these.
- **EPR compares different capacity calculation methods but uses the same market coupling algorithm and same order books as in NTC.**
  - This enables a fair comparison of the two capacity calculation methods. It isolates the impacts solely from FB without further assumptions.
  - EPR is not a forecast of future prices and flows.
    - With higher capacity available, there may be other changes in the market after go-live, but these are not considered.
    - EPR is intended to show the impact if we would have used FB for any single day-ahead coupling instead of NTC.
- **Why we measure the SEW impact of FB?**
  - EPR is done the way NRAs and CACM require TSOs to perform it.*
  - Higher SEW **per MTU** indicates **higher or economically more efficient flows**
  - Higher SEW **over a long time** indicates **a trend of the above**

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.

* https://www.fingrid.fi/globalassets/dokumentit/fi/tiedotteet/sahkomarkkinat/2020/paatos-cacm-suuntaviivojen-202-artiklan-mukaisen-nordic-kapasiteetin-laskenta-alueen-yhteisen-kapasiteetin-laskentamenetelman-muuttamisesta.pdf

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Summary of week 15-18, 2024
8 April – 5 May

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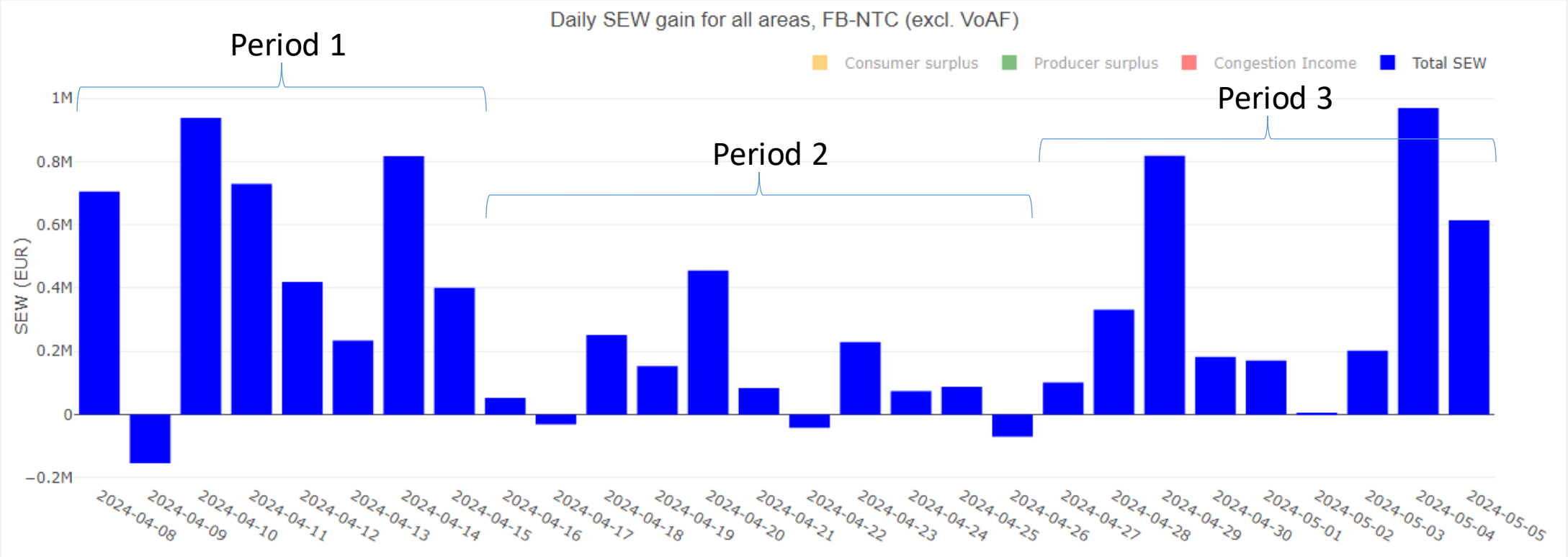
Social welfare change W15-18

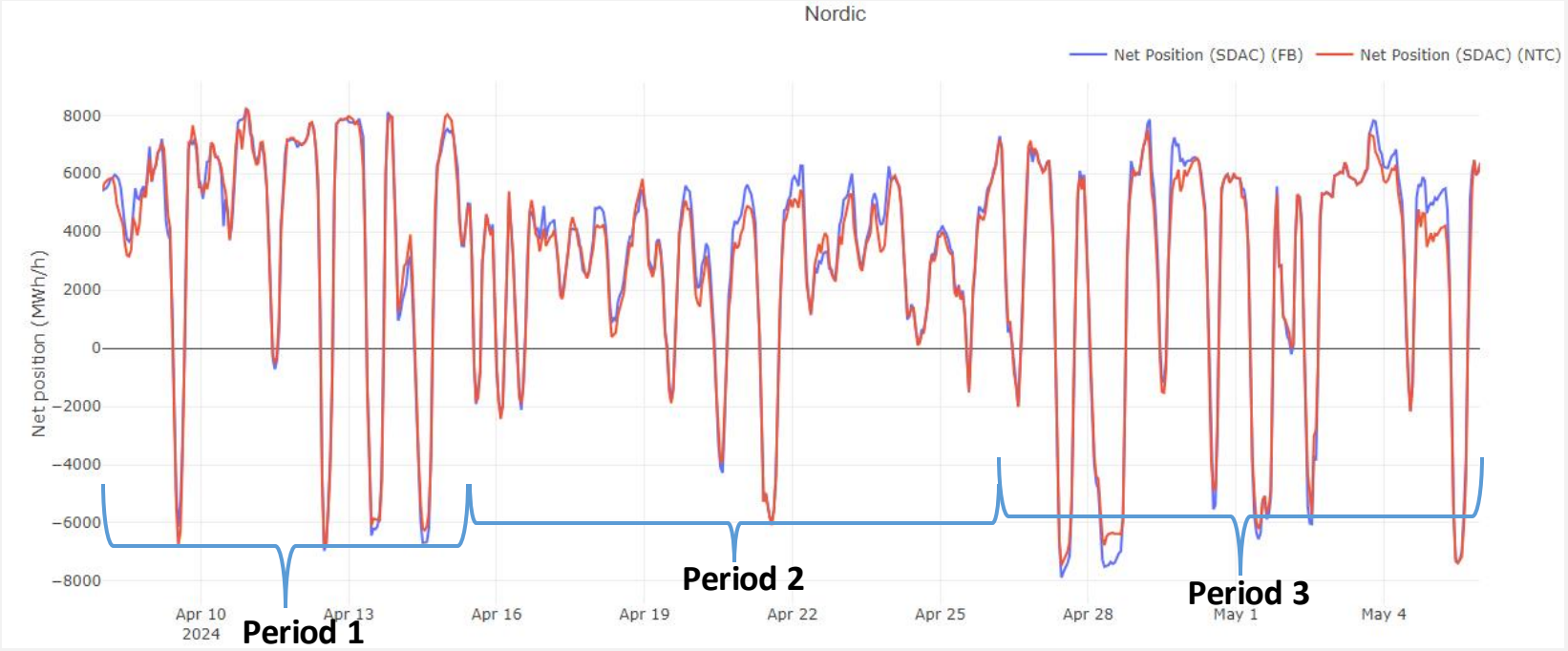
- These four weeks are split into three periods:
  - **Period 1**, 8/4-15/4 and **Period 3**, 27/4-5/5 : Mostly daily positive welfare impacts & varying net position. Sauda CNEC are causing negative SEW on 9/4.
  - **Period 2**, 16/4-26/4: Less positive and some negative welfare impacts. Less variable net position.

- Over the full 4-week period, flow-based results in a higher SEW compared to NTC for the Nordic region, and also for the whole market coupling region (SDAC).
  - Total Nordic SEW change +1.78 M€ (+4.70 M€ including Hansa congestion income)
  - Total SEW change in the SDAC region +8.73 M€



Nordic Net Position W15-18

- The total cumulative Nordic net position increased with 79 GWh from 1901 GWh to 1980 GWh in FB compared to NTC
- Period 1 and 3: Variable with generally high export and for some hours during daytime high import.
  - In the first period there is no cumulative difference in net position between NTC and FB. In period 3 the cumulative net position increases with 28 GWh from 447 GWh to 475 GWh
- Period 2: Net position less varying and more hours with export.
  - The cumulative net position increases with 51 GWh from 706 GWh to 758 GWh in FB.



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Nordic region in NTC in Period 1 (8.4 - 15.4)

- As indicated by the net position, during the first period, the Nordics are net exporting to the continent, but there are several hours with high imports to the Nordic areas as well.

- The highest average prices for the first period are found in Denmark and the continent, while the lowest prices are found in Sweden and Finland.

- Overall constraints in the grid:
  - Sweden -> Norway & Denmark
  - Nordics -> Continent & Baltics

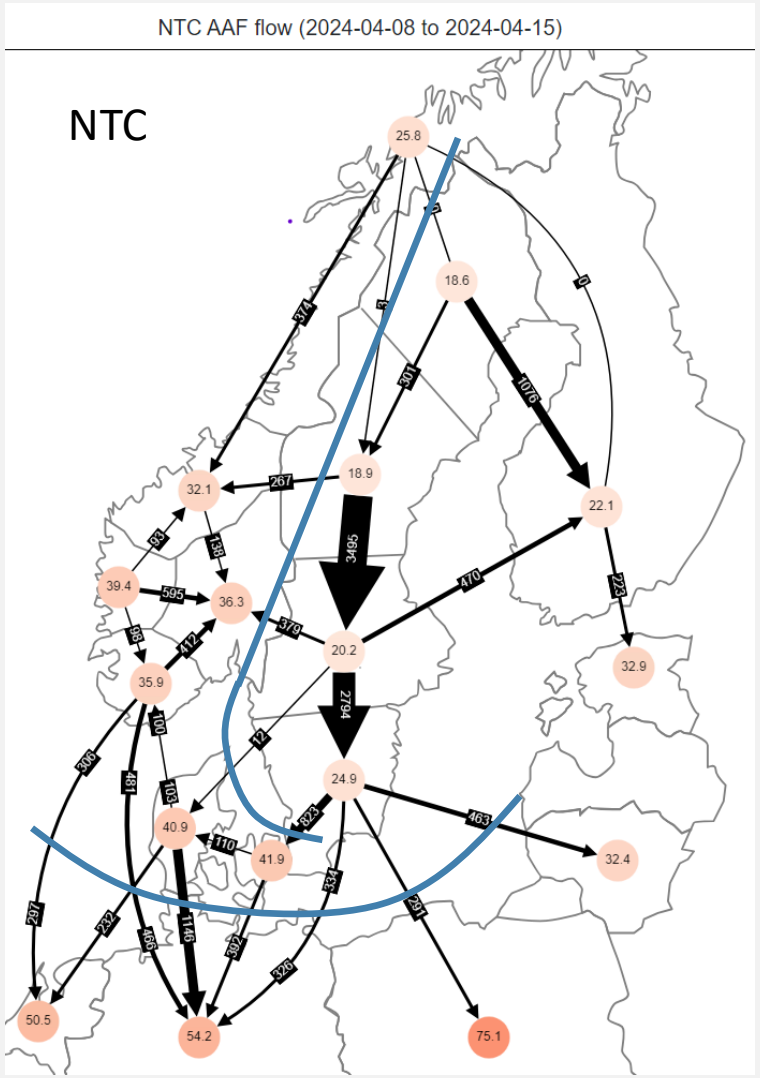

Figure: Average prices and flows in each BZ in NTC

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Average prices and flows in the Nordic region - Period 1 (8.4 - 15.4)

Overall constraints in the grid:

- Sweden -> Norway & Denmark
  - The overall flow on these borders was increased with 149 GWh in FB
- Nordics -> Continent & Baltics
  - The overall flow on these borders was increased with 3 GWh in FB

Prices:

- The price decreases with ~6 EUR/MWh in DK1 and with ~2-3 EUR/MWh in DK2. In Southern Norway the prices decreases with between 2 and 4 EUR/MWh because of the higher flow from Sweden.

- The price increases with ~2-6 EUR/MWh in Sweden and Finland.

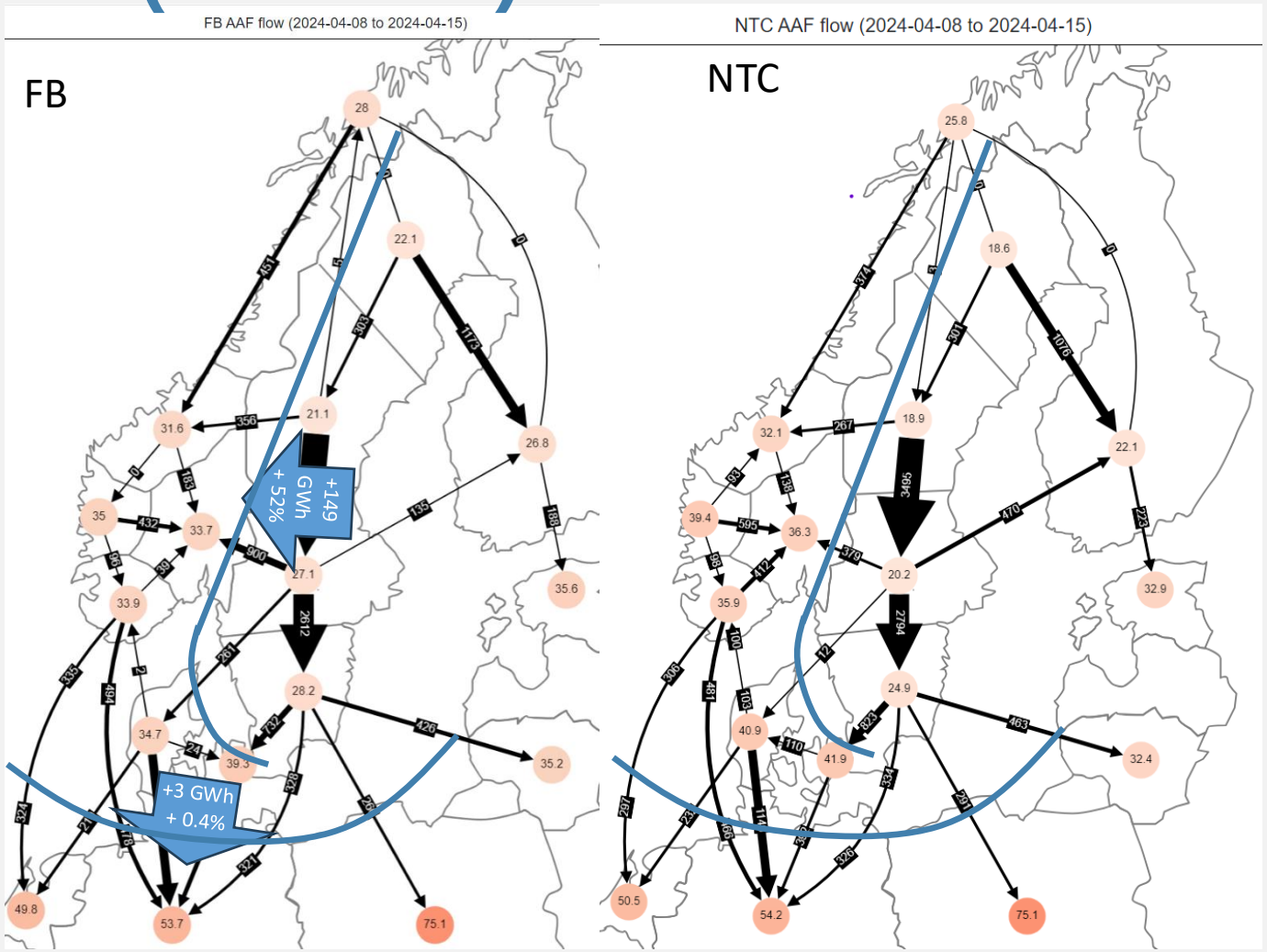

Figure: Average price in each BZ in FB and NTC. Blue arrows show the increased flow over constraining elements.

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Impact on buy and sell volumes (FB-NTC) Period 1 (8.4-15.4)

- The largest changes on net positions are in DK1, NO5, NO2, SE3 and FI.
- Except for SE3 the change in supply volumes affects the changes in net positions most.
- Biggest difference in the demand volumes is noted in FI and SE3.

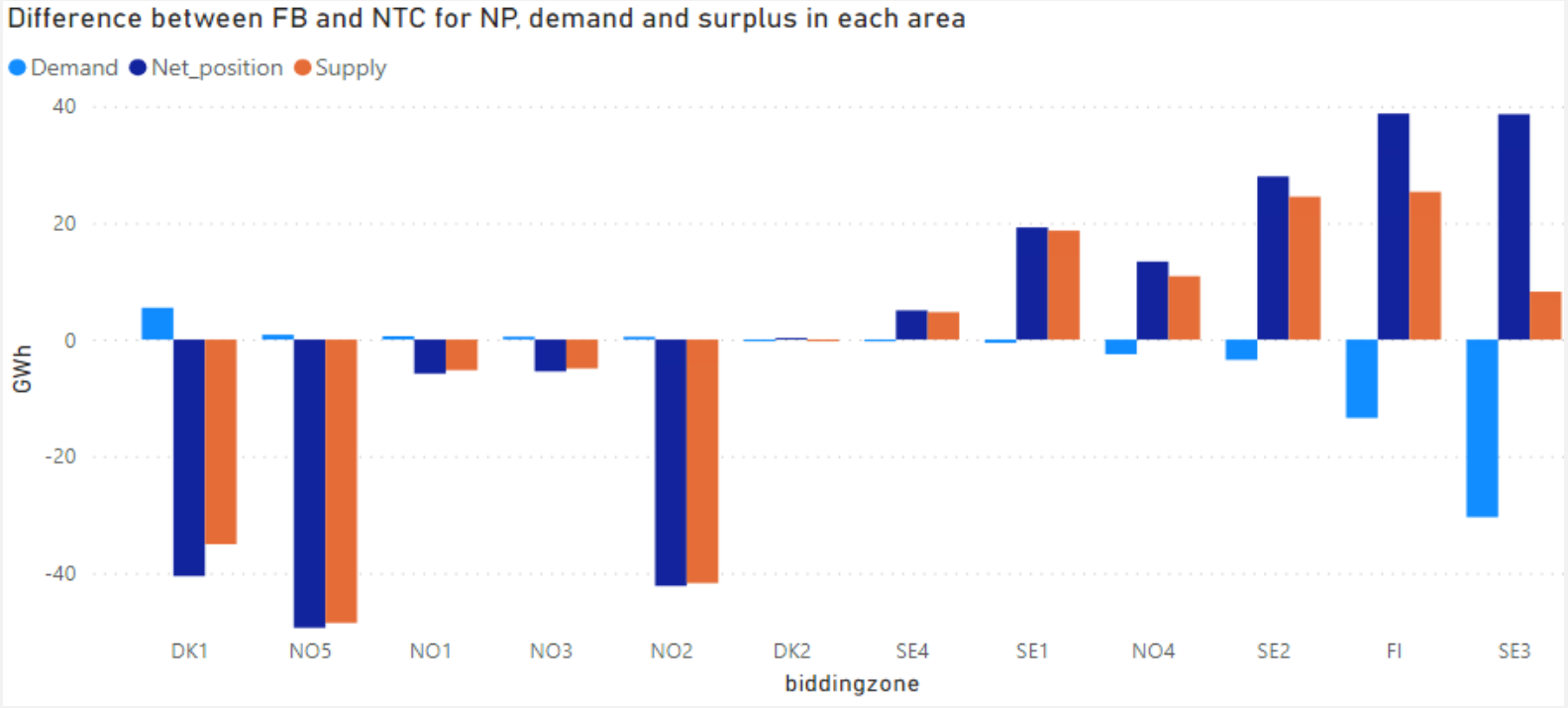

Figure: Demand and supply volumes difference (FB-NTC) and the corresponding net position change

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Prices Period 1 (8.4 - 15.4)

- The maximum prices decreased in all bidding zones except for NO4 and SE4.
- The average prices decreased in 5 bidding zones, mostly in Norway and Denmark. And the average prices increased in 5 bidding zones, mostly in Sweden, Finland and NO4.
- The one with decreased prices are the ones with the highest average prices in NTC, and the ones with an increased average price are the once with the lowest average price in NTC.

Market prices

Rounded to nearest integer. Thousands separated by comma. Example: `1,234,567`

Bidding zone	Min. price		Max. price		Avg. price		
	FB	NTC	FB	NTC	FB	NTC	FB-NTC
DK1	-57	-60	↓ 166	169	35	41	↓ -6
DK2	-29	-54	↓ 166	169	39	42	↓ -3
FI	-2	-3	↓ 96	104	27	22	↑ 5
NO1	-30	-32	↓ 81	141	34	36	↓ -3
NO2	-25	-32	↓ 82	141	34	36	↓ -2
NO3	3	5	↓ 61	77	32	32	= 0
NO4	2	10	↑ 60	45	28	26	↑ 2
NO5	-2	5	↓ 77	86	35	39	↓ -4
SE1	-27	-32	↓ 71	77	22	19	↑ 4
SE2	-27	-32	↓ 72	77	21	19	↑ 2
SE3	-29	-32	↓ 127	145	27	20	↑ 7
SE4	-29	-54	↑ 160	150	28	25	↑ 3

Table: Min, max and mean prices for all bidding zones in FB and NTC

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Constraining CNECs in FB
Period 1 (8.4 - 15.4)

- High shadow prices indicate that more flow would have increased the total SDAC welfare.
- The most constraining CNEC is located on the Danish west coast and is typically limiting in situations with a high share of renewable energy production.
- Mainly HVDCs are the most limiting elements.
  - Here, especially CCR-border HVDC to the continent & the Baltics are constraining
- Swedish CNEC on the SE2-SE3 limiting too much in FB due to a problem in the modelling of series capacitors in FB.
  - More about this can be found in the Operational Learning Points document.

Counts of hours with shadowprice (FB)

Thousands separated by comma and decimal separated by dot. Example: 1,234.56

CNEC	Count of hours	Average shadowprice	Total shadowprice
ACLineSegment (ZBR) ENDK DK1 E_KAE-STSV Z1 F Terminal : F|400KV LINE C_IDU-TJE	20	216.03	4,320.65
AC_Minimum_SE4_BC	103	40.84	4,206.86
AC_Minimum_NO2_NK	121	33.78	4,087.51
fee84152abb74959891079a51a4f7614	25	152.86	3,821.45
1b9fcf6714b3461bb4685b77043aa9ff	79	44.67	3,529.11
AC_Minimum_NO2_ND	107	30.32	3,243.76
AC_Minimum_DK2_KO|BASECASE	105	30.41	3,193.10
9baae4dd394548648d558f718b5ebf84	52	43.18	2,245.61
DK2_SV_IMP|BASECASE	92	23.33	2,146.54
AC_Minimum_SE4_SP	40	52.72	2,108.68
FI_PTC_FI_EL_EXPORT	97	19.05	1,848.08
DK1_NL_EXP|BASECASE	58	29.35	1,702.32
14311_11 95% Sauda T2 Transformator P + Sauda T3 Transformator P	20	65.34	1,306.84
AC_Minimum_SE3_KS	38	31.70	1,204.54
d0d77cee2500478fa5cefda3c056c40b	64	18.28	1,169.75
ACLineSegment ENDK DK1 E_KAE-LYK_3 1 N Terminal : N|165KV LINE E_KAE-LYK_2	2	546.90	1,093.80
335b0a2b109248d2b0570abd8b44b0aa	10	106.25	1,062.50
7ca10d78b4834b769dbaf7110abb01ee	19	47.78	907.82
FI_PTC_RAC_SE1-FI	116	7.75	898.77
1ca8b9272ef44b34b577e5aeb1562d4d	21	39.74	834.61
7e9d747987c849b1bcc277408f970602	29	25.36	735.49
AC_Minimum_NO2_SK	25	24.21	605.29
DK2_DK_IMP|BASECASE	43	14.00	602.20
d045f3cf05724a4f88378506fcb86e7c	31	18.79	582.60

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SEW impact on bidding zone level
Period 1 (8.4. - 15.4.)

- The impact on the different parts of the SEW from FB differs between the Nordic bidding zones.
- Positive total SEW change with FB compared to NTC is observed in NO1, NO2, NO3, NO4, SE1, SE2 and SE3.
- FB results in a gain for consumers in DK1, DK2, NO1, NO2, NO3 and NO5.

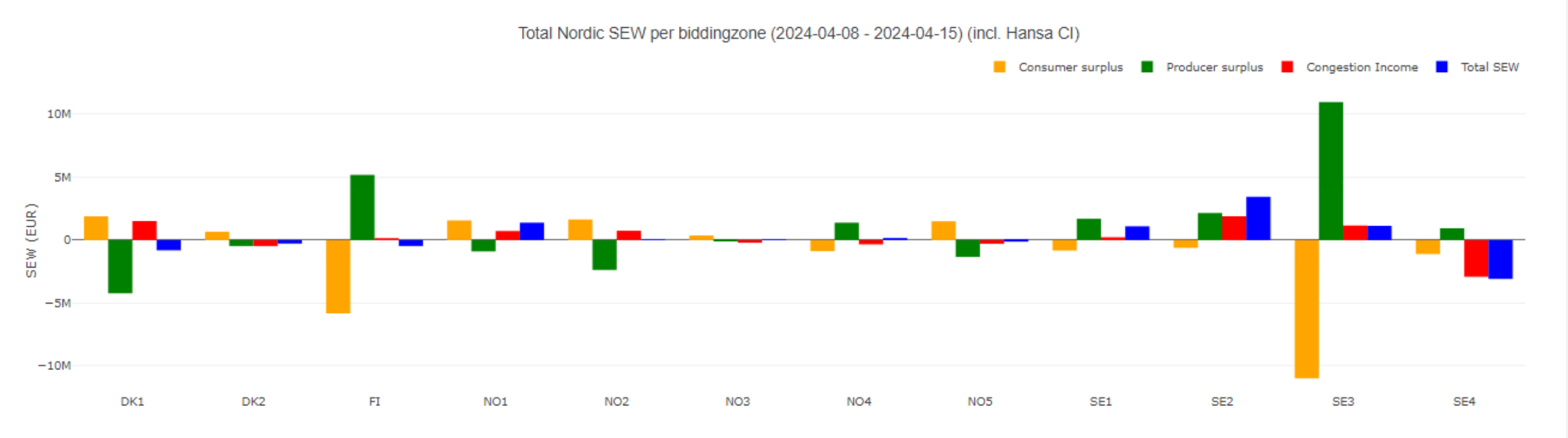

Figure: SEW change per stakeholder group in CCR Nordic, per bidding zone

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Nordic region in NTC in Period 2 (16.4 – 26.4)

- For the second period, there are few major constraints.
- The Nordics are still a net exporting region, and have less import compared to period 1 and 3.
- The average prices are higher compared to period 1 and 3.
- The highest average prices are found at the continent, Denmark and SE4.
- Constraints in the grid:
  - NO4 -> South Norway & Sweden
  - Nordics -> Continent & SE4 & DK

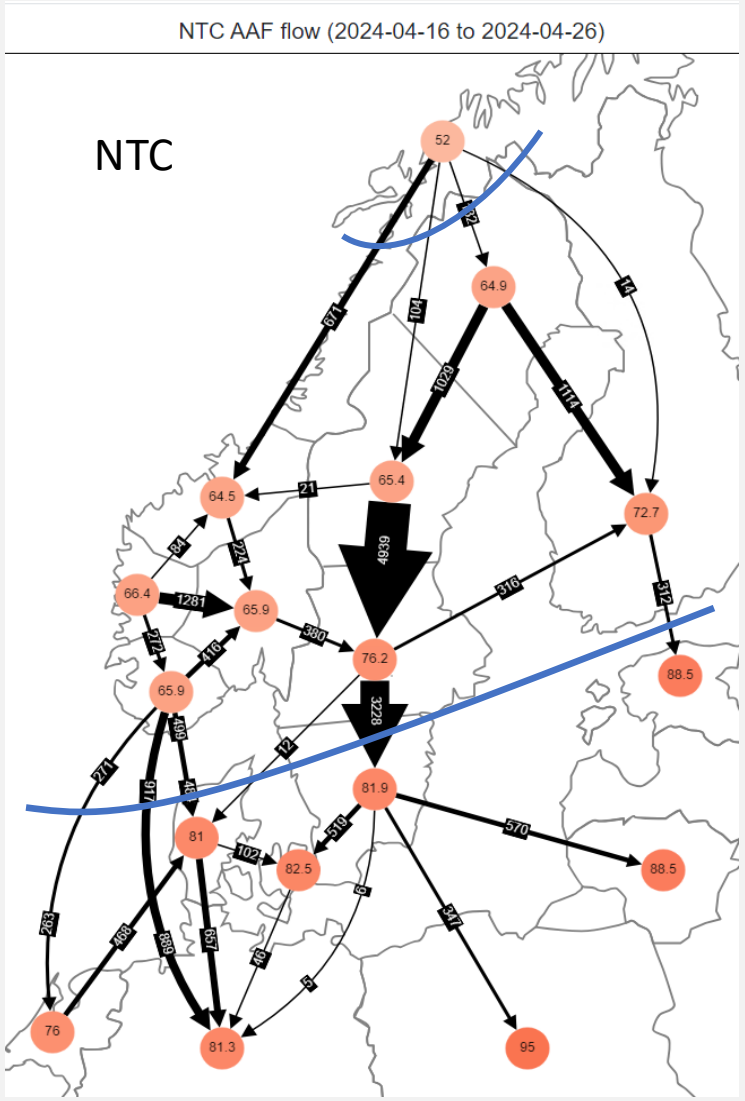

Figure: Average prices and flows in each BZ in NTC

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Average prices and flows in the Nordic region Period 2 (16.4. - 26.4)

For this period, there are constrains between:

- NO4 -> SE1, SE2 & NO3
  - The overall flow was increased with 5 GWh over this constraint.
- Nordics -> Continent & SE4 + DK
  - Flow was increased with 52 GWh over this constraint.

Relatively small average price changes between NTC and FB:

- The average prices decrease by 3 EUR/MWh in SE2
- The average prices increase by ~3-5 EUR/MWh in NO1, NO2, NO5, NO4 and SE3.

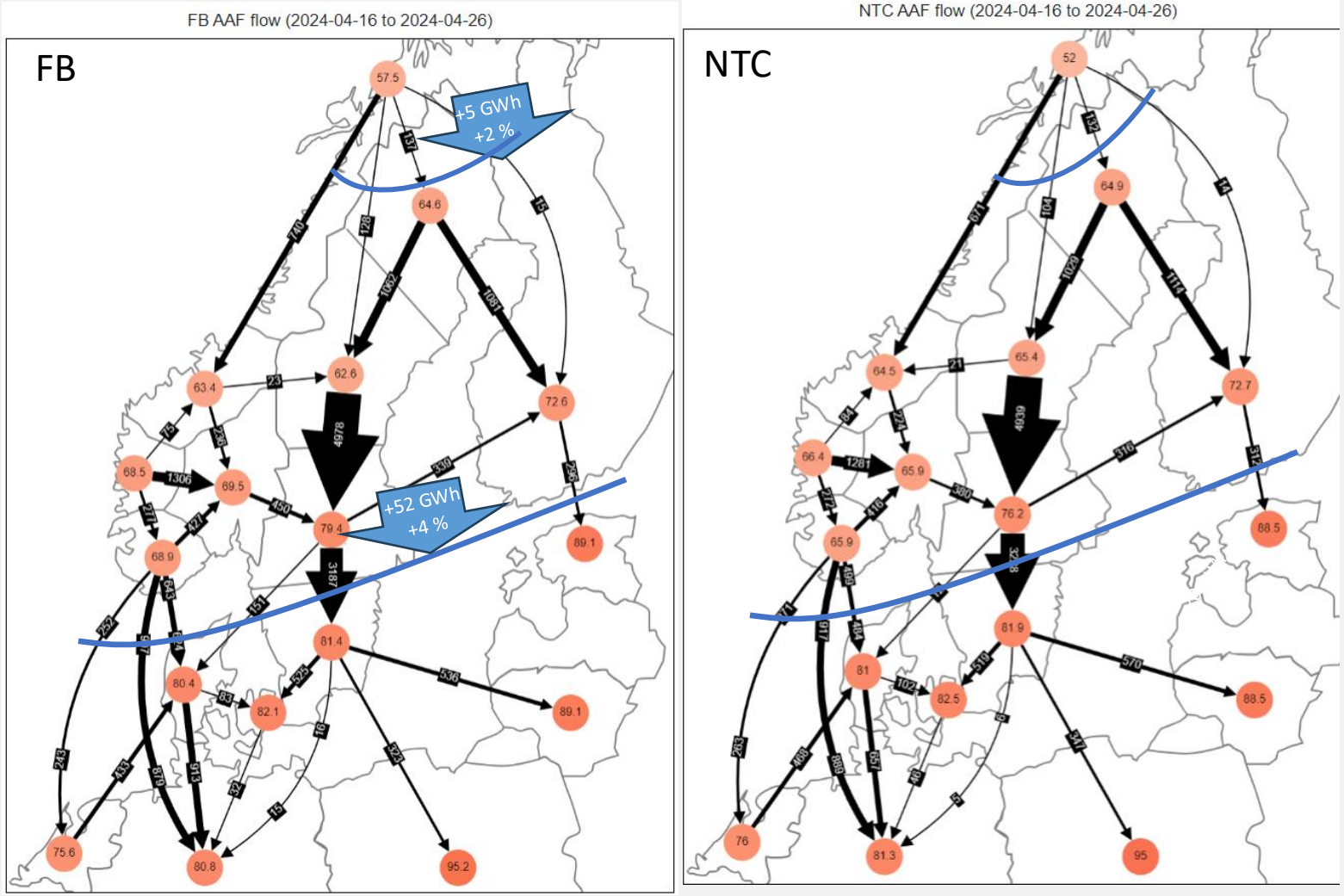

Figure: Average price in each BZ in FB and NTC. Arrows show the increased flow over constraining elements.

SEW Impact on bidding zone level
Period 2 (16.4. - 26.4)

- The largest changes in SEW can be seen for NO5, SE4, NO2, NO1 and NO4, with overall gains in NO5, NO2 and NO4 and loss in SE4 and NO1.
- The SEW gains are typically driven by producer surplus.
- Several bidding zones have smaller changes in total SEW, but larger changes between consumer and producer surplus.

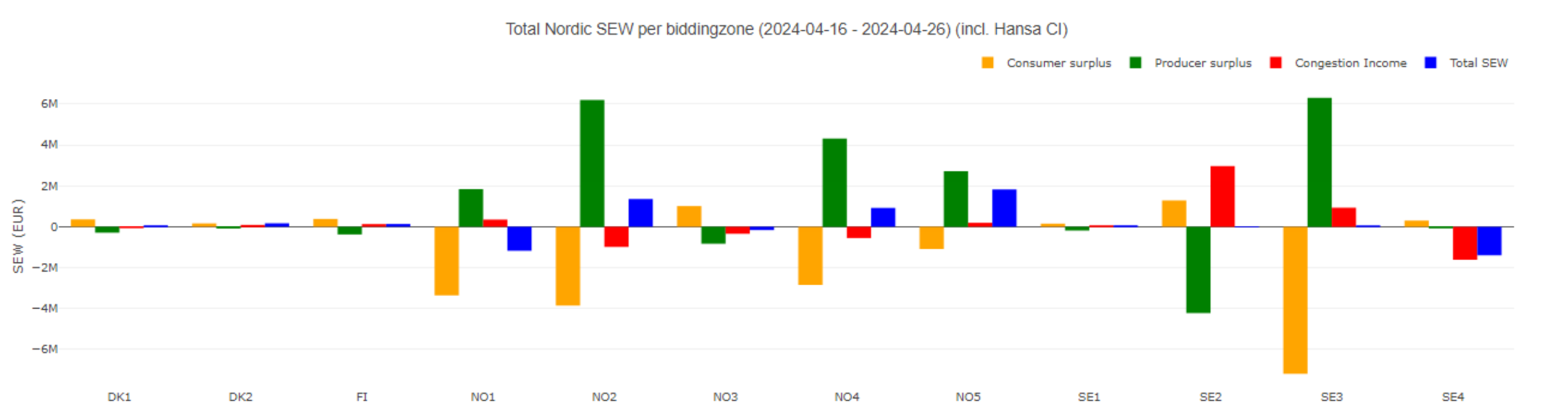

Figure: SEW change per stakeholder in CCR Nordic per BZ

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Prices in Period 2 (16.4. - 26.4)

- In general, the average prices are relatively similar in FB and NTC for all Nordic bidding zones.
  - The average prices vary between 52-82 €/MWh in NTC and between 58-81 €/MWh in FB
  - 3 €/MWh decrease in SE2, 1 €/MWh decrease in DK1, NO3 & SE4, while the average price in DK2, FI & SE1 does not change at all
  - The average prices in the rest of the BZs increase
- For many BZs, the maximum price difference is small, e.g. for DK1, DK2, Sweden, NO1, NO2 & NO4.
  - In Norway, the maximum price in NO3 and NO5 decreases. In Finland, the maximum price increases.

Market prices

Rounded to nearest integer. Thousands separated by comma. Example: 1,234,567

Bidding zone	Min. price		Max. price		Avg. price		
	FB	NTC	FB	NTC	FB	NTC	FB-NTC
DK1	0	-1	182	181	80	81	-1
DK2	12	5	186	181	82	82	0
FI	10	5	230	203	73	73	0
NO1	17	5	164	171	70	66	4
NO2	14	5	163	171	69	66	3
NO3	27	30	124	156	63	64	-1
NO4	27	28	125	131	58	52	5
NO5	21	30	157	171	69	66	2
SE1	10	5	161	156	65	65	0
SE2	9	5	160	156	63	65	-3
SE3	11	5	189	181	79	76	3
SE4	11	5	187	181	81	82	-1

Table: Min, max and average prices for all bidding zones in FB and NTC

Constraining CNECs in FB
Period 2 (16.4. - 26.4)

- The most constraining CNECs are on the HVDC cable between SE3 and DK1, which was due to an outage.
- There were also some Swedish CNECs between SE2 and SE3.
- Finally, there were constraints between the Nordics and the Continent.

Counts of hours with shadowprice (FB)

Thousands separated by comma and decimal separated by dot. Example: 1,234.56

CNEC	Count of hours	Average shadowprice	Total shadowprice
AC_Minimum_SE3_KS	98	623.80	61,131.97
DK1_SV_EXP|BASECASE	26	659.39	17,144.21
ec32cdd63103466a8d12d7c639d5746e	38	168.87	6,417.01
cdba87f6589a430091d9df32501457c6	27	150.36	4,059.68
05c3a9866a9d41d699cbdb7b434a9a17	29	120.14	3,484.03
FI_PTC_FI_EL_EXPORT	124	23.17	2,873.59
AC_Minimum_NO2_NK	176	15.93	2,803.07
AC_Minimum_NO2_ND	115	18.19	2,091.36
AC_Minimum_FI_EL	76	26.13	1,986.14
AC_Maximum_SE3_FS	61	26.74	1,631.20
FI_PTC_RAC_SE1-FI	100	16.21	1,621.19
13427_11 40% 420 Tegneby-Hasle + Hasle T6 Transformator S	75	20.20	1,515.32
13c5af78cb2a422ea13b946d96a7cbd4	110	12.79	1,406.50
15326_11 60% 420 Namsos-Ogndal + 300 Tunnsjødal-Verdal	53	24.20	1,282.78
fc3e7c5451e44845894648ca31b035f4	41	27.96	1,146.34
19b4fcd9bcd24ca4a298905dd70c1e78	84	12.52	1,052.07
9784006029d943c1a0710ba4e4965a8a	24	41.58	997.86
DK1_SN_IMP|BASECASE	67	14.51	972.21
23a9e84c58ab429782aeb4e32f587029	28	30.10	842.80
2f547da9f6aa4f74b5404900b47313b1	13	64.45	837.79
AC_Minimum_SE3_FS	32	25.42	813.35
AC_Maximum_NO2_ND	25	27.97	699.17
dfef9f16778341ffaf2ac8c7d59b1e28	16	40.17	642.80
AC_Minimum_SE4_SP	63	9.49	597.94
6eeee0efb9c04d868e8ca18619534b85	11	51.67	568.34

Table: The 25 CNECs with highest aggregated shadow prices during the period

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Impact on buy and sell volumes (FB-NTC) Period 2 (16.4 - 26.4)

- Largest net position decrease is observed in SE2.
- Largest net position increases observed in NO2 & NO4.
- The change in supply volumes is the main impacting factor for the changes in bidding zone net positions.

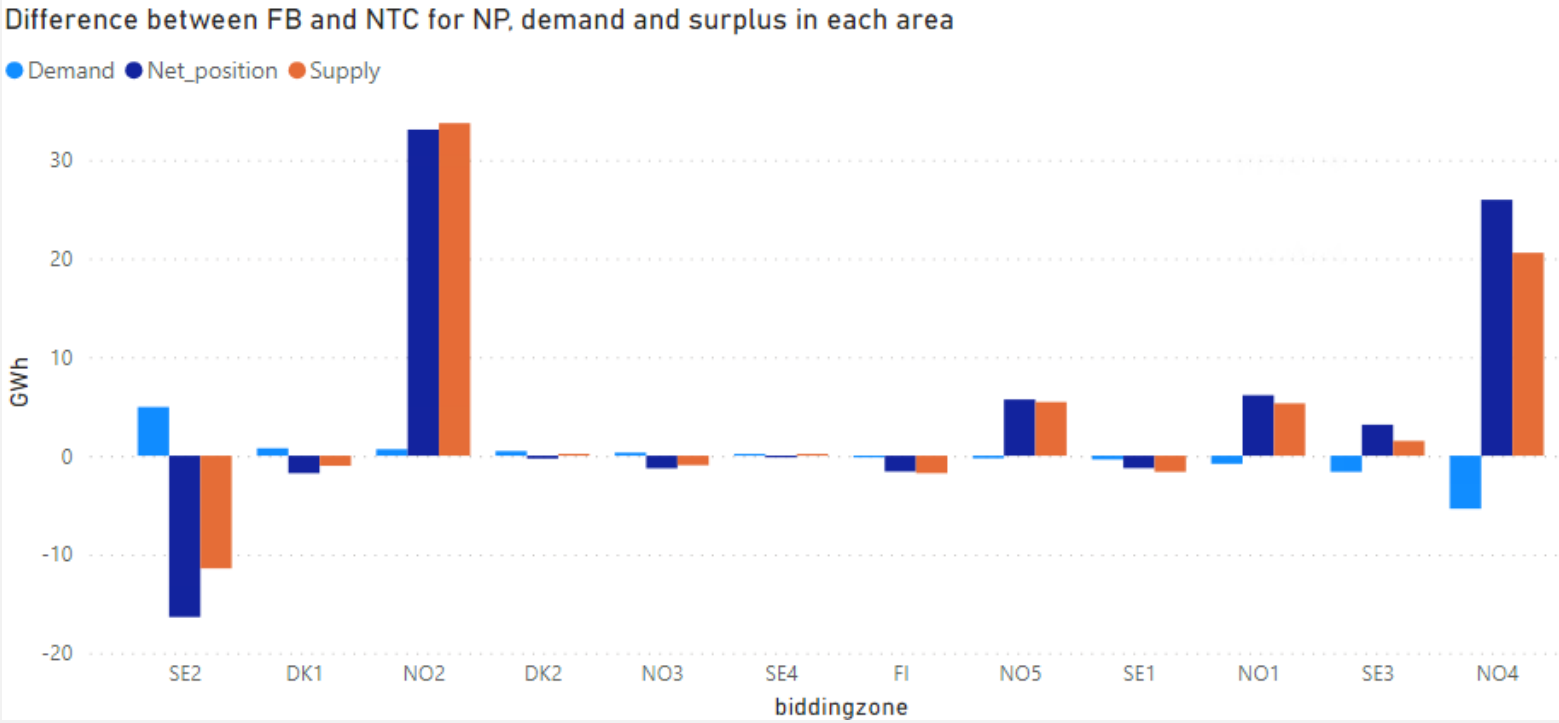

Figure: Demand and supply volume difference (FB-NTC) and the corresponding net position change

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Nordic region in NTC in Period 3 (27.4 – 5.5)

- In the third period, there are generally few major constrains.
- Average prices have decreased compared to period 2 and are more similar to period 1.
- Highest prices are still in the continent, but now also in Finland.
- Nordics are still a net export region, but with several hours during daytime with high import from the continent.
- Constraints in the grid:
  - NO4 and Sweden –> Finland
  - Nordics -> Continent & SE4 & DK

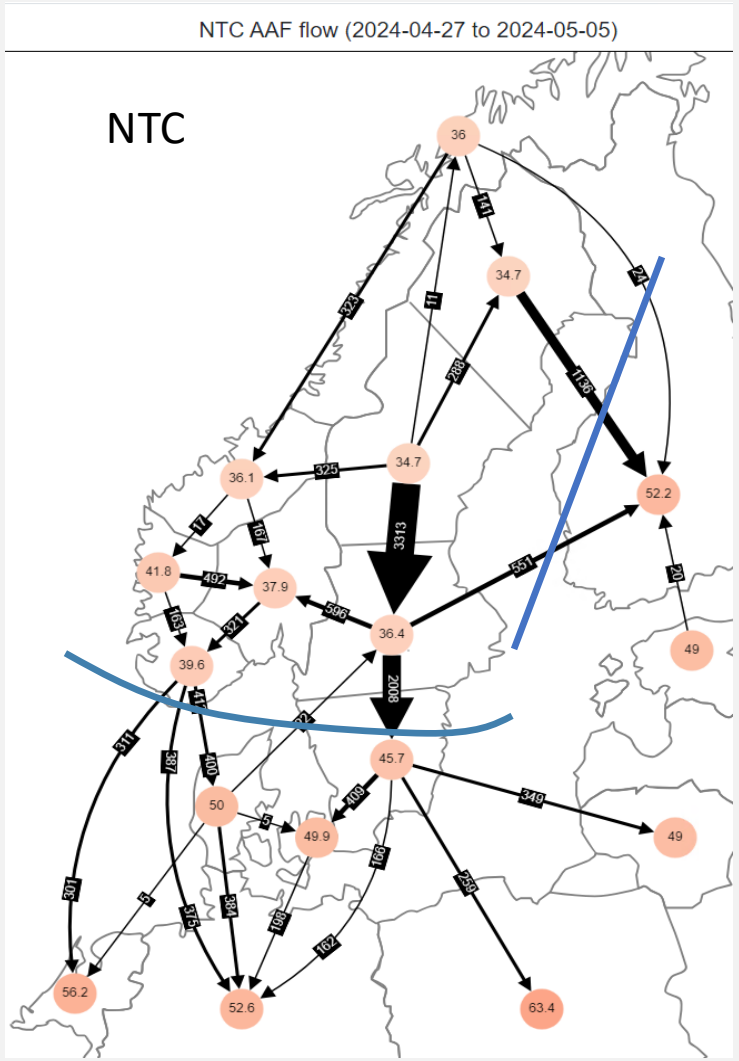

Figure: Average prices and flows in each BZ in NTC

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Average prices and flows in the Nordic region - Period 3 (27.4. - 5.5.)

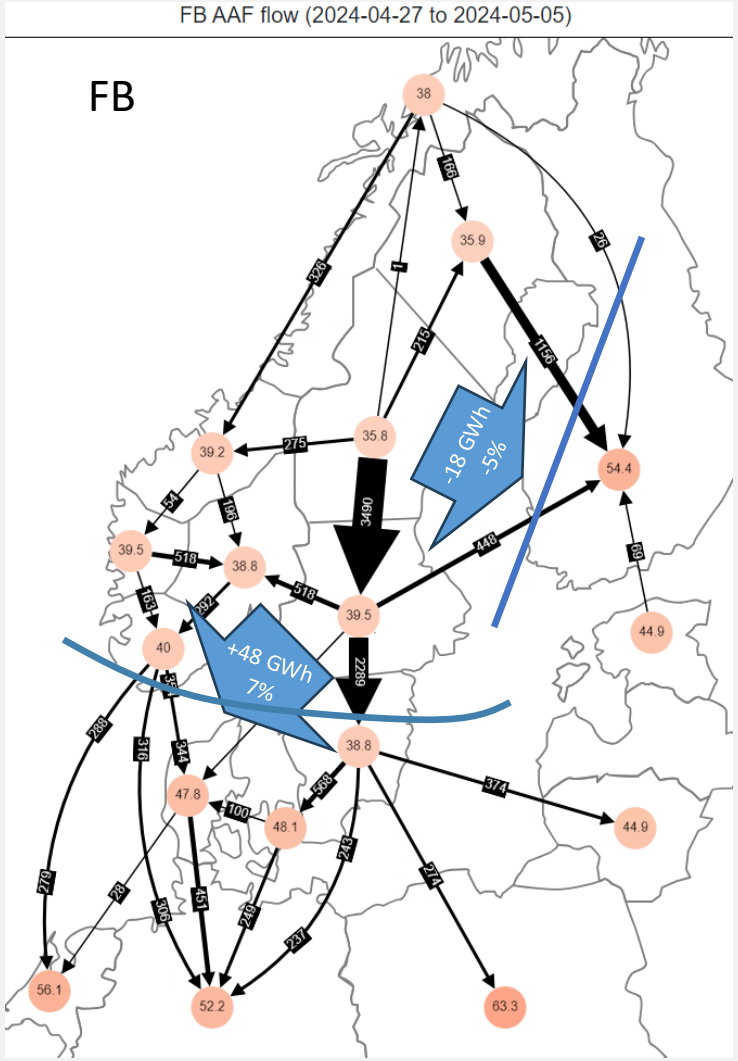
Overall constraints in the grid:

- Nordics-> Continent & DK & SE4
  - The overall flow on these borders was increased with 48 GWh in FB
- SE + NO -> FI
  - The overall flow on these borders was reduced with 18 GWh due to Fennoskan incident

Prices:

- The price decreases with ~7 EUR/MWh in SE4 and with ~1-2 EUR/MWh in Southern Norway (except NO1) & Denmark. The prices in the continent are only decreased slightly, but the prices in the Baltics drop by ~4 EUR/MWh.

- The price increases with ~1-4 EUR/MWh in SE1-SE3, Finland, NO3 & NO4.



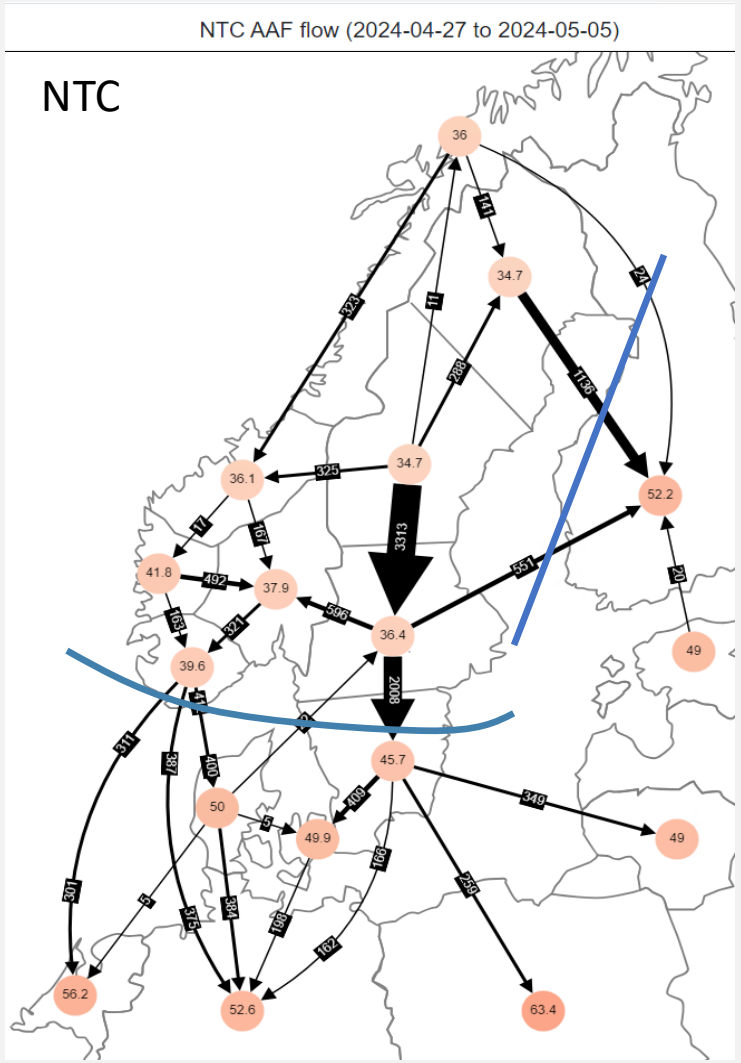


Figure: Average price in each BZ in FB and NTC. Arrows show the increased flow over constraining elements.

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SEW impact on bidding zone level
Period 3 (27.4. - 5.5.)

- The impact on the different parts of the SEW from FB differs between the Nordic bidding zones.
- Positive total SEW change with FB compared to NTC is observed in DK1, DK2, NO3, NO4, NO5, SE1 and SE2.
- FB results in a gain for consumers in DK1, DK2, NO5 and SE4.

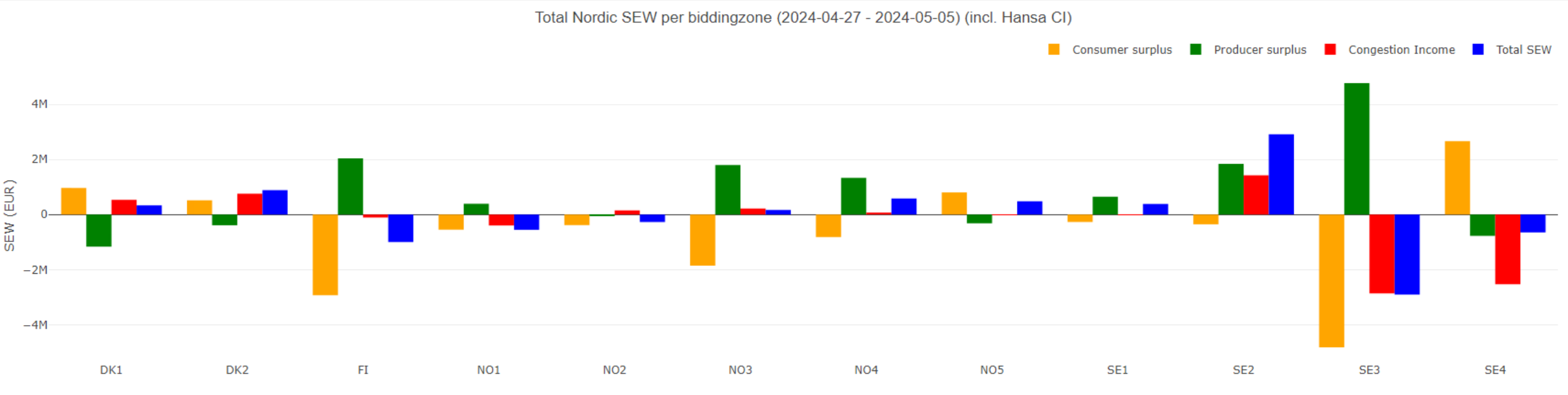

Figure: SEW change per stakeholder group in CCR Nordic, per bidding zone

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Impact on buy and sell volumes (FB-NTC)
Period 1 (27.4. - 5.5)

- The largest changes on net positions are in NO2, SE1 and NO3.
- The change in supply volumes affects the changes in net positions most.
- Multiple bidding zones have very small changes in both the demand and supply side, e.g. DK2, NO1, SE4.
- Biggest difference in the demand volumes is noted in DK1, SE2, NO3 and FI.

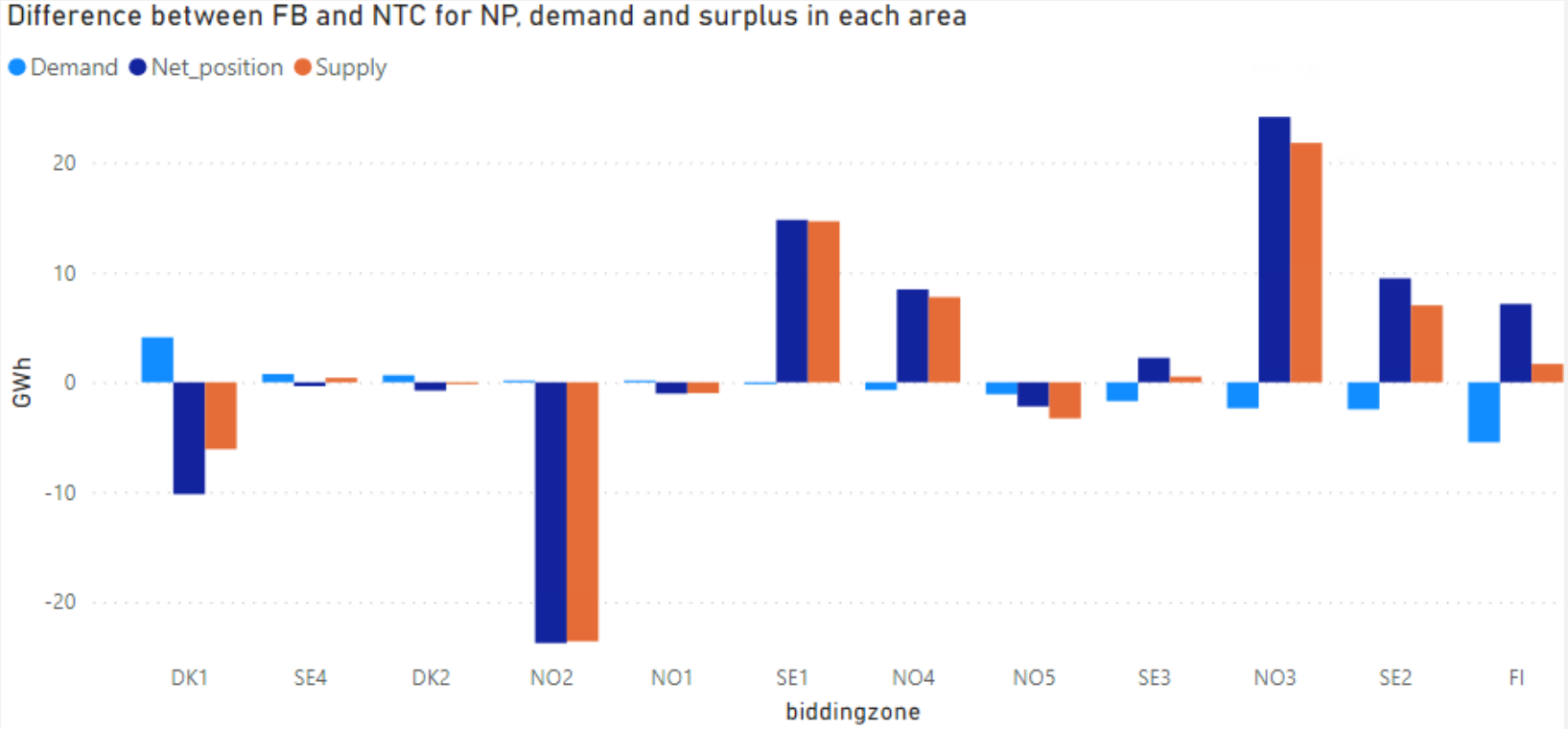

Figure: Demand and supply volumes difference (FB-NTC) and the corresponding net position change

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

Prices Period 3 (27.4. - 5.5.)

- Average prices in Denmark, NO5 & SE4 are decreased, and increased in the other bidding zones (except NO2 where the price is the same)
- The bidding zones with decreased prices are the ones with the highest average price (except FI), while the ones with the lowest prices increase the most.
- The maximum prices decreased for DK, NO1 and NO2 and NO5. Increased in the rest.

Market prices

Rounded to nearest integer. Thousands separated by comma. Example: 1,234,567

Bidding zone	Min. price		Max. price		Avg. price		
	FB	NTC	FB	NTC	FB	NTC	FB-NTC
DK1	-5	-3	↓ 200	205	48	50	↓ -2
DK2	-5	-3	↓ 200	205	48	50	↓ -2
FI	2	2	= 398	398	54	52	↑ 2
NO1	-7	0	↓ 91	96	39	38	↑ 1
NO2	-3	0	↓ 90	96	40	40	= 0
NO3	2	2	↑ 95	90	39	36	↑ 3
NO4	2	2	↑ 98	90	38	36	↑ 2
NO5	1	2	↓ 91	96	40	42	↓ -2
SE1	2	0	↑ 100	90	36	35	↑ 1
SE2	2	0	↑ 100	90	36	35	↑ 1
SE3	1	0	↑ 153	120	40	36	↑ 3
SE4	-3	-3	↓ 175	205	39	46	↓ -7

Table: Min, max and mean prices for all bidding zones in FB and NTC

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

Constraining CNECs in FB
Period 3 (27.4. - 5.5.)

- A Swedish CNEC in SE3 is the most constraining for this period
- Mainly HVDCs are the most limiting elements.
  - Here, especially HVDCs to the continent & the Baltics are constraining
- High shadow prices indicate that more flow would have increased the total SDAC welfare.

Counts of hours with shadowprice (FB)

Thousands separated by comma and decimal separated by dot. Example: 1,234.56

CNEC	Count of hours	Average shadowprice	Total shadowprice
d959d21ed54b41ffab81adfe6fd6f1db	36	148.61	5,350.06
AC_Minimum_NO2_ND	123	36.58	4,499.65
FI_PTC_RAC_SE1-FI	92	43.86	4,034.70
202d19e5c40d42cabdd39ac782e243fb	104	38.30	3,982.95
AC_Minimum_NO2_NK	111	33.63	3,732.40
AC_Maximum_FI_EL	74	43.35	3,207.66
AC_Minimum_SE4_BC	113	27.26	3,080.12
19b4fcd9bcd24ca4a298905dd70c1e78	95	29.32	2,785.42
DK2_SV_IMP|BASECASE	81	25.15	2,036.83
AC_Minimum_NO2_SK	53	37.12	1,967.49
DK1_NL_EXP|BASECASE	74	25.59	1,893.35
AC_Minimum_DK2_KO|BASECASE	79	22.68	1,791.41
7aa439a2ed7e4c77b0afd671cab8fd5f	52	29.44	1,530.98
AC_Maximum_NO2_ND	23	59.48	1,368.07
AC_Maximum_NO2_NK	28	48.20	1,349.51
FI_PTC_FI_EL_EXPORT	52	25.29	1,315.25
13792_325 30% 420 Nea-Klæbu + 300 Vågåmo-Aura	18	66.54	1,197.74
13c5af78cb2a422ea13b946d96a7cbd4	40	25.57	1,022.75
AC_Maximum_DK2_KO|BASECASE	29	30.91	896.37
AC_Maximum_SE4_BC	35	23.47	821.42
AC_Minimum_SE3_KS	31	23.91	741.11
cdba87f6589a430091d9df32501457c6	15	48.17	722.51
78cd02a764b647658f25ea3eb149b67f	36	19.47	700.81
AC_Minimum_SE4_SP	24	29.17	700.07
ACLineSegment ENDK DK1 E_KAE-LYK_3 1 N Terminal : N|165KV LINE E_KAE-LYK_2	1	686.45	686.45

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Specific hour walkthrough

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

Specific hours

- 18 April, 07:00-08:00, Price peak in all of the Nordics
- 27 April, 19:00-20:00 Maintenance work, southbound flows
- 28 April 17:00-18:00, Maintenance work, northbound flows
- May 3, 08:00, Difference on Fennoskan (FI-SE3)

Figure: Left (FB) and right (FB-NTC) simulated flows and prices for 17 March, MTU 20

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

Price peak in the Nordics on 18 April, 07:00-08:00

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

Price peak in the Nordics on 18 April, 07:00-08:00

- On 18 April 07:00-08:00, a price peak in all Nordic Bidding Zones was observed in both FB and NTC.
- Low wind production and morning peak in demand.
- Weighted Average price of 148 €/MWh in the Nordics in NTC.
- The prices are lower in the previous and following MTUs, and also for the other morning/evening price peaks.

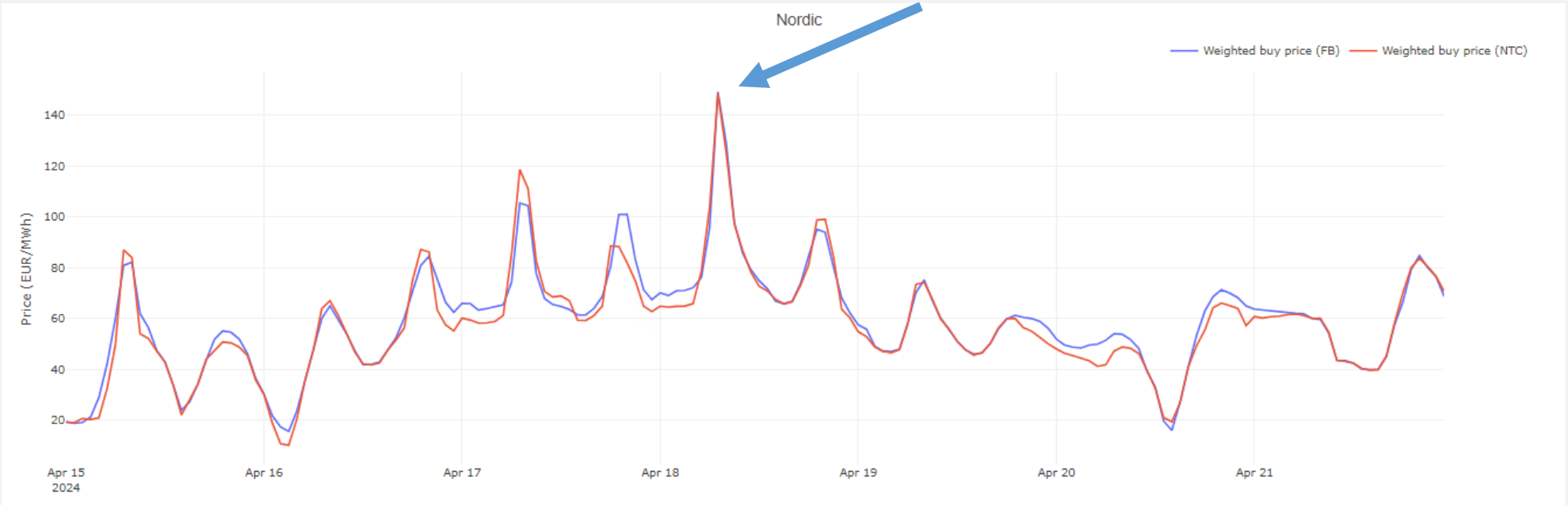


Figure: Weighted buy price in the Nordics for W16

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

Price peak in the Nordics on 18 April, 07:00-08:00

- In NTC, NO4 is isolated from the high prices in the neighbouring BZs, due to the interconnector capacity being fully used. The price in NO4 is 34 €/MWh, while it is 156 in SE1, SE2 and NO3.
- There is 0 MW flow between NO4-SE1 due to an outage which further isolates NO4 from it's neighbours.
- In FB, the prices in South Norway, Denmark & SE4 are decreasing with 1-8 €/MWh, while the prices in SE1-3, Finland and the Baltics are increasing with up to 5.5 €/MWh. The extra flow from NO4 to NO3 decreases the price in NO3 with 32 €/MWh.
- The price decreases are caused by an increased North-South-flow, as the Net Position in NO4 is increased with 450 MWh, increasing the price with 66 €/MWh.
- FB increases the export from NO4 by using the grid more efficiently, resulting in a SEW gain of 45.26 k€ for this MTU for the entire SDAC region.

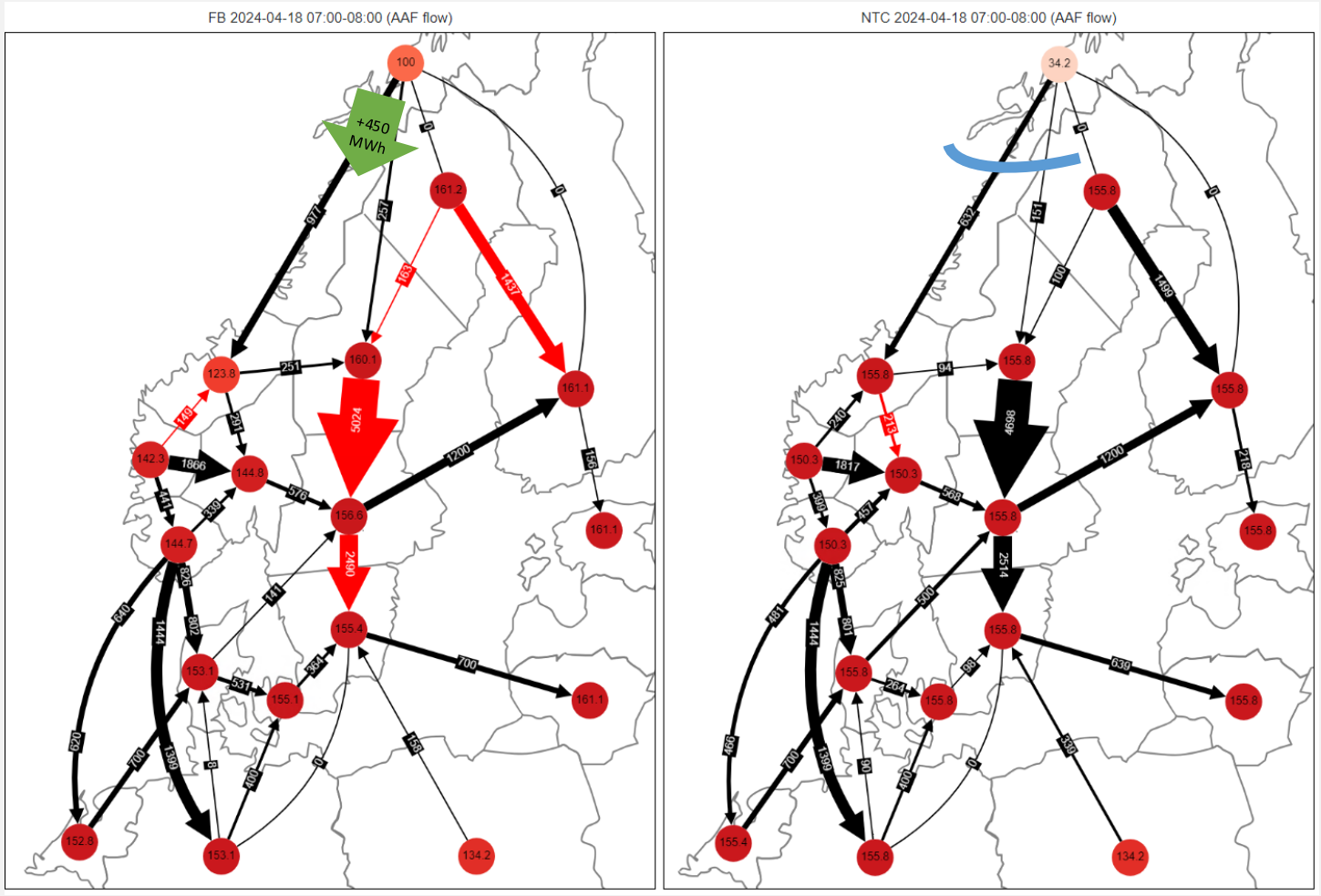


Figure: Left (FB) and right (NTC) simulated flows and prices for 18 April, MTU 8

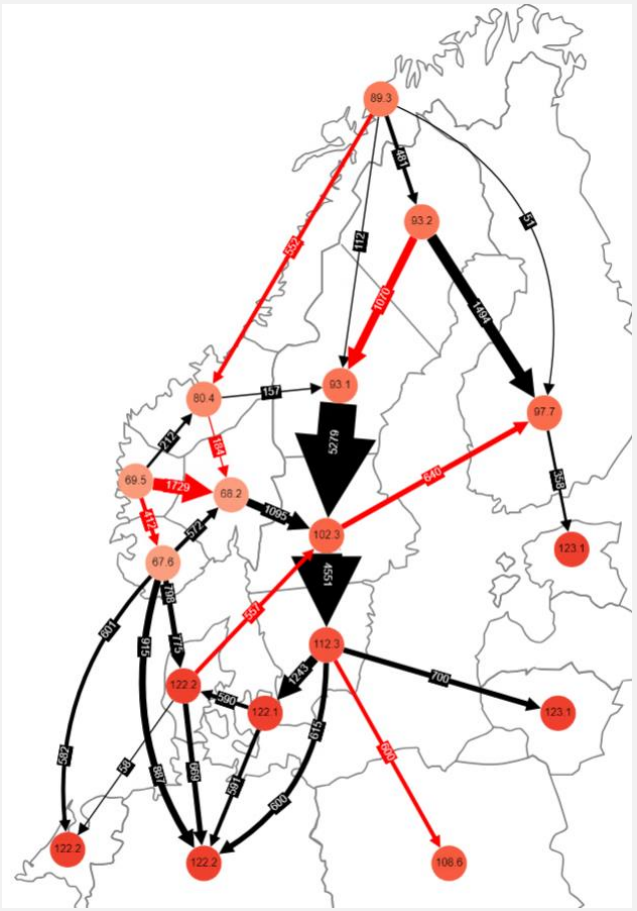
ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

April 27, 19:00-20:00
Optimised flow between NO1-SE3-DK1 during internal outage in SE3

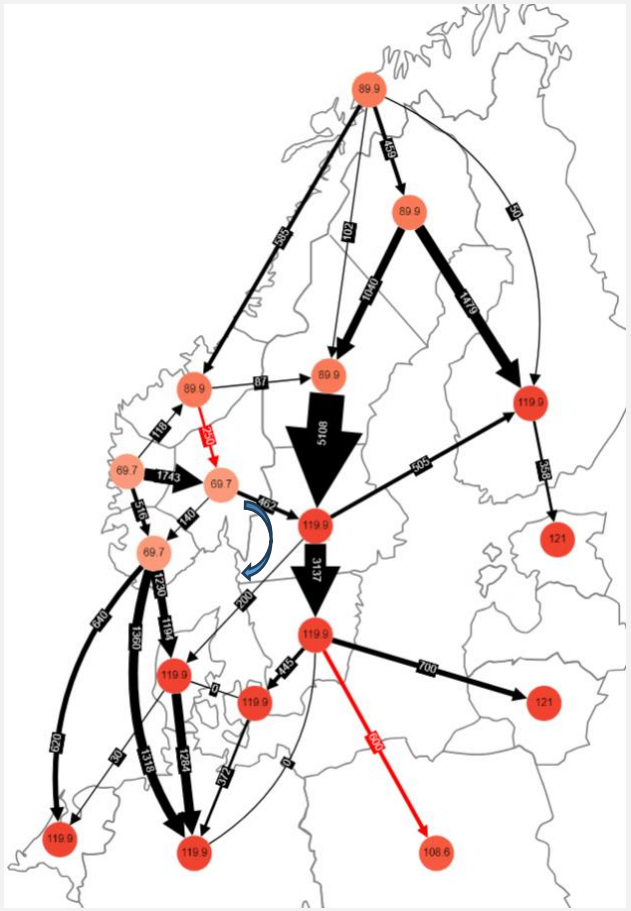
ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

April 27, 19:00-20:00
Optimised flow in FB between NO1-SE3-DK1 during outage in SE3

- April 27, prices in the Nordics ranging between 80-123 €/MWh. Net export from the Nordics.
- Planned outage in SE3 affects the capacity between NO1-SE3, SE3-DK1, SE2-SE3 and SE3-SE4.
- The most limiting CNEC is located in SE3 and is affected by the planned outage.
- Flow on Kontiskan (SE3-DK1) is turned in FB compared to NTC, non-intuitive flow on Fennoskan (SE3-FI)



FB AAF, April 27, 19:00



NTC AAF, April 27, 19:00

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

April 27, 19:00-20:00

- Kontiskan import to SE3 and Fennoskan export from SE3 relieves the CNEC

	DK1_CO	DK1_DE	DK1_KS	DK1_SK	DK1_SB	DK2_KO	DK2_SB	FI_EL	FI_FS	NO2_ND	NO2_NK	NO2_SK	SE3_FS	SE3_KS	SE3_SWL	SE4_BC	SE4_NB	SE4_SP	SE4_SWL	load	shadowprice
DK2_SV_IMP|BASECASE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	7.96
FI_PTC_RAC_SE1-FI	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.99	-0.99	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	4.61
d959d21ed54b41ffab81adfe6fd6f1db	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.04	0.04	0.09	0.09	0.09	0.03	-0.02	0.01	0.00	0.01	0.01	0.00	1.00	520.91

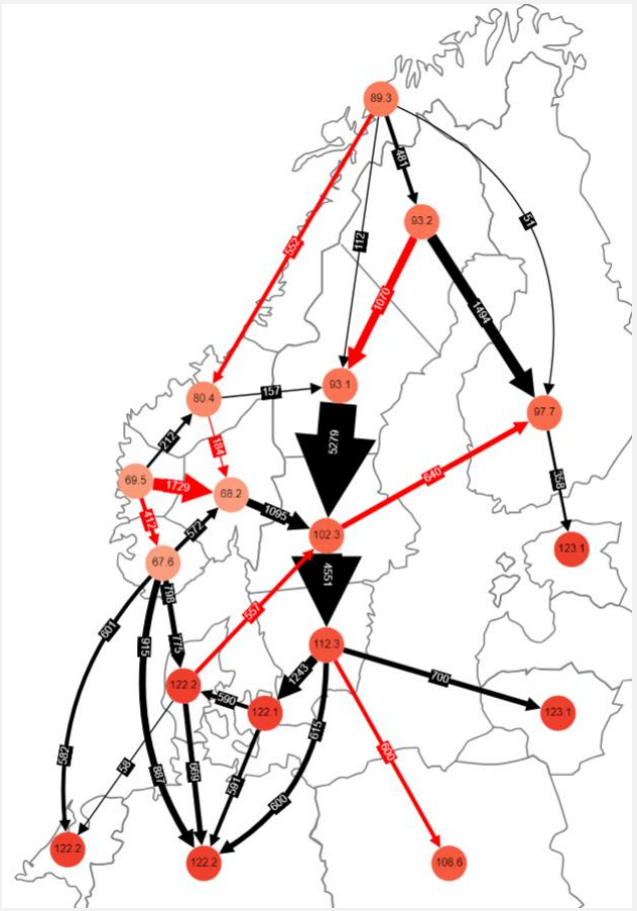
- NO1->SE3 border is most limited by the CNEC, but the flow on SE2-SE3 and SE3-SE4 is also limited by the CNEC

	DK2-SE4	FI-NO4	FI-SE1	NO1-NO2	NO1-NO3	NO1-NO5	NO1-SE3	NO2-NO5	NO3-NO4	NO3-NO5	NO3-SE2	NO4-SE1	NO4-SE2	SE1-SE2	SE2-SE3	SE3-SE4	load	shadowprice
FI_PTC_RAC_SE1-FI	0.00	-0.96	-0.99	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	-0.04	-0.03	0.00	0.00	0.00	1.00	4.61
d959d21ed54b41ffab81adfe6fd6f1db	0.00	-0.01	0.00	0.00	0.02	0.00	0.07	0.00	0.02	-0.02	0.02	0.01	0.01	0.00	0.02	0.02	1.00	520.91
DK2_SV_IMP|BASECASE	-1.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	7.96

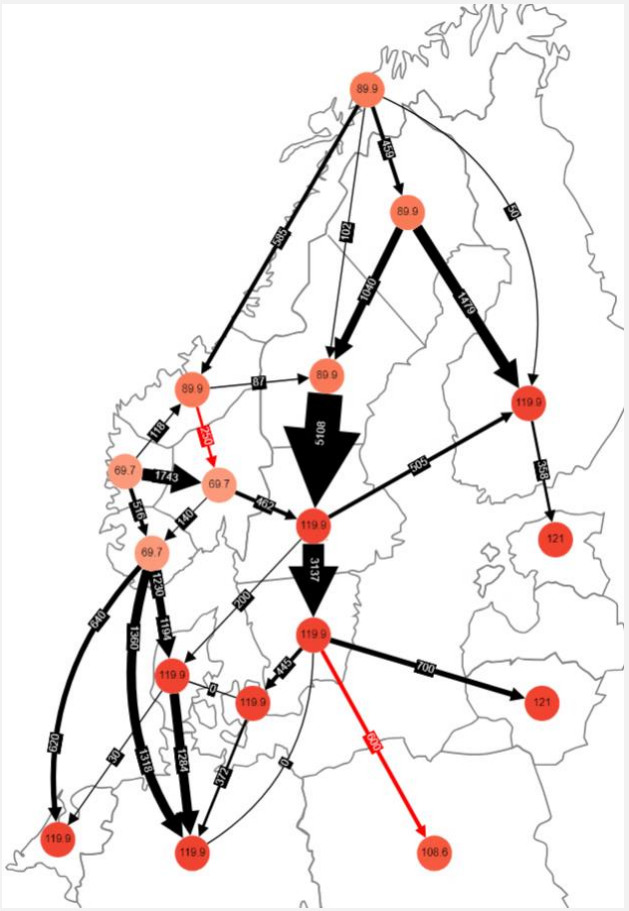
ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

April 27, 19:00-20:00
Optimised flow in FB between NO1-SE3-DK1 during internal outage in SE3

- The CNEC is relieved by import to SE3 on Kontiskan, and export from SE3 on Fennoskan which explains the non-intuitive flows on these connectors.
- Because of the non-intuitive flow on Kontiskan more power can be imported to SE3 on Hasle (NO1-SE3)
- The relieving effects and the import on Hasle opens up for more southbound flow on SE2-SE3 and SE3-SE4, leading to lower prices in SE3 and SE4.
- Prices are decreased in FB in SE2, SE3, SE4, FI, NO3 and slightly in NO4, NO2.



FB AAF, April 27, 19:00



NTC AAF, April 27, 19:00

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

April 28, 17:00-18:00
Northbound flow SE4-SE3

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

April 28, 17:00-18:00

- Low prices in general, especially on the continent (0 €/MWh)
    - All Nordic bidding zones are net importing, except for SE2
- Same outage in SE3 as on April 27 still ongoing
- Northbound flow from the continent-SE4-SE3-SE2 and export SE3->NO1 (Hasle)
    - Opposite direction from the previous case
- Most limiting CNEC located in SE3 (another from the previous case), which is too restrictive thus allowing less than in NTC on SE3->NO1
- Lower flow DE->NO2 in NTC due to ramping limits on Nordlink

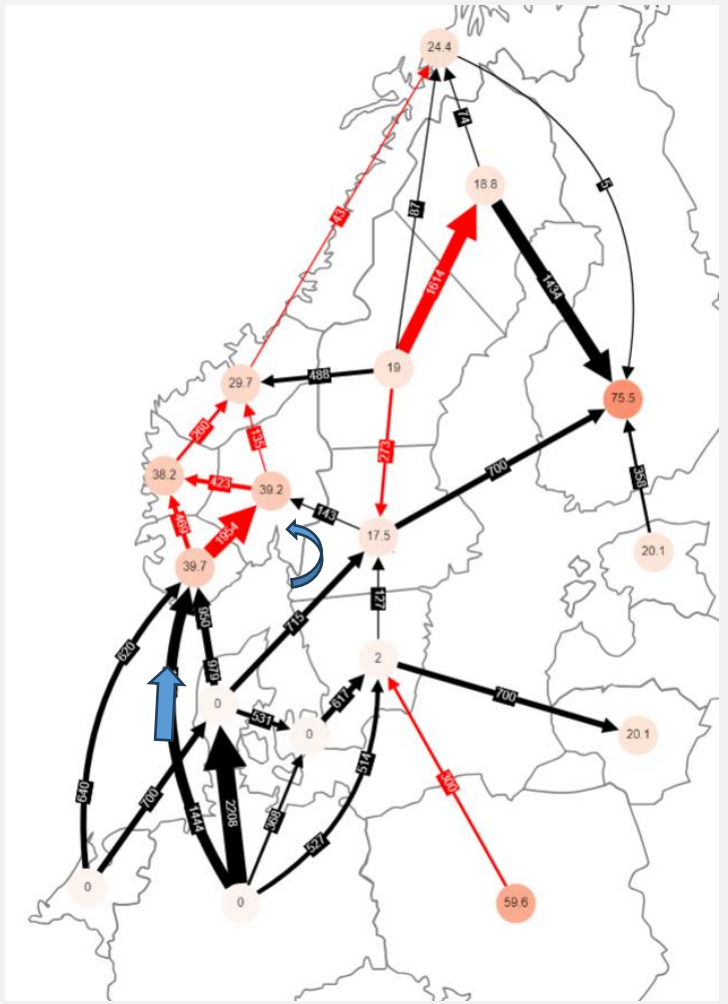


Figure: April 28, 17:00. FB EPR

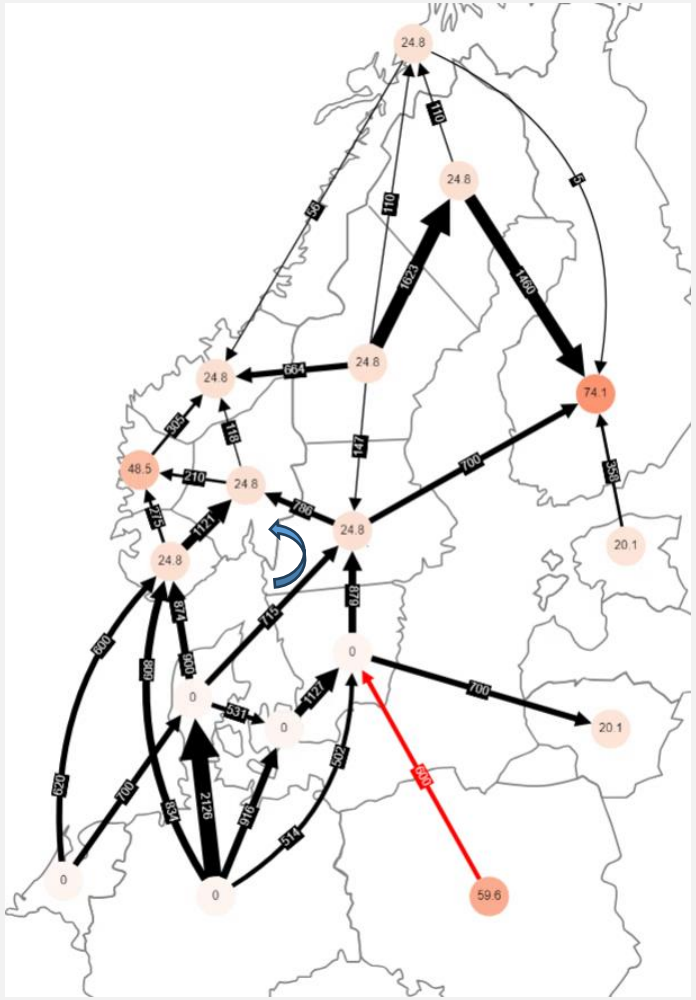


Figure: April 28, 17:00. NTC results

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

April 28, 17:00-18:00

CNEC is relieved by flow NO1->SE3

SE3->SE4 relieves the CNEC; northbound flow SE4->SE3 is decreased in FB compared to NTC

Constraining PTDF matrix z2z (Real)

	DK2-SE4	FI-NO4	FI-SE1	NO1-NO2	NO1-NO3	NO1-NO5	NO1-SE3	NO2-NO5	NO3-NO4	NO3-NO5	NO3-SE2	NO4-SE1	NO4-SE2	SE1-SE2	SE2-SE3	SE3-SE4	load	shadowprice
FI_PTC_RAC_SE1-FI	0.00	-0.96	-0.99	0.00	0.00	0.00	0.00	0.00	0.03	0.00	0.00	-0.04	-0.04	0.00	0.00	0.00	1.00	56.91
7aa439a2ed7e4c77b0afd671cab8fd5f	0.02	0.04	0.00	0.01	-0.12	-0.01	-0.27	-0.02	-0.09	0.11	-0.13	-0.04	-0.04	0.00	-0.02	-0.19	1.00	80.57
AC_Maximum_NO2_NK	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	0.35
AC_Maximum_SE4_BC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	1.78
AC_Maximum_FI_EL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	55.52
202d19e5c40d42cabdd39ac782e243fb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	60.31
AC_Minimum_SE4_NB	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.00	14.42
AC_Minimum_SE4_SWL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	9999.00	4.42

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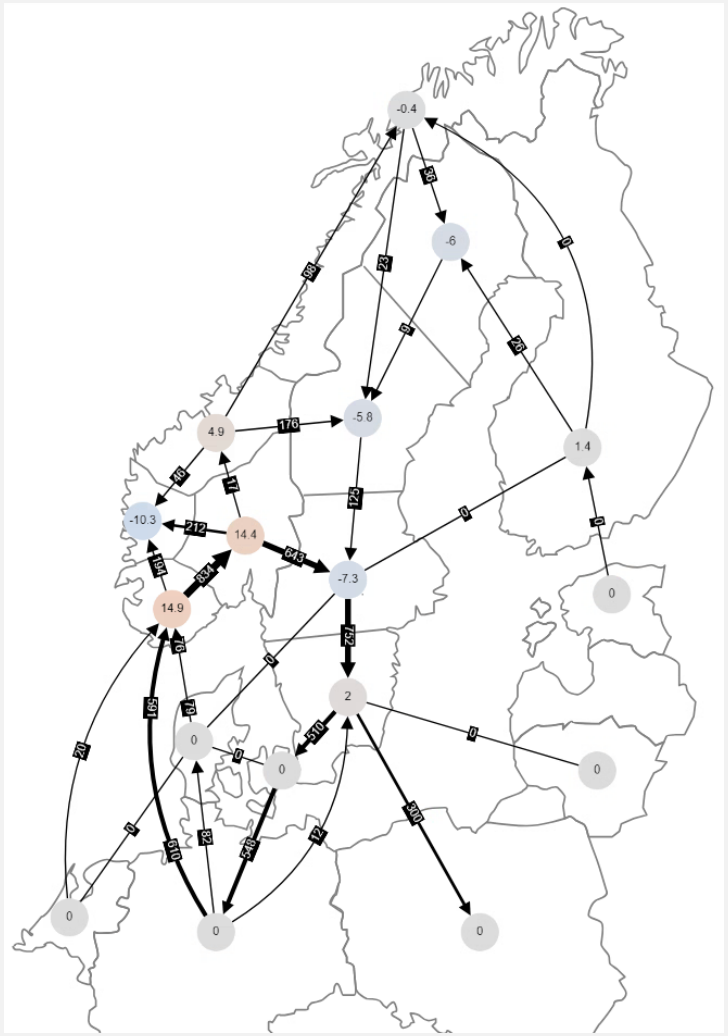
April 28, 17:00-18:00

- The CNEC is relieved by import to SE3 from NO1; export to NO1 is decreased in FB compared to NTC
- Also flow SE3->SE4 relieves the CNEC; northbound flow SE4->SE3 is decreased in FB compared to NTC
- More import to NO2 in FB than NTC (on DE-NO2), but NO2 also exports more in FB --> higher price.
  - More import to NO5 from NO2, NO1 and NO3. Prices in southern Norway are close to each other in FB.
- In FI, the price is the highest in the Nordics both in NTC and FB, due to full import on HVDC, outage NO4-FI and very small change in flow SE1-FI.



ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

May 3, 08:00-09:00
Difference in capacity on SE3-FI

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

May 3, 08:00-09:00

- The capacity on Fennoskan (SE3-FI) was incorrectly set to 700 MW in FB, when it should have been 900 MW, as in NTC, for the period from May 3rd to May 6th, 2024.
- On May 3, 08:00, FI had the highest price in NTC. As a result of the lower capacity in FB, the price in FI was increased further in FB.
  - Congestion income and producer surplus were increased, and consumer surplus decreased in this hour.
- From May 3, 20:00 and until end of May 5th, no price spread between SE3-FI; Fennoskan not limiting
- This issue will be further elaborated in the upcoming operational learning points document.

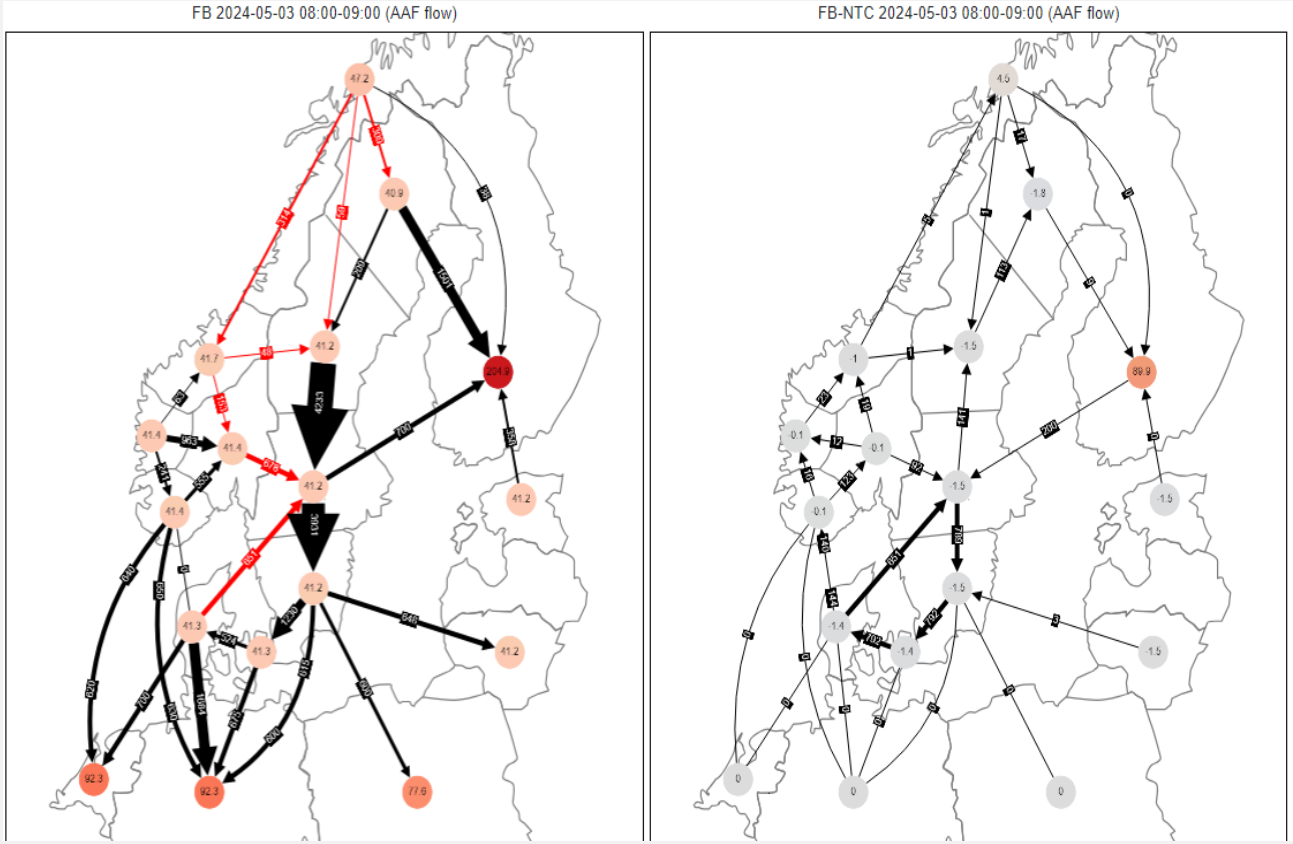


Figure: Left (FB) and right (FB-NTC) simulated flows and prices for 3 of May, MTU 9

Figure: SEW change in FB compared to NTC, full day May 3.

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Intraday

ENERGINET SVENSKA KRAFTNÄT FINGRID Statnett

Agenda

1. Introduction
2. Background and methodology of ATCE
3. EPR intraday results, weeks 15-18
   - Comparison to NTC ID capacities, actual trades etc
4. Specific hour walkthrough

Summary of week 15-18, 2024
8 April – 5 May

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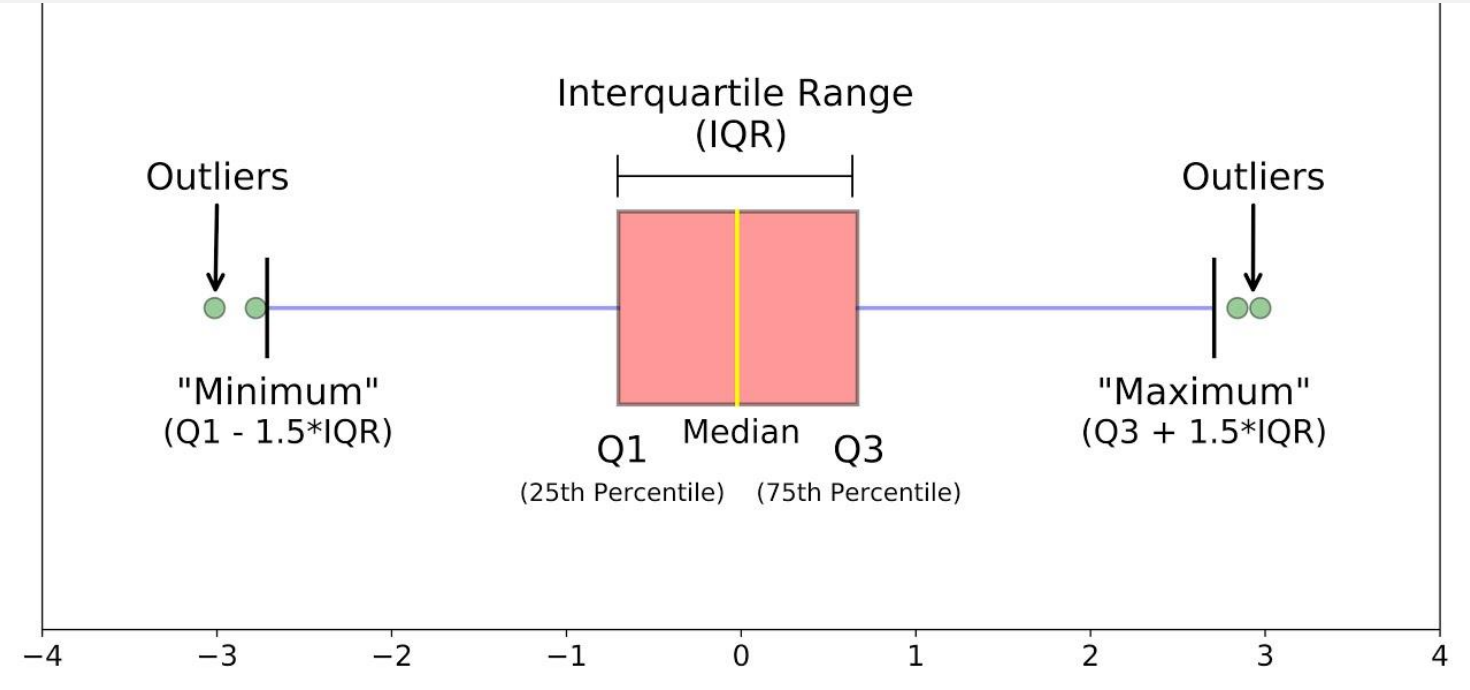
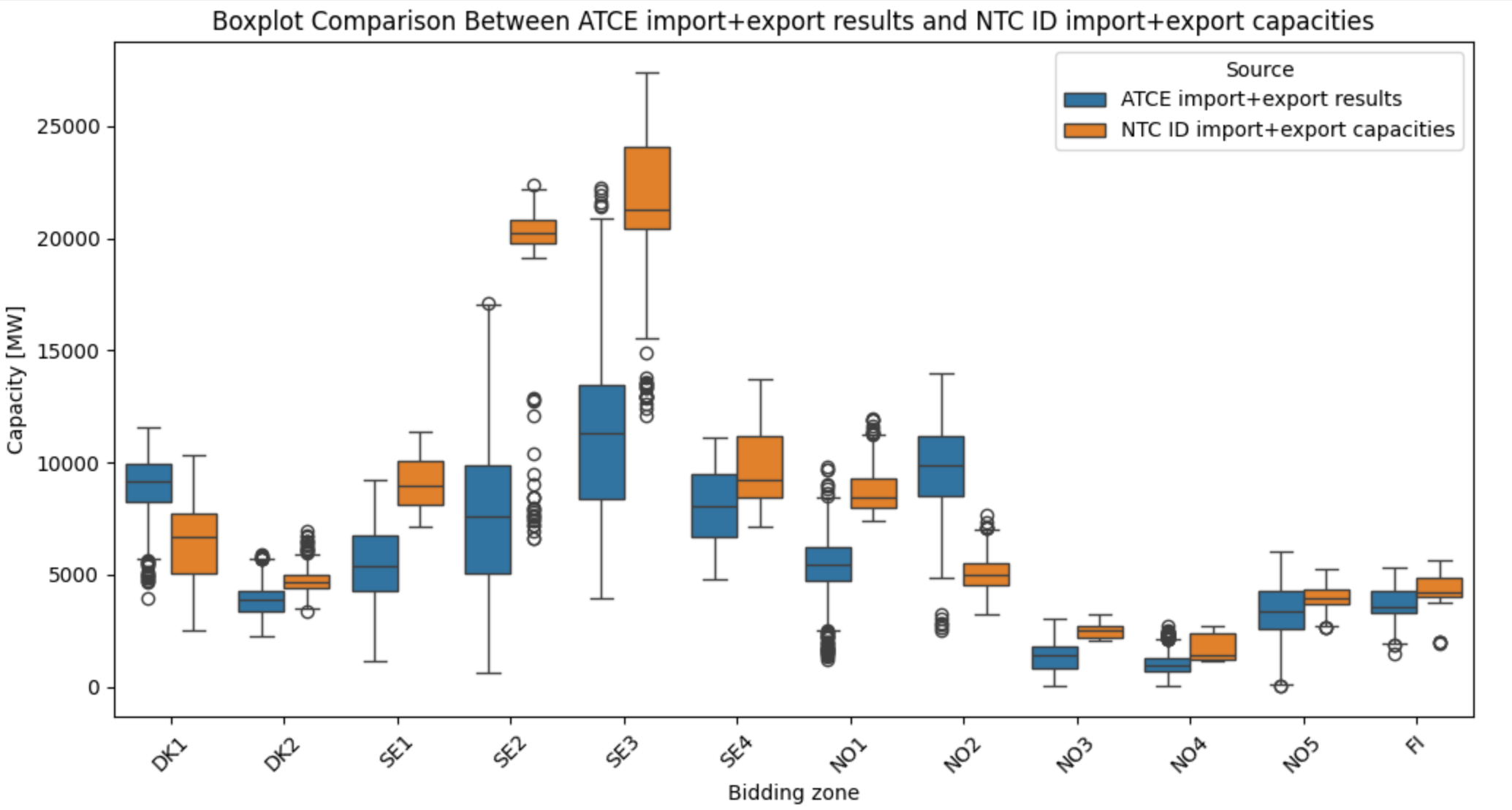
Explanation of box-plots for the next figures

- The box-plots show statistical results of hourly values. They show the median value (yellow line in the middle of the box), 50% of the values (inner box – interquartile range) and ~99% of all values (vertical lines - "minimum" & "maximum") for each border
  - Outliers that are beyond the "minimum" and "maximum" are marked as circles



Comparison of ATCE export+import results (blue) and NTC intraday export+import capacities given to the market (orange)

- Swedish bidding zones have much higher capacity in NTC, but otherwise, the median capacity and the spread is not much different between the two.



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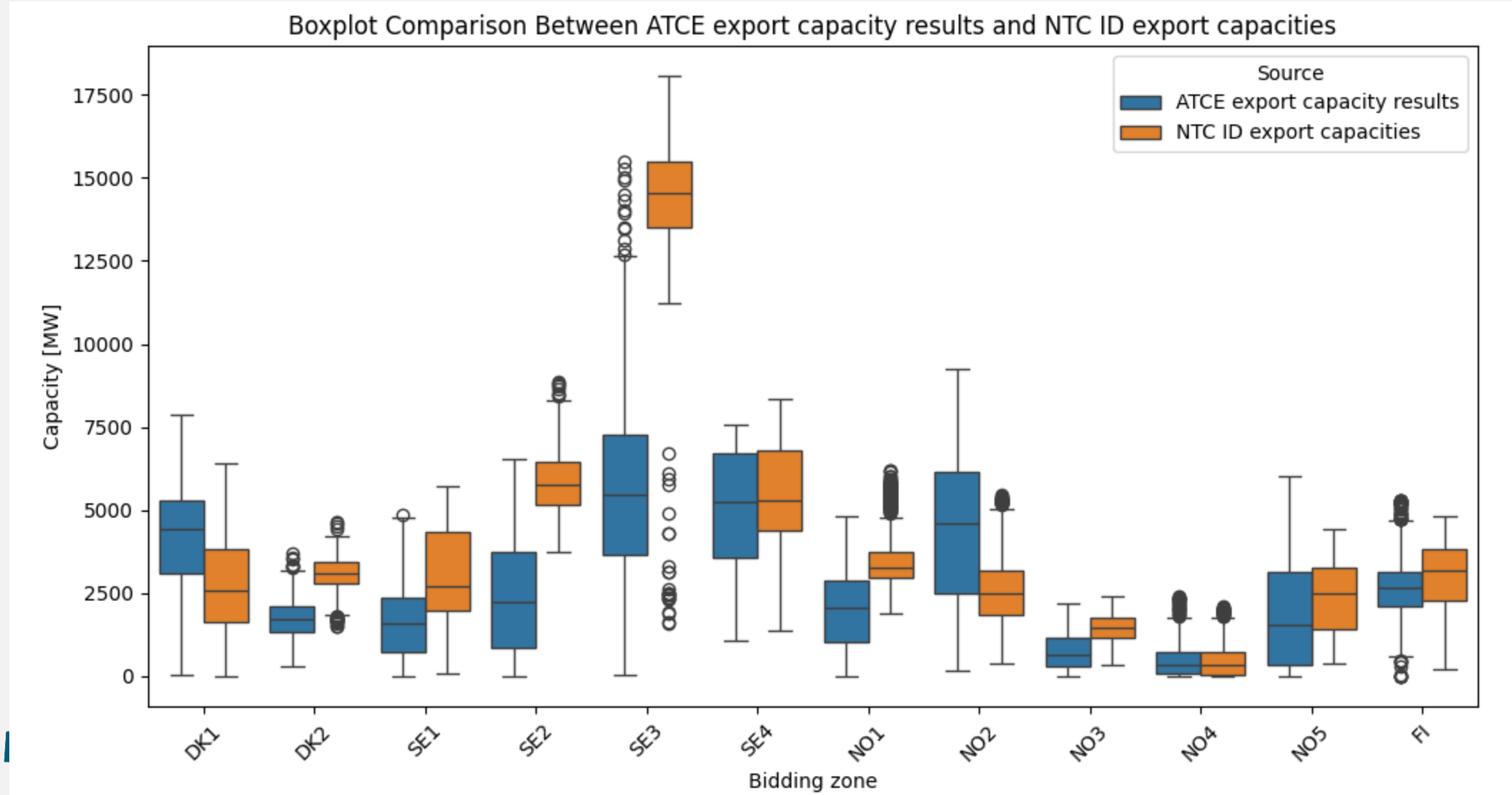
Comparison of ATCE export results (blue) and NTC intraday export capacities given to the market (orange)

- Again, the Swedish bidding zones stand out (especially SE3), but the other bidding zones are not very different.



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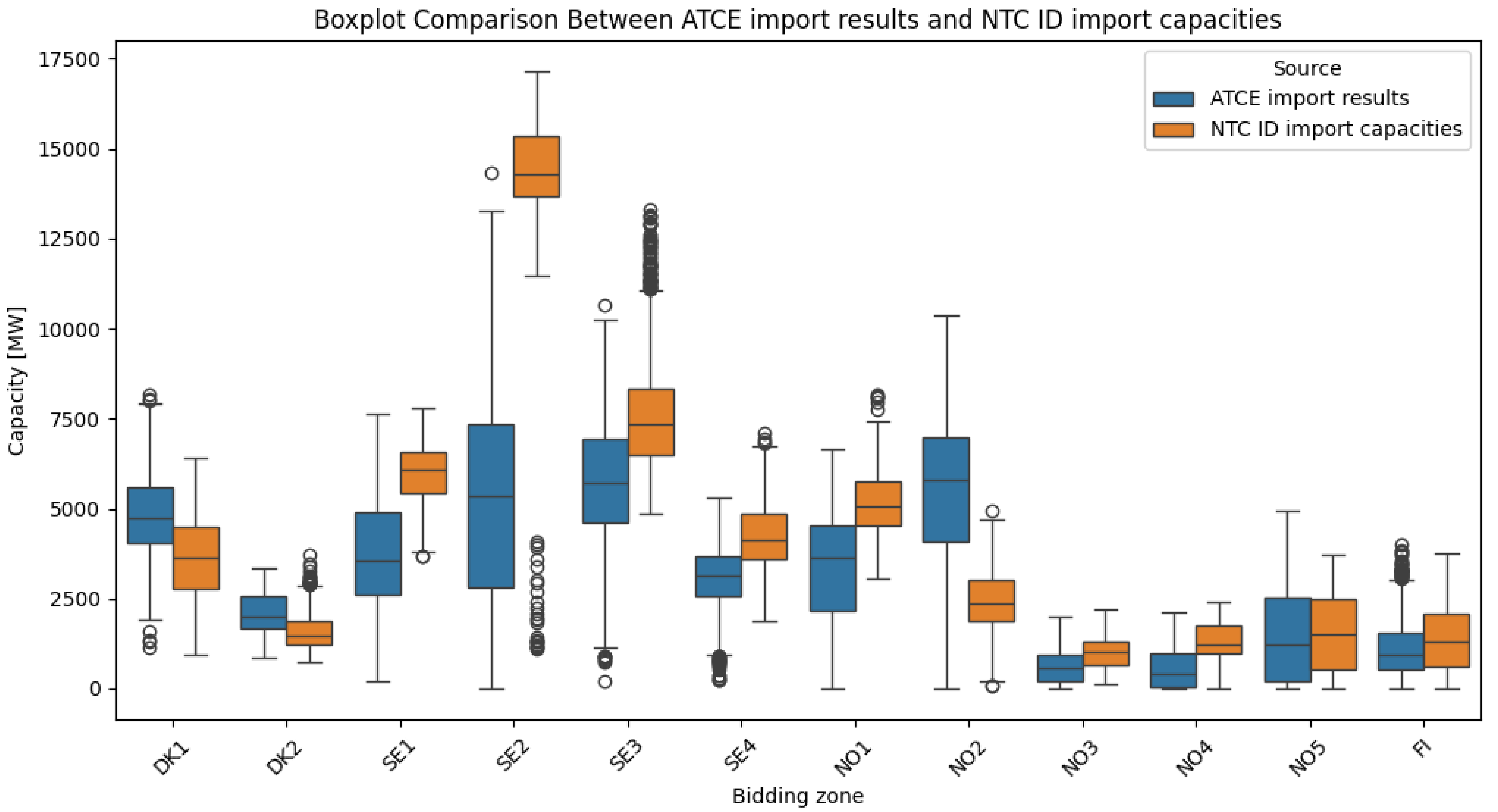
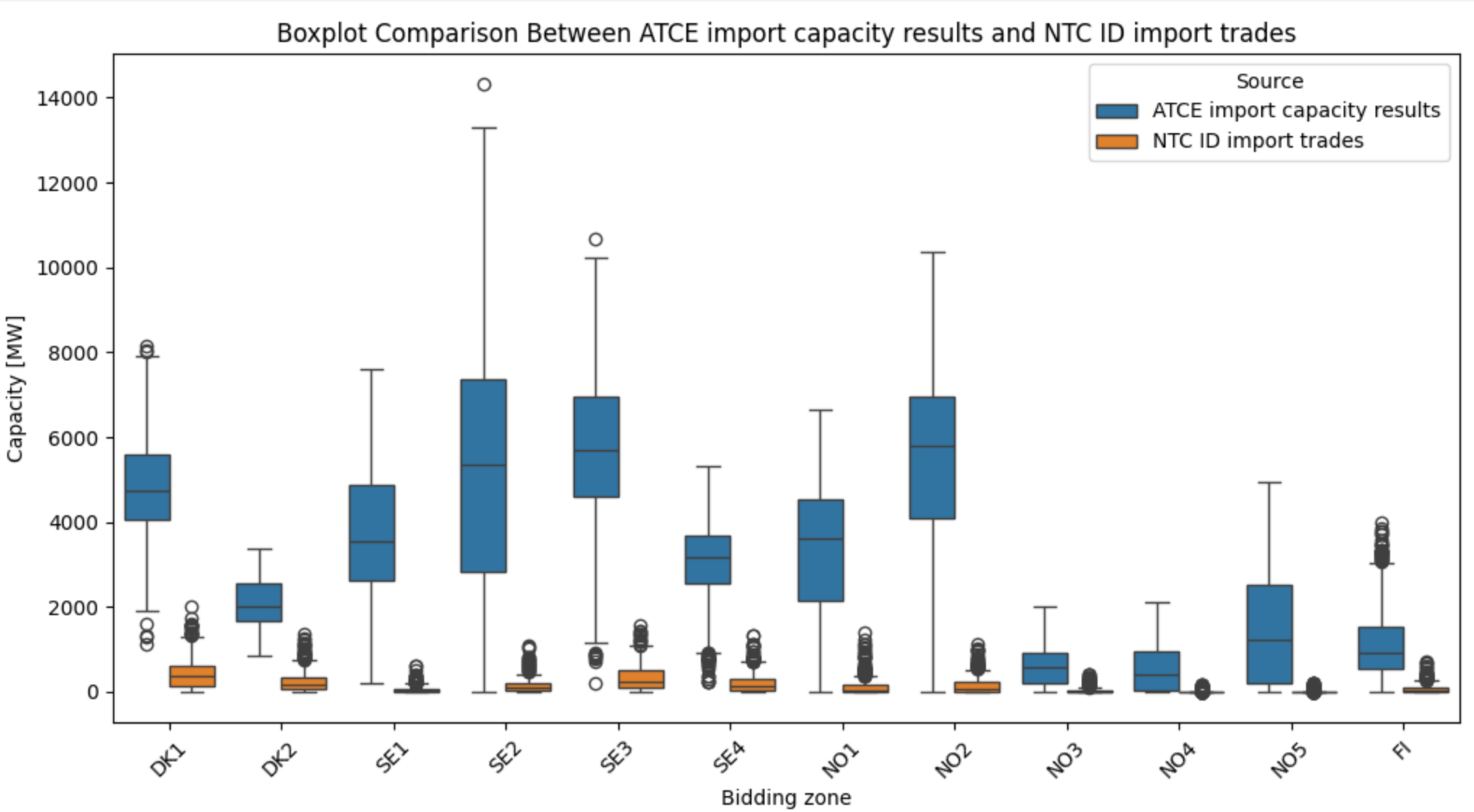
Comparison of ATCE import results (blue) and NTC intraday import capacities given to the market (orange)

- Here, SE2 stands out, but the rest are not very different. NO2 has a higher intraday capacity in ATCE.



Comparison of ATCE export results (blue) and actual traded intraday export volumes (orange)

- Compared to actual traded volumes, the export capacities provided by ATCE should suffice most of the time.



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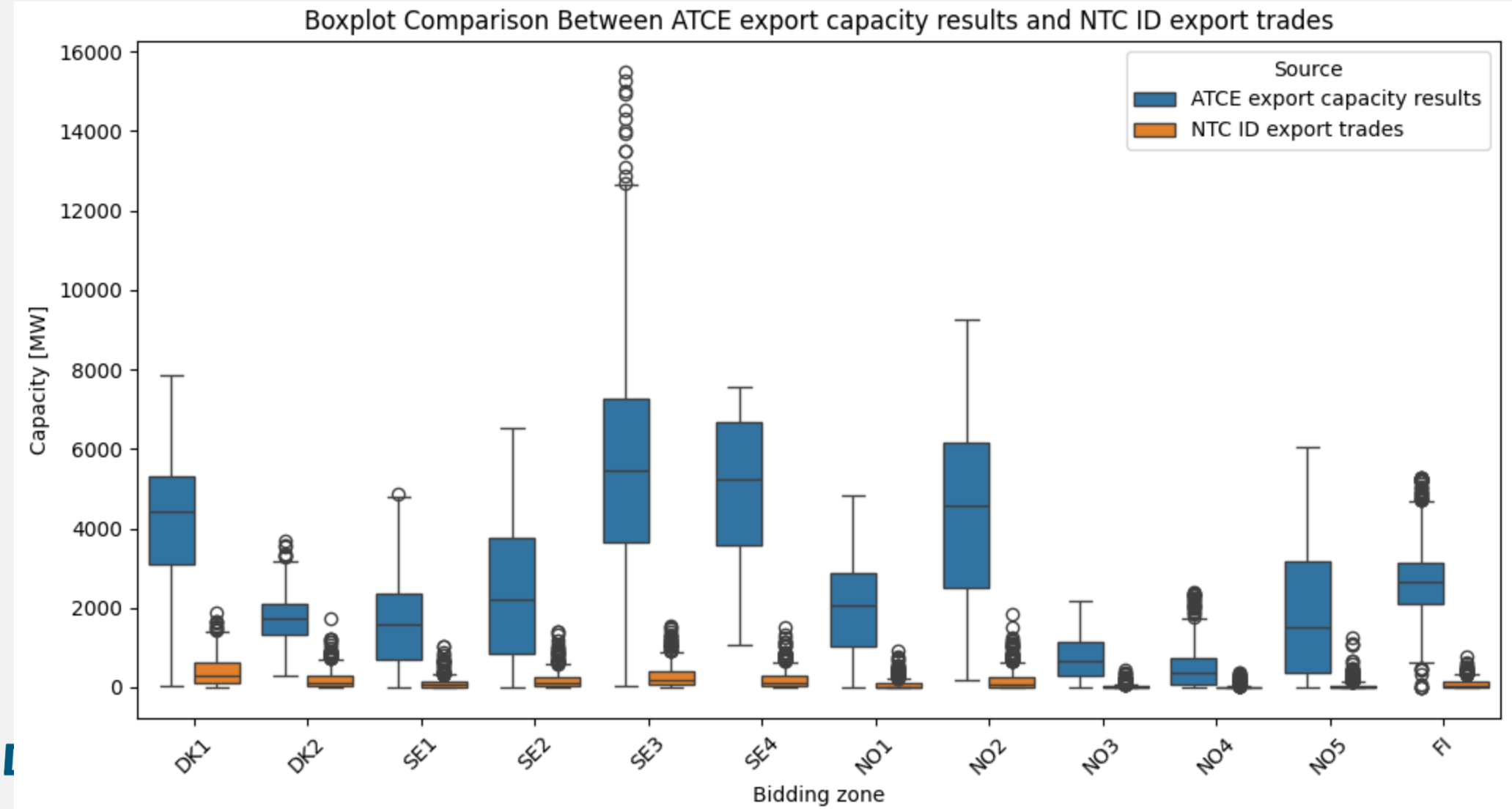
Comparison of ATCE import results (blue) and actual traded intraday import volumes (orange)

- Compared to actual traded volumes, the import capacities provided by ATCE should also suffice most of the time.



ENERGINET

Percentage of time where ATCE capacities are not able to facilitate ID needs (import + export)

- Only three bidding zones (NO3, NO4 and NO5) have larger intraday trades than the given ATCE capacity (export + import) for this period

Bidding zone	Percentage of time ID trade > ATCE capacity
DK1	0.00 %
DK2	0.00 %
SE1	0.00 %
SE2	0.00 %
SE3	0.00 %
SE4	0.00 %
NO1	0.00 %
NO2	0.00 %
NO3	1.39 %
NO4	0.15 %
NO5	0.31 %
FI	0.00 %

Percentage of time where ATCE capacities are not able to facilitate ID needs (export)

- For export, the ATCseveral bidding zones that usually export fully (SE1, SE2, NO3 and NO4) have quite a hgih percentage of times where actual intraday trades were higher than the ATCE result

Bidding zone	Percentage of time ID trade > ATCE capacity
DK1	4.02 %
DK2	0.15 %
SE1	9.91 %
SE2	8.51 %
SE3	0.31 %
SE4	0.00 %
NO1	1.08 %
NO2	1.39 %
NO3	5.26 %
NO4	4.95 %
NO5	5.42 %
FI	0.31 %

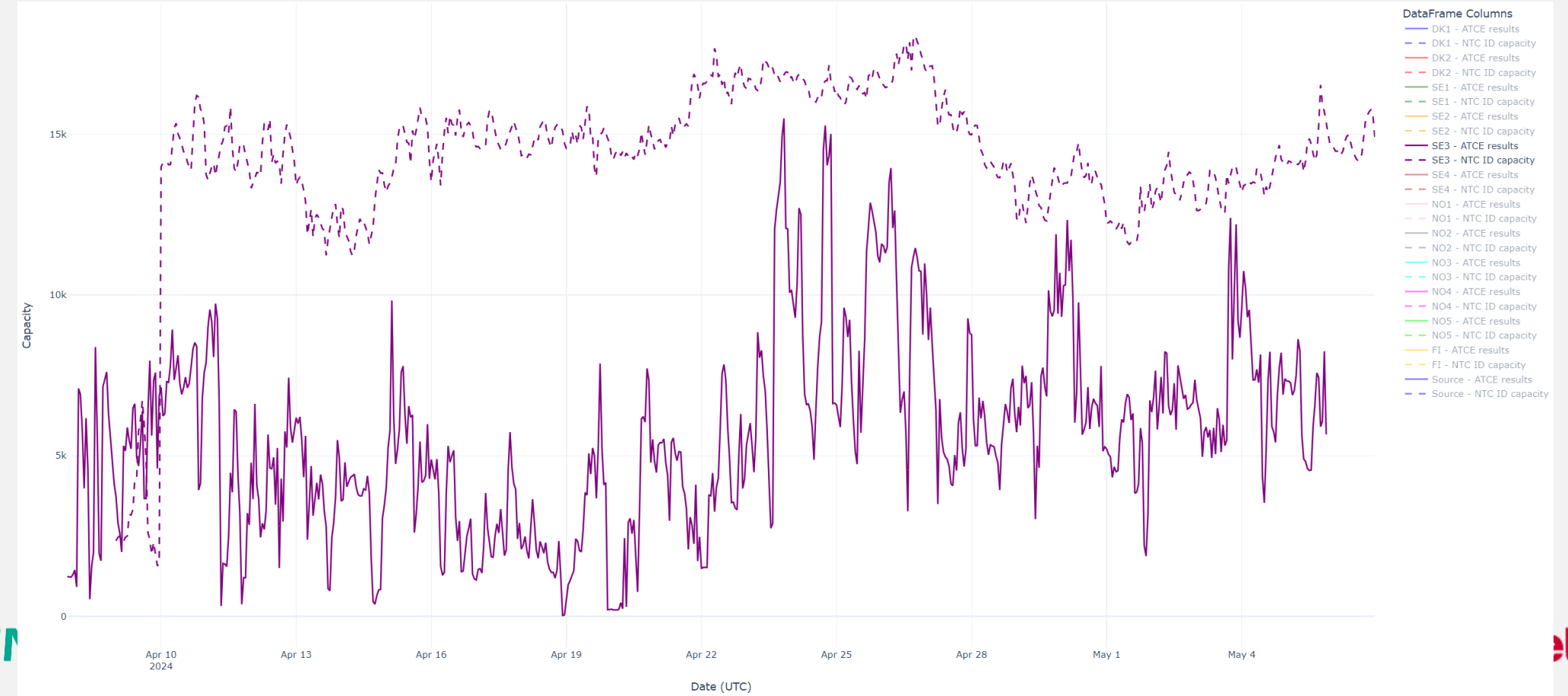
Percentage of time where ATCE capacities are not able to facilitate ID needs (import)

- For import, some bidding zones have less capacity provided by ATCE than the actual traded volumes.

Bidding zone	Percentage of time ID trade > ATCE capacity
DK1	0.00 %
DK2	0.00 %
SE1	0.00 %
SE2	5.11 %
SE3	0.31 %
SE4	0.46 %
NO1	1.08 %
NO2	1.55 %
NO3	3.56 %
NO4	6.35 %
NO5	3.87 %
FI	7.59 %

SE3 export capacities in today's market and ATCE results

- The figure shows export capacities given in today's market (dotted line) and ATCE export results (solid line) for the historical data
- Here, ATCE capacities are more varying, and also lower than in today's market

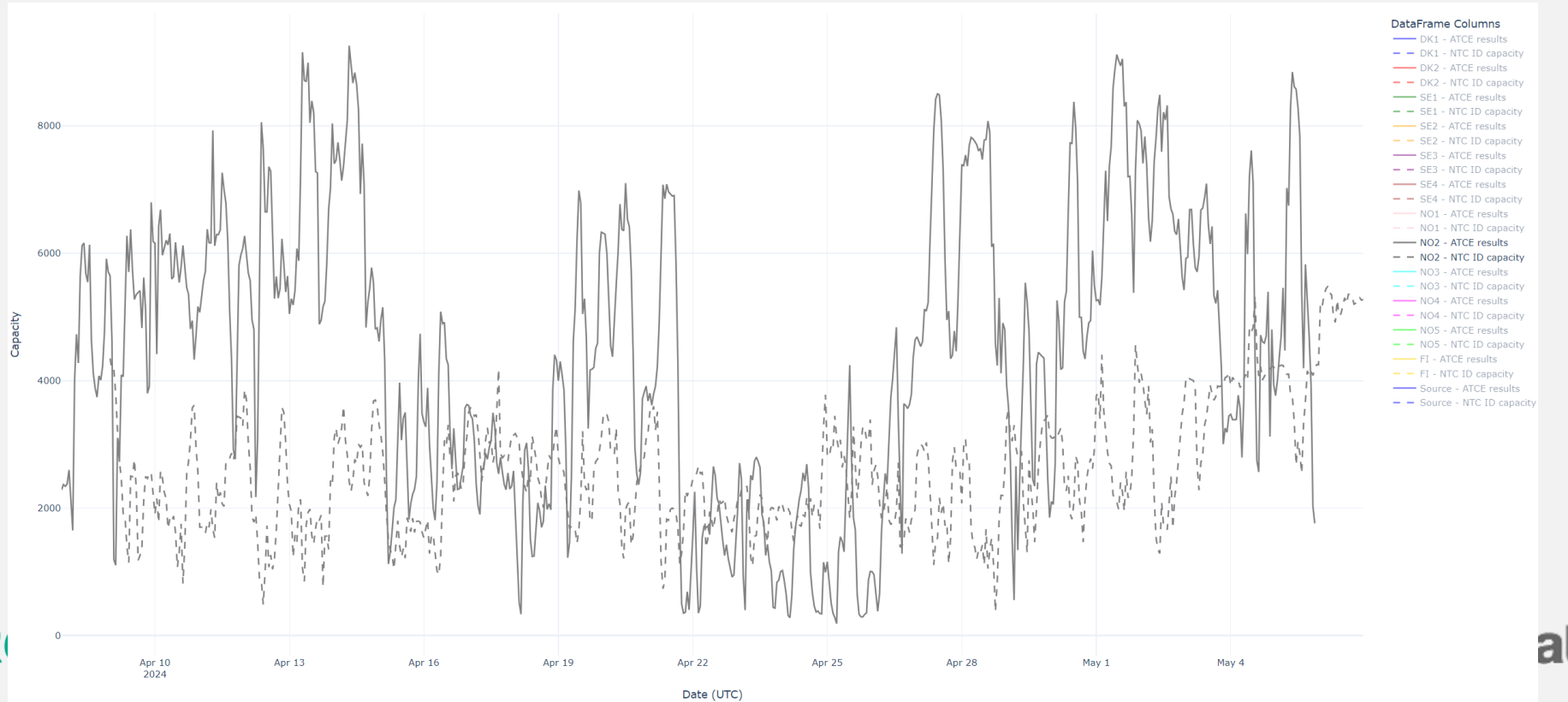


SE1 import capacities in today's market and ATCE results

- The figure shows SE1 import capacities given in today's market (dotted line) and ATCE import results (solid line) for the historical data
- Here, the ATCE results show significantly lower capacities and more volatility

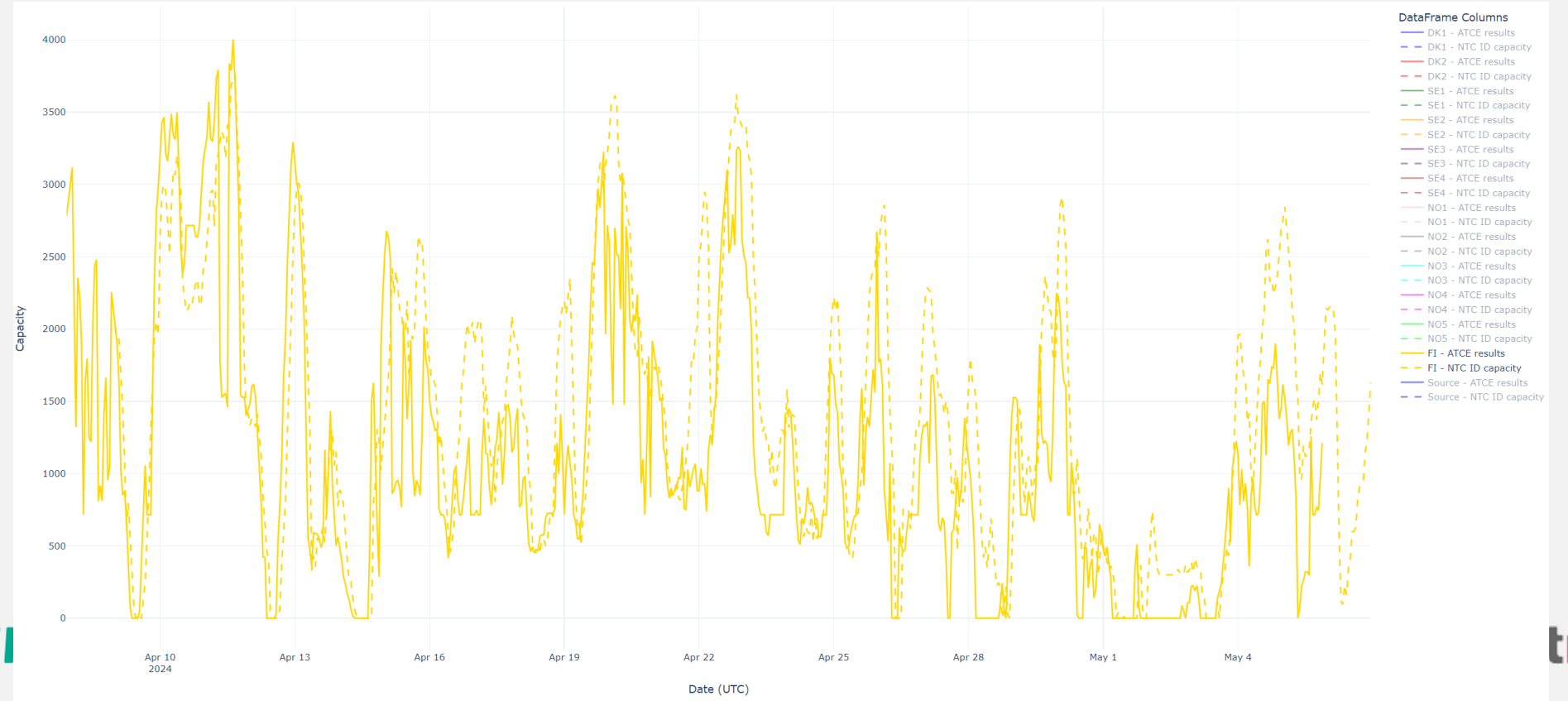
NO2 export capacities in today's market and ATCE results

- The figure shows NO2 export capacities given in today's market (dotted line) and ATCE export results (solid line) for the historical data
- Here, ATCE capacities are more varying, but overall higher than today's market



FI import capacities in today's market and ATCE results

- The figure shows FI import capacities given in today's market (dotted line) and ATCE import results (solid line) for the historical data
- Here, the capacities are quite similar for this period



Specific hour walkthrough

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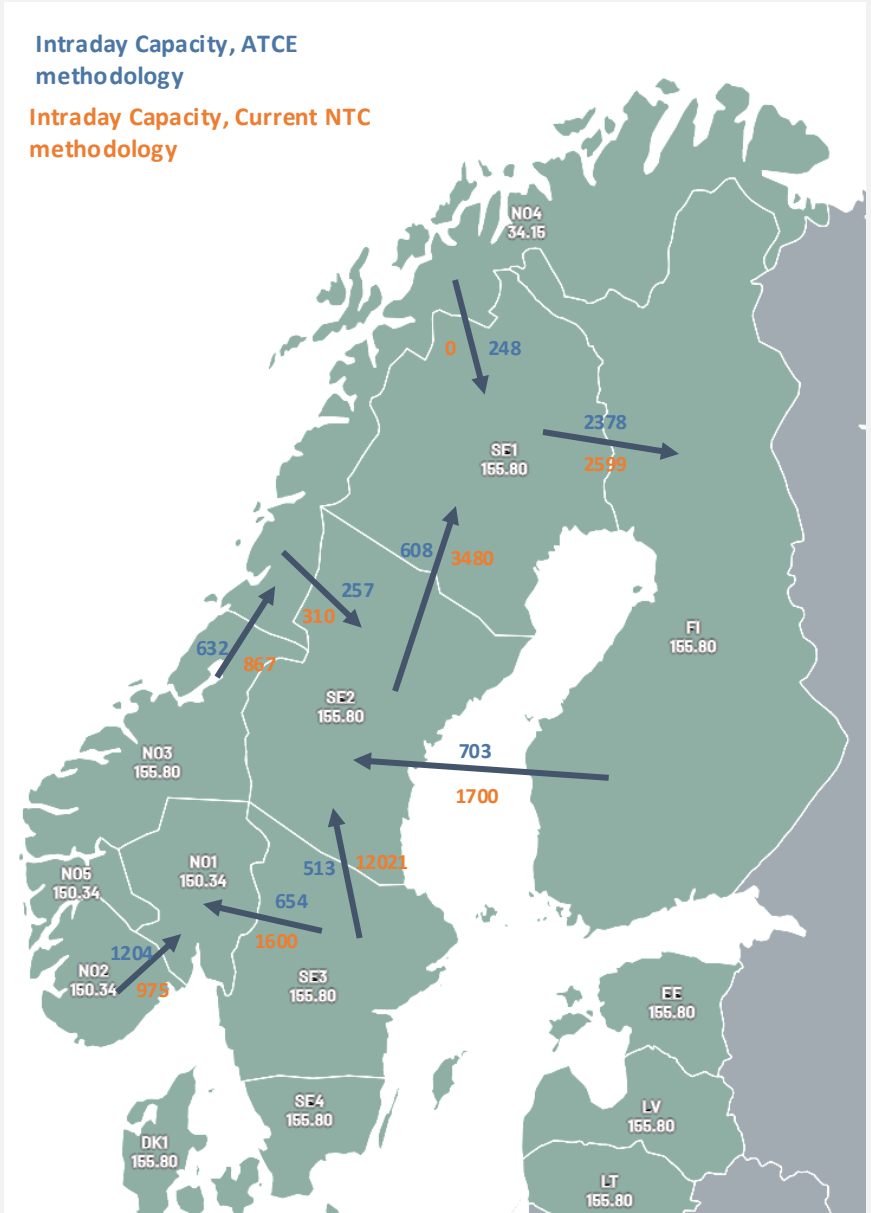
Price peak in the Nordics on 18 April, 07:00-08:00
Available Intraday Capacities

- For some borders, the ATCE methodology gave much less capacity than the current NTC methodology (SE2-SE1, SE3-SE2).
- However, for most borders, there are smaller differences between NTC and the ATCE capacities
- Based on actual traded intraday volumes for this day, all capacities provided in ATCE would facilitate these trades



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Questions?

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Thank you!

Contact: ccm@nordic-rcc.net

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