

Short-term analysis in FBMC environment: Service providers' challenges and solutions

Ljubov Cherney,
Director Analysis, Montel - SYSPower
05 Feb 2025

MONTEL



Who we are

Long Term Power Outlook

Nordic/Baltic and European power forecast for up to 40 years

Risk report

PPA analysis and area-specific report

SYSPOWER

Web tool – data, forecasts and analysis on power markets

Montel SYSPOWER -

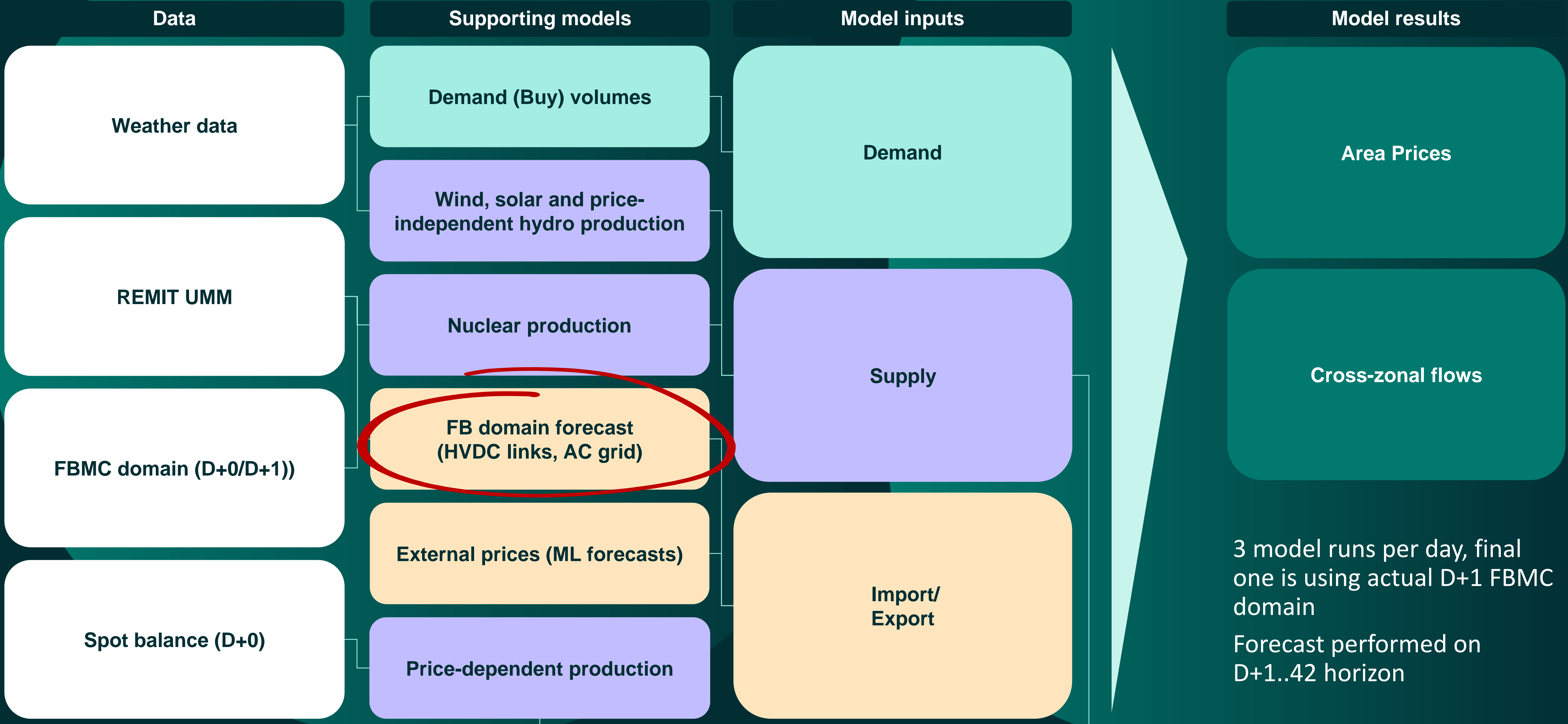
leading provider of analysis and advisory services for Nordic power and renewable markets

Profitability of RES production

Standard and tailor-made calculations

Advisory

Short-term analysis process



List of Challenges

Challenge 1 – Commercial vs Physical flows

Challenge 2 – Utilization of FB domain data

Challenge 3 – Counter-intuitive flows

Challenge 4 – UMMs on HVDC links

Challenge 1 – Commercial vs Physical flows:

how to explain why EUPHEMIA cross-zonal commercial flows are “not realistic”

CHALLENGE: “Unrealistic” commercial flows after FBMC start

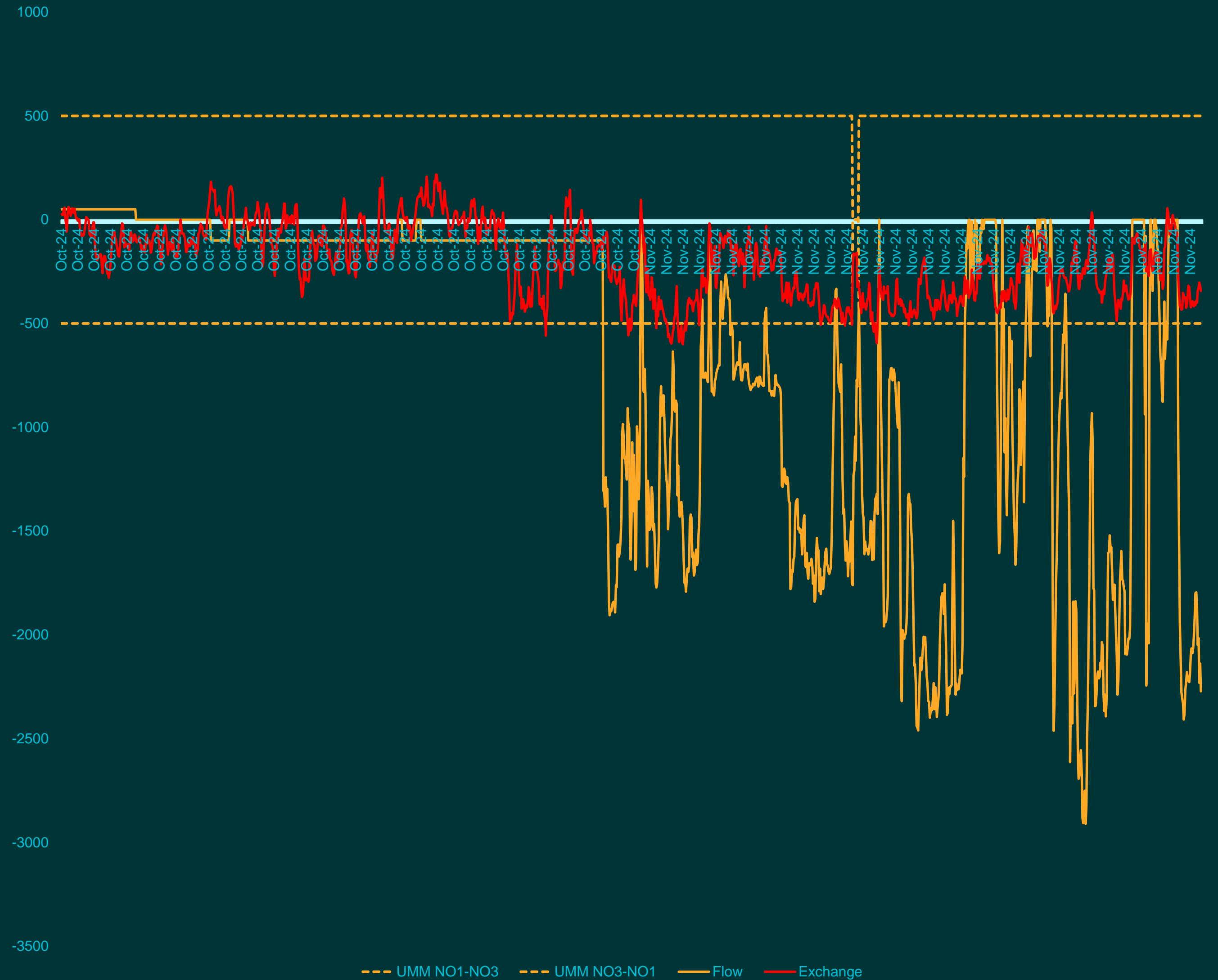
In the NTC model, cross-border commercial flows were calculated using allocated spot capacities (SCAP), which were respected in the final scheduled flow calculations.

With FBMC, commercial flows between price areas are nearly irrelevant, especially for AC interconnectors, as optimization focuses on net positions of areas.

Scheduled flows are then derived from net positions, based on the principle of cost minimization.

https://www.acer.europa.eu/sites/default/files/documents/Individual%20Decisions_annex/ACER_Decision_10-2023_on_the_DA_Scheduled_Exchanges_Annex%20I.pdf

Power flow on NO1-NO3 border vs available capacity, MWh



SOLUTION: FBMC flow

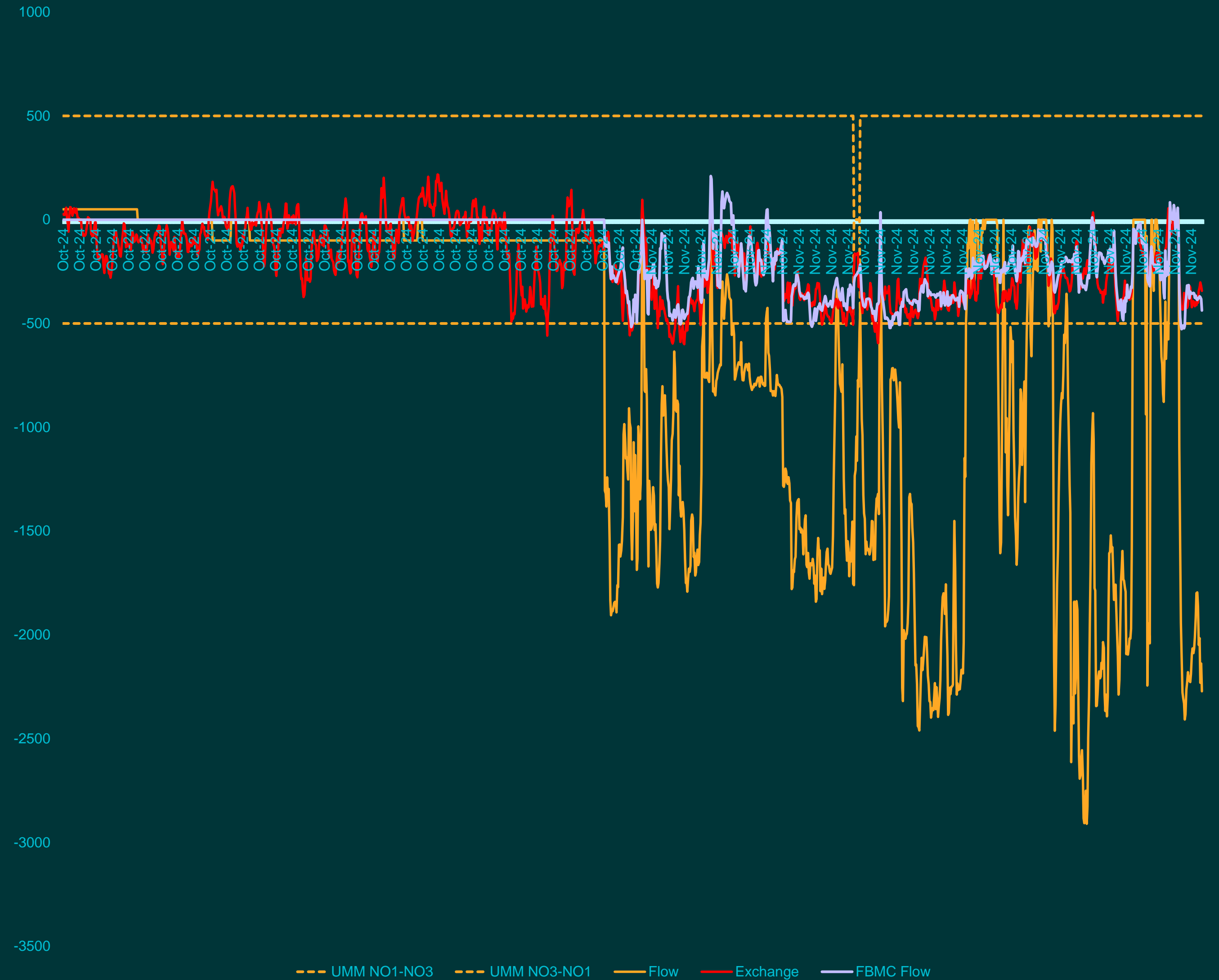
Fundamental market models calculate zonal balances and net positions using the supply/demand stack and FBMC domain.

Forecasted cross-zonal flow relates to physical flow when calculated with PTDF.

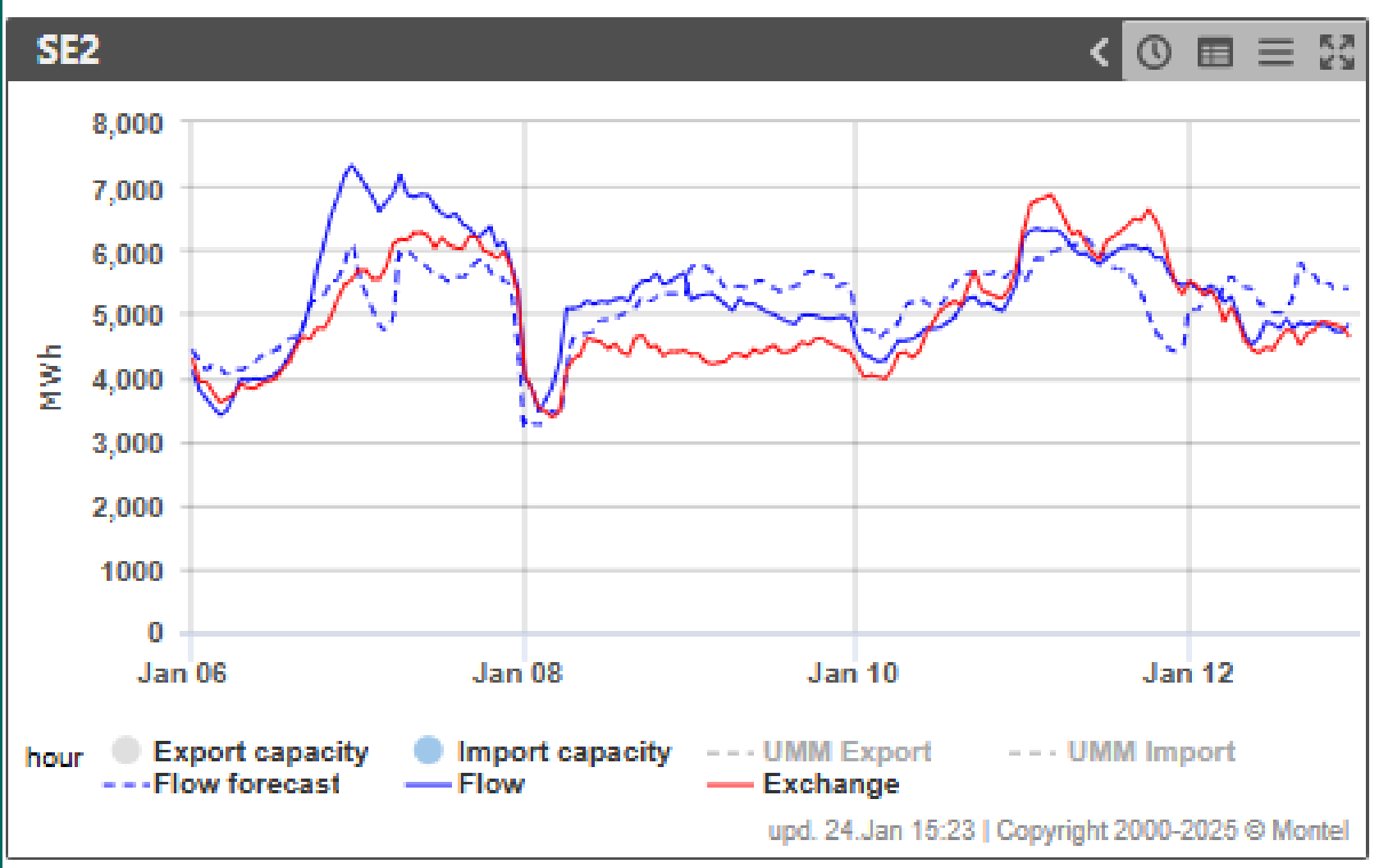
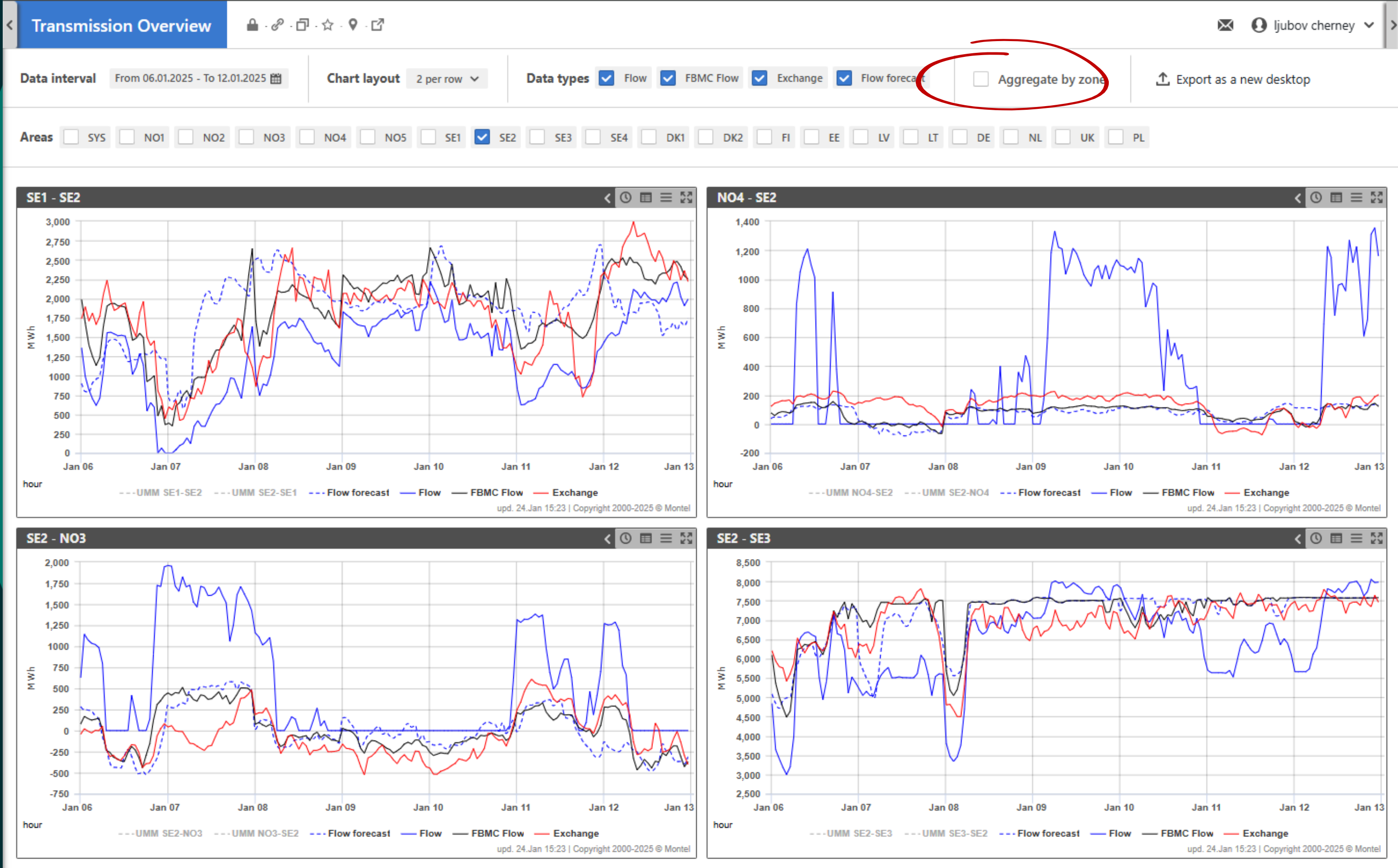
The matching series for modelled cross-border flow is not the commercial flow published by NEMOs.

Instead, it is the FBMC flow, derived from the realized FBMC domain (border CNEC), indicating expected physical cross-border flow in the Day-ahead market.

Power flow on NO1-NO3 border vs available capacity, MWh



USE CASE: It is about forecasting net positions, not flows



When aggregated by price area, commercial flows reflect physical exchange levels
Fundamental modelling forecasts physical flows on market net positions

Challenge 2 – Utilization of FB domain data:

how to visualize FB data and explain price differences to customers

CHALLENGE: FB domain information processing

JAO Flowbased Domain Download

JAO Publication Tool
Nordic CCR

DATE: 2025-01-24
23:00 - 24:00

Home
Market Graphs
Market Map
Flowbased Domain
Shadow Price & Flow_FB
Max and Min Net Pos
Max Exchanges (MaxBox)
Max Border Flow (MaxFlow)
Validation Reductions
Ref Net Pos. and HVDC exch.
FB Domain Backup
CGM Forecast

Date	CNEC or Combined Dynamic Constraint				Information on the CNE							Information on the Contingency					Detailed Breakdown																						
	Name	mRID	Type	T SO	Name	EIC	Status	Bidding Zone From	Bidding Zone To	Substation From	Substation To	Type	Name	EIC	Status	Substation From	Substation To	Imax method	Non-redundant	Significant	RAM	Min Flow	Max Flow	U	Imax	Fmax	FRM	FrF	F0	FRA	AMR	FAAC	IVA	DK1	DK2	FI			
2025-01-24 23:00:00	FI_RAC_FI-SE1_PETAJASKOSKI-VUENNONKOSKI_KUKKOLANKOSKI-KEMINMAA	023e074e-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	PETAJASKOSKI - VUENNONKOSKI - Terminal: PT: PT4-VUJ4 1 400	10T-SE-FI-00002J	OK	FI	FI	Petajaskoski	Vuennonkoski	CNE	FI_KUKKOLANKOSKI - KEMINMAA	10T-SE-FI-00003H	NK	Kukkolankoski	Keminmaa		X	✓	1548	-1200	1077	410	2340	1654	83	-352	0	0	0	23	0	0	0	1			
2025-01-24 23:00:00	FI_RAC_SE1-FI_KUKKOLANKOSKI-KEMINMAA_OLG2	4a083dd6-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	KUKKOLANKOSKI - KEMINMAA - Terminal: KU: KU4-KI4LÄ 1 400	10T-SE-FI-00003H	OK			Kukkolankoski	Keminmaa	CNE	FI_OL2		NK	Oikiluoto 2			X	✓	1460	-740	991	403	2444	1619	81	362	64	0	0	0	14	0	0	0.00001	-0.52731		
2025-01-24 23:00:00	FI_RAC_SE1-FI_KUKKOLANKOSKI-KEMINMAA_PETAJASKOSKI-VUENNONKOSKI	4a083dd7-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	KUKKOLANKOSKI - KEMINMAA - Terminal: KU: KU4-KI4LÄ 1 400	10T-SE-FI-00003H	OK			Kukkolankoski	Keminmaa	CNE	FI_PETAJASKOSKI - VUENNONKOSKI	10T-SE-FI-00002J	NK	Petajaskoski	Vuennonkoski		X	✓	1538	-1077	1200	403	2444	1619	81	352	0	0	0	0	0	0	0	0	-1		
2025-01-24 23:00:00	FI_P0_KEMINMAA-PIKKARALA_ISOKANGAS-PYHANSELKA	80843459-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	KEMINMAA - PIKKARALA - Terminal: : KI4IT-PR4 1 400	44T-KI-PR-00000R	OK	FI	FI	Keminmaa	Pikkarala	CNE	FI_ISOKANGAS - PYHANSELKA	44T-IS-PS-000007	NK	Isokangas	Pyhanselka		X	✓	1771	-786	381	406	2444	1633	82	-52	-223	0	0	3	0	0	0	0	0	-0.39649	
2025-01-24 23:00:00	FI_P0_KEMINMAA-PIKKARALA_PIRTTIKOSKI-PIKKARALA	8084345a-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	KEMINMAA - PIKKARALA - Terminal: : KI4IT-PR4 1 400	44T-KI-PR-00000R	OK	FI	FI	Keminmaa	Pikkarala	CNE	FI_PIRTTIKOSKI - PIKKARALA	44T-PI-PR-000004	NK	Pirttikoski	Pikkarala		X	✓	1768	-741	358	406	2444	1633	82	-56	-220	0	0	3	0	0	0	0	0	-0.36894	
2025-01-24 23:00:00	FI_P0_KEMINMAA-PIKKARALA_OLG2	8a682859-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	KEMINMAA - PIKKARALA - Terminal: : KI4IT-PR4 1 400	44T-KI-PR-00000R	OK	FI	FI	Keminmaa	Pikkarala	CNE	FI_OL2		NK	Oikiluoto 2			X	✓	1560	-483	512	406	2444	1633	82	140	-13	0	0	4	0	0	0	0	-0.32446		
2025-01-24 23:00:00	FI_P0_PIRTTIKOSKI-PIKKARALA_KEMINMAA-PIKKARALA	a847b05-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	PIRTTIKOSKI - ASMUNTI - Terminal: PI: PI4-AS4PO 1 400	44T-PI-PR-000004	OK	FI	FI	Pirttikoski	Pikkarala	CNE	FI_KEMINMAA - PIKKARALA	44T-KI-PR-00000R	NK	Keminmaa	Pikkarala		X	✓	1245	-314	240	410	1870	1262	63	16	-46	0	0	0	0	0	0	0	0	-0.16381	
2025-01-24 23:00:00	FI_P0_PIRTTIKOSKI-PIKKARALA_OLG2	a847b06-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	PIRTTIKOSKI - ASMUNTI - Terminal: PI: PI4-AS4PO 1 400	44T-PI-PR-000004	OK	FI	FI	Pirttikoski	Pikkarala	CNE	FI_OL2		NK	Oikiluoto 2			X	✓	1114	-101	278	410	1870	1262	63	113	85	0	0	0	0	0	0	0	0	-0.11007	
2025-01-24 23:00:00	FI_P0_PIRTTIKOSKI-PIKKARALA_ISOKANGAS-PYHANSELKA	a847b07-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	PIRTTIKOSKI - ASMUNTI - Terminal: PI: PI4-AS4PO 1 400	44T-PI-PR-000004	OK	FI	FI	Pirttikoski	Pikkarala	CNE	FI_ISOKANGAS - PYHANSELKA	44T-IS-PS-000007	NK	Isokangas	Pyhanselka		X	✓	1195	-280	297	410	1870	1262	63	48	3	0	0	1	0	0	0	0	0	-0.17629	
2025-01-24 23:00:00	FI_P0_PYHANSELKA-ISOKANGAS_PIRTTIKOSKI-PIKKARALA	ca0f0dad-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	ISOKANGAS - PYHANSELKA - Terminal: PS: IK4-PS4 1 400	44T-IS-PS-000007	OK	FI	FI	Pyhanselka	Isokangas	CNE	FI_PIRTTIKOSKI - PIKKARALA	44T-PI-PR-000004	NK	Pirttikoski	Pikkarala		X	✓	1187	-431	415	410	1870	1262	63	-69	2	0	0	10	0	0	0	0	0	0.27667	
2025-01-24 23:00:00	FI_P0_PYHANSELKA-ISOKANGAS_KEMINMAA-PIKKARALA	ca0f0dae-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	ISOKANGAS - PYHANSELKA - Terminal: PS: IK4-PS4 1 400	44T-IS-PS-000007	OK	FI	FI	Pyhanselka	Isokangas	CNE	FI_KEMINMAA - PIKKARALA	44T-KI-PR-00000R	NK	Keminmaa	Pikkarala		X	✓	1130	-397	486	410	1870	1262	63	-39	60	0	0	0	9	0	0	0	0	0	0.31327
2025-01-24 23:00:00	FI_P1_ALAJARVI-PIKKARALA_J2_TUOVILA-HIRVISUO	e8a0cbaf-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	UUSNIVALA - ALAJARVI ITÄINEN J2 - Terminal: : UN4ETIT-AJ4 1 400	44T-AJ-PS-00000H	OK	FI	FI	Alajarvi	Pyhanselka	CNE	FI_TUOVILA - HIRVISUO	44T-HI-TU-000003	NK	Tuovila	Hirvisuo		X	✓	1102	-243	403	410	1870	1261	63	14	92	0	0	4	0	0	0	0	0	0.19182	
2025-01-24 23:00:00	FI_P1_ALAJARVI-PIKKARALA_J2_VUOLUJOKI-ALAPITKA	ef19b615-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	UUSNIVALA - ALAJARVI ITÄINEN J2 - Terminal: : UN4ETIT-AJ4 1 400	44T-AJ-PS-00000H	OUT	FI	FI	Alajarvi	Pyhanselka	CNE	FI_VUOLUJOKI - ALAPITKA	44T-VJ-AP-00000Z	NK	Vuolijoki	Alapitka		X	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025-01-24 23:00:00	FI_P1_ALAJARVI-PIKKARALA_J1_VUOLUJOKI-ALAPITKA	3ef7e928-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	UUSNIVALA - ALAJARVI LÄNTINEN J1 - Terminal: : UN4ETLA-AJ4 1 400	44T-AJ-PR-00000P	OUT	FI	FI	Alajarvi	Pikkarala	CNE	FI_VUOLUJOKI - ALAPITKA	44T-VJ-AP-00000Z	NK	Vuolijoki	Alapitka		X	X	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2025-01-24 23:00:00	FI_P1_ALAJARVI-PIKKARALA_J1_PIKKARALA-ALAJARVI	4527657a-767a-11eb-bdca-e470b89ef59a	BRANCH	FINGRID	UUSNIVALA - ALAJARVI LÄNTINEN J1 - Terminal: : UN4ETLA-AJ4 1 400	44T-AJ-PR-00000P	OK	FI	FI	Alajarvi	Pikkarala	CNE	FI_PIKKARALA - ALAJARVI	44T-AJ-PS-00000R	NK	Pyhanselka	Alajarvi		X	✓	1153	-357	390	407	1870	1252	63	-65	31	0	0	5	0	0	0	0	0	0	0.23372

previous 1 2 3 4 5 6 7 8 9 10 next

SOLUTION: user friendly visualization

System desktops

- Home
- Analysis
- Overview
- Spot Overview
- FBMC Overview**
- Operational Overview
- Transmission Overview
- Generator Overview
- Short-term Nordic
- Short-term Europe
- Long-term Overview
- EMPS Overview
- Gas Overview
- Insights
- UMM
- Weather
- Webquery
- Task manager
- Info and help

LTPO

1. LTPO REPORT
2. LTPO ASSUMPTIONS
3. LTPO PRICES
4. LTPO NP BALANCES
5. LTPO CWE BALANC...
6. LTPO CR SOLAR
7. LTPO CR ONSHORE...
8. LTPO CR OFFSHOR...

Favorite links

FBMC Overview

24.01.2025

FBMC flows are displayed in the Nordic areas instead of commercial flows.

Binding FBMC constraints (24.Jan)

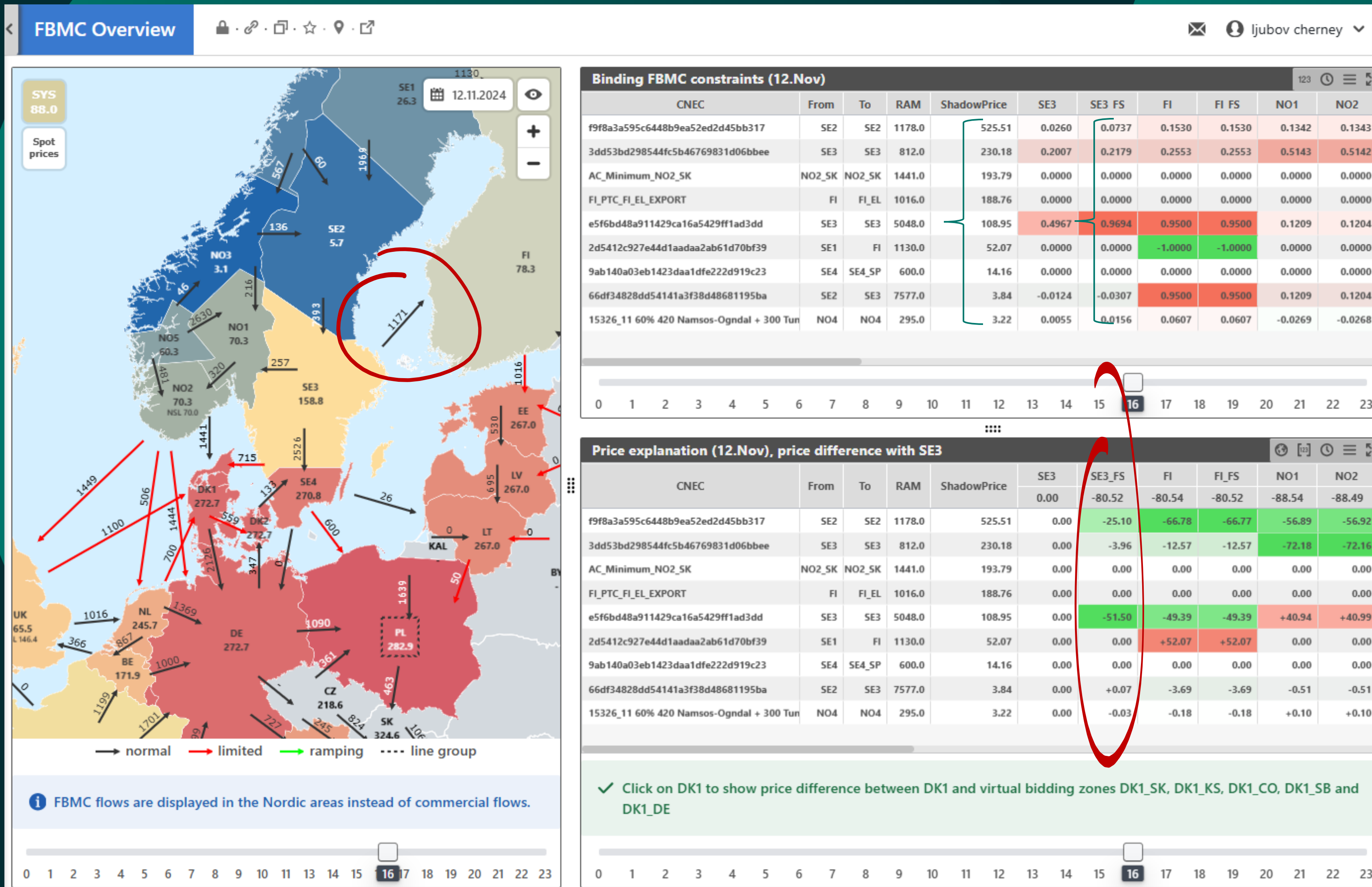
CNEC	From	To	RAM	ShadowPrice	NO1	NO2	NO3	NO4	NOS	SE1	SE2	SE3	SE4	FI	DK1	DK2	NO2_I
00e1d6d73a124197b044e4c5caee651d	SE3	SE4	0.0	1725.40	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
AC_Minimum_SE4_SWL	E4_SWL	E4_SWL	0.0	1724.61	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15291_11 40% 420 Hayanger-Sogndal + 300	NO1	NO1	796.0	71.63	-0.1323	-0.1007	0.2791	0.1293	-0.1136	0.0653	0.0546	0.0177	0.0038	0.0650	0.0000	0.0001	-0.0000
e1c67ee6682449baab92c884a9900080	SE4	SE4_SP	600.0	58.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
15326_11 65% 420 Namsos-Ogndal + 300 Tun	NO4	NO4	304.0	47.75	-0.0350	-0.0320	-0.0834	0.2695	-0.0430	0.0660	0.0151	0.0071	0.0014	0.0649	0.0000	0.0000	-0.0000
1a69f353fef04461843154e445f4ed71	SE4	SE4_BC	615.0	41.88	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
DK1_EO_EXP	DK1	DK1_DE	2500.0	31.75	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
13792_457 300 Mauranger-Blåfålli	NO5	NO5	885.0	13.24	0.0111	-0.1615	0.0582	0.0212	0.1681	0.0107	0.0090	0.0029	0.0006	0.0107	0.0000	0.0000	-0.0000
DK2_SV_IMP	SE4	DK2	1277.0	11.47	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0.0000	0.0000	1.0000
AC_Minimum_SE3_KS	SE3_KS	SE3_KS	715.0	10.51	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
FI_PTC_RAC_SE1-FI	SE1	FI	1200.0	3.96	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-1.0000	0.0000	0.0000	0.0000
FI_PTC_FI_EL_EXPORT	FI	FI_EL	358.0	2.83	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Price explanation (24.Jan), price difference with NO1

CNEC	From	To	RAM	ShadowPrice	NO1	NO2	NO3	NO4	NOS	SE1	SE2	SE3	SE4	FI	DK2	NO2_ND	NO2_I
00e1d6d73a124197b044e4c5caee651d	SE3	SE4	0.0	1725.40	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
AC_Minimum_SE4_SWL	E4_SWL	E4_SWL	0.0	1724.61	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
15291_11 40% 420 Hayanger-Sogndal + 300	NO1	NO1	796.0	71.63	0.00	-2.26	-29.47	-18.74	-1.35	-14.16	-13.39	-10.75	-9.76	-14.14	-9.48	-2.38	-0.00
e1c67ee6682449baab92c884a9900080	SE4	SE4_SP	600.0	58.00	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
15326_11 65% 420 Namsos-Ogndal + 300 Tun	NO4	NO4	304.0	47.75	0.00	-0.14	+2.31	-14.54	+0.38	-4.82	-2.39	-2.01	-1.74	-4.77	-1.67	-0.15	-0.00
1a69f353fef04461843154e445f4ed71	SE4	SE4_BC	615.0	41.88	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
DK1_EO_EXP	DK1	DK1_DE	2500.0	31.75	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
13792_457 300 Mauranger-Blåfålli	NO5	NO5	885.0	13.24	0.00	+2.28	-0.62	-0.13	-2.08	+0.00	+0.03	+0.11	+0.14	+0.01	+0.15	+2.55	+0.00
DK2_SV_IMP	SE4	DK2	1277.0	11.47	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	+11.47	0.00	0.00
AC_Minimum_SE3_KS	SE3_KS	SE3_KS	715.0	10.51	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
FI_PTC_RAC_SE1-FI	SE1	FI	1200.0	3.96	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	+3.96	0.00	0.00	0.00
FI_PTC_FI_EL_EXPORT	FI	FI_EL	358.0	2.83	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

Click on DK1 to show price difference between DK1 and virtual bidding zones DK1_SK, DK1_KS, DK1_CO, DK1_SB and DK1_DE

USE CASE: HVDC hub prices calculation



FBMC overview provides access to HVDC hub prices, that are not part of SDAC price settlement package, but are available through FB domain

Illustration: Flow is not directed from high-priced SE3 to low-priced FI area, but from SE3_FS hub, where price level is competitive to FI, as it helps unloading constraint in SE2-SE3

USE CASE: Swedish CNECs

Sweden's grid elements have been often found in the list of constraints affecting the non-intuitive market settlement.

CNEC names are encrypted due to security reasons, and it significantly slows down the advancement of analysis and model development.

We conduct research work that helps to identify these CNECs to utilize in modelling and tooling

But simply working with visualized domain data helps to recognize the 'familiar' CNECs by their features, e.g. PTDFs and RAMs

Binding FBMC constraints (04.Nov)

CNEC	From	To	RAM	ShadowPrice	NO1	NO2	NO3	NO4	NO5	SE1	SE2	SE3	SE4	FI	DI
10a62bda216d4e9f88bd55cb77d0ec8b	SE2	SE2	1083.0	528.38	0.1546	0.1516	0.2187	0.1842	0.1544	0.1484	0.1733	0.0218	-0.0061	0.1486	0
13792_457_300 Mauranger-Blåfalli	NO5	NO5	552.0	424.90	0.0190	-0.1004	0.0077	0.0032	0.1524	0.0013	0.0009	0.0003	0.0001	0.0013	0
e51d41c2ddc047d5807488b0989cd969	SE2	SE2	1157.0	214.60	-0.1434	-0.1590	0.0754	0.1206	-0.1495	0.1345	0.1609	0.0455	0.0129	0.1347	0
FI_PTC_FI_EL_EXPORT	FI	FI_EL	1016.0	60.39	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
FI_PTC_RAC_SE1-FI	SE1	FI	1259.0	48.49	0.0000	0.0000	0.0000	-0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	-1.0000	0
96d9bb4c26747b1a3e4ba1ba2271936	NO1	NO1	613.0	8.61	-0.6992	-0.6992	0.0903	0.0399	-0.6966	0.0191	0.0152	0.0053	0.0013	0.0189	0
AC_Minimum_SE4_SWL	E4_SWL	E4_SWL	0.0	5.67	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
PowerTransformer ENDK DK1 ASR KT51 1 Teri	DK1	DK1	188.0	2.68	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
DK2_VE_EXP	DK2	DK2_KO	585.0	1.72	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
87d2687df7324edf8ca6c18bd41f35d3	SE4	SE4_NB	700.0	0.28	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0

CNEC_SE2#1

CNEC_SE2#2

Binding FBMC constraints (05.Nov)

CNEC	From	To	RAM	ShadowPrice	NO1	NO2	NO3	NO4	NO5	SE1	SE2	SE3	SE4	FI	DI
fc07bbd89a4d4a0aad647b9ec8bc0a96	SE2	SE2	1073.0	657.39	0.1554	0.1523	0.2199	0.1877	0.1550	0.1482	0.1932	0.0228	-0.0061	0.1483	0
L15827_10 20% 420 Rjukan-Kvilldal + 300 Hus	NO2	NO2	732.0	86.84	0.0255	-0.0877	0.0101	0.0043	0.1878	0.0017	0.0012	0.0003	0.0001	0.0017	0
NO2->DK1	NO2	NO2_SK	1400.0	81.42	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
FI_PTC_RAC_SE1-FI	SE1	FI	1200.0	55.82	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	-1.0000	0
AC_Minimum_FI_EL	FI_EL	FI_EL	1016.0	53.00	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
15326_11 60% 420 Namsos-Ogndal + 300 Tun	NO4	NO4	334.0	30.49	-0.0401	-0.0334	-0.1114	0.2670	-0.0377	0.0584	0.0078	0.0042	0.0009	0.0563	0
5b7c881422644b0f852d47c345e349f7	NO3	NO3	996.0	18.65	-0.4918	-0.4917	-0.5988	-0.2841	-0.4975	-0.0512	0.0074	0.0004	0.0004	-0.0488	0
AC_Minimum_SE4_SWL	E4_SWL	E4_SWL	0.0	14.15	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
7dfd24df7ca0497da3d4541da35e8db3	SE3	DK1	715.0	8.78	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
DK2_SV_IMP	SE4	DK2	1260.0	5.26	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	0
DK2_VE_EXP	DK2	DK2_KO	585.0	2.93	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0
9dbcc00cfbe44886ae07c8e4bc4582d6	SE2	SE2	1112.0	1.85	-0.1436	-0.1592	0.0754	0.1199	-0.1502	0.1343	0.1569	0.0445	0.0129	0.1345	0
3314a958a553414ab9b1c930f054a0a2	SE4	SE4_BC	615.0	1.50	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0

CNEC_SE2#1

CNEC_SE2#2

ADD-ON: user friendly visualization

CNEC Overview
Aleksei Seleznev

Select CNEC

Data interval

From 01.11.2024 - To 08.12.2024

Flows on df9ff45fdfe6406b854fb91eb3b6fac4

Legend: RAM (orange line), FlowFB-F0 (blue area), Shadow price (green bars)

Active constraints

Date	From	To	Cnec name	Hours	Avg price	Syspower Id
05.02.2025	SE4	SE4_BC	6169fc249b03441793bd100e6cc79635	24	92.76	SWSE4SE4BC
05.02.2025	DK1	DK1_DE	DK1_EO_EXP	14	11.89	T1108
05.02.2025	FI	SE1	FI_PTC_RAC_FI-SE1	5	0.43	T1188
05.02.2025	DK1	DK1	ACLineSegment ENDK DK1 E_KAE-LYK_1 1 N Terminal : N	2	245.91	T1226
05.02.2025	SE4_SWL	SE4_SWL	AC_Minimum_SE4_SWL	20	0.21	ACMINSE4SWL
05.02.2025	NO1	NO1	15291_11 40% 420 Heyanger-Sogndal + 300 Øvre Vinstra-Fåberg	15	33.92	T1365
05.02.2025	SE3	SE3	c7b55bb261bb4584a875a29bba247f64	24	39.34	
05.02.2025	SE3	DK1	96c37a85b8554881b834fbc52e49497d	11	14.40	
05.02.2025	SE4	DK2	DK2_SV_IMP	24	70.65	T1772
05.02.2025	SE4	SE4_SP	f85ae90b94134424838c6390711147da	24	97.18	SWSE4SE4SP
05.02.2025	FI_EL	FI_EL	AC_Minimum_FI_EL	15	118.55	ACMINFIEL
05.02.2025	SE4_NB	SE4_NB	AC_Minimum_SE4_NB	12	94.08	ACMINSE4NB
05.02.2025	DK1	DK1	ACLineSegment ENDK DK1 E_KAE-LYK_2 1 N Terminal : N	4	482.89	T1586
05.02.2025	FI	FI_EL	FI_PTC_FI_EL_EXPORT	9	114.50	T1821
05.02.2025	SE3_KS	SE3_KS	AC_Minimum_SE3_KS	13	20.95	ACMINSE3KS
05.02.2025	SE4	SE4_NB	c1016d62616246dd921ca540e549adc0	10	74.98	SWSE4SE4NB
05.02.2025	SE4	SE4	162b4962ee1049bf8b6ac10a0f4ce416	3	43.74	
05.02.2025	NO1	NO1	15291_11 40% 420 Viklandet-Ørskog + 40% 132 Bø-Kjelbotn + 300 Øvre Vinstra-Få...	7	43.91	T1535
05.02.2025	SE3_SWL	SE3_SWL	AC_Minimum_SE3_SWL	1	0.01	ACMINSE3SWL
05.02.2025	DK1	DK1	ACLineSegment (ZBR) ENDK DK1 E_STSV-VID Z1 F Terminal : F	10	390.99	T1815
05.02.2025	NO4	NO4	15326_11 65% 420 Namsos-Ogndal + 300 Tunnsjødal-Verdal	6	2.43	T1855
05.02.2025	SE2	SE3	ae7e58dbdfee4a39a430afa369c2b957	16	4.57	
05.02.2025	NO5	NOS	15288_11 80% 300 Refsdal-Modalen + Aurland1 T4 Transformator S	12	34.64	T2008
05.02.2025	DK1	DK1	ACLineSegment (ZBR) ENDK DK1 E_KAE-STSV Z1 F Terminal : F	3	239.28	T1313
05.02.2025	DK1	DK1	ACLineSegment ENDK DK1 E_IDU-VID 2 N Terminal : N	6	483.00	T1520
05.02.2025	SE2	SE2	56d1b2e751474a7295175b6debd0dadd	3	2.69	
05.02.2025	SE1	FI	FI_PTC_RAC_SE1-FI	6	10.69	T1453
05.02.2025	SE1	SE1	2746492037094ab6967faf4de615b1b9	3	0.59	
04.02.2025	SE4	SE4_NB	95099531c72842b196b74130a7297038	9	51.24	SWSE4SE4NB
04.02.2025	SE4	SE4_SP	55c2ef5789964904b313440a7bf6b07d	22	53.90	SWSE4SE4SP
04.02.2025	SE3	SE4	499ec85d625945399658e50aba77617f	1	0.37	
04.02.2025	SE3	DK1	4224f128184343c68b0974b8c88649a9	10	19.00	
04.02.2025	SE1	FI	FI_PTC_RAC_SE1-FI	17	106.66	T1453
04.02.2025	SE2	SE3	dc8fa739491b4ad0a5216275389e45d2	22	40.80	
04.02.2025	SE4	SE4_BC	fc8f9a7525c74220ac8699c34db1b707	17	60.64	SWSE4SE4BC
04.02.2025	SE3_FS	SE3_FS	AC_Minimum_SE3_FS	3	41.19	ACMINSE3FS
04.02.2025	SE4	DK2	DK2_SV_IMP	24	43.64	T1772
04.02.2025	DK1	DK1	ACLineSegment (ZBR) ENDK DK1 E_STSV-VID Z1 F Terminal : F	2	82.10	T1815
04.02.2025	FI	FI_EL	FI_PTC_FI_EL_EXPORT	9	74.47	T1821
04.02.2025	NO4	NO4	15326_11 65% 420 Namsos-Ogndal + 300 Tunnsjødal-Verdal	4	17.68	T1855
04.02.2025	NO5	NOS	15288_11 80% 300 Refsdal-Modalen + Aurland1 T4 Transformator S	22	121.00	T2008
04.02.2025	SE2	SE2	4c92198e12714d2fab7087bb539218cb	19	22.77	
04.02.2025	DK1	DK1	ACLineSegment (ZBR) ENDK DK1 E_KAE-STSV Z1 F Terminal : F	17	236.57	T1313
04.02.2025	SE3_KS	SE3_KS	AC_Minimum_SE3_KS	11	15.61	ACMINSE3KS
04.02.2025	SE3	FI	0b5c422d934f42ec87a5ba4747ad927c	5	16.56	
04.02.2025	SE4_NB	SE4_NB	AC_Minimum_SE4_NB	15	65.81	ACMINSE4NB
04.02.2025	FI_EL	FI_EL	AC_Minimum_FI_EL	10	115.73	ACMINFIEL
04.02.2025	SE4_SWL	SE4_SWL	AC_Minimum_SE4_SWL	19	0.66	ACMINSE4SWL
04.02.2025	DK1	DK1_DE	DK1_EO_EXP	5	16.68	T1108
04.02.2025	SE3	SE3	a63df2b666804f7c8bb61677d786316b	4	412.25	
04.02.2025	SE3	SE4	3d51612207c948529b6d7ef5e47ee315	7	62.12	
04.02.2025	SE3	SE3	137e13faa596412a9ae8db1f616f6d2c	2	1.94	
04.02.2025	NO5	NOS	15291_11 70% 420 Ørskog-Viklandet + 70% 132 Kjelbotn-Bø Rauma + Aurland1 T4 ...	1	48.69	T1393
04.02.2025	SE3	SE3	595f80f0160d481ba3aa2009bde76eab	8	45.76	
04.02.2025	DK1	DK1	ACLineSegment ENDK DK1 E_KAE-LYK_2 1 N Terminal : N	3	595.62	T1586

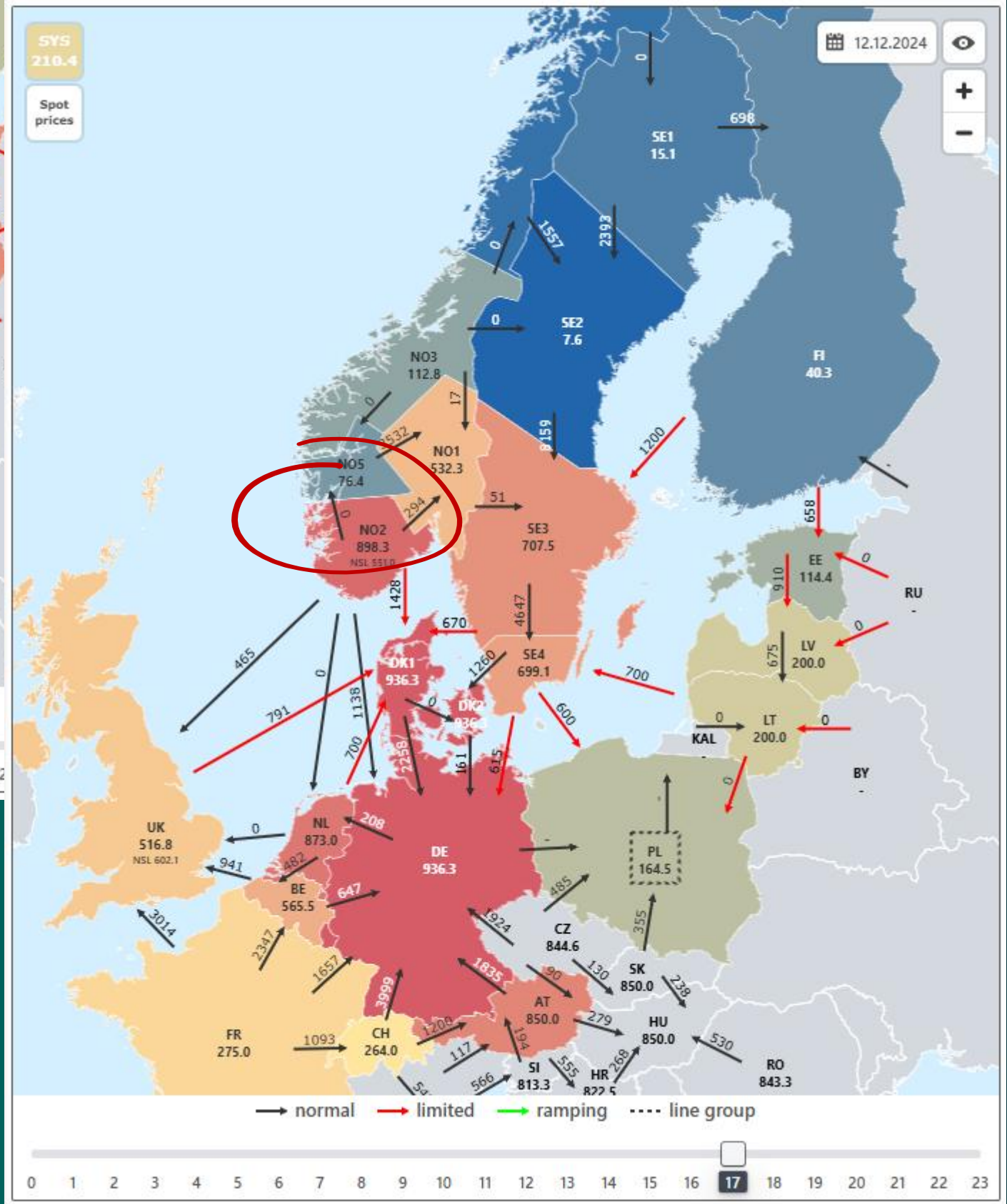
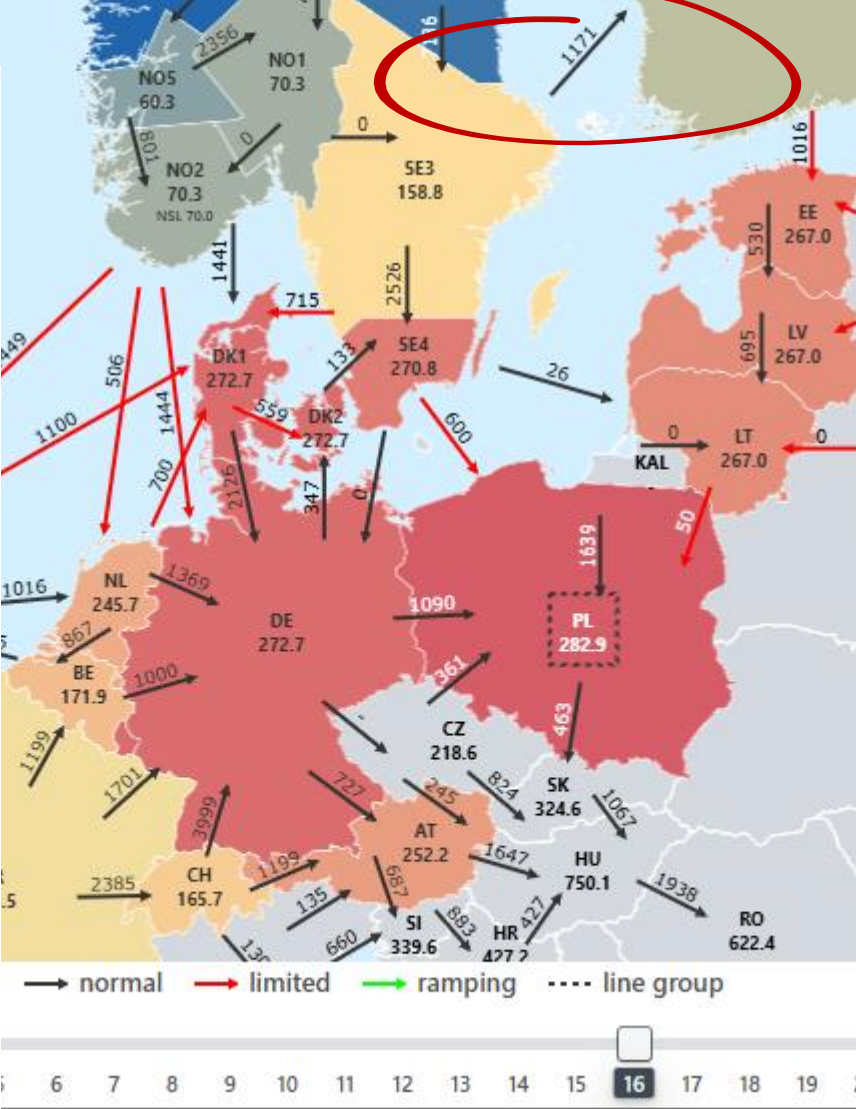
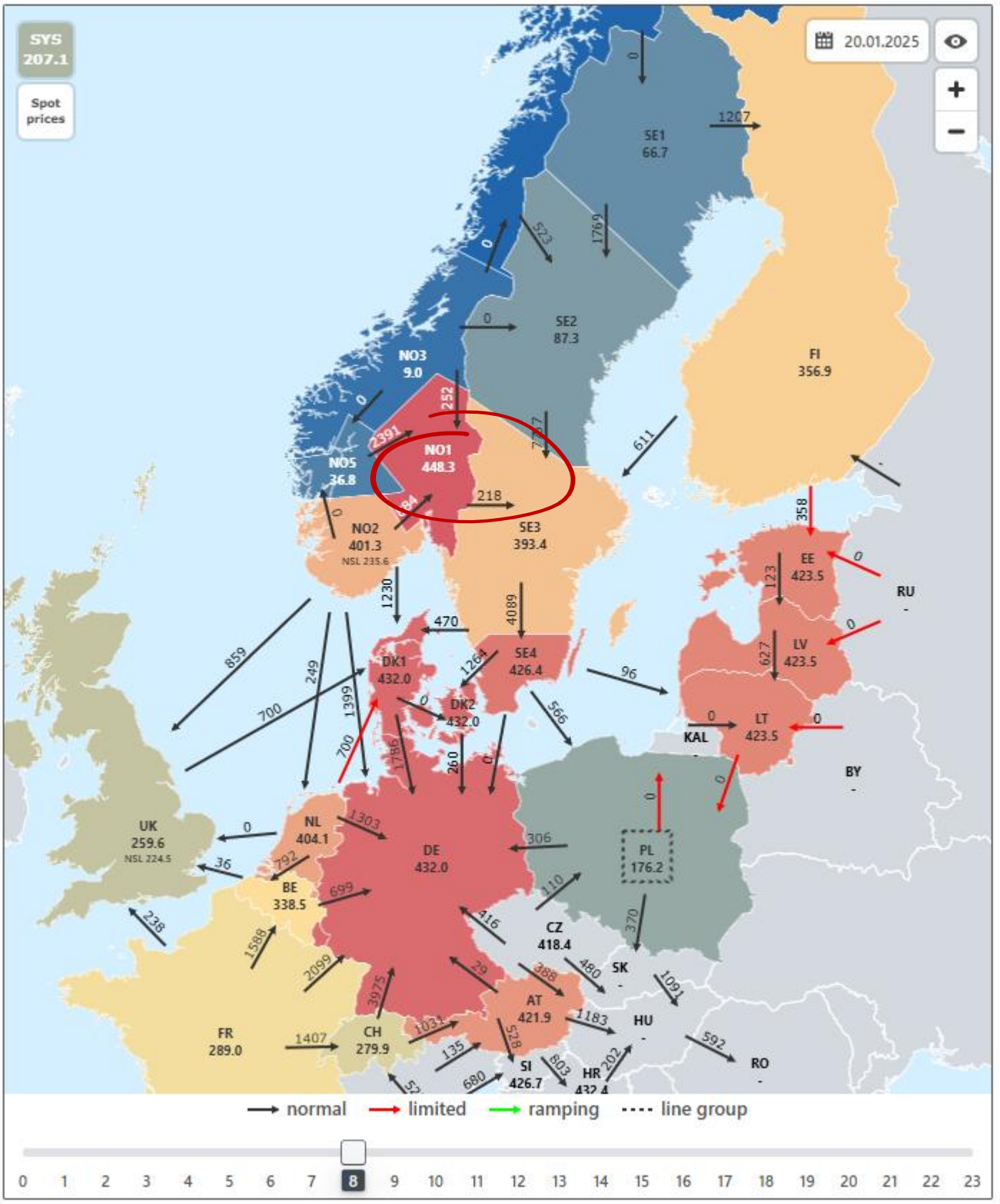
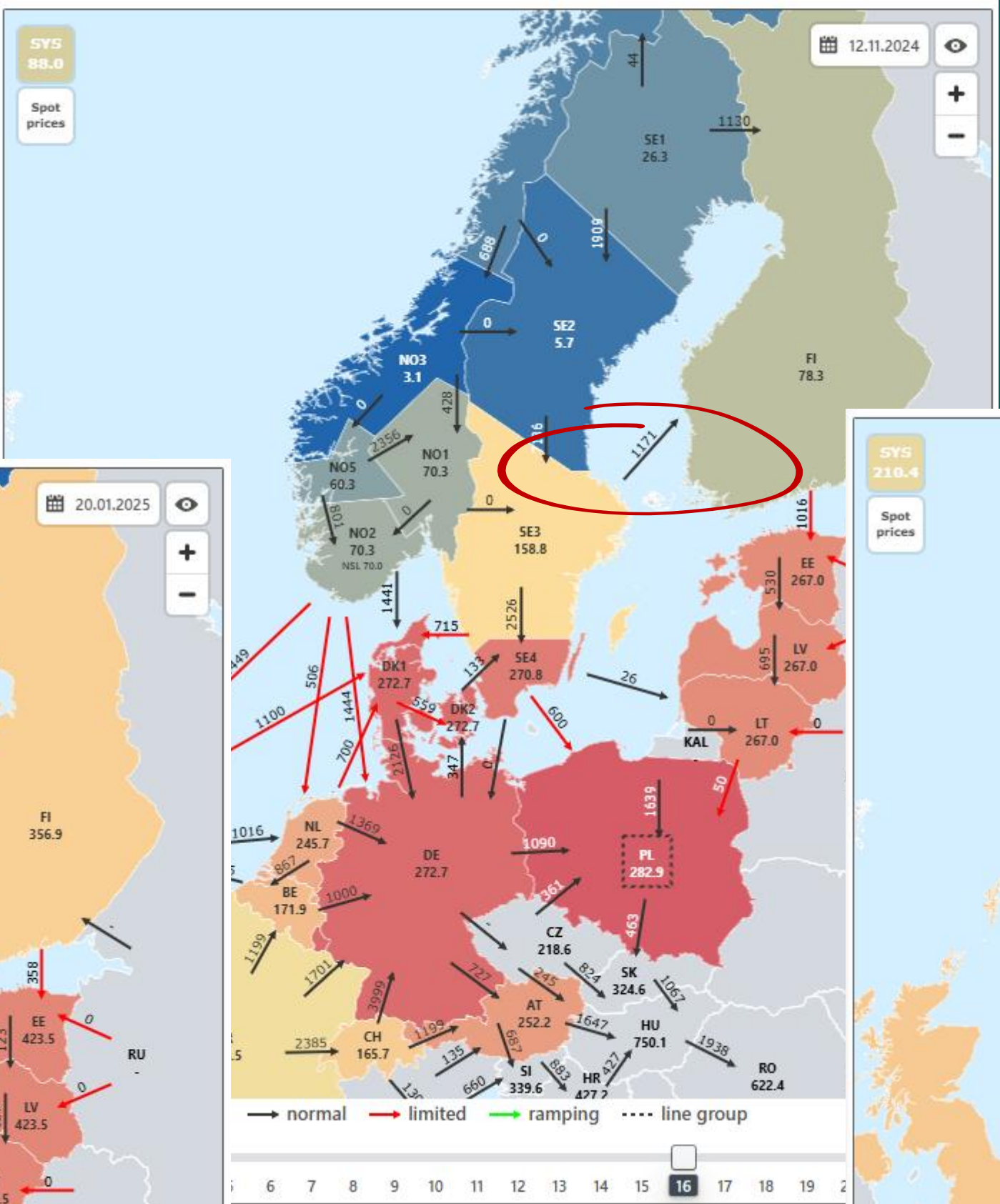
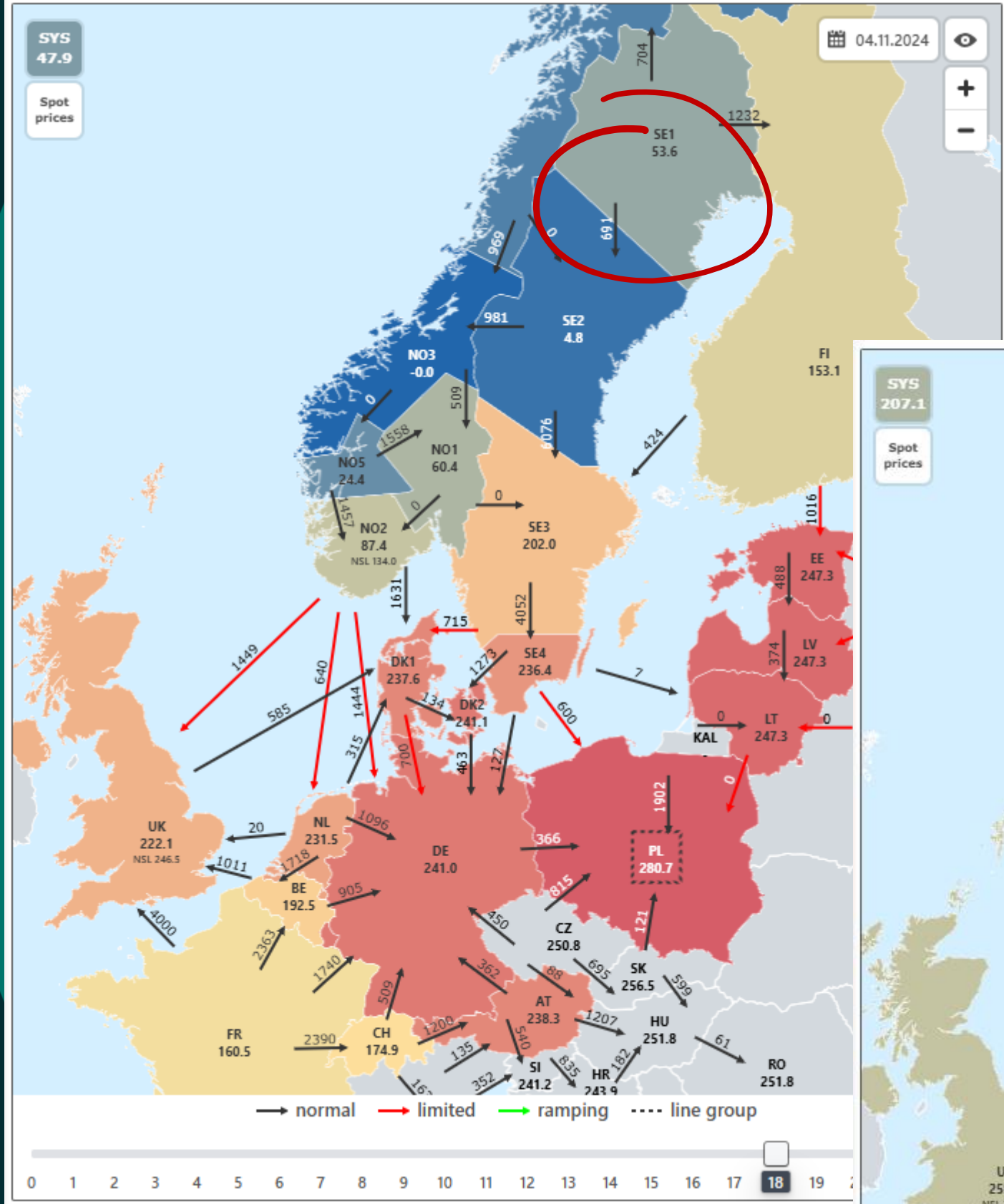
Constraints on df9ff45fdfe6406b854fb91eb3b6fac4

Legend: IVA (dark grey), Fm (light grey), AAC (orange), F0-Fnrao (light blue), Rest RAM (green), Fnrao (dark green), Fmax (black line), RAM (orange line)

Challenge 3 – Counter-intuitive flows:

how to defend the optimality of the price settlement
when electricity flows from high- to low-priced zone

CHALLENGE: "Is it optimal?"



SOLUTION: building knowledge database

Operational analysis: Practice explaining unusual cases using data and Syspower tools.

Customer communication: Engage via platform and other channels (e.g., LinkedIn) to provide insights and updates.

Identify knowledge gaps: Spot areas of missing information and systematic data errors to escalate for further investigation.

Develop a structured approach for analysing complex market scenarios to ensure consistent reporting and communication.

Create detailed case studies of unusual market behaviours to enhance expertise and knowledge sharing.

Montel SYSPower on LinkedIn:

[First days of operation](#)

[Has 20 years of experience in forecasting the Nordic power market suddenly been invalidated?](#)

[Price Formation and FBMC: How Counterintuitive Can It Get?](#)

[CNEC of the week](#)

[How price difference between zones can be explained in the FBMC?](#)

[Extreme price differences between the Nordic areas and the Continent on 12th of December](#)

[One month of Nordic FBMC. What have we learned?](#)

[Why NO1 is the highest price in SDAC on 20.01.25?](#)

USE CASE: NO1 highest in SDAC

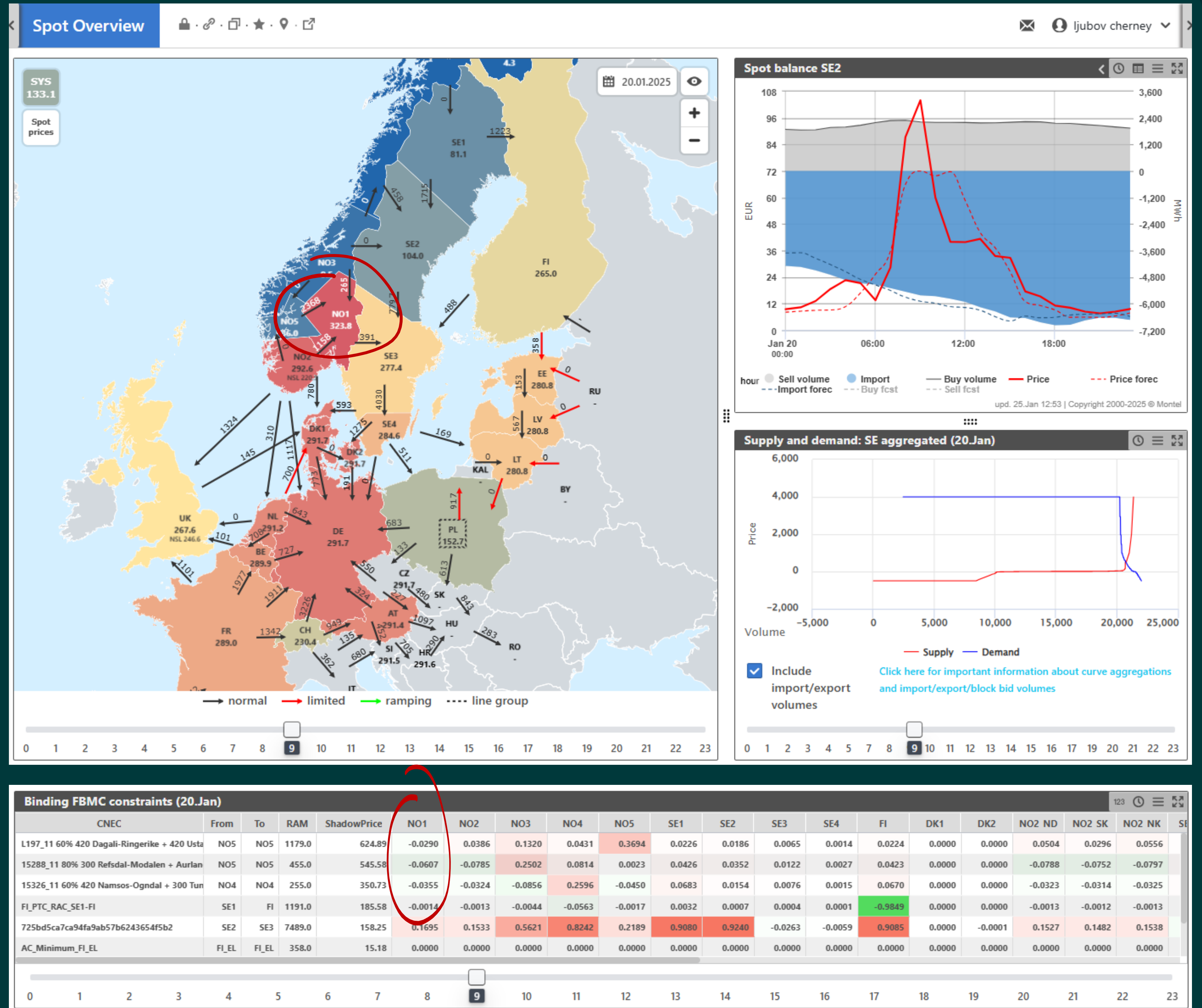
NO1 experienced a price peak of 324 EUR/MWh, surpassing neighbouring areas, the Nordic region, and the entire SDAC region.

The price surge was driven by grid contingencies, not extraordinary demand.

Constraint occurred on CNEC "L197_11 60% 420 Dagali-Ringerike + 420 Usta-Ådal" in NO5 due to [UMM](#).

Negative PTFD in NO1 highlights its role in relieving the constraint.

Despite high prices and limited supply (no wind), generation in NO1 alleviated the constraint and directed flow counterintuitively toward SE3



Challenge 4 – UMMs on HVDC links:

how to make use of NTC UMM data for forecasting in
FB environment

CHALLENGE: How to interpret UMMs on HVDC links

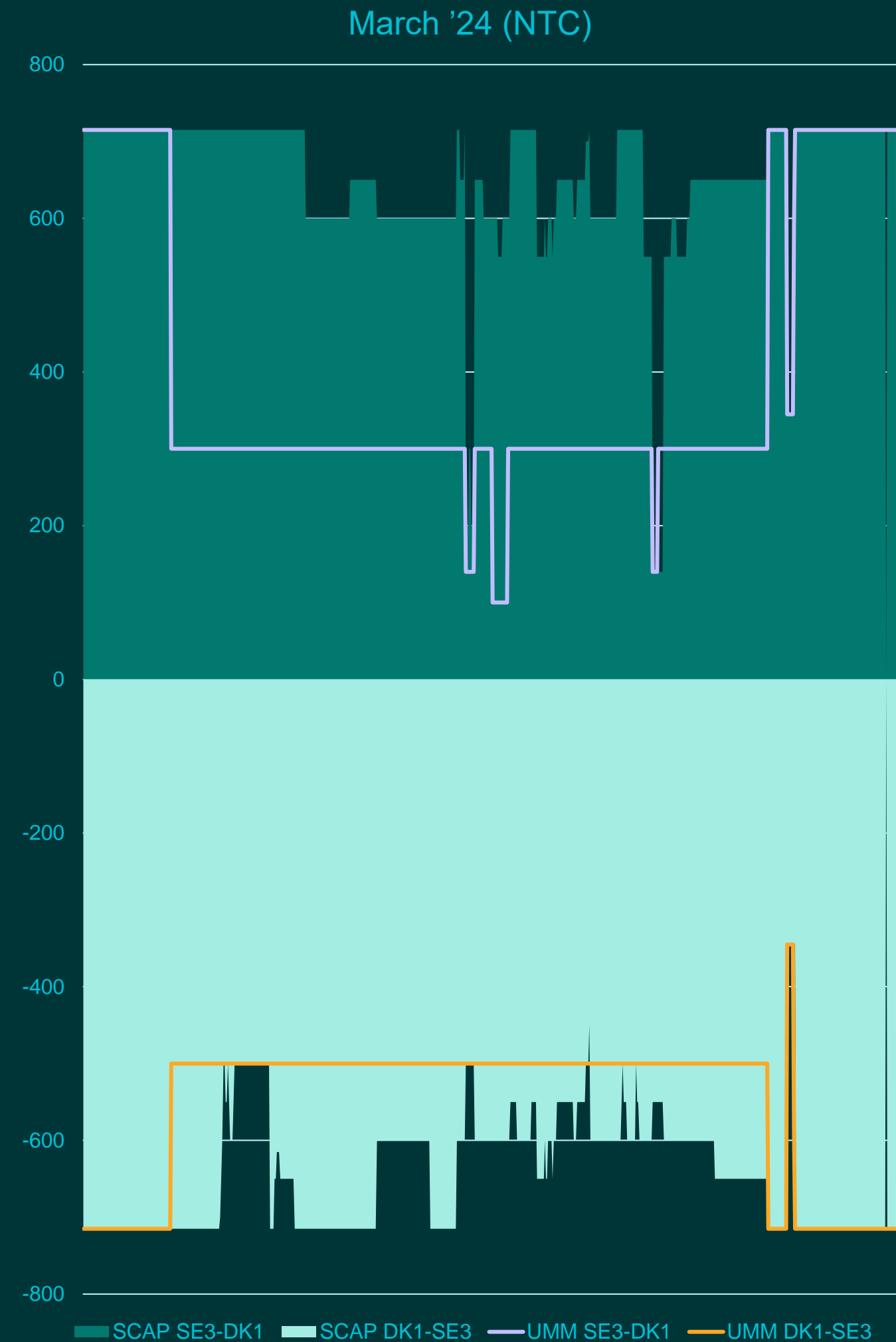
Urgent Market Messages are published on the NTC domain still and cannot be directly translated into FBMC.

Transmission UMMs on AC interconnectors are irrelevant, while DC cables are still possible to inform of capacity changes coming from UMMs

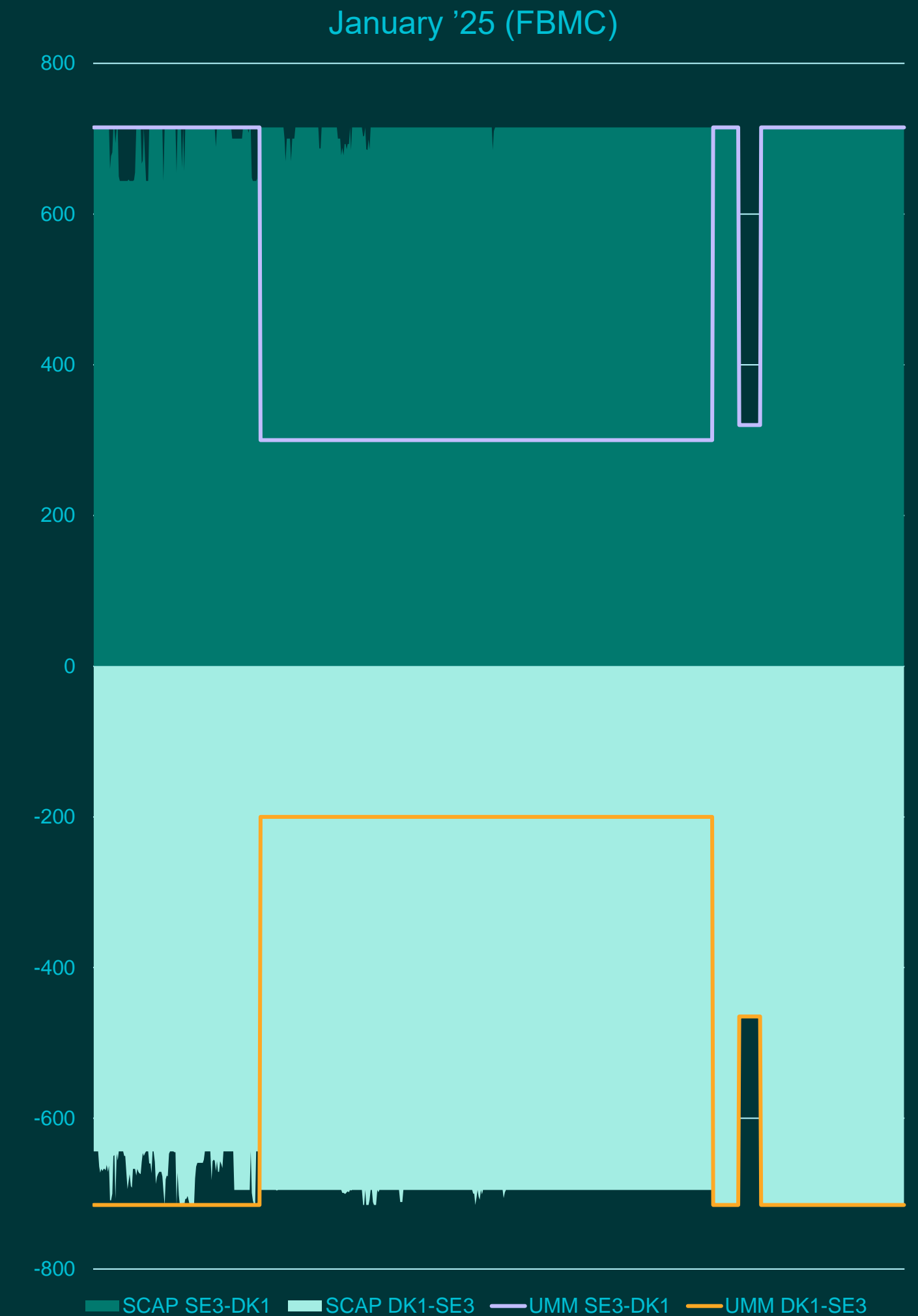
Outages on the elements of AC grid did not always limit the Spot capacities of DC links also in the NTC setup.

In FBMC setup it is possible to foresee the outages that will or will not have direct impact on DC capacities.

UMM: asset 45T000000000073K : FER_400_TJE



UMM: asset 45T000000000070Q : ASR_400_TJE



SOLUTION: Filtering HVDC cable maintenances and researching on use cases

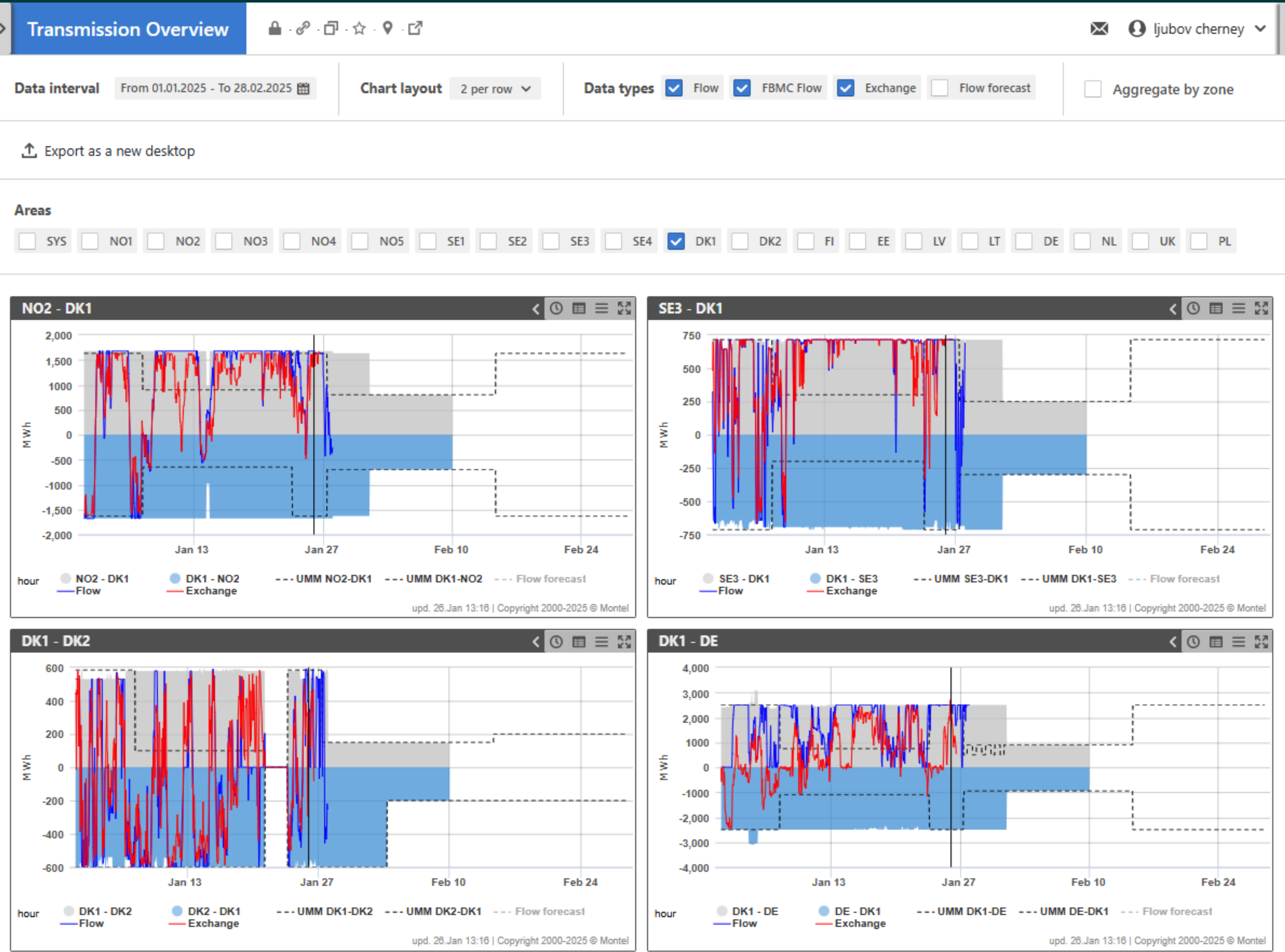
Only HVDC link/converter outages are relevant UMMs for forecasting purposes.

UMMs on AC grid elements lack straightforward application for data utilization.

Constraints in FBMC are satisfied by multiple solutions, depending on market conditions.

The FB domain cannot be expressed as specific NTCs.

The entire domain should be represented as a system of inequalities for effective analysis and forecasting.



USE CASE: Energinet UMM in Jan-2025

A UMM reports that an internal DK1 400kV line outage reduces all cross-border capacities in DK1

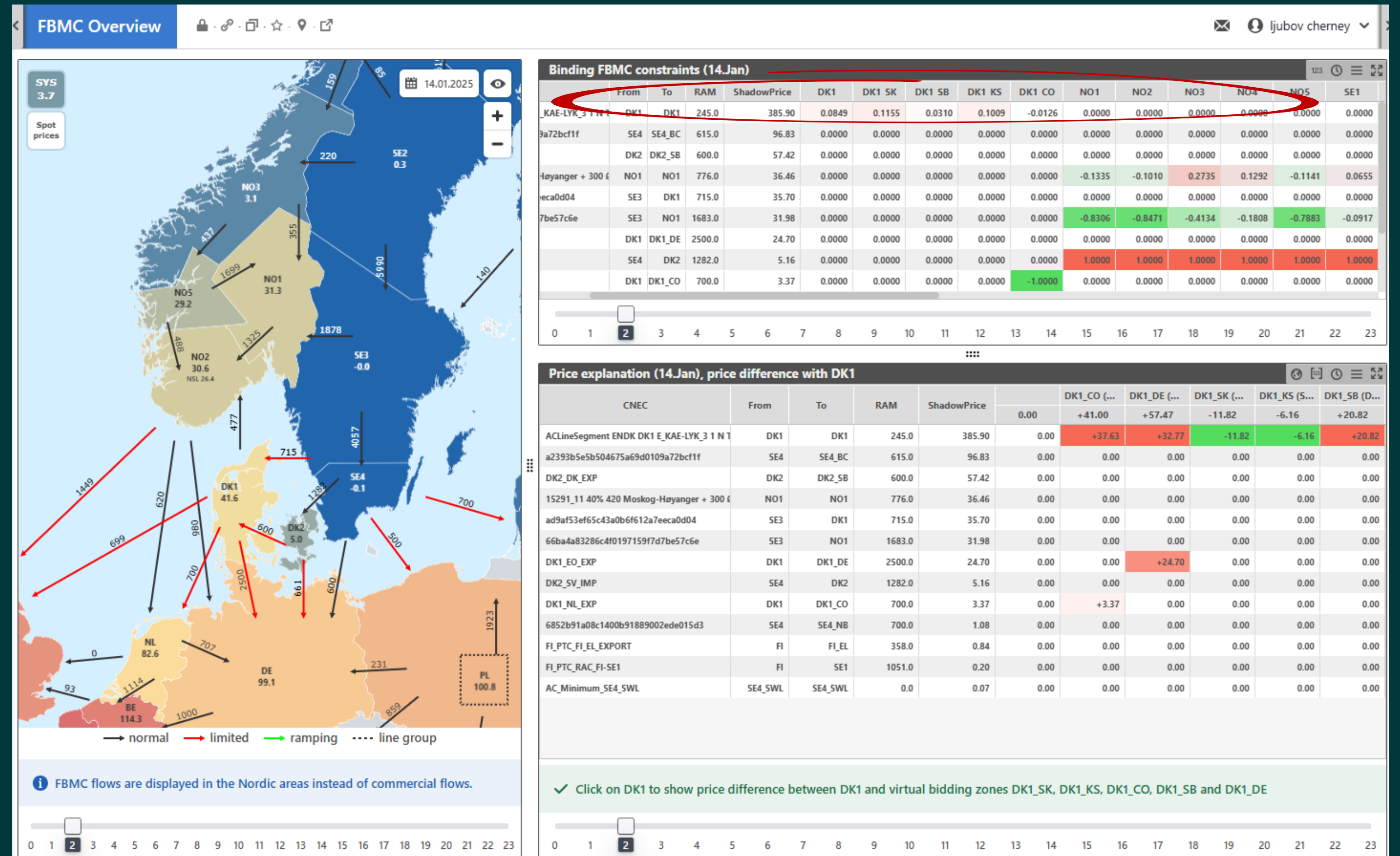
Focusing on the DK1-DE part, the FB domain can be expressed as:

$$0.08492 * DK1 + 0.11554 * DK1_SK (NO2) + 0.03098 * DK1_SB (DK2) + 0.10088 * DK1_KS (SE3) - 0.0126 * DK1_CO \leq 245$$

These conditions can be satisfied in multiple ways, depending on the market situation.

For example, counterintuitive flow towards NO2 (negative DK1_SK) enables better utilization of DK1_KS and Danish generation.

This allows increased exports to Germany or the Netherlands, showing that Skagerrak and Konti-Skan capacities depend on generation bids in DK1 and NO2



Work in progress...

Analytics on CNECs (including Sweden): Enable visualization of time series data for PTDF, shadow price, flow, RAM, and more in charts and tables.

Upgrade of FBMC Overview functionality: Display major CNECs on the map with detailed analytics available on click.

Scenario modelling on CNECs: Perform calculations for grid state scenarios, including custom FB domains.

Visualization of FB domain and net positions: Represent these in polygonal shapes for better clarity.

Short-term forecasting of FB domain: Incorporate UMMs and weather data to improve predictive capacity.

Transparency

Curiosity

Patience

Thank you!

Q&A

Ljubov Cherney,
Montel – SYSPOWER

Feel free to reach out to me on LinkedIn if you have any questions.
<https://www.linkedin.com/in/ljubov-cherney/>

MONTEL