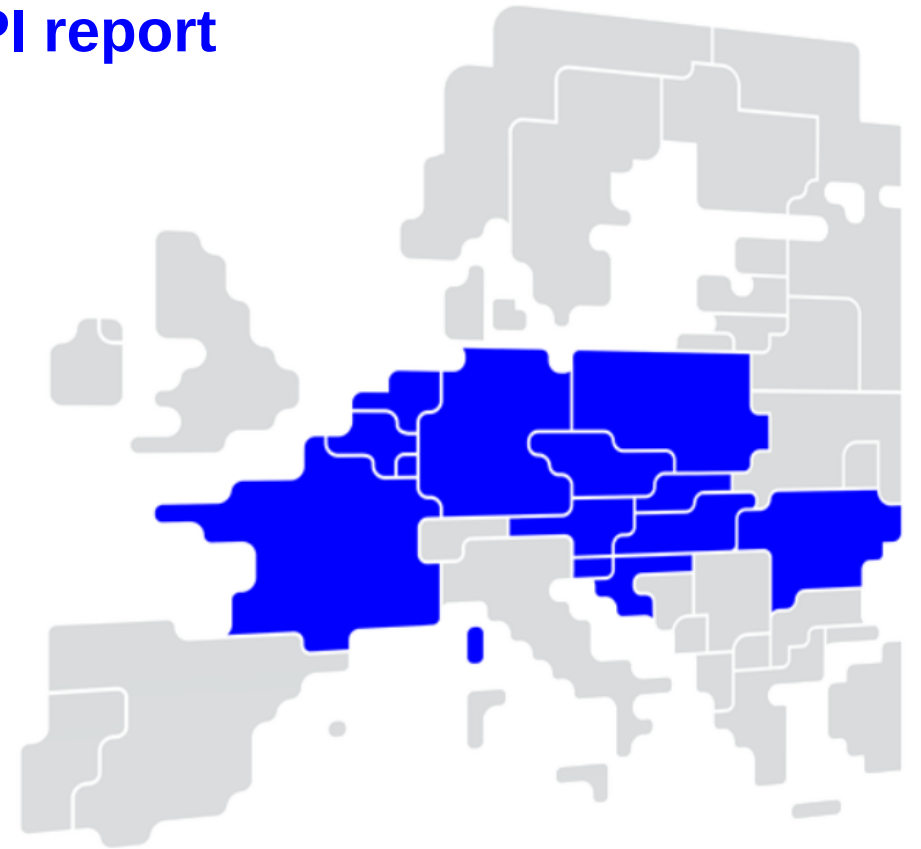


# Core FB MC Operational KPI report

December 2022



# Overview of Operational KPIs



## Adjustment for minimum RAM Inclusion

- KPI 1: Average maximum AMR per CNE
- KPI 2: Average maximum AMR per TSO

## TSOs' adjustment after validation

- KPI 3: Share of MTUs with intervention per TSO
- KPI 4: Average IVA applied for each CNE affected by TSO intervention

## Power System Impact Analysis

- KPI 5: Min & max net positions per BZ hub
- KPI 6: Virtual margins at market balance for CORE TSOs
- KPI 7: Non-Core exchanges delta flow

## Non-costly Remedial Action Optimization Analysis

- KPI 8: Relative Time Share of Applied RAs, by TSO, Type and Mode
- KPI 9: Most limiting CNEC per TSO (NRAO)
- KPI 10: Average variation of relative RAM before and after NRAO

## Market Impact Assessment

- KPI 11: Most often presolved CNEs (top 20)
- KPI 12: Most limiting CNEs (top 20)
- KPI 13: Allocation Constraints

# KPI 1: Average maximum AMR per CNE (Top 10)

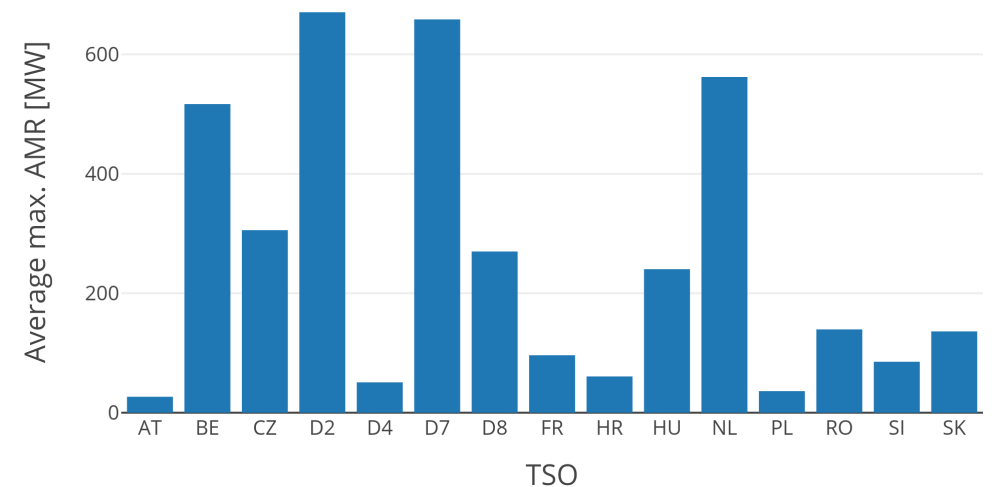
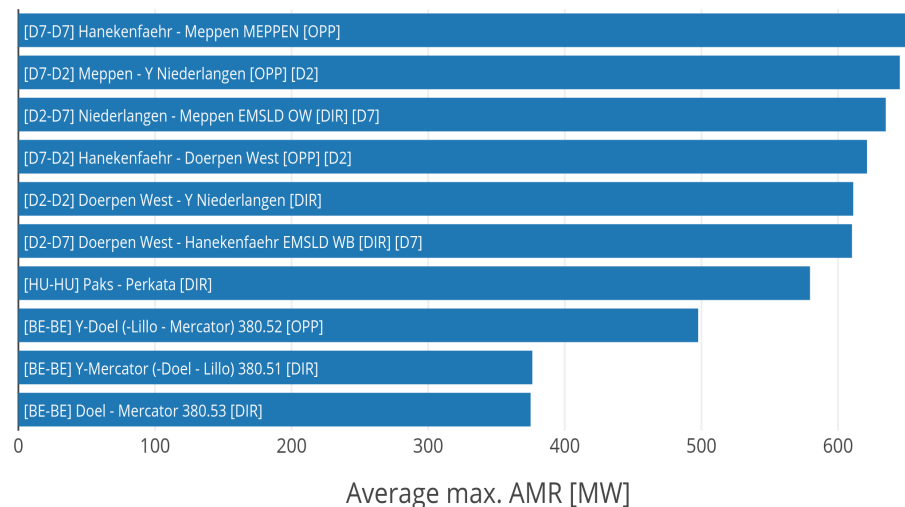
# KPI 2: Average maximum AMR per TSO



CNE	Average Maximum AMR (MW)	AMR as % of Fmax
[D7-D7] Hanekenfaehr - Meppen MEPPEN [OPP]	653.63	25.89%
[D7-D2] Meppen - Y Niederlangen [OPP] [D2]	645.26	29.44%
[D2-D7] Niederlangen - Meppen EMSLD OW [DIR] [D7]	634.95	26.60%
[D7-D2] Hanekenfaehr - Doerpen West [OPP] [D2]	621.20	27.91%
[D2-D2] Doerpen West - Y Niederlangen [DIR]	611.14	27.77%
[D2-D7] Doerpen West - Hanekenfaehr EMSLD WB [DIR] [D7]	610.21	25.31%
[HU-HU] Paks - Perkata [DIR]	579.50	0.34%
[BE-BE] Y-Doel (-Lillo - Mercator) 380.52 [OPP]	497.62	31.77%
[BE-BE] Y-Mercator (-Doel - Lillo) 380.51 [DIR]	376.24	22.44%
[BE-BE] Doel - Mercator 380.53 [DIR]	374.96	21.94%

TSO	Average maximum AMR per TSO
AT	26.74
BE	516.62
CZ	305.57
D2	670.42
D4	50.89
D7	658.39
D8	269.87
FR	96.23
HR	60.73
HU	240.25

TSO	Average maximum AMR per TSO
NL	561.97
PL	36.10
RO	139.45
SI	85.26
SK	136.04



# KPI 3: Share of MTUs with intervention per TSO



Total BDs

31

Total MTUs

742

MTUs without IVA

211

Share of distinct MTUs without IVA

28.44%

MTUs with IVA

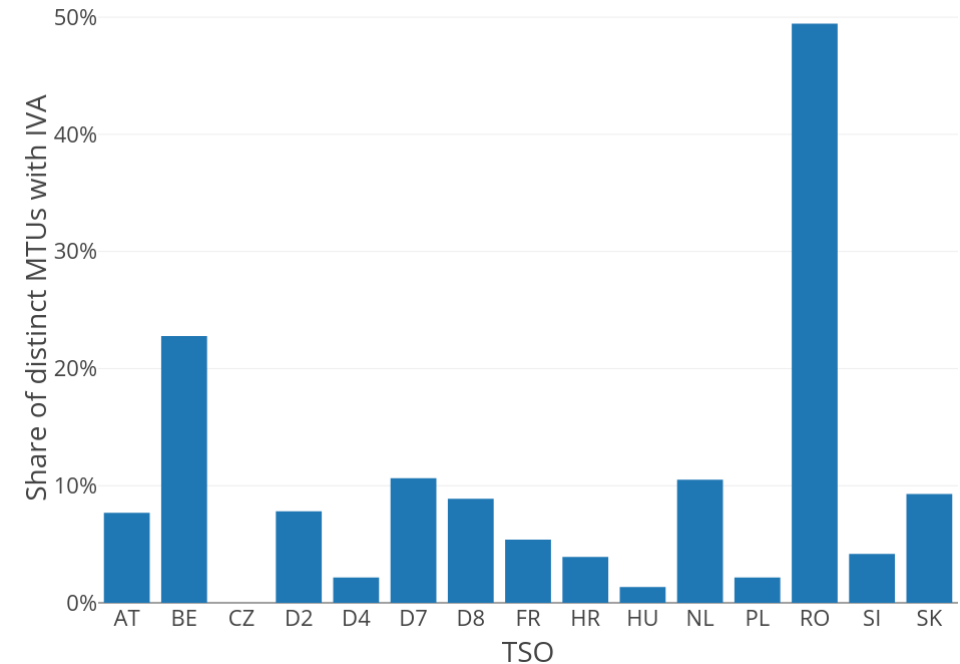
531

Share of distinct MTUs with IVA

71.6%

TSO	Share of distinct MTUs with IVA	Distinct MTUs with IVA
AT	7.68%	57
BE	22.78%	169
CZ	0.00%	0
D2	7.82%	58
D4	2.16%	16
D7	10.65%	79
D8	8.89%	66
FR	5.39%	40
HR	3.91%	29
HU	1.35%	10

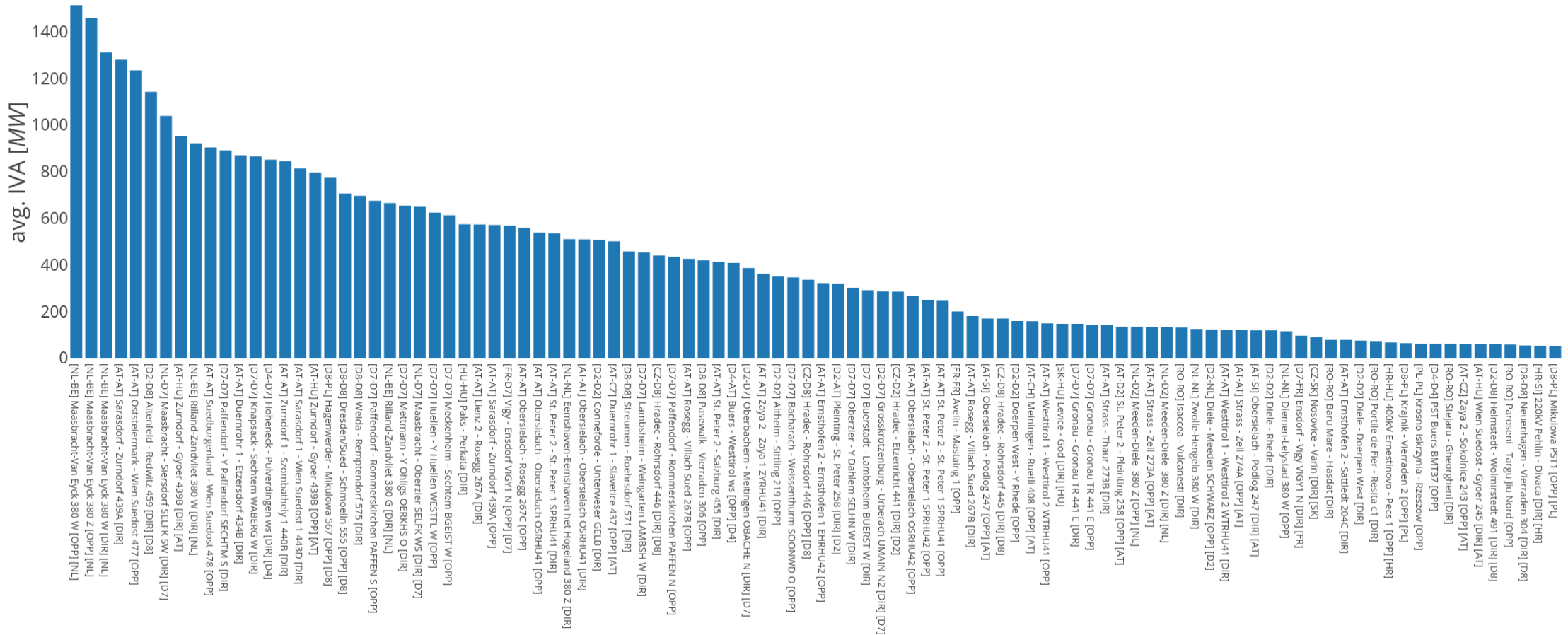
TSO	Share of distinct MTUs with IVA	Distinct MTUs with IVA
NL	10.51%	78
PL	2.16%	16
RO	49.46%	367
SI	4.18%	31
SK	9.30%	69



# KPI 4a: Average IVA applied for each CNE affected by TSO intervention



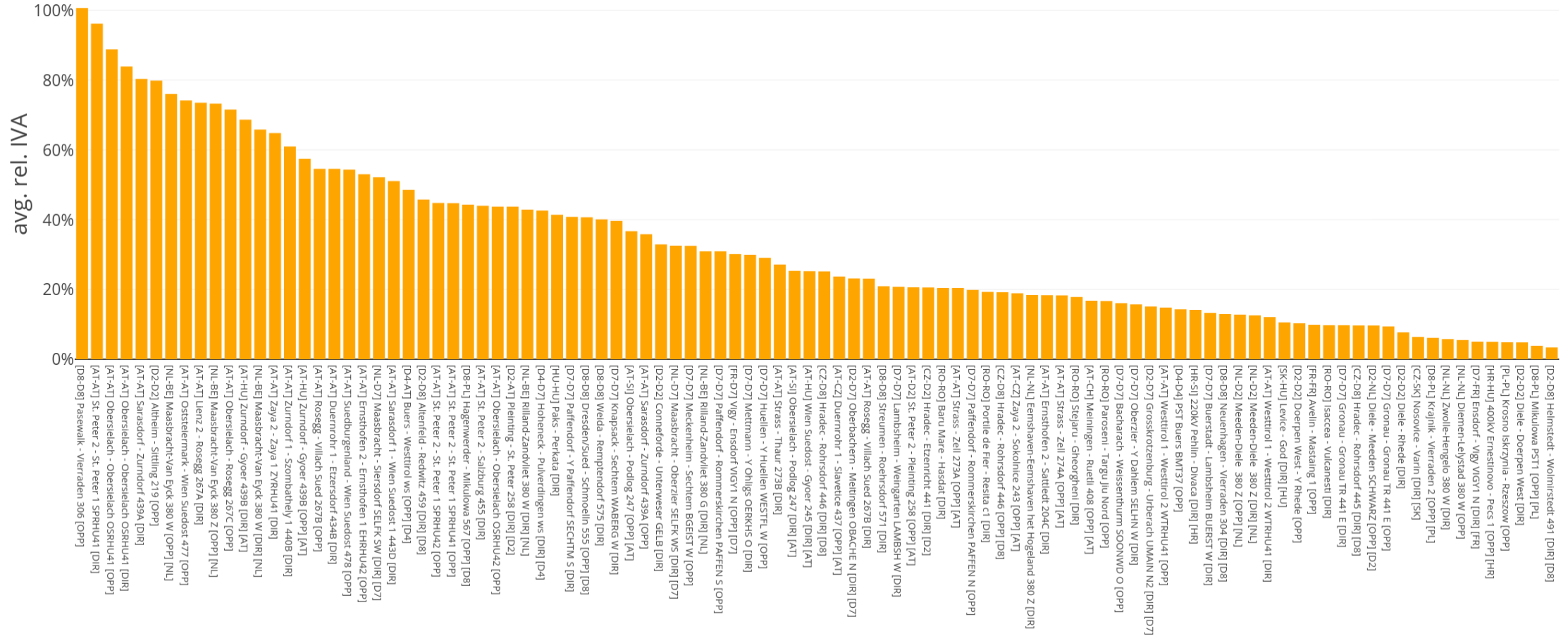
$$\text{avg. IVA}_{CNE} = \frac{1}{\#(CNEC, MTU)[IVA_{CNEC, MTU} > 0]} \sum_{MTU, CNEC} IVA_{CNEC, MTU} [IVA_{CNEC, MTU} > 0]$$



# KPI 4b: Average relative IVA applied for each CNE affected by TSO intervention



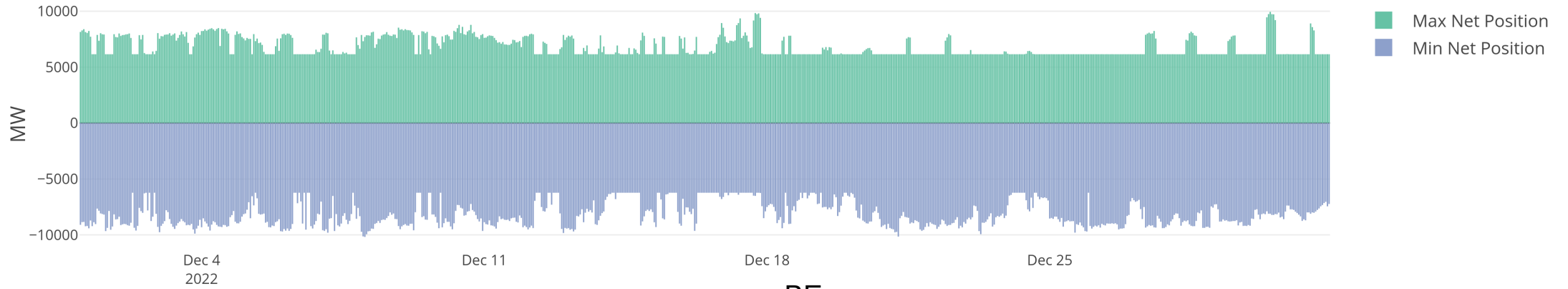
$$\text{avg. rel. IVA}_{CNE} = \frac{1}{\#(CNEC, MTU)[IVA_{CNEC, MTU} > 0]} \sum_{MTU, CNEC} \frac{IVA_{CNEC, MTU}[IVA_{CNEC, MTU} > 0]}{F_{max_{CNEC, MTU}[IVA_{CNEC, MTU} > 0]}}$$



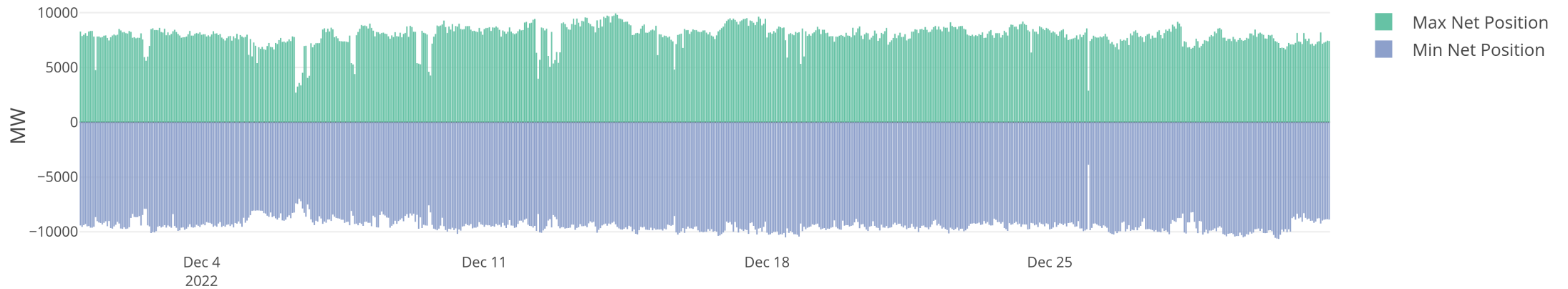
# KPI 5: Min & max net positions per BZ hub



AT



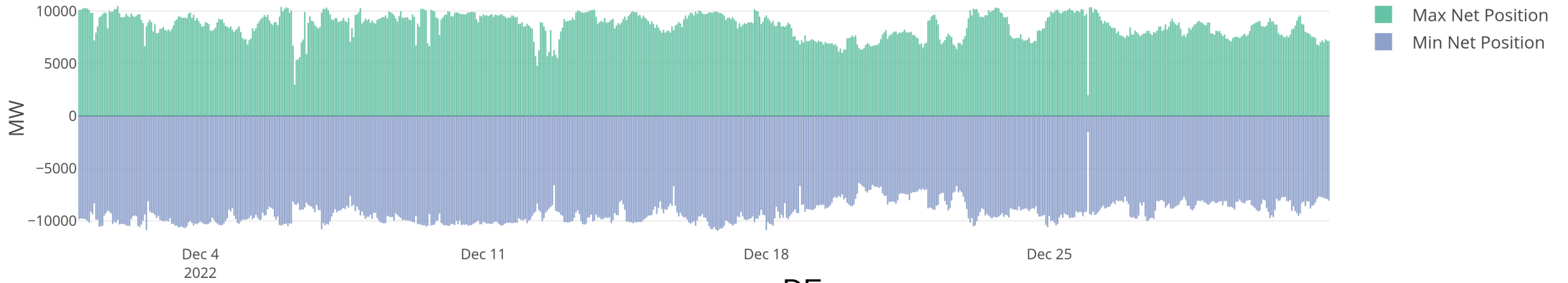
BE



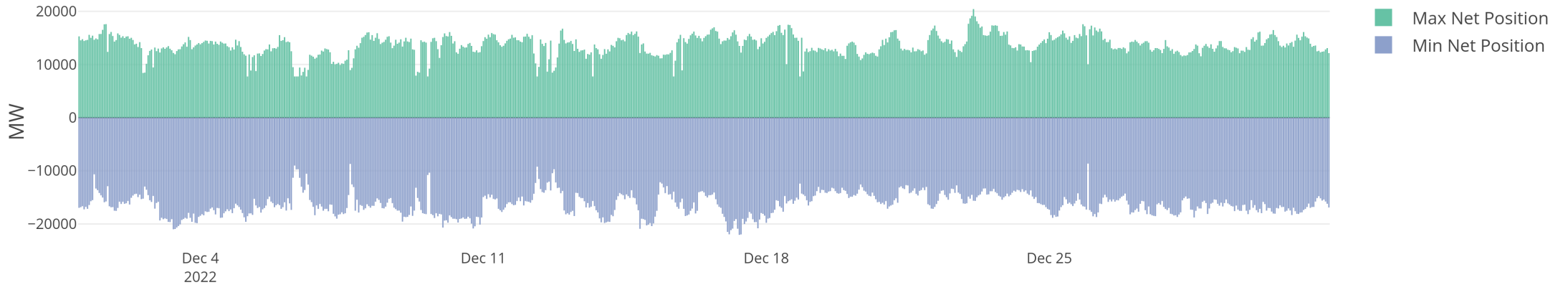
# KPI 5: Min & max net positions per BZ hub



CZ

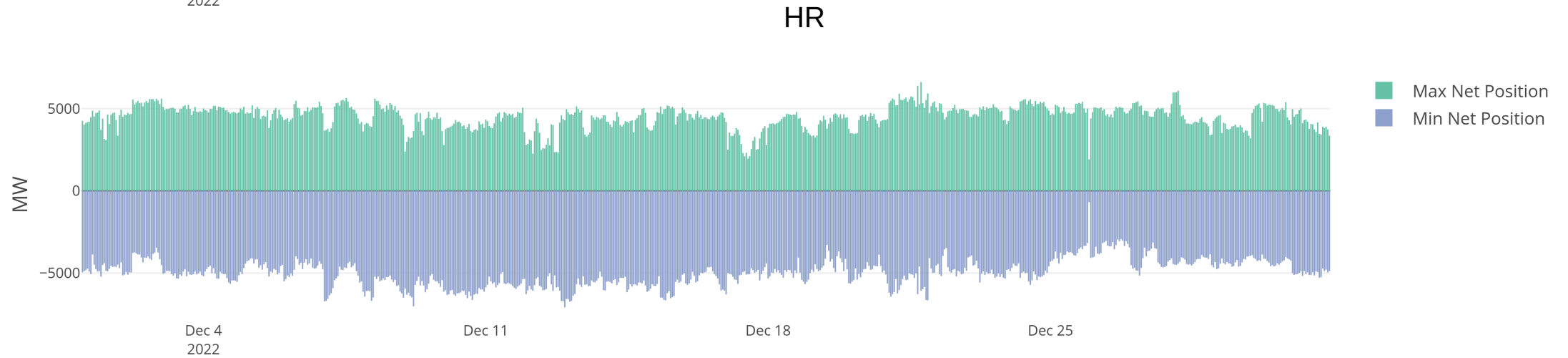
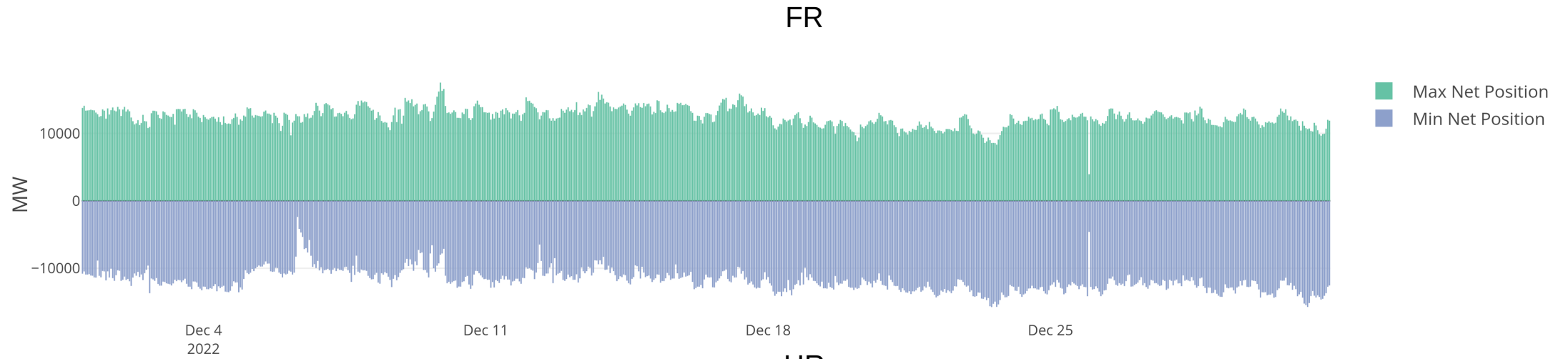


DE

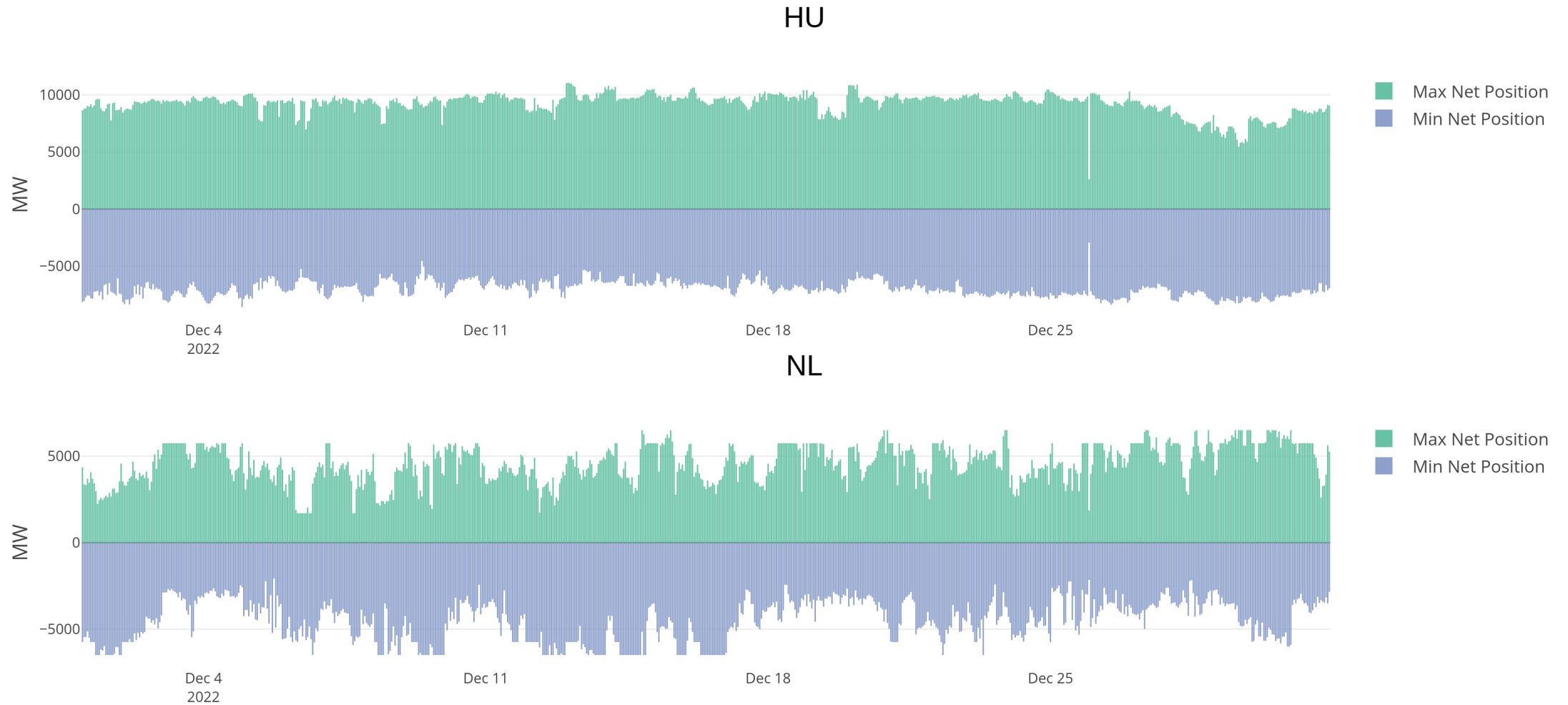




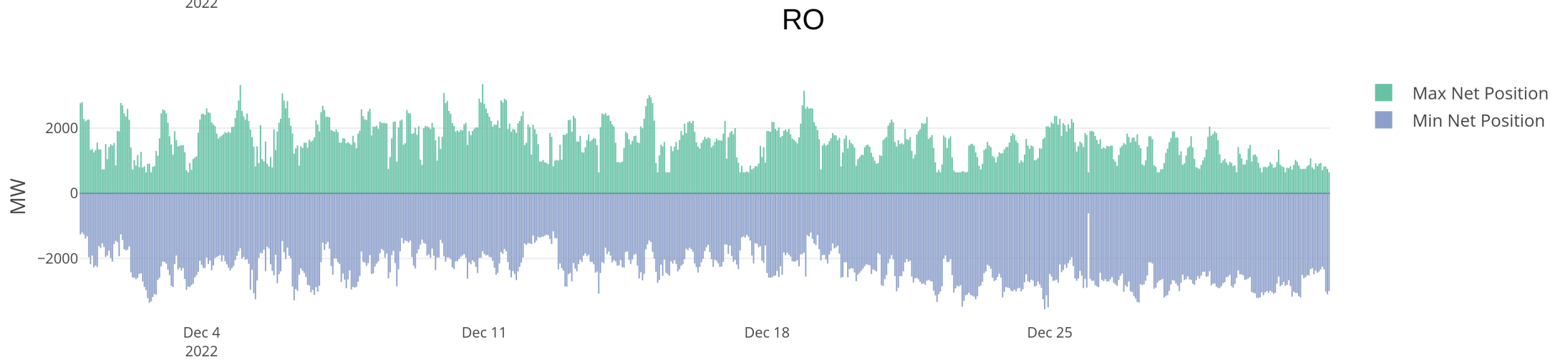
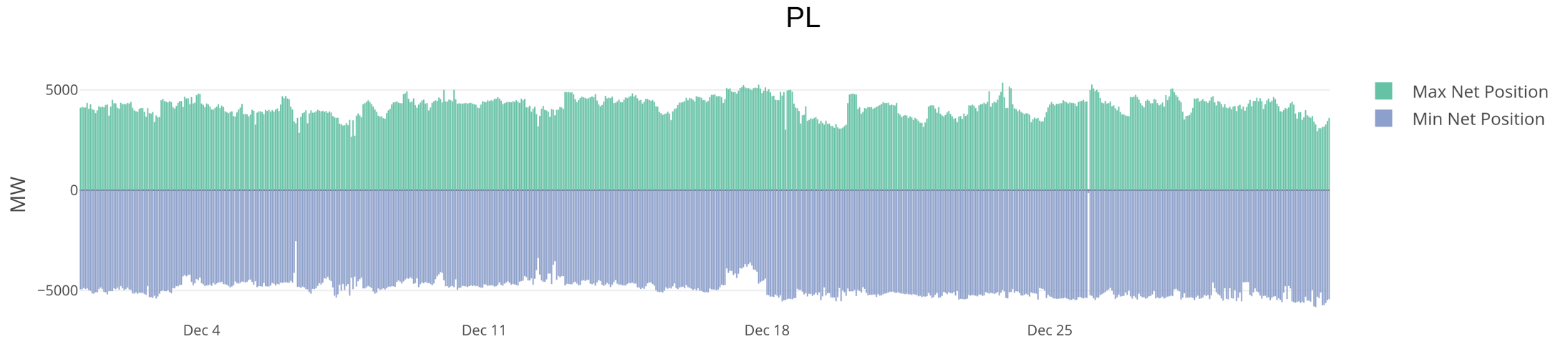
# KPI 5: Min & max net positions per BZ hub



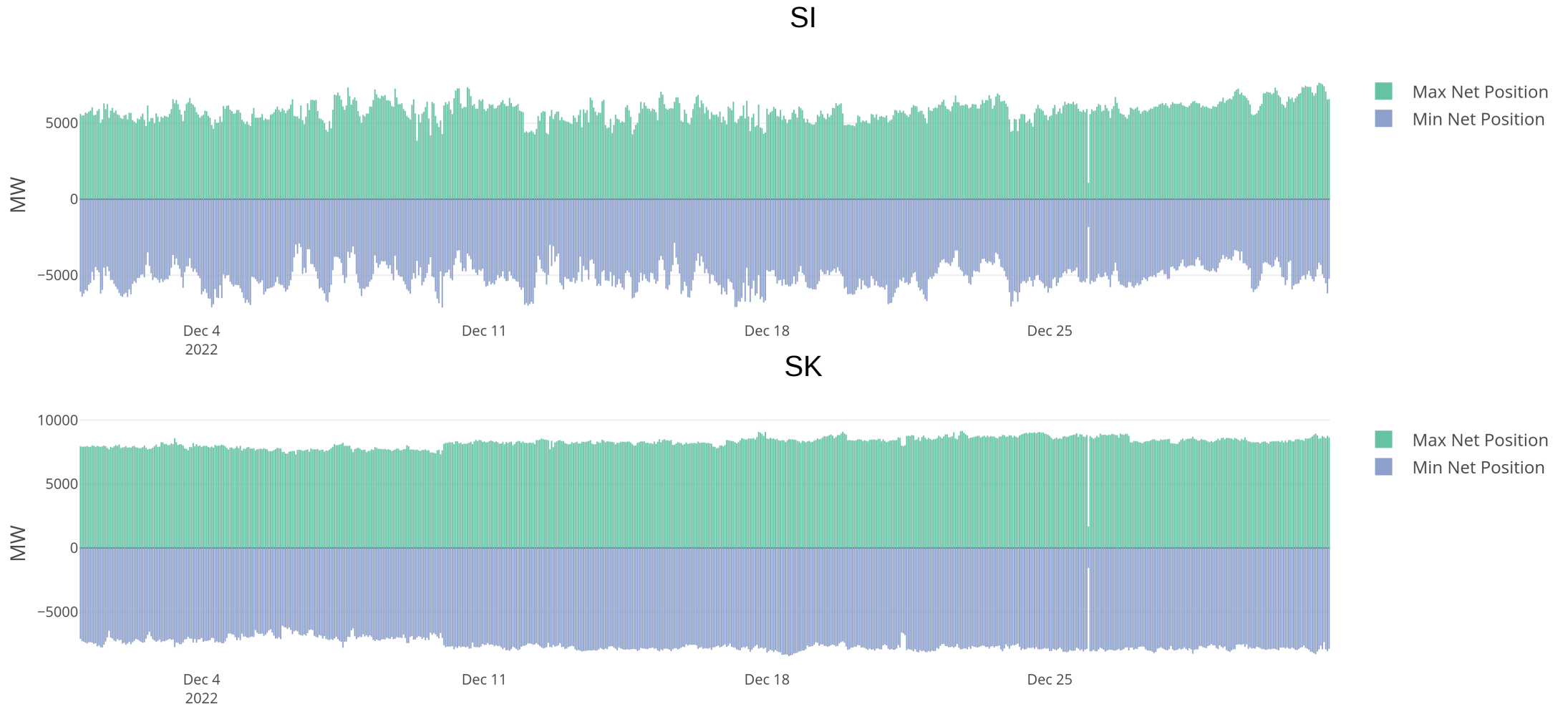
# KPI 5: Min & max net positions per BZ hub



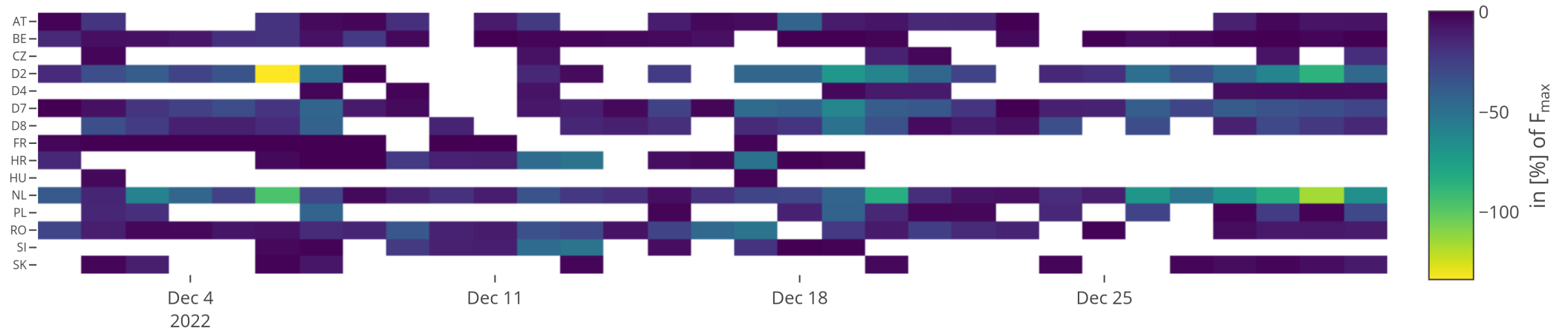
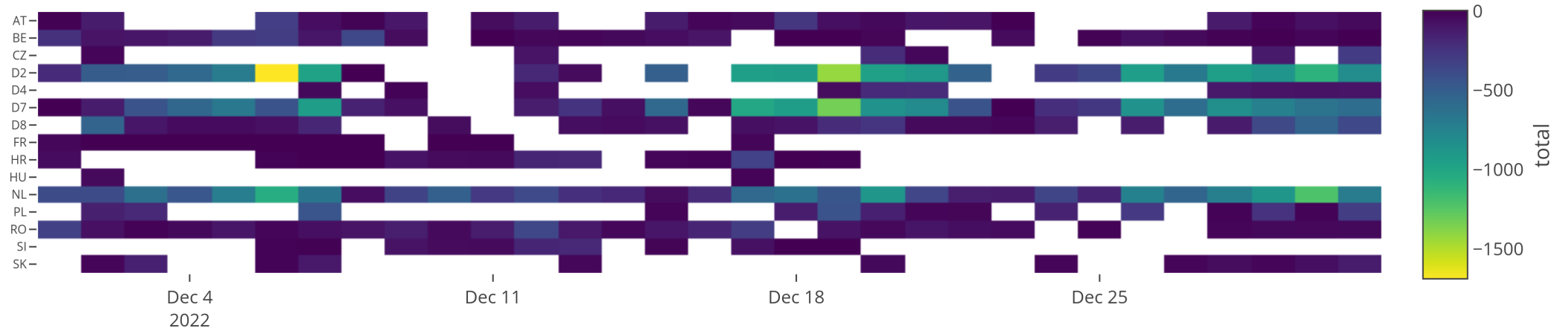
# KPI 5: Min & max net positions per BZ hub



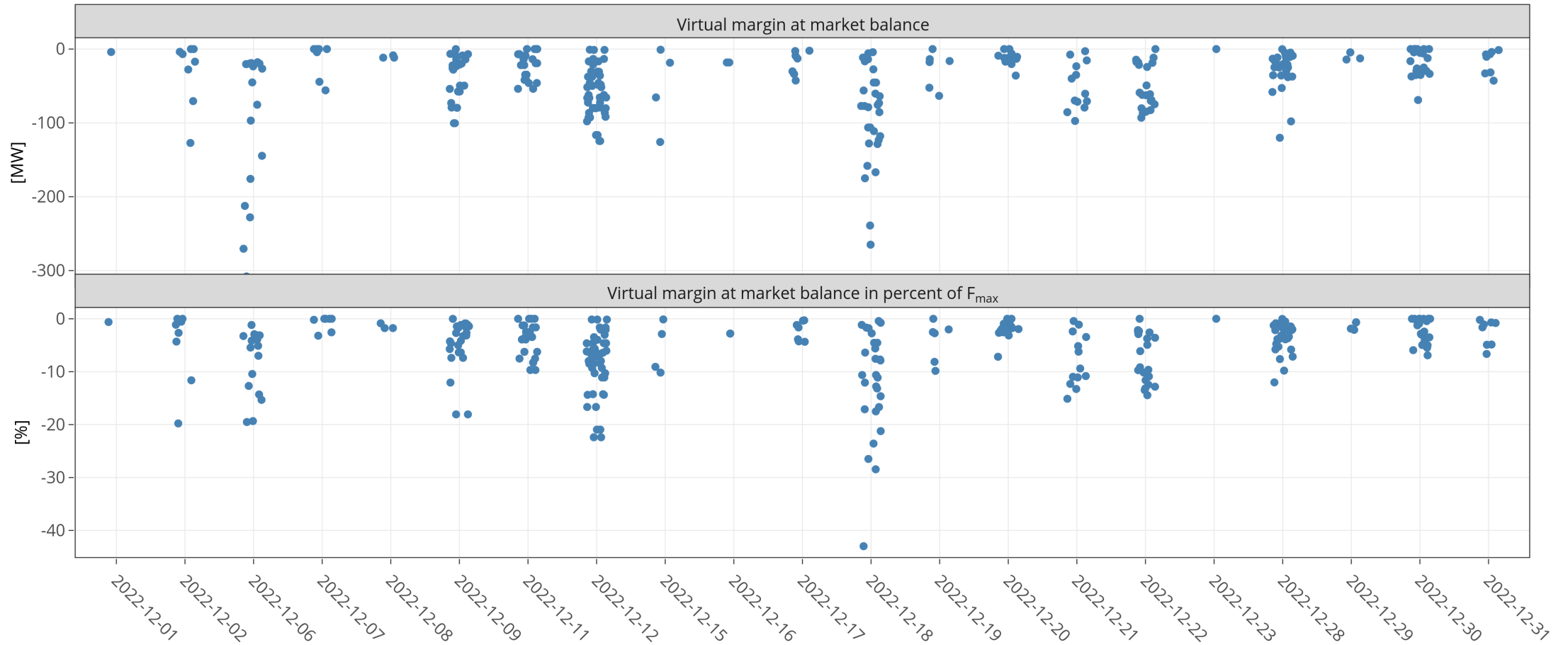
# KPI 5: Min & max net positions per BZ hub



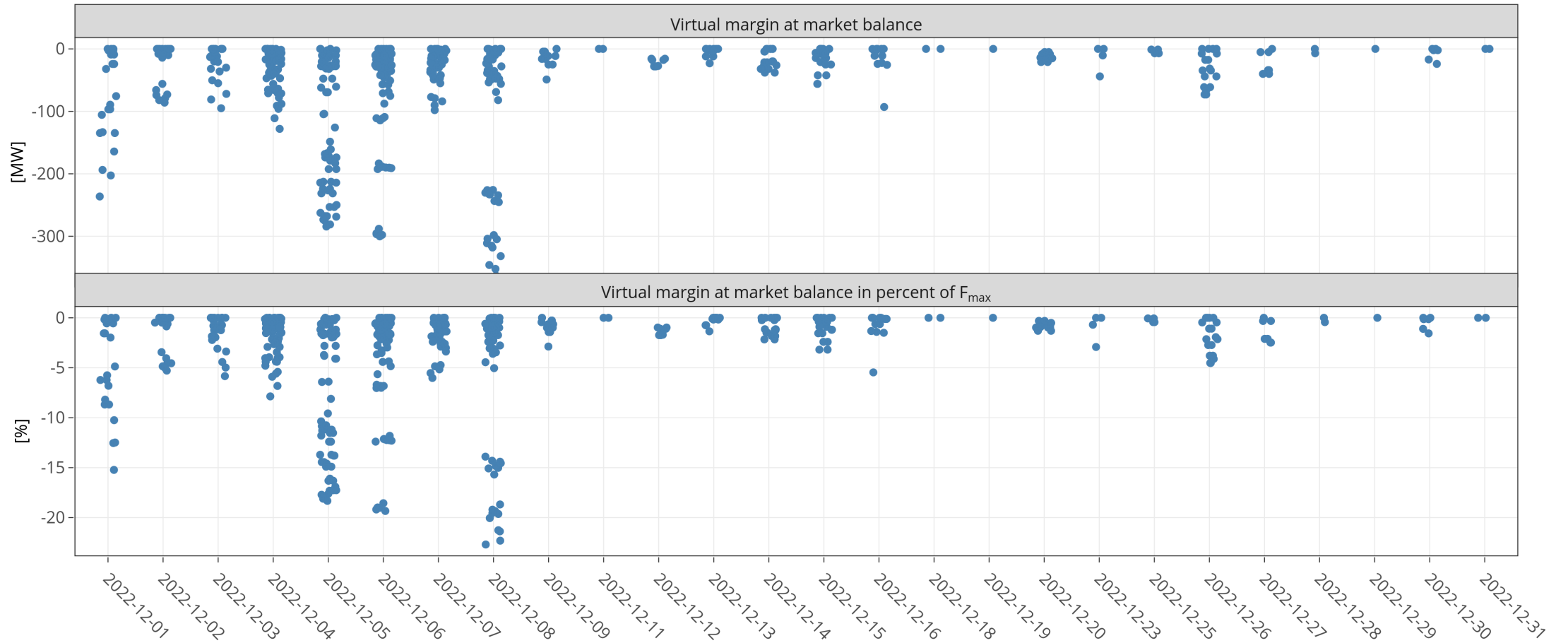
# KPI 6a: Highest virtual margins at market balance for CORE TSOs



# KPI 6b: Virtual margins at market balance AT



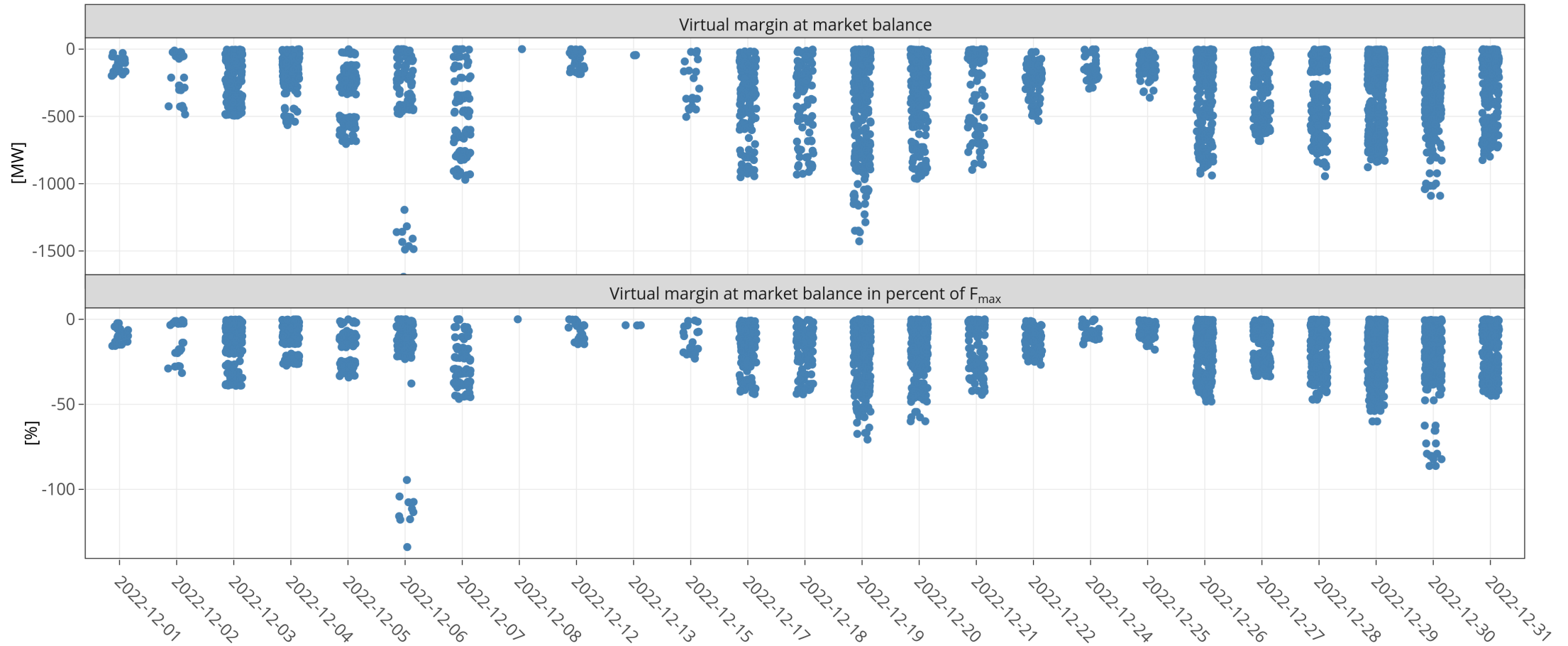
# KPI 6b: Virtual margins at market balance BE





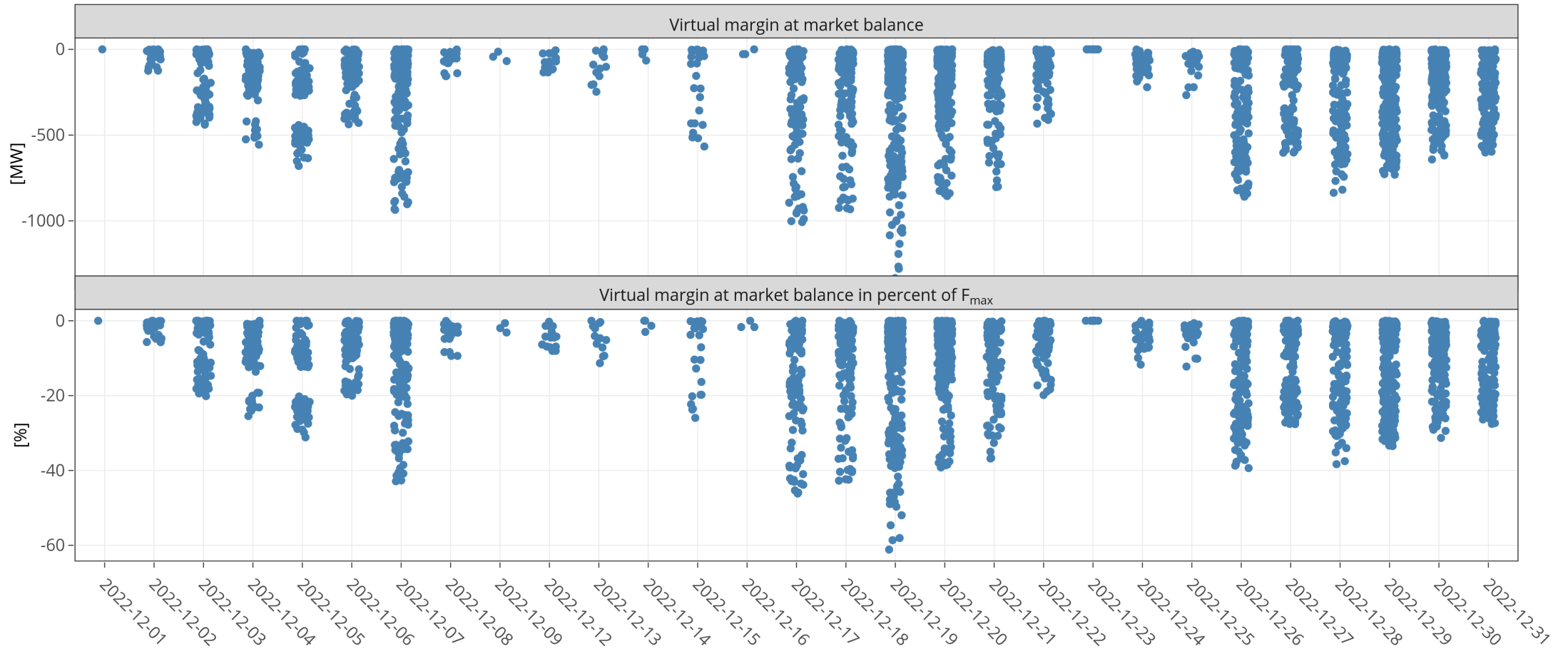


# KPI 6b: Virtual margins at market balance D2

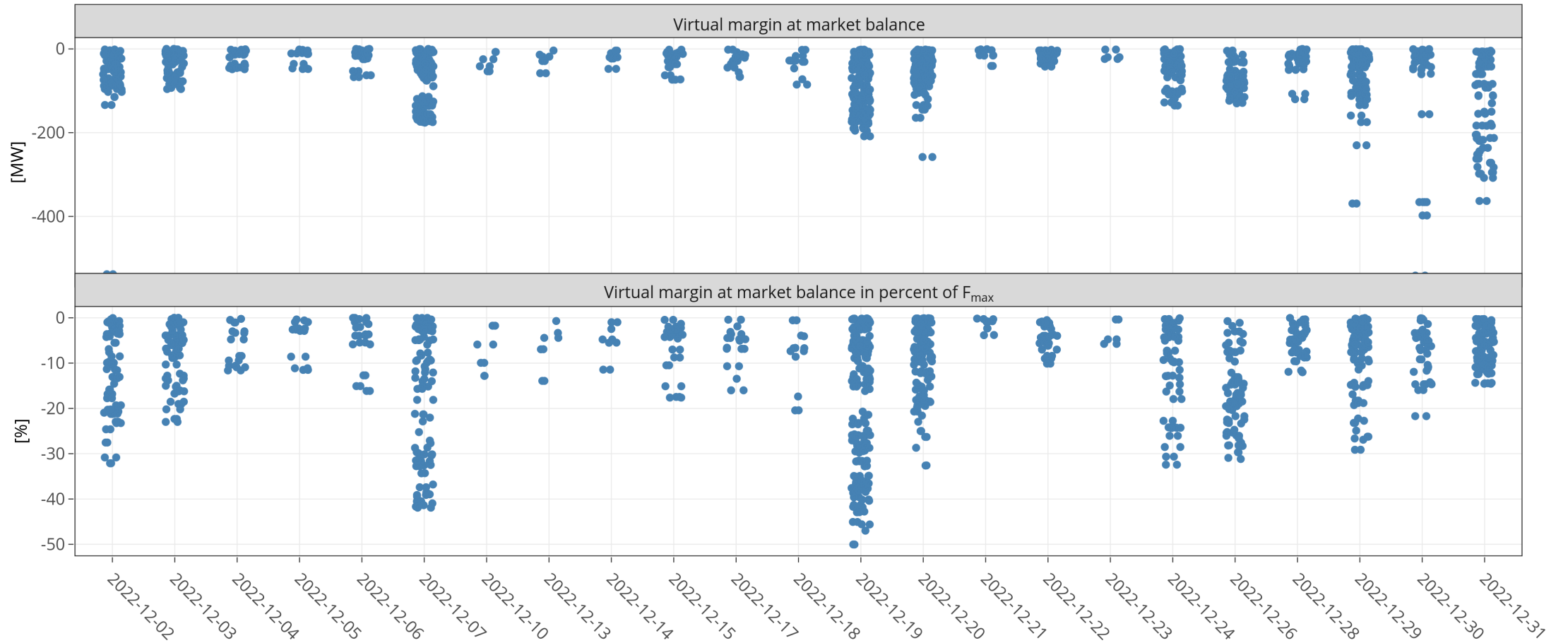




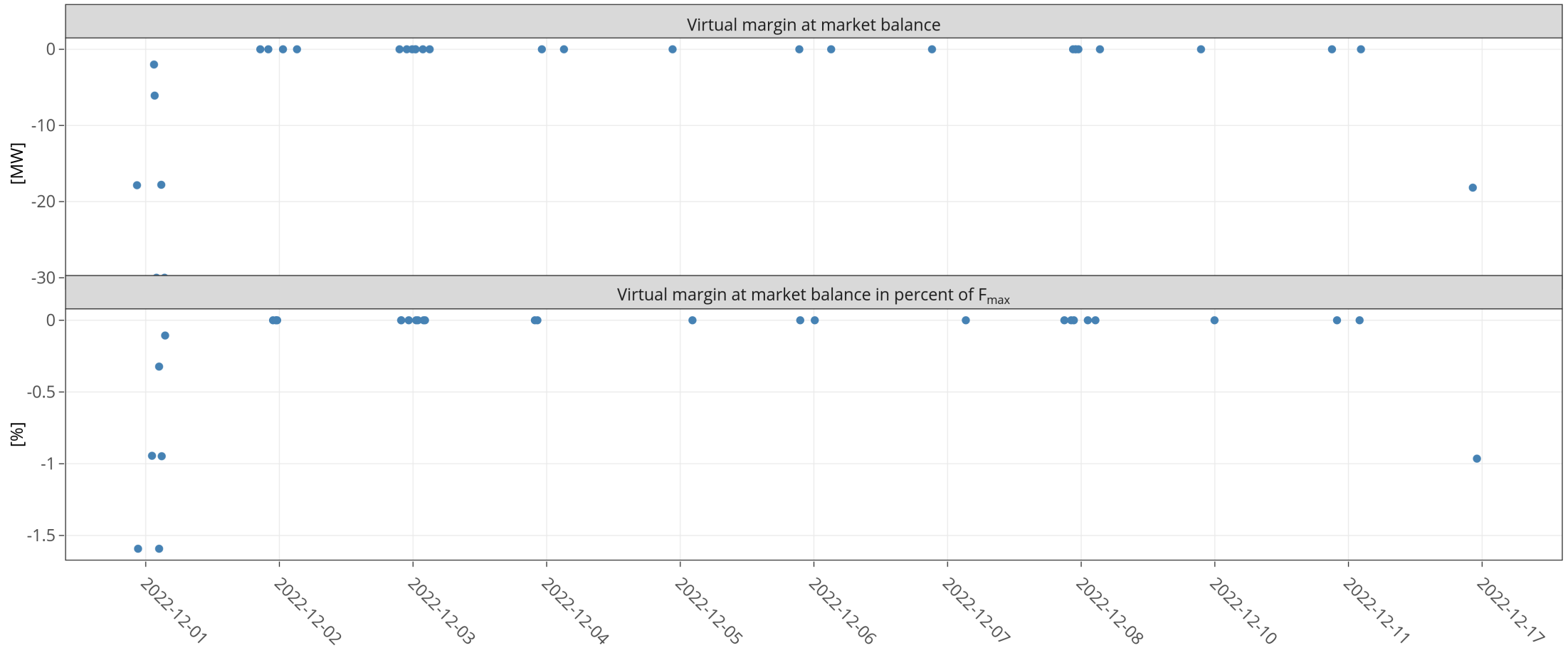
# KPI 6b: Virtual margins at market balance D7



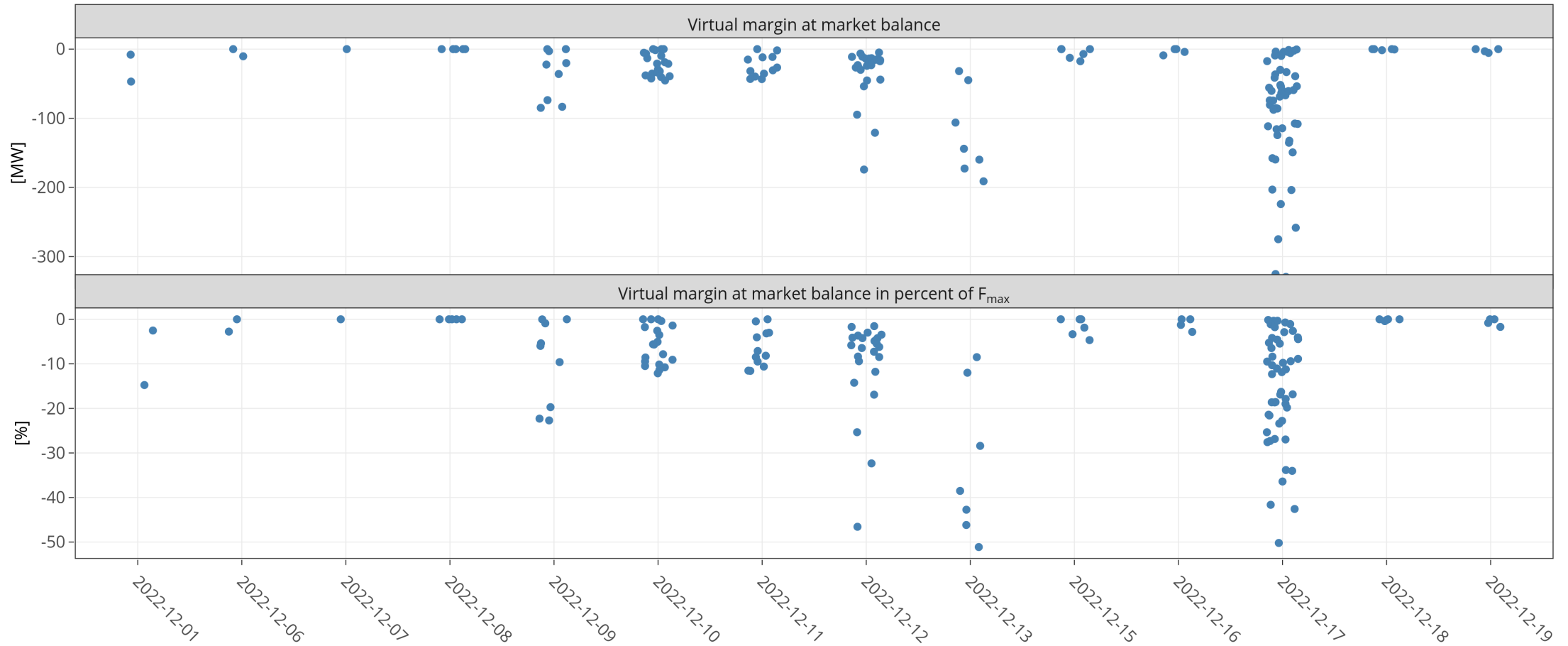
# KPI 6b: Virtual margins at market balance D8



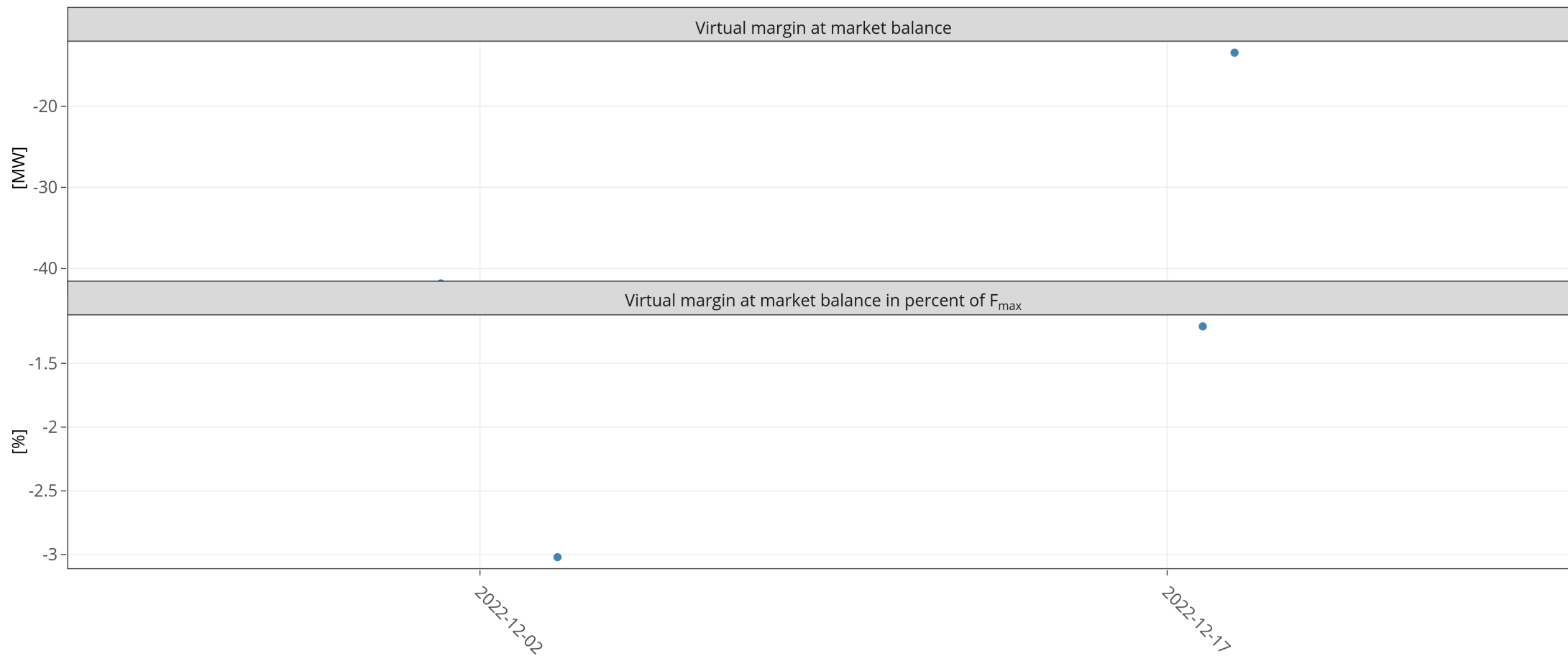
# KPI 6b: Virtual margins at market balance FR



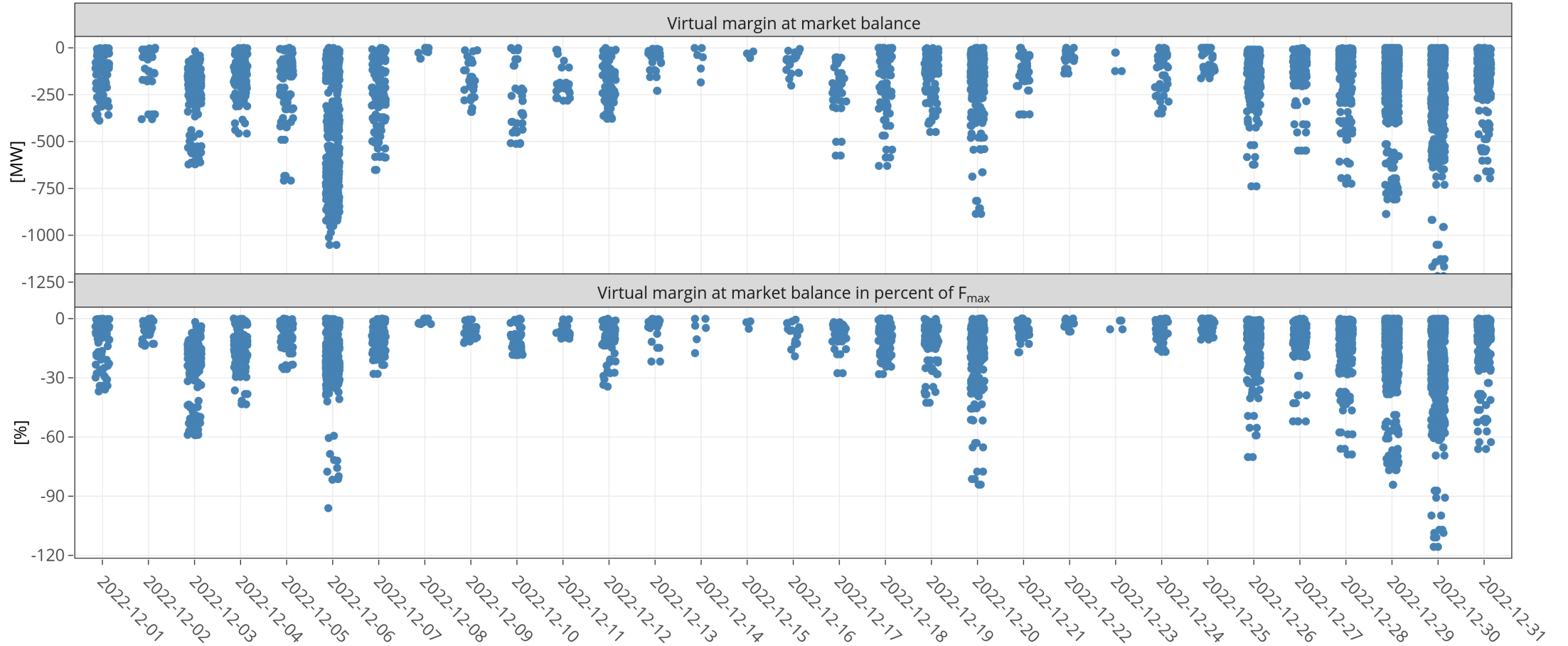
# KPI 6b: Virtual margins at market balance HR



# KPI 6b: Virtual margins at market balance HU

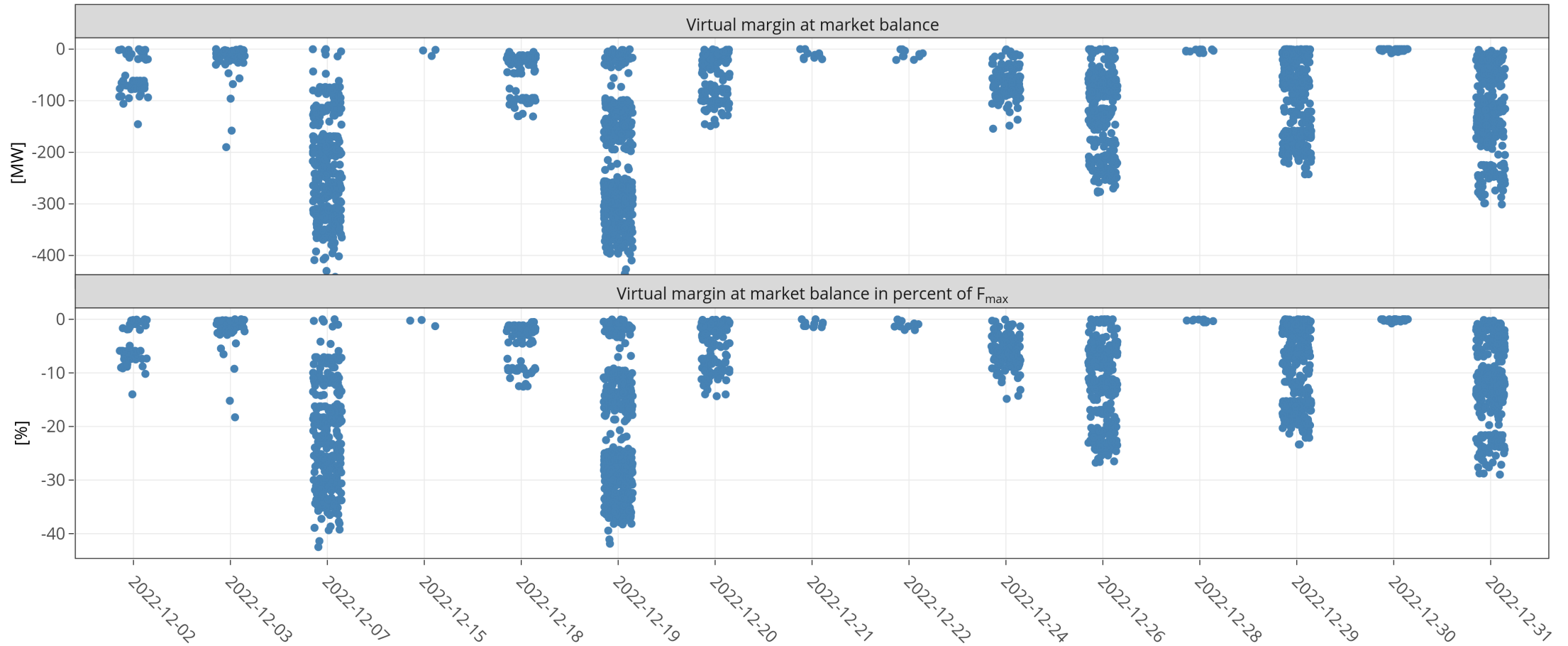


# KPI 6b: Virtual margins at market balance NL

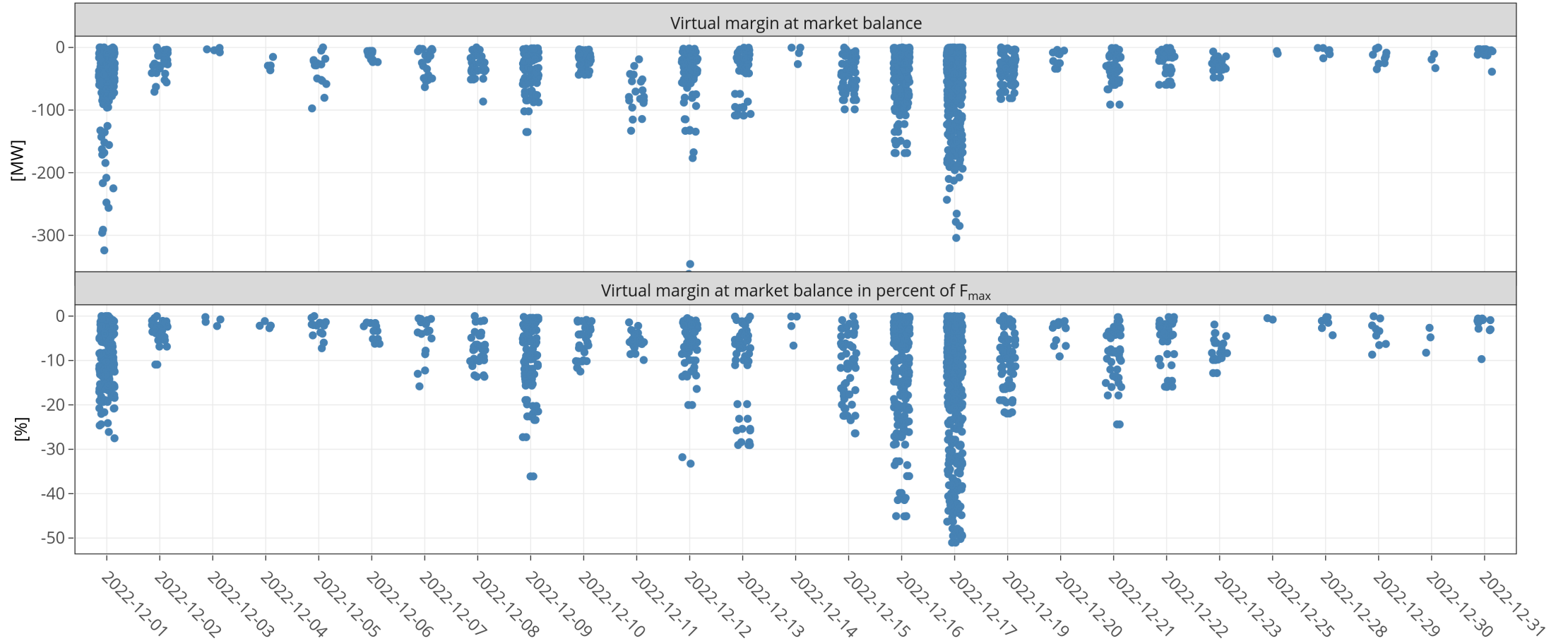




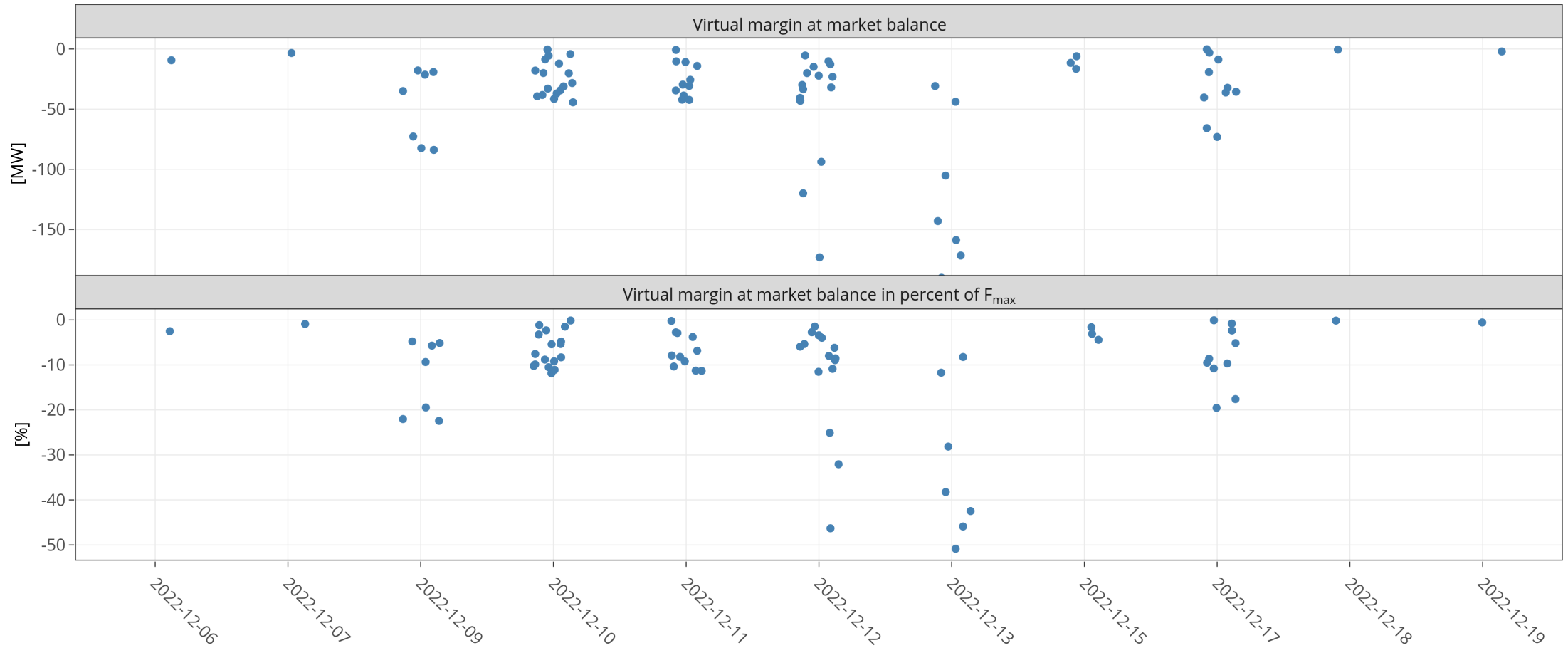
# KPI 6b: Virtual margins at market balance PL



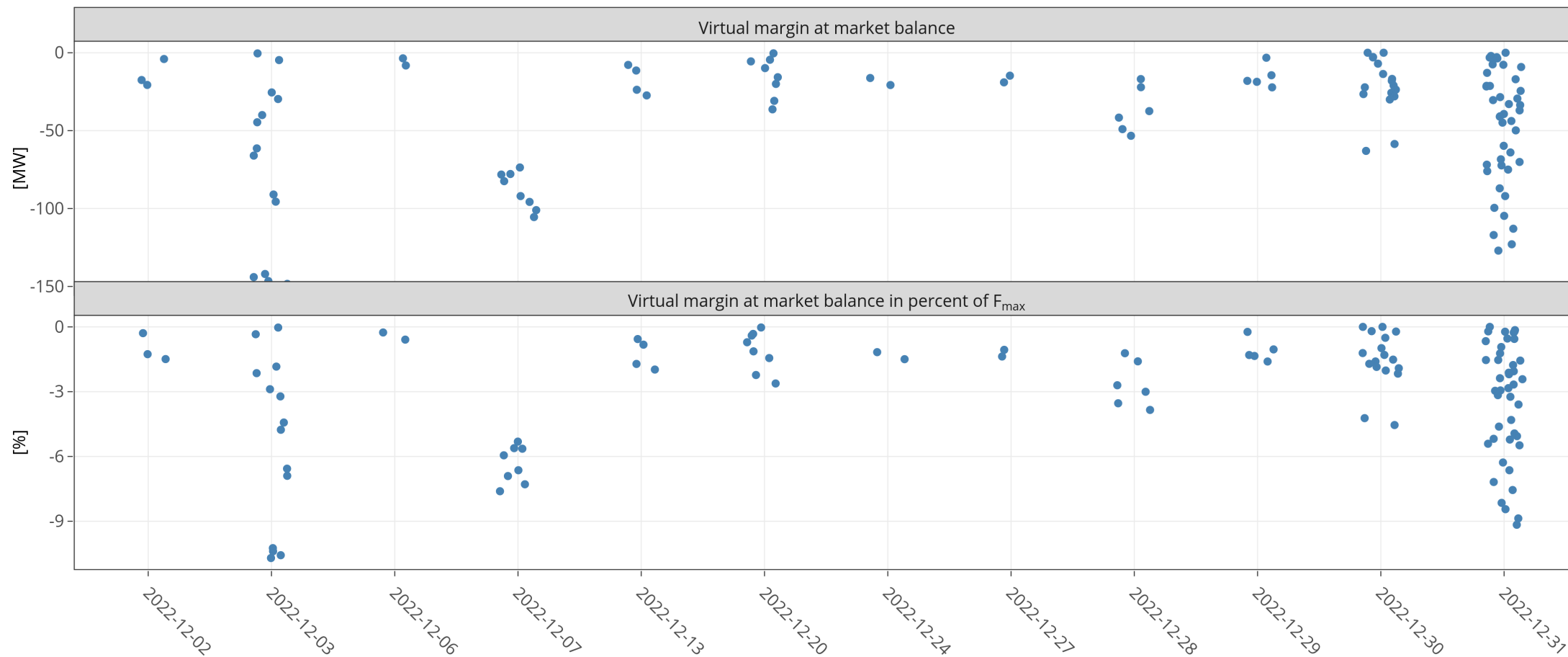
# KPI 6b: Virtual margins at market balance RO



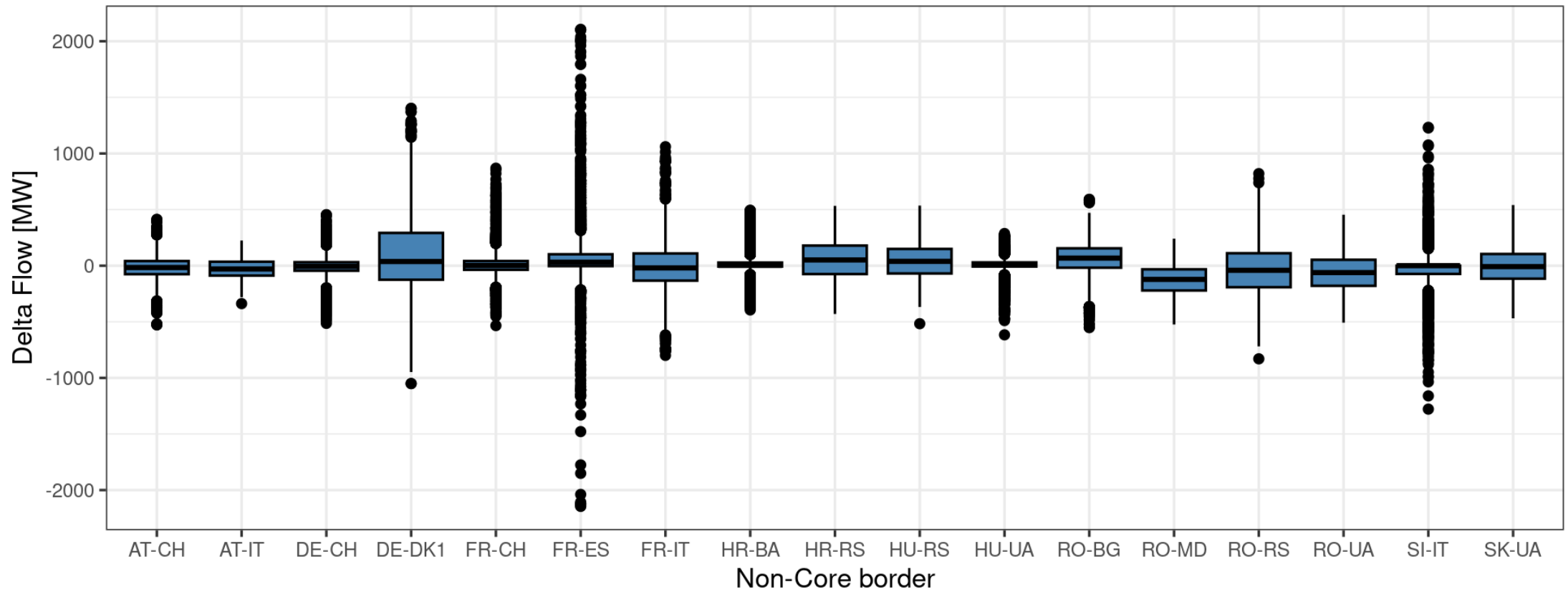
# KPI 6b: Virtual margins at market balance SI



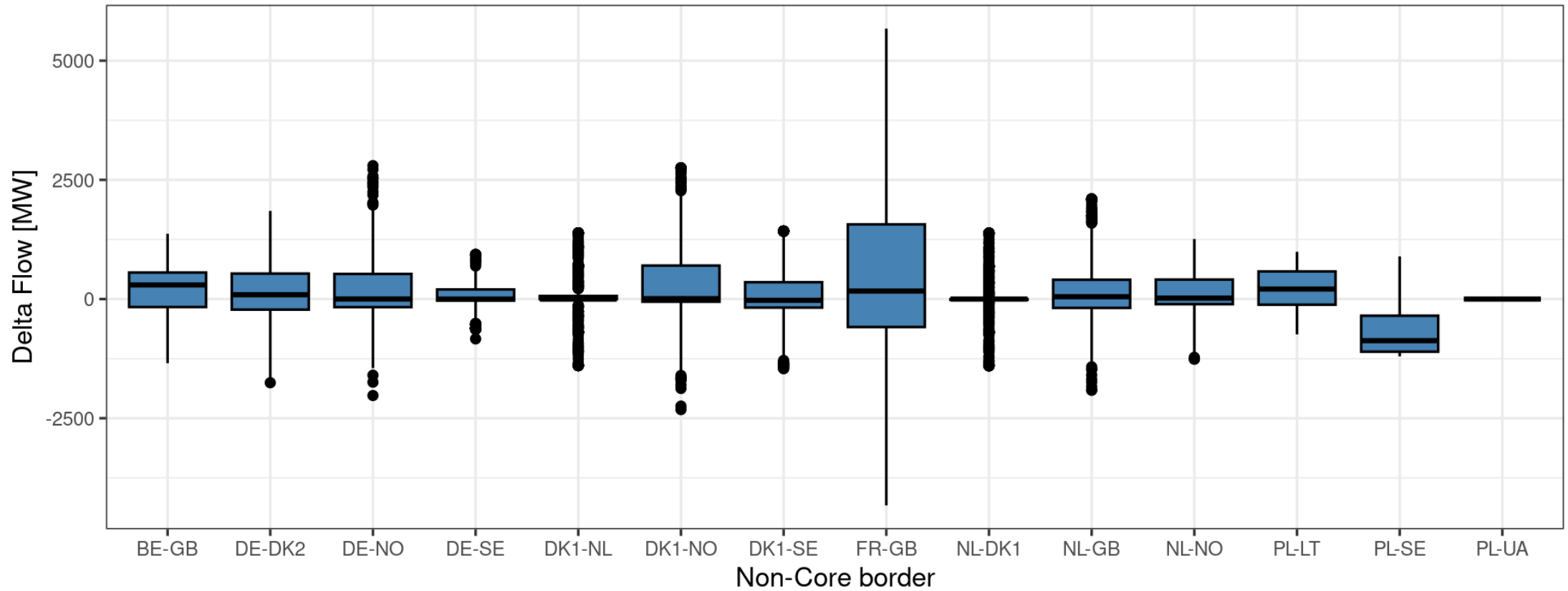
# KPI 6b: Virtual margins at market balance SK



# KPI 7: Non-Core exchanges AC delta flow



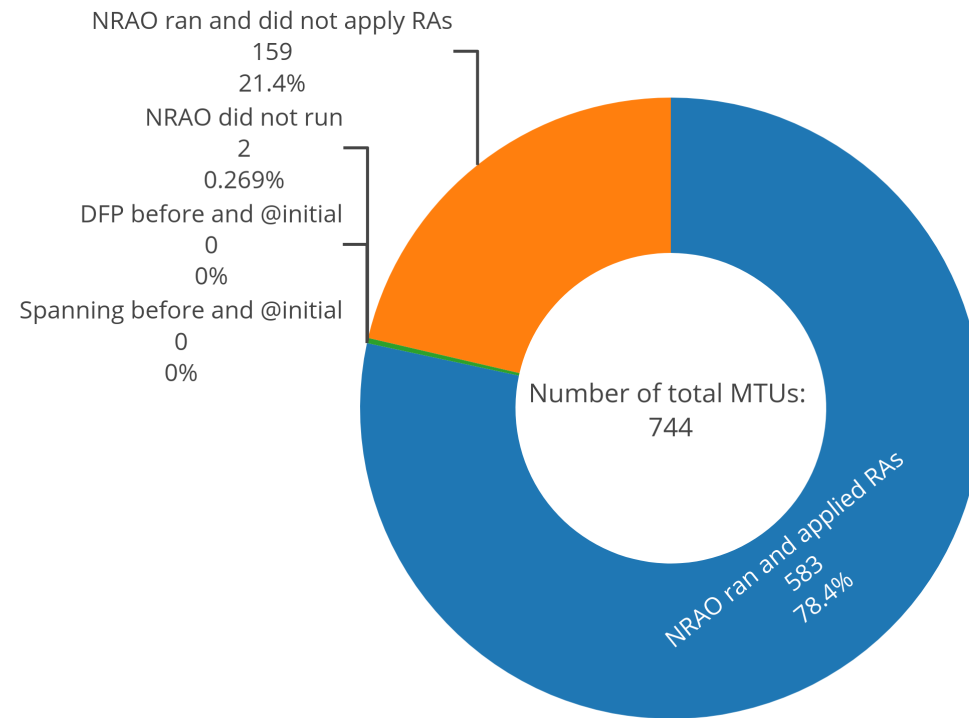
# KPI 7: Non-Core exchanges DC delta flow



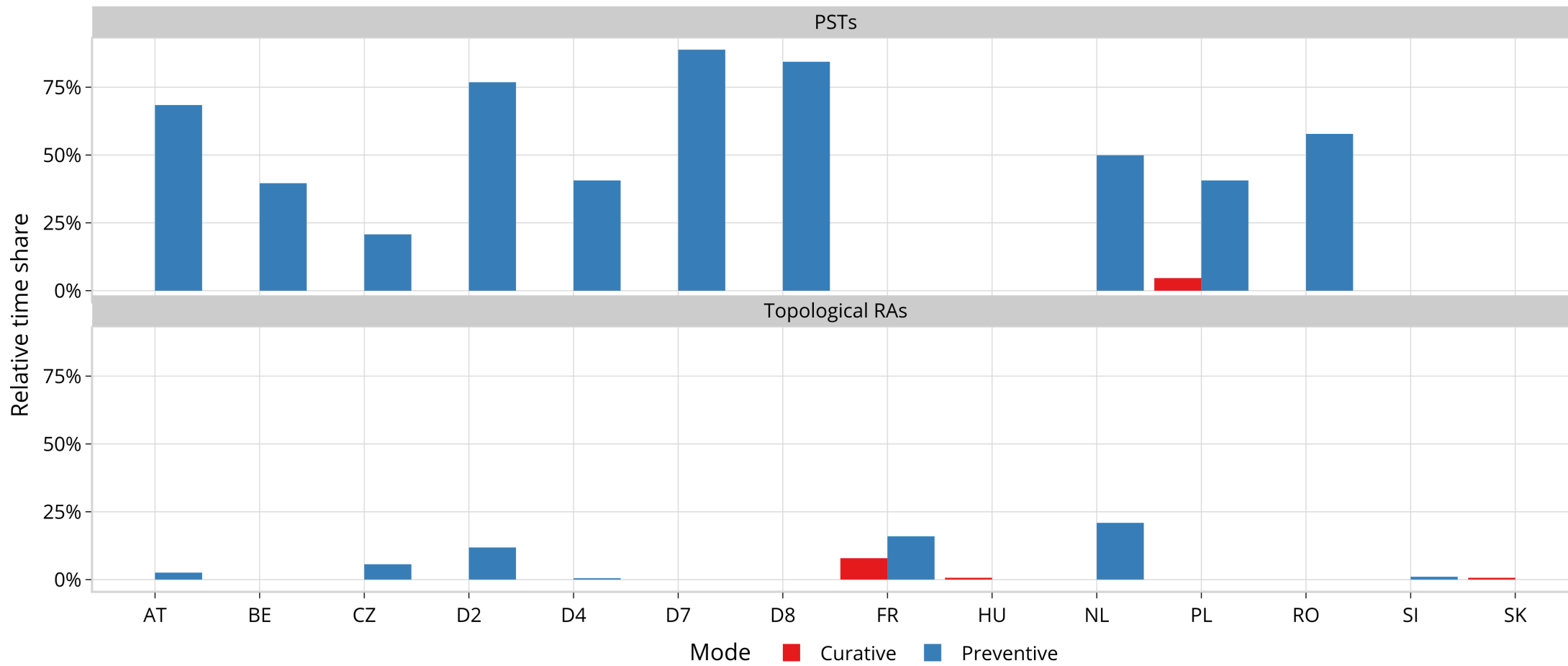
# KPI 8: NRAO – Applied Remedial Action



In the following plots, the relative time share relates to the hours labeled 'NRAO Ran and Applied RAs'.



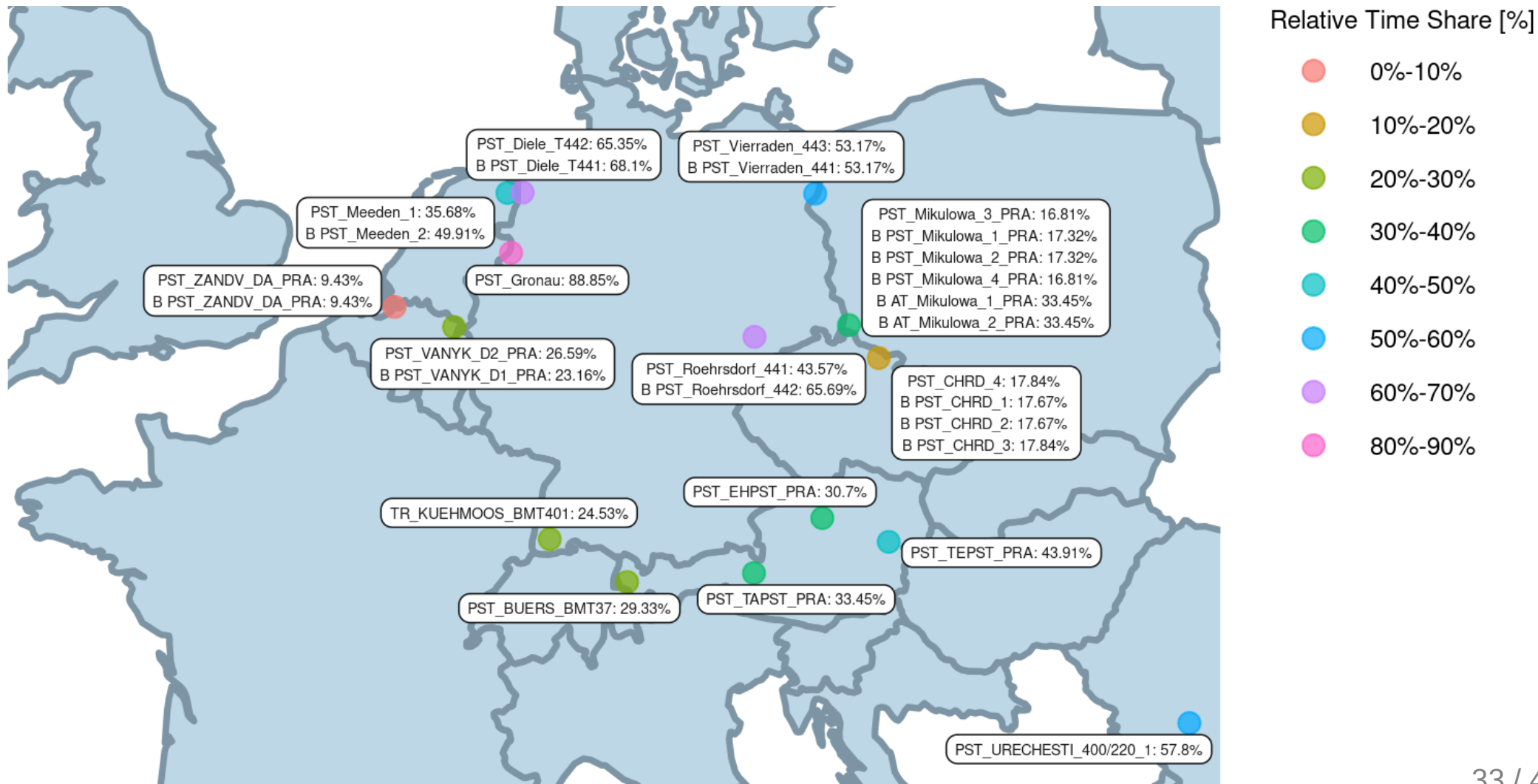
# KPI 8: Relative Time Share of Applied RAs, by TSO, Type and Mode





# KPI 8: Relative Time Share of Applied RAs, by TSO, Type and Mode

## Relative Time Share of Applied PSTs in Preventive Mode



# KPI 8: Relative Time Share of Applied RAs, by TSO, Type and Mode



## Relative Time Share of Applied PSTs in Curative Mode



Relative Time Share [%]

● 20%-30%

# KPI 8: Relative Time Share of Applied RAs, by TSO, Type and Mode

## Relative Time Share of Applied Topological RAs in Preventive Mode

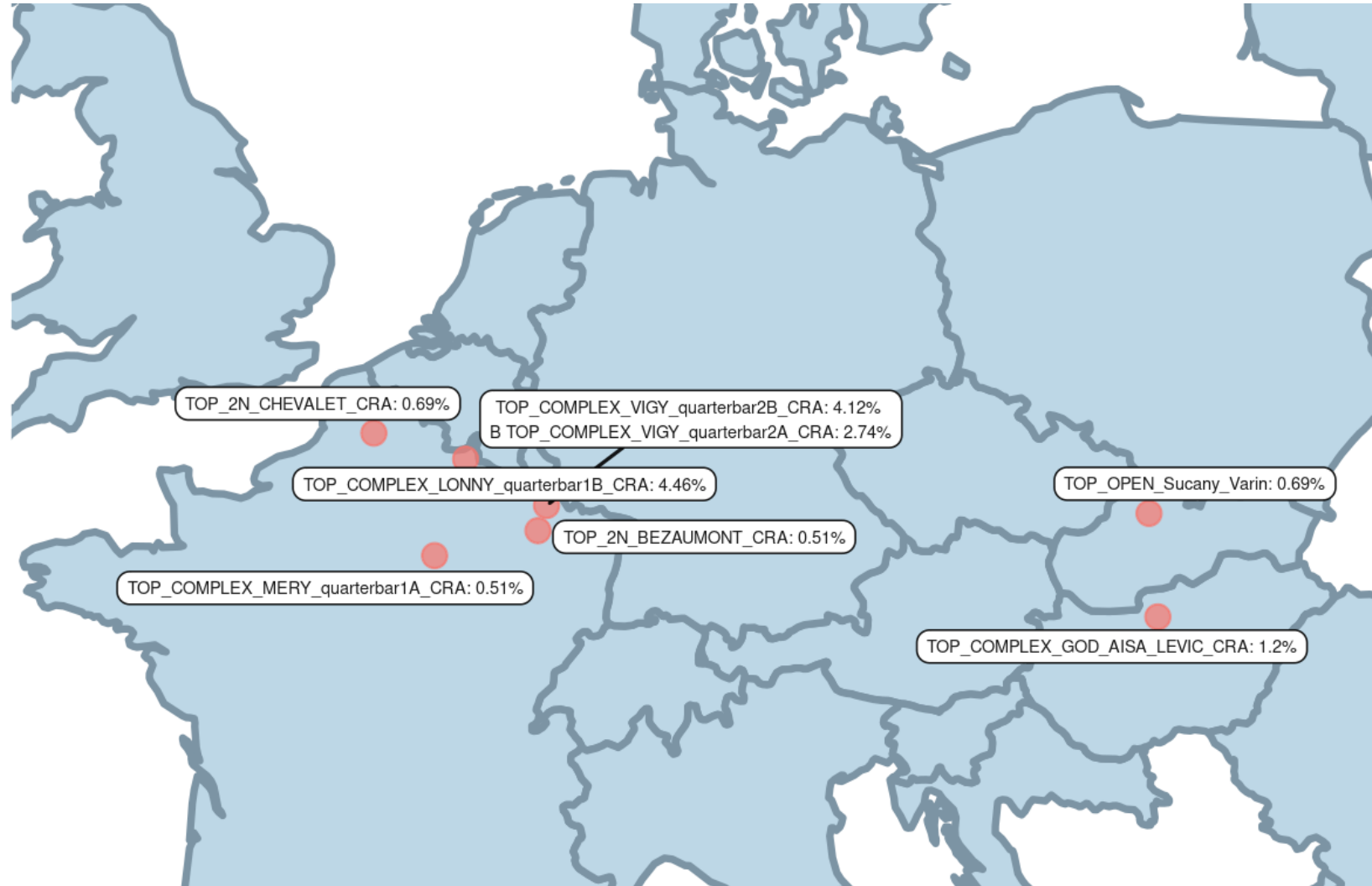


Relative Time Share [%]

- 0%-10%
- 10%-20%

# KPI 8: Relative Time Share of Applied RAs, by TSO, Type and Mode

## Relative Time Share of Applied Topological RAs in Curative Mode



Relative Time Share [%]

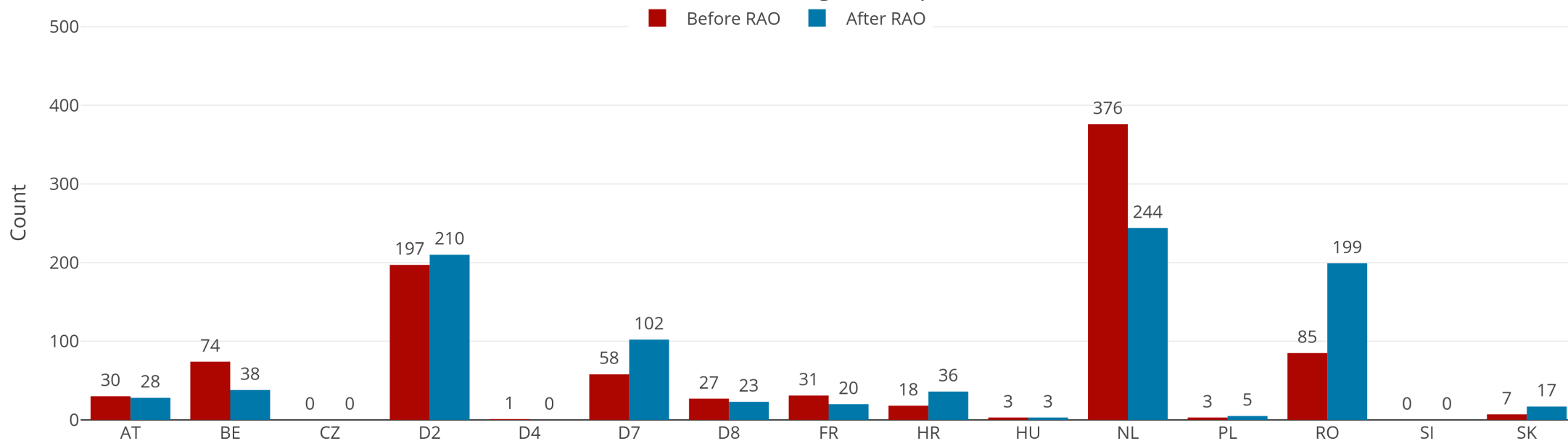
● 0%-10%

# KPI 9: Most limiting CNEC per TSO (NRAO)



The graph below shows the distribution of CNECs which are the most limiting from NRAO perspective, these are the CNECs with lowest relative RAM per MTU

Distribution of Limiting CNECs per TSO



As expected, there is redistributing of the most limiting CNECs. This is because the application of Remedial Actions does not eliminate flows but re-routes, reducing the flows on some limiting CNECs and increasing the load on others, which at the end impacts also the RAM values.

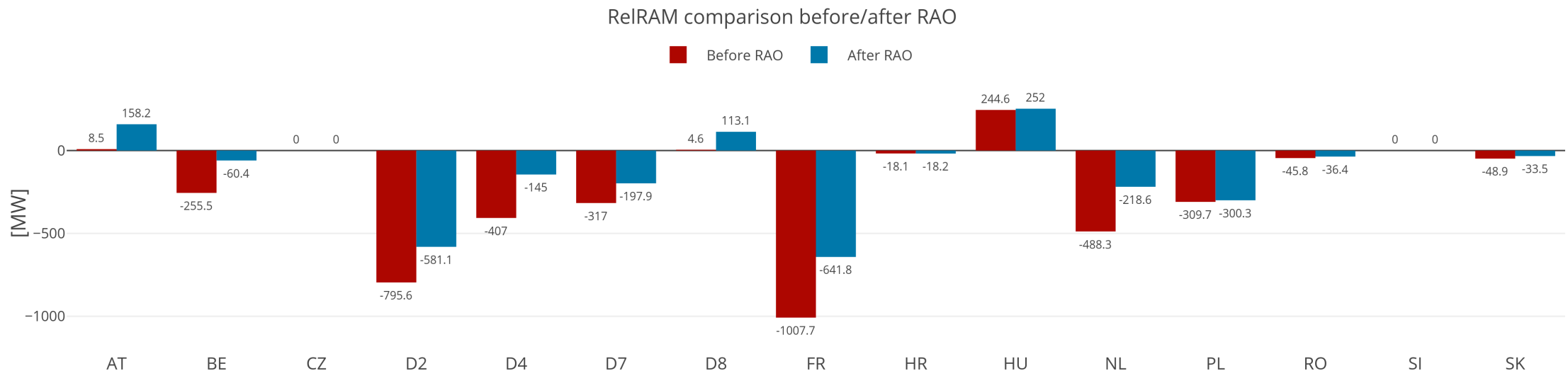
# KPI 10: Average variation of relative RAM before and after NRAO



The graph shows average values of relative RAM before and after NRAO, per TSO on the most limiting CNECs from NRAO perspective. Selected CNECs before RAO are the same as after RAO, and average computed for MTUs when was used further in the process.

- Most limiting element from NRAO perspective is the one which has the lowest relative RAM per MTU
- To determine value of relative RAM, the following formula was used

$$RAM_{rel} = \begin{cases} \frac{RAM_{nrao}}{\sum_{(A,B) \in \text{neighbouring Core bidding zones pairs}} |PTDF_{A \rightarrow B, nrao}|}, & \text{if } RAM_{nrao} \geq 0 \\ RAM_{nrao}, & \text{if } RAM_{nrao} < 0 \end{cases}$$



# KPI 11: Most often presolved CNEs (top 20)



CNE	Distinct hours CNE was presolved	Count of presolved CNECs	Avg RAM/Fmax	Min RAM/Fmax	Max RAM/Fmax	Max z2zPTDF	Max sum z2zPTDF
[HU-HU] Felsozsolca - Sajovivanka [DIR]	738	773	87.17%	66.61%	111.91%	0.1919	0.6624
[SK-HU] Gabcikovo - Gonyu [OPP] [HU]	737	1258	85.65%	67.58%	126.43%	0.2508	0.8577
[HU-HU] Gonyu - Gyor [DIR]	736	1554	77.82%	57.04%	110.11%	0.2551	1.4154
[CZ-SK] Sokolnice - Senice [OPP] [CZ]	734	734	101.08%	78.92%	116.24%	0.0773	0.2763
[SI-HU] Cirkovce - Heviz [DIR] [HU]	734	750	107.74%	59.75%	143.86%	0.2081	1.0448
[CZ-SK] Nosovice - Varin [OPP] [SK]	732	1947	106.02%	68.40%	143.36%	0.3169	1.1509
[SI-HU] Cirkovce - Heviz [OPP] [HU]	732	752	71.63%	49.37%	116.43%	0.2081	1.0448
[CZ-PL] Wielopole - Nosovice [DIR] [PL]	731	731	53.13%	24.03%	80.09%	0.3251	1.1229
[SK-SK] Gabcikovo - P.Biskupice [DIR]	730	730	87.86%	67.09%	116.96%	0.2766	1.0006
[SK-CZ] Krizovany - Sokolnice [OPP] [SK]	729	729	93.09%	70.71%	110.10%	0.2522	1.0573
[CZ-SK] Nosovice - Varin [DIR] [SK]	727	2179	76.93%	31.46%	114.29%	0.3169	1.1509
[RO-RO] TR Rosiori 400/220 1 [DIR]	721	721	46.21%	13.25%	103.75%	0.1147	0.195
[CZ-SK] Sokolnice - Senice [DIR] [CZ]	716	716	82.25%	67.24%	104.56%	0.0773	0.2763
[CZ-D2] Hradec - Etzenricht 441 [DIR] [D2]	714	714	51.28%	11.18%	79.80%	0.1784	0.7661
[AT-SI] Obersielach - Podlog 247 [DIR] [AT]	712	893	73.46%	6.10%	152.48%	0.1757	0.5409
[HR-SI] 220kV Pehlin - Divaca [DIR] [HR]	709	732	68.46%	9.09%	114.97%	0.1854	0.5274
[HR-SI] 220kV Pehlin - Divaca [OPP] [HR]	709	910	107.15%	65.24%	181.02%	0.1854	0.5274
[HU-HU] Gonyu - Gyor [OPP]	698	699	105.85%	69.96%	138.74%	0.2347	1.4154
[AT-AT] Sarasdorf - Zurndorf 439A [OPP]	691	691	71.82%	2.70%	104.83%	0.284	1.1912
[AT-D2] St. Peter 2 - Pleinting 258 [OPP] [AT]	689	692	84.23%	8.40%	132.01%	0.1397	0.5377

Note 1: The shown z2zPTDF values do not correspond to the maximum zone-to-zone PTDFs according to equation 5 of the Day-ahead CCM and hence are not the ones used for the CNEC Selection. The z2zPTDFs are calculated only between neighbouring BZs. See KPI reading guide on JAO.

Note 2: RAM for Core exchanges can be higher than 100% due to the relieving effect of Fuaf:  $RAM_{Core} = CEP_{target} - Fuaf$ . So if Fuaf is very negative you can get above 100%.

# KPI 12: Most limiting CNEs (top 20)



CNE	Distinct hours CNE has shadow price	Count of CNECs with shadow price	Max shadow price [€/MW]	Avg RAM/Fmax	Min RAM/Fmax	Max RAM/Fmax	Max z2zPTDF
[NL-D2] Meeden-Diele 380 Z [OPP] [NL]	148	148	993.7	27.82%	18.23%	75.59%	0.2813
[NL-BE] PST Zandvliet 2 [DIR] [BE]	132	132	604.59	57.79%	36.18%	80.48%	0.3815
[AT-D2] St. Peter 2 - Pleinting 258 [OPP] [AT]	115	115	612.74	77.85%	25.35%	102.80%	0.1328
[HR-SI] 220kV Pehlin - Divaca [DIR] [HR]	102	102	1924.19	53.29%	28.88%	82.35%	0.1843
[NL-NL] Diemen-Lelystad 380 W [OPP]	89	90	1545.33	24.74%	19.92%	57.70%	0.3256
[D8-PL] Krajnik - Vierraden 2 [OPP] [PL]	78	78	775.2	21.52%	5.29%	33.21%	0.2392
[RO-RO] Paroseni - Targu Jiu Nord [OPP]	76	76	3812.43	20.28%	0.00%	54.18%	0.0942
[D7-D7] Buerstadt - Lamsheim BUERST W [DIR]	69	69	1535.31	47.33%	33.87%	63.93%	0.1371
[D7-FR] Ensdorf - Vigy VIGY1 N [DIR] [FR]	61	61	365.45	75.97%	61.36%	96.82%	0.1944
[SK-SK] V.Dur - Levice 1 [DIR]	60	60	1193.09	49.47%	41.27%	53.46%	0.1941
[RO-RO] TR Rosiori 400/220 1 [DIR]	57	57	2498.25	26.14%	13.25%	51.50%	0.1106
[CZ-D2] Hradec - Etzenricht 441 [DIR] [D2]	54	54	903.27	39.30%	11.18%	66.16%	0.1723
[BE-BE] Achene - Gramme 380.10 [OPP]	36	36	551.42	71.37%	52.64%	86.23%	0.249
[D8-PL] Mikulowa PST1 [OPP] [PL]	33	33	278.97	45.60%	21.82%	58.41%	0.303
[BE-BE] Doel - Zandvliet 380.25 [OPP]	29	29	251.57	58.75%	48.76%	77.81%	0.3899
[BE-FR] Achene - Lonny 380.19 [DIR] [BE]	29	29	485.72	69.32%	54.52%	85.56%	0.246
[D7-D7] Paffendorf - Rommerskirchen PAFFEN S [OPP]	27	27	1099.44	24.04%	7.61%	42.44%	0.229
[D7-FR] Ensdorf - Vigy VIGY2 S [DIR] [FR]	26	26	563.99	79.58%	56.05%	111.62%	0.1997
[NL-BE] PST Van Eyck 2 [OPP] [BE]	25	26	37.21	59.24%	47.21%	68.10%	0.2888
[NL-BE] Rilland-Zandvliet 380 W [DIR] [NL]	25	25	354.28	27.95%	13.04%	44.37%	0.3778

Note 1: The RAM values (expressed as % of Fmax) should not be interpreted as "the capacities offered by the Core TSOs to the market coupling". Indeed, since the introduction of Ext LTA inclusion Euphemia performs an optimization where it takes a portion of the FB domain and a portion of the LTA domain to maximize welfare. The RAM value shown in this KPI report correspond to the "portion of the FB domain" resulting from this optimization

Example:

- RAM = 500MW
- Portion of FB Domain = 40%
- RAM offered by Core TSOs =  $400\text{mW}/0.4 = 1250\text{MW}$



# KPI 13a: Allocation Constraints - Belgium



	# MTUs
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AC was Limiting MC 0

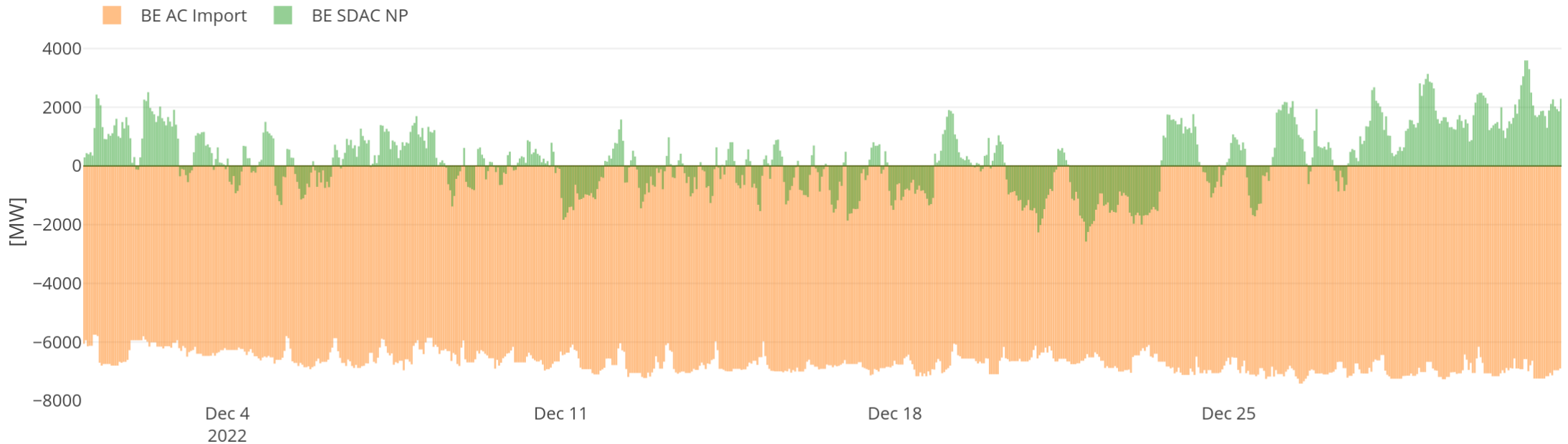
	BE AC Import [MW]
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Avg. -6683.34

Min. -7390.00

Max. -5728.00

Belgium only uses import allocation constraints



# KPI 13b: Allocation Constraints - Poland



	# MTUs
AC was limiting MC	627
AC < 0 MW	16
AC = 0 MW	502
AC > 0 MW	109

	PL AC Import [MW]	PL AC Export [MW]
Avg.	-2395.61	914.71
Min.	-8644.00	0.00
Max.	0.00	9018.00

