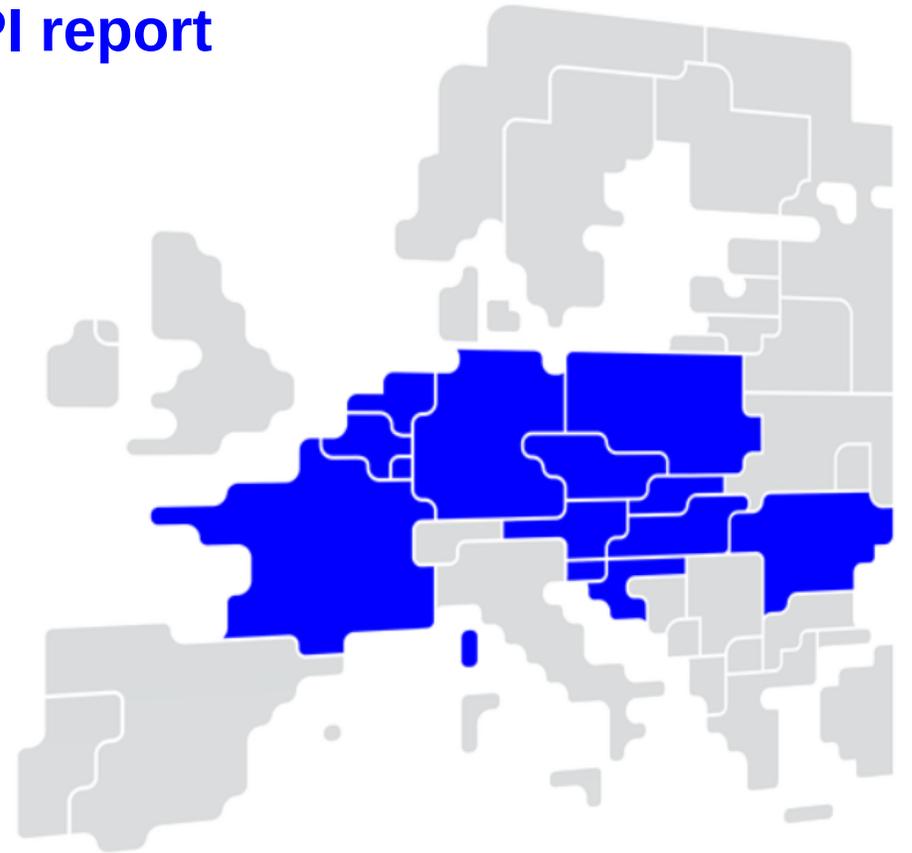


Core FB MC Operational KPI report

July 2023



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)

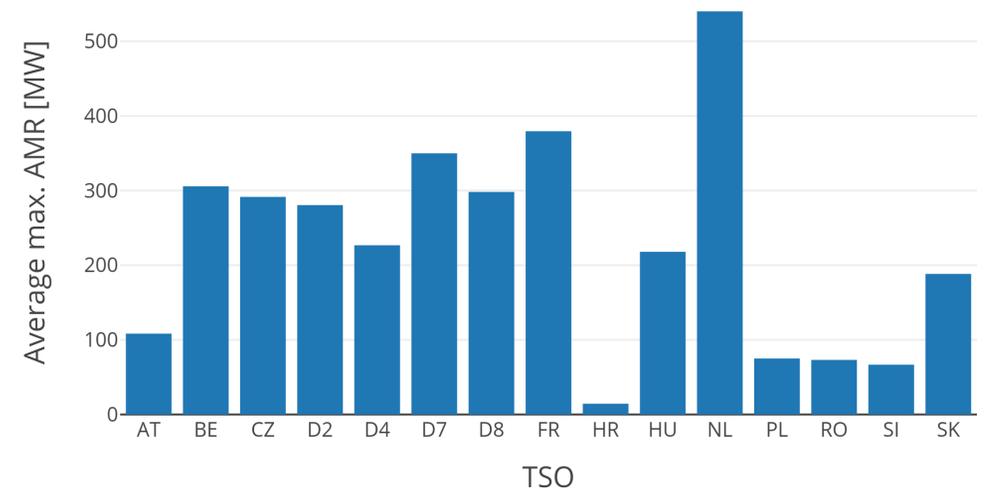
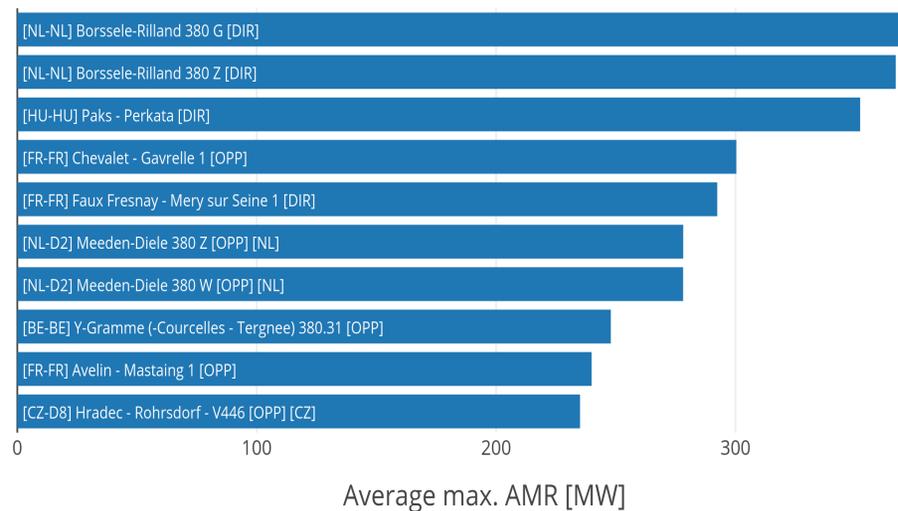
KPI 2: Average maximum AMR per TSO



CNE	Average Maximum AMR (MW)	AMR as % of Fmax
[NL-NL] Borssele-Rilland 380 G [DIR]	370.83	16.00%
[NL-NL] Borssele-Rilland 380 Z [DIR]	366.93	15.83%
[HU-HU] Paks - Perkata [DIR]	352.08	25.42%
[FR-FR] Chevalet - Gavrelle 1 [OPP]	300.35	0.28%
[FR-FR] Faux Fresnay - Mery sur Seine 1 [DIR]	292.38	17.71%
[NL-D2] Meeden-Diele 380 Z [OPP] [NL]	278.17	26.42%
[NL-D2] Meeden-Diele 380 W [OPP] [NL]	278.12	26.41%
[BE-BE] Y-Gramme (-Courcelles - Tergnee) 380.31 [OPP]	247.93	16.71%
[FR-FR] Avelin - Mastaing 1 [OPP]	239.88	13.42%
[CZ-D8] Hradec - Rohrsdorf - V446 [OPP] [CZ]	235.07	14.44%

TSO	Average maximum AMR per TSO
AT	108.35
BE	305.67
CZ	291.61
D2	280.62
D4	226.70
D7	349.86
D8	298.21
FR	379.49
HR	14.36
HU	218.02

TSO	Average maximum AMR per TSO
NL	540.10
PL	74.87
RO	73.15
SI	66.61
SK	188.40



KPI 3: Share of MTUs with intervention per TSO



Total BDs

31

Total MTUs

744

MTUs without IVA

341

Share of distinct MTUs without IVA

45.8%

MTUs with IVA

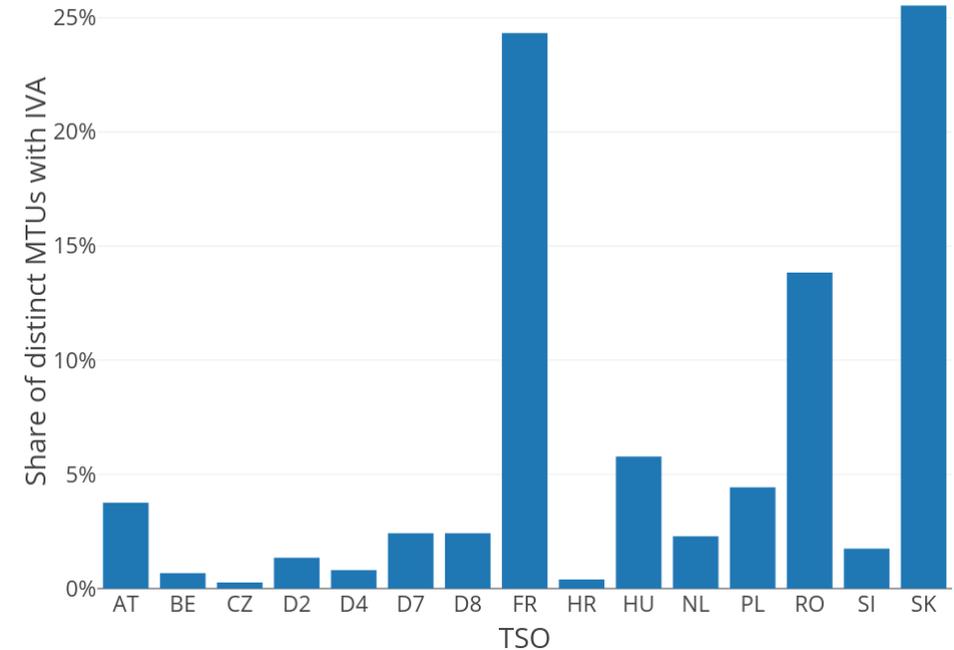
403

Share of distinct MTUs with IVA

54.2%

TSO	Share of distinct MTUs with IVA	Distinct MTUs with IVA
CZ	0.27%	2
SI	1.75%	13
AT	3.76%	28
D7	2.42%	18
D8	2.42%	18
D2	1.34%	10
PL	4.44%	33
D4	0.81%	6
SK	25.54%	190
HU	5.78%	43

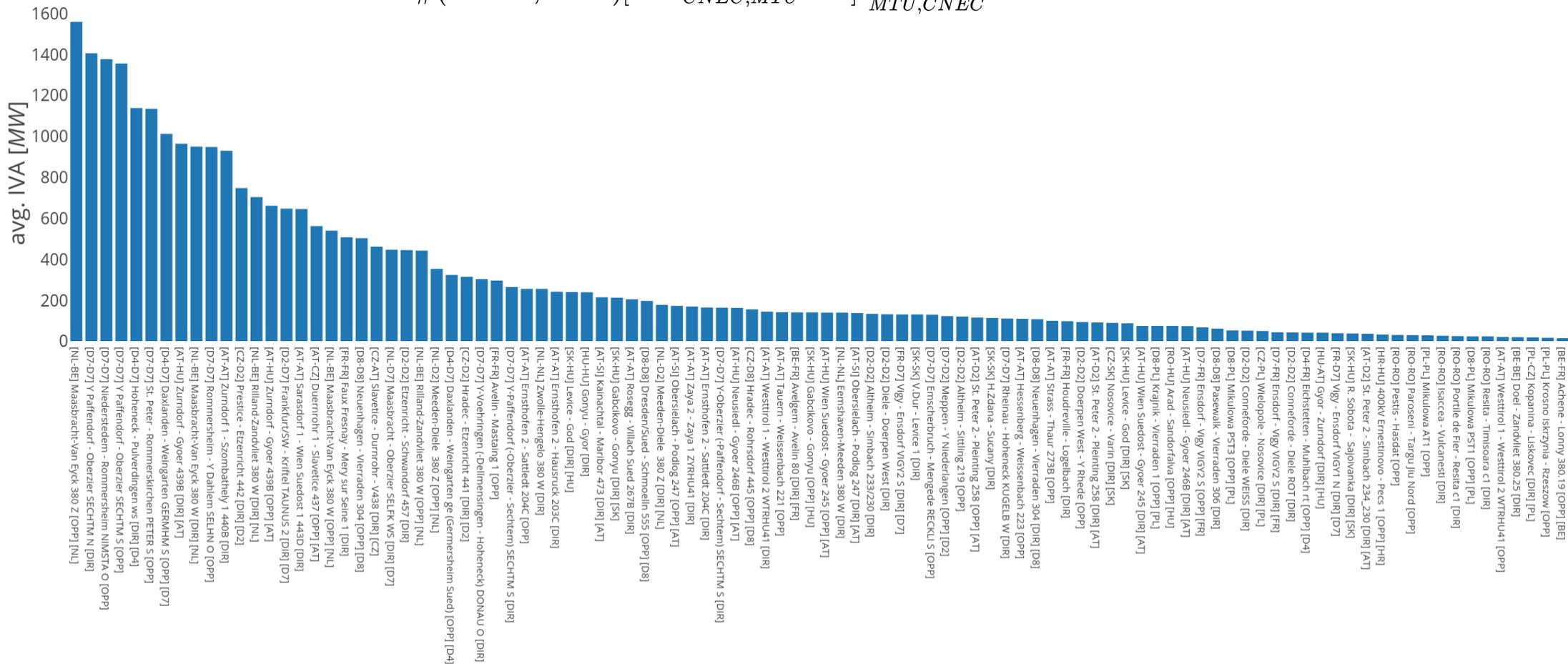
TSO	Share of distinct MTUs with IVA	Distinct MTUs with IVA
BE	0.67%	5
NL	2.28%	17
FR	24.33%	181
RO	13.84%	103
HR	0.40%	3



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



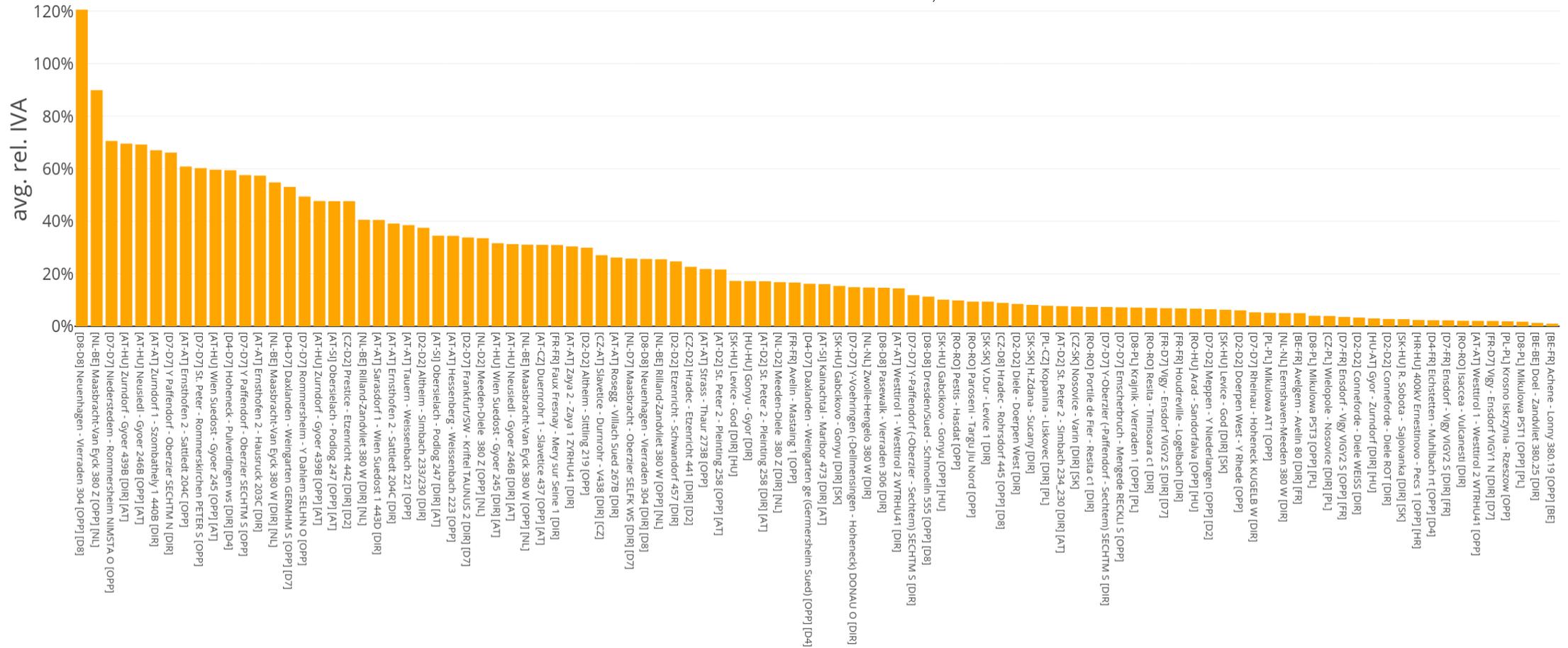
$$\text{avg. IVA}_{CNE} = \frac{1}{\#(CNEC, MTU)[IVA_{CNEC, MTU} > 0]} \sum_{MTU, CNEC} IVA_{CNEC, MTU} [IVA_{CNEC, MTU} > 0]$$



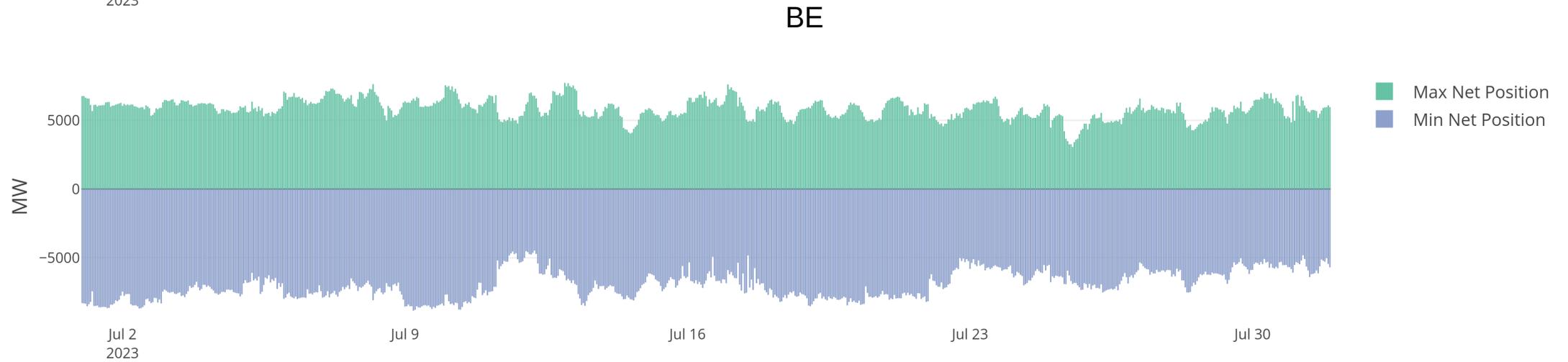
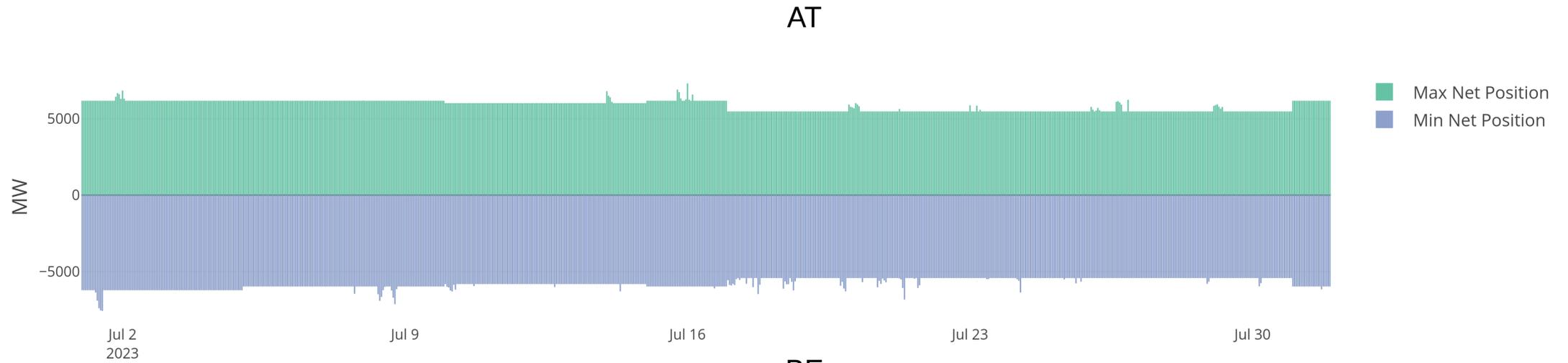
KPI 4b: Average relative IVA applied for each CNE affected by TSO intervention



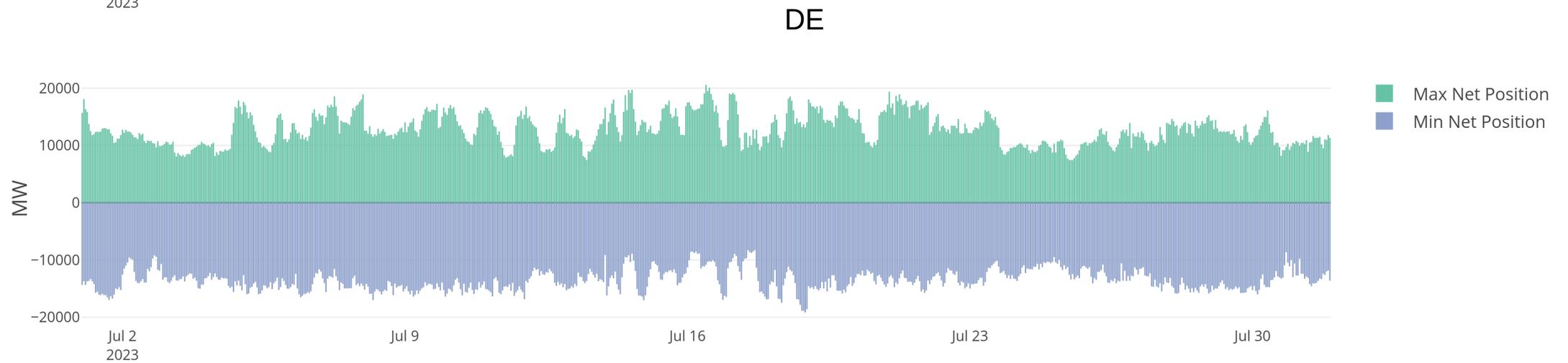
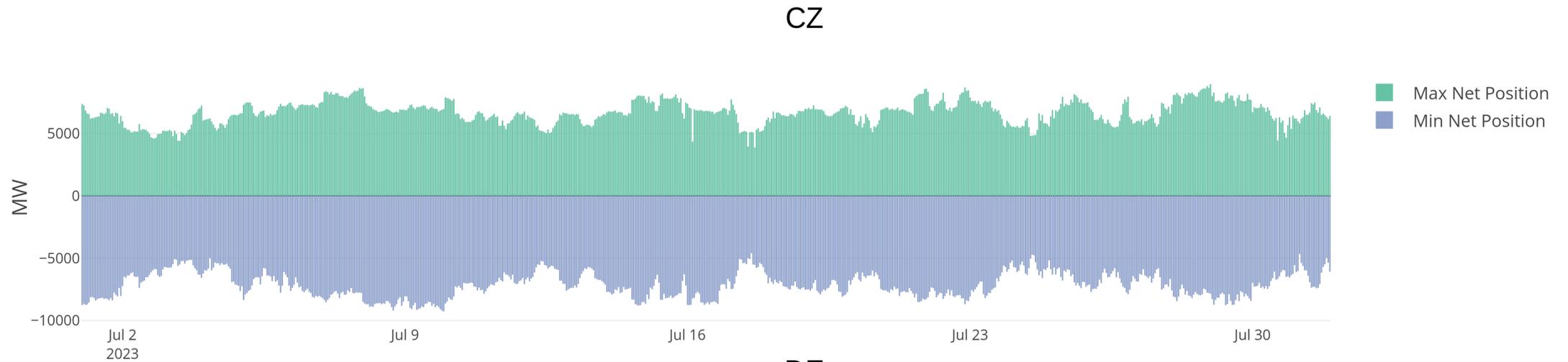
$$\text{avg. rel. IVA}_{CNE} = \frac{1}{\#(CNEC, MTU)[IVA_{CNEC, MTU} > 0]} \sum_{MTU, CNEC} \frac{IVA_{CNEC, MTU}[IVA_{CNEC, MTU} > 0]}{F_{max CNEC, MTU}[IVA_{CNEC, MTU} > 0]}$$



KPI 5: Min & max net positions per BZ hub



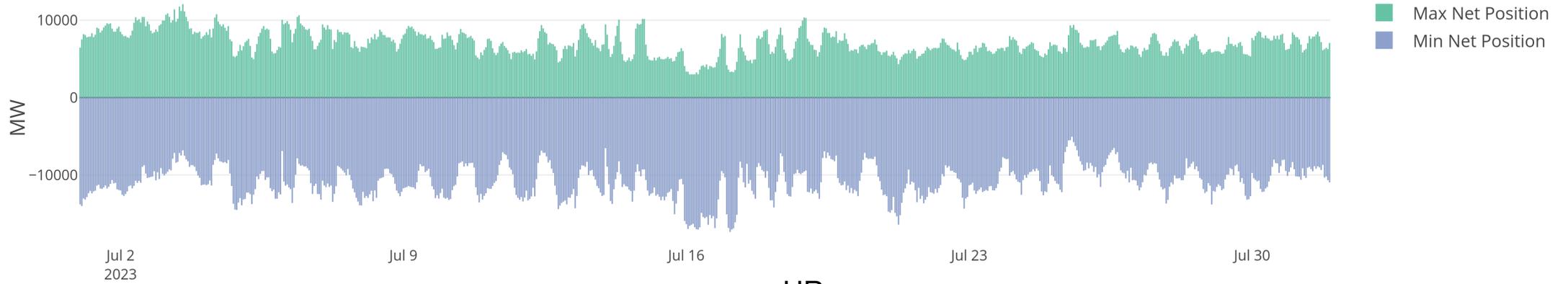
KPI 5: Min & max net positions per BZ hub



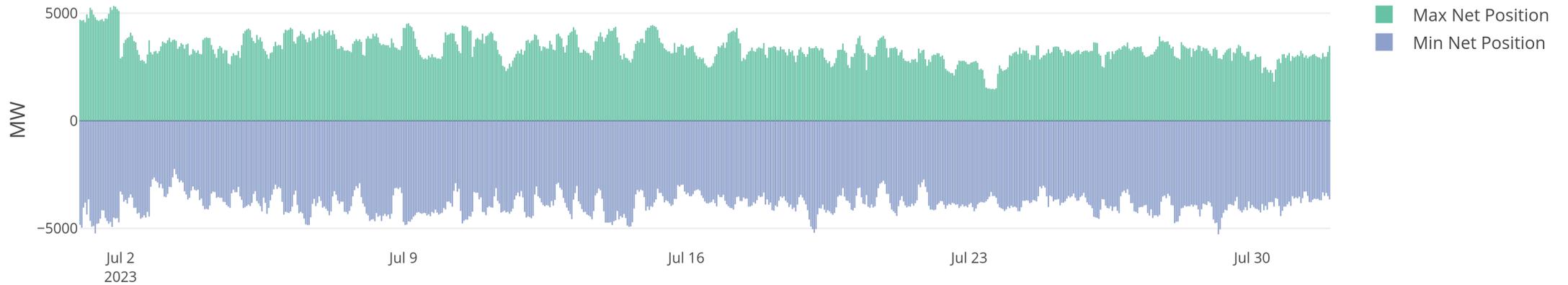
KPI 5: Min & max net positions per BZ hub



FR



HR



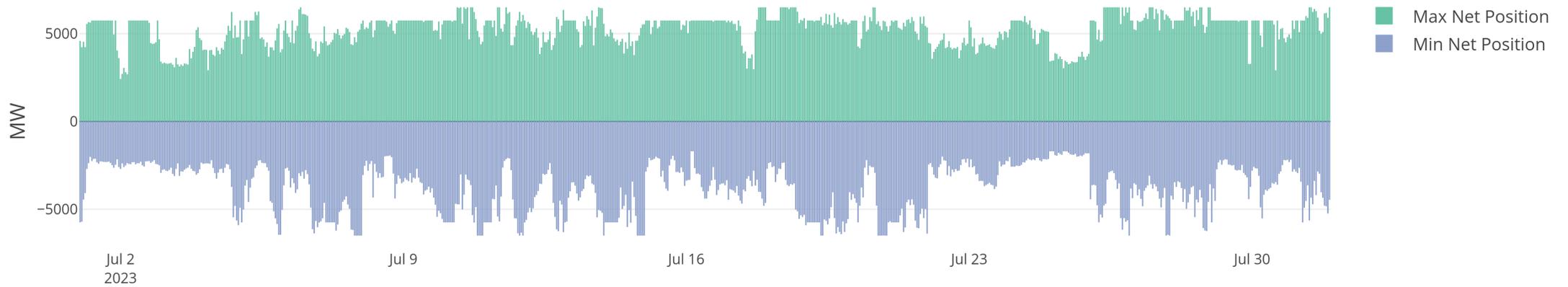
KPI 5: Min & max net positions per BZ hub



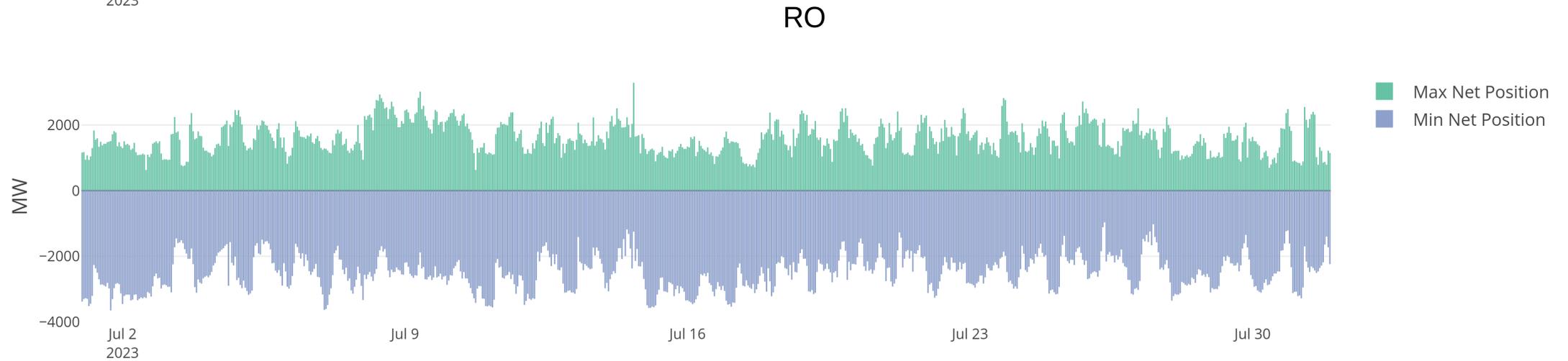
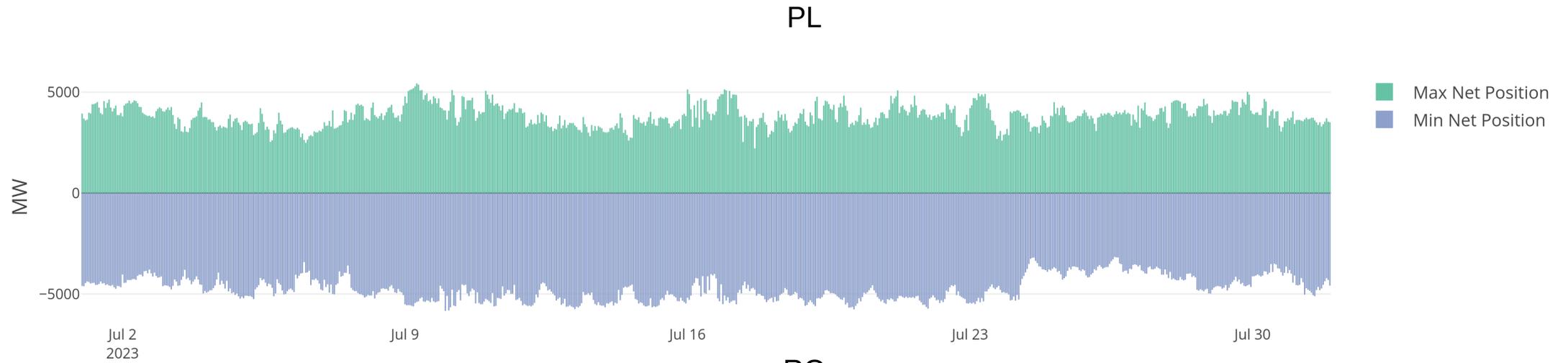
HU



NL



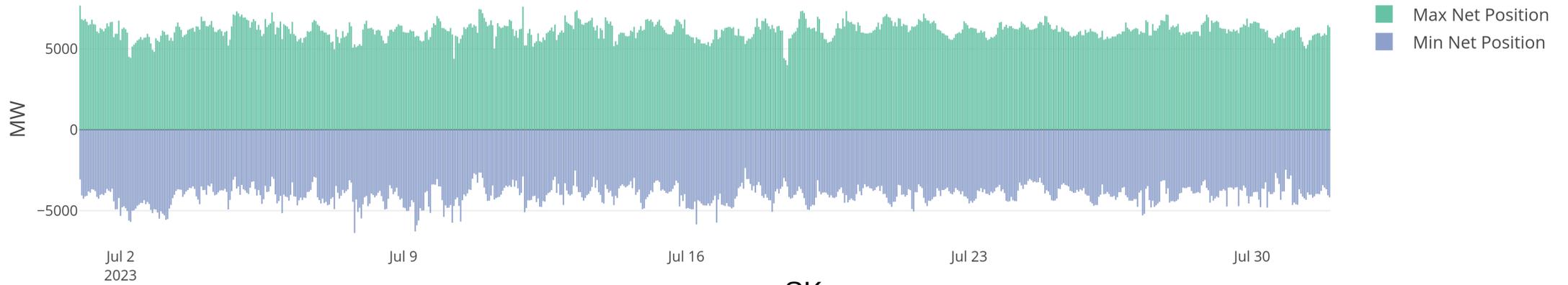
KPI 5: Min & max net positions per BZ hub



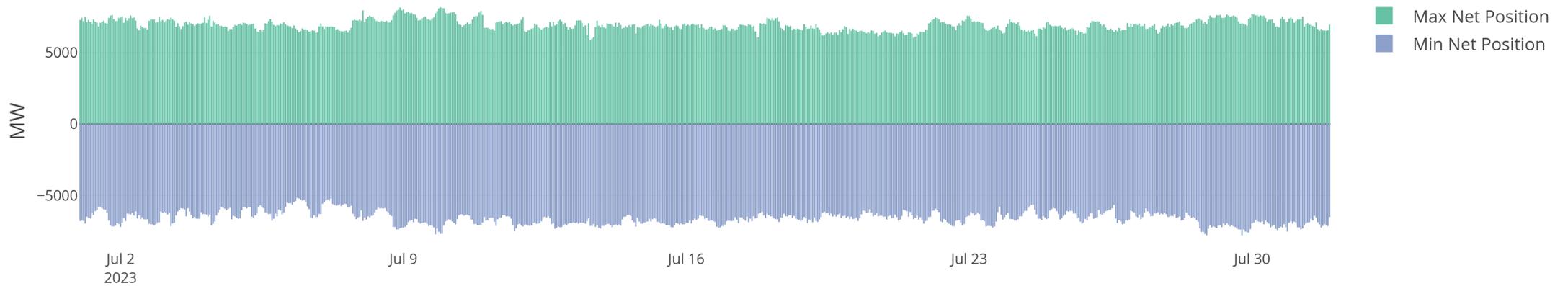
KPI 5: Min & max net positions per BZ hub



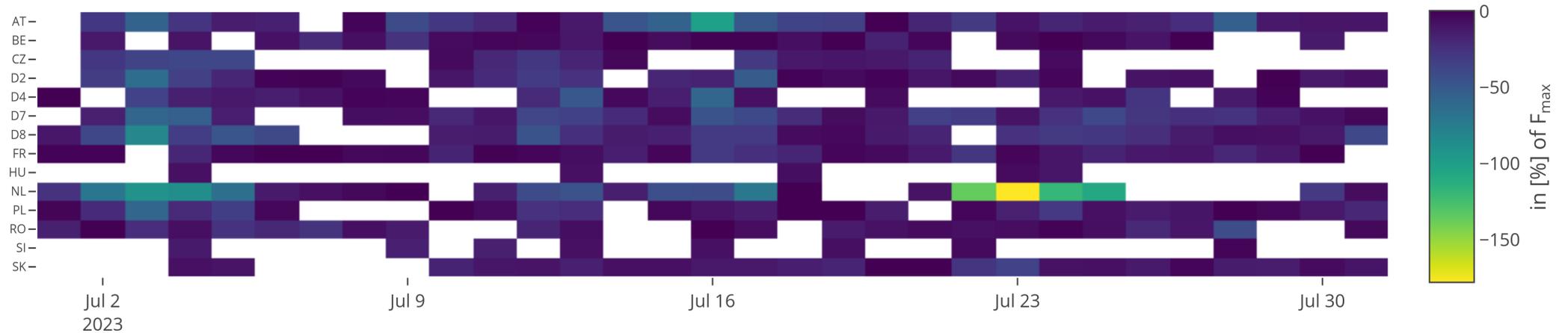
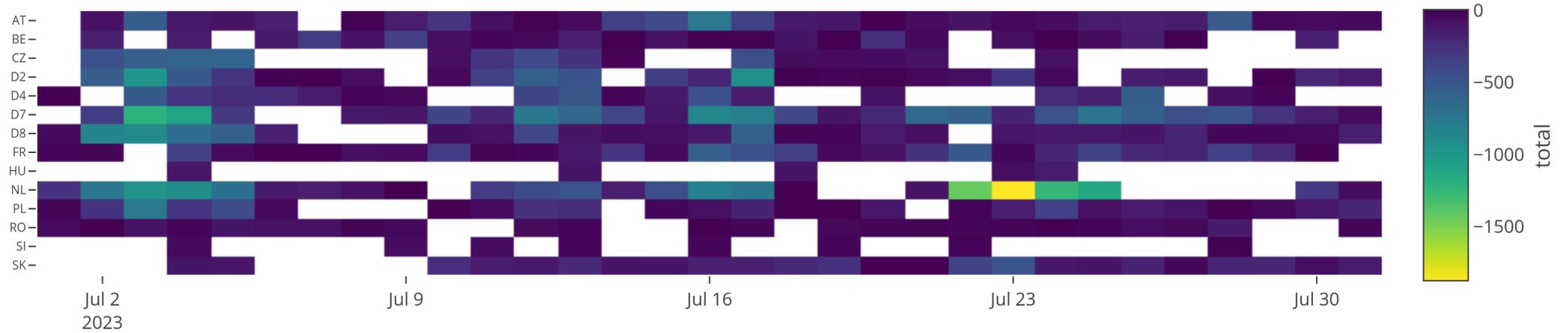
SI



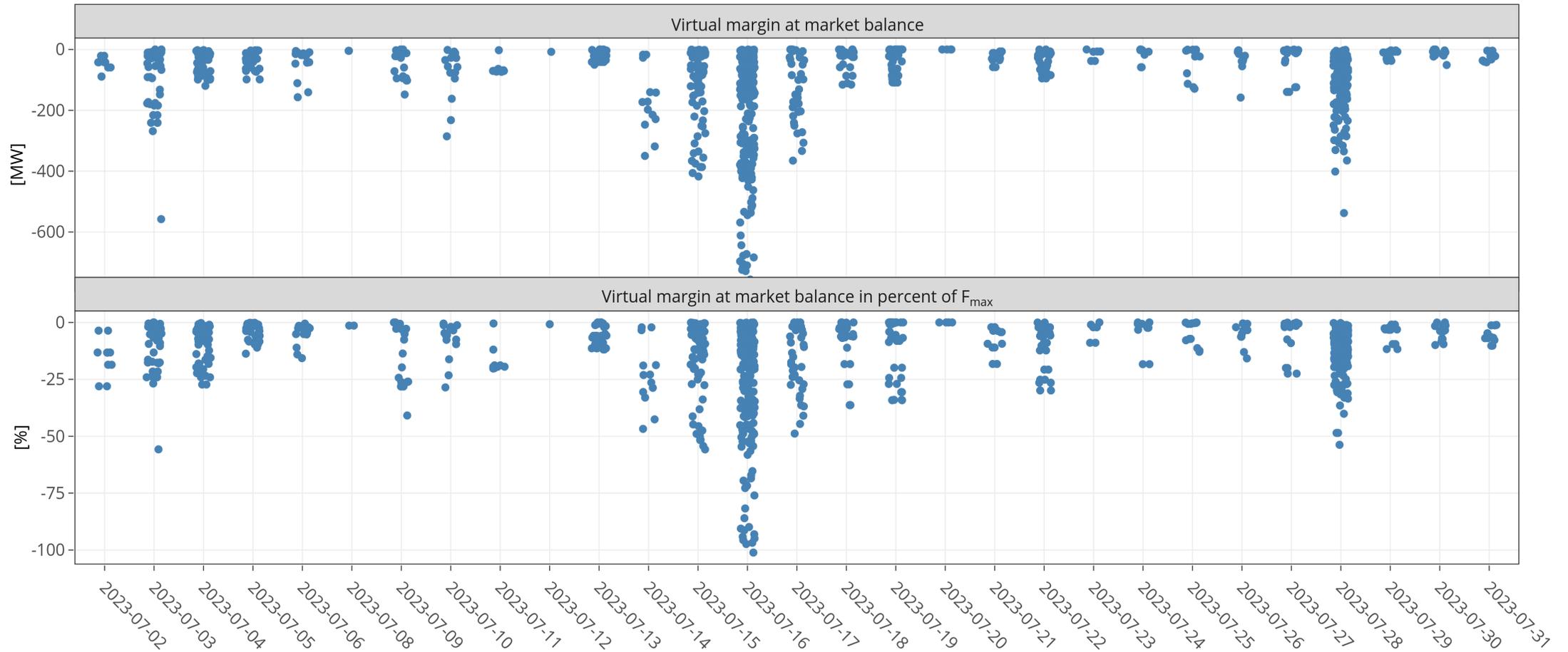
SK



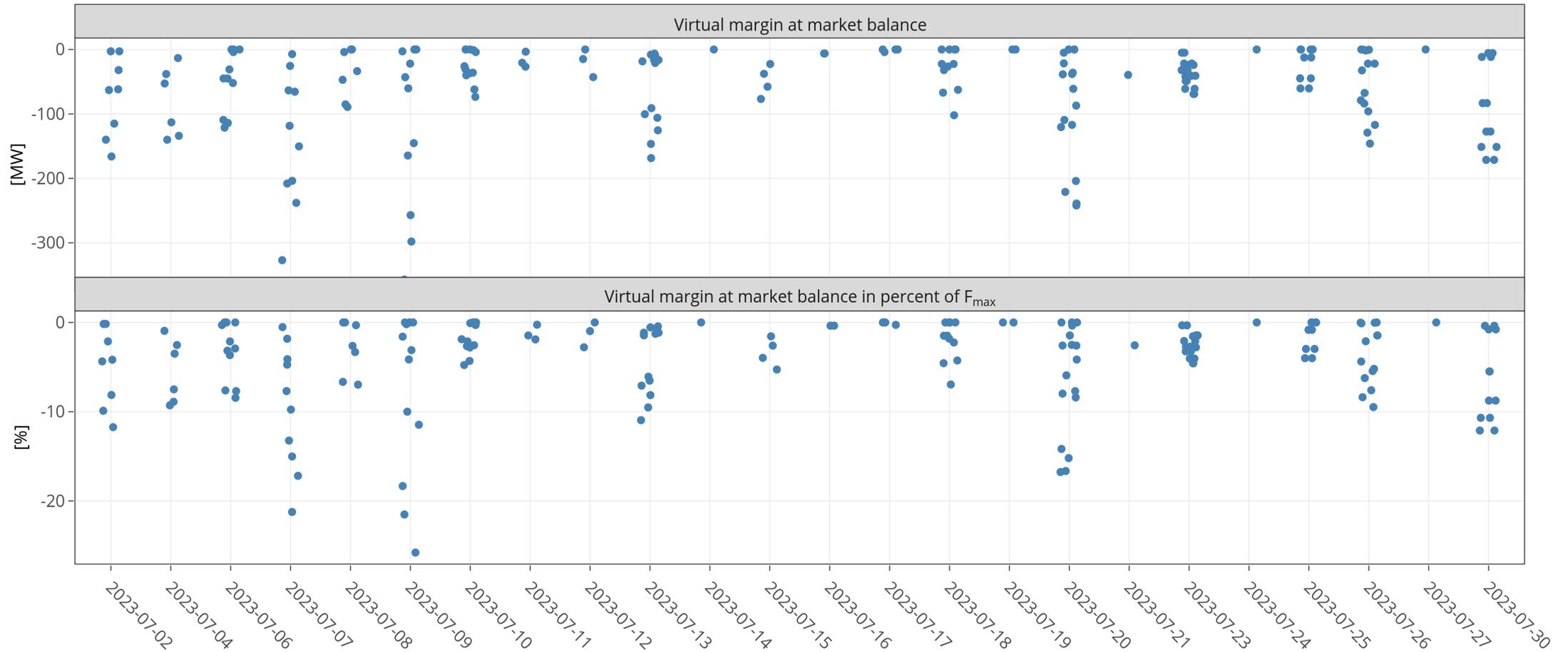
KPI 6a: Highest virtual margins at market balance for CORE TSOs



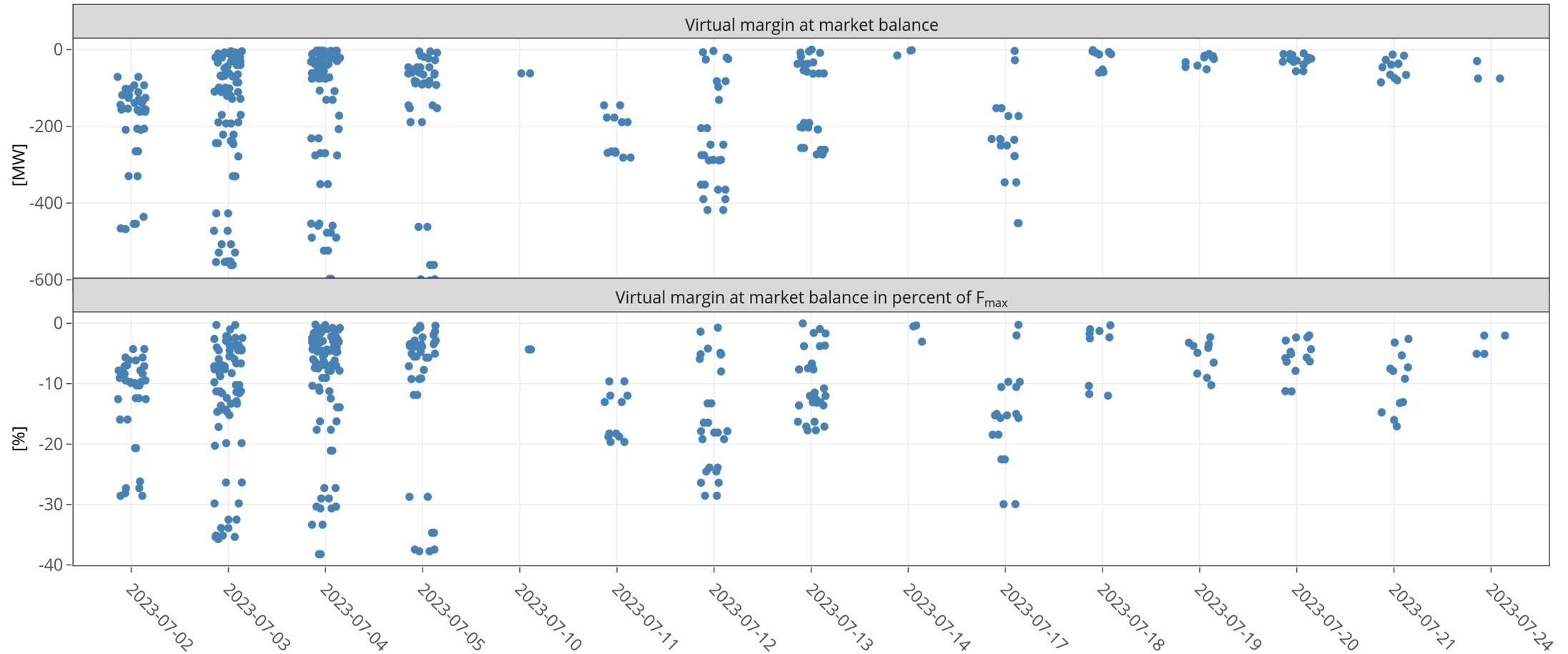
KPI 6b: Virtual margins at market balance AT



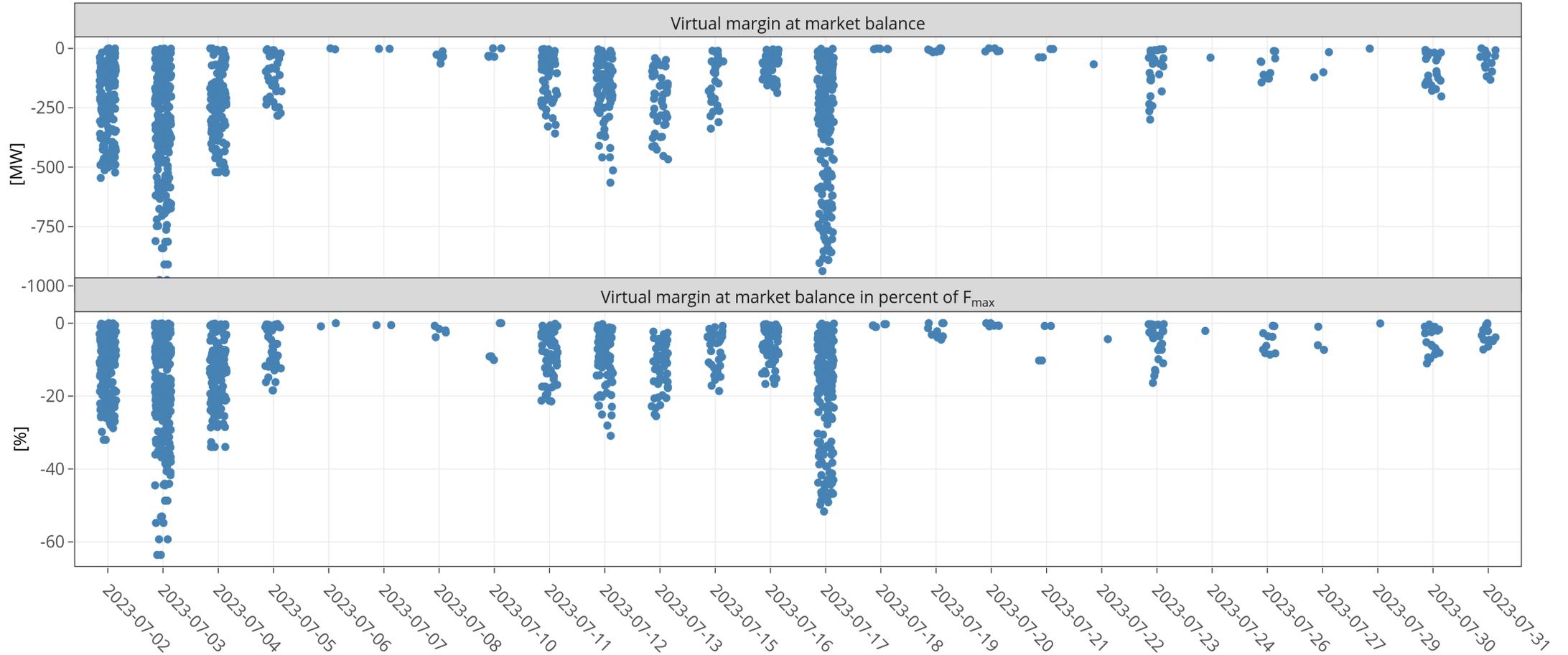
KPI 6b: Virtual margins at market balance BE



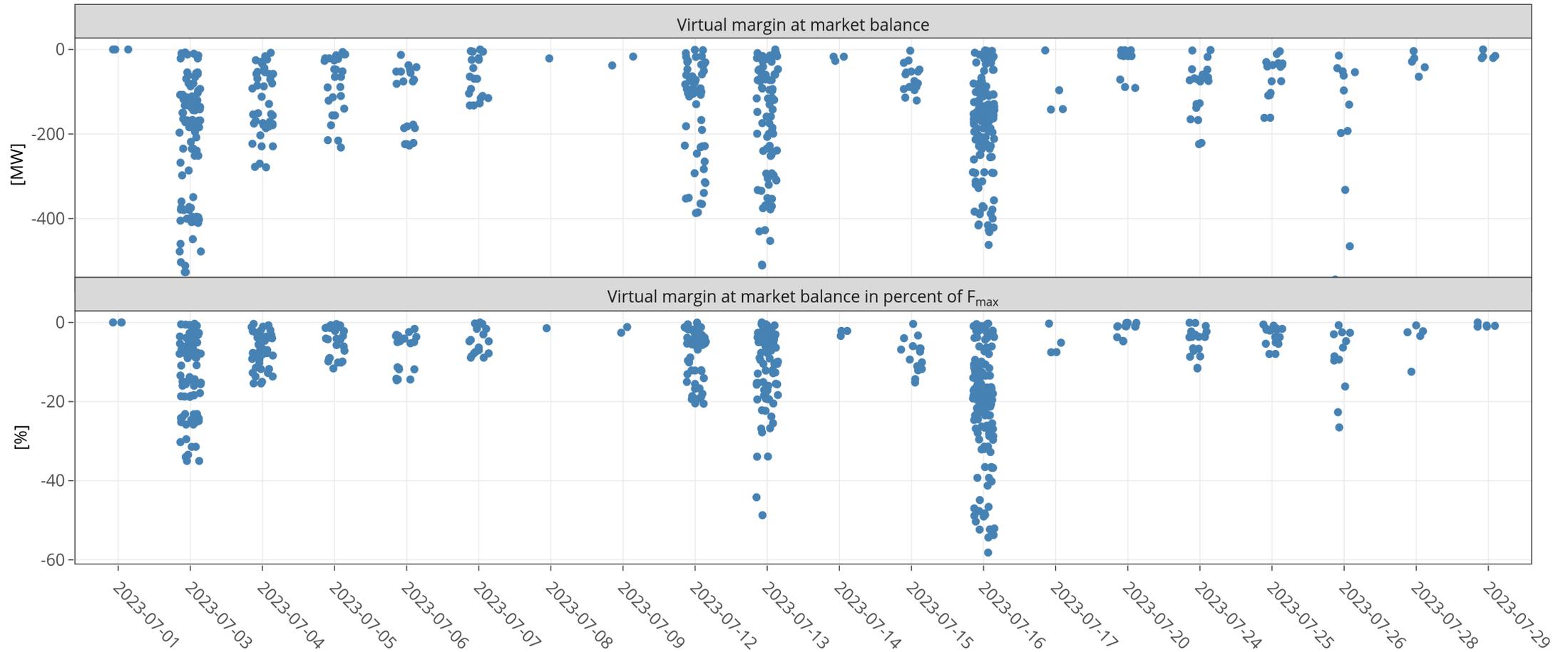
KPI 6b: Virtual margins at market balance CZ



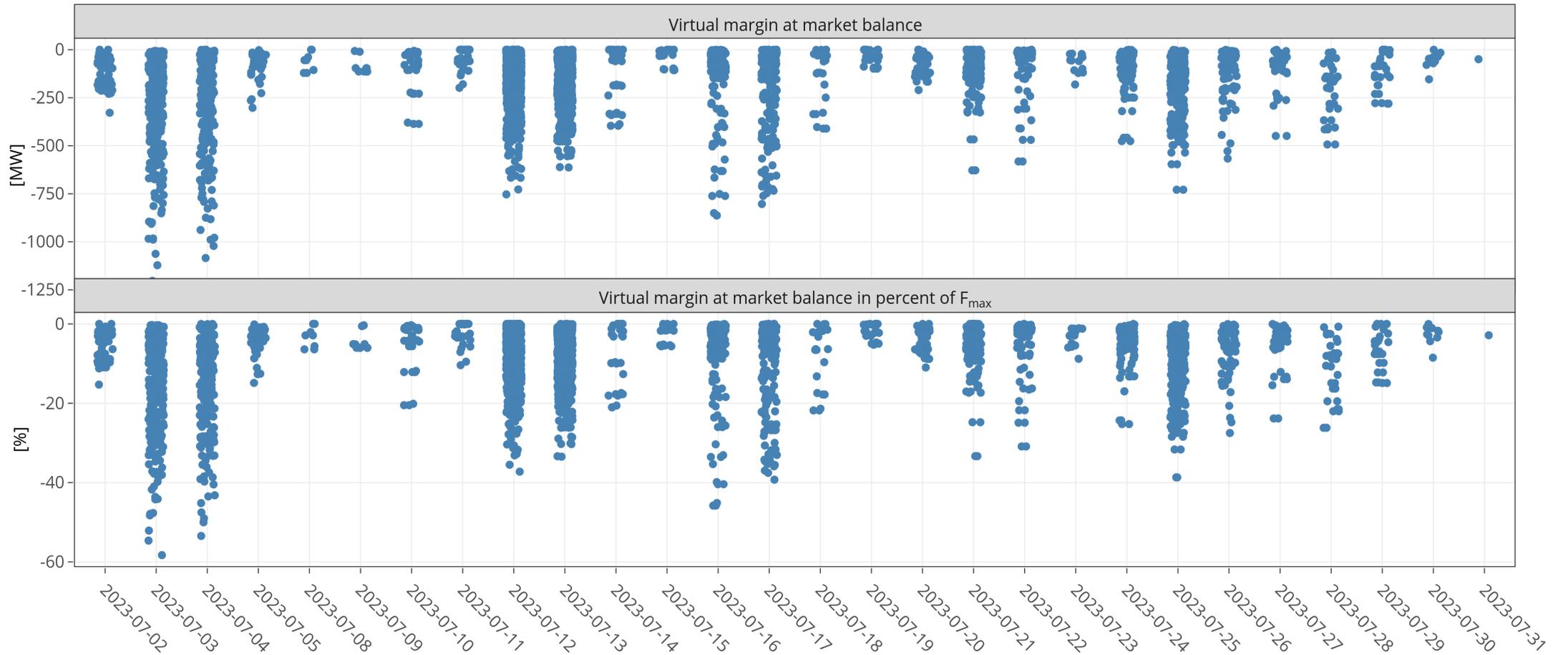
KPI 6b: Virtual margins at market balance D2



KPI 6b: Virtual margins at market balance D4



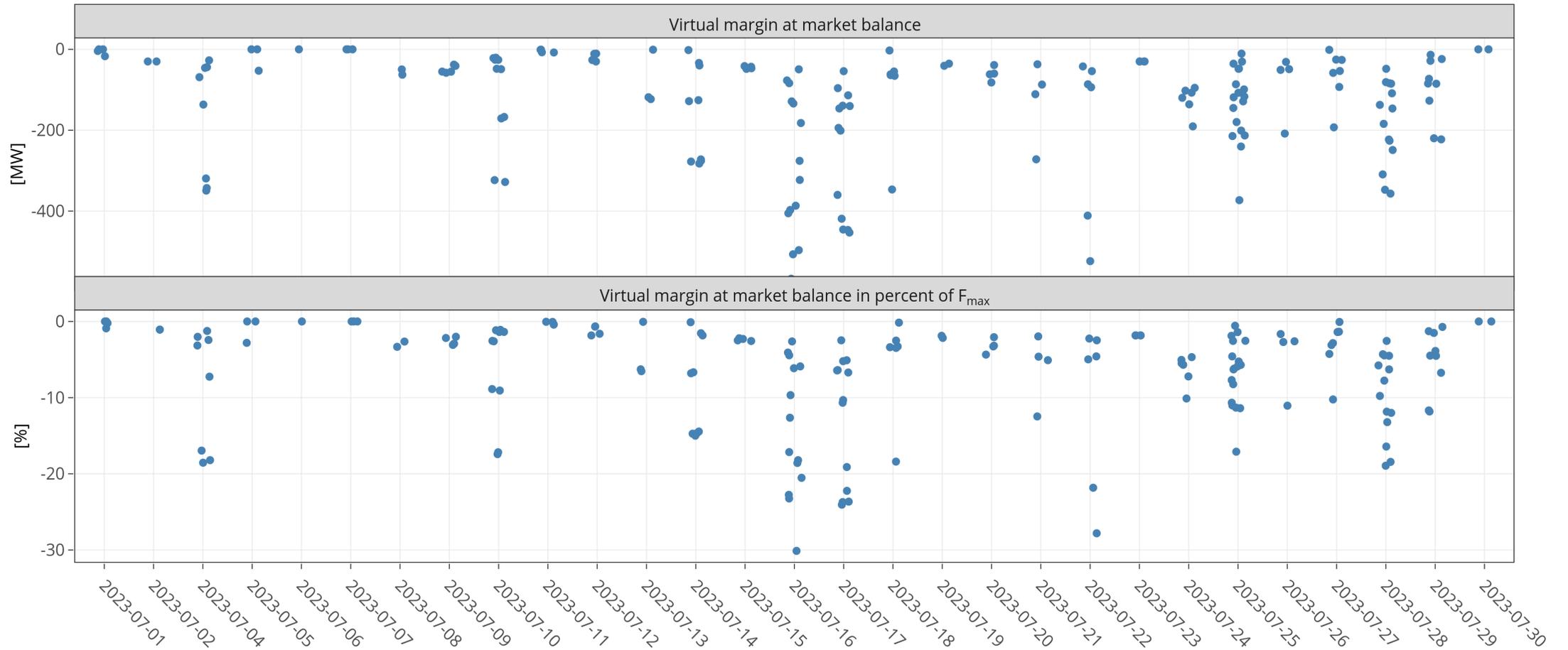
KPI 6b: Virtual margins at market balance D7



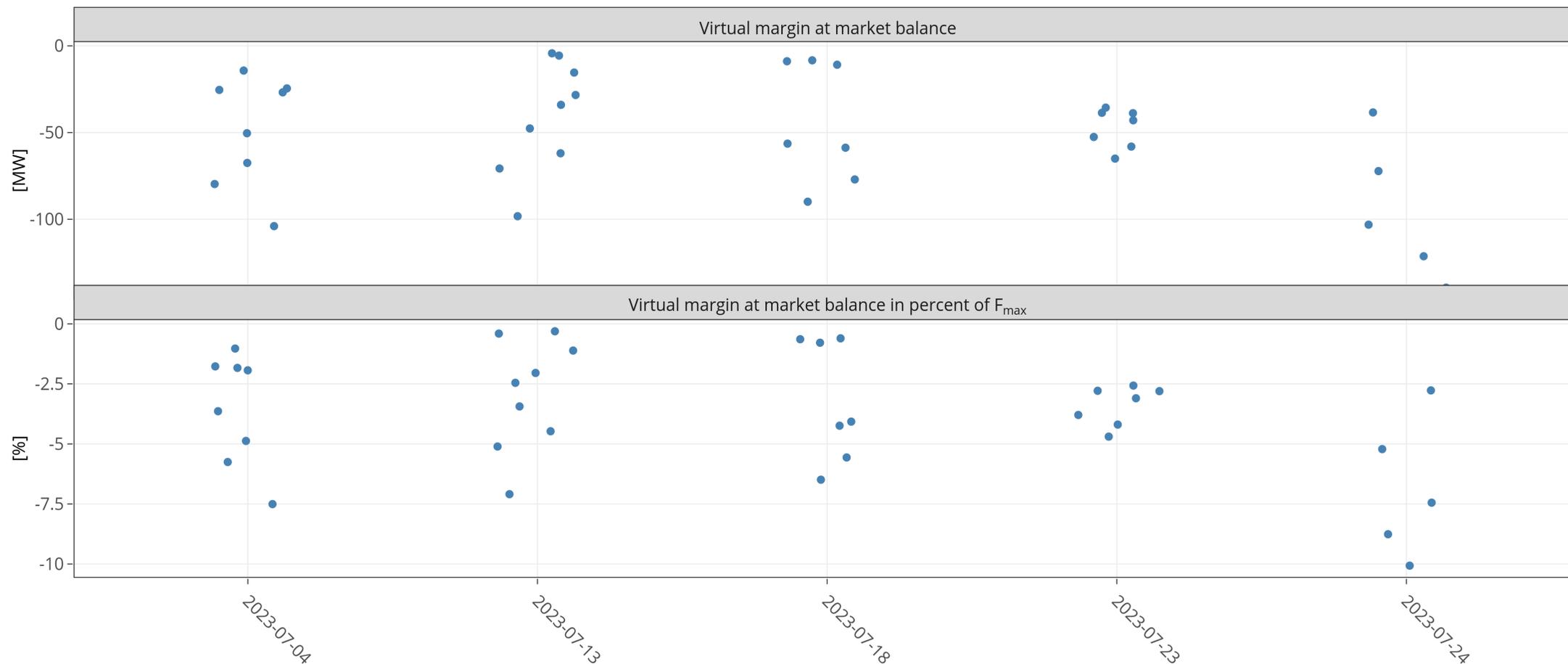
KPI 6b: Virtual margins at market balance D8



KPI 6b: Virtual margins at market balance FR



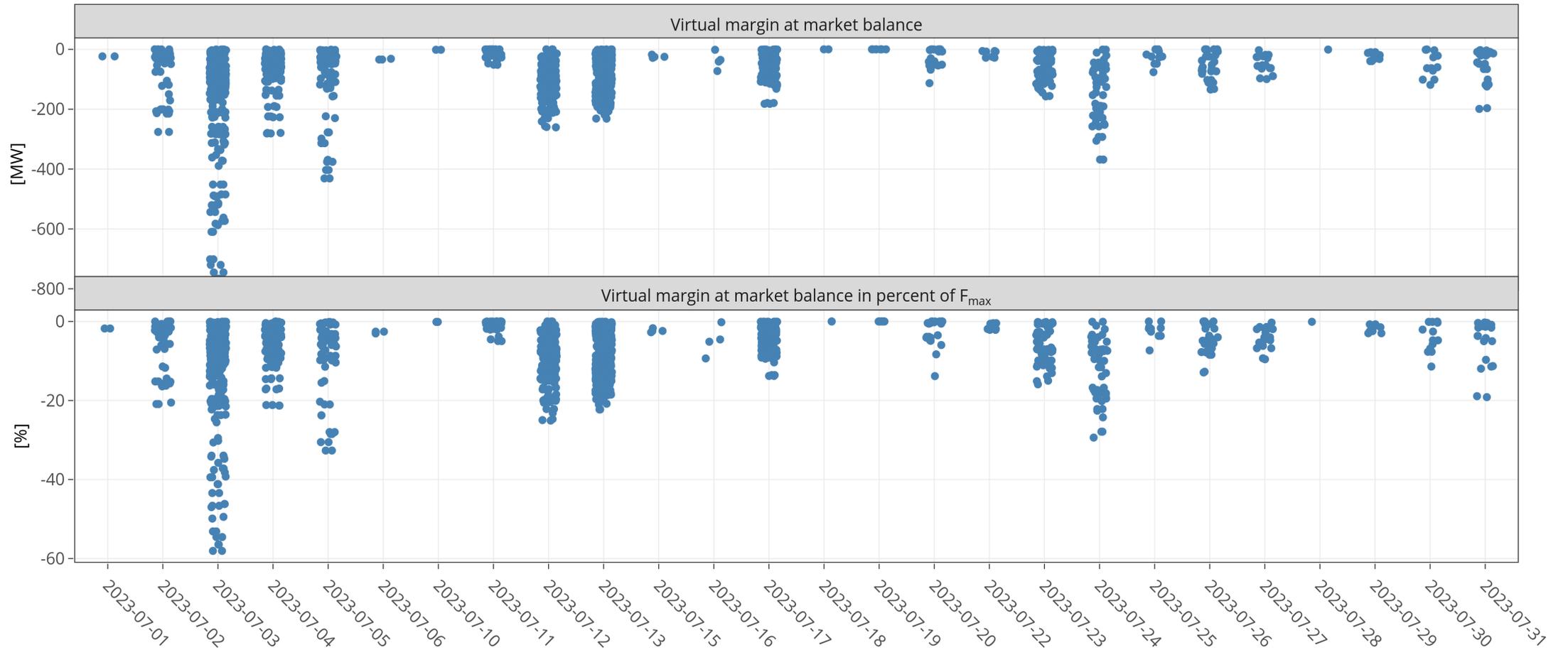
KPI 6b: Virtual margins at market balance HU



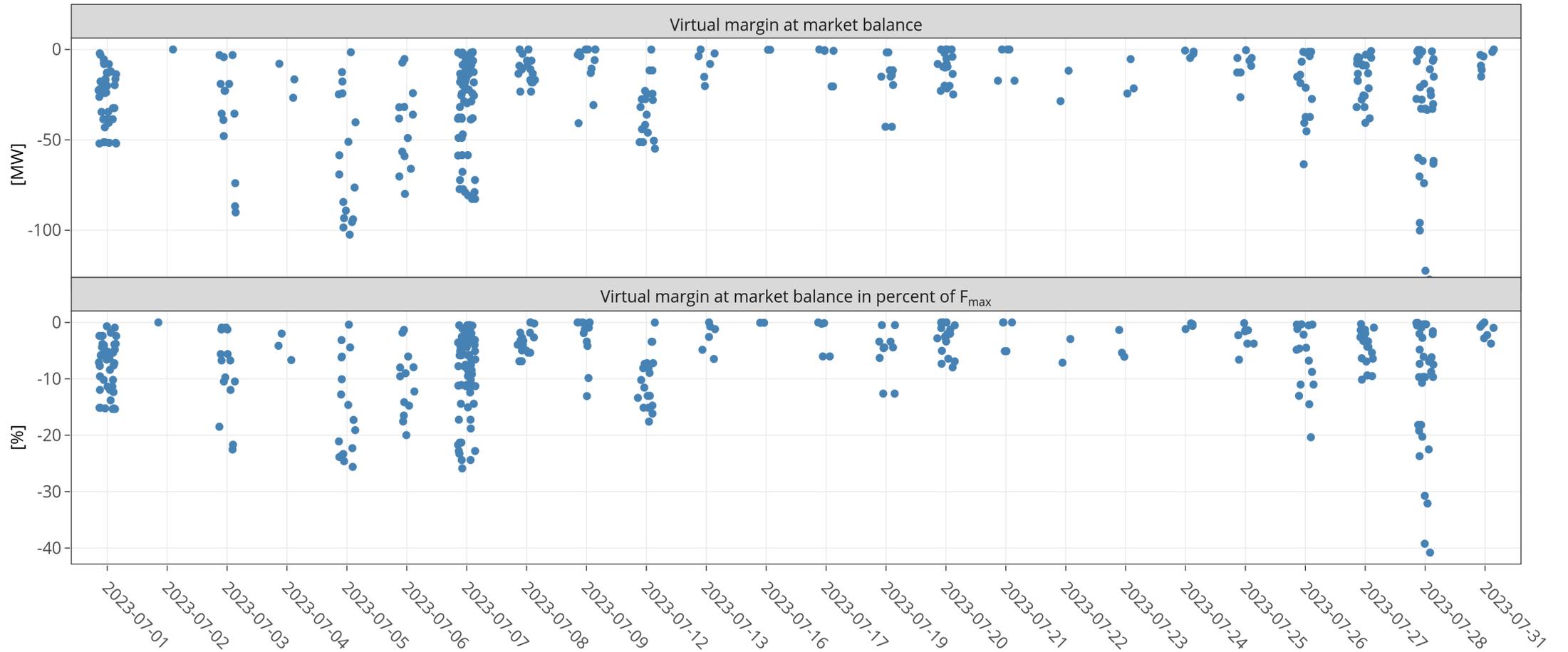
KPI 6b: Virtual margins at market balance NL



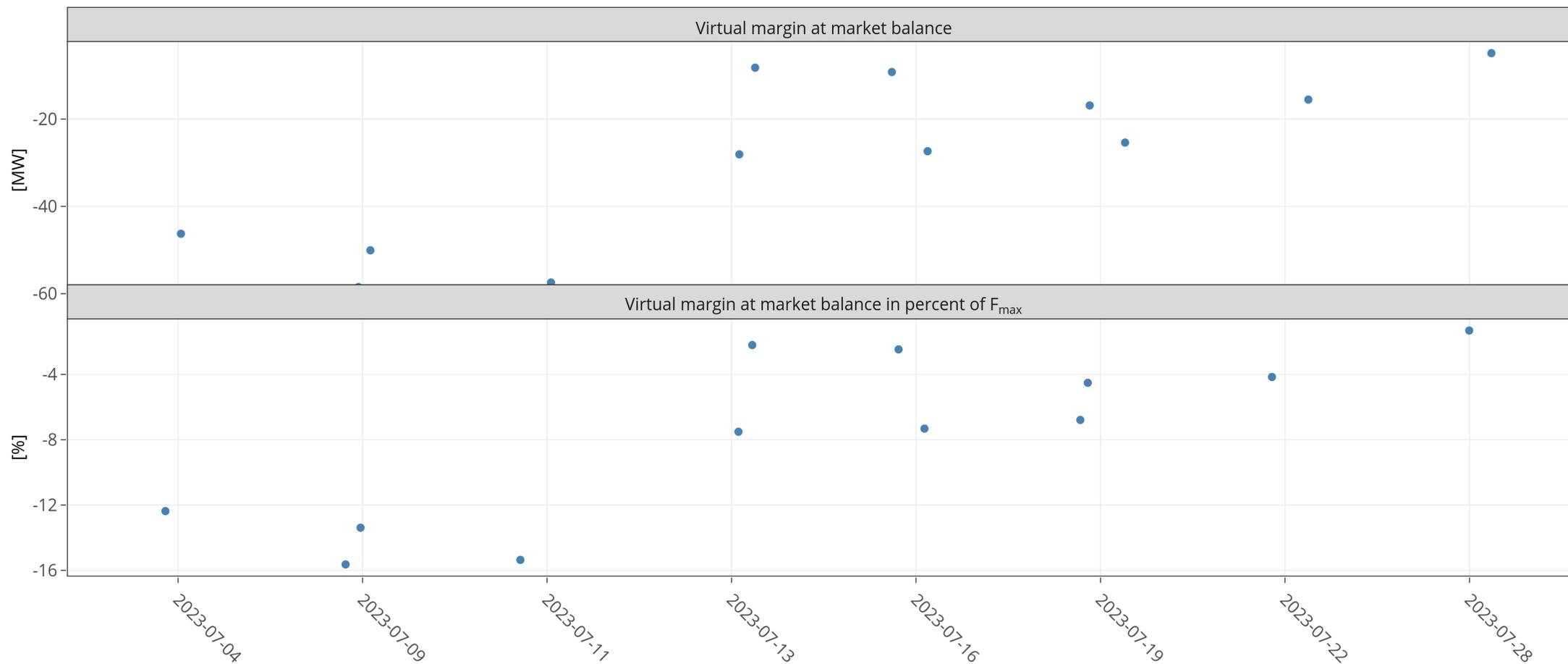
KPI 6b: Virtual margins at market balance PL



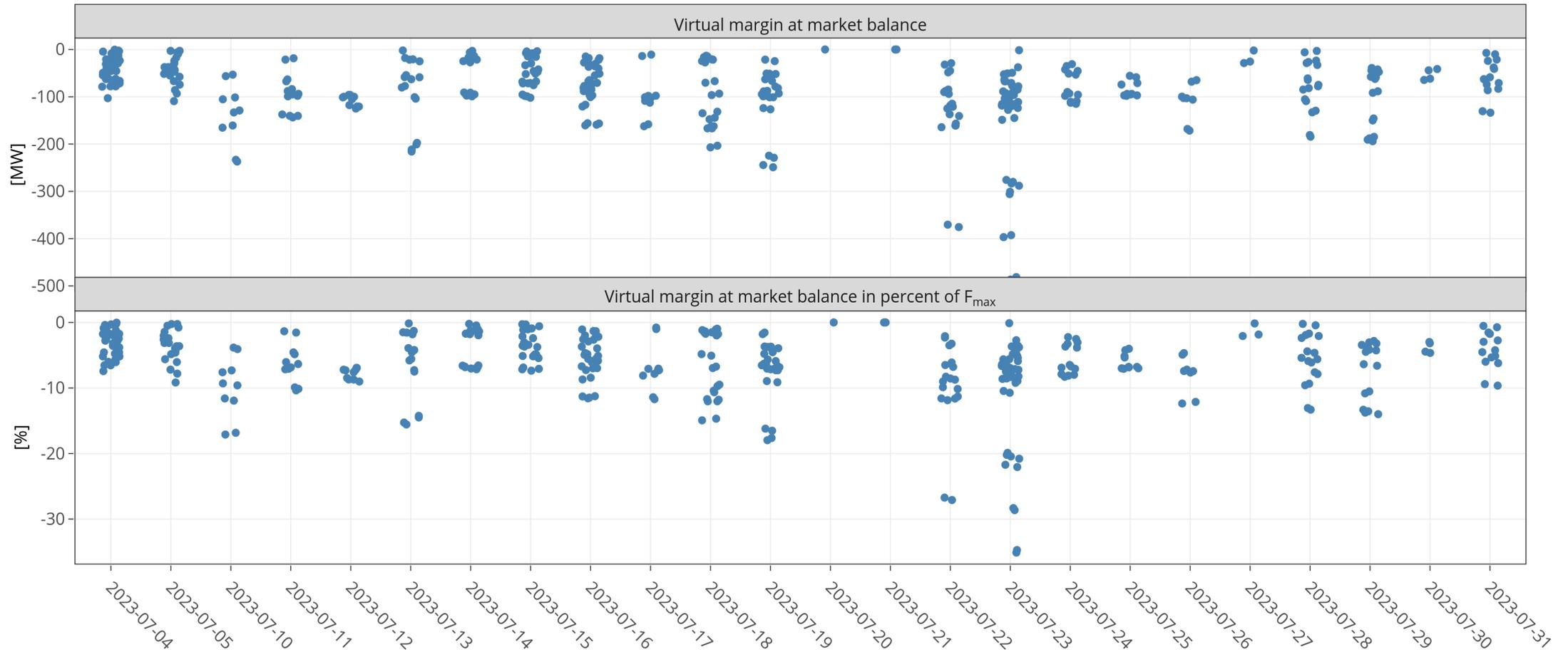
KPI 6b: Virtual margins at market balance RO



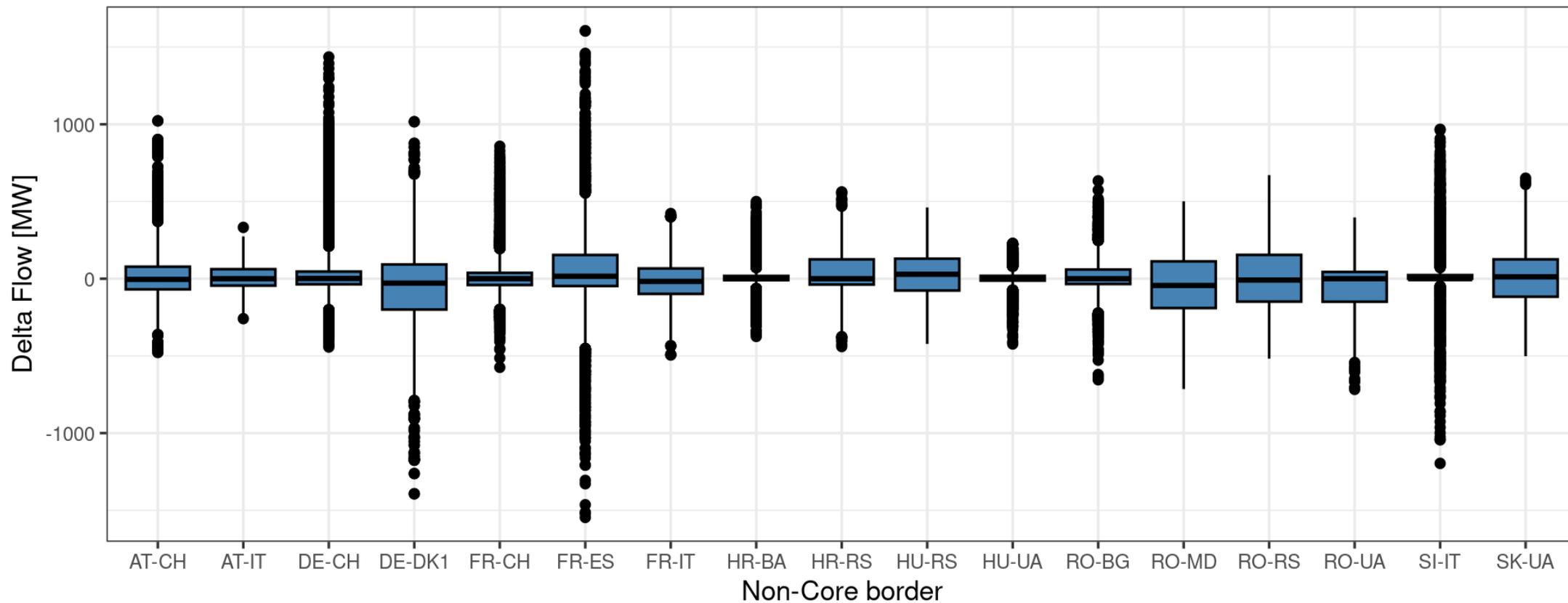
KPI 6b: Virtual margins at market balance SI



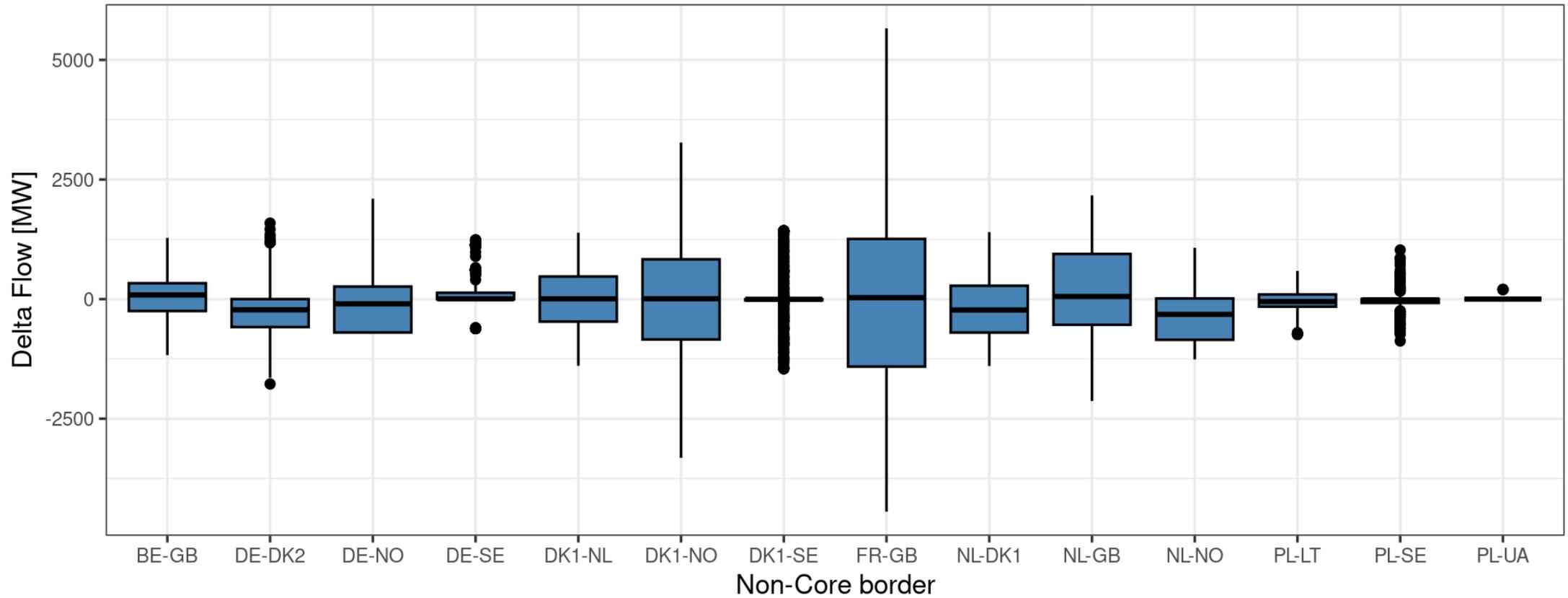
KPI 6b: Virtual margins at market balance SK



KPI 7: Non-Core exchanges AC delta flow



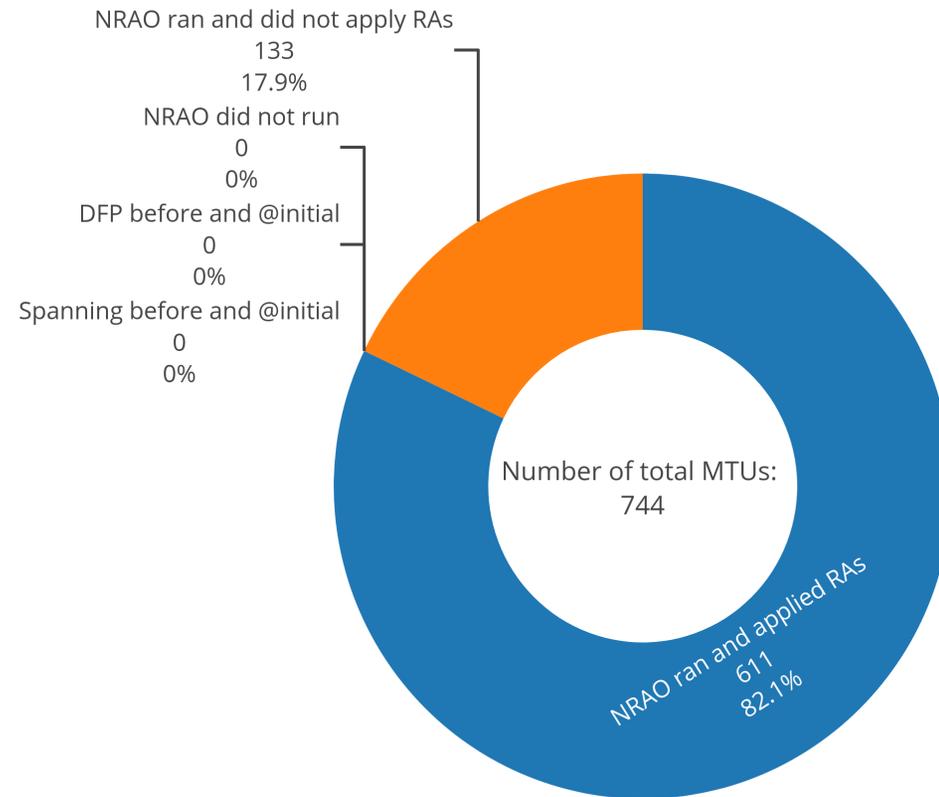
KPI 7: Non-Core exchanges DC delta flow



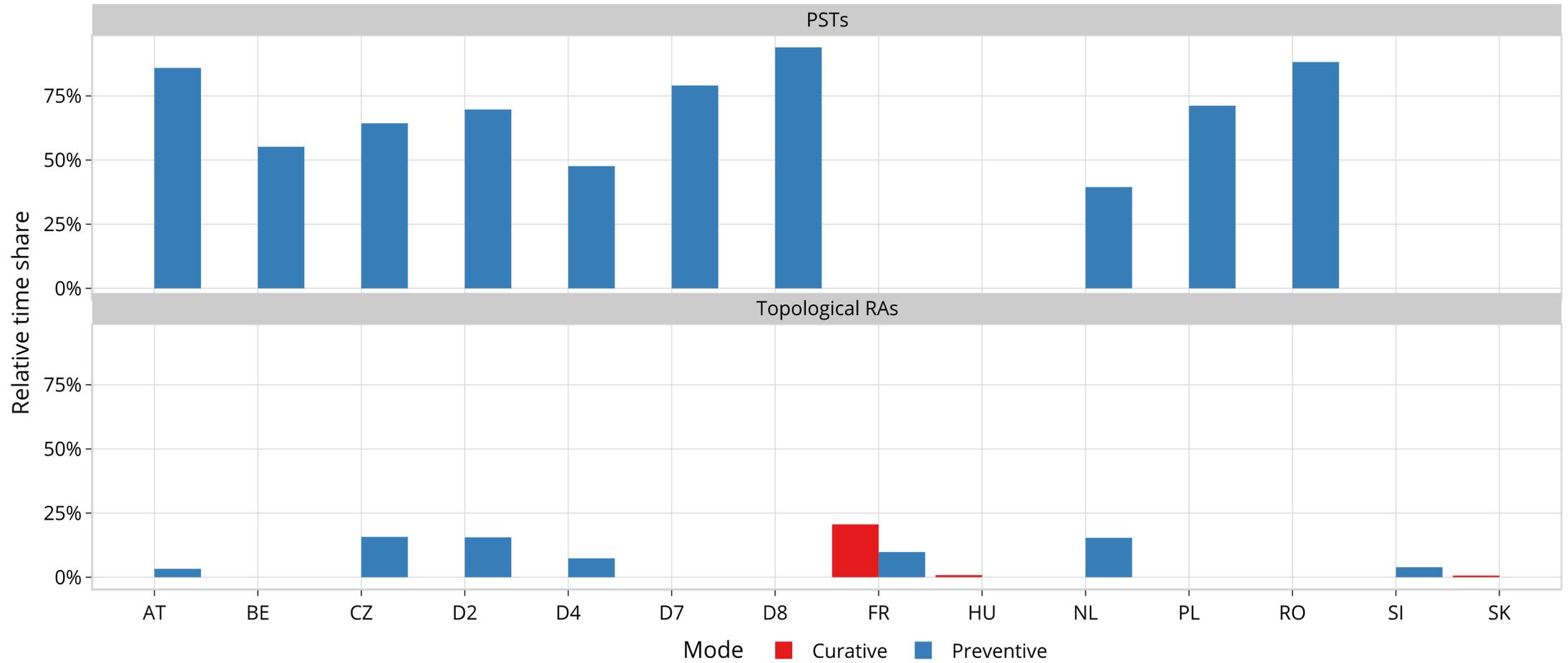
KPI 8: NRAO – Applied Remedial Action



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

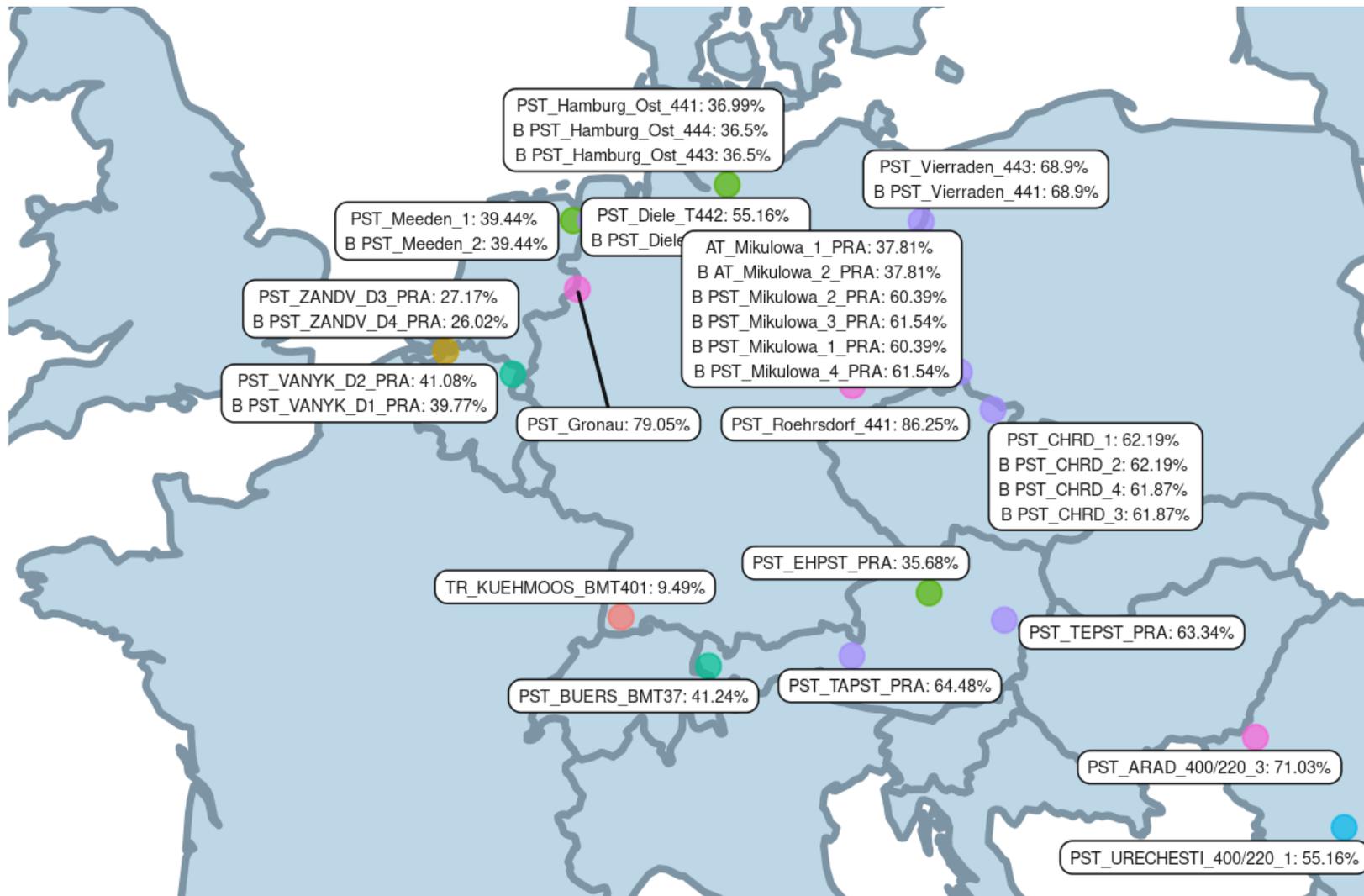


KPI 8: Relative Time Share of Applied RAs, by TSO, Type and Mode



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

Relative Time Share of Applied PSTs in Preventive Mode



Relative Time Share [%]

- 0%-10%
- 20%-30%
- 30%-40%
- 40%-50%
- 50%-60%
- 60%-70%
- 80%-90%

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

Relative Time Share of Applied PSTs in Curative Mode



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

Relative Time Share of Applied Topological RAs in Preventive Mode



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

Relative Time Share of Applied Topological RAs in Curative Mode

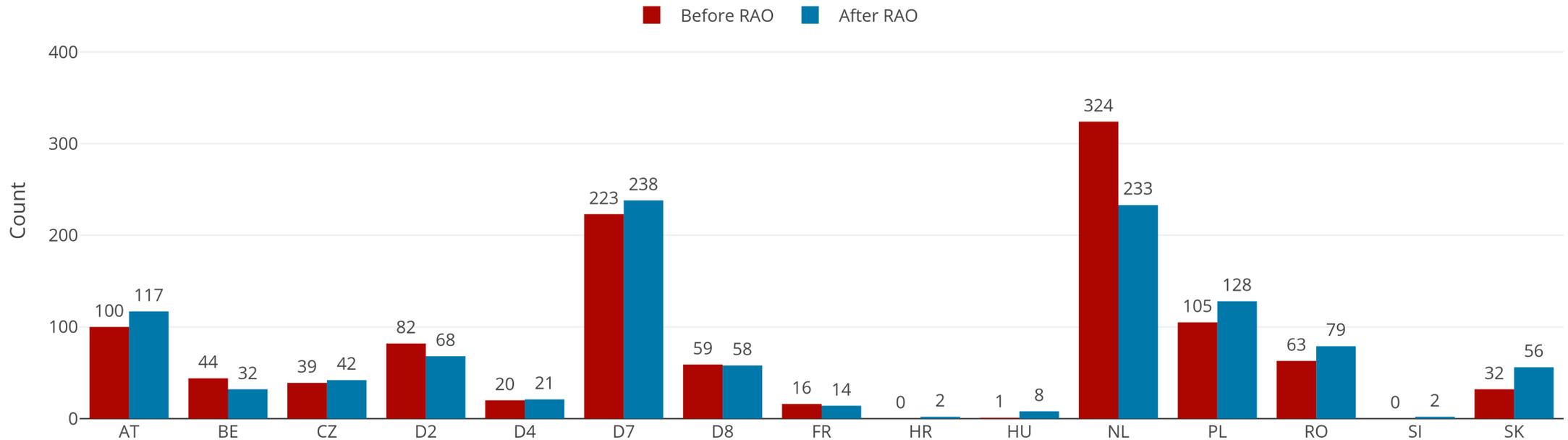


KPI 9: Most limiting CNEC per TSO (NRAO)



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.

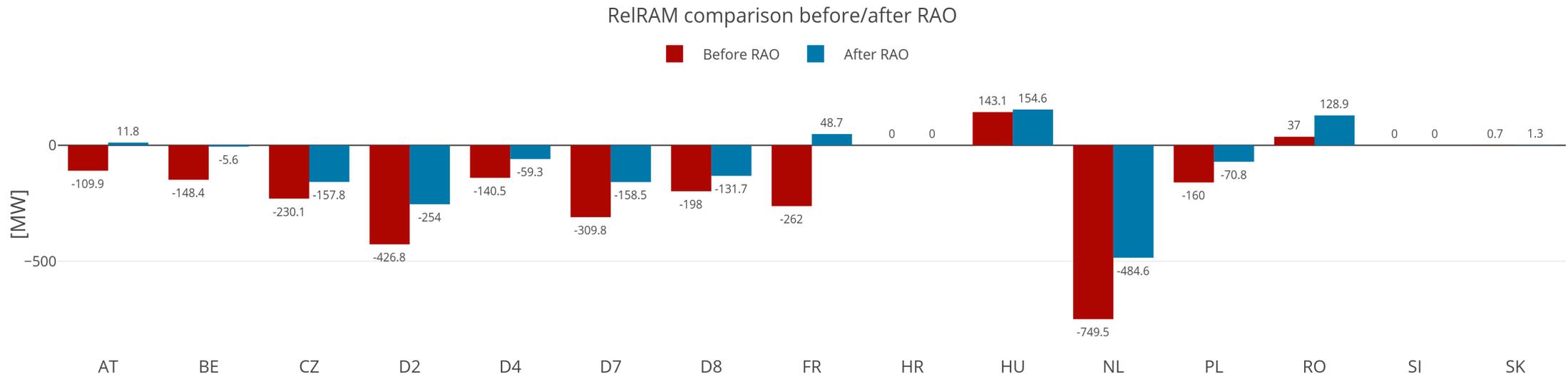
KPI 10: Average variation of relative RAM before and after NRAO



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
[SK-CZ] Krizovany - Sokolnice [OPP] [SK]	744	744	95.49%	81.53%	116.45%	0.3435	1.3606
[HR-SI] 220kV Pehlin - Divaca [OPP] [HR]	744	1113	106.29%	75.67%	144.39%	0.1974	0.4725
[HU-HU] Gonyu - Gyor [DIR]	743	2145	64.39%	9.96%	97.62%	0.2922	1.4274
[HR-SI] 220kV Pehlin - Divaca [DIR] [HR]	743	743	67.53%	36.36%	105.08%	0.1974	0.4725
[CZ-SK] Sokolnice - Stupava [DIR] [SK]	738	738	79.34%	65.30%	92.14%	0.3316	1.312
[SI-HU] Cirkovce - Heviz [OPP] [HU]	737	737	71.42%	49.37%	99.01%	0.2818	1.269
[SI-HU] Cirkovce - Heviz [DIR] [HU]	736	736	105.80%	78.52%	140.16%	0.2818	1.269
[SK-UA] V.Kapusany - Mukachevo (WPS) [OPP] [SK]	730	730	100.81%	76.93%	149.08%	0.2604	0.9365
[PL-PL] Krosno Iskrzynia - Rzeszow [OPP]	712	712	51.33%	31.66%	78.21%	0.334	1.1319
[AT-SI] Obersielach - Podlog 247 [DIR] [AT]	712	1829	56.55%	20.99%	126.24%	0.2615	0.9523
[AT-SI] Obersielach - Podlog 247 [OPP] [AT]	697	1393	121.81%	27.07%	198.62%	0.2615	0.9523
[NL-D2] Meeden-Diele 380 Z [OPP] [NL]	694	785	48.78%	19.94%	158.59%	0.2911	0.6879
[SK-UA] V.Kapusany - Mukachevo (WPS) [DIR] [SK]	692	692	78.85%	31.07%	103.22%	0.2604	0.9365
[SK-HU] Gabcikovo - Gonyu [OPP] [HU]	691	1454	94.76%	61.30%	148.59%	0.389	1.3162
[AT-HU] Neusiedl - Gyoer 246B [OPP] [AT]	669	669	98.22%	21.37%	125.21%	0.0931	0.3633
[AT-AT] Westtirol 1 - Westtirol 2 WTRHU41 [OPP]	664	1509	57.27%	19.90%	157.00%	0.292	1.2573
[HR-BA] 220kV Zakucac - Mostar [DIR] [HR]	640	640	85.40%	27.30%	129.93%	0.1066	0.2428
[SK-SK] V.Dur - Levice 1 [DIR]	630	630	45.10%	5.27%	72.73%	0.2847	1.1941
[HU-HU] Gonyu - Gyor [OPP]	630	1059	117.76%	81.81%	151.70%	0.2922	1.4274
[CZ-SK] Nosovice - Varin [OPP] [SK]	627	2121	111.99%	83.14%	148.91%	0.3335	1.1344

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 CNEs with shadow price	Max shadow price [€/MW]	Avg RAM/Fmax	Min RAM/Fmax	Max RAM/Fmax	Max z2zPTDF
[FR-D7] Vigy - Ensdorf VIGY2 S [DIR] [D7]	169	169	236.7	26.82%	19.85%	76.49%	0.2362
[D8-PL] Mikulowa PST1 [OPP] [PL]	141	141	239.09	33.26%	19.62%	65.76%	0.4304
[NL-D7] Maasbracht - Oberzier SELFK WS [DIR] [D7]	126	142	207.09	52.14%	19.98%	83.20%	0.3361
[SK-SK] V.Dur - Levice 1 [DIR]	118	118	547.58	37.48%	5.27%	59.96%	0.2847
[AT-SI] Obersielach - Podlog 247 [DIR] [AT]	113	120	585.06	45.24%	21.27%	99.17%	0.2612
[RO-RO] TR Rosiori 400/220 1 [DIR]	80	80	5428.4	37.47%	20.75%	69.00%	0.1248
[D8-D8] Pasewalk - Vierraden 306 [DIR]	71	71	1484.36	26.40%	19.66%	43.41%	0.1085
[CZ-D8] Hradec - Rohrsdorf 445 [OPP] [D8]	64	64	20548.64	32.40%	18.90%	51.95%	0.3232
[BE-BE] Achene - Gramme 380.10 [OPP]	48	48	243.31	88.54%	56.69%	149.23%	0.3004
[NL-D2] Meeden-Diele 380 Z [DIR] [NL]	45	45	188.12	53.00%	19.85%	108.17%	0.2545
[NL-D2] Meeden-Diele 380 Z [OPP] [NL]	40	40	389.12	29.44%	19.94%	53.37%	0.291
[PL-PL] Krosno Iskrzynia - Rzeszow [OPP]	40	40	3613.1	43.34%	35.44%	61.77%	0.3203
[D8-PL] Mikulowa PST3 [OPP] [PL]	37	37	15366.39	27.93%	20.53%	46.14%	0.4187
[AT-AT] Westtirol 1 - Westtirol 2 WTRHU41 [OPP]	36	36	296.75	45.72%	20.00%	87.40%	0.292
[D7-FR] Ensdorf - Vigy VIGY2 S [OPP] [FR]	34	34	254.87	45.36%	20.54%	69.53%	0.2339
[AT-AT] Zaya 2 - Zaya 1 ZYRHU41 [DIR]	33	33	929.23	33.60%	20.32%	69.42%	0.1199
[NL-BE] PST Zandvliet 2 [DIR] [BE]	25	25	54407.67	73.07%	59.29%	89.26%	0.3597
[AT-AT] Hessenberg - Weissenbach 223 [OPP]	25	25	1176.59	36.00%	20.21%	68.87%	0.1125
[D2-D2] Altheim - Simbach 233/230 [DIR]	24	24	957.91	57.30%	34.71%	86.19%	0.0874
[BE-FR] Achene - Lonny 380.19 [DIR] [BE]	20	20	141.82	64.20%	46.75%	91.80%	0.2943

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
--	--------

AC was Limiting MC 0

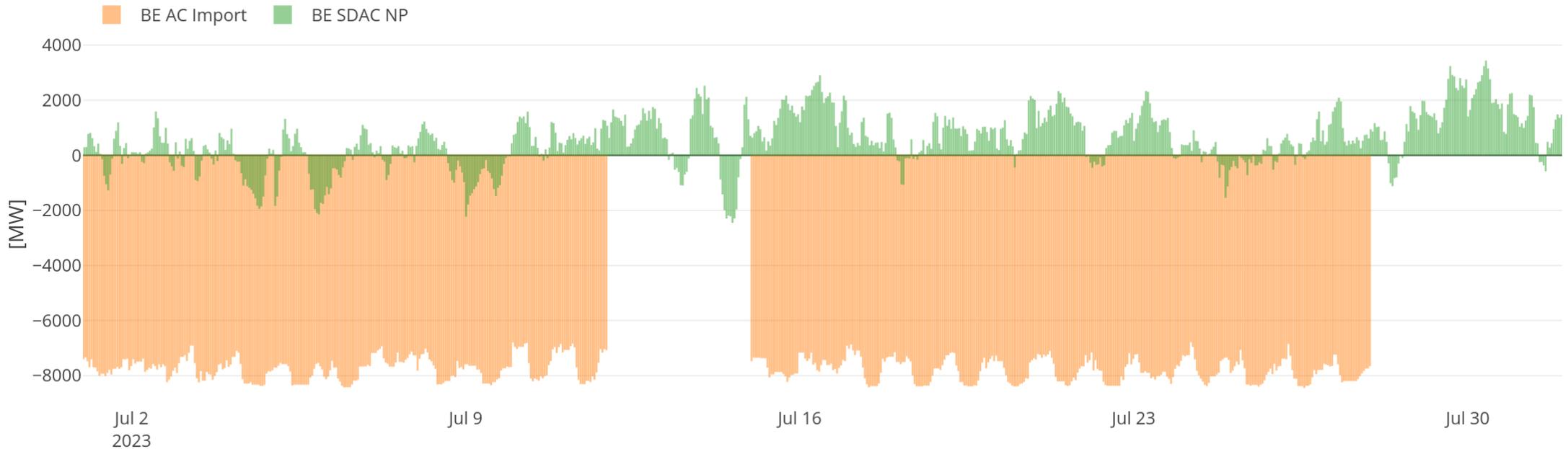
	BE AC Import [MW]
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Avg. -7745.49

Min. -8425.00

Max. -6767.00

Belgium only uses import allocation constraints



KPI 13b: Allocation Constraints - Poland



	# MTUs
AC was limiting MC	463
AC < 0 MW	245
AC = 0 MW	217
AC > 0 MW	1

	PL AC Import [MW]	PL AC Export [MW]
Avg.	-1335.12	3128.9
Min.	-8836.00	0.0
Max.	0.00	9849.0

