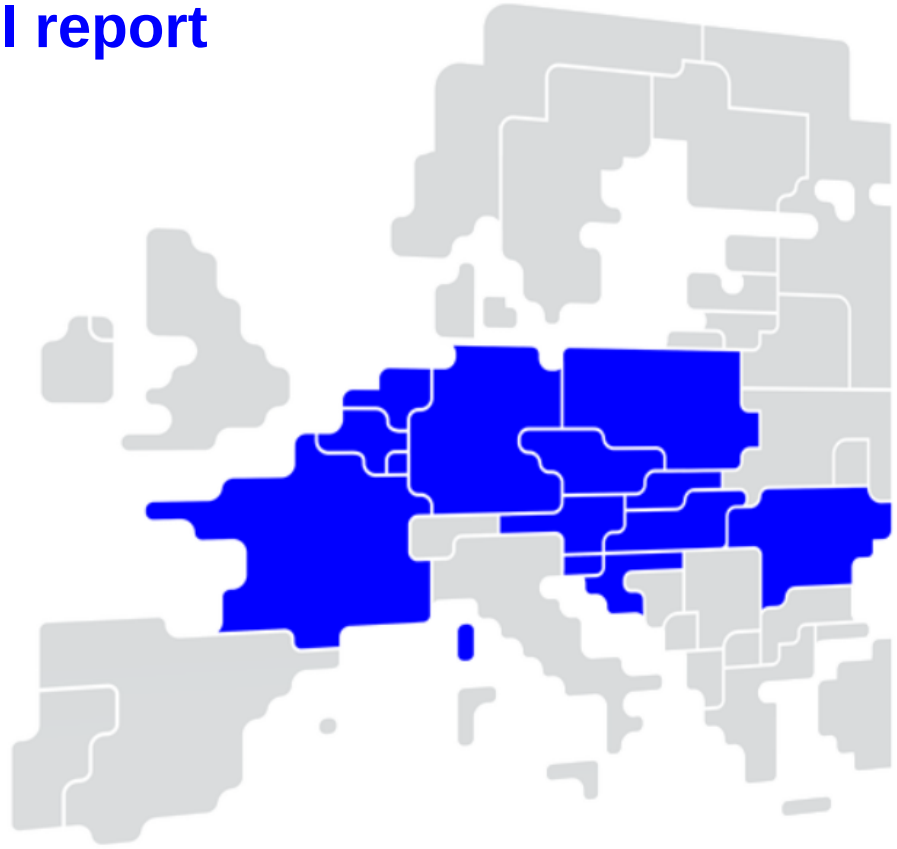
Core FB MC Operational KPI report

October 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

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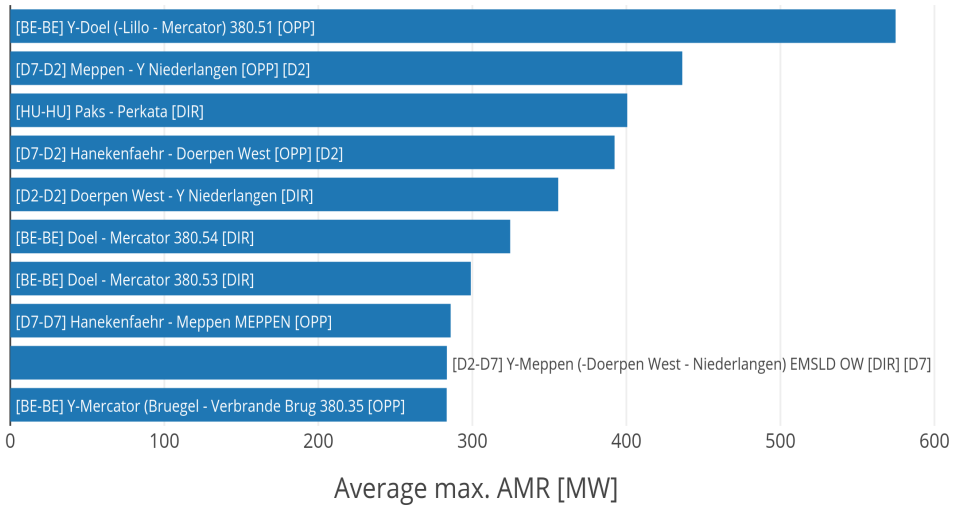
- KPI 11: Most often presolved CNEs (top 20)
- KPI 12: Most limiting CNEs (top 20)
- KPI 13: Allocation Constraints

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

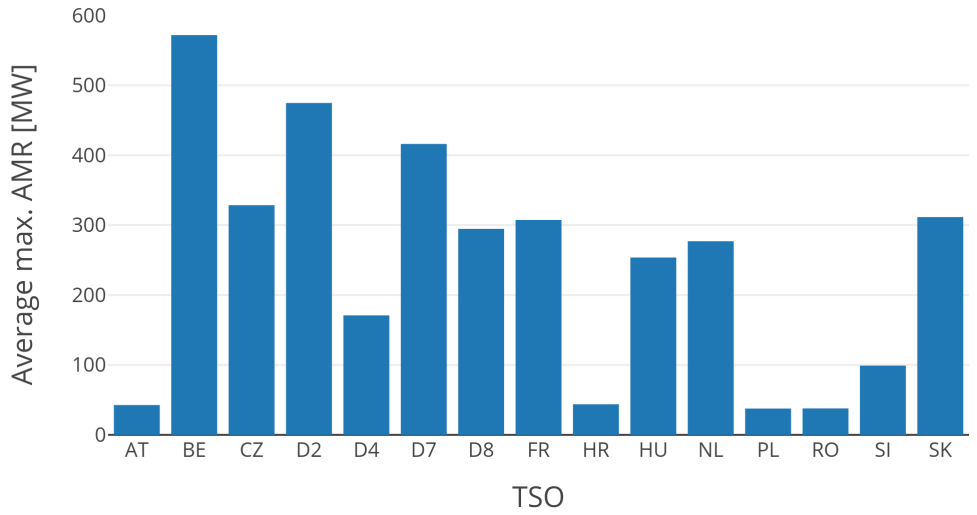
CNE	Average Maximum AMR (MW)	AMR as % of Fmax
[BE-BE] Y-Doel (-Lillo - Mercator) 380.51 [OPP]	574.78	38.38%
[D7-D2] Meppen - Y Niederlangen [OPP] [D2]	436.30	22.59%
[HU-HU] Paks - Perkata [DIR]	400.56	28.80%
[D7-D2] Hanekenfaehr - Doerpen West [OPP] [D2]	392.33	19.48%
[D2-D2] Doerpen West - Y Niederlangen [DIR]	355.74	18.41%
[BE-BE] Doel - Mercator 380.54 [DIR]	324.57	20.04%
[BE-BE] Doel - Mercator 380.53 [DIR]	299.00	18.47%
[D7-D7] Hanekenfaehr - Meppen MEPPEN [OPP]	285.90	12.51%
[D2-D7] Y-Meppen (-Doerpen West - Niederlangen) EMSLD OW [DIR] [D7]	283.45	11.98%
[BE-BE] Y-Mercator (Bruegel - Verbrande Brug 380.35 [OPP]	283.34	18.35%



KPI 2: Average maximum AMR per TSO

TSO	Average maximum AMR per TSO
AT	42.60
BE	571.77
CZ	328.53
D2	474.63
D4	170.96
D7	416.08
D8	294.68
FR	307.46
HR	43.61
HU	253.58

TSO	Average maximum AMR per TSO
NL	276.93
PL	37.68
RO	37.84
SI	99.09
SK	311.56

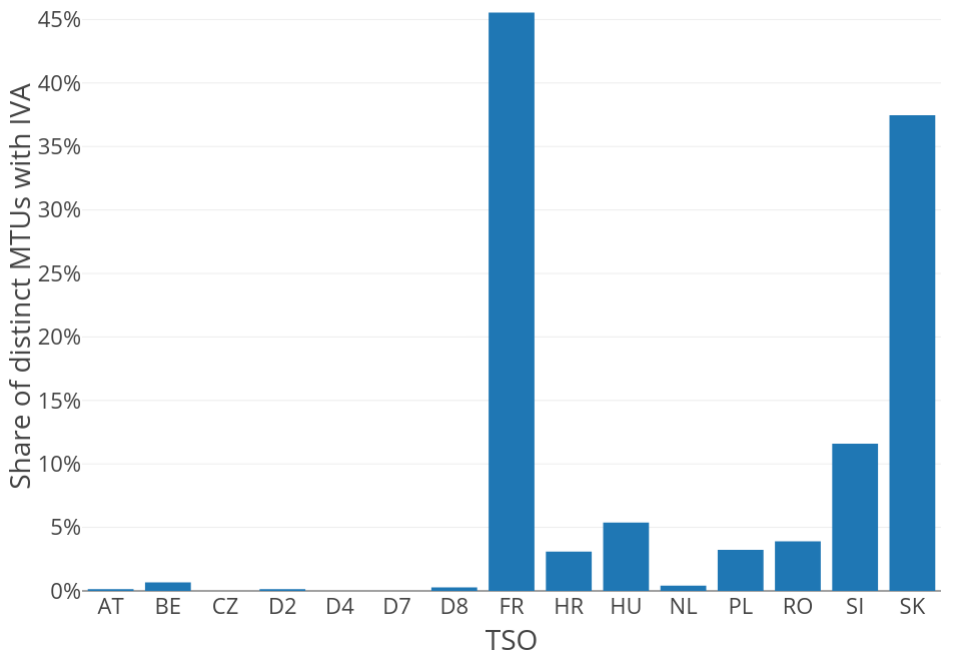


KPI 3: Share of MTUs with intervention per TSO

Total BDs	Total MTUs	MTUs without IVA	Share of distinct MTUs without IVA	MTUs with IVA	Share of distinct MTUs with IVA
31	742	183	24.66%	559	75.3%

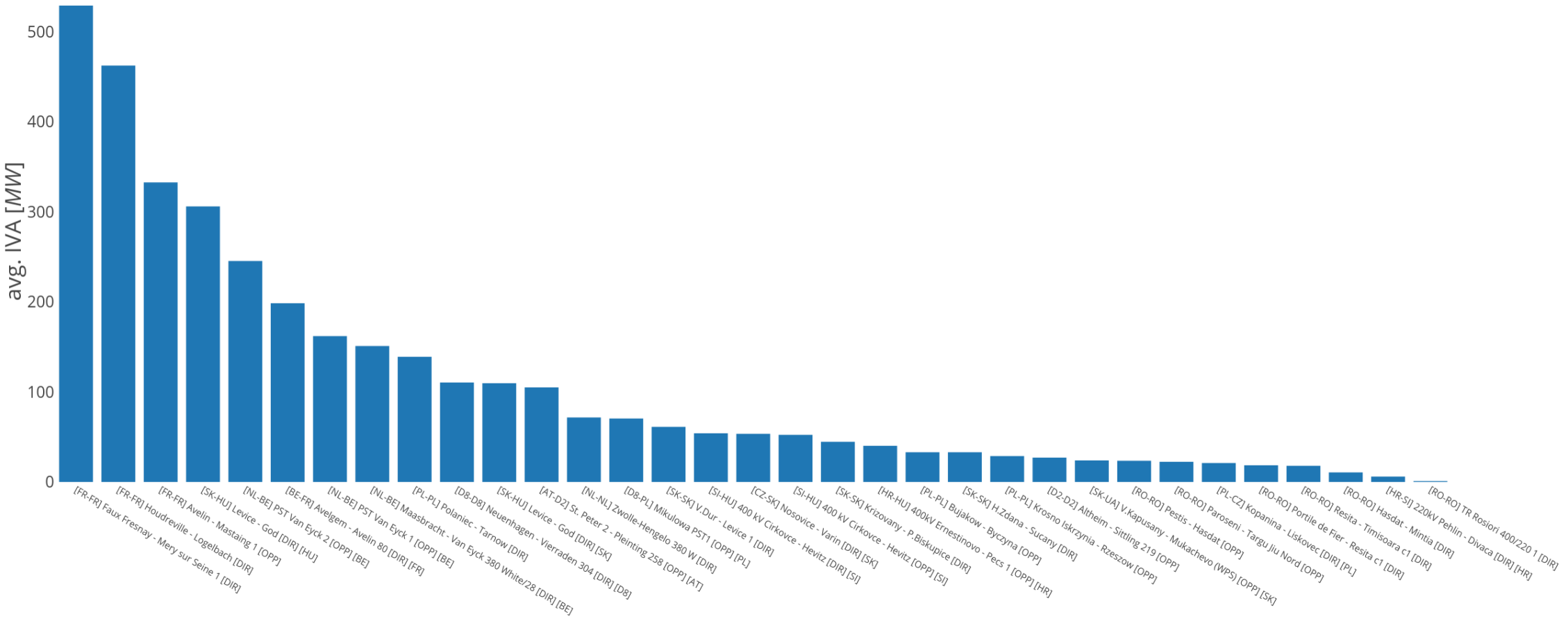
TSO	Share of distinct MTUs with IVA	Distinct MTUs with IVA
CZ	0.00%	0
SI	11.59%	86
AT	0.13%	1
D7	0.00%	0
D8	0.27%	2
D2	0.13%	1
PL	3.23%	24
D4	0.00%	0
SK	37.47%	278
HU	5.39%	40

TSO	Share of distinct MTUs with IVA	Distinct MTUs with IVA
BE	0.67%	5
NL	0.40%	3
FR	45.55%	338
RO	3.91%	29
HR	3.10%	23



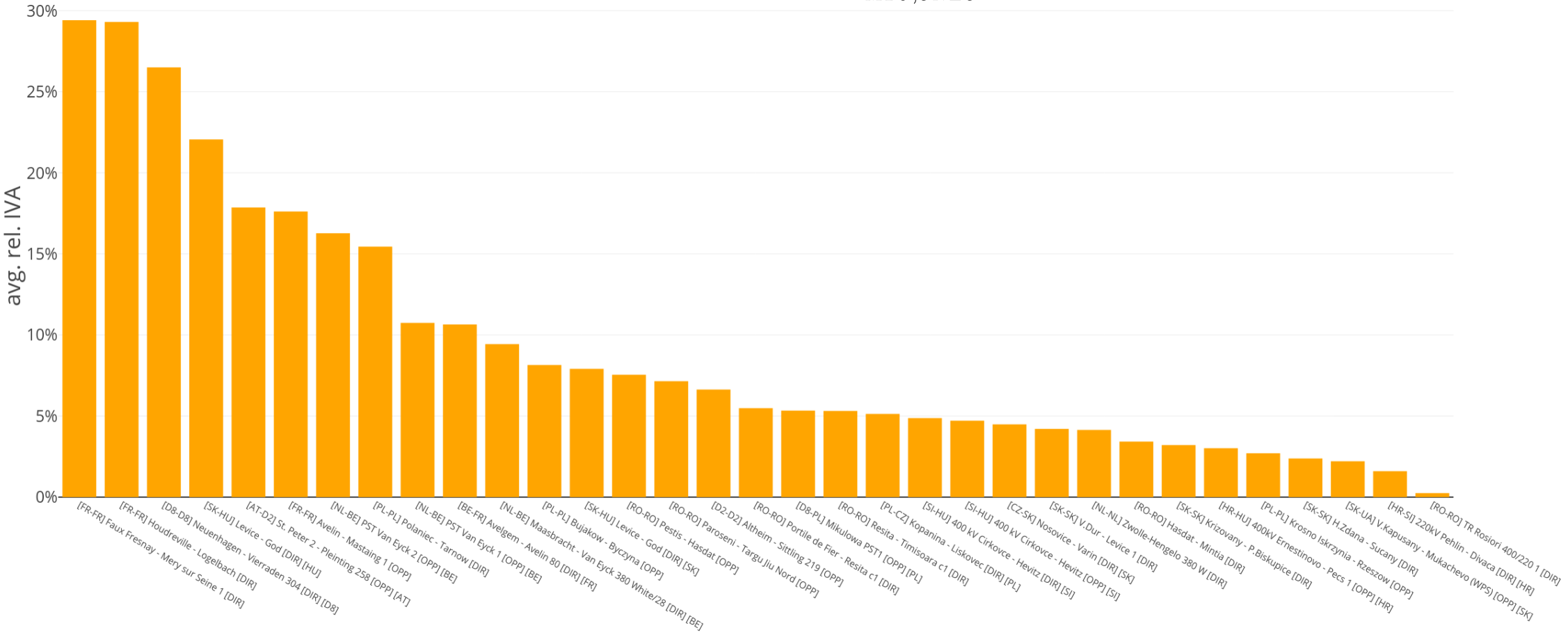
KPI 4a: Average IVA applied for each CNE affected by TSO intervention

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

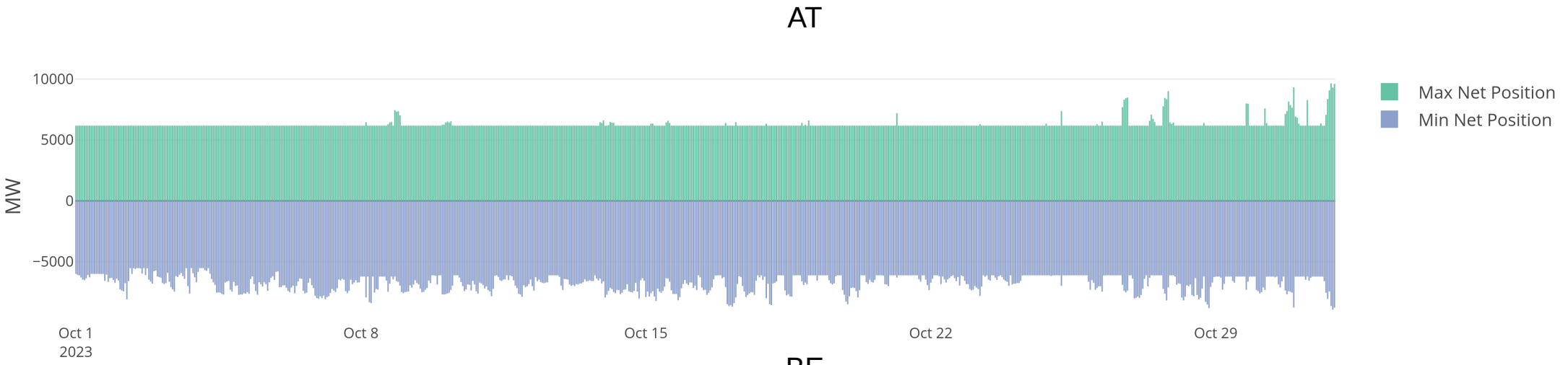


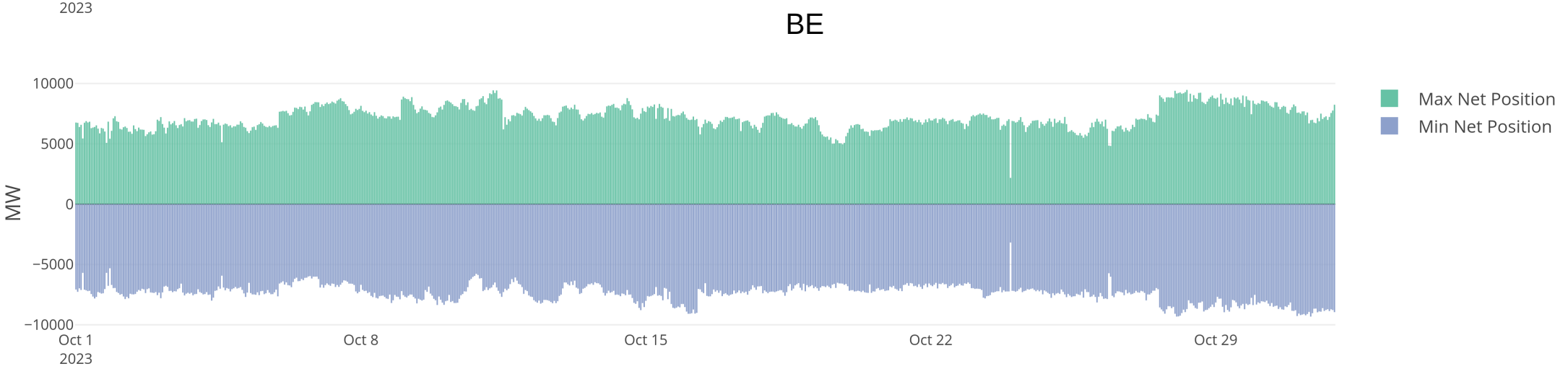
KPI 4b: Average relative IVA applied for each CNE affected by TSO intervention

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

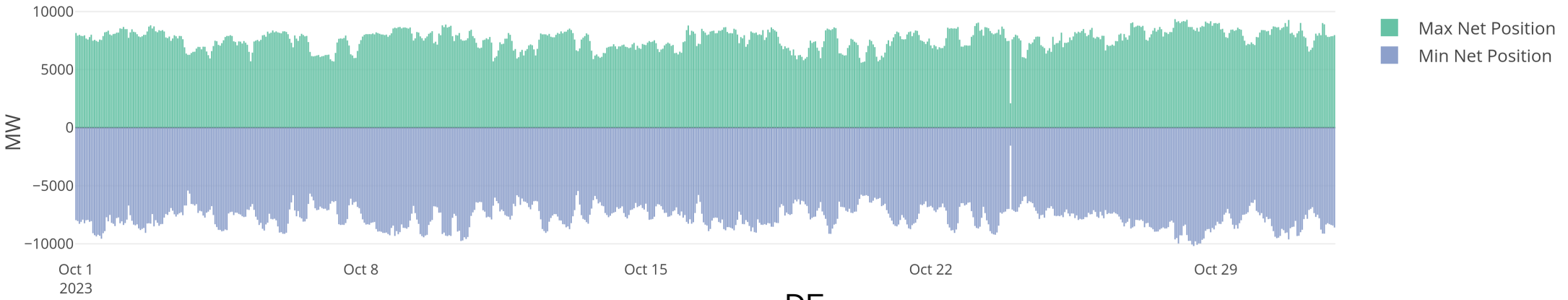


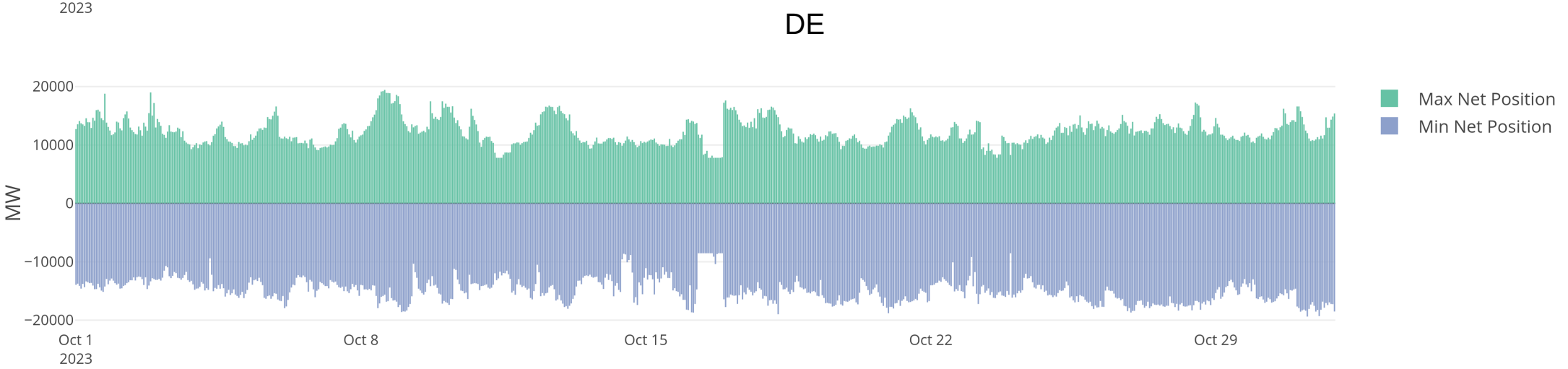
KPI 5: Min & max net positions per BZ hub





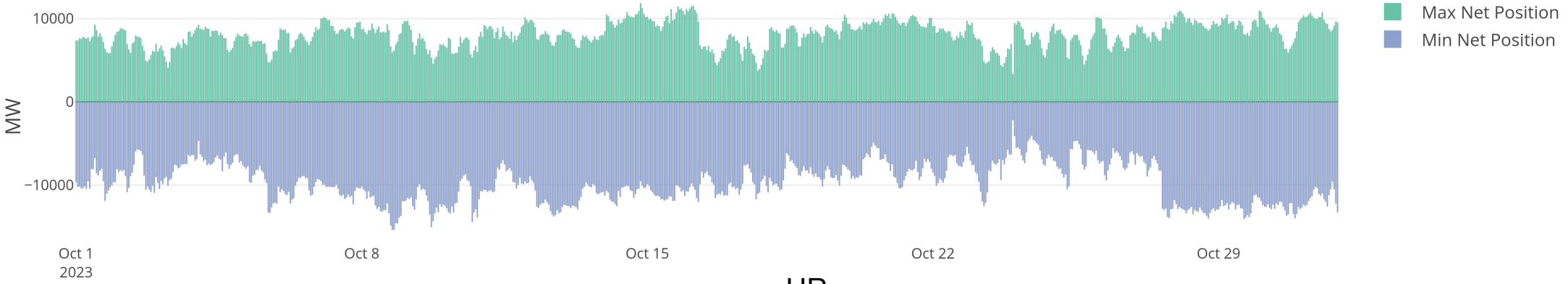
KPI 5: Min & max net positions per BZ hub



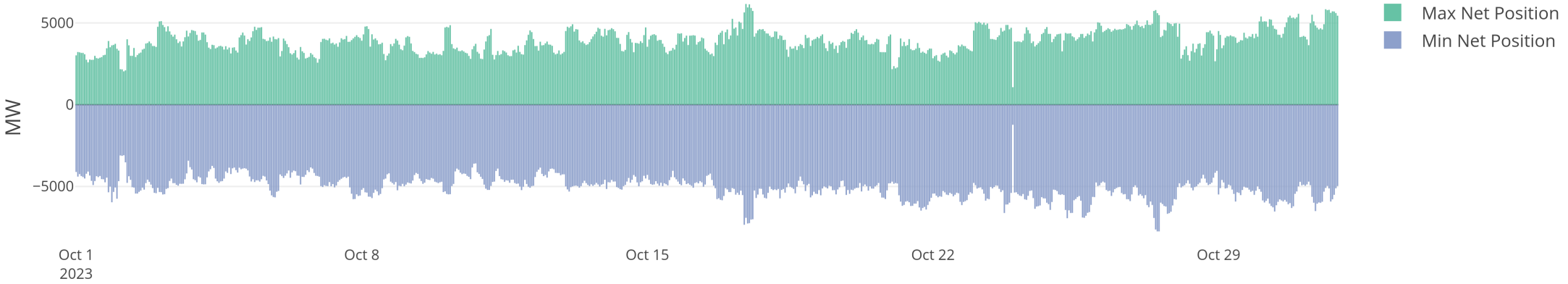


KPI 5: Min & max net positions per BZ hub

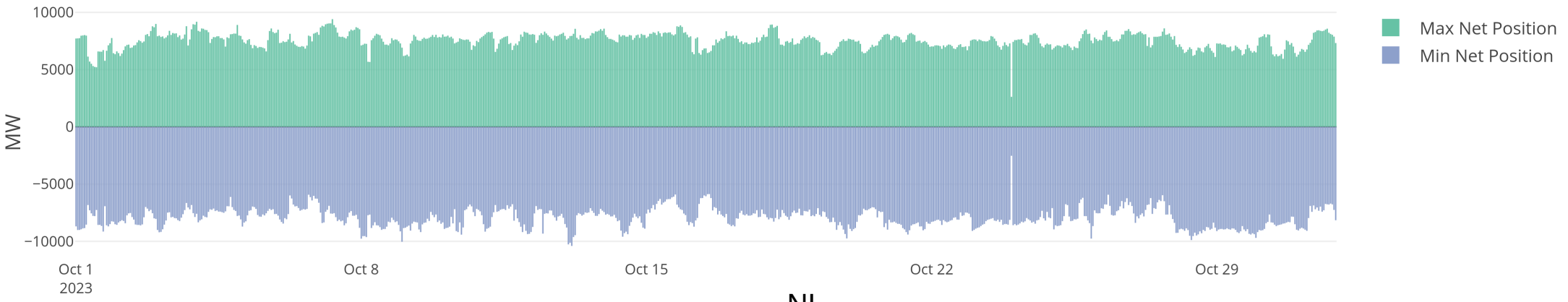
FR

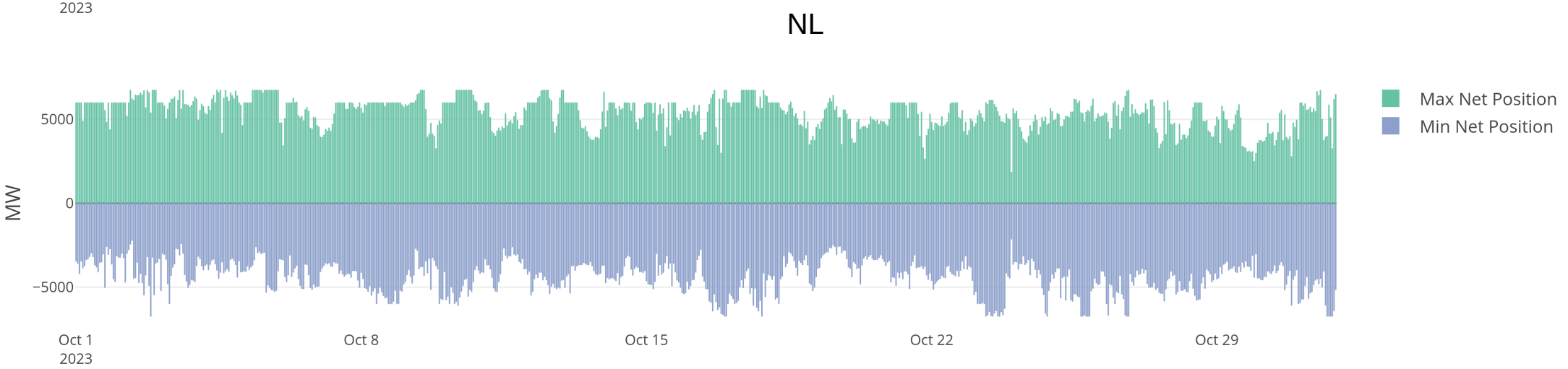


HR



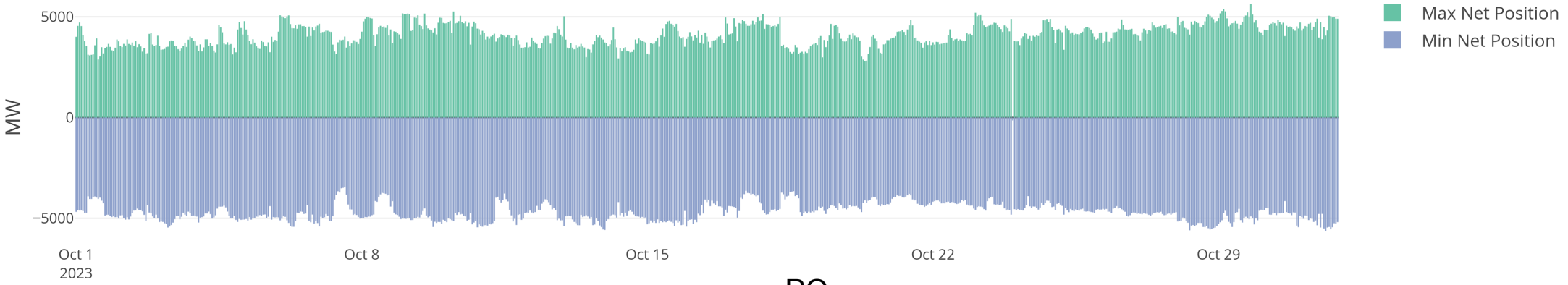
KPI 5: Min & max net positions per BZ hub



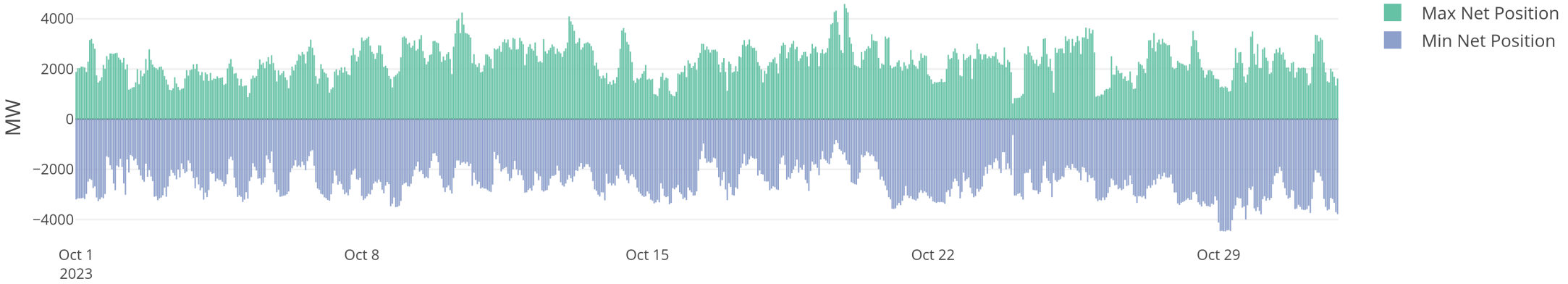


KPI 5: Min & max net positions per BZ hub

PL

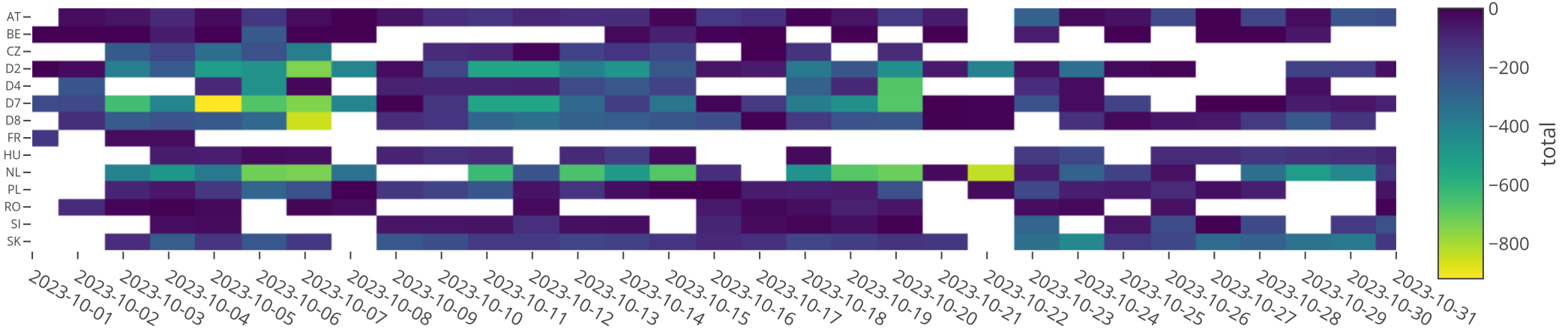


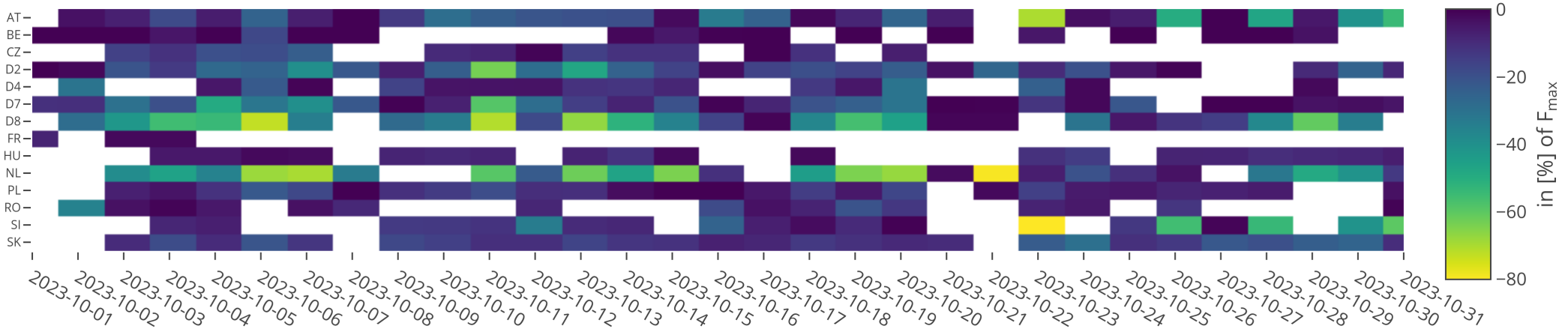
RO



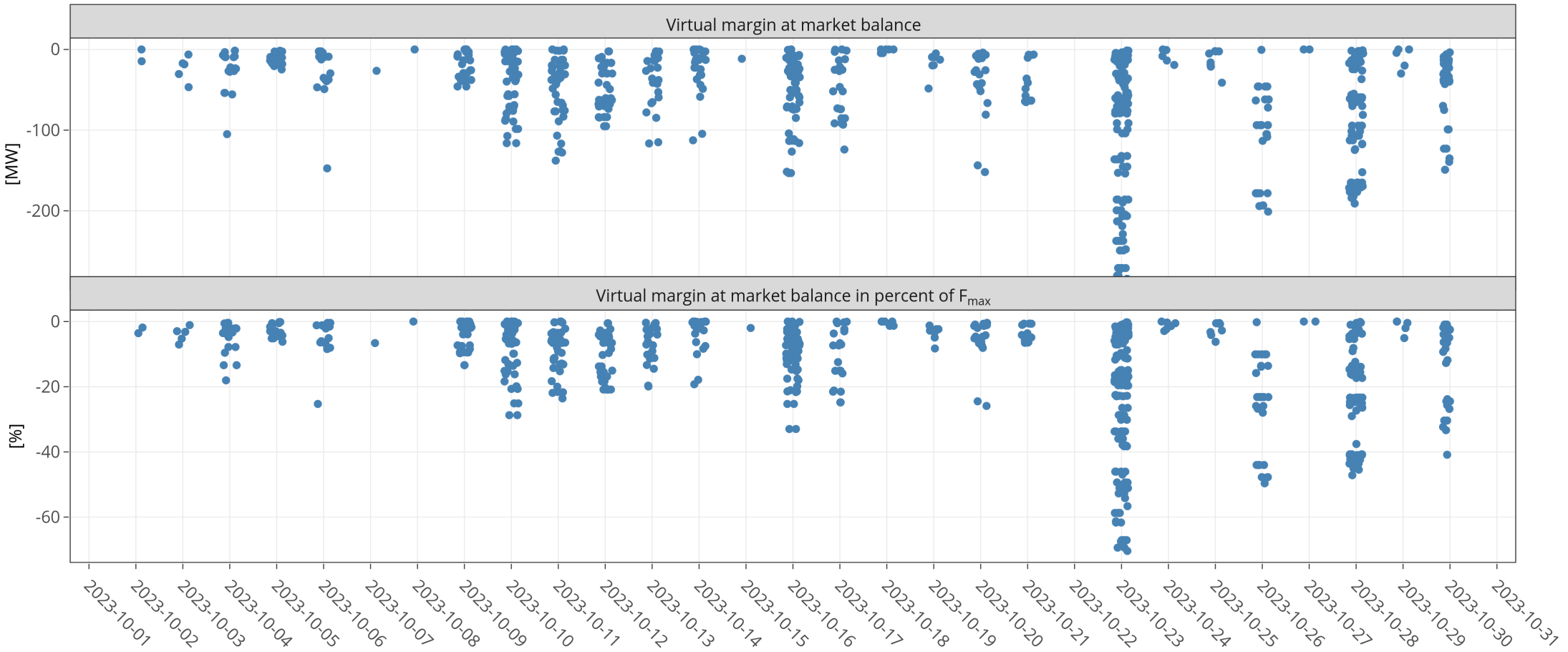
KPI 5: Min & max net positions per BZ hub

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

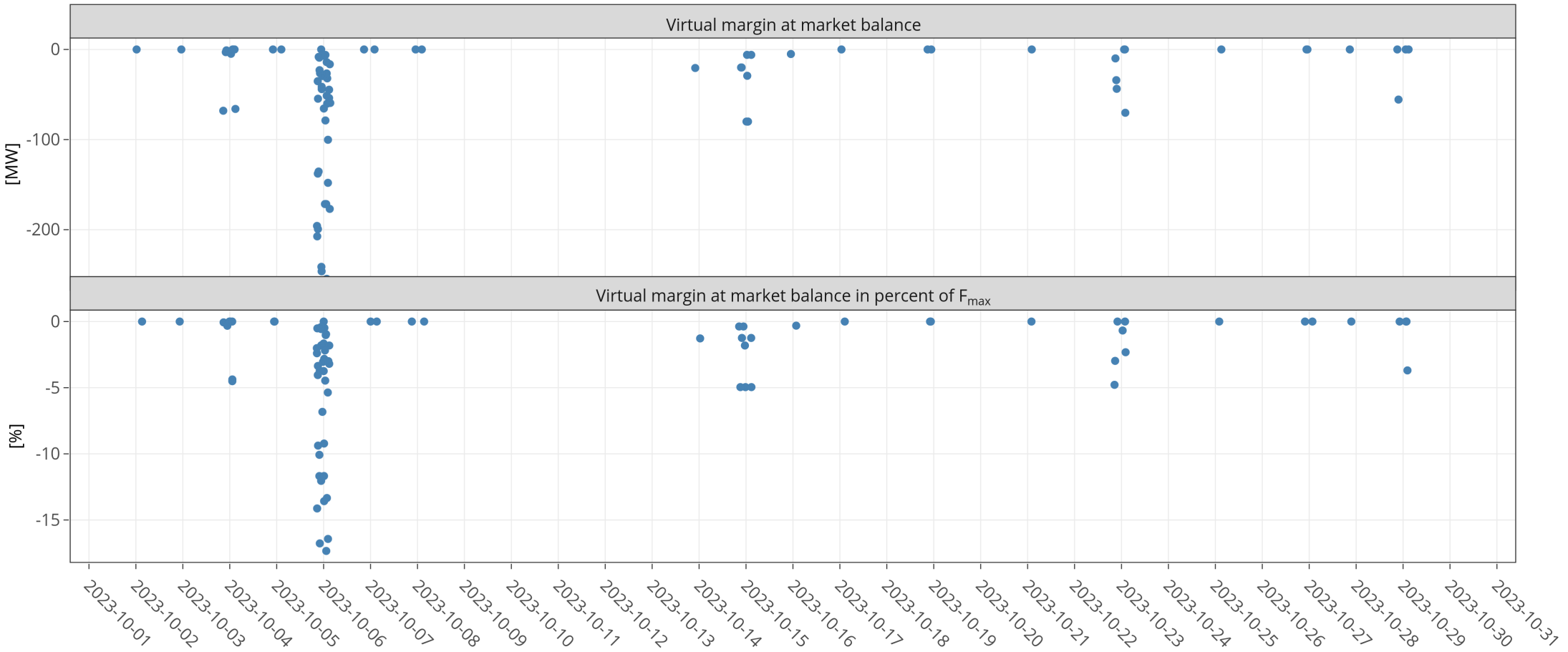




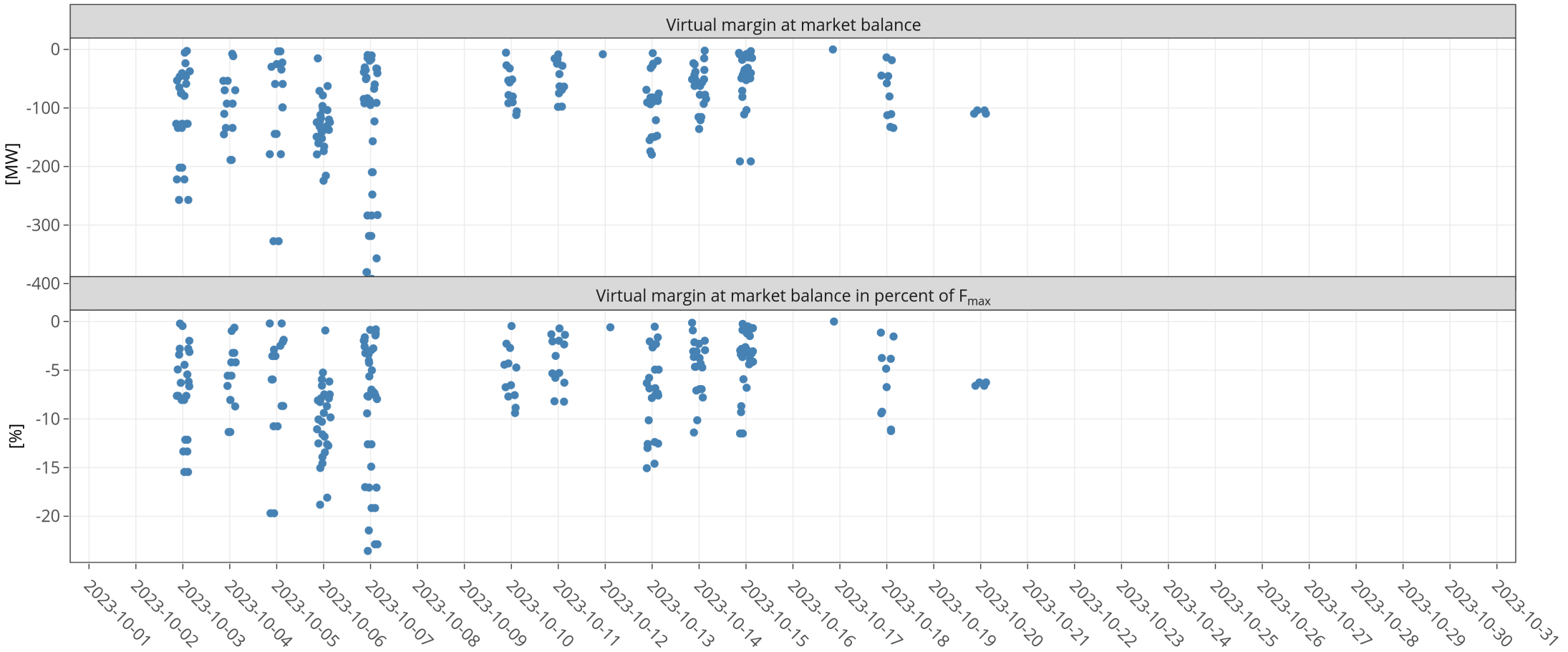
KPI 6b: Virtual margins at market balance AT



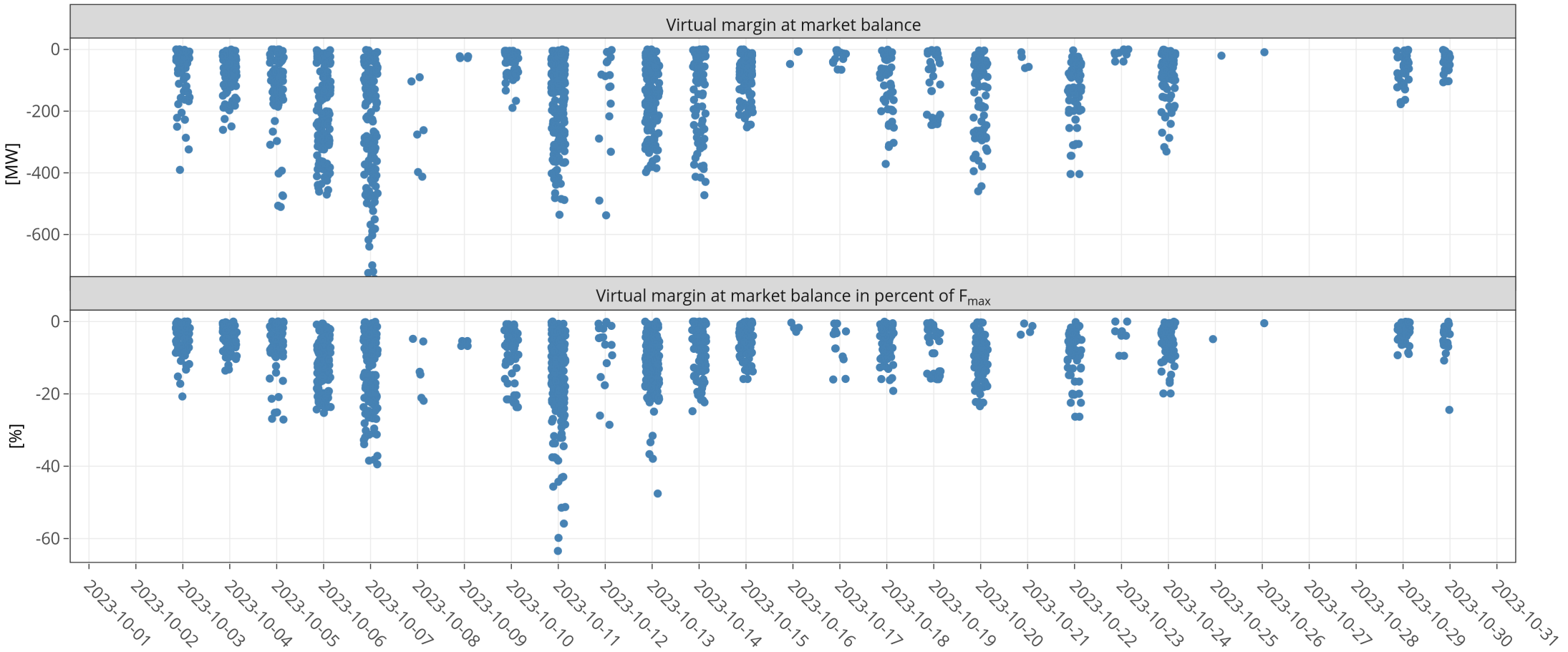
KPI 6b: Virtual margins at market balance BE



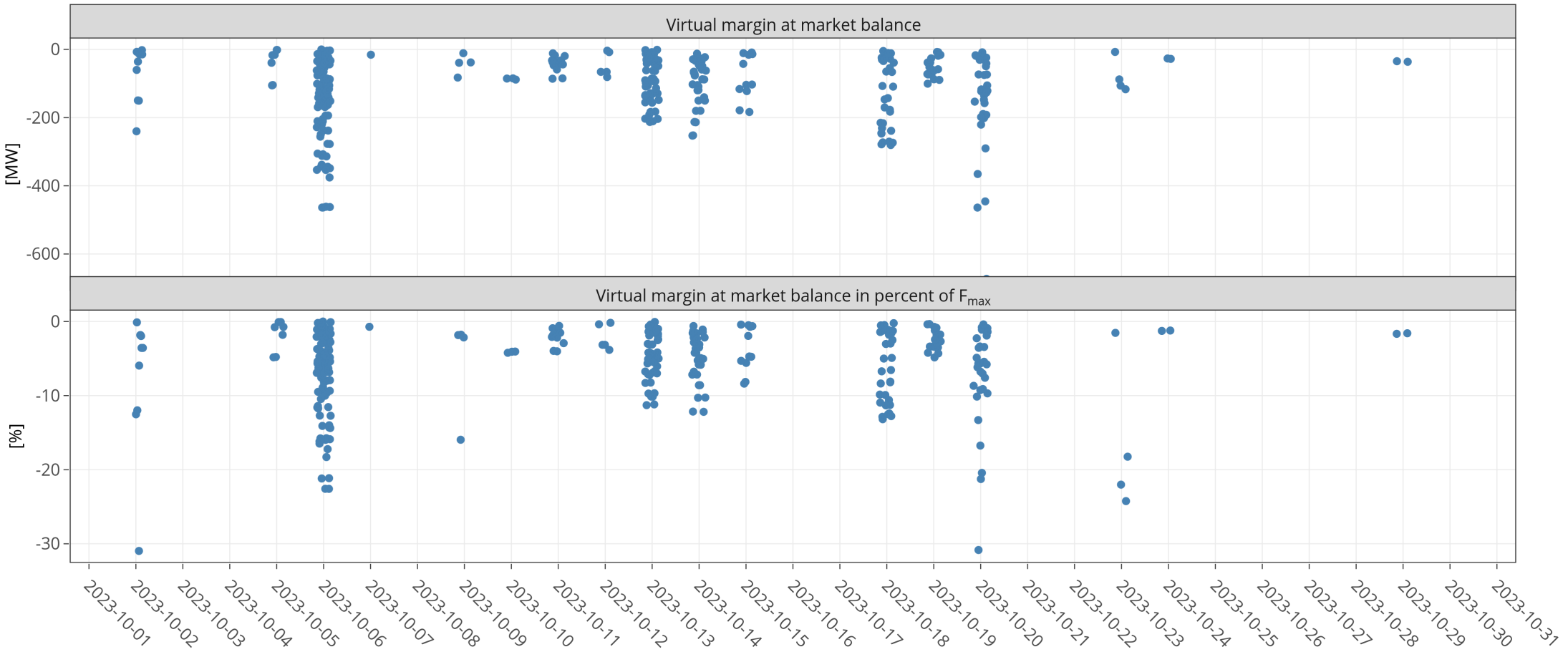
KPI 6b: Virtual margins at market balance CZ



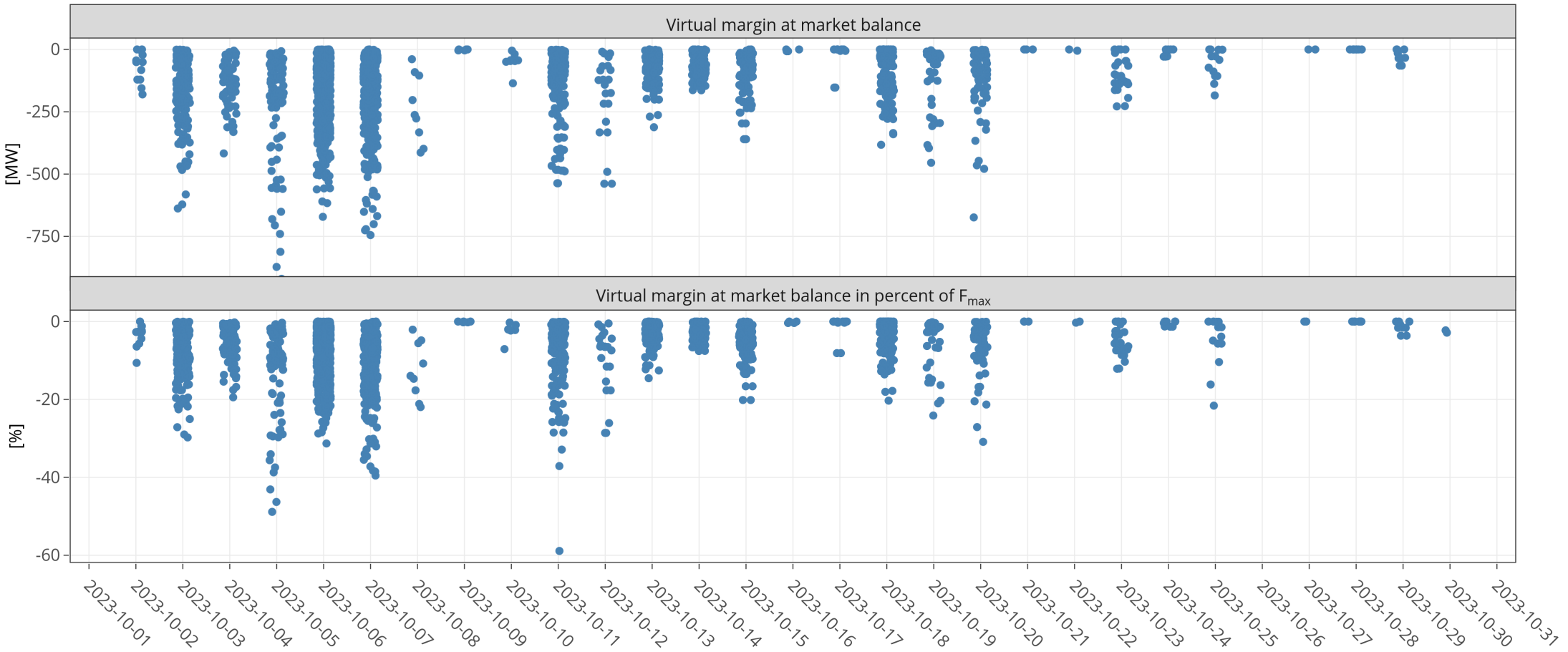
KPI 6b: Virtual margins at market balance D2



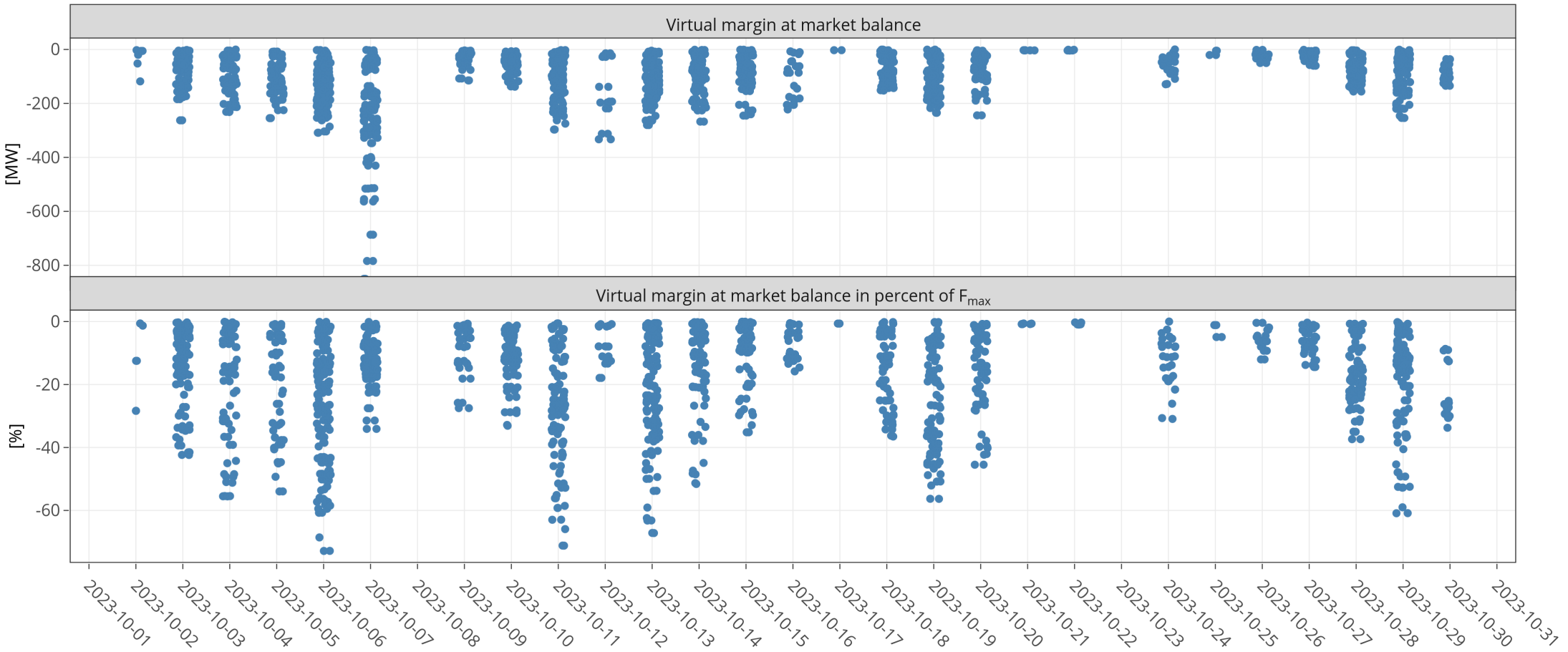
KPI 6b: Virtual margins at market balance D4



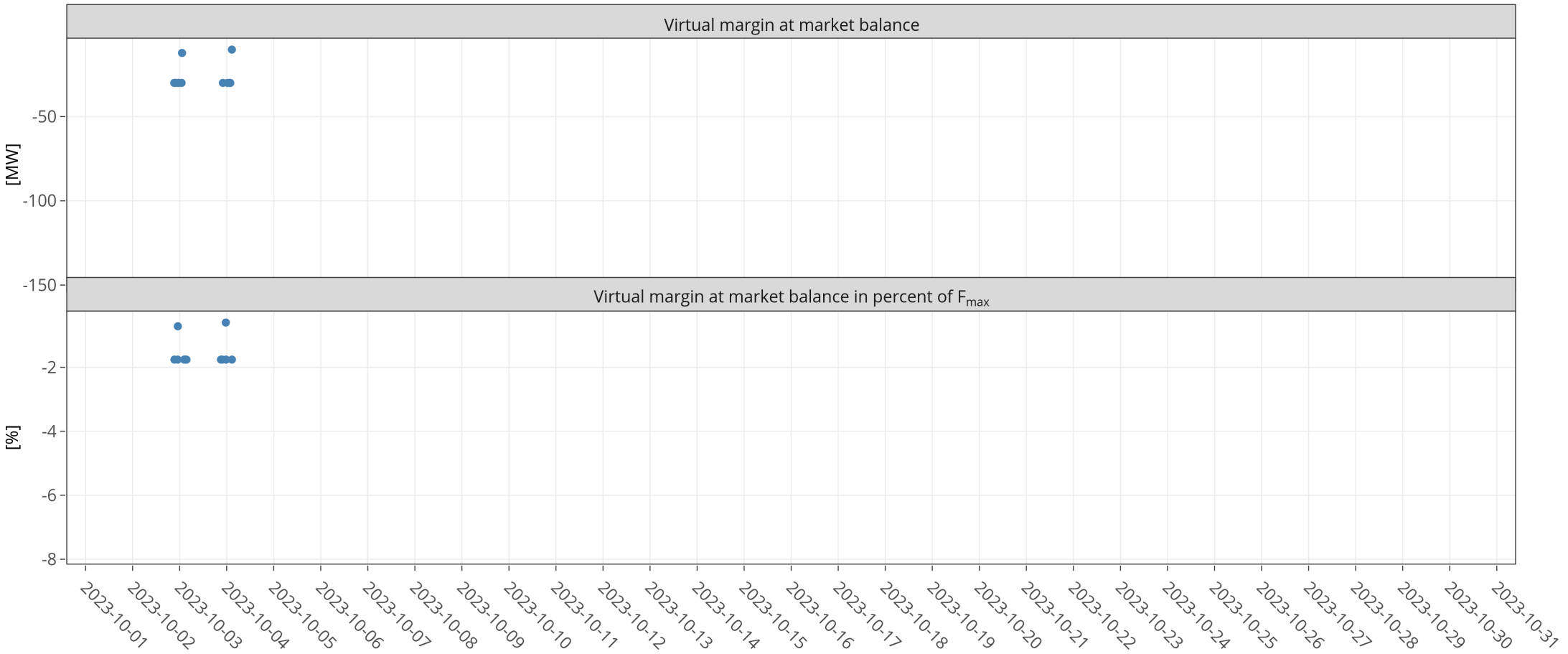
KPI 6b: Virtual margins at market balance D7



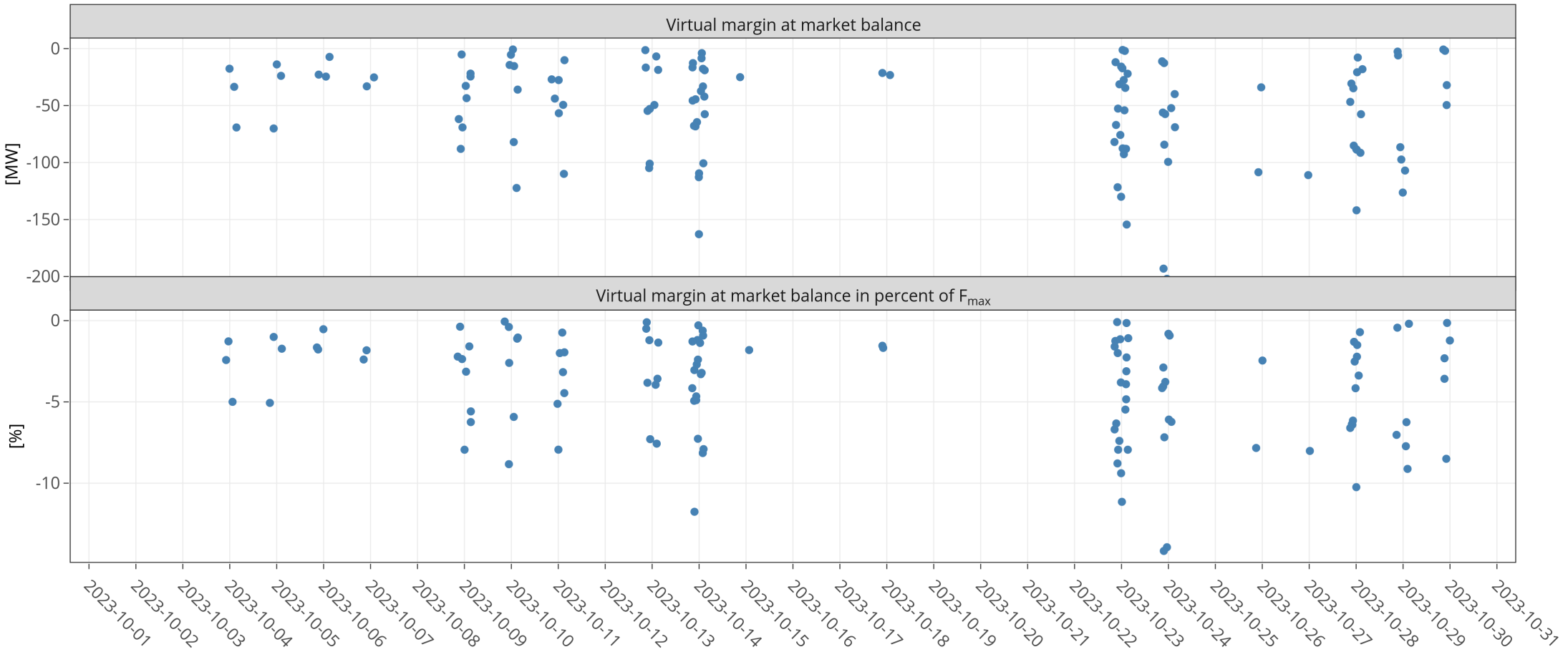
KPI 6b: Virtual margins at market balance D8



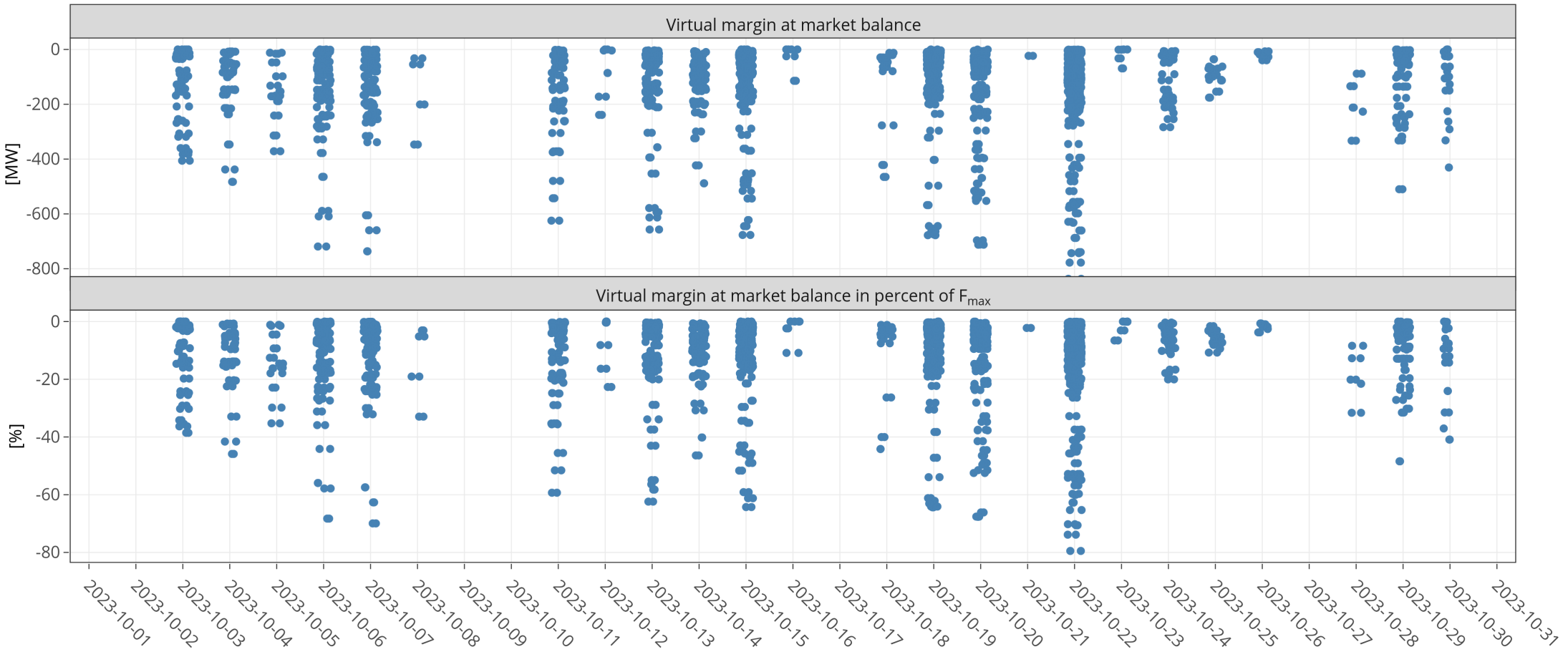
KPI 6b: Virtual margins at market balance FR



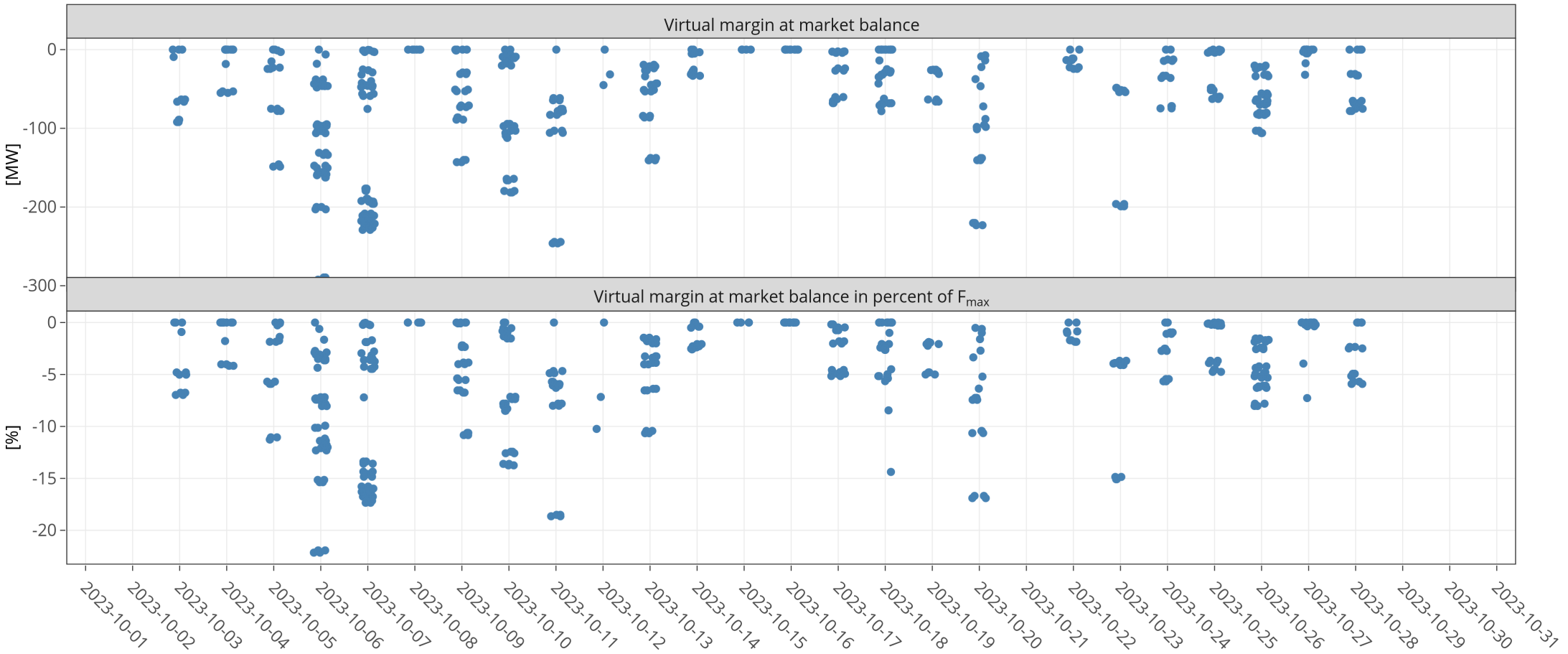
KPI 6b: Virtual margins at market balance HU



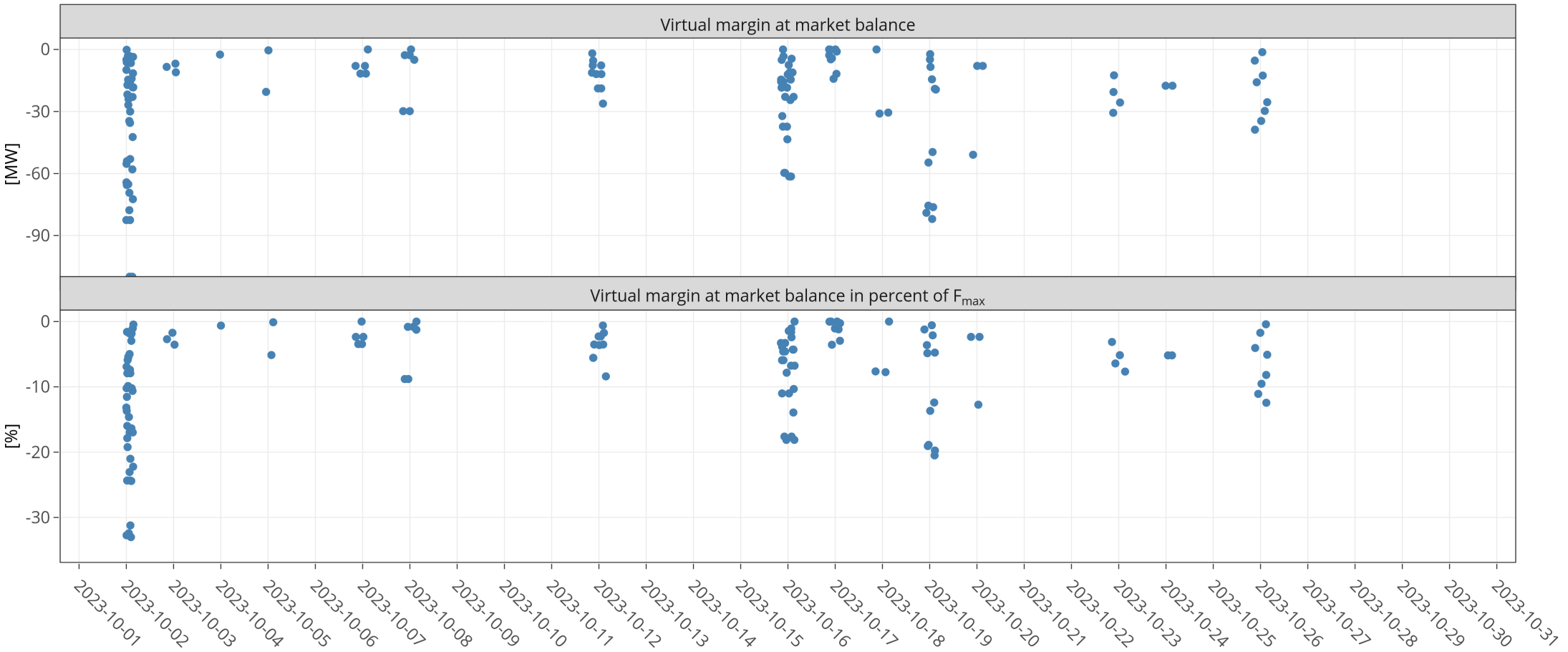
KPI 6b: Virtual margins at market balance NL



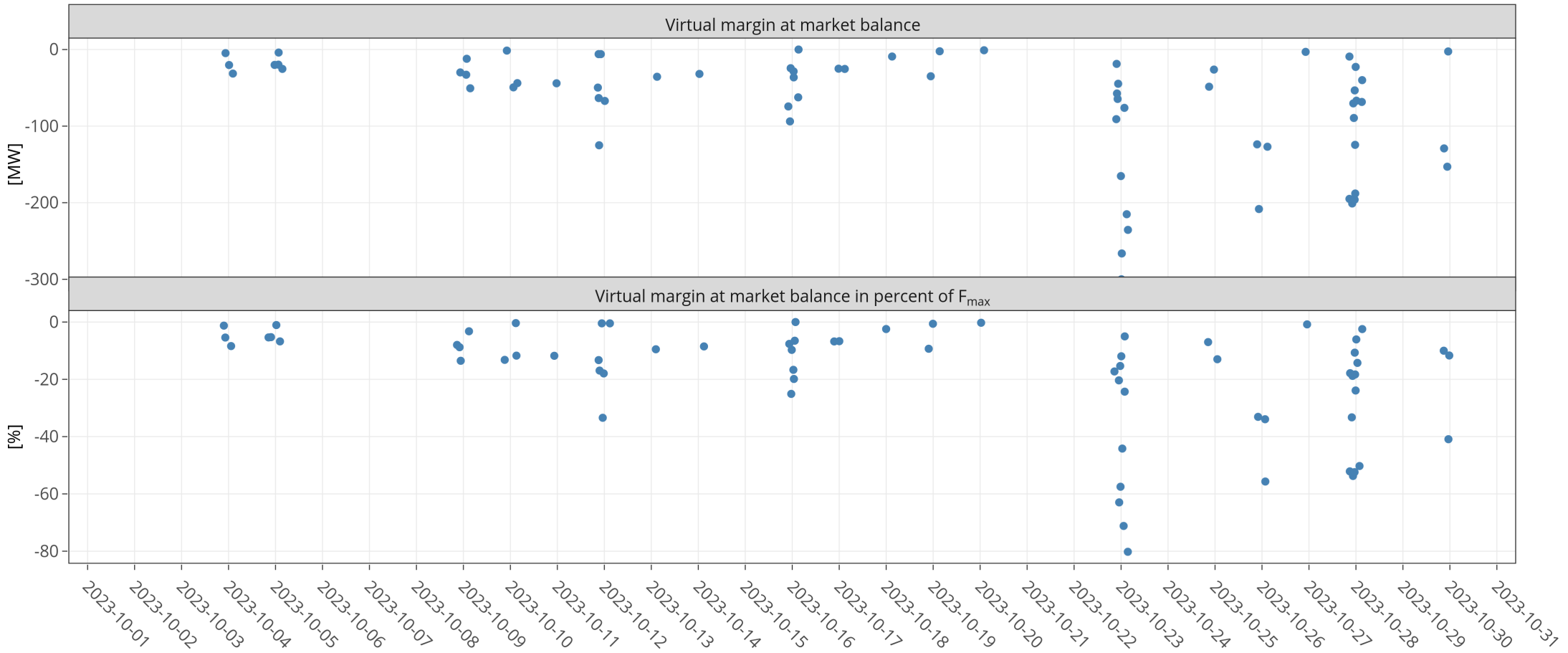
KPI 6b: Virtual margins at market balance PL



KPI 6b: Virtual margins at market balance RO

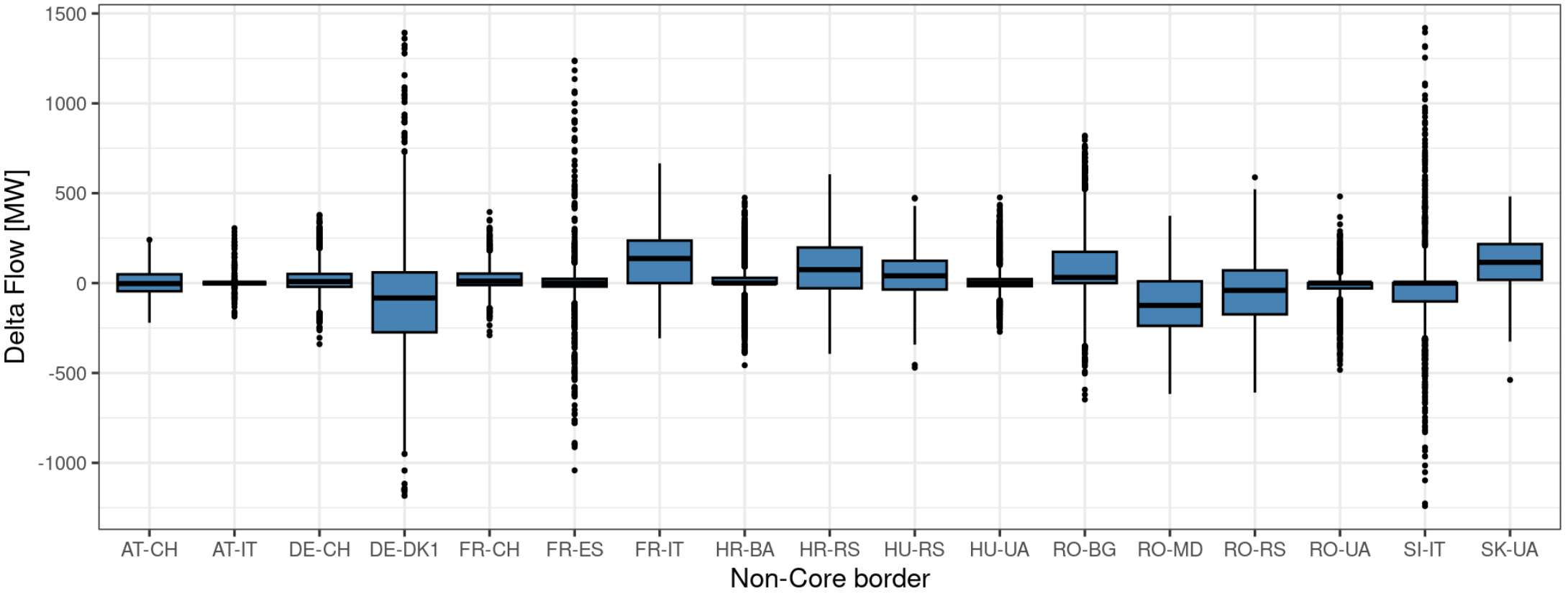


KPI 6b: Virtual margins at market balance SI

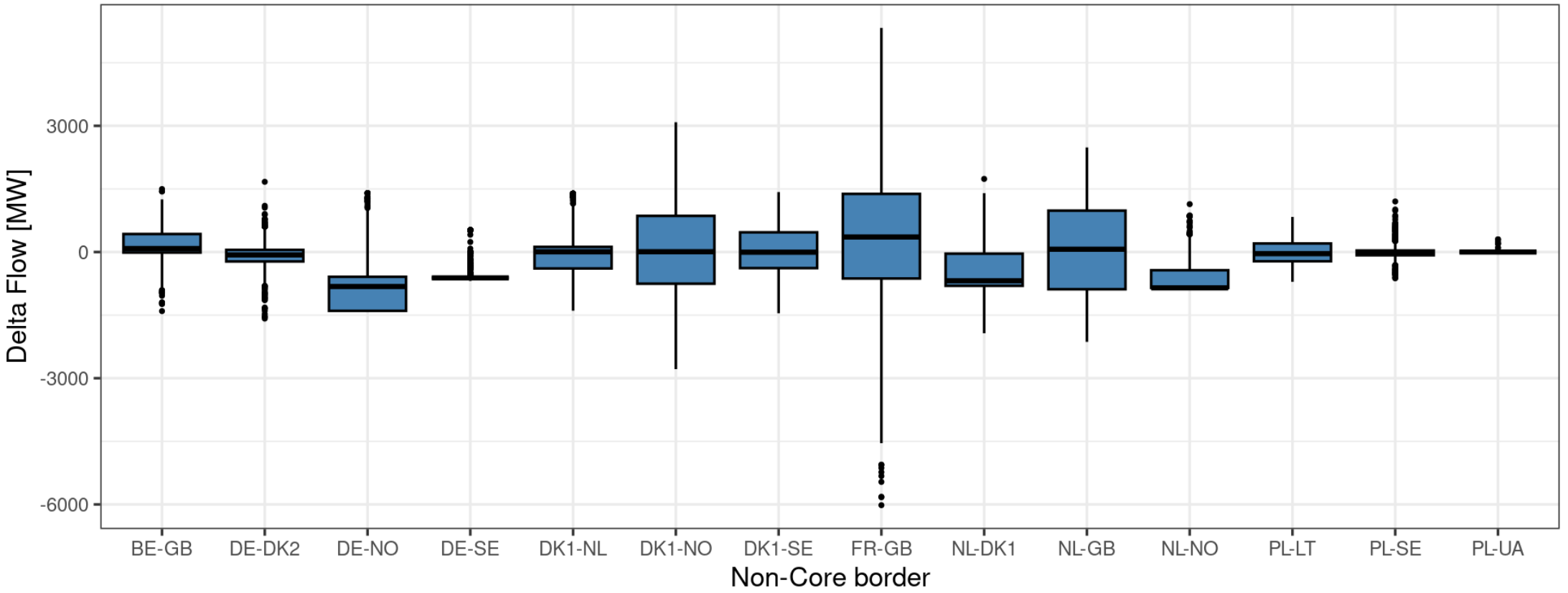


KPI 6b: Virtual margins at market balance SK

KPI 7: Non-Core exchanges AC delta flow

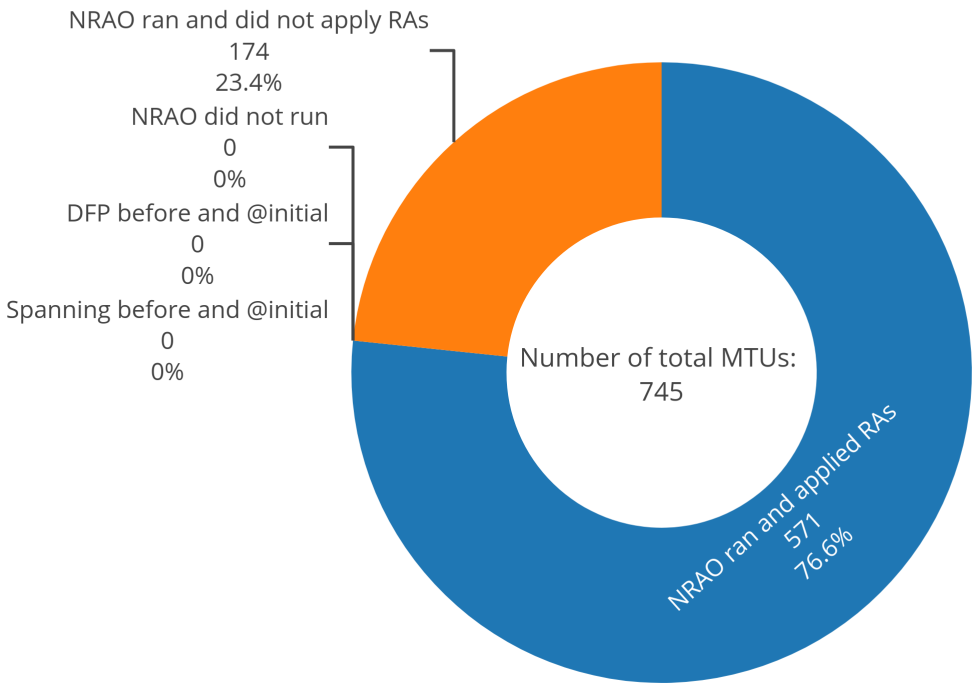


KPI 7: Non-Core exchanges DC delta flow

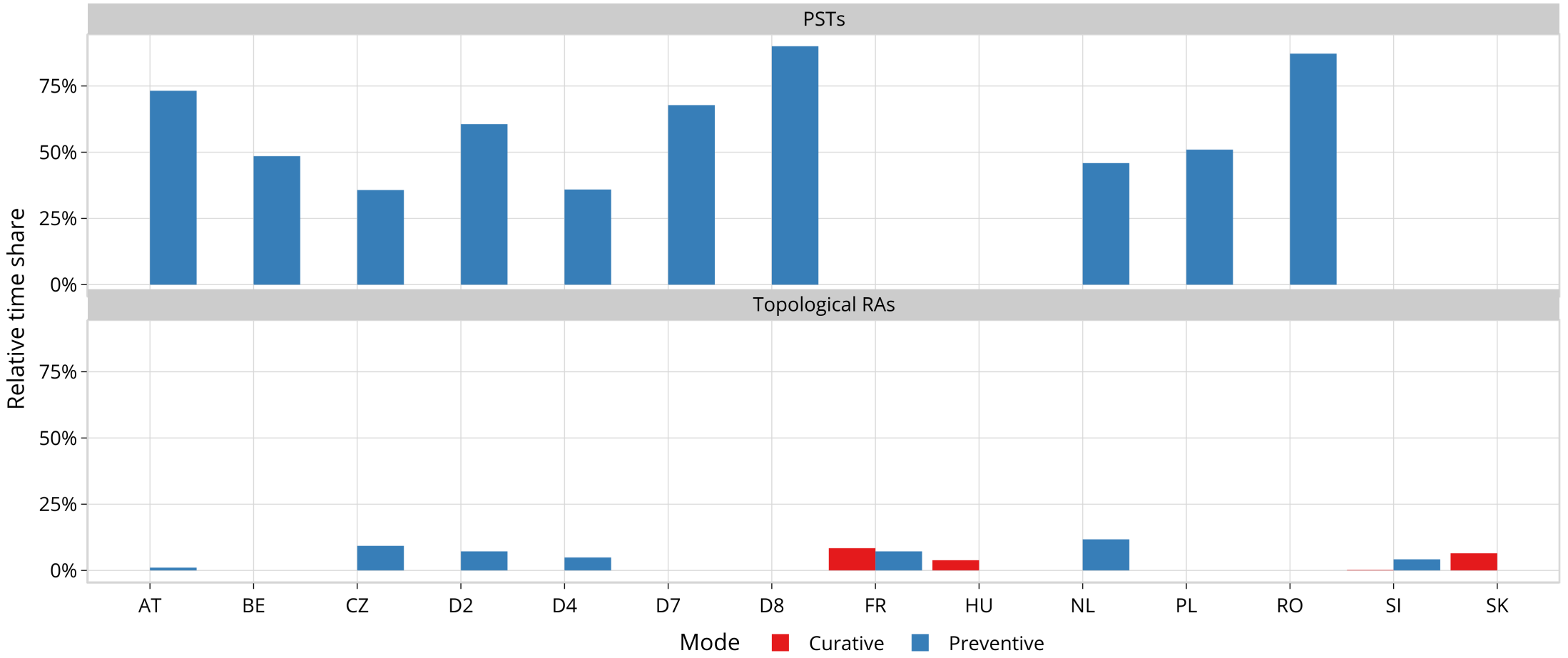


KPI 8: NRAO – Applied Remedial Action

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

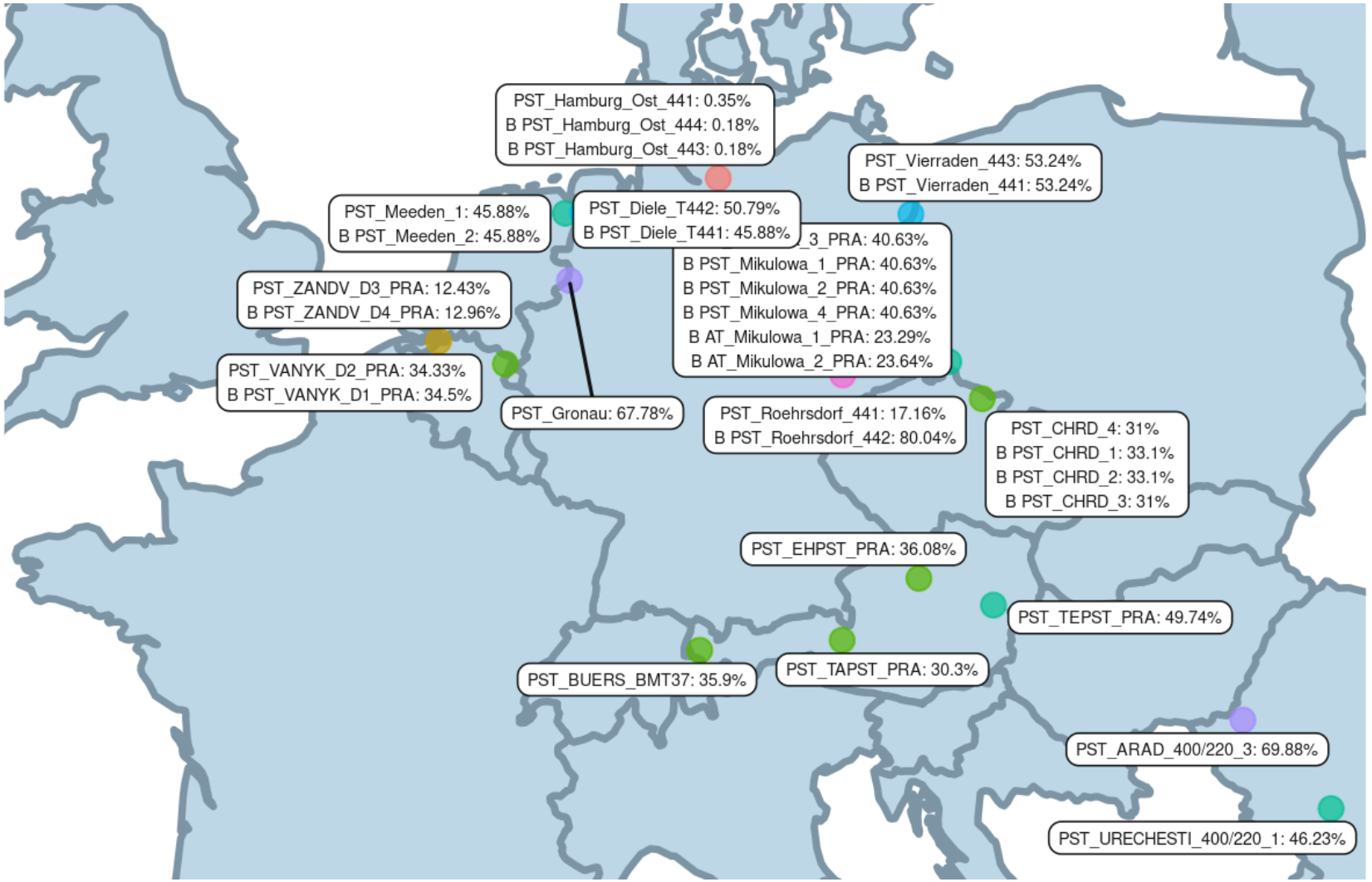


KPI 8: Relative Time Share of Applied RAs, by TSO, Type and Mode



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

Relative Time Share of Applied PSTs in Preventive Mode



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

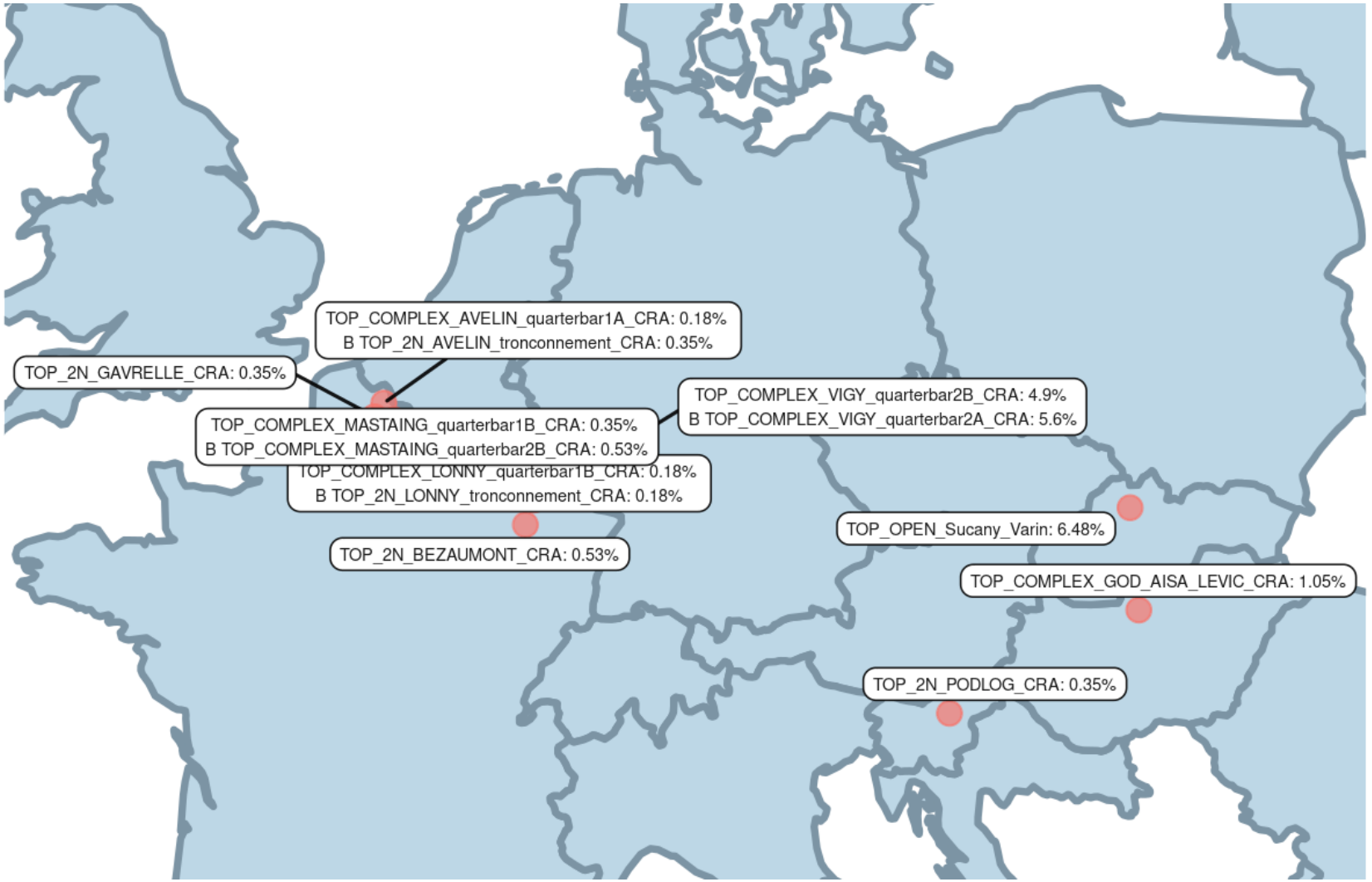
Relative Time Share of Applied PSTs in Curative Mode

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

Relative Time Share of Applied Topological RAs in Preventive Mode

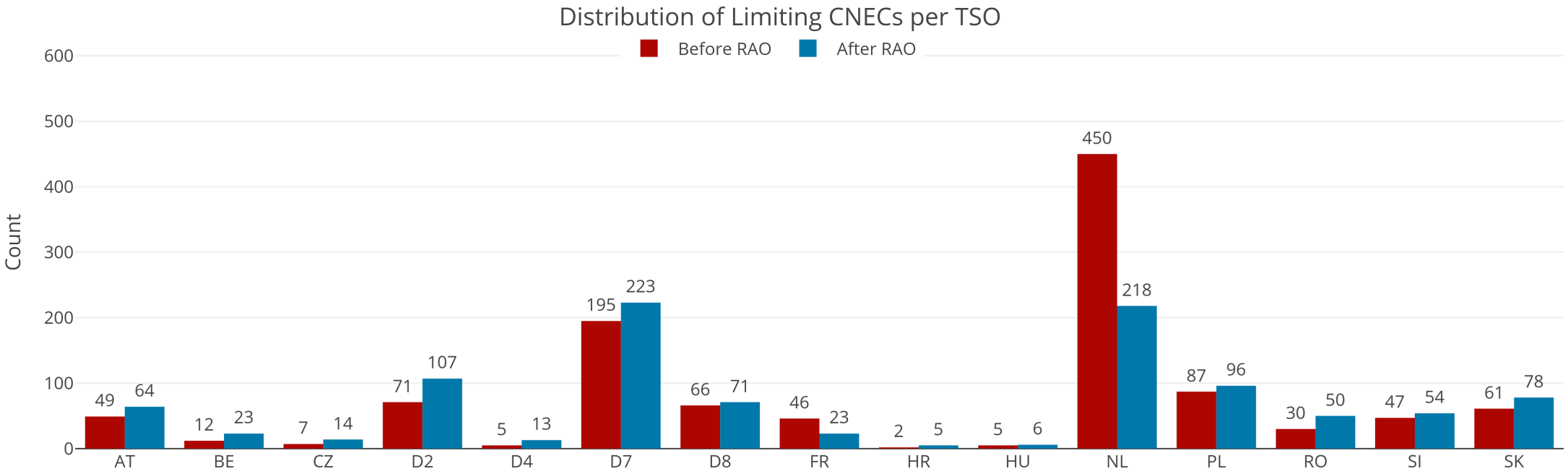
KPI 8: Relative Time Share of Applied RAs, by TSO, Type and Mode

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



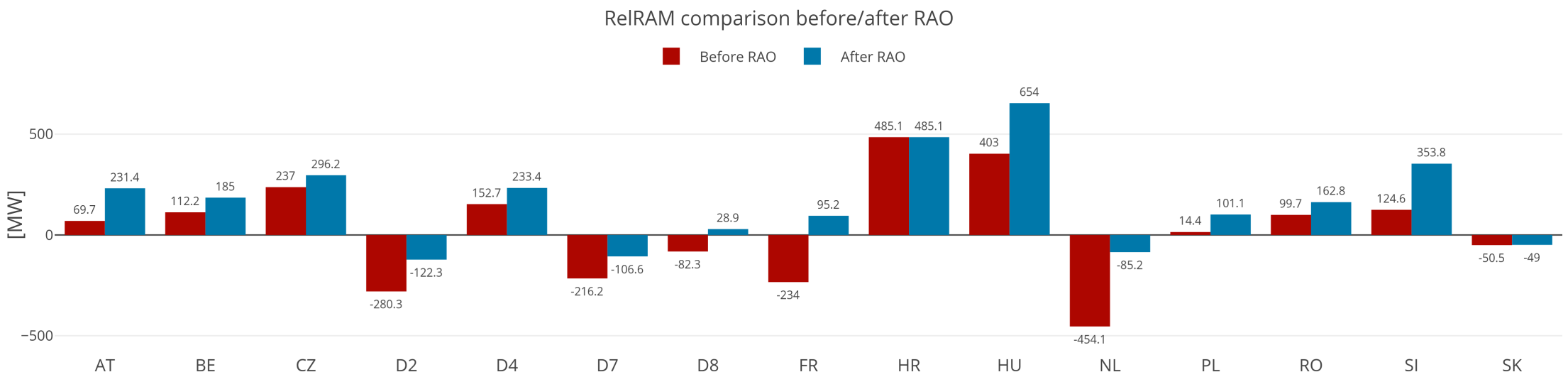
As expected, there is redistributing of the most limiting CNECs. This is because the application of Remedial Actions does not eliminate flows but re-routes, reducing the flows on some limiting CNECs and increasing the load on others, which at the end impacts also the RAM values.

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

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



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
[NL-D2] Meeden-Diele 380 Z [OPP] [NL]	734	752	37.58%	19.94%	122.60%	0.2619	0.5955
[HR-SI] 220kV Pehlin - Divaca [DIR] [HR]	732	732	54.01%	15.78%	83.42%	0.1837	0.4418
[HR-SI] 220kV Pehlin - Divaca [OPP] [HR]	732	1303	114.33%	82.35%	166.58%	0.1837	0.4418
[HU-HU] Gonyu - Gyor [DIR]	727	1244	69.79%	56.90%	89.68%	0.3077	1.5141
[SK-SK] H.Zdana - Sucany [DIR]	725	1258	75.98%	65.87%	104.55%	0.274	0.9185
[SI-HU] 400 kV Cirkovce - Hevitz [DIR] [SI]	719	1363	105.77%	71.24%	131.11%	0.1745	0.9132
[AT-SI] Obersielach - Podlog 247 [OPP] [AT]	718	1037	123.99%	35.73%	237.87%	0.2335	0.7901
[AT-SI] Obersielach - Podlog 247 [DIR] [AT]	718	1881	51.03%	19.11%	142.18%	0.2335	0.7901
[SK-SK] V.Dur - Krizovany [DIR]	716	1183	83.32%	56.63%	108.04%	0.2665	1.0792
[SI-HU] 400 kV Cirkovce - Hevitz [OPP] [SI]	716	1374	73.80%	51.67%	106.49%	0.1745	0.9132
[SK-SK] V.Dur - Levice 1 [DIR]	715	715	48.03%	37.25%	64.67%	0.1725	0.7653
[BE-FR] Achene - Lonny 380.19 [OPP] [BE]	713	1596	84.09%	34.46%	134.81%	0.3833	0.9099
[HR-HU] 400kV Ernestinovo - Pecs 1 [OPP] [HR]	712	712	70.91%	47.29%	101.73%	0.2758	0.8874
[AT-HU] Wien Suedost - Gyoer 245 [DIR] [AT]	708	1202	76.37%	50.43%	120.51%	0.0883	0.3618
[NL-BE] PST Van Eyck 2 [OPP] [BE]	699	1904	80.25%	33.78%	121.55%	0.593	1.3832
[NL-D7] Maasbracht - Siersdorf SELFK SW [DIR] [D7]	698	4291	58.06%	19.92%	102.02%	0.303	0.6415
[AT-CZ] Duernrohr 1 - Slavetice 437 [OPP] [AT]	698	698	65.61%	31.23%	90.83%	0.3598	1.4485
[NL-BE] PST Van Eyck 2 [DIR] [BE]	692	1717	91.80%	53.38%	139.93%	0.593	1.3832
[D8-PL] Mikulowa PST1 [OPP] [PL]	692	692	45.19%	23.71%	78.11%	0.3471	1.2507
[AT-AT] Westtirol 1 - Westtirol 2 WTRHU41 [OPP]	684	1022	56.33%	19.90%	132.90%	0.289	1.2456

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
[FR-D7] Vigy - Ensdorf VIGY2 S [DIR] [D7]	182	182	482.28	47.70%	19.85%	87.05%	0.2369
[AT-SI] Obersielach - Podlog 247 [DIR] [AT]	152	158	393.93	40.63%	19.20%	86.18%	0.2214
[NL-D2] Meeden-Diele 380 Z [OPP] [NL]	143	143	711.87	27.48%	19.94%	63.44%	0.24
[D8-PL] Mikulowa PST1 [OPP] [PL]	113	113	610.1	39.29%	23.71%	68.03%	0.3422
[AT-D2] St. Peter 2 - Pleinting 258 [OPP] [AT]	96	96	858.96	59.46%	19.83%	125.38%	0.1618
[PL-PL] Krosno Iskrzynia - Rzeszow [OPP]	93	93	688.18	51.44%	32.31%	74.24%	0.3815
[BE-FR] Achene - Lonny 380.19 [OPP] [BE]	88	88	133.68	90.62%	48.21%	134.03%	0.3512
[D2-D2] Altheim - Sittling 219 [OPP]	51	51	1406.15	59.04%	26.37%	81.46%	0.0756
[NL-D7] Maasbracht - Siersdorf SELFK SW [DIR] [D7]	47	51	114.63	53.19%	36.66%	78.98%	0.2716
[PL-PL] Krosno Iskrzynia - Tarnow [OPP]	46	46	249.06	46.05%	32.68%	73.88%	0.43
[D2-D2] Altheim - Simbach 233/230 [DIR]	46	46	1191.92	63.61%	32.21%	87.40%	0.0925
[RO-RO] TR Rosiori 400/220 1 [DIR]	45	45	1144.17	30.43%	19.25%	58.50%	0.155
[D8-D8] Pasewalk - Vierraden 306 [DIR]	43	43	1060.92	30.63%	21.58%	41.97%	0.0748
[PL-PL] Mikulowa AT1 [OPP]	34	34	434.97	91.65%	70.55%	125.64%	0.1814
[AT-CZ] Duernrohr 1 - Slavetice 437 [OPP] [AT]	33	33	181.67	54.10%	37.38%	67.49%	0.3354
[AT-HU] Wien Suedost - Gyoer 245 [DIR] [AT]	33	33	712.1	65.82%	50.43%	85.90%	0.0778
[CZ-SK] Nosovice - Varin [DIR] [SK]	30	32	350.33	61.52%	51.34%	69.88%	0.3306
[D7-D7] Mittelbexbach - Uchtelfangen BLIES N [OPP]	28	28	711.39	32.38%	19.94%	42.16%	0.1331
[NL-D7] Maasbracht-Siersdorf 380 Z [DIR] [NL]	22	22	6.32	42.90%	23.85%	71.71%	0.2868
[SK-UA] V.Kapusany - Mukachevo (WPS) [DIR] [SK]	22	22	575.5	67.25%	52.48%	93.47%	0.2539

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:

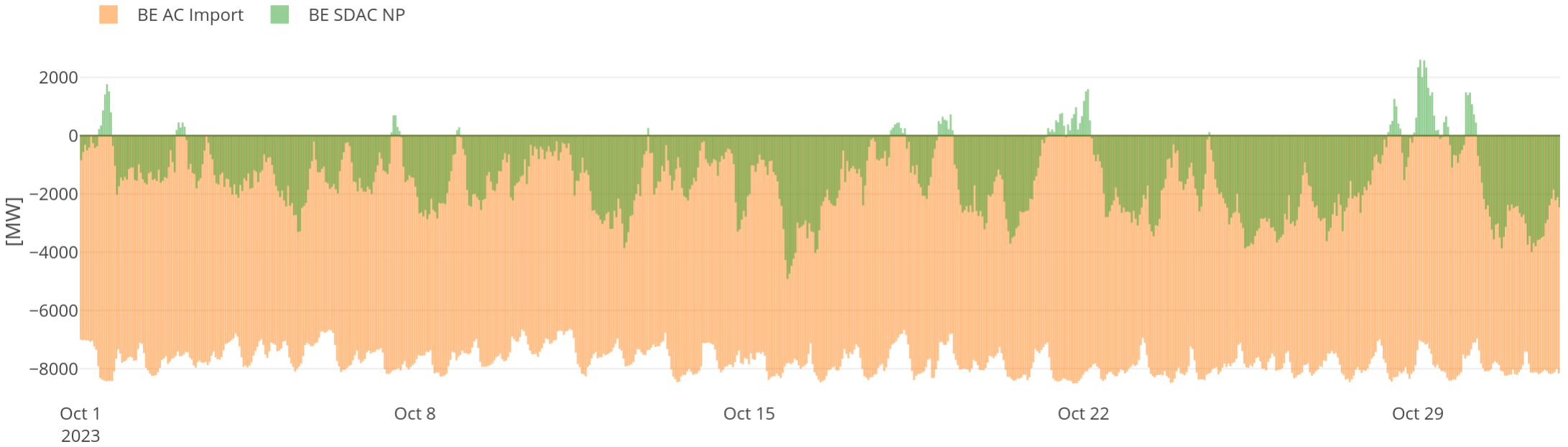
- RAM = 500MW
- Portion of FB Domain = 40%
- RAM offered by Core TSOs = 400mW/0.4 = 1250MW

KPI 13a: Allocation Constraints - Belgium

	# MTUs
AC was Limiting MC	0

	BE AC Import [MW]
Avg.	-7731.03
Min.	-8493.00
Max.	-6619.00

Belgium only uses import allocation contraints



KPI 13b: Allocation Constraints - Poland

	# MTUs
AC was limiting MC	206
AC < 0 MW	53
AC = 0 MW	126
AC > 0 MW	27

	PL AC Import [MW]	PL AC Export [MW]
Avg.	-1297.37	3432.94
Min.	-8257.00	0.00
Max.	0.00	11567.00