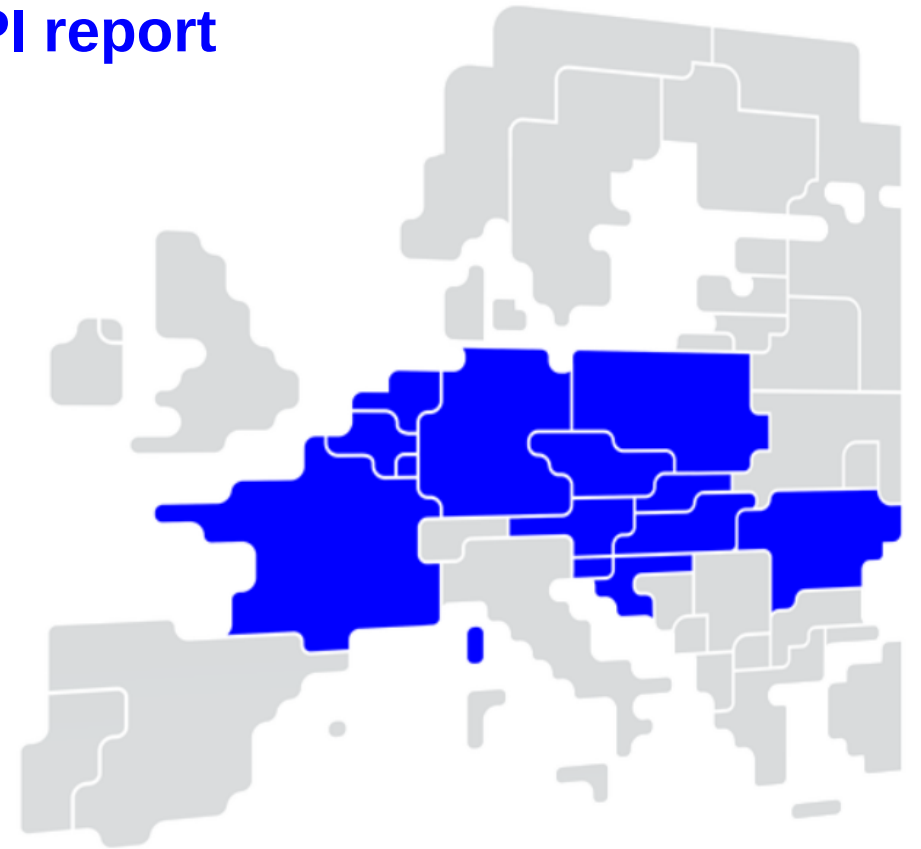


# Core FB MC Operational KPI report

April 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)

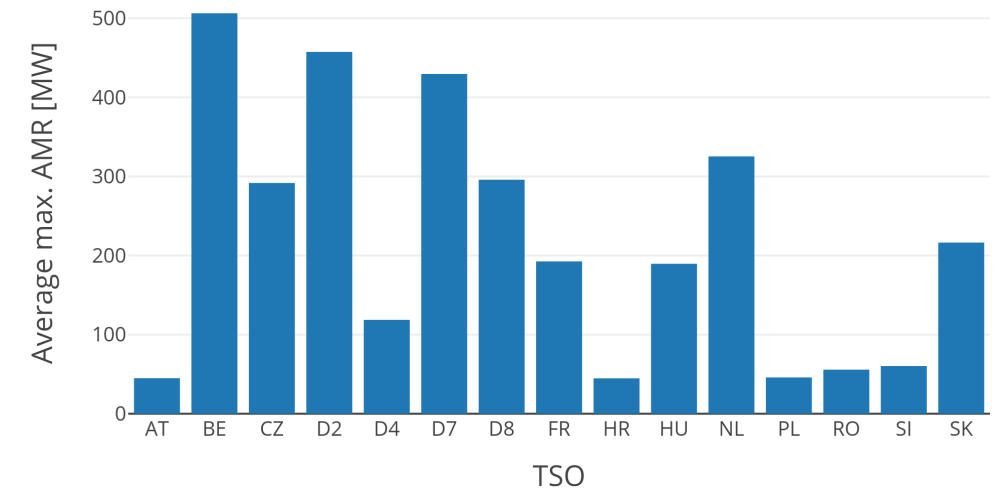
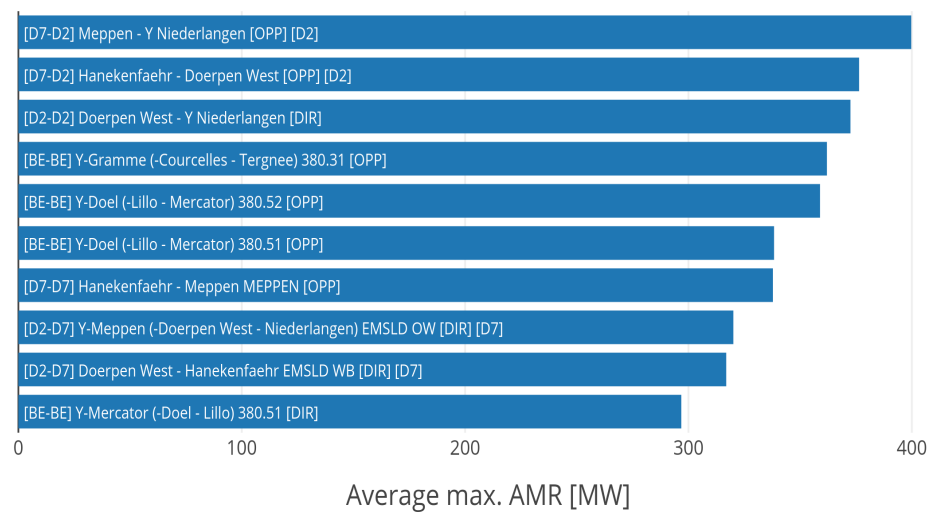
# KPI 2: Average maximum AMR per TSO



CNE	Average Maximum AMR (MW)	AMR as % of Fmax
[D7-D2] Meppen - Y Niederlangen [OPP] [D2]	399.75	19.04%
[D7-D2] Hanekenfaehr - Doerpen West [OPP] [D2]	376.39	17.63%
[D2-D2] Doerpen West - Y Niederlangen [DIR]	372.52	17.66%
[BE-BE] Y-Gramme (-Courcelles - Tergnee) 380.31 [OPP]	361.98	22.67%
[BE-BE] Y-Doel (-Lillo - Mercator) 380.52 [OPP]	358.90	23.44%
[BE-BE] Y-Doel (-Lillo - Mercator) 380.51 [OPP]	338.32	21.45%
[D7-D7] Hanekenfaehr - Meppen MEPPEN [OPP]	337.81	13.06%
[D2-D7] Y-Meppen (-Doerpen West - Niederlangen) EMSLD OW [DIR] [D7]	320.09	12.23%
[D2-D7] Doerpen West - Hanekenfaehr EMSLD WB [DIR] [D7]	316.91	12.46%
[BE-BE] Y-Mercator (-Doel - Lillo) 380.51 [DIR]	296.78	19.19%

TSO	Average maximum AMR per TSO
AT	44.90
BE	506.31
CZ	291.72
D2	457.49
D4	118.59
D7	429.48
D8	295.79
FR	192.58
HR	44.66
HU	189.59

TSO	Average maximum AMR per TSO
NL	325.30
PL	45.83
RO	55.68
SI	60.23
SK	216.30



# KPI 3: Share of MTUs with intervention per TSO



Total BDs

30

Total MTUs

720

MTUs without IVA

290

Share of distinct MTUs without IVA

40.3%

MTUs with IVA

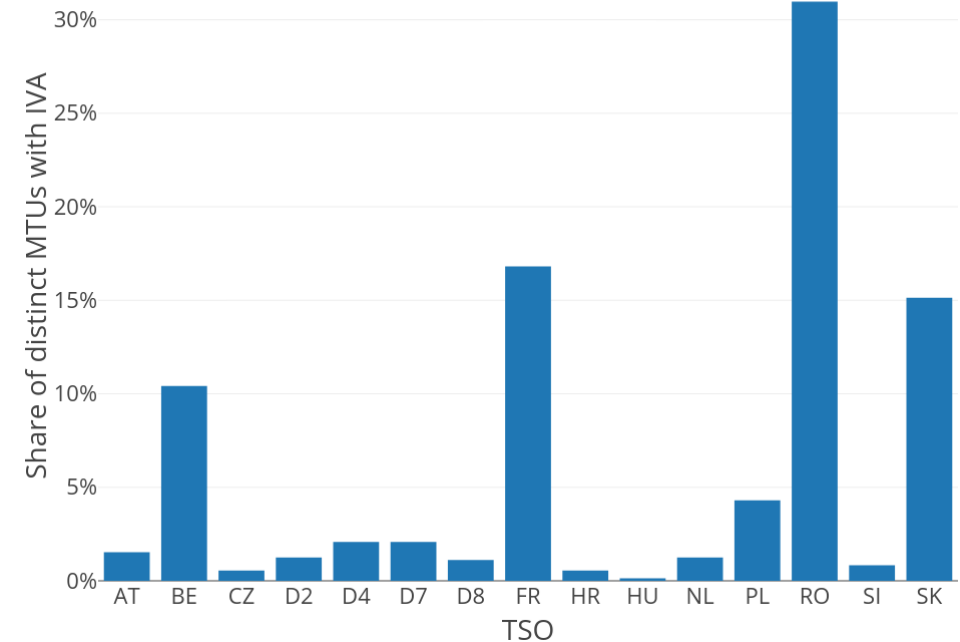
430

Share of distinct MTUs with IVA

59.7%

TSO	Share of distinct MTUs with IVA	Distinct MTUs with IVA
SI	0.83%	6
CZ	0.56%	4
AT	1.53%	11
D7	2.08%	15
D8	1.11%	8
D2	1.25%	9
PL	4.31%	31
D4	2.08%	15
SK	15.14%	109
HU	0.14%	1

TSO	Share of distinct MTUs with IVA	Distinct MTUs with IVA
BE	10.42%	75
NL	1.25%	9
FR	16.81%	121
RO	30.97%	223
HR	0.56%	4

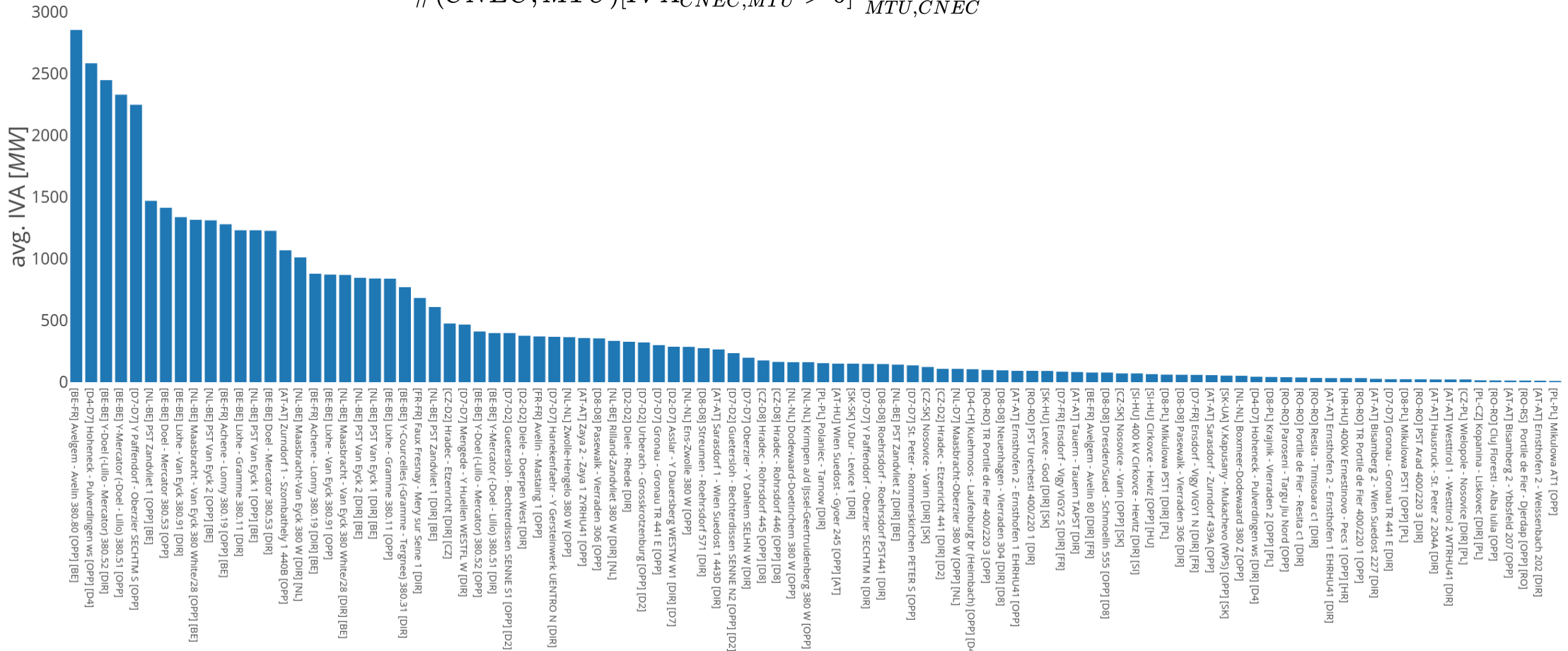




# KPI 4a: Average IVA applied for each CNE affected by TSO intervention



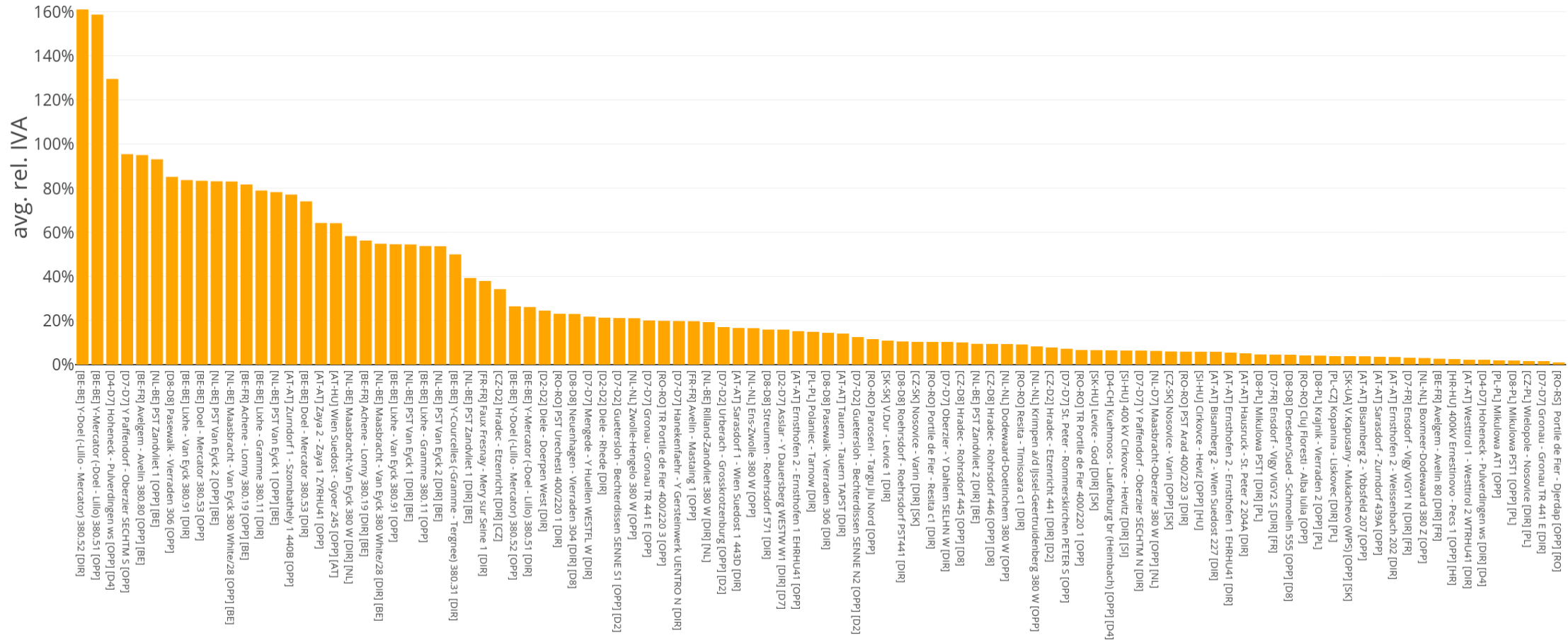
$$\text{avg. IVA}_{CNE} = \frac{1}{\#(CNEC, MTU)[IVA_{CNEC, MTU} > 0]} \sum_{MTU, CNEC} IVA_{CNEC, MTU} [IVA_{CNEC, MTU} > 0]$$



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



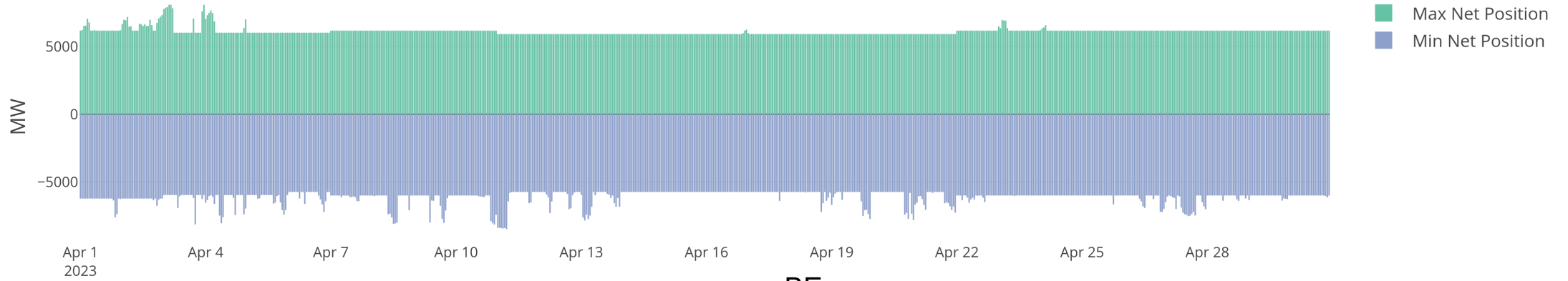
$$\text{avg. rel. IVA}_{CNE} = \frac{1}{\#(CNEC, MTU)[IVA_{CNEC, MTU} > 0]} \sum_{MTU, CNEC} \frac{IVA_{CNEC, MTU}[IVA_{CNEC, MTU} > 0]}{F_{max, CNEC, MTU}[IVA_{CNEC, MTU} > 0]}$$



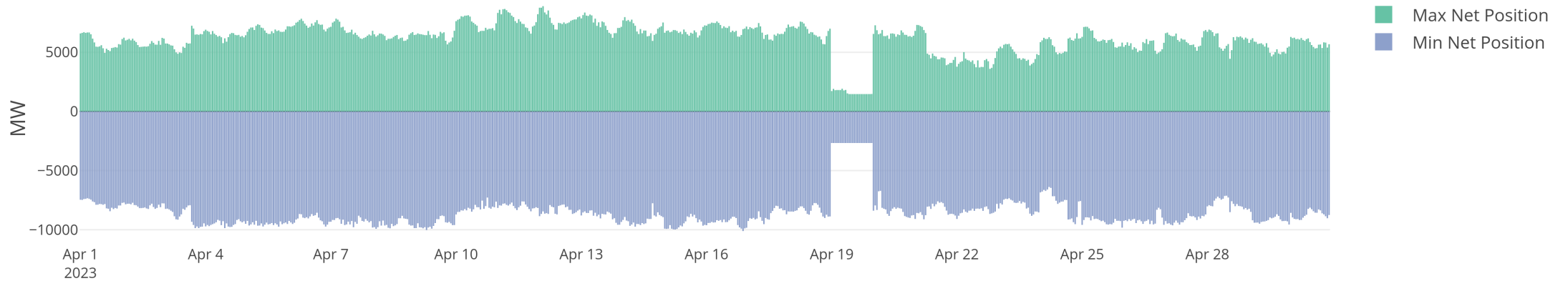
# KPI 5: Min & max net positions per BZ hub



AT



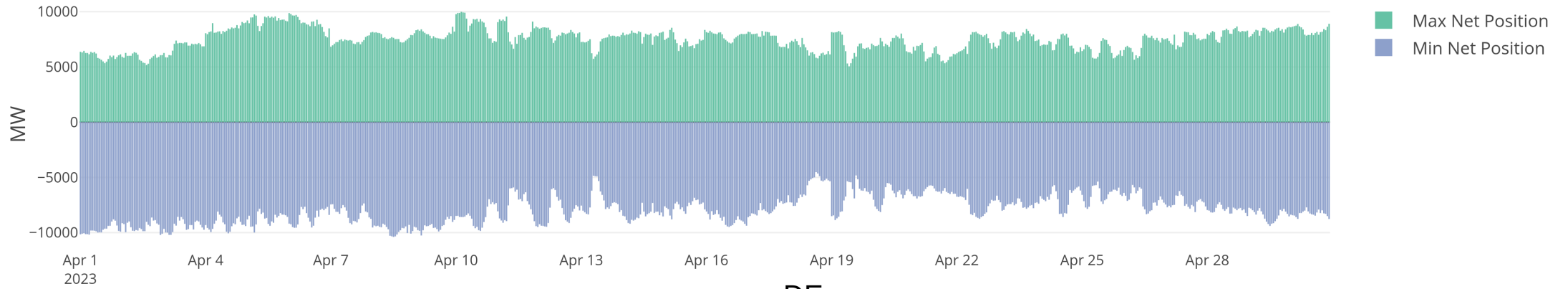
BE



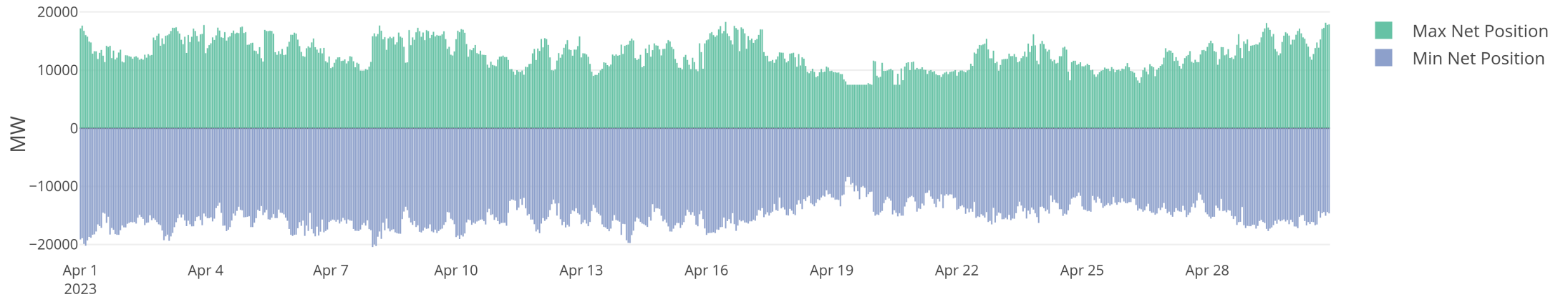
# KPI 5: Min & max net positions per BZ hub



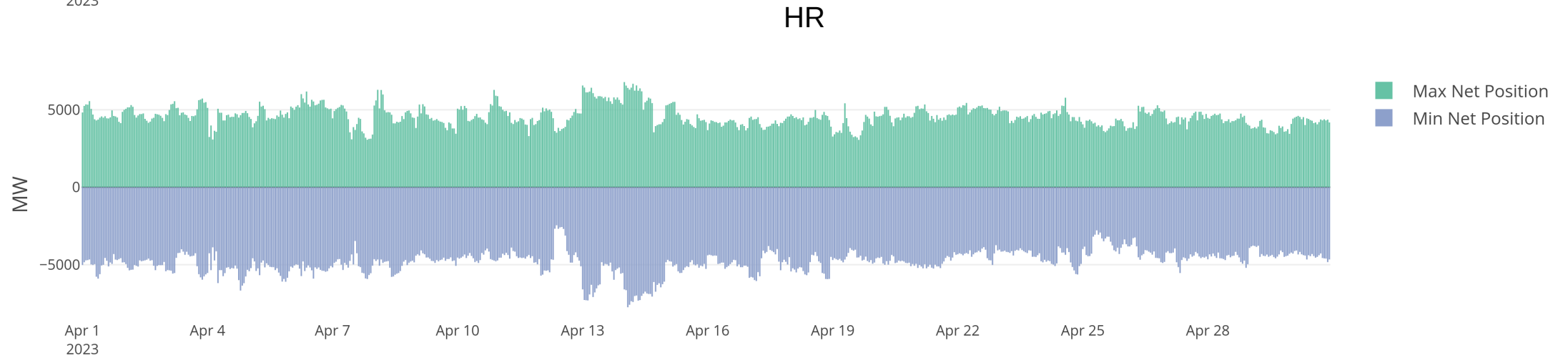
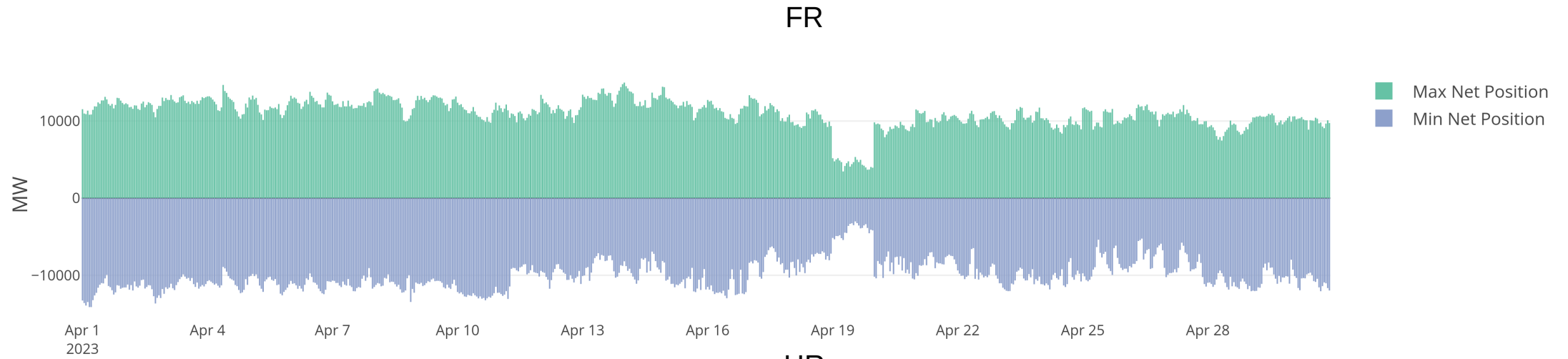
CZ



DE



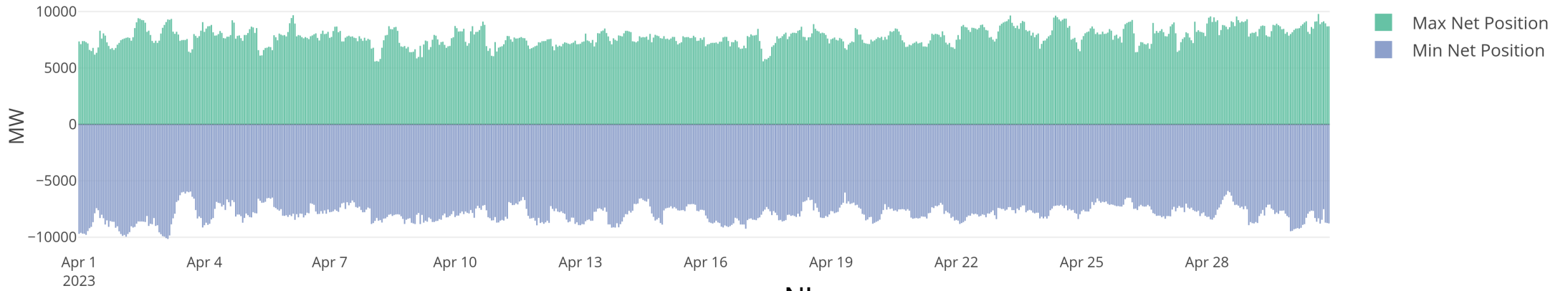
# KPI 5: Min & max net positions per BZ hub



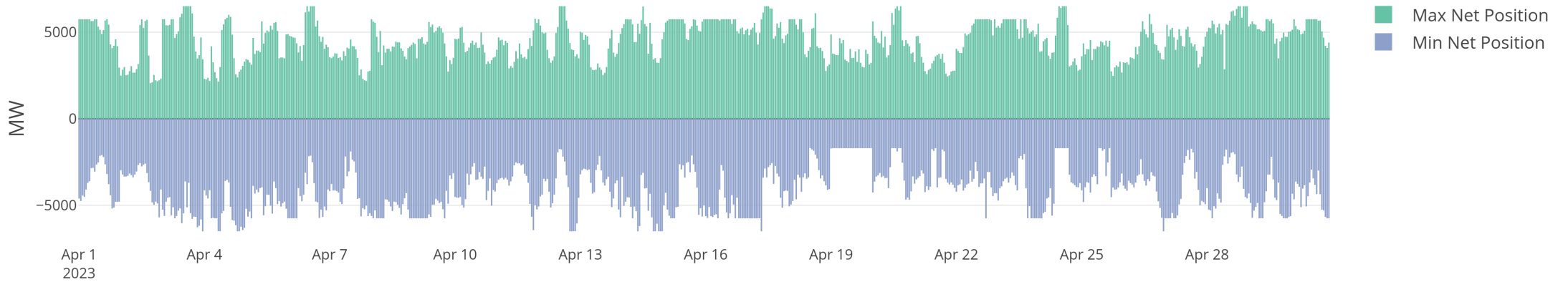
# KPI 5: Min & max net positions per BZ hub



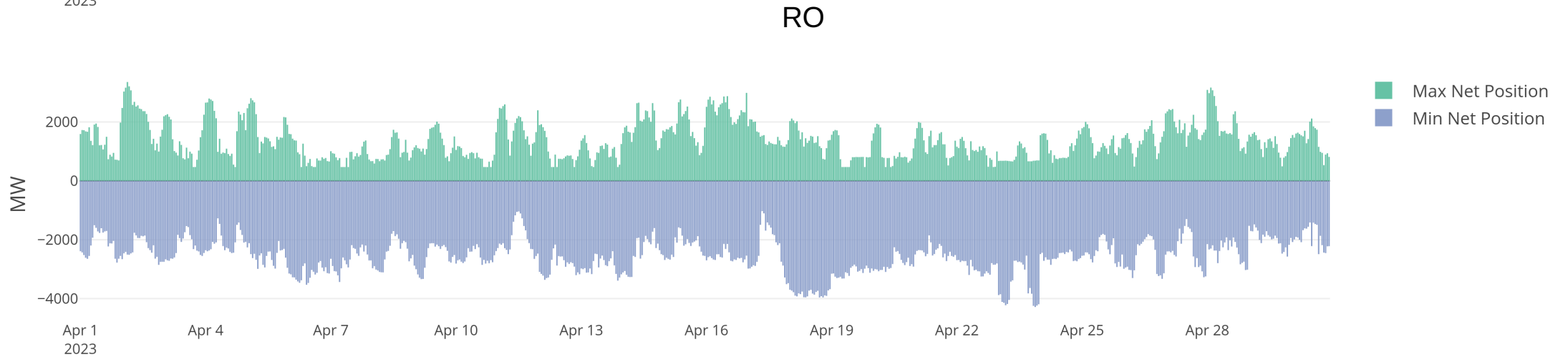
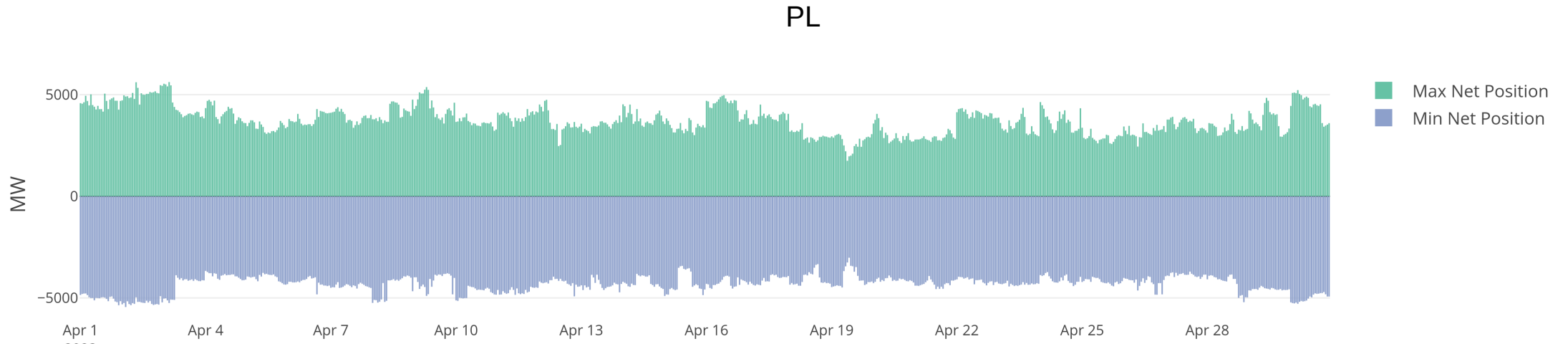
HU



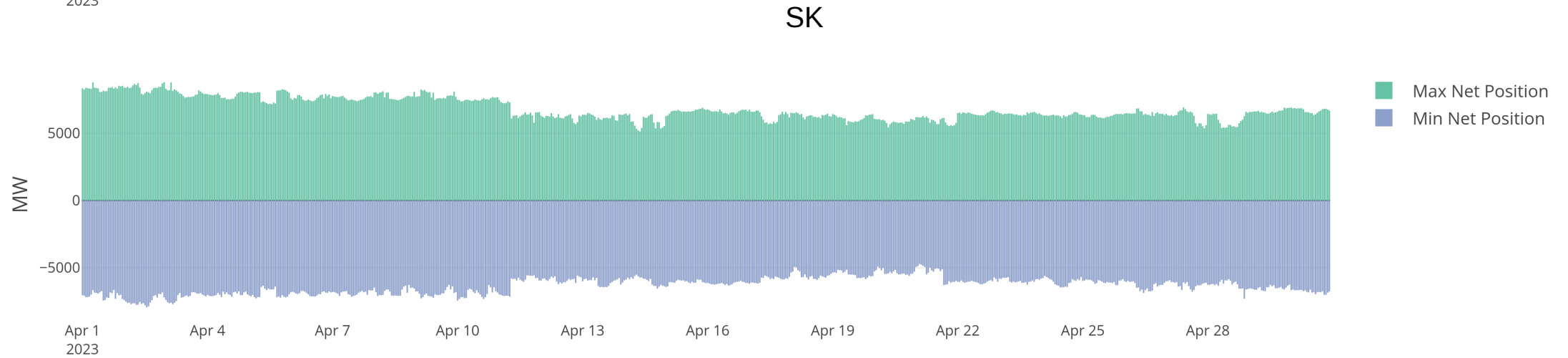
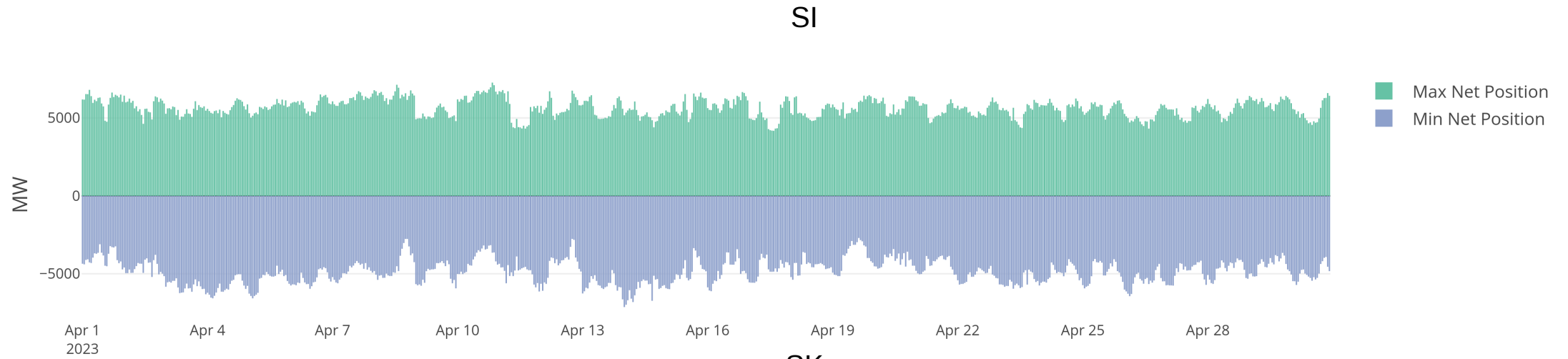
NL



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

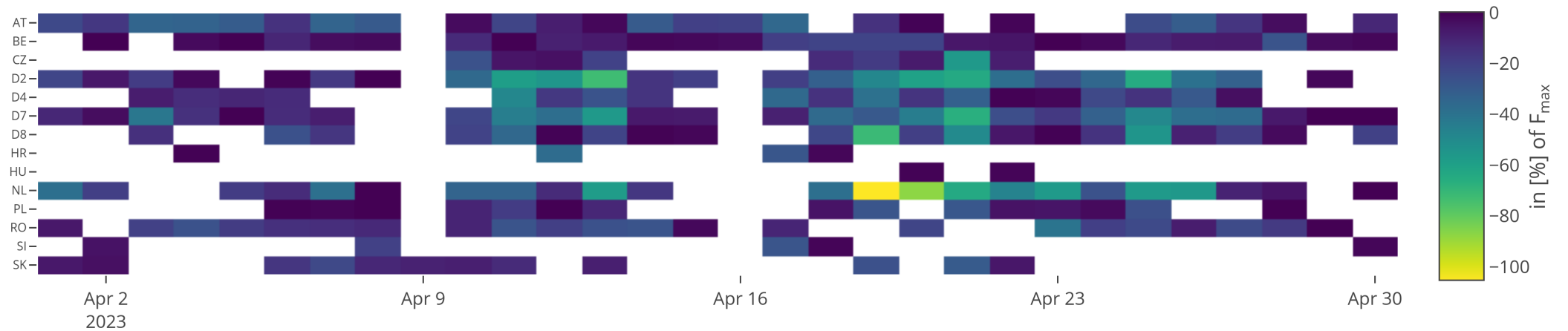
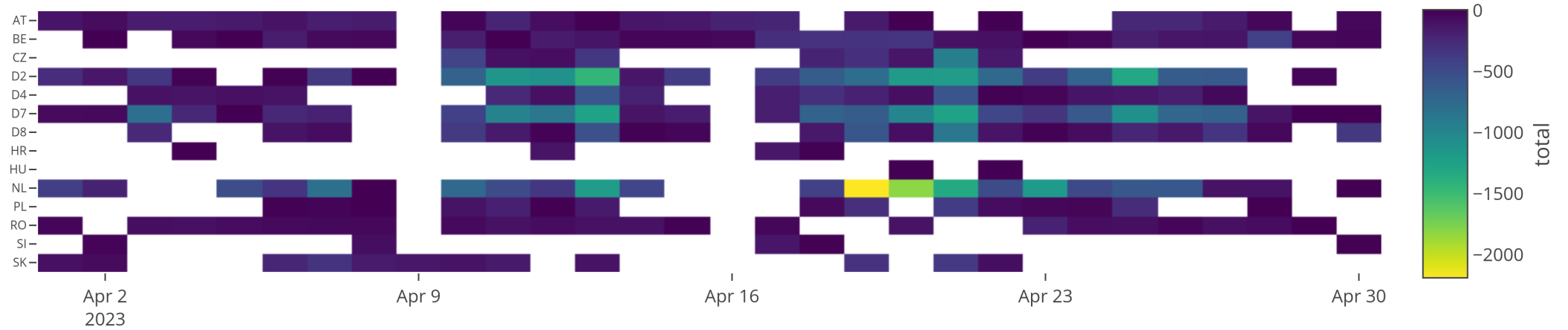


# KPI 5: Min & max net positions per BZ hub

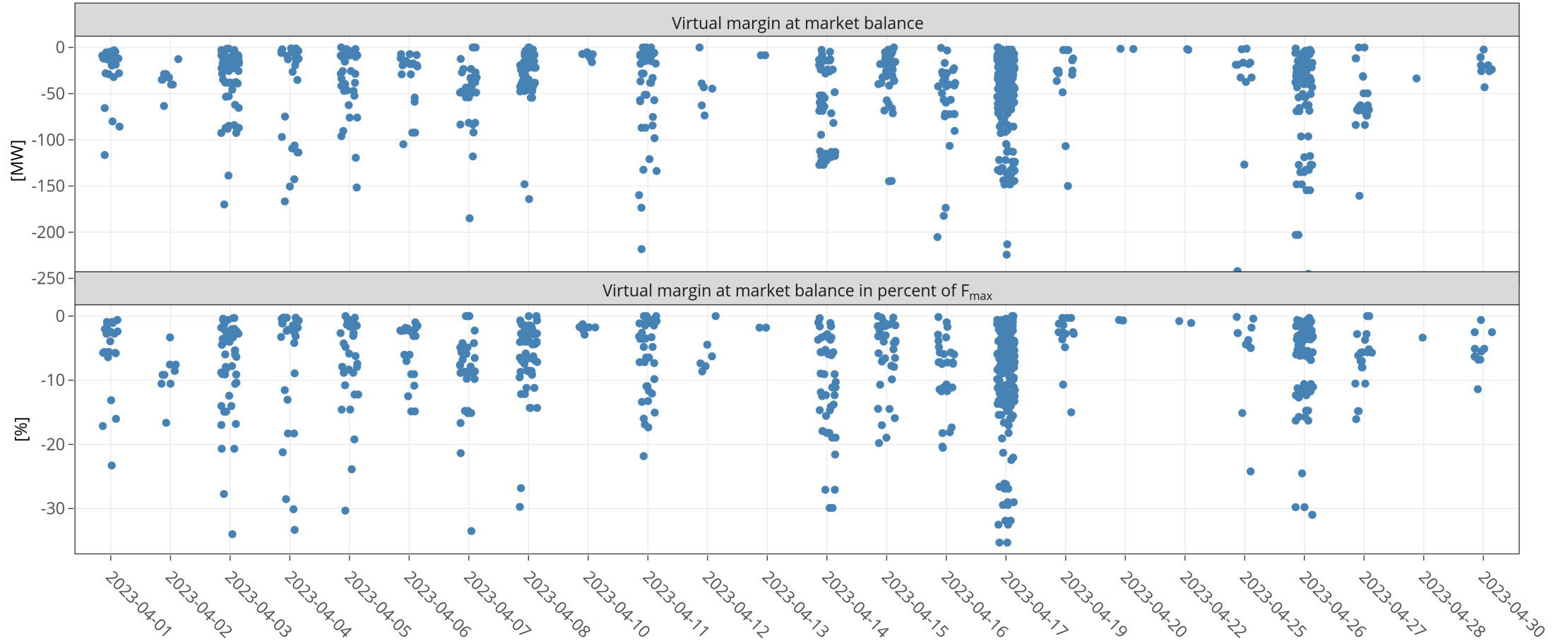




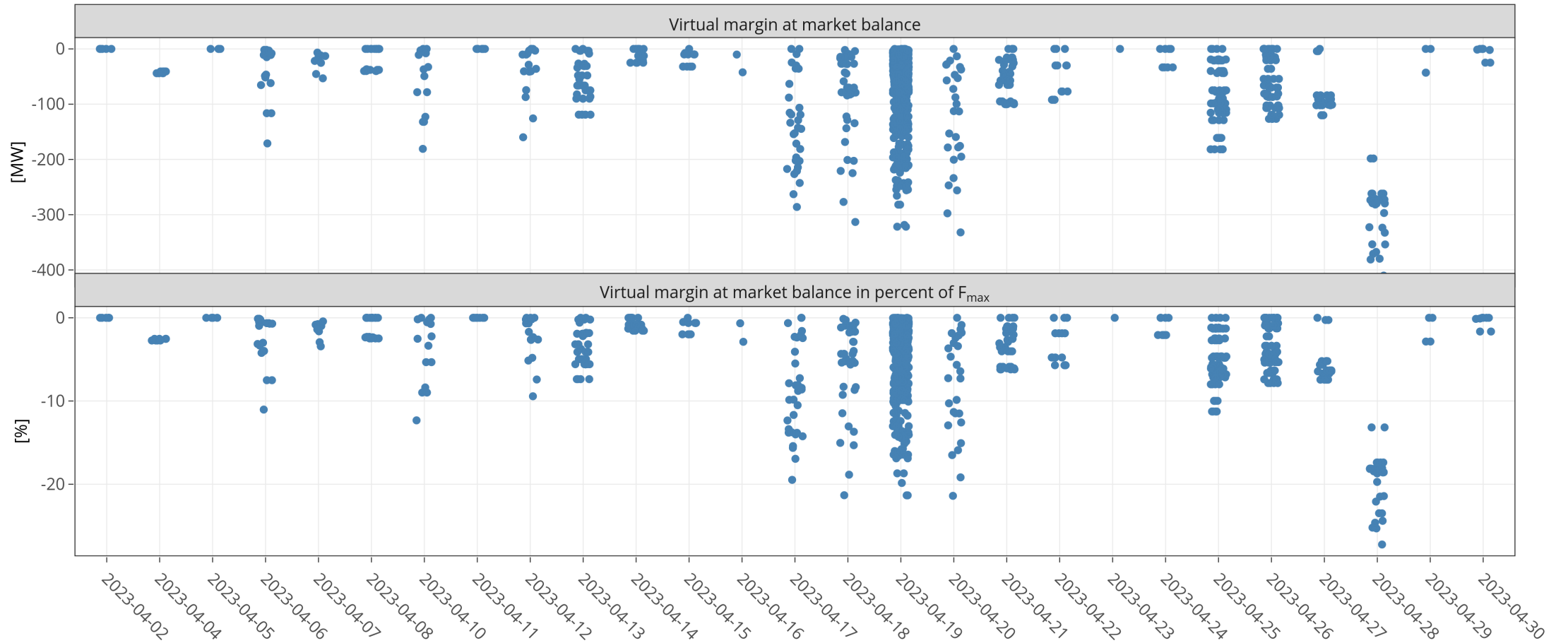
# KPI 6a: Highest virtual margins at market balance for CORE TSOs



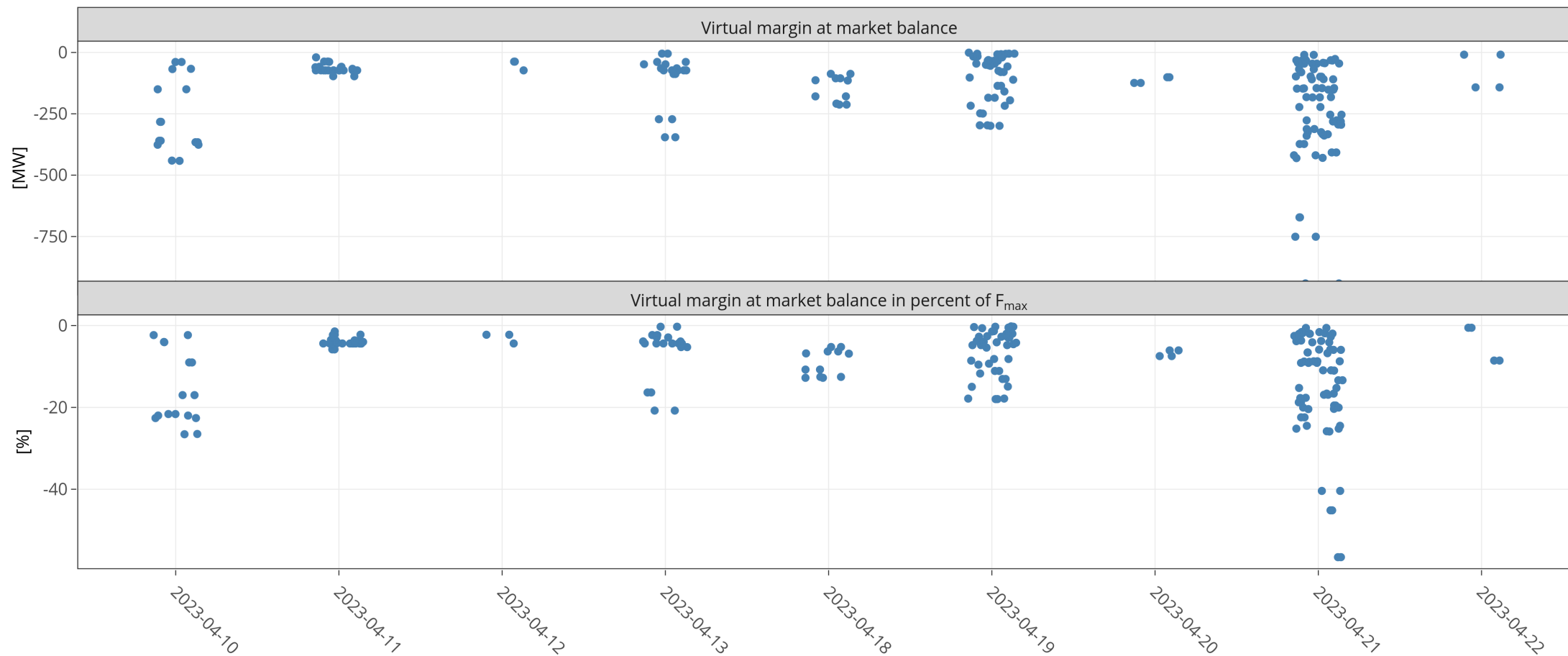
# KPI 6b: Virtual margins at market balance AT



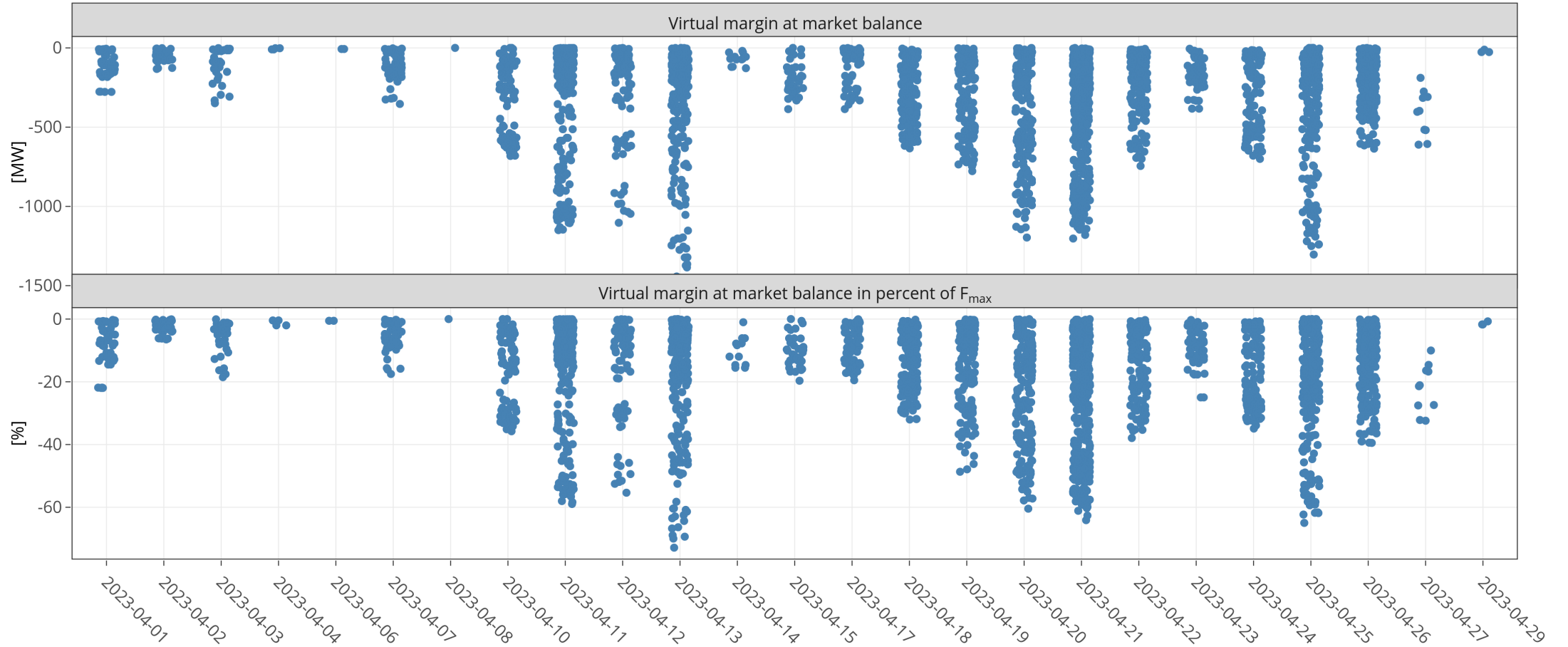
# KPI 6b: Virtual margins at market balance BE



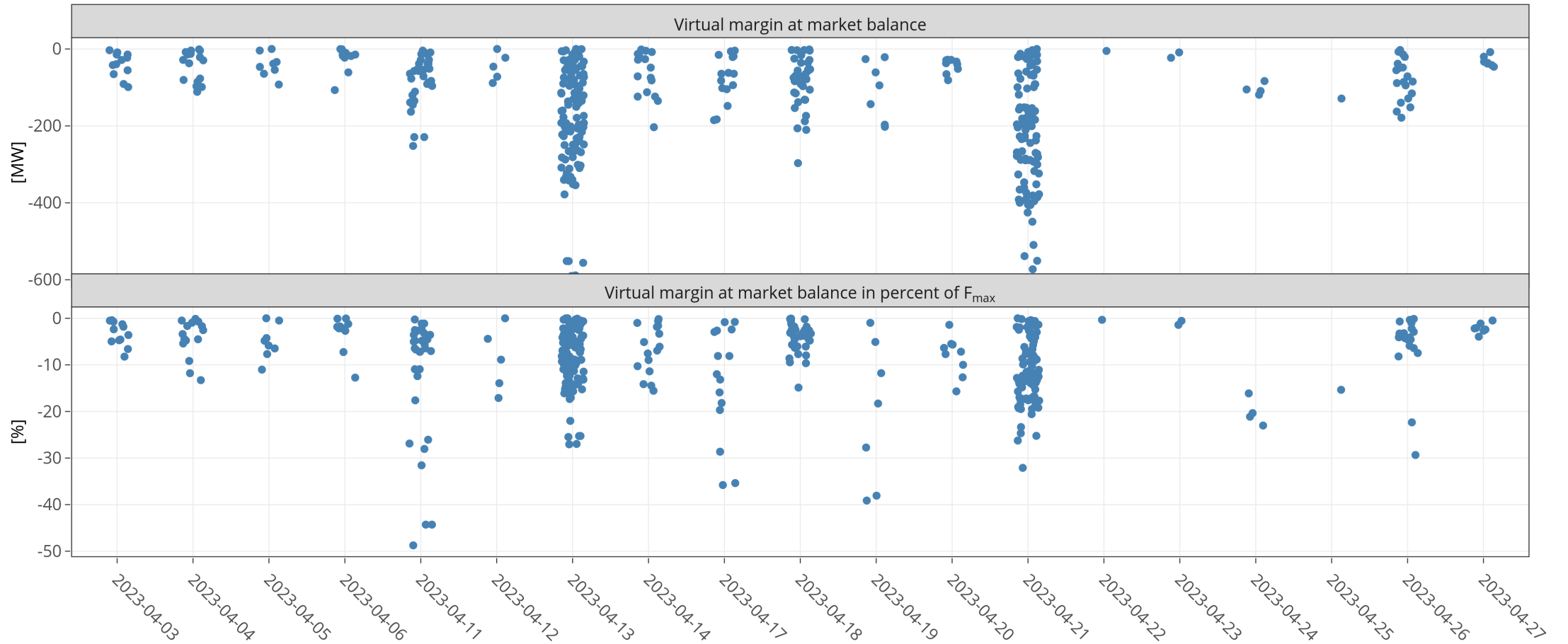
# KPI 6b: Virtual margins at market balance CZ



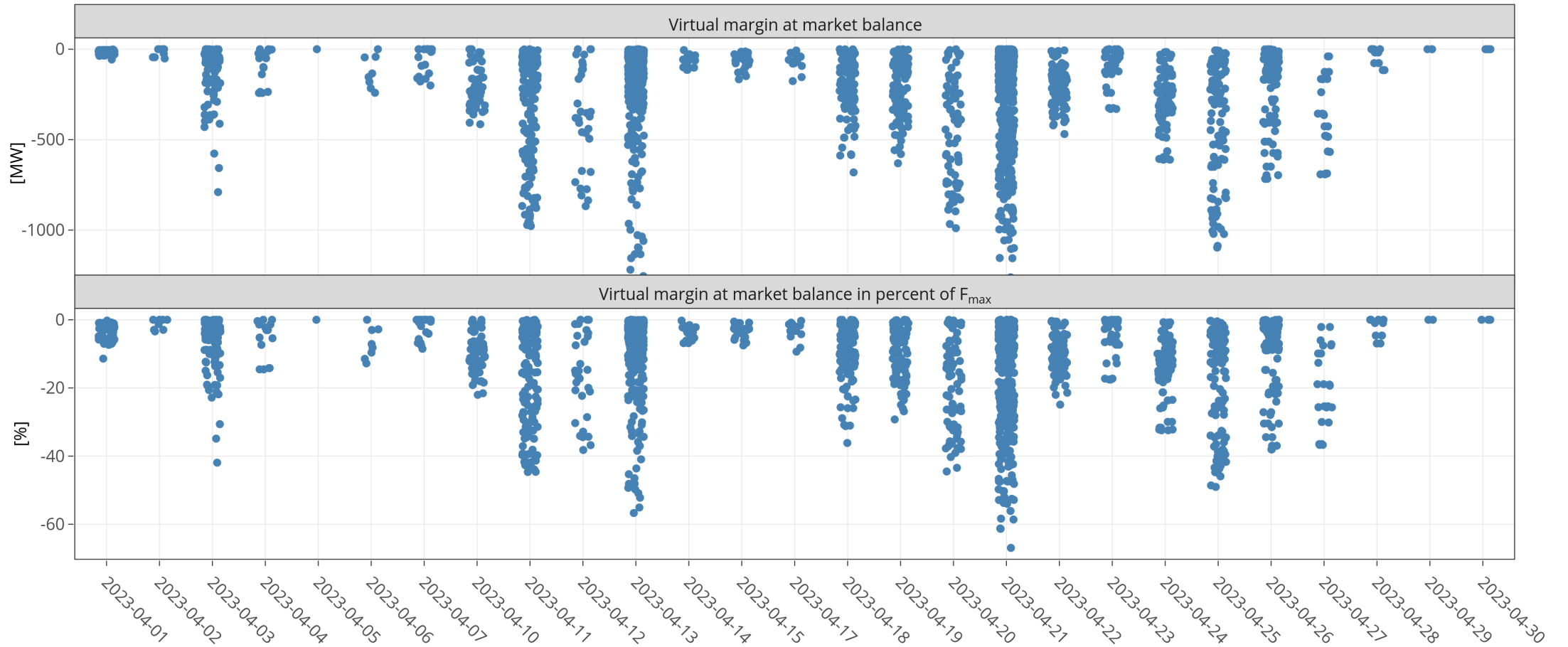
# KPI 6b: Virtual margins at market balance D2



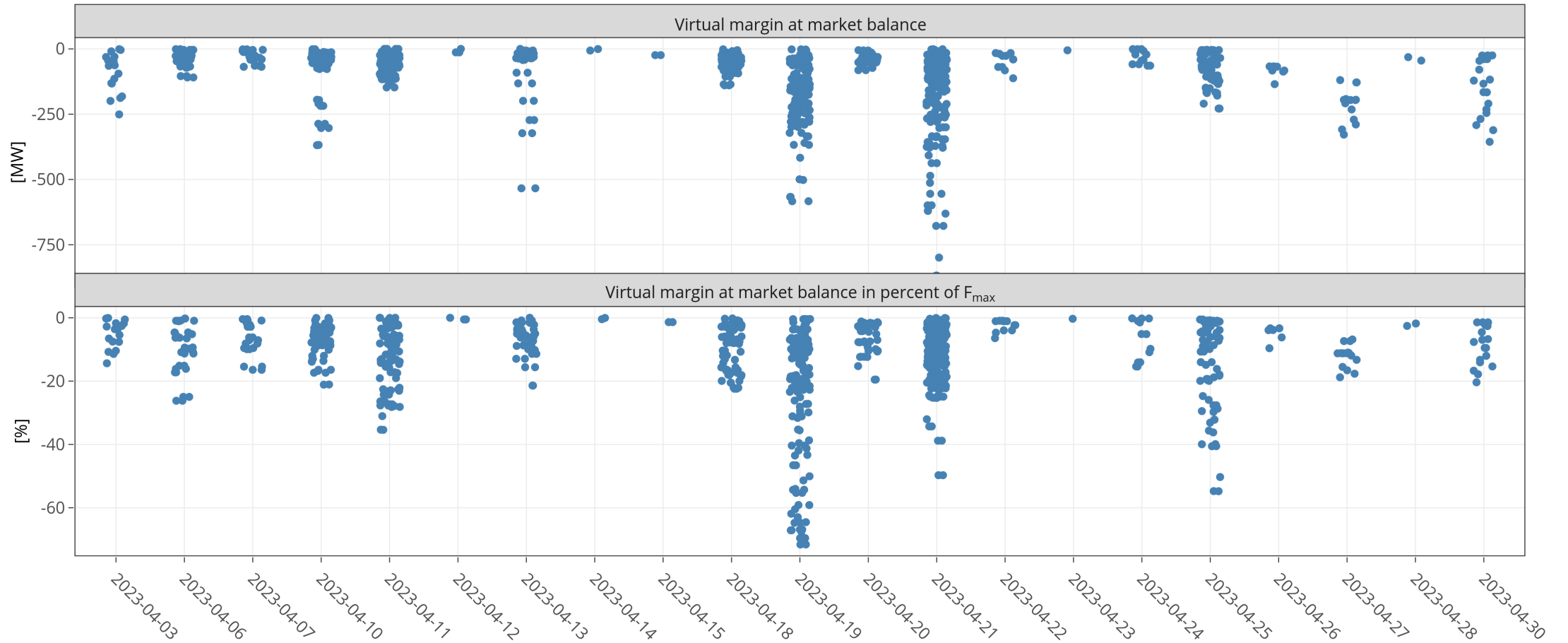
# KPI 6b: Virtual margins at market balance D4



# KPI 6b: Virtual margins at market balance D7

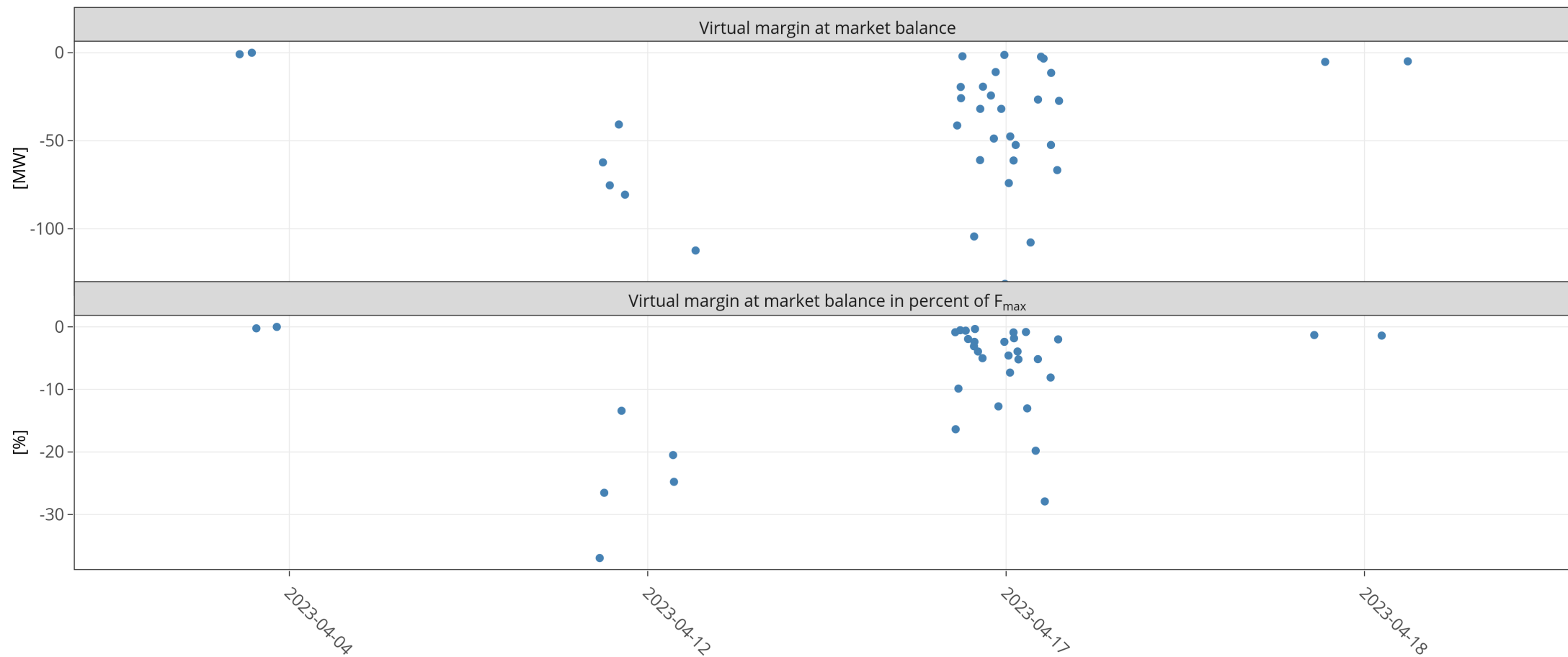


# KPI 6b: Virtual margins at market balance D8

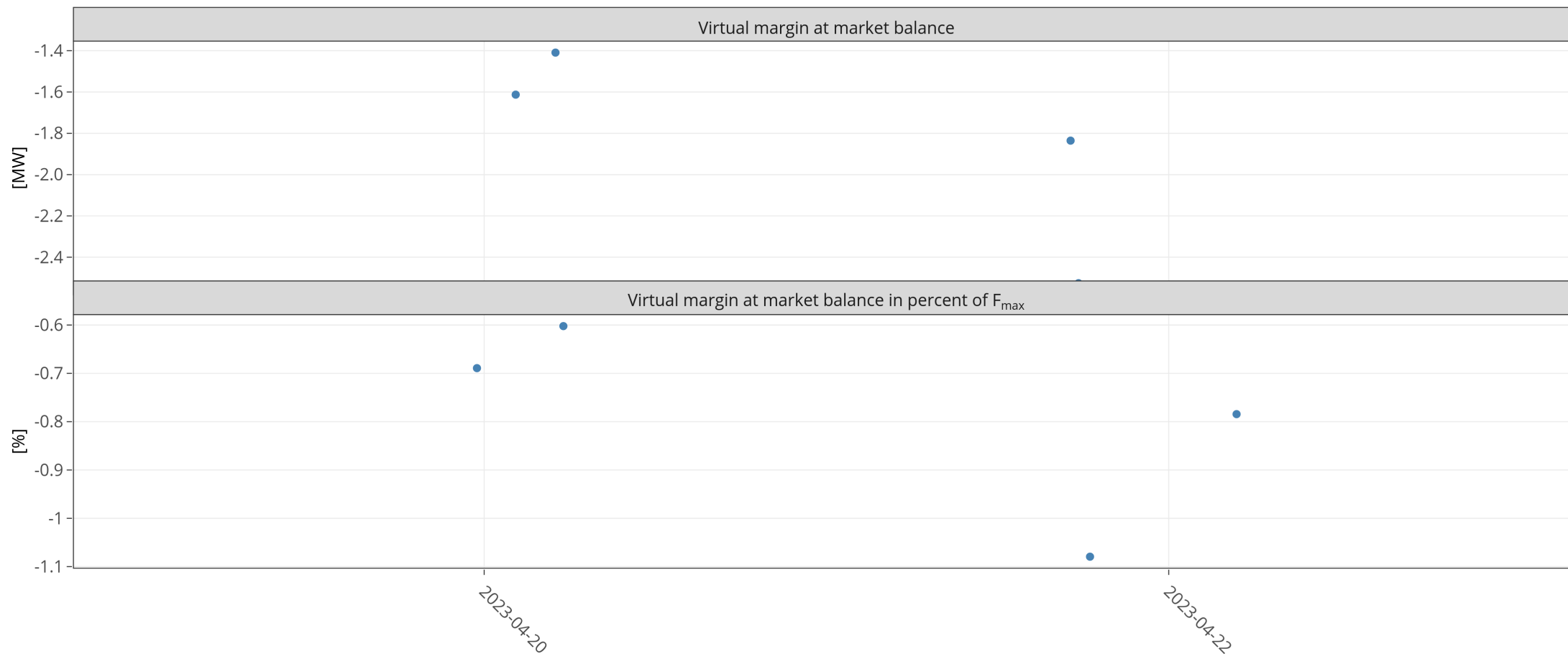




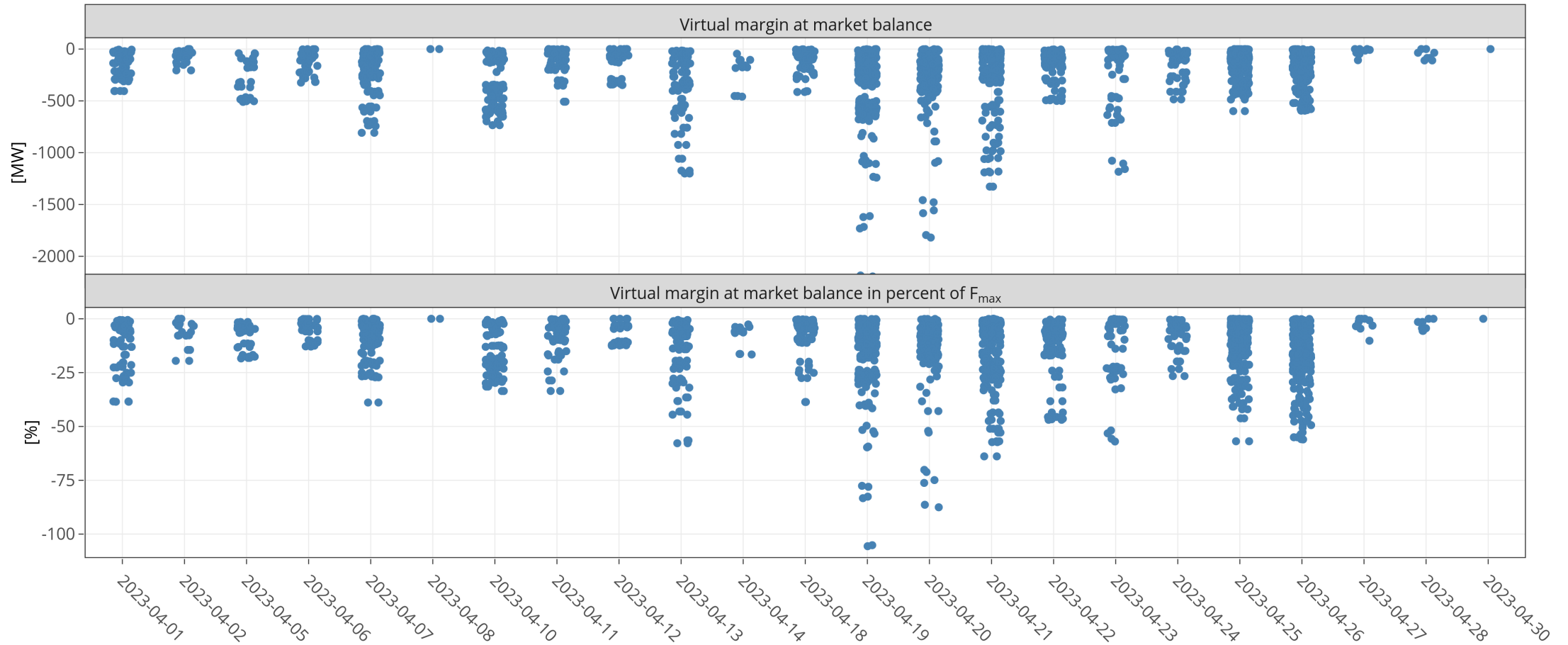
# KPI 6b: Virtual margins at market balance HR



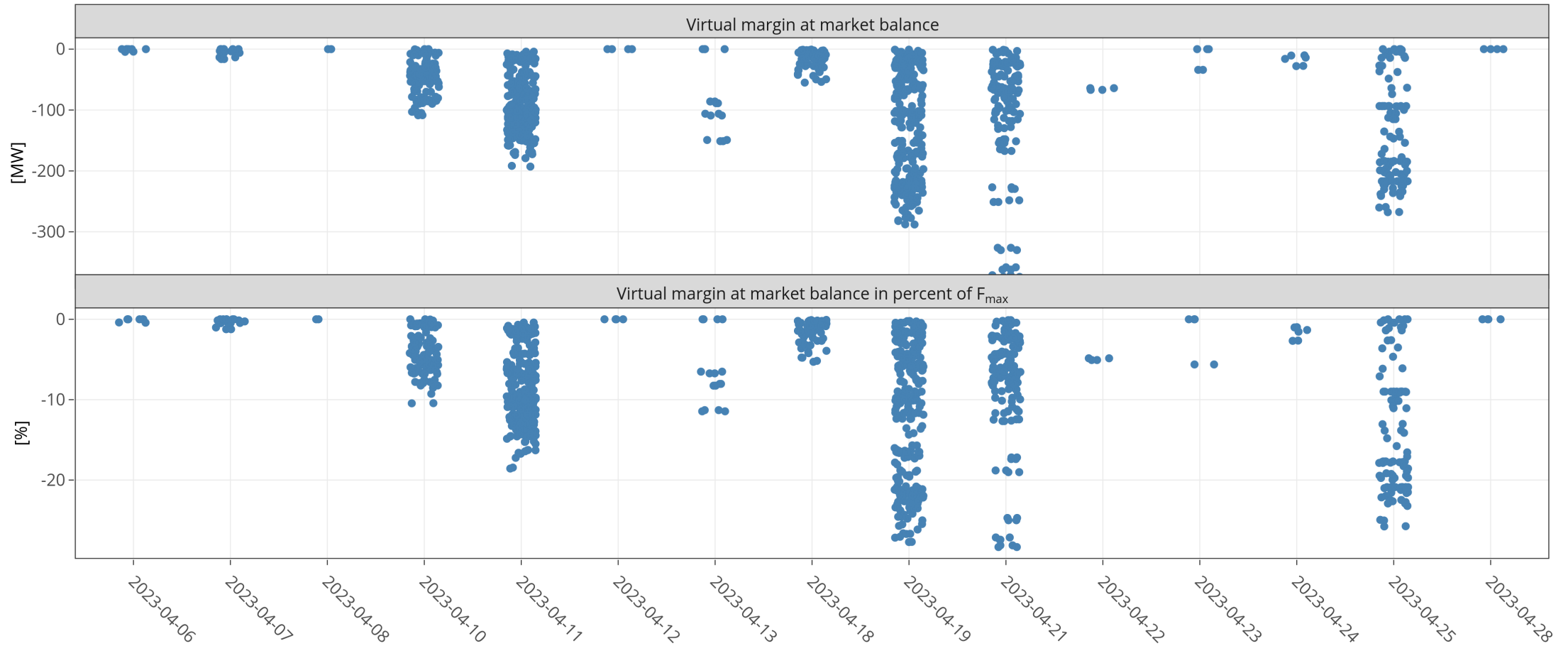
# KPI 6b: Virtual margins at market balance HU



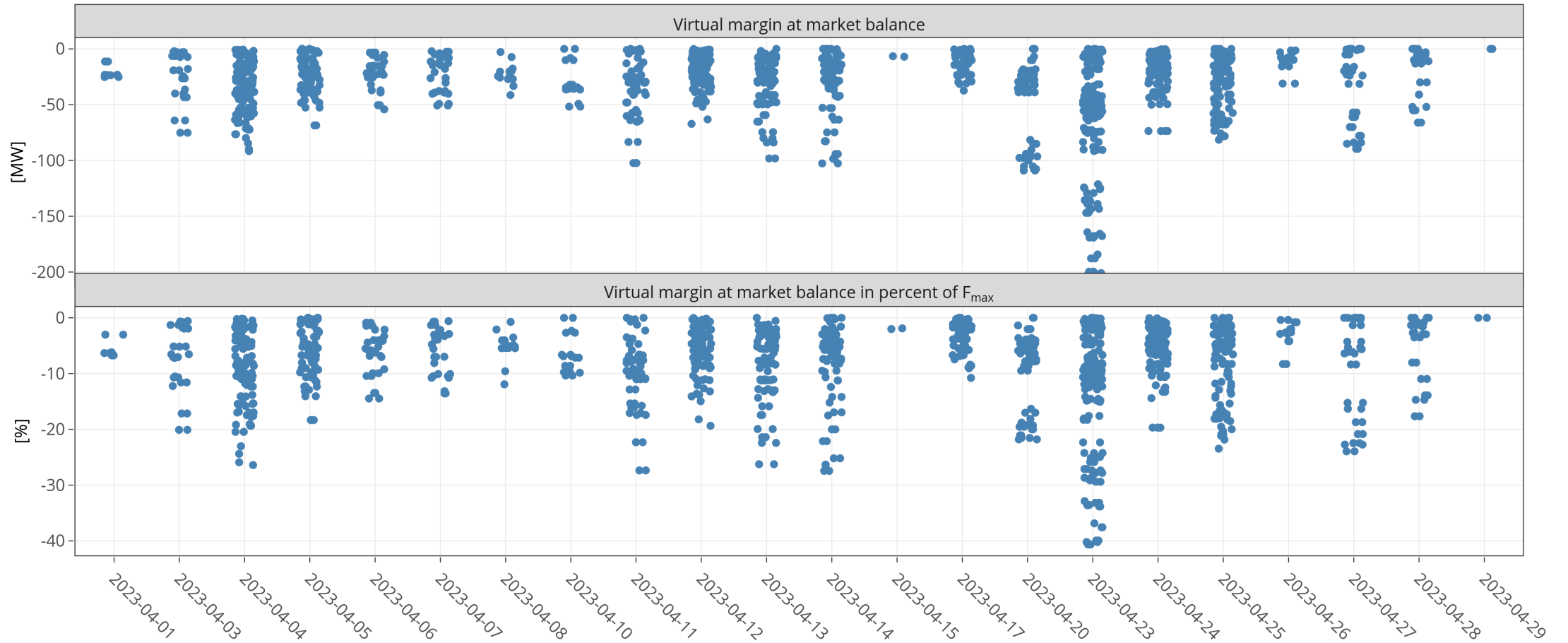
# KPI 6b: Virtual margins at market balance NL



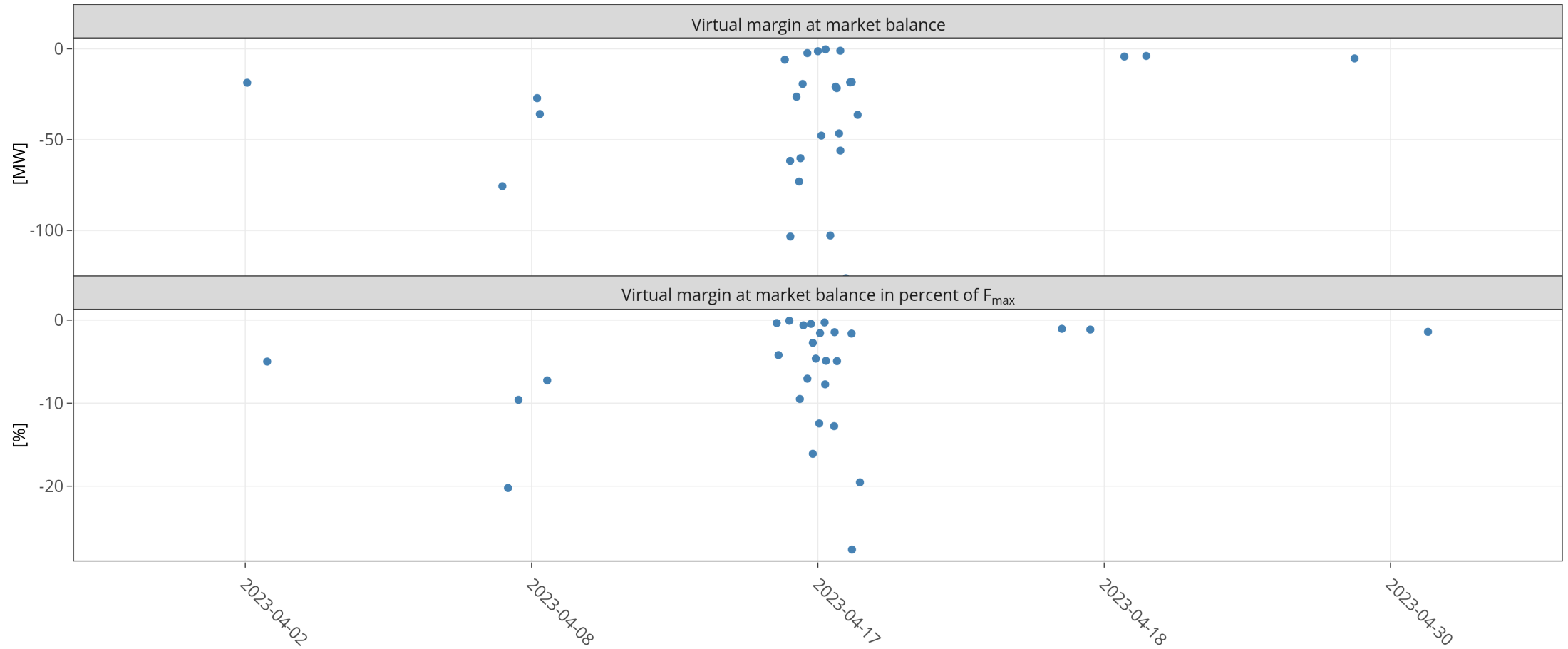
# KPI 6b: Virtual margins at market balance PL



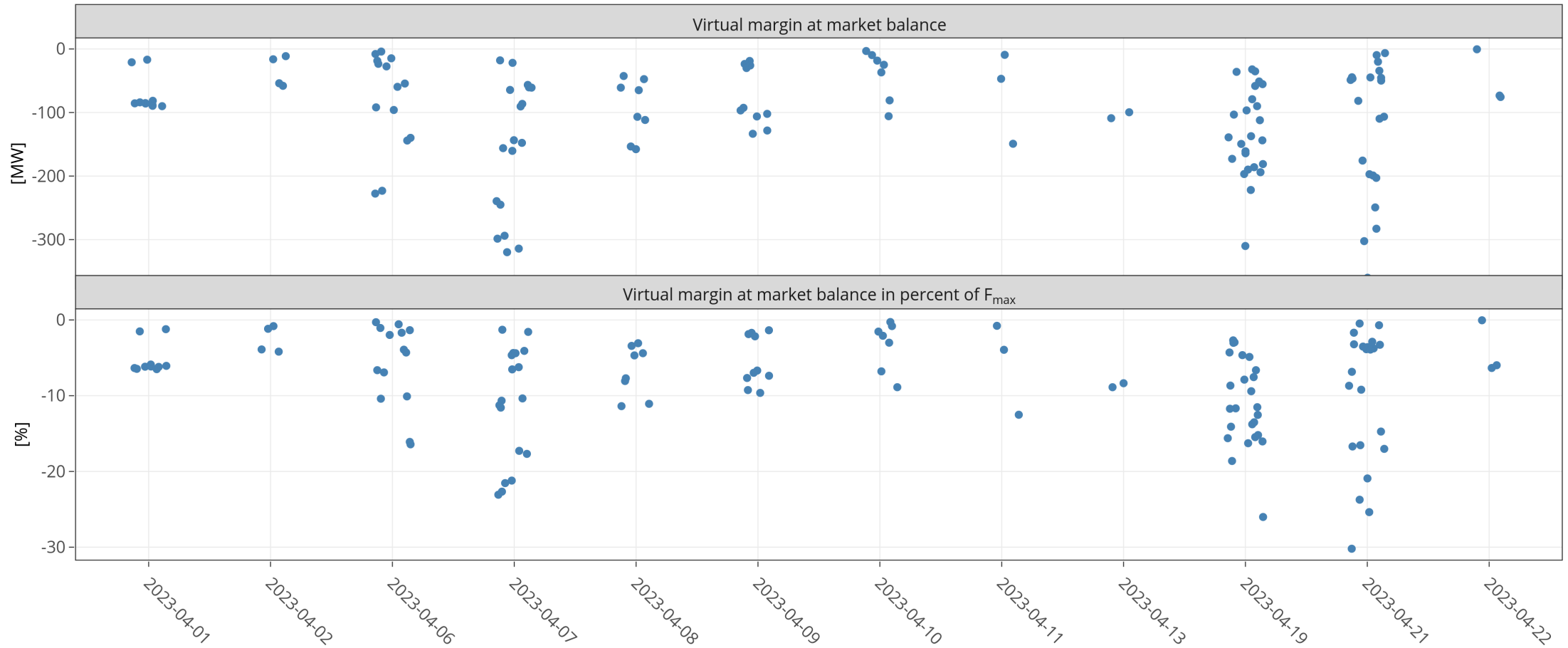
# KPI 6b: Virtual margins at market balance RO



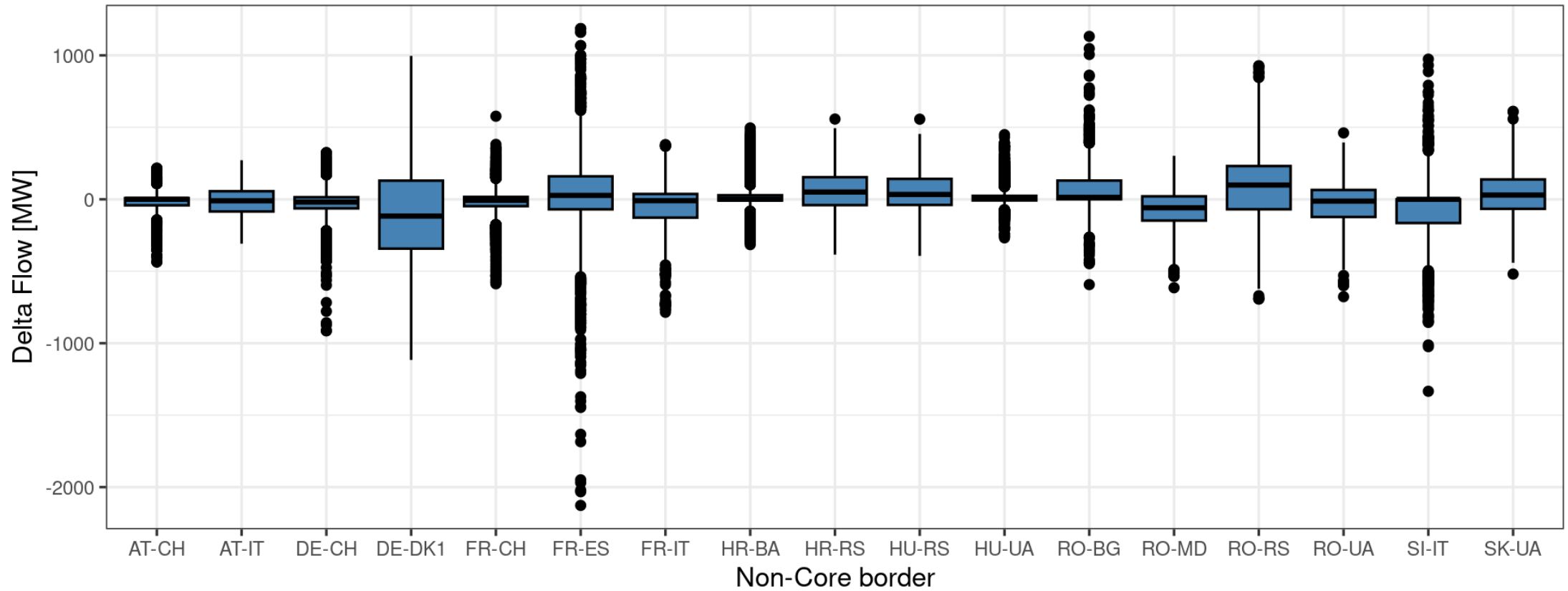
# KPI 6b: Virtual margins at market balance SI



# KPI 6b: Virtual margins at market balance SK

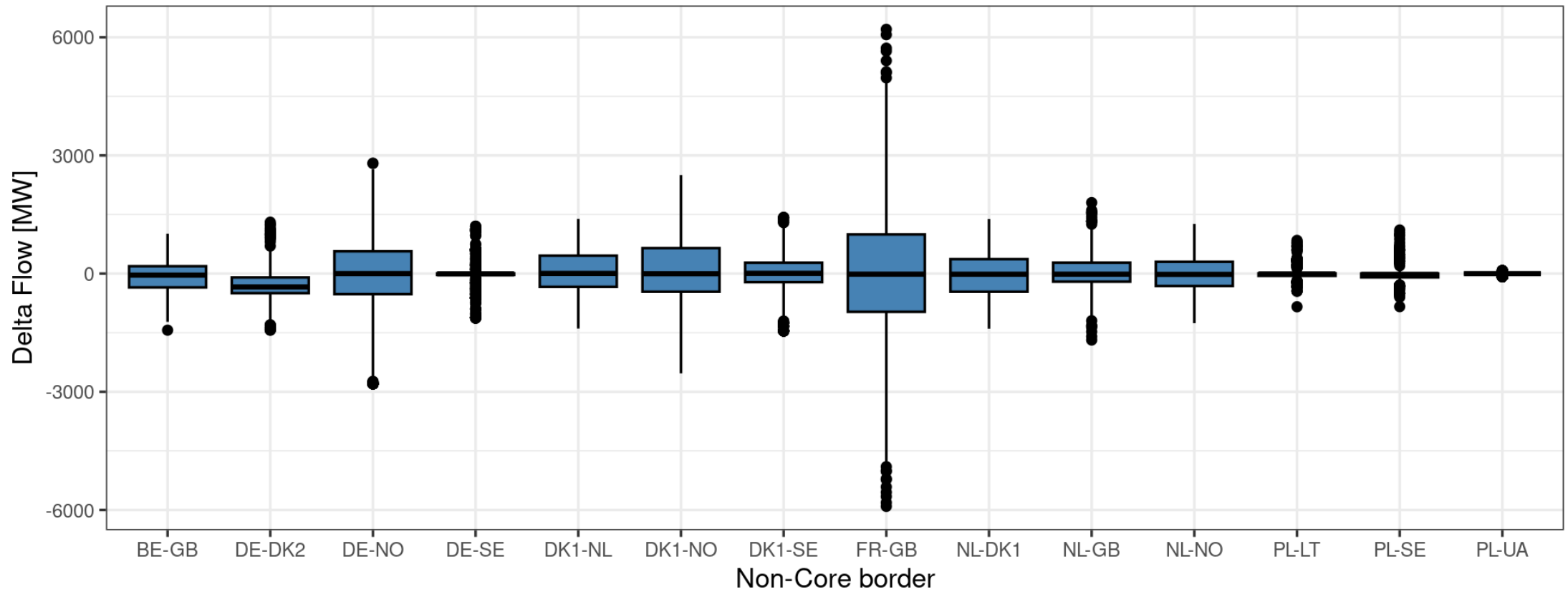


# KPI 7: Non-Core exchanges AC delta flow





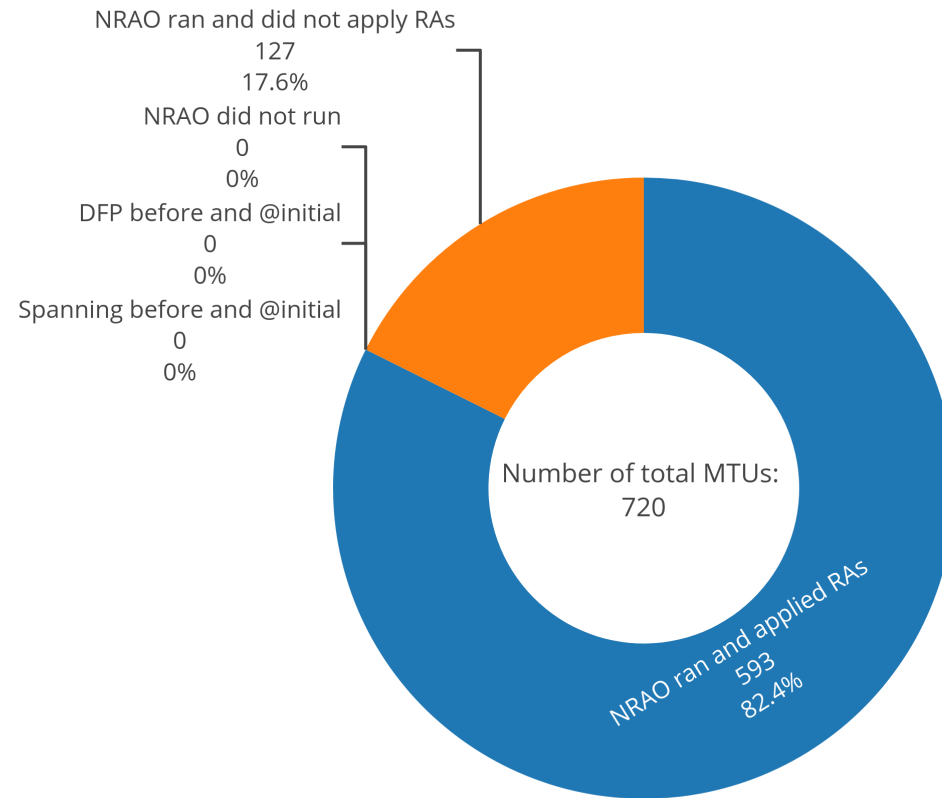
# KPI 7: Non-Core exchanges DC delta flow



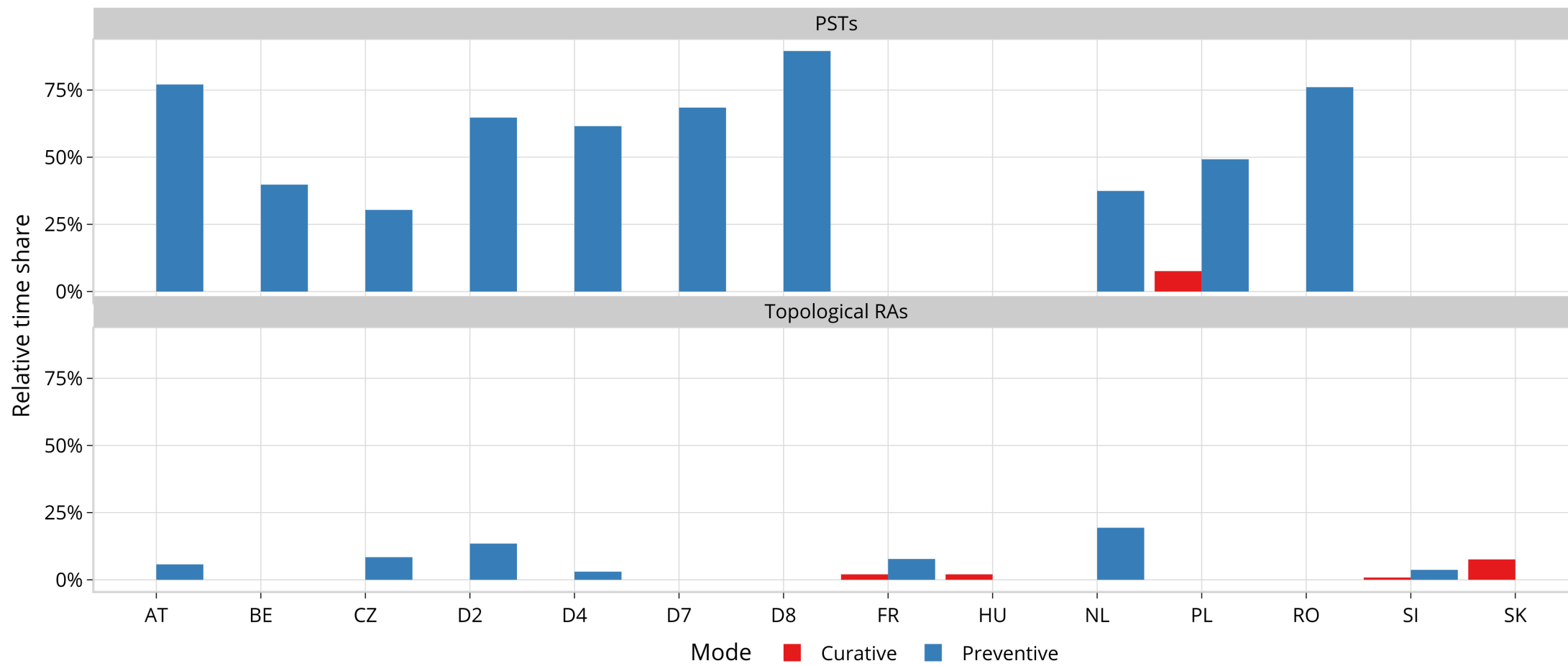
# KPI 8: NRAO – Applied Remedial Action



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

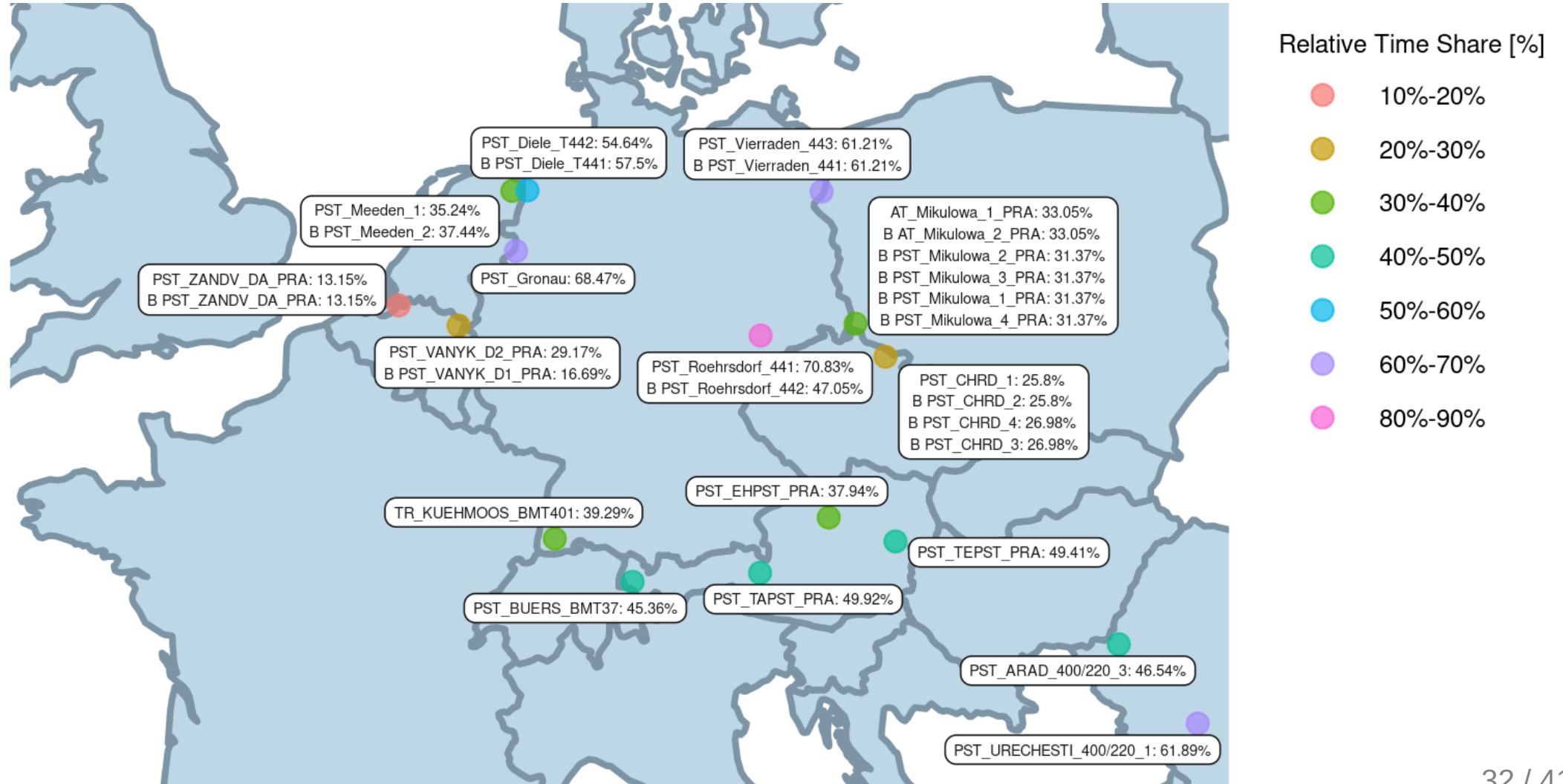


# KPI 8: Relative Time Share of Applied RAs, by TSO, Type and Mode



# 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

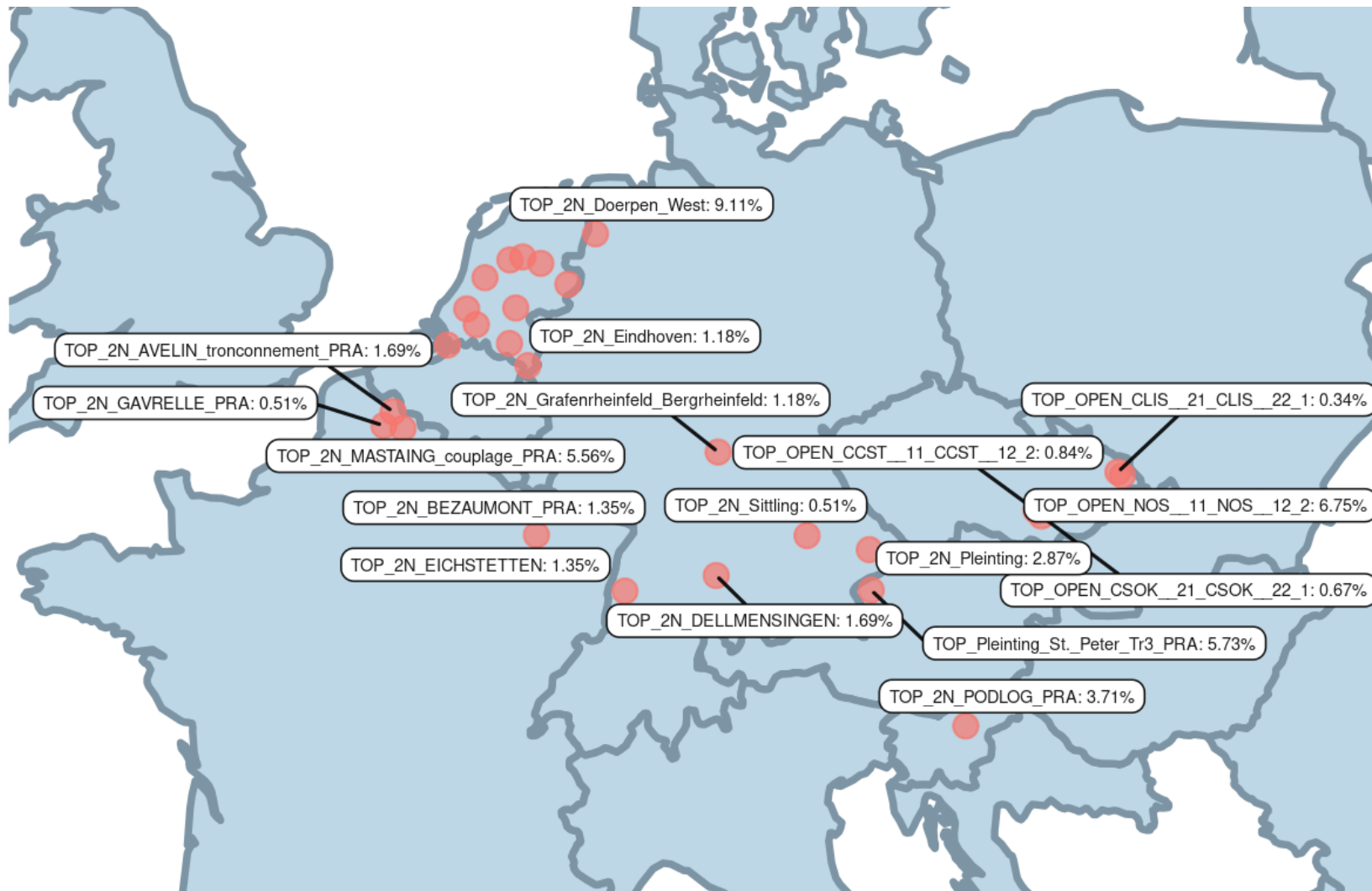


Relative Time Share [%]

● 30%-40%

# 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



Relative Time Share [%]

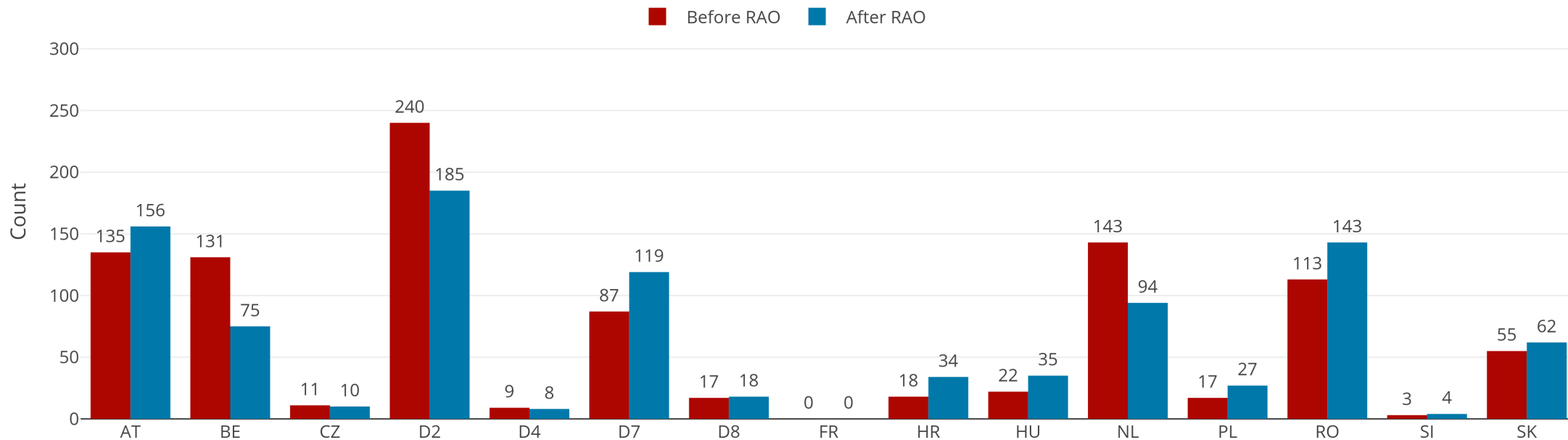
● 0%-10%

# 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.



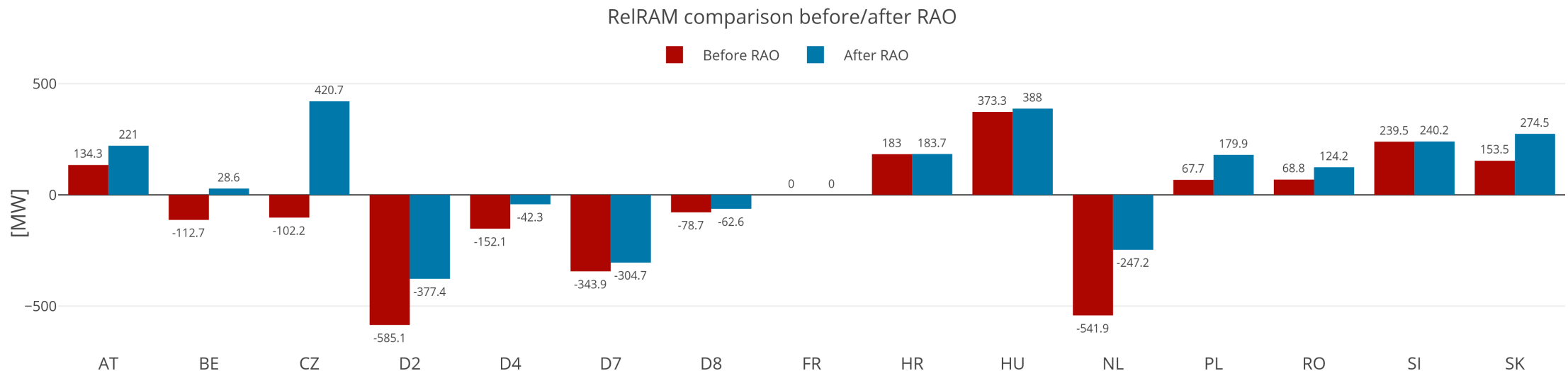
# KPI 10: Average variation of relative RAM before and after NRAO



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
[SI-HU] Cirkovce - Heviz [OPP] [HU]	720	720	71.46%	52.26%	99.82%	0.2672	1.2347
[SI-HU] Cirkovce - Heviz [DIR] [HU]	717	720	105.84%	76.81%	138.27%	0.2672	1.2347
[CZ-SK] Nosovice - Varin [OPP] [SK]	715	1540	104.39%	66.36%	162.08%	0.4561	1.6282
[SK-SK] Gabcikovo - P.Biskupice [DIR]	711	711	89.19%	71.39%	112.34%	0.3736	1.2521
[SK-HU] Gabcikovo - Gonyu [OPP] [HU]	711	1479	85.16%	66.93%	114.15%	0.3495	1.2177
[FR-D7] Vigy - Ensdorf VIGY2 S [DIR] [D7]	711	963	63.00%	22.13%	111.57%	0.2792	0.7469
[CZ-SK] Nosovice - Varin [DIR] [SK]	703	1374	77.33%	36.91%	116.61%	0.4561	1.6282
[CZ-SK] Sokolnice - Stupava [DIR] [SK]	694	697	78.75%	62.48%	108.15%	0.3387	1.3295
[SK-HU] Gabcikovo - Gonyu [DIR] [HU]	692	784	89.35%	66.43%	120.07%	0.3495	1.2177
[AT-CZ] Duernrohr 1 - Slavetice 437 [OPP] [AT]	691	691	68.97%	28.06%	92.31%	0.3413	1.3768
[HU-HU] Gonyu - Gyor [DIR]	690	1391	72.43%	58.05%	98.19%	0.3221	1.443
[D8-PL] Mikulowa PST1 [OPP] [PL]	682	682	50.43%	26.82%	82.05%	0.4055	1.4639
[CZ-PL] Wielopole - Nosovice [DIR] [PL]	680	1114	64.52%	28.64%	94.30%	0.3827	1.3181
[RO-RO] TR Rosiori 400/220 1 [DIR]	679	717	57.13%	19.25%	118.00%	0.1482	0.3038
[HR-SI] 220kV Pehlin - Divaca [DIR] [HR]	679	688	71.54%	31.28%	106.15%	0.19	0.4622
[HR-SI] 220kV Pehlin - Divaca [OPP] [HR]	679	1090	103.17%	62.57%	169.52%	0.19	0.4622
[BE-FR] Achene - Lonny 380.19 [OPP] [BE]	678	1787	102.64%	8.91%	138.05%	0.3031	0.6382
[HR-HU] 400kV Ernestinovo - Pecs 1 [OPP] [HR]	670	670	69.38%	44.81%	105.79%	0.28	0.824
[NL-BE] PST Van Eyck 2 [OPP] [BE]	667	2436	70.47%	6.56%	103.47%	0.3946	0.9104
[HU-HU] Gonyu - Gyor [OPP]	664	746	110.85%	78.70%	141.66%	0.3221	1.443

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-BE] PST Zandvliet 1 [DIR] [BE]	120	120	304.5	51.53%	17.90%	97.15%	0.4198
[NL-D2] Meeden-Diele 380 Z [OPP] [NL]	65	65	293.26	31.22%	19.85%	87.46%	0.3026
[D8-PL] Mikulowa PST1 [OPP] [PL]	63	63	143.88	40.63%	29.32%	59.09%	0.3264
[RO-RO] Resita - Timisoara c1 [DIR]	59	59	1314.98	29.27%	10.96%	48.93%	0.1693
[RO-RO] Paroseni - Targu Jiu Nord [OPP]	52	54	2123.3	21.03%	0.00%	37.75%	0.1102
[NL-NL] Diemen-Lelystad 380 W [OPP]	51	51	345.16	21.12%	19.97%	31.67%	0.2989
[CZ-D8] Hradec - Rohrsdorf 446 [OPP] [D8]	47	47	664.27	37.45%	22.45%	59.56%	0.2867
[D7-D7] Y Paffendorf - Oberzier SECHTM N [DIR]	39	39	146.65	50.82%	34.21%	65.03%	0.574
[D4-D4] PST Buers BMT37 [OPP]	35	36	2373.23	24.43%	20.12%	56.09%	0.0618
[FR-D7] Vigy - Ensdorf VIGY2 S [DIR] [D7]	29	29	146.23	52.50%	26.49%	83.55%	0.2236
[RO-RO] TR Portile de Fier 400/220 1 [OPP]	28	28	554.55	33.94%	2.40%	91.20%	0.18
[AT-D2] St. Peter 2 - Pleinting 258 [OPP] [AT]	27	27	451.47	69.86%	27.17%	108.55%	0.1776
[AT-SI] Obersielach - Podlog 247 [DIR] [AT]	25	25	247.31	41.61%	21.84%	87.63%	0.2319
[D2-D7] Grosskrotzenburg - Urberach UMAIN N2 [DIR] [D7]	24	24	276.31	34.16%	25.11%	47.61%	0.0989
[NL-D2] Meeden-Diele 380 Z [DIR] [NL]	23	23	152.91	64.42%	30.58%	112.06%	0.2756
[CZ-SK] Nosovice - Varin [DIR] [SK]	22	22	61.22	57.58%	36.91%	72.48%	0.4432
[NL-NL] Krimpen a/d IJssel-Geertruidenberg 380 W [DIR]	19	19	76.98	39.86%	22.06%	63.13%	0.5101
[D7-D7] Buerstadt - Lamsheim BUERST W [DIR]	16	16	468.02	41.21%	28.98%	60.27%	0.1548
[AT-HU] Wien Suedost - Gyoer 245 [DIR] [AT]	16	16	1644.14	55.93%	50.00%	65.81%	0.0623
[RO-RO] Portile de Fier - Resita c1 [DIR]	15	15	368.11	26.49%	9.09%	44.39%	0.1049

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

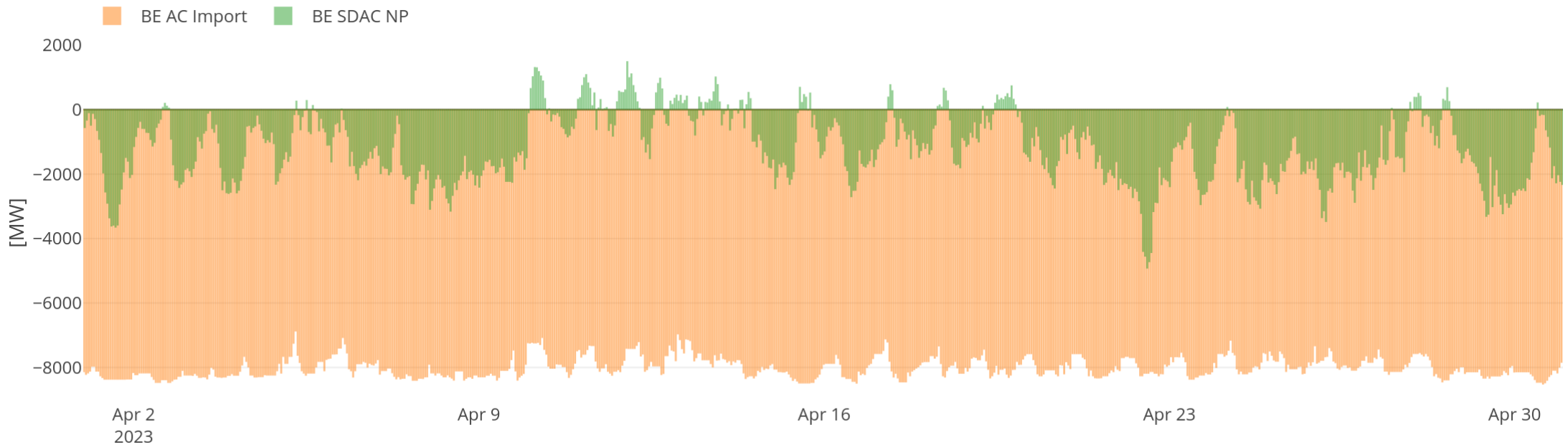
	BE AC Import [MW]
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Avg. -8002.2

Min. -8511.0

Max. -6866.0

Belgium only uses import allocation constraints



# KPI 13b: Allocation Constraints - Poland



	# MTUs
AC was limiting MC	448
AC < 0 MW	228
AC = 0 MW	213
AC > 0 MW	7

	PL AC Import [MW]	PL AC Export [MW]
Avg.	-1214.47	3141.72
Min.	-8349.00	0.00
Max.	0.00	11371.00

