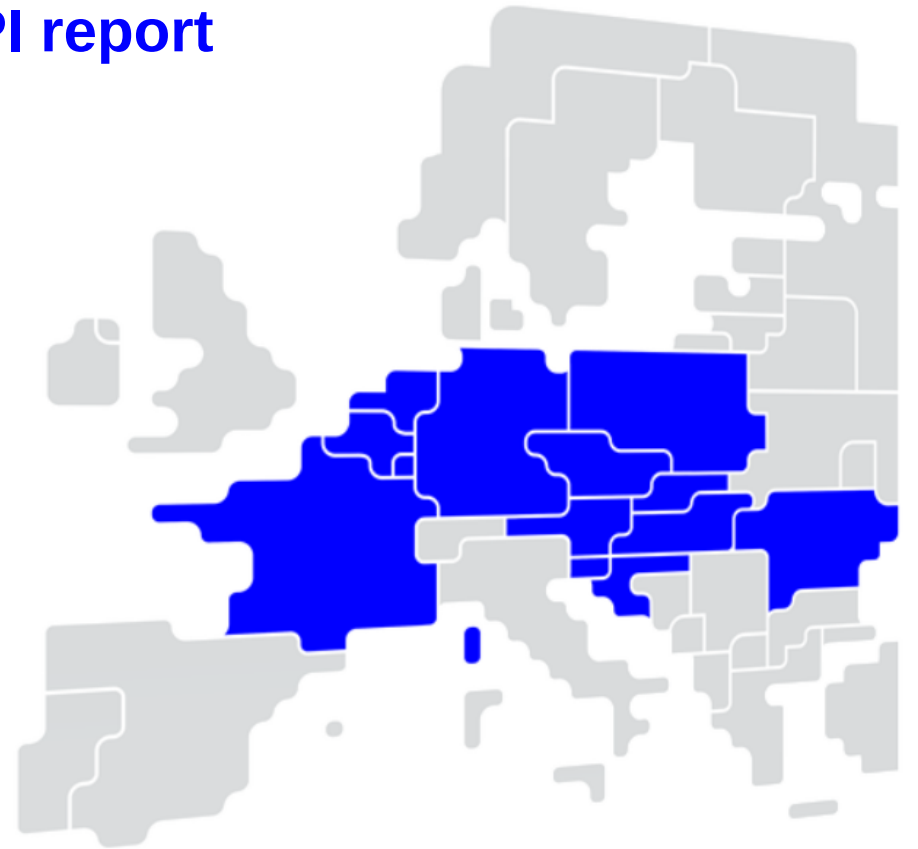


# Core FB MC Operational KPI report

February 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

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

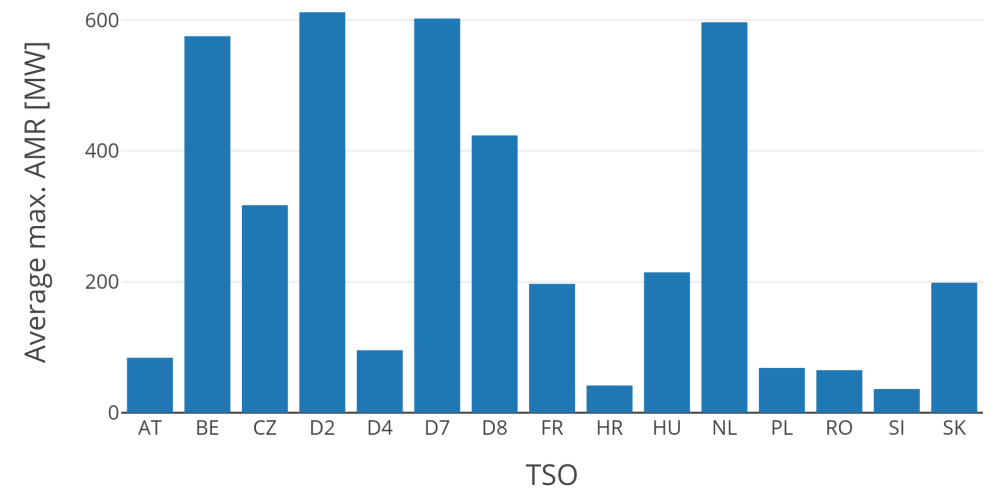
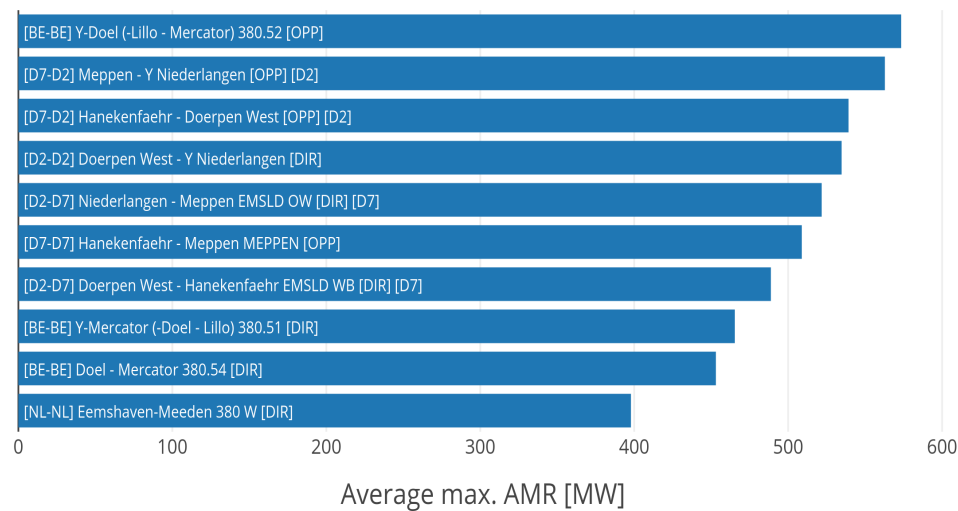
# KPI 2: Average maximum AMR per TSO



CNE	Average Maximum AMR (MW)	AMR as % of Fmax
[BE-BE] Y-Doel (-Lillo - Mercator) 380.52 [OPP]	573.39	37.15%
[D7-D2] Meppen - Y Niederlangen [OPP] [D2]	562.80	27.89%
[D7-D2] Hanekenfaehr - Doerpen West [OPP] [D2]	539.21	26.62%
[D2-D2] Doerpen West - Y Niederlangen [DIR]	534.70	26.44%
[D2-D7] Niederlangen - Meppen EMSLD OW [DIR] [D7]	521.76	21.60%
[D7-D7] Hanekenfaehr - Meppen MEPPEN [OPP]	508.84	21.89%
[D2-D7] Doerpen West - Hanekenfaehr EMSLD WB [DIR] [D7]	488.76	21.25%
[BE-BE] Y-Mercator (-Doel - Lillo) 380.51 [DIR]	465.34	28.39%
[BE-BE] Doel - Mercator 380.54 [DIR]	453.05	26.87%
[NL-NL] Eemshaven-Meeden 380 W [DIR]	397.87	14.36%

TSO	Average maximum AMR per TSO
AT	83.91
BE	575.35
CZ	317.04
D2	611.92
D4	95.53
D7	602.26
D8	423.62
FR	196.83
HR	41.65
HU	214.47

TSO	Average maximum AMR per TSO
NL	596.65
PL	68.40
RO	65.03
SI	36.27
SK	198.62



# KPI 3: Share of MTUs with intervention per TSO



Total BDs

28

Total MTUs

672

MTUs without IVA

340

Share of distinct MTUs without IVA

50.6%

MTUs with IVA

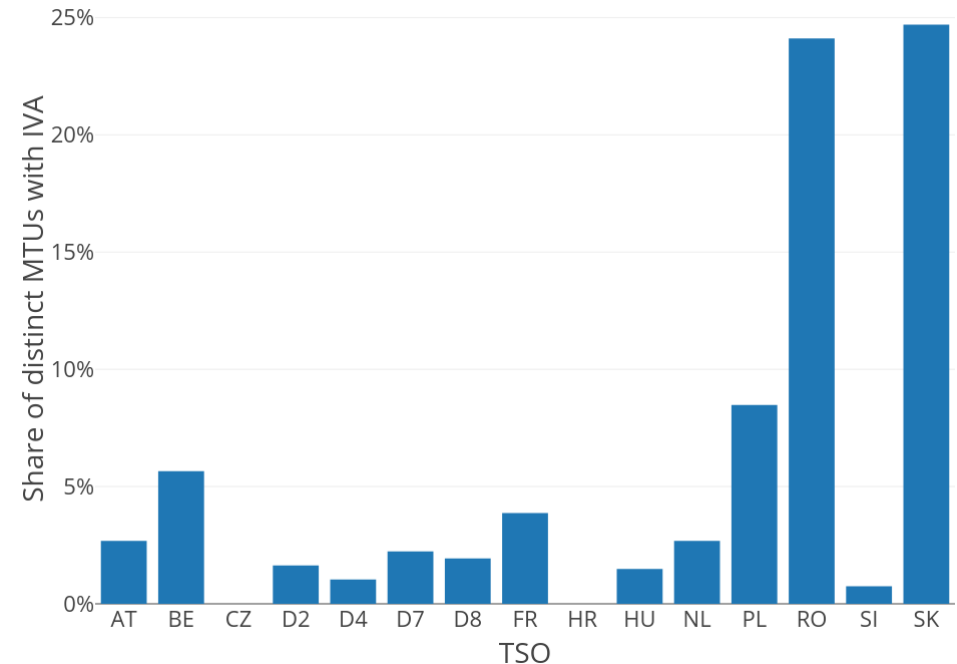
332

Share of distinct MTUs with IVA

49.4%

TSO	Share of distinct MTUs with IVA	Distinct MTUs with IVA
CZ	0.00%	0
SI	0.74%	5
AT	2.68%	18
D7	2.23%	15
D8	1.93%	13
D2	1.64%	11
PL	8.48%	57
D4	1.04%	7
SK	24.70%	166
HU	1.49%	10

TSO	Share of distinct MTUs with IVA	Distinct MTUs with IVA
BE	5.65%	38
NL	2.68%	18
FR	3.87%	26
RO	24.11%	162
HR	0.00%	0

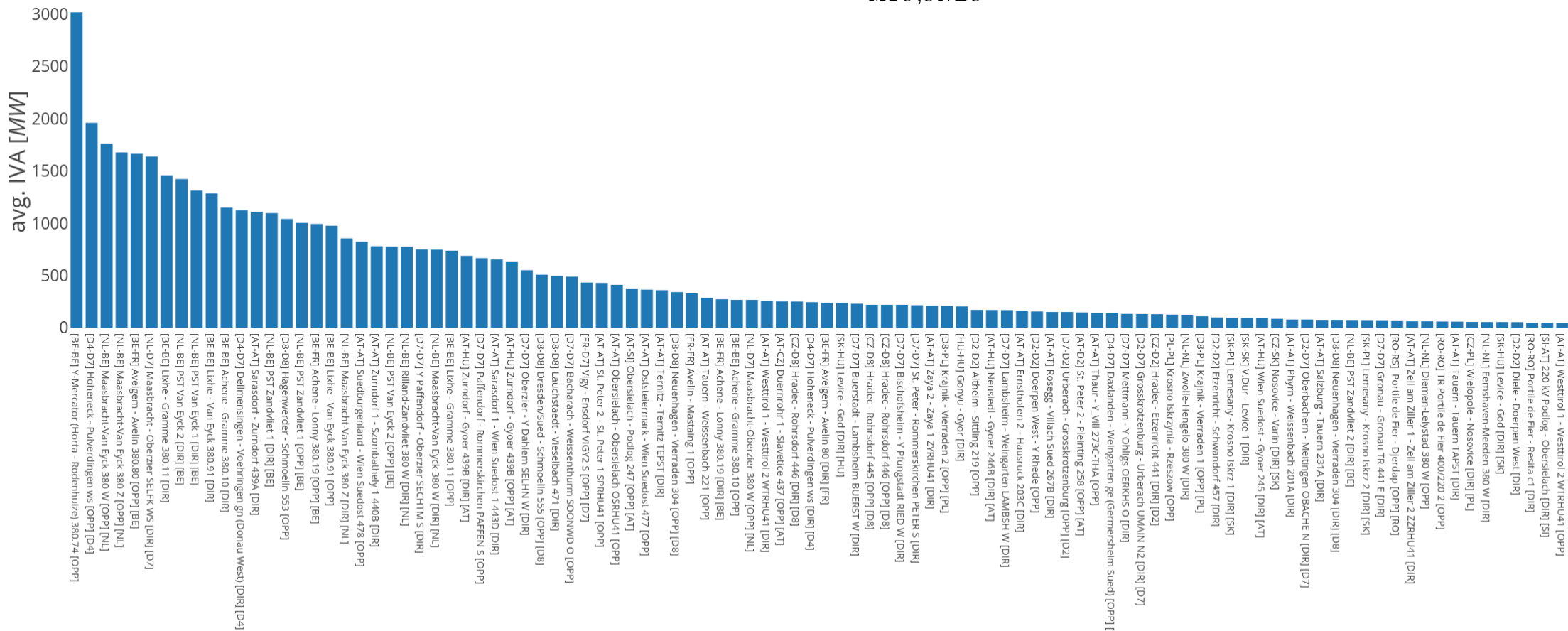




# KPI 4a: Average IVA applied for each CNE affected by TSO intervention



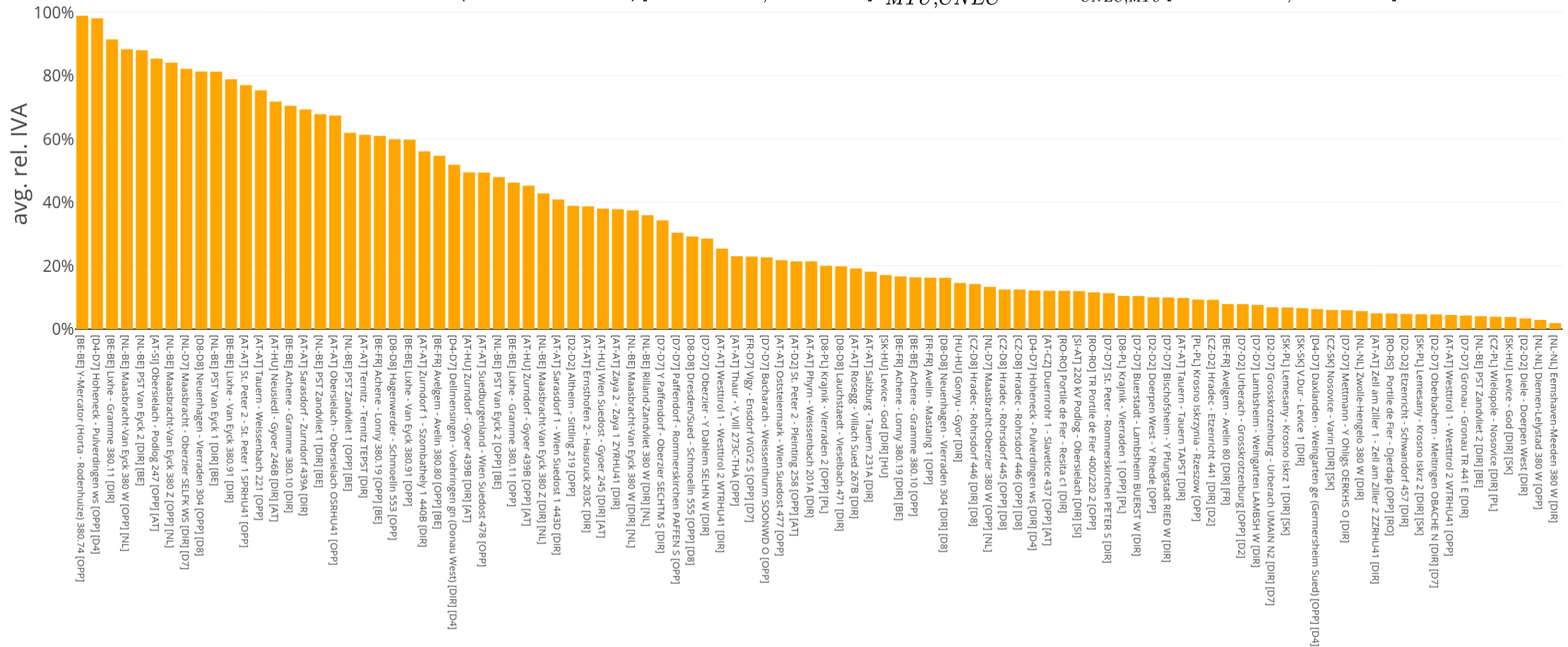
$$\text{avg. IVA}_{CNE} = \frac{1}{\#(CNEC, MTU)[IVA_{CNEC, MTU} > 0]} \sum_{MTU, CNEC} IVA_{CNEC, MTU} [IVA_{CNEC, MTU} > 0]$$



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



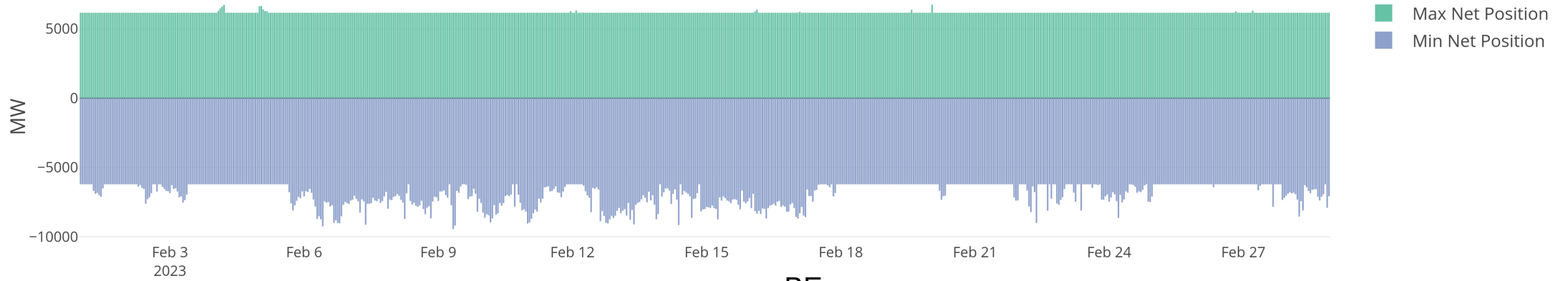
$$\text{avg. rel. IVA}_{CNE} = \frac{1}{\#(CNEC, MTU)[IVA_{CNEC, MTU} > 0]} \sum_{MTU, CNEC} \frac{IVA_{CNEC, MTU}[IVA_{CNEC, MTU} > 0]}{F_{max CNEC, MTU}[IVA_{CNEC, MTU} > 0]}$$



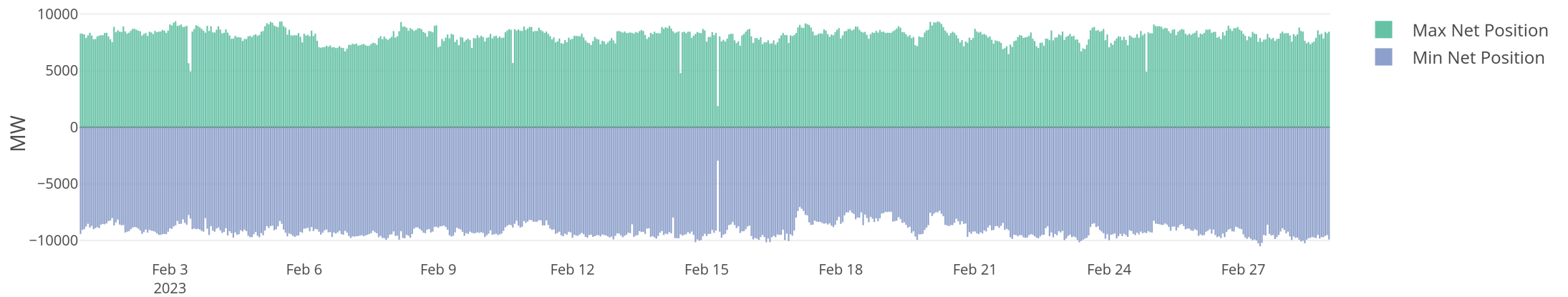
# KPI 5: Min & max net positions per BZ hub



AT



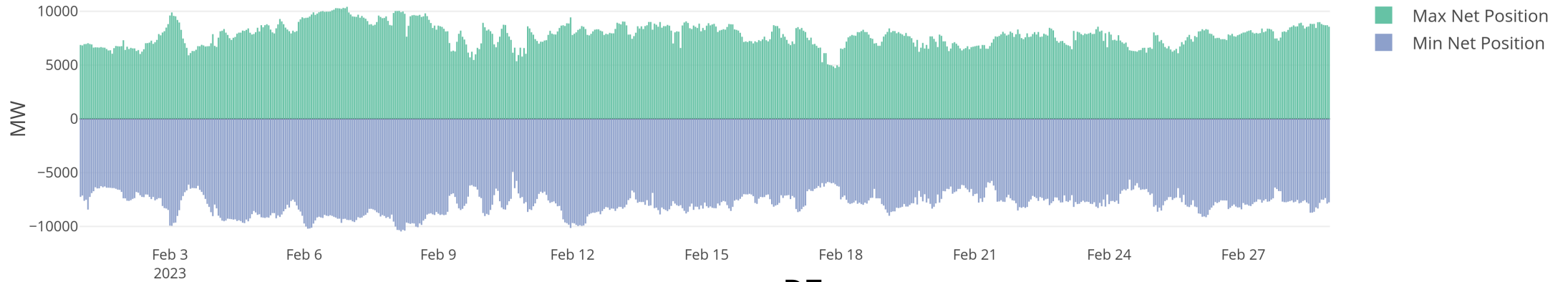
BE



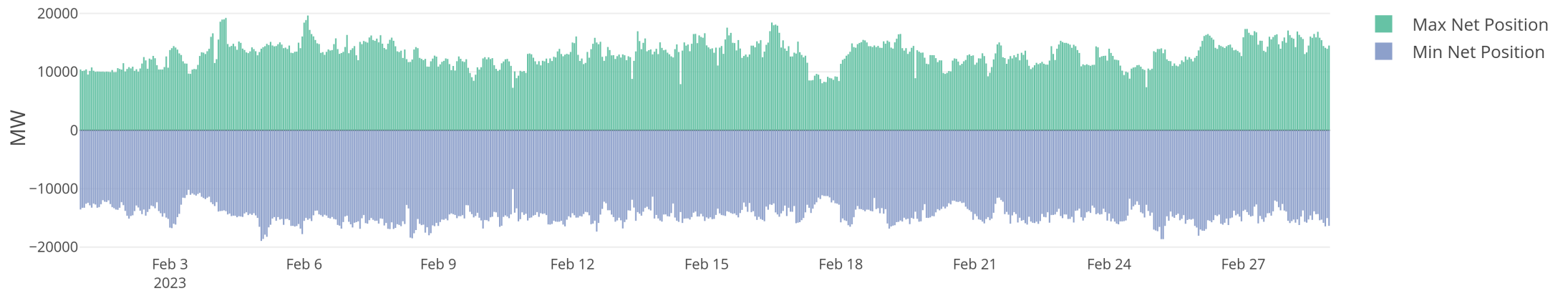
# KPI 5: Min & max net positions per BZ hub



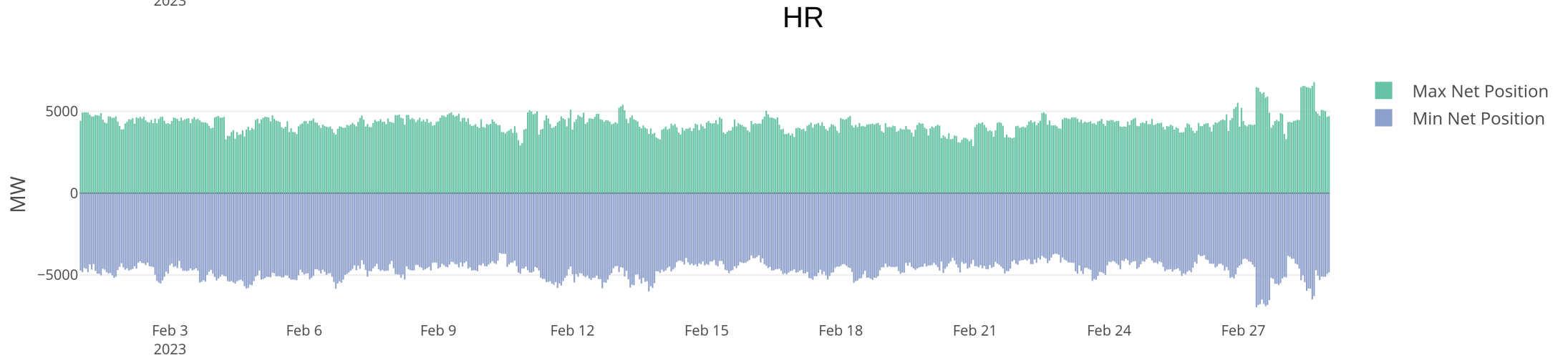
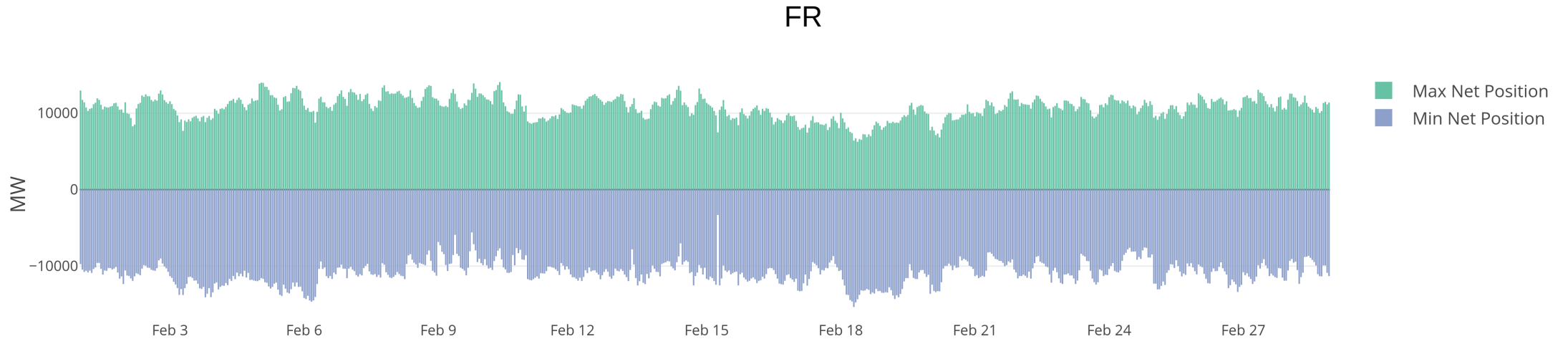
CZ



DE



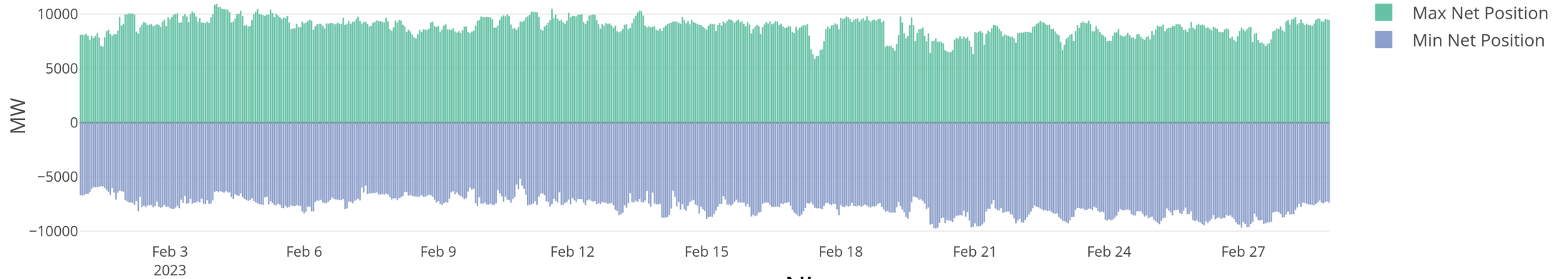
# KPI 5: Min & max net positions per BZ hub



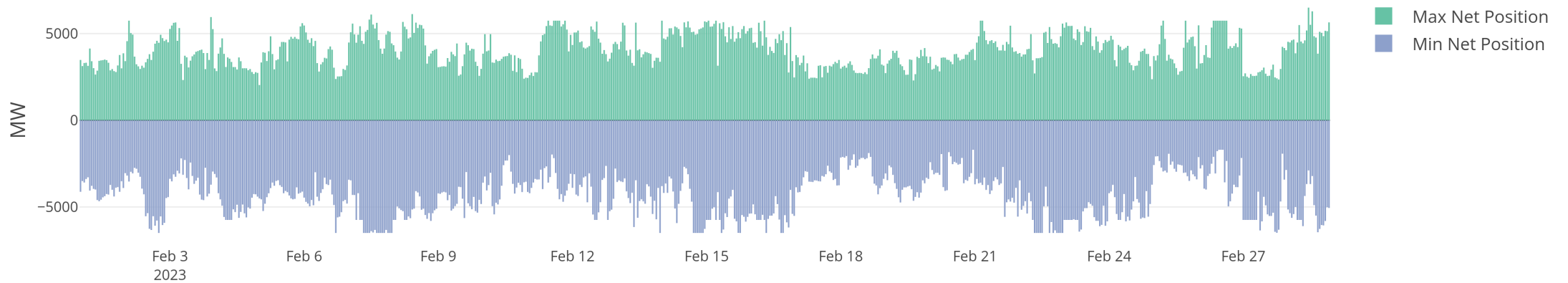
# KPI 5: Min & max net positions per BZ hub



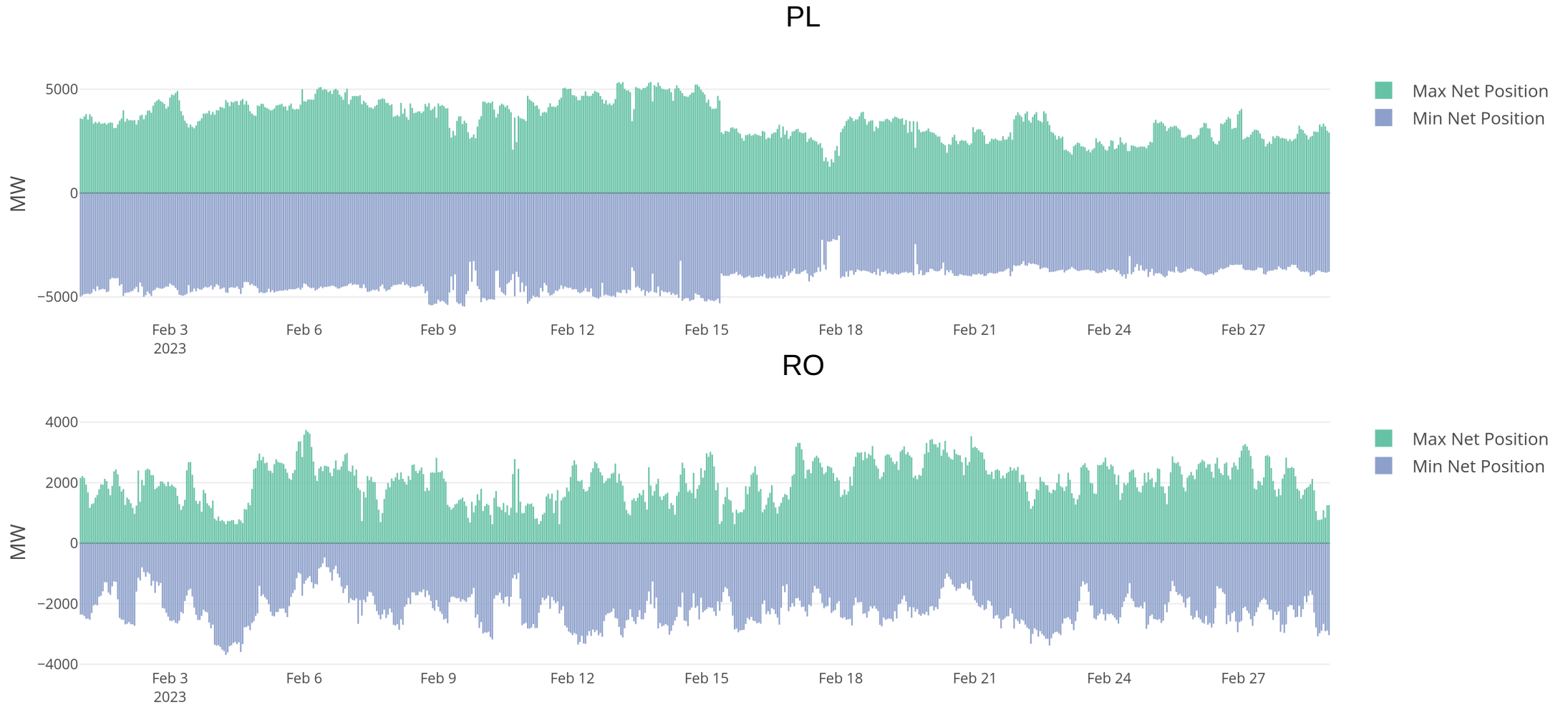
## HU



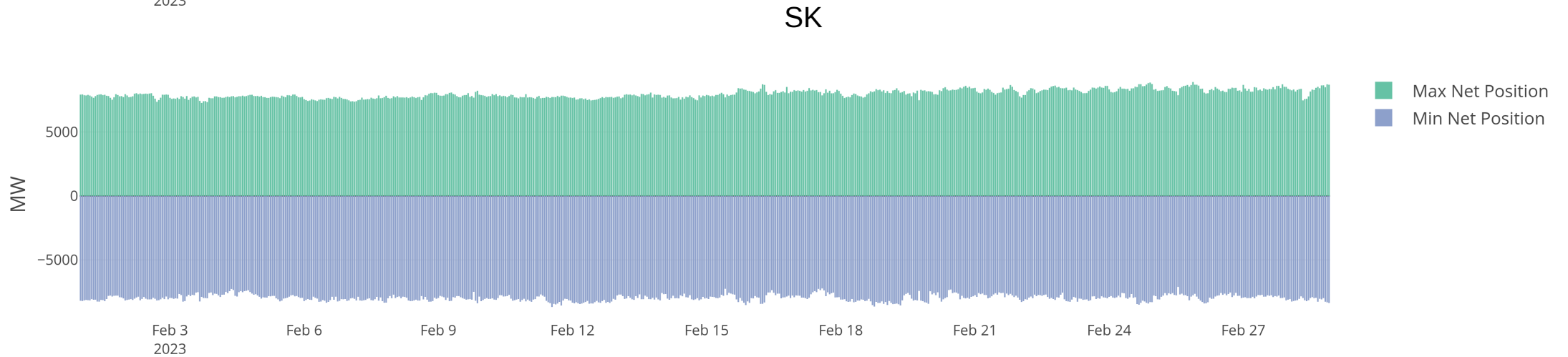
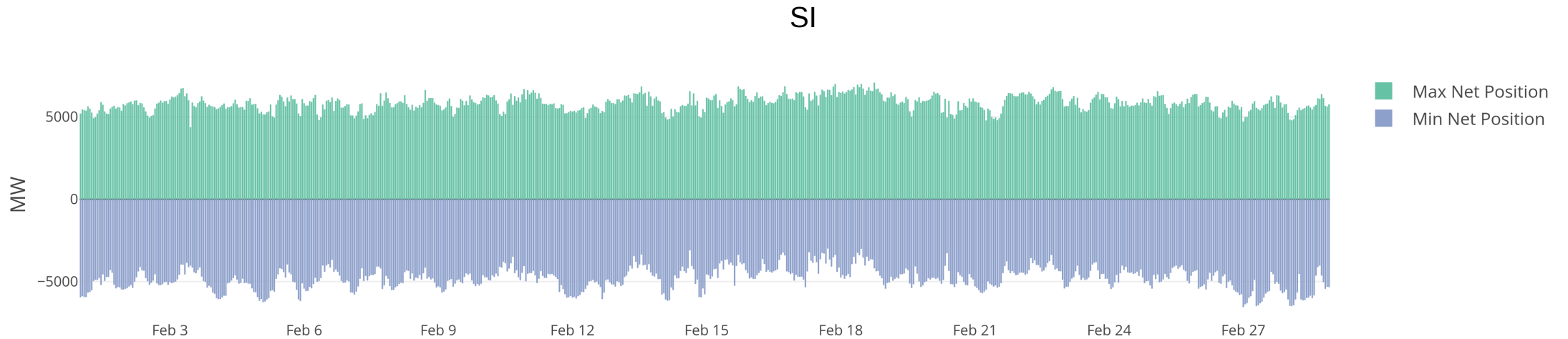
## NL



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

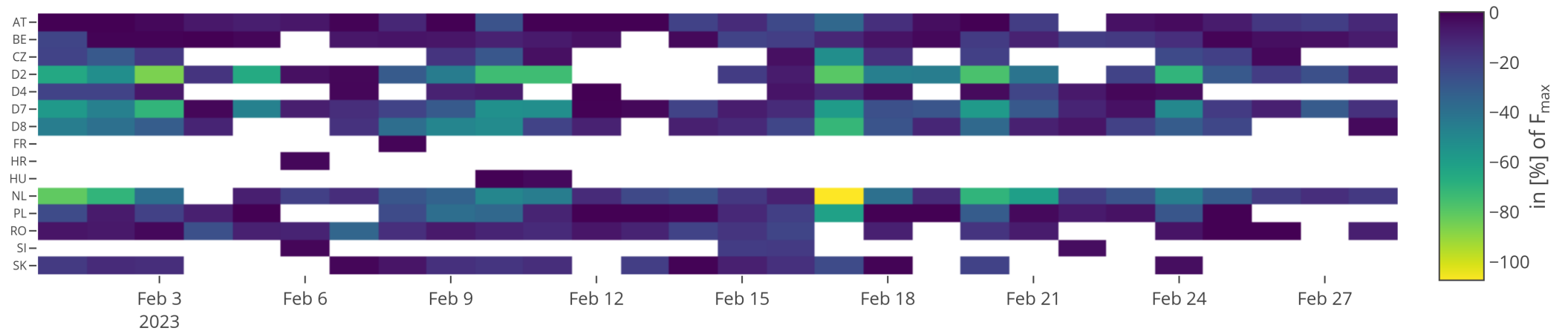
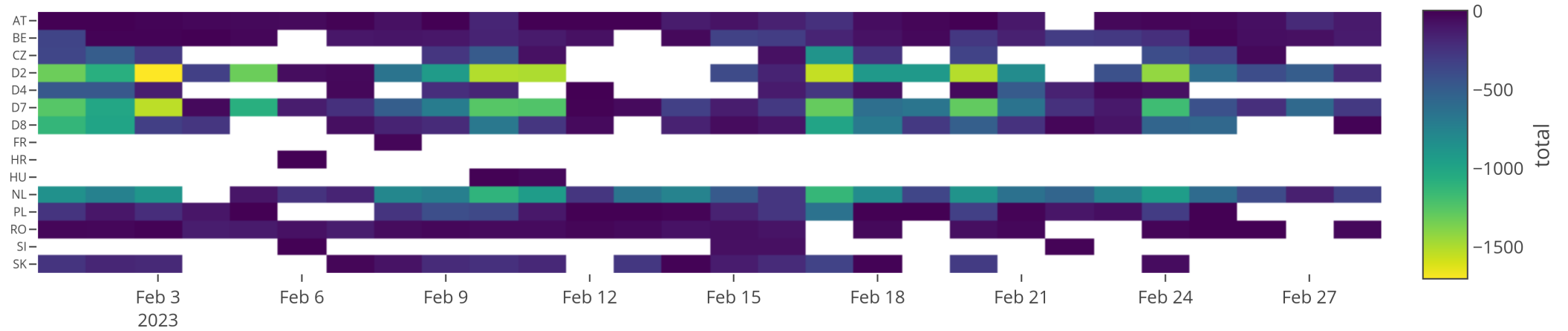


# KPI 5: Min & max net positions per BZ hub

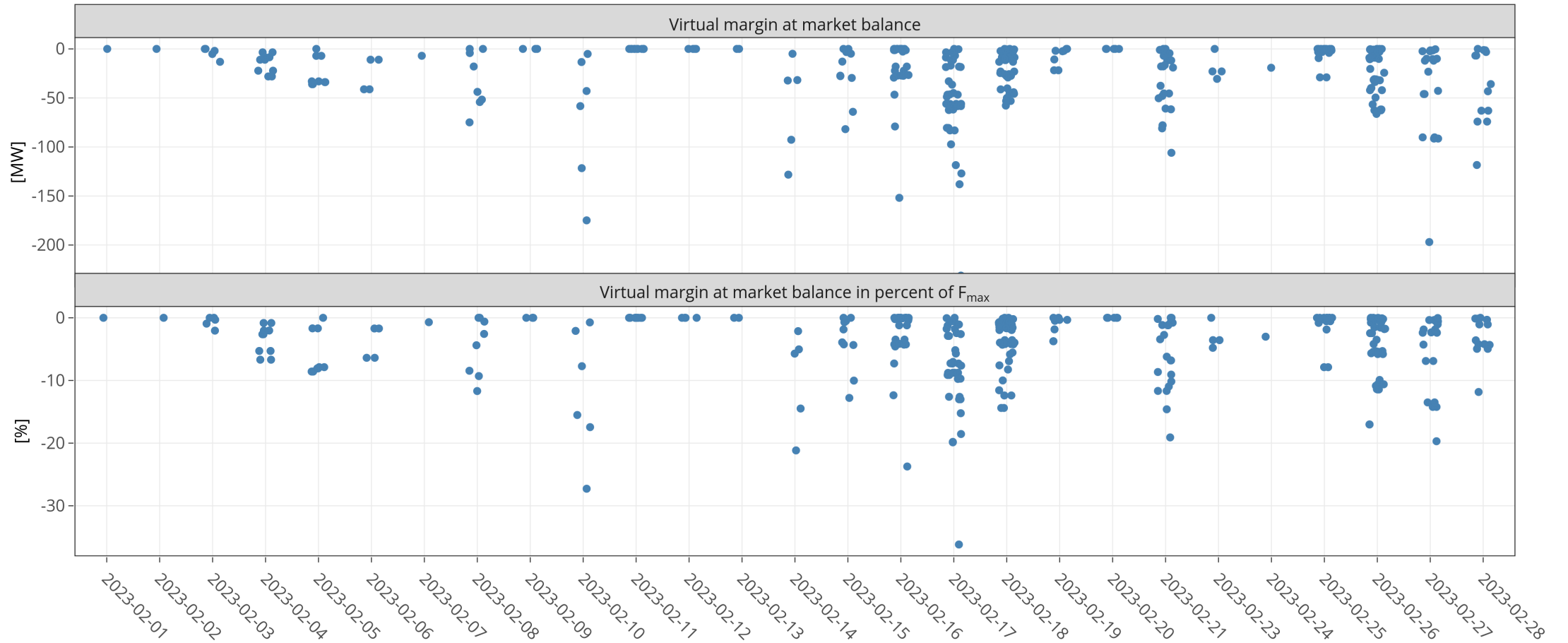




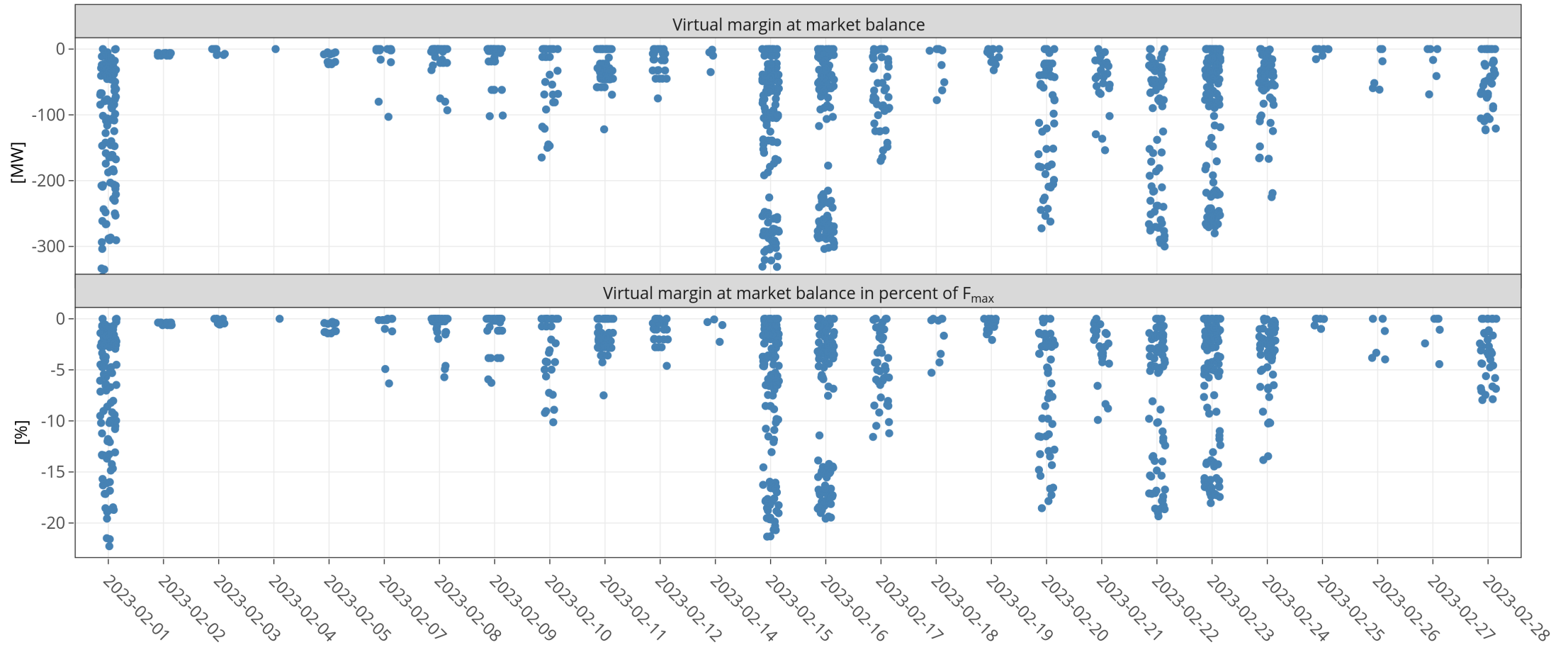
# KPI 6a: Highest virtual margins at market balance for CORE TSOs



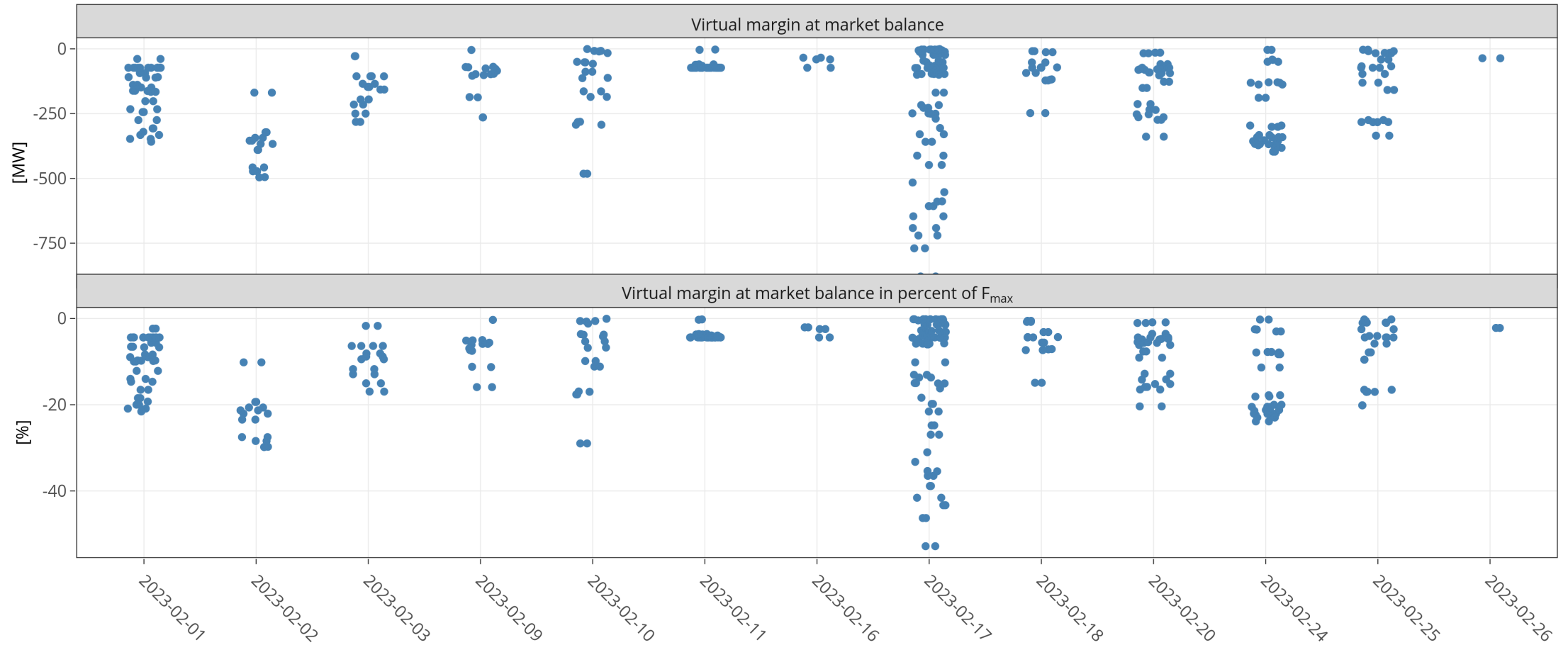
# KPI 6b: Virtual margins at market balance AT



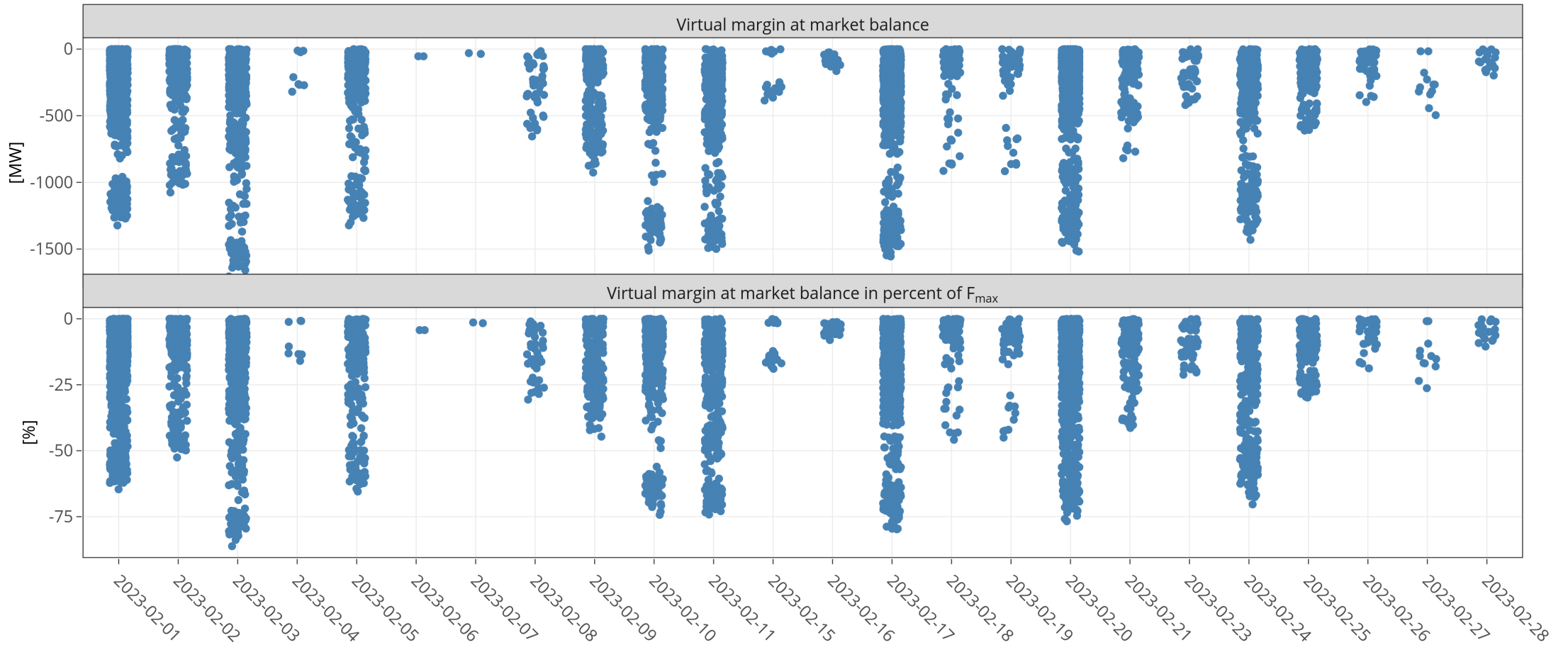
# KPI 6b: Virtual margins at market balance BE



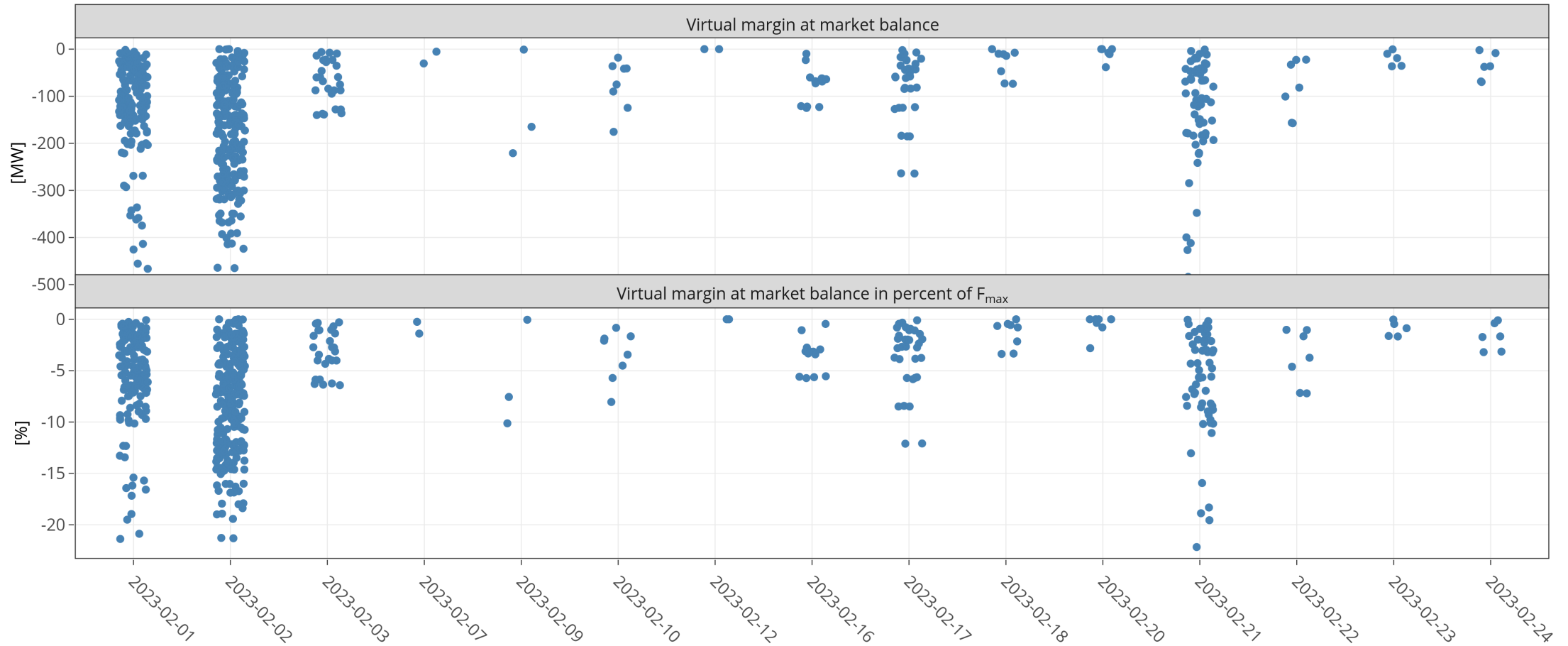
# KPI 6b: Virtual margins at market balance CZ



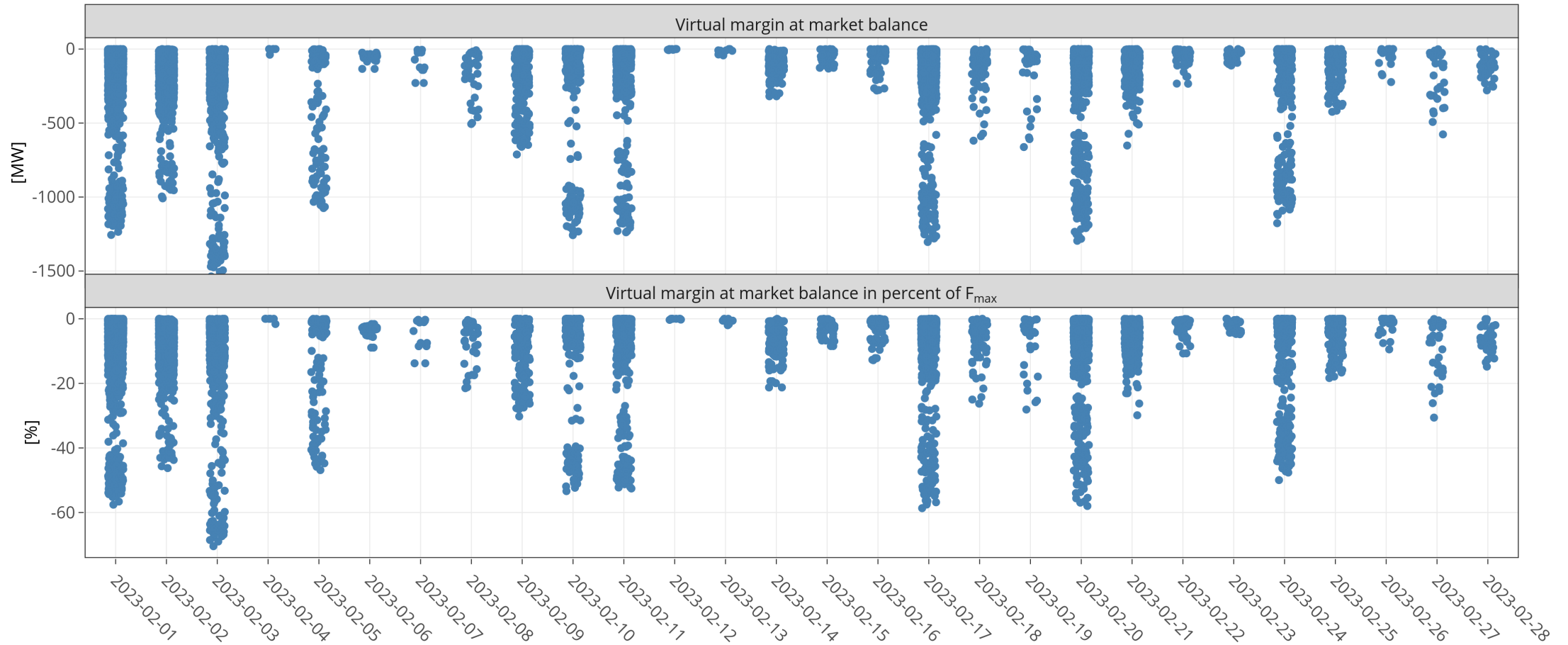
# KPI 6b: Virtual margins at market balance D2



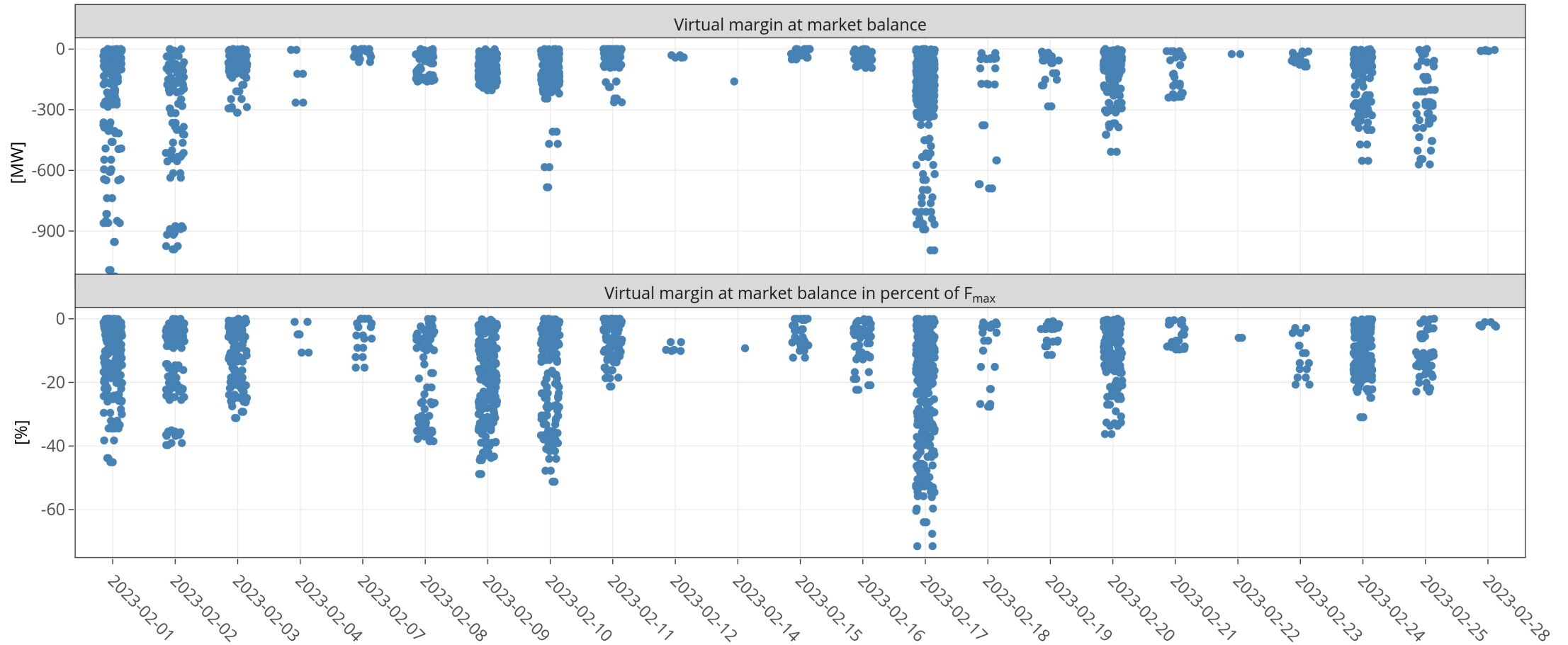
# KPI 6b: Virtual margins at market balance D4



# KPI 6b: Virtual margins at market balance D7

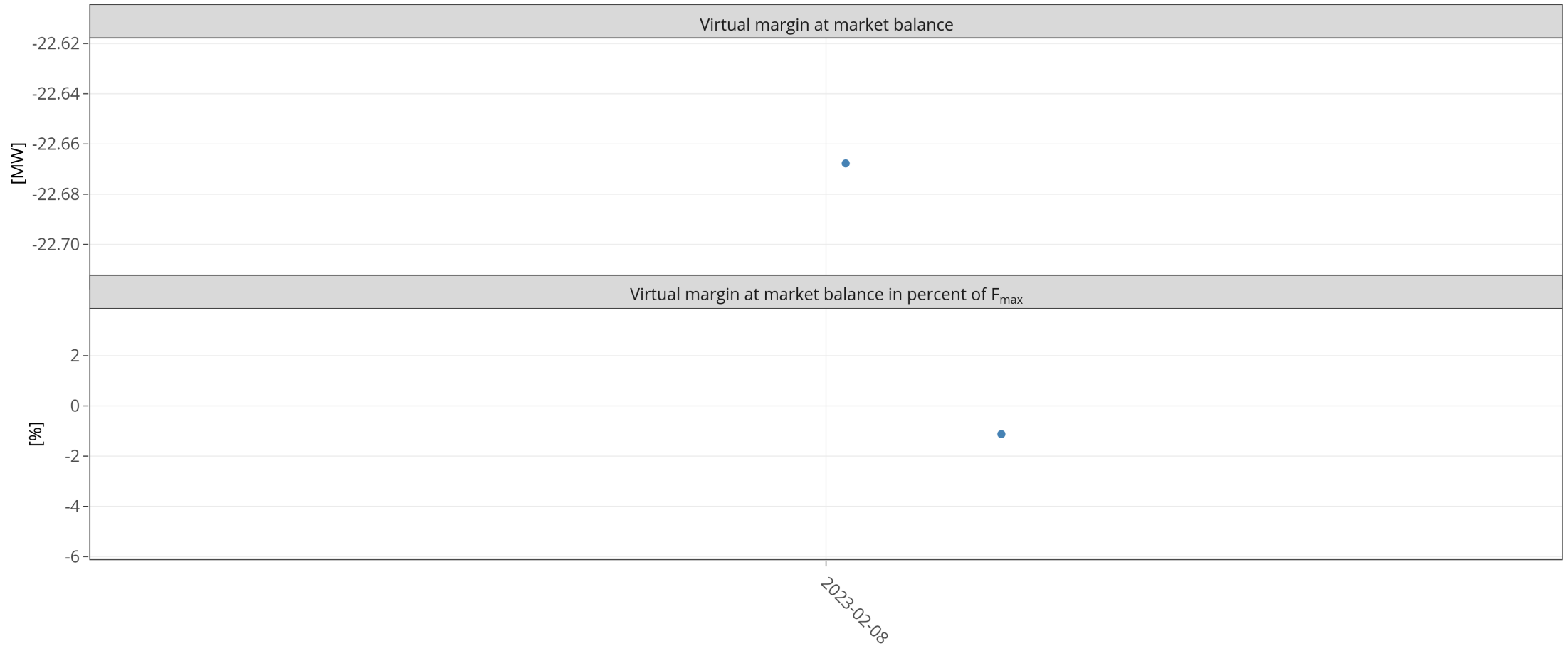


# KPI 6b: Virtual margins at market balance D8

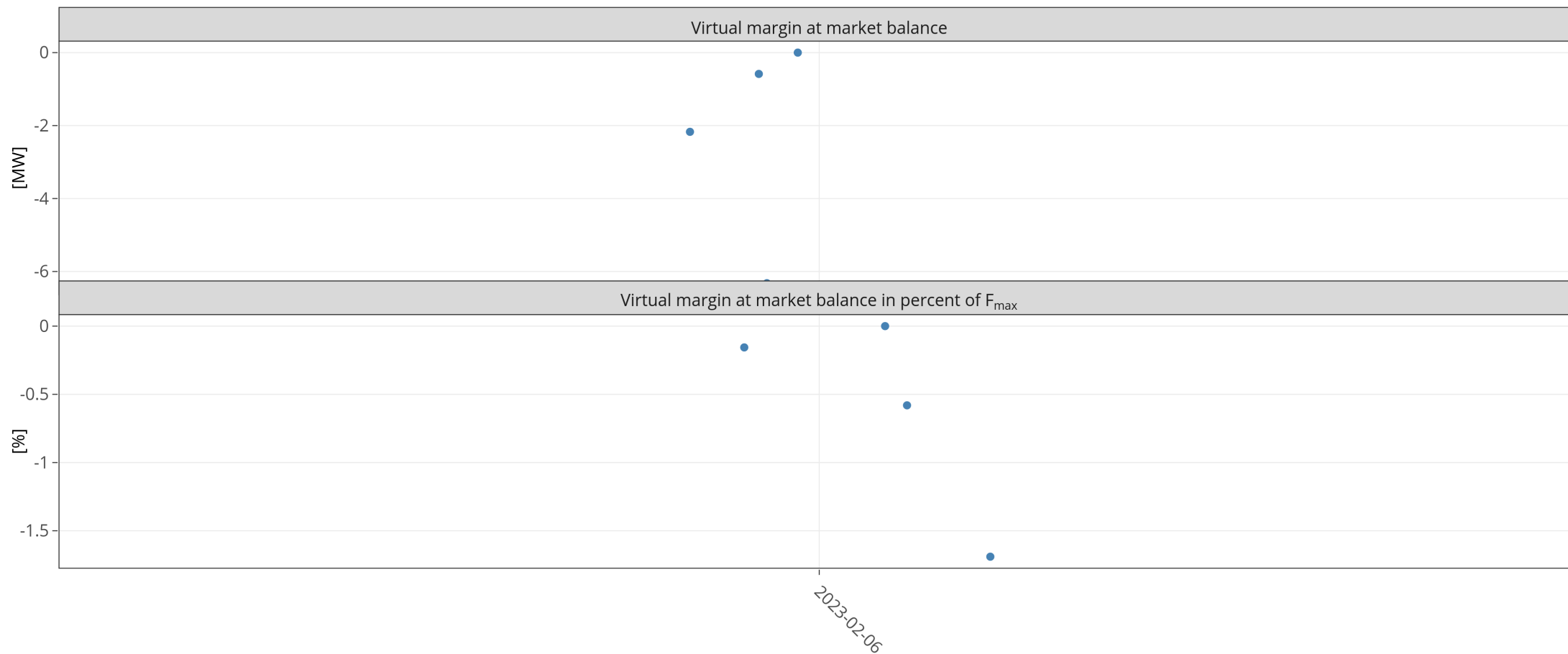




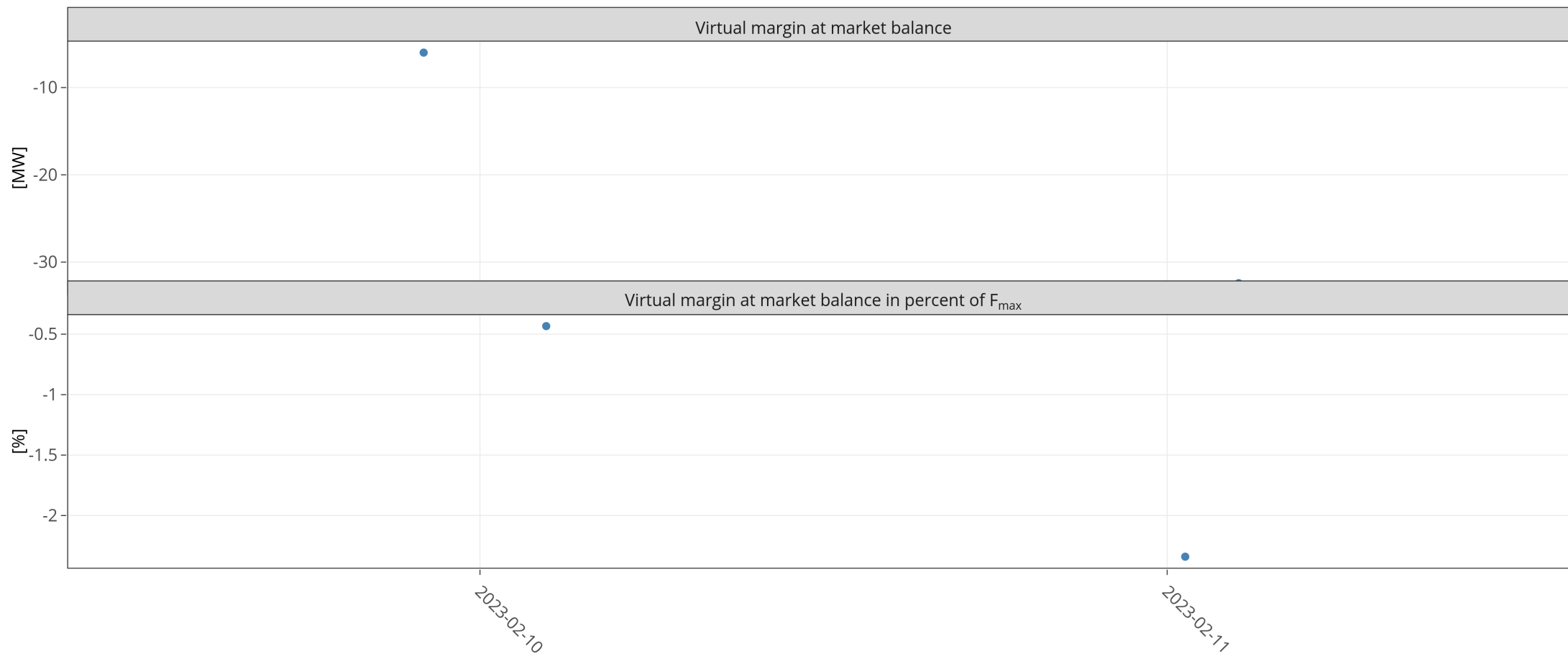
# KPI 6b: Virtual margins at market balance FR



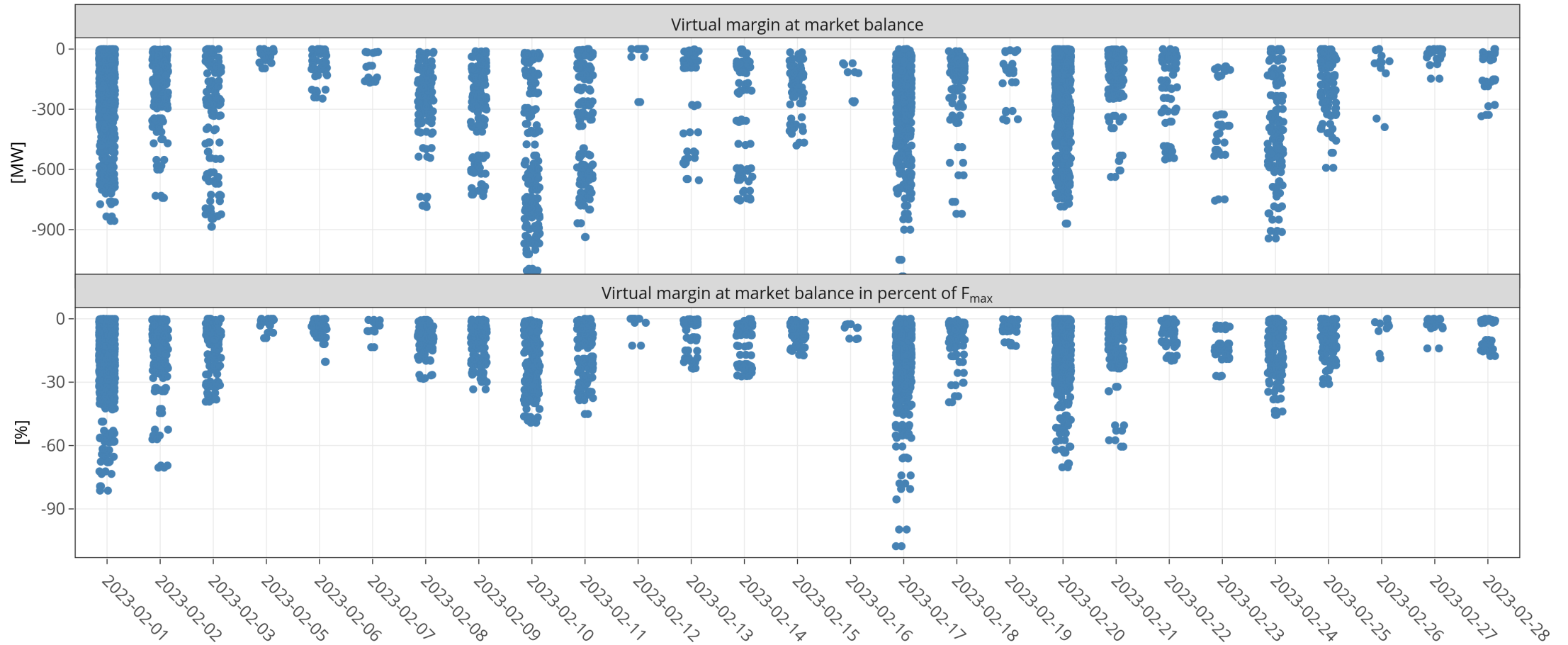
# KPI 6b: Virtual margins at market balance HR



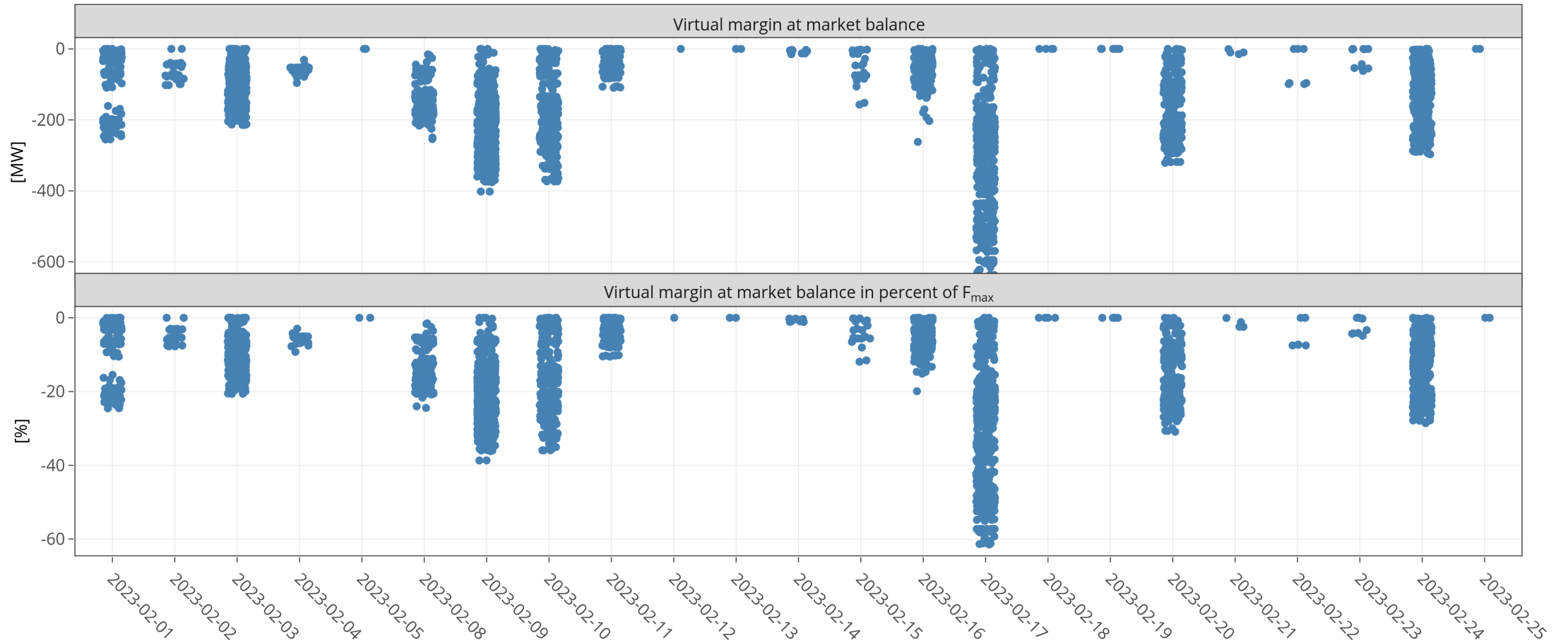
# KPI 6b: Virtual margins at market balance HU



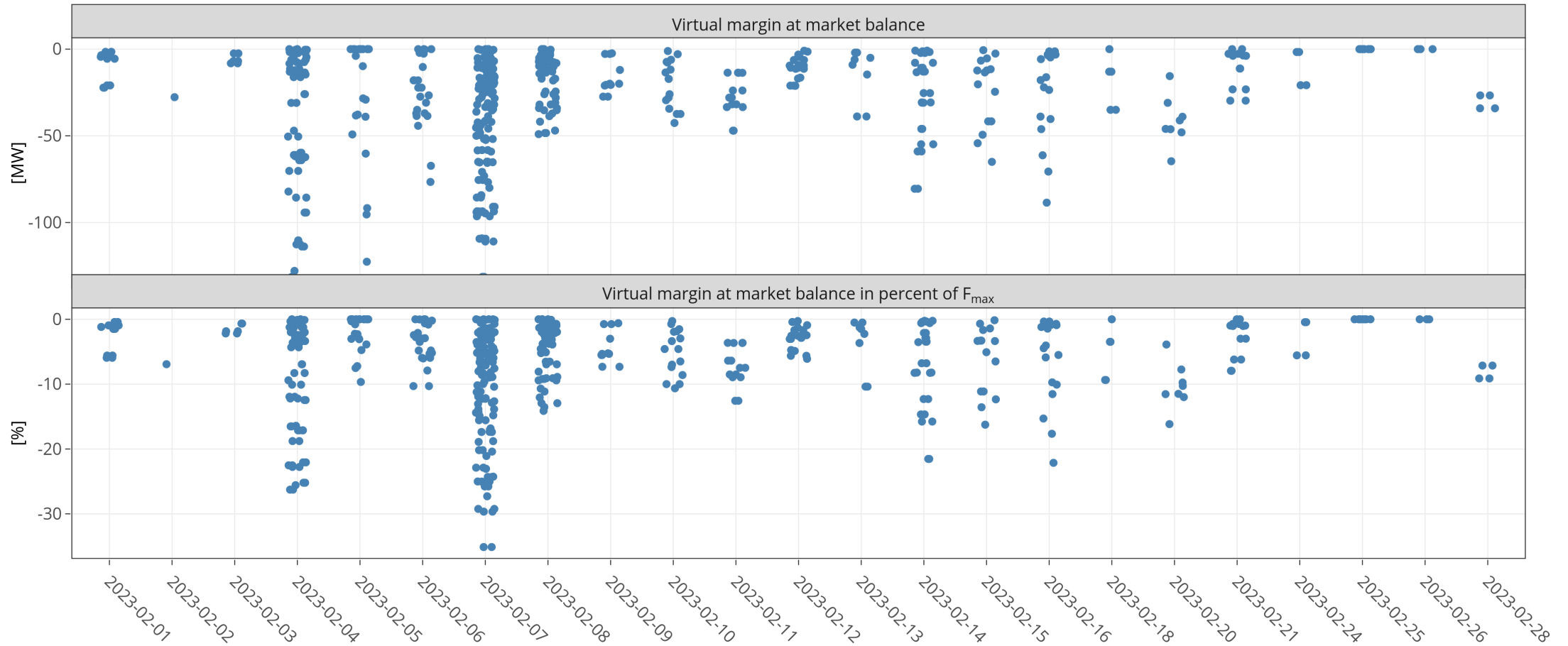
# KPI 6b: Virtual margins at market balance NL



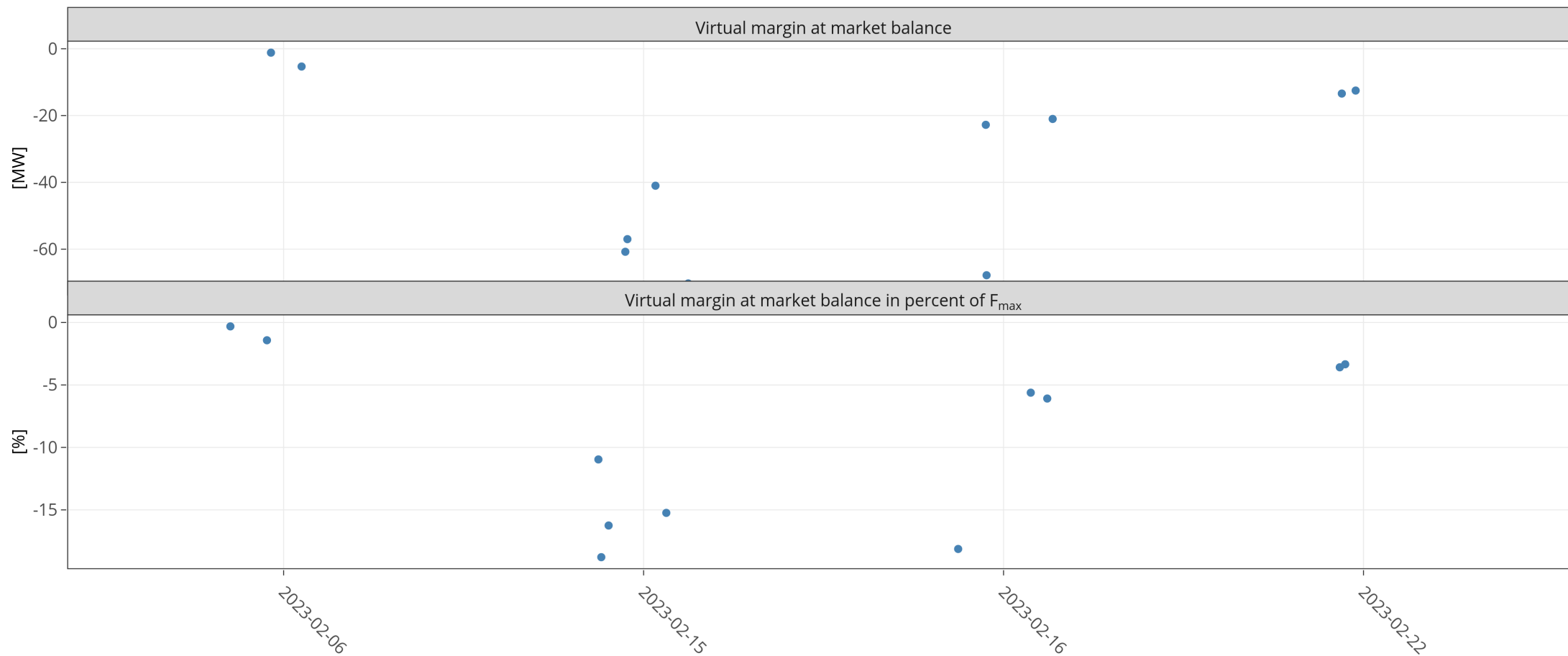
# KPI 6b: Virtual margins at market balance PL



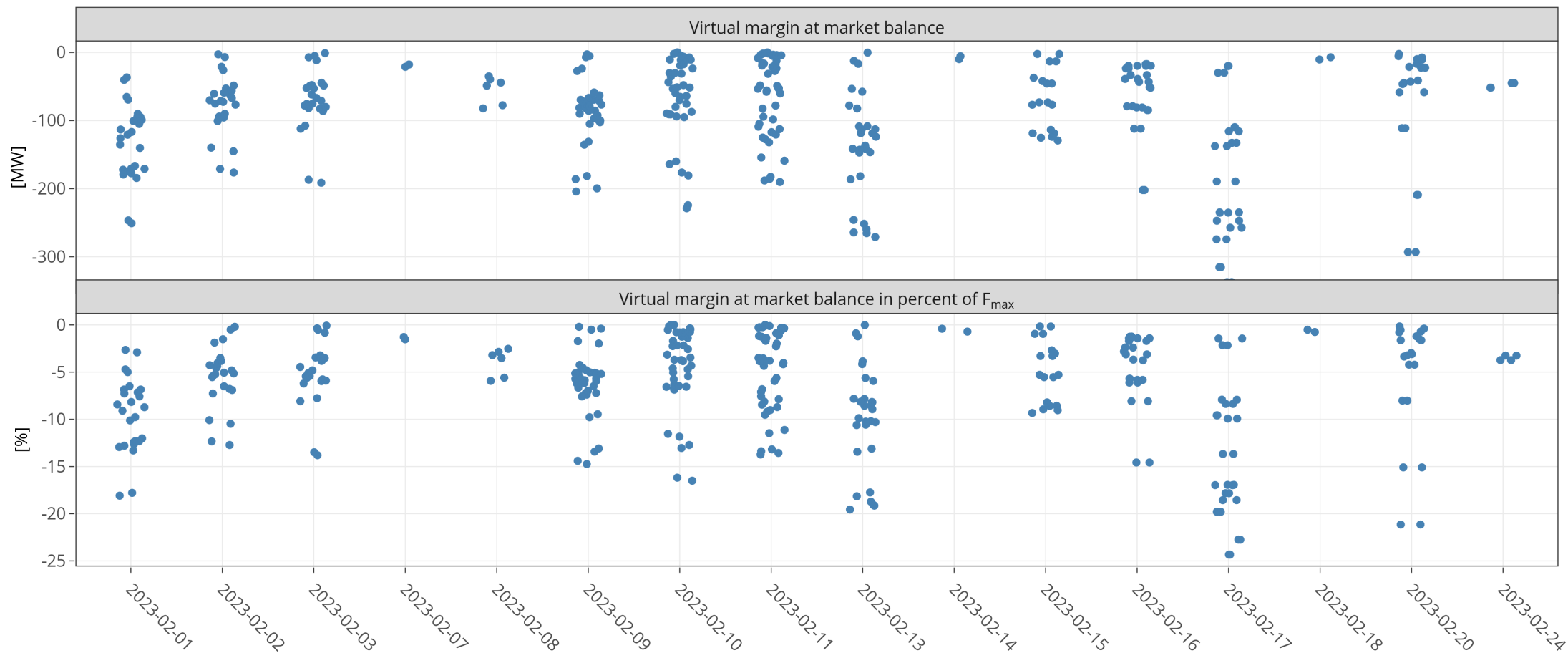
# KPI 6b: Virtual margins at market balance RO



# KPI 6b: Virtual margins at market balance SI

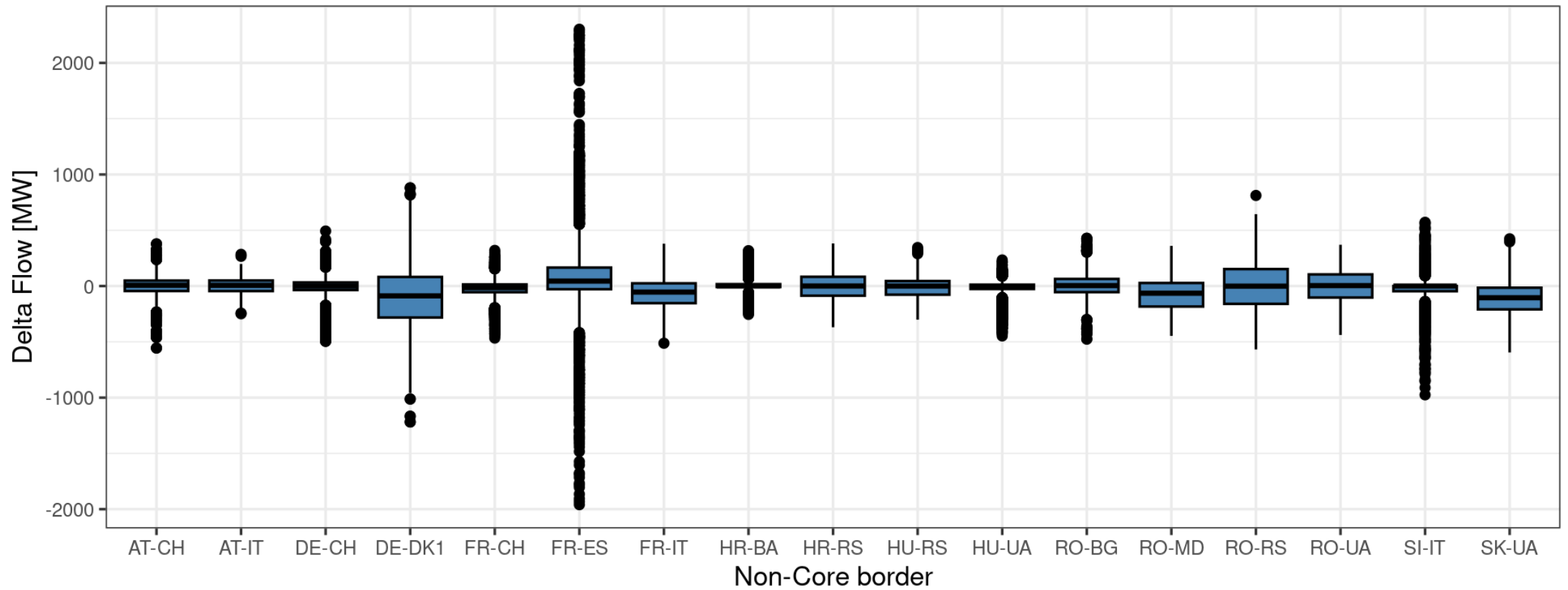


# KPI 6b: Virtual margins at market balance SK

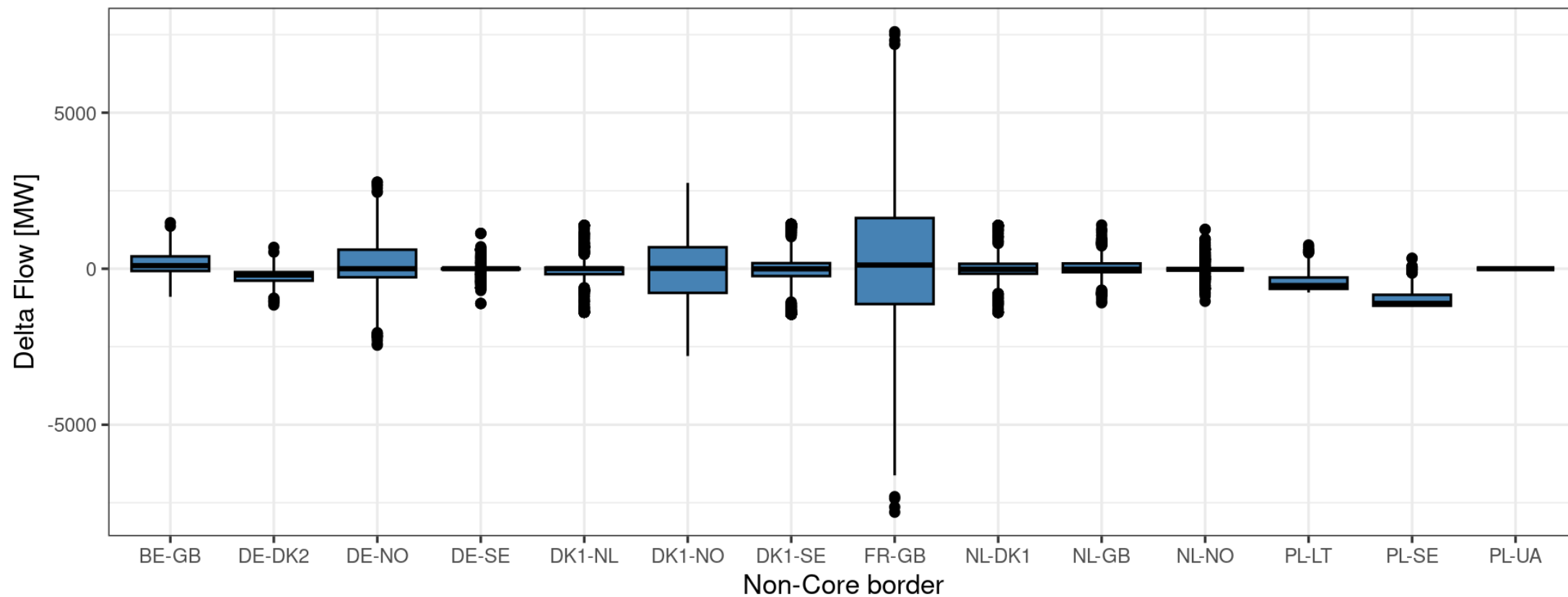




# KPI 7: Non-Core exchanges AC delta flow



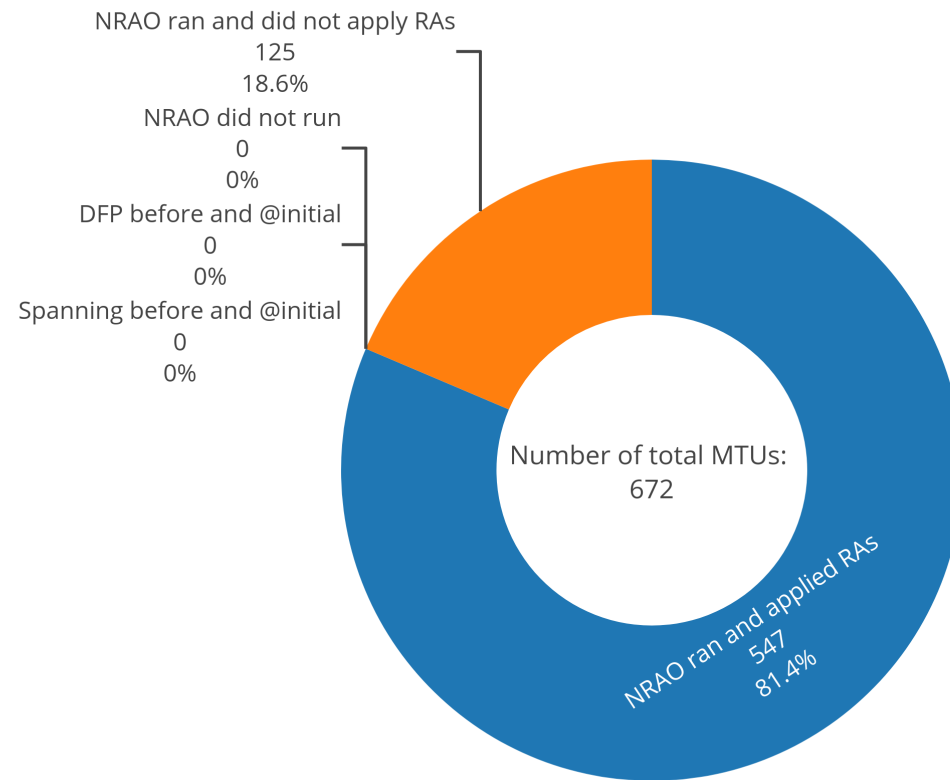
# KPI 7: Non-Core exchanges DC delta flow



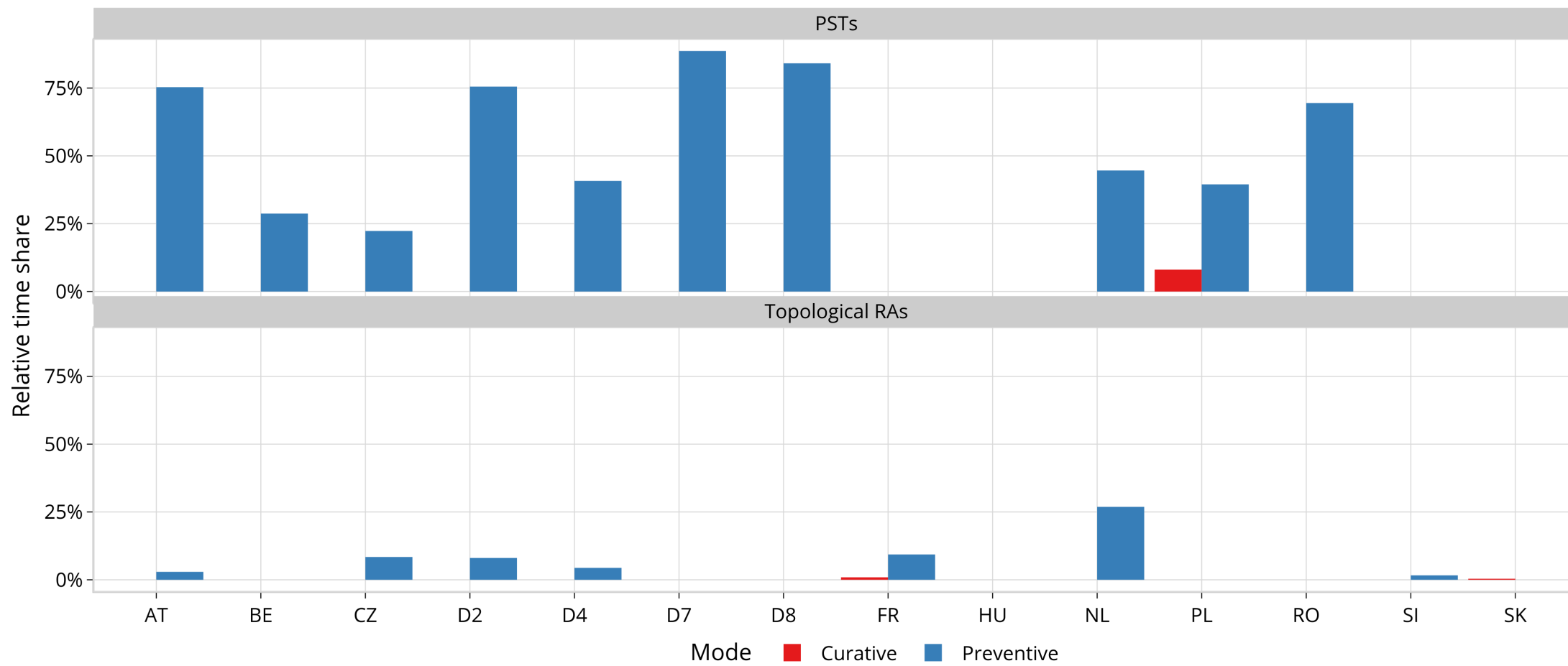
# KPI 8: NRAO – Applied Remedial Action



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

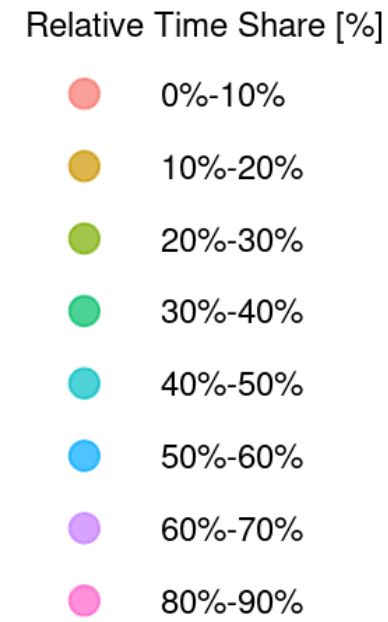
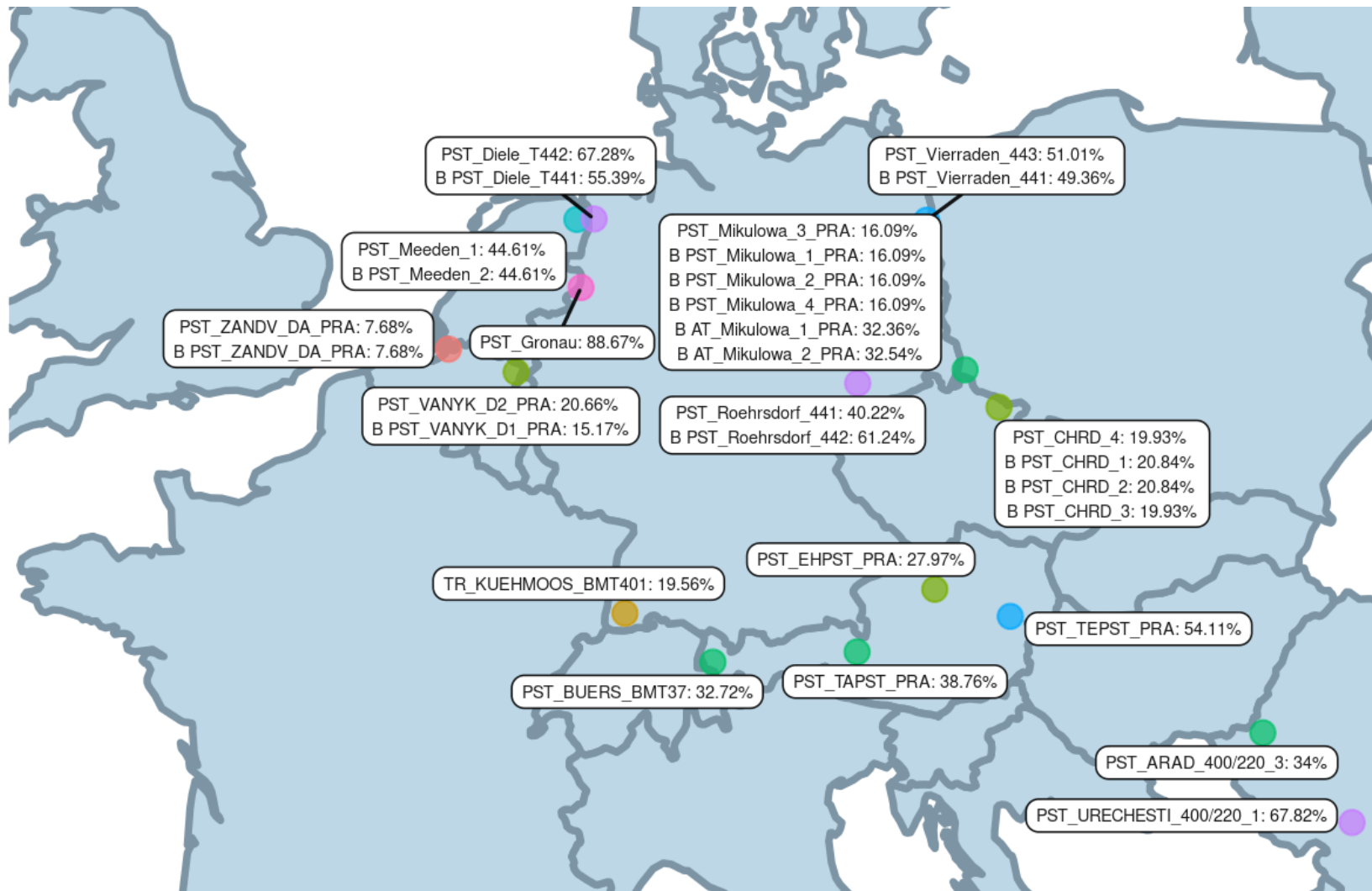


# KPI 8: Relative Time Share of Applied RAs, by TSO, Type and Mode



# 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

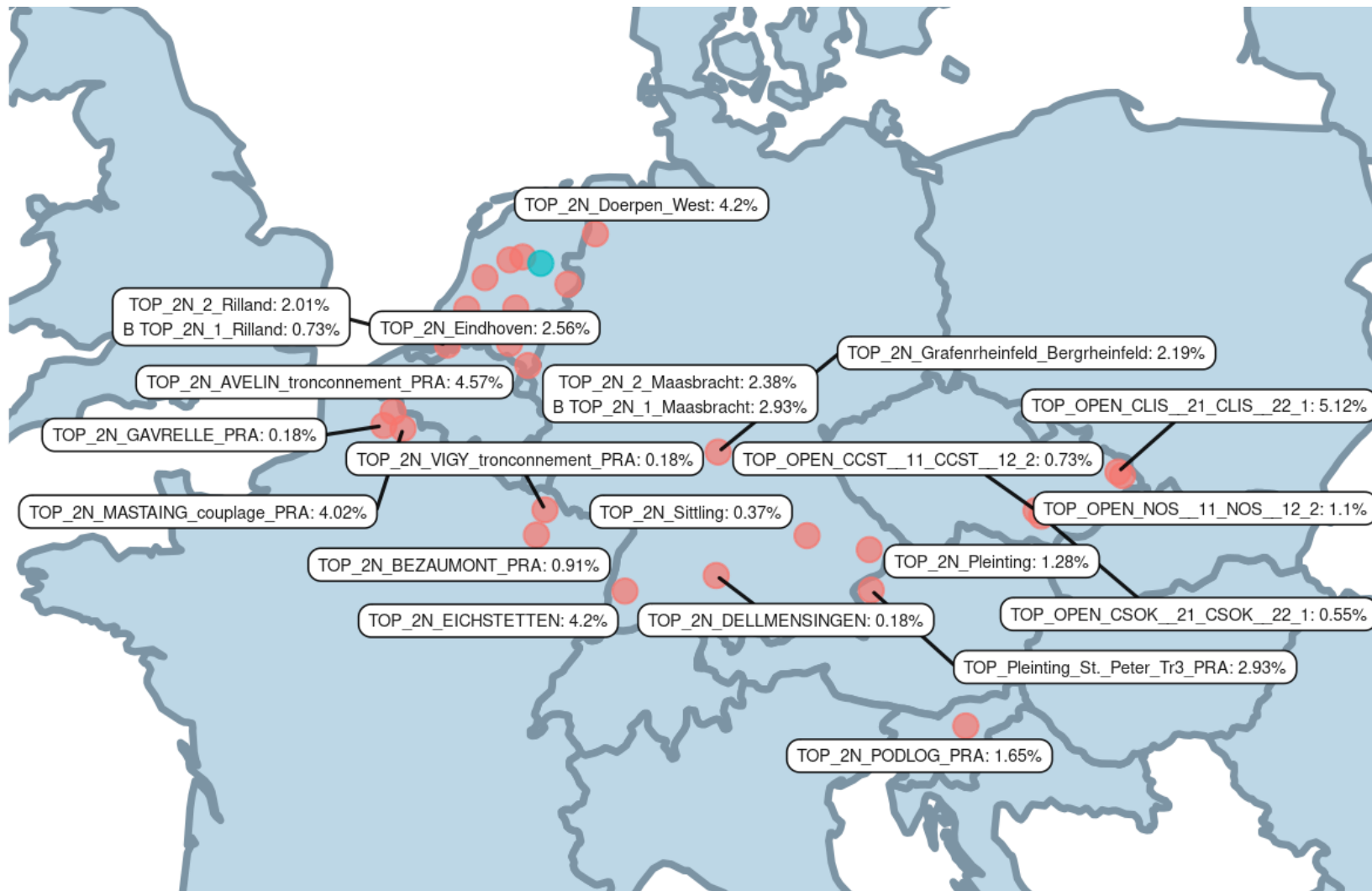


Relative Time Share [%]

● 40%-50%

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

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



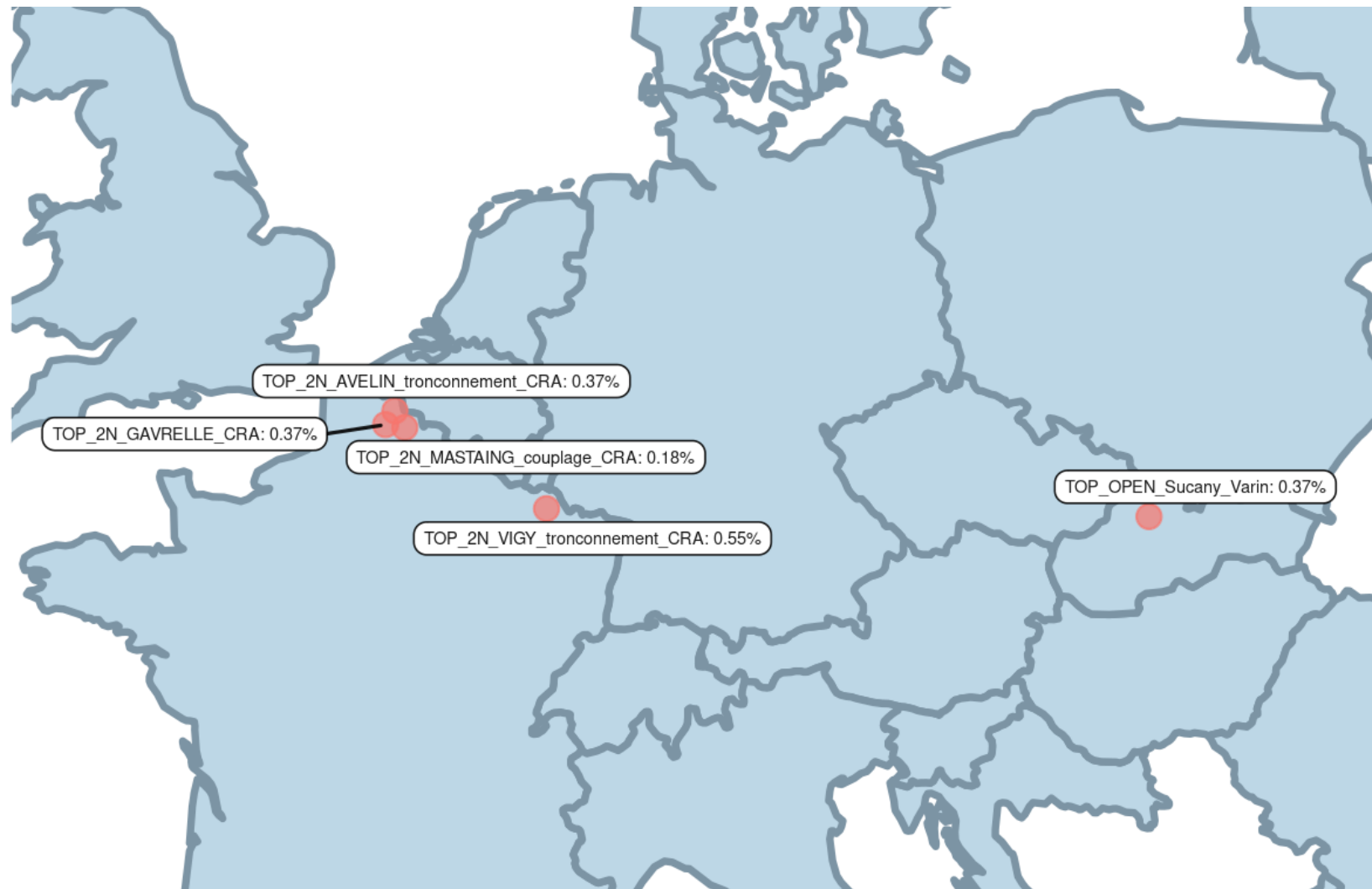
Relative Time Share [%]

● 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



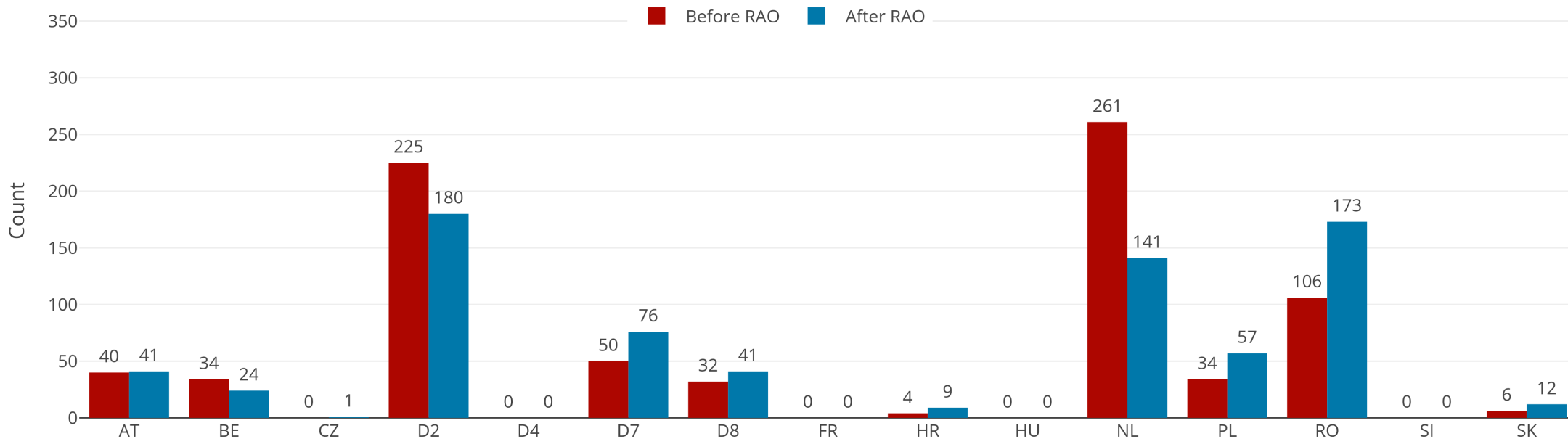


# KPI 9: Most limiting CNEC per TSO (NRAO)



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.

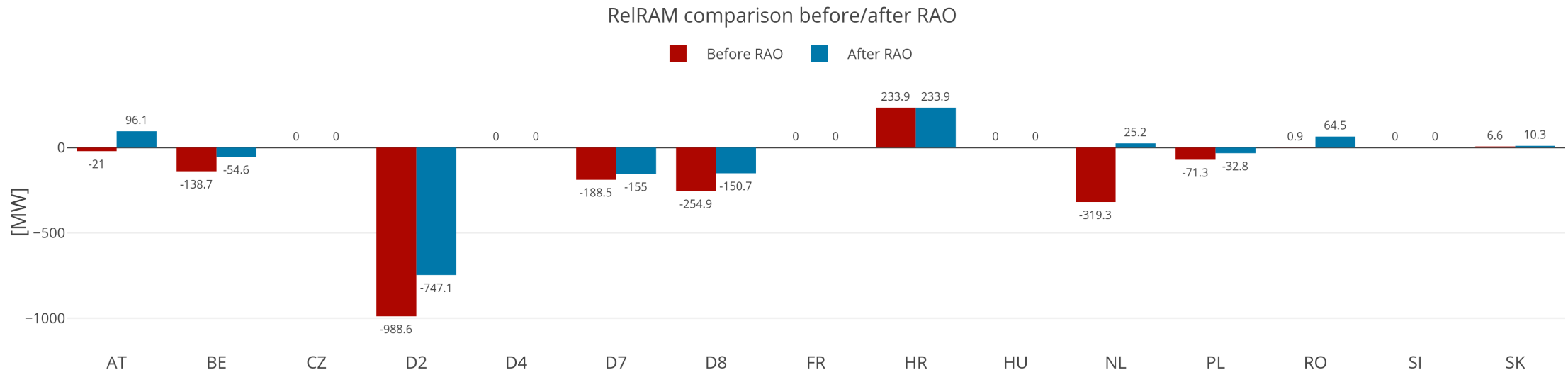
# KPI 10: Average variation of relative RAM before and after NRAO



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]	672	672	68.34%	50.90%	97.83%	0.2165	1.0599
[CZ-D2] Hradec - Etzenricht 441 [DIR] [D2]	672	672	52.23%	24.10%	88.74%	0.1994	0.8743
[SK-SK] Gabcikovo - P.Biskupice [DIR]	672	672	91.71%	73.61%	112.91%	0.321	1.1992
[HU-HU] Gonyu - Gyor [DIR]	672	1544	69.69%	47.36%	94.73%	0.2571	1.2455
[SK-HU] Gabcikovo - Gonyu [OPP] [HU]	672	1199	87.14%	64.26%	115.02%	0.2828	0.9736
[SK-SK] V.Dur - Levice 1 [DIR]	671	671	44.16%	12.91%	57.50%	0.2089	0.8579
[SI-HU] Cirkovce - Heviz [DIR] [HU]	671	675	109.61%	78.34%	138.63%	0.2165	1.0599
[RO-RO] TR Rosiori 400/220 1 [DIR]	671	671	36.91%	5.75%	81.75%	0.1089	0.1894
[CZ-SK] Sokolnice - Stupava [DIR] [SK]	669	669	81.11%	65.87%	102.81%	0.3096	1.2524
[BE-FR] Achene - Lonny 380.19 [OPP] [BE]	664	1597	97.82%	28.09%	133.44%	0.2294	0.5732
[SK-HU] Gabcikovo - Gonyu [DIR] [HU]	664	670	84.60%	65.05%	108.09%	0.2828	0.9736
[AT-SI] Obersielach - Podlog 247 [OPP] [AT]	663	885	104.29%	36.19%	154.21%	0.2182	0.6092
[AT-SI] Obersielach - Podlog 247 [DIR] [AT]	662	858	70.98%	22.84%	126.43%	0.2182	0.6092
[HR-SI] 220kV Pehlin - Divaca [OPP] [HR]	656	937	105.32%	77.54%	142.78%	0.2314	0.5783
[HR-SI] 220kV Pehlin - Divaca [DIR] [HR]	656	656	69.68%	37.43%	98.66%	0.2314	0.5783
[CZ-SK] Nosovice - Varin [OPP] [SK]	647	1034	94.43%	71.21%	129.65%	0.3138	1.1463
[SK-UA] V.Kapusany - Mukachevo (WPS) [DIR] [SK]	643	643	75.79%	46.57%	109.99%	0.239	0.9438
[HR-HU] 400kV Ernestinovo - Pecs 1 [OPP] [HR]	635	635	67.58%	47.37%	96.39%	0.2583	0.8475
[HU-HU] Gonyu - Gyor [OPP]	634	640	116.60%	85.34%	145.42%	0.2571	1.2455
[NL-BE] PST Van Eyck 2 [DIR] [BE]	634	1685	91.13%	13.26%	119.08%	0.3685	0.8668

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
[NL-NL] Diemen-Lelystad 380 W [OPP]	144	144	564.94	20.66%	19.97%	35.56%	0.288
[AT-D2] St. Peter 2 - Pleinting 258 [OPP] [AT]	114	114	644.83	71.47%	32.55%	100.72%	0.1192
[D7-D7] Buerstadt - Lamsheim BUERST W [DIR]	103	103	717.22	42.02%	29.93%	58.62%	0.1483
[NL-BE] PST Zandvliet 1 [DIR] [BE]	95	95	219.39	68.09%	11.15%	103.59%	0.3922
[BE-BE] Achene - Gramme 380.10 [OPP]	94	94	477.93	72.54%	33.68%	113.05%	0.2294
[CZ-D8] Hradec - Rohrsdorf 446 [OPP] [D8]	84	84	372.99	36.61%	21.88%	53.89%	0.2972
[PL-PL] Krosno Iskrzynia - Rzeszow [OPP]	69	69	522.89	41.02%	5.47%	65.68%	0.3963
[D8-D8] Neuenhagen - Vierraden 304 [DIR] [D8]	68	68	911.23	23.15%	19.66%	35.01%	0.0837
[D8-PL] Krajnik - Vierraden 2 [OPP] [PL]	62	62	1033.69	16.86%	0.00%	41.19%	0.1765
[PL-CZ] Kopanina - Liskovec [DIR] [PL]	49	49	1211.43	39.03%	0.00%	77.02%	0.1337
[BE-FR] Achene - Lonny 380.19 [DIR] [BE]	48	48	741.91	63.43%	0.00%	116.65%	0.225
[D7-D7] Y Paffendorf - Oberzier SECHTM S [DIR]	46	46	349.36	58.38%	26.08%	74.29%	0.4735
[RO-RO] Portile de Fier - Resita c1 [DIR]	43	43	1140.94	32.82%	3.48%	53.48%	0.093
[NL-D2] Meeden-Diele 380 Z [OPP] [NL]	40	40	666.74	24.07%	19.94%	37.51%	0.2459
[CZ-PL] Wielopole - Nosovice [DIR] [PL]	38	38	428.63	50.98%	29.94%	68.47%	0.3119
[D2-D7] Grosskrotzenburg - Urberach UMAIN N2 [DIR] [D7]	36	36	655.83	33.87%	24.20%	51.22%	0.0829
[D7-D7] Mettmann - Y Ohligs OERKHS O [DIR]	34	34	813.59	34.23%	28.28%	43.35%	0.1227
[NL-D2] Meeden-Diele 380 Z [DIR] [NL]	33	33	187.81	38.98%	19.94%	64.77%	0.2445
[AT-CH] Westtirol 1 - Pradella 427 [DIR] [AT]	32	32	1075.95	26.60%	20.05%	39.91%	0.0922
[D8-PL] Mikulowa PST1 [OPP] [PL]	32	32	162.77	45.29%	32.88%	59.55%	0.3748

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

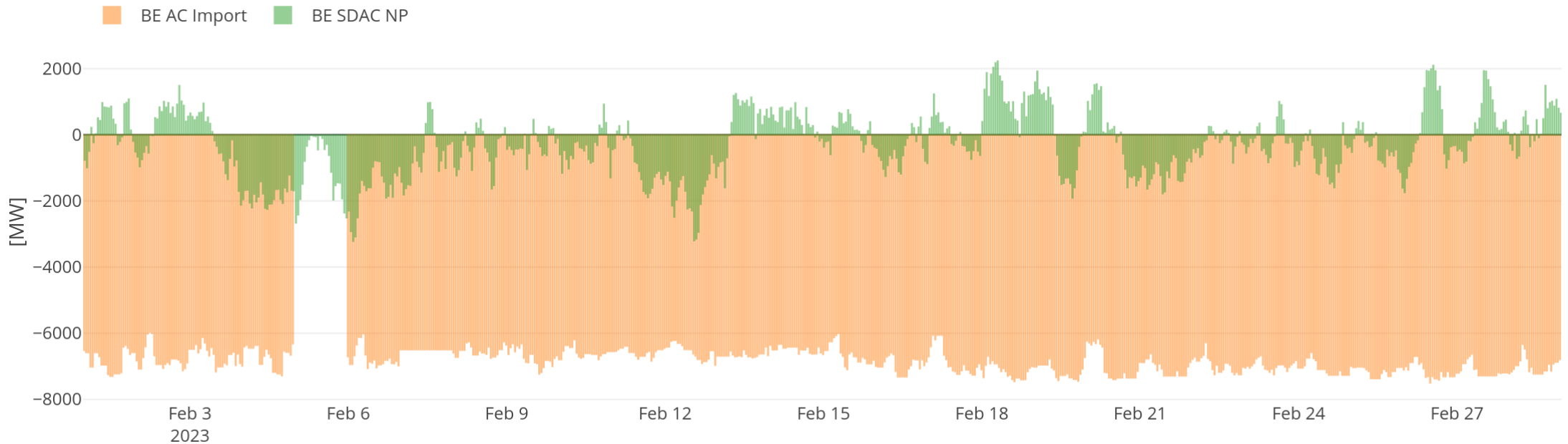
	BE AC Import [MW]
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Avg. -6841.16

Min. -7503.00

Max. -5968.00

Belgium only uses import allocation constraints



# KPI 13b: Allocation Constraints - Poland



	# MTUs
AC was limiting MC	212
AC < 0 MW	50
AC = 0 MW	132
AC > 0 MW	30

	PL AC Import [MW]	PL AC Export [MW]
Avg.	-2169.31	2379.2
Min.	-8575.00	0.0
Max.	0.00	12029.0

