Short-term market highlights – a Danish market perspective

Priyanka Shinde
13th March 2025

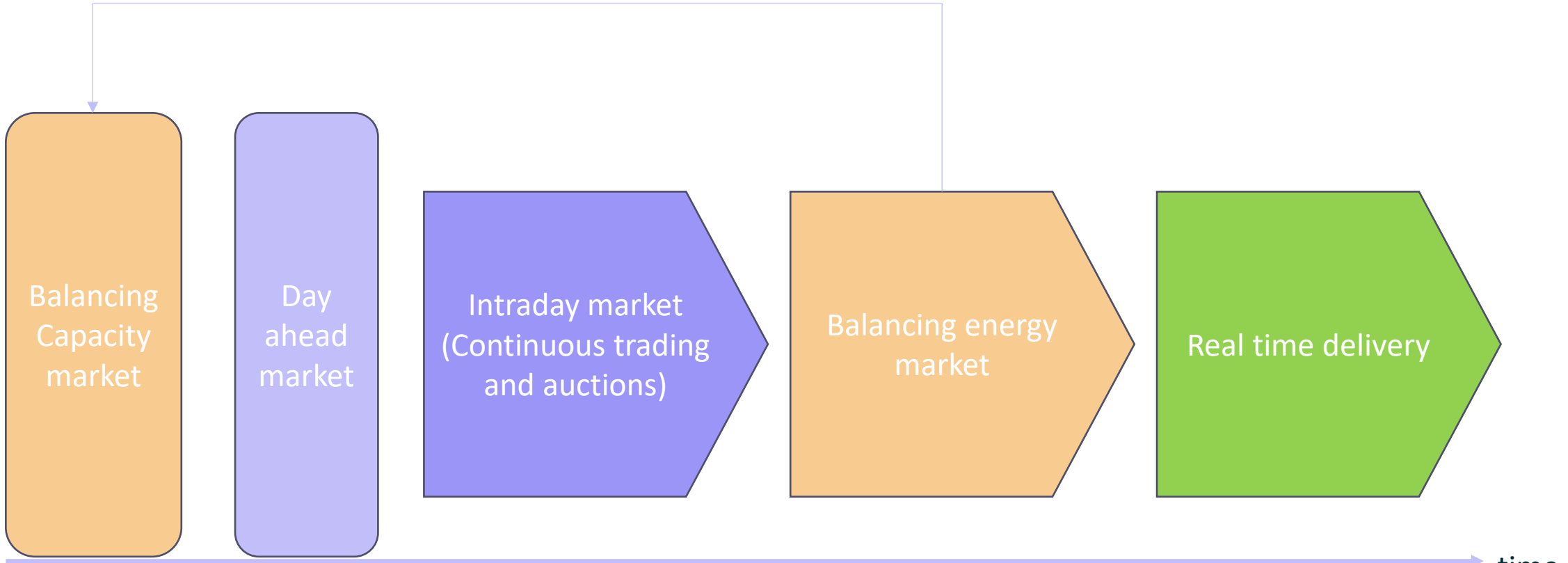
Harmonization of balancing markets, a logical next step?

European Harmonization Previous Steps:
- Single Day-Ahead Coupling
- Single Intra-Day Coupling of continuous trading
- Start of Pan-Central European FCR auctions

Why would balancing activation be a logical next step for integration of markets?
- Intraday trading driven by forecast deviations, balancing risks
- Harmonizing balancing markets, harmonizing risks, levelling the playing field?

But, what about market dynamics?
- Contracting of balancing capacity was left out-of-scope
- Different market sizes
- Different local rules, for trading *and* balancing

What are we going to talk about?



Topics to be covered

FBMC

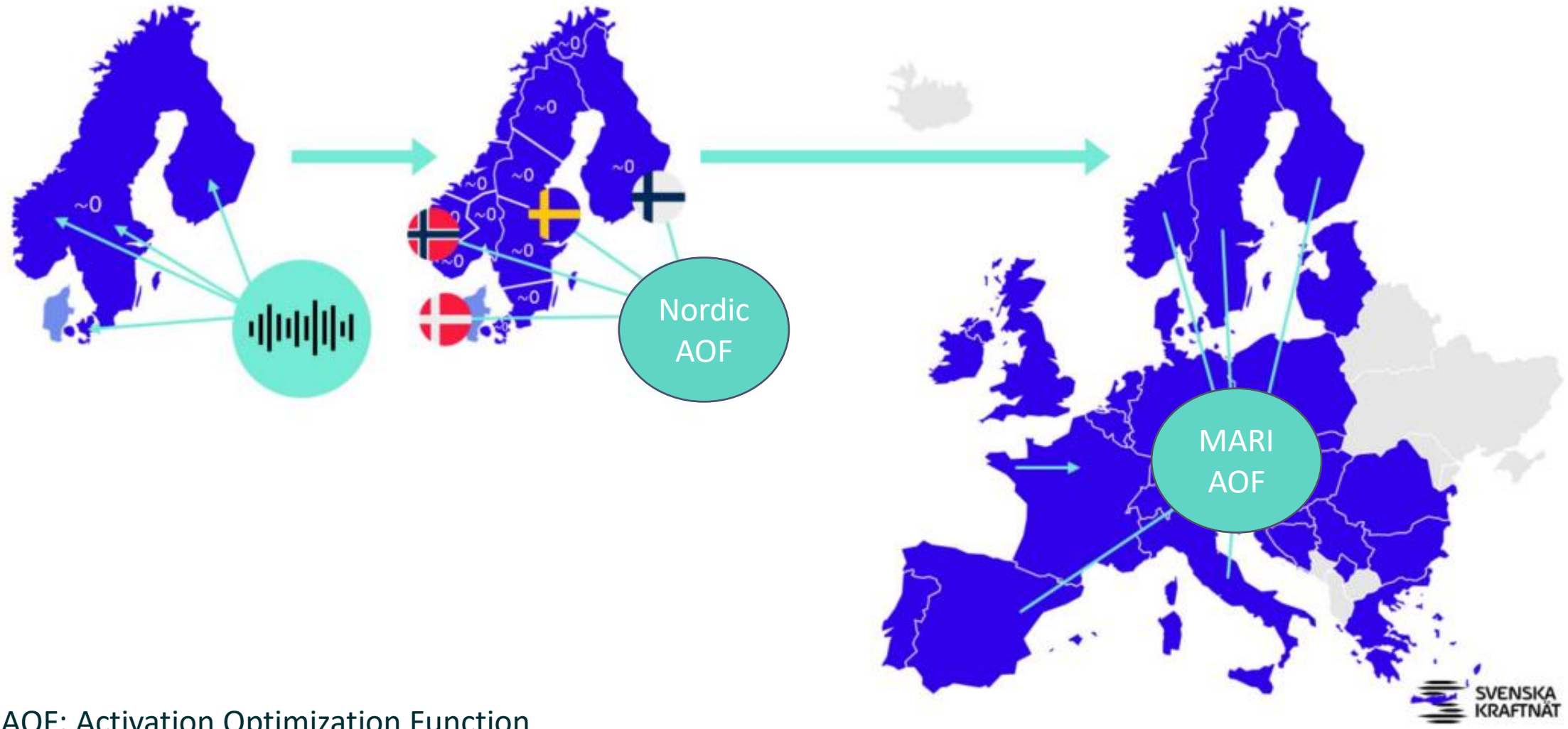
Automated mFRR clearing

PICASSO

mFRR Energy Activation Market

Go-live successful on 4th March 2025

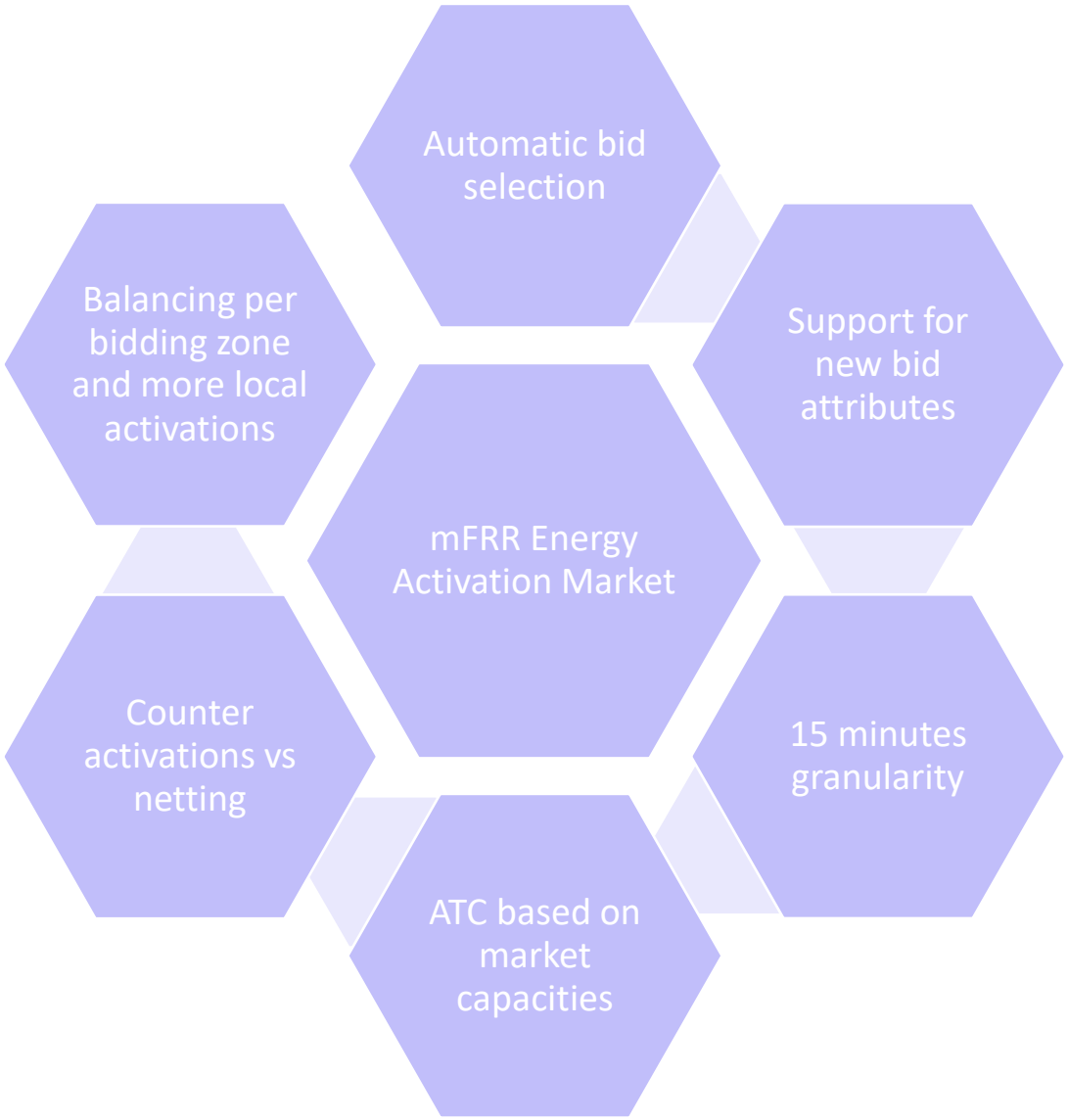
Motivation and background



AOF: Activation Optimization Function
MARI: Manually Activated Reserves Initiative

Fig source: Swedish TSO, SVK

Summary of changes



Two types of activations?

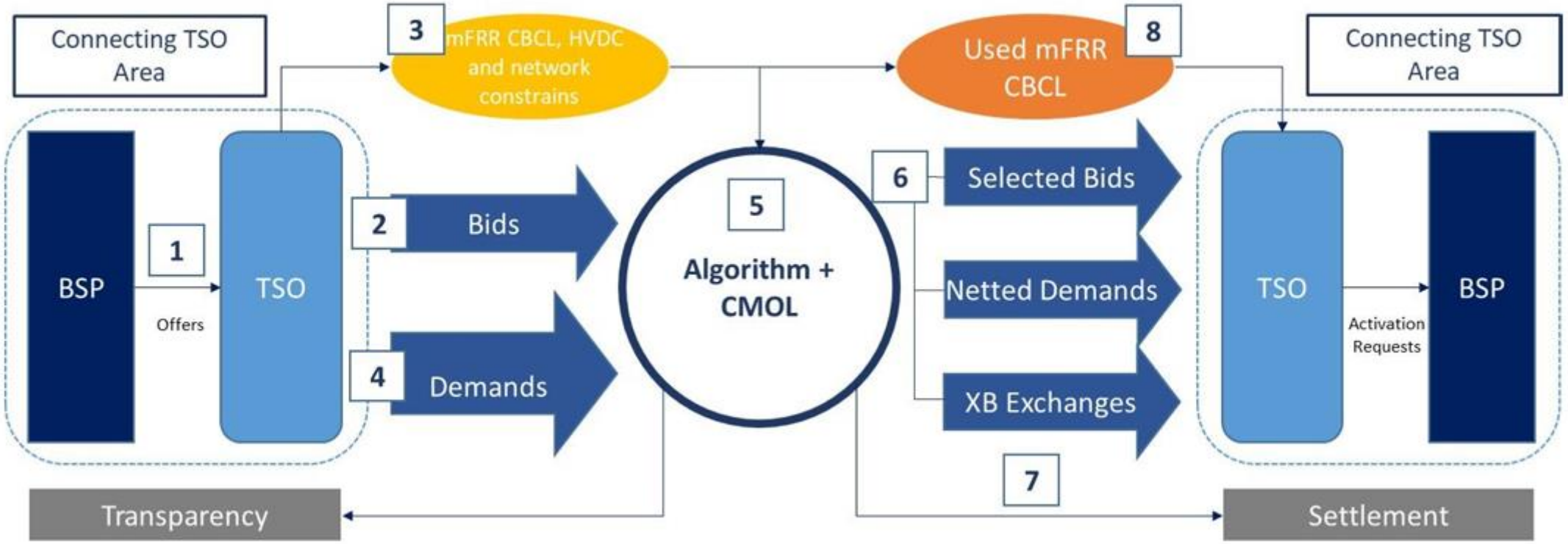
……per bidding zone

Scheduled activation

(Proactive)

Direct Activation (Reactive)

Scheduled activation process



- The scheduled activation (SA) process runs every 15 minutes and uses the Nordic Activation Optimization Function (AOF) to select bids for an upcoming 15-minute period.
- When the Nordic TSOs connect to MARI, the Nordic AOF will be replaced with MARI.
- Scheduled activation, a proactive process since the mFRR request, determining the activated volumes in the AOF, is based on an imbalance forecast made by each TSO.

Source of figure: ENTSOE

Nordic Activation Optimization Function

Soft constraints

- **Maximize satisfied mFRR request**
- Maximize social welfare
- Minimize unforeseeable rejected bids
- Minimize cross border flows
- Maximize traded volumes (sum of accepted quantities of bids and mFRR request)

Hard constraints

- Prevent unforeseeable accepted bids
- Prevent adverse flows
- Enforce price convergence

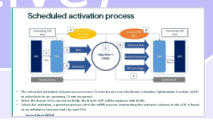
The aim of AOF algorithm is to satisfy the inelastic mFRR request and maximize social welfare.

Two types of activations?

……per bidding zone

Scheduled activation

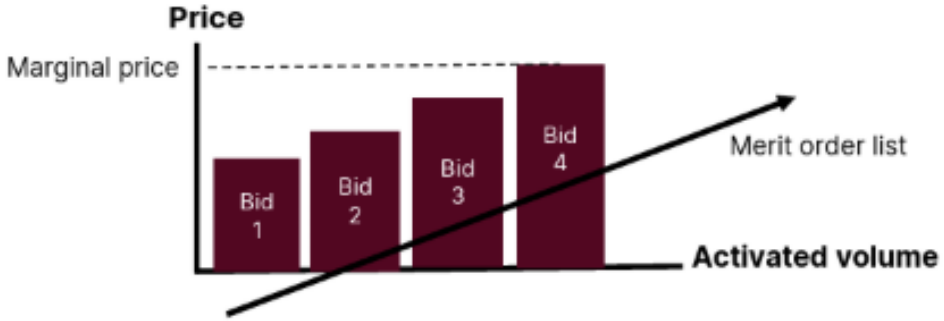
(Proactive)



Direct Activation (Reactive)

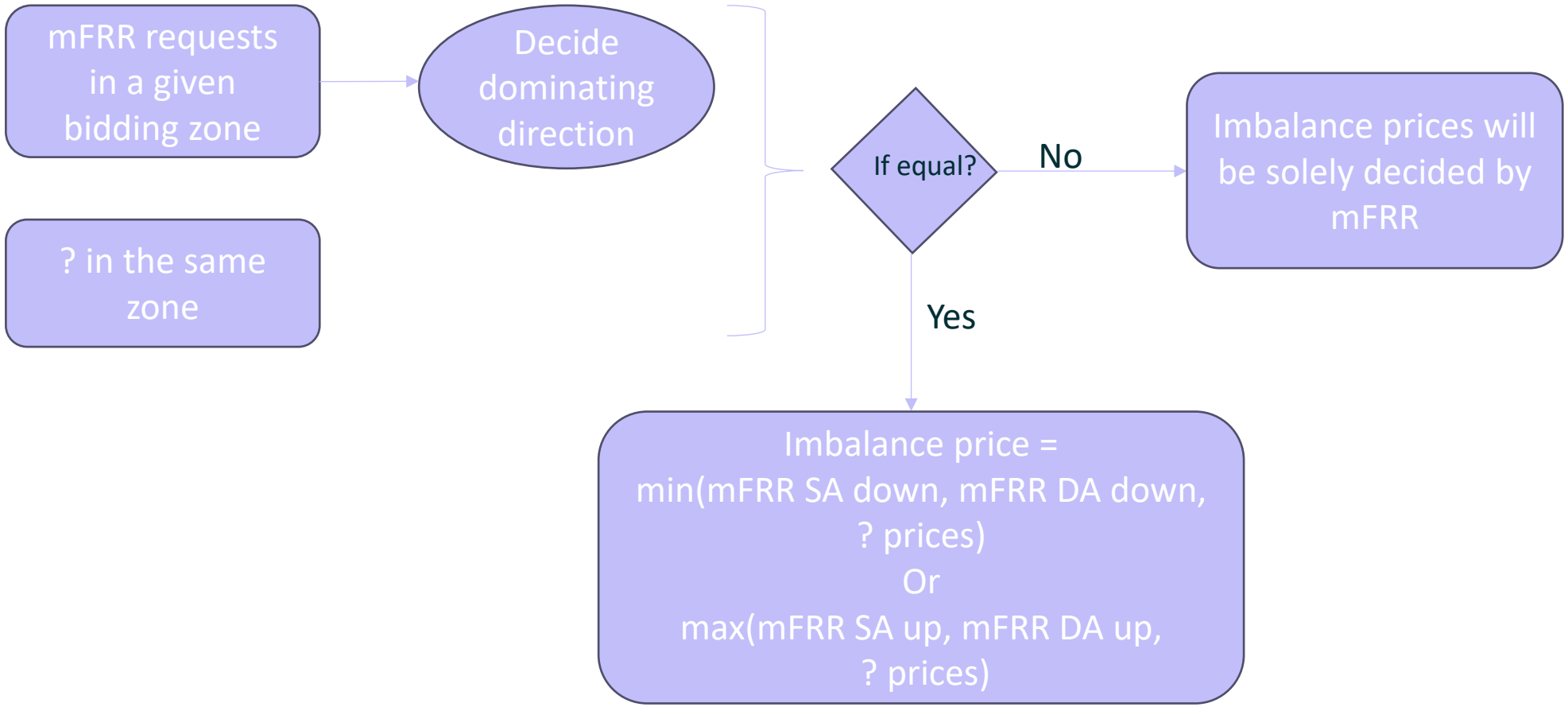
Direct activation

- Local process, bids only from national process with ATC availability within same TSO control area
- Handling incidents in system, or if SA not enough
- Rule-based solution in price order
- Full activation will always start in one quarter hour and continue into the next quarter hour

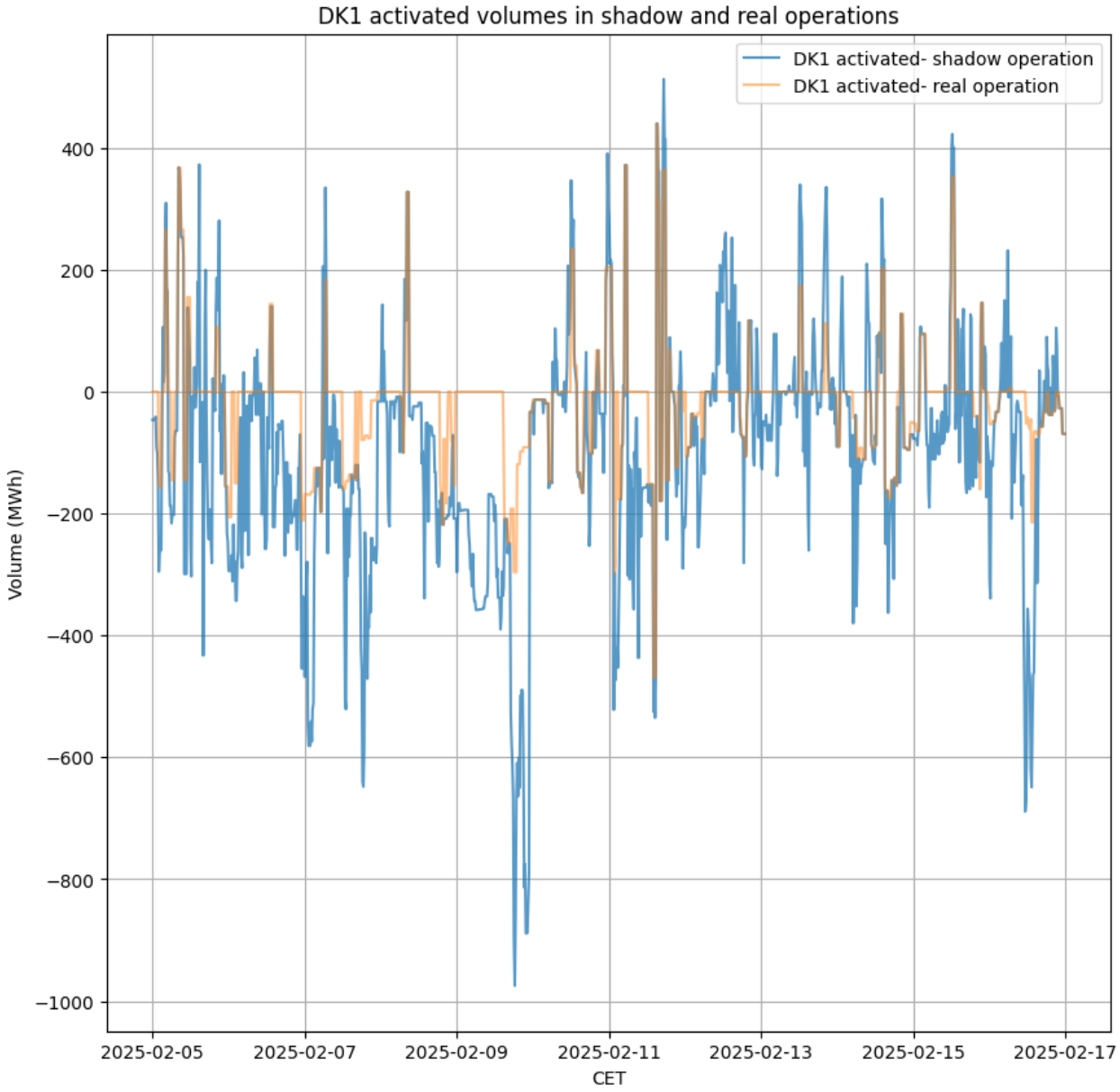


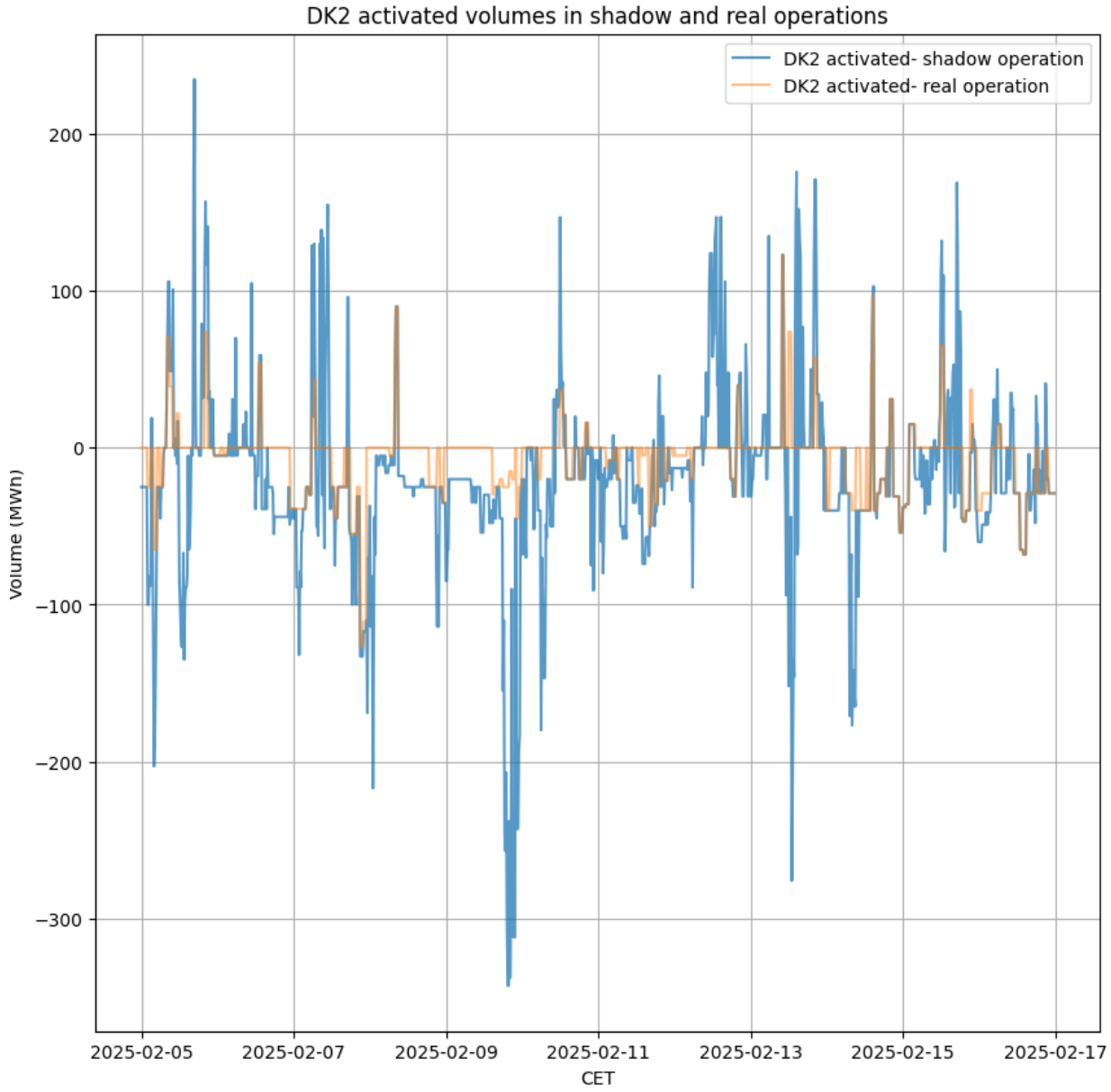
Imbalance price calculation changes

- Including Direct Activation and Scheduled Activation

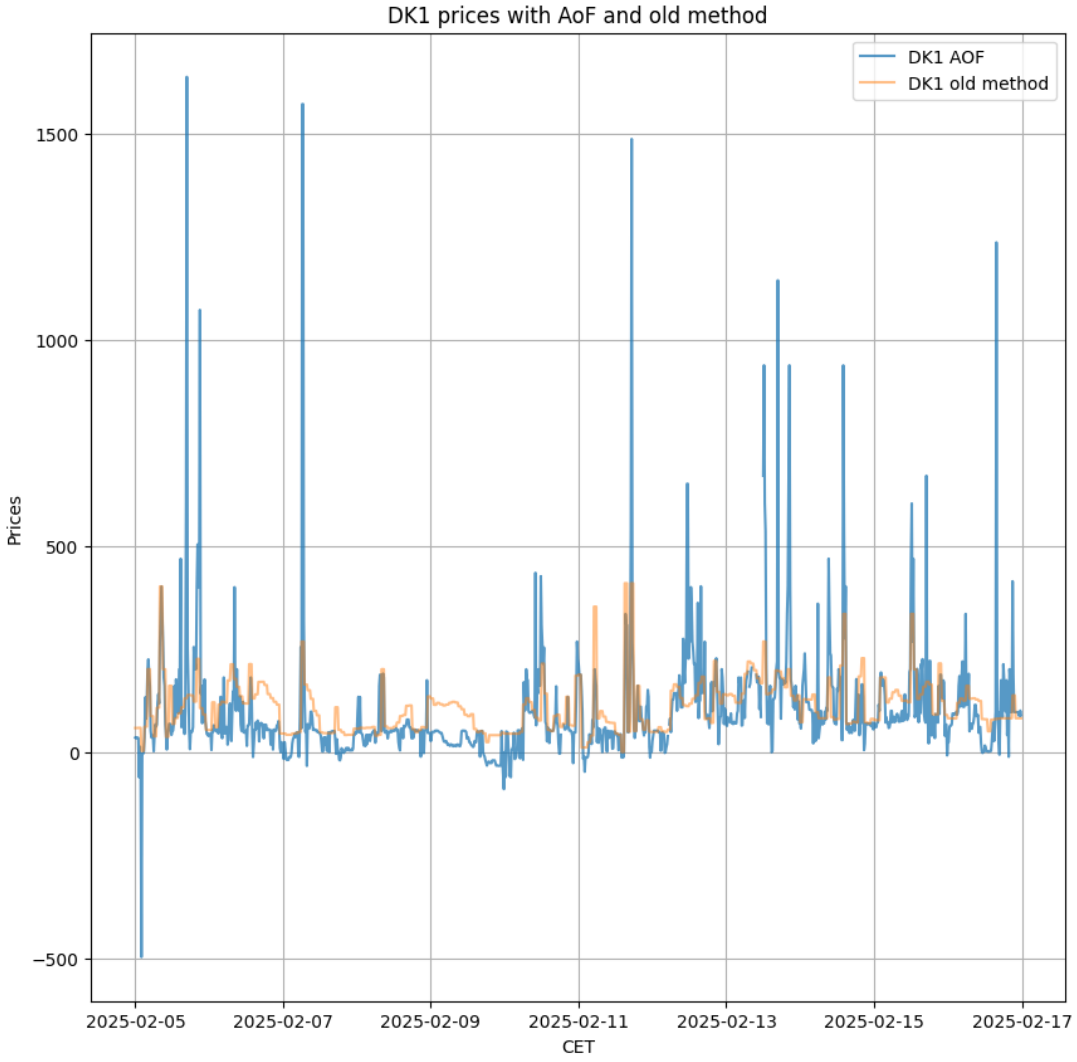


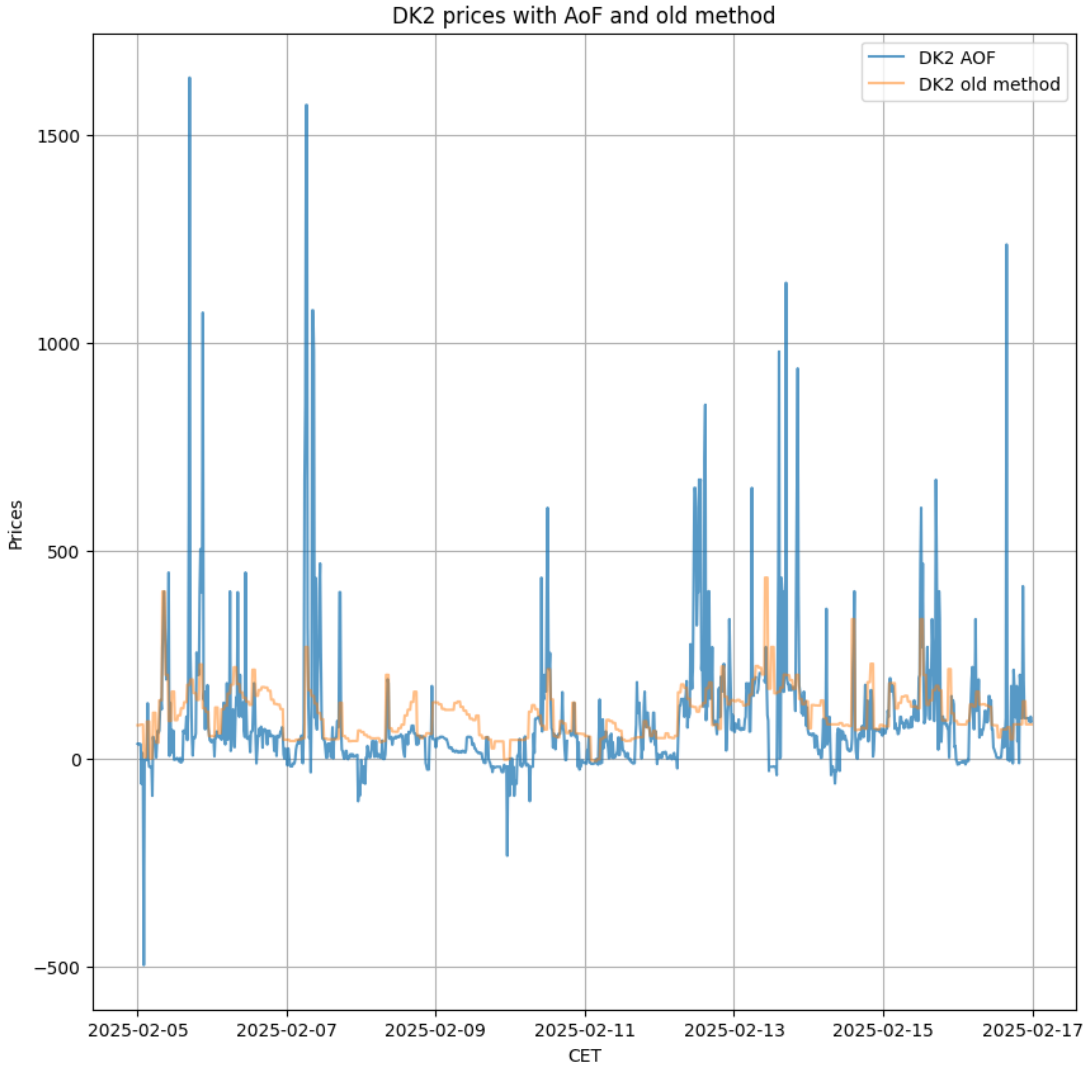
Activated volumes from shadow operations





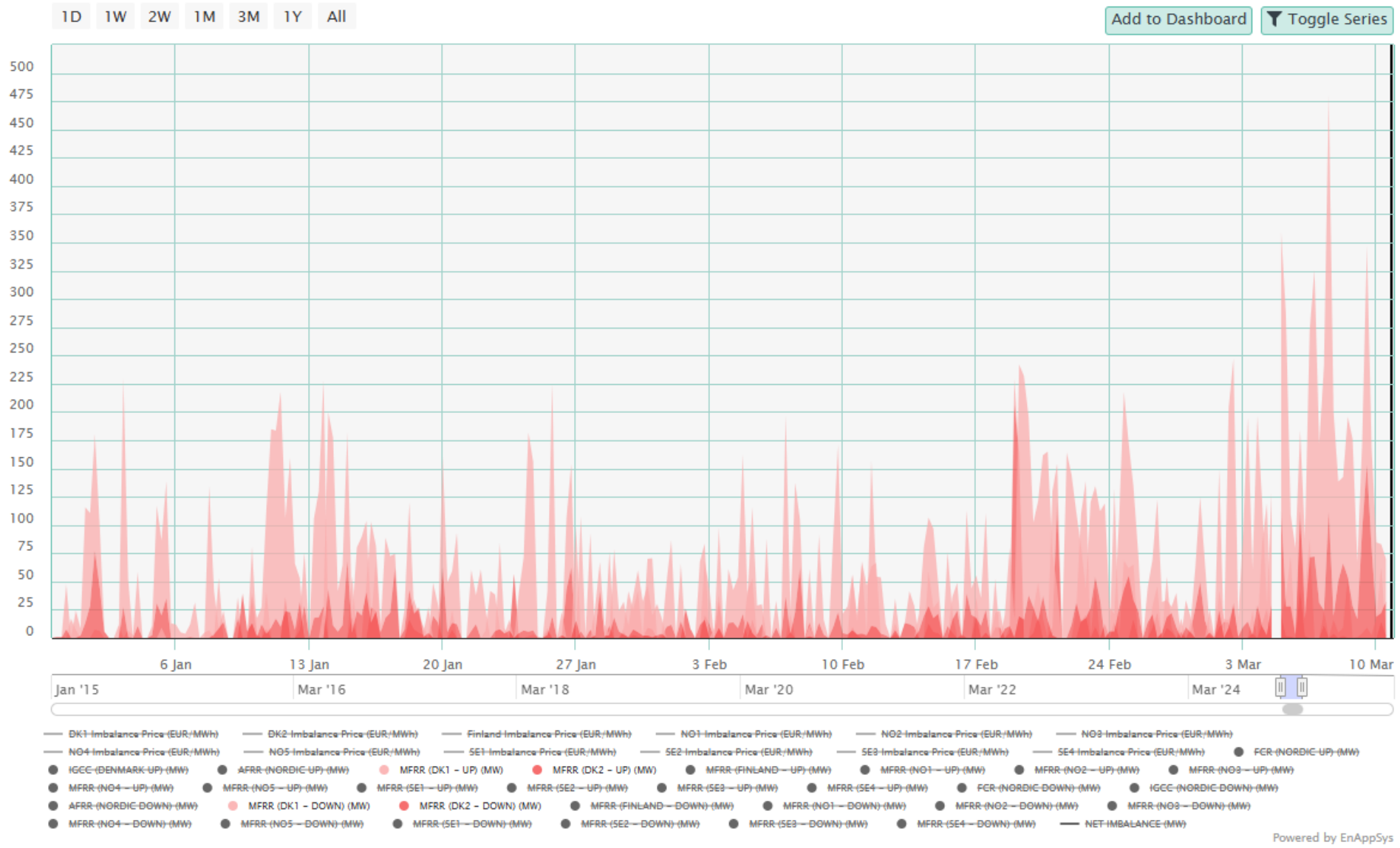
Prices from shadow operations



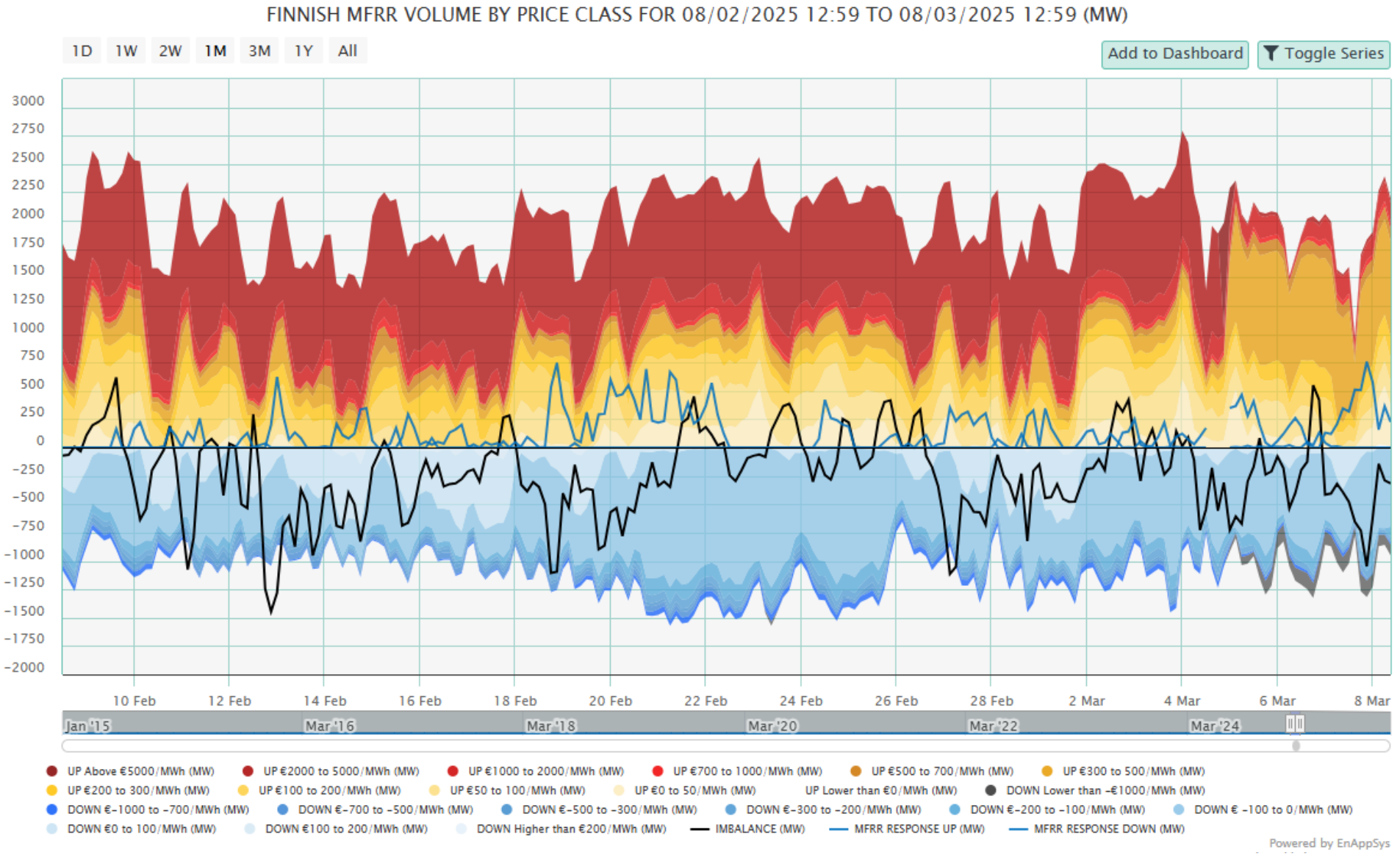


mFRR up and activations in DK1 and DK2

- More local activations were going to be needed and so far the data suggests the same.



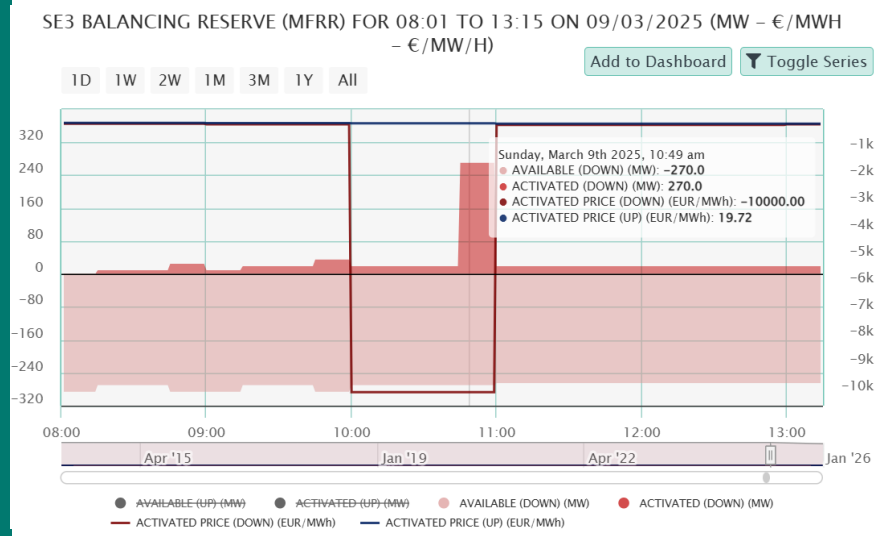
Trading behavior updates

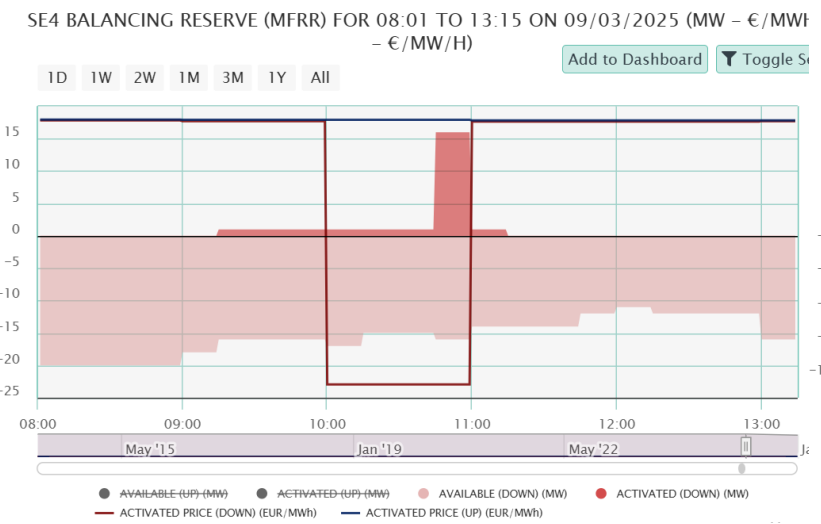


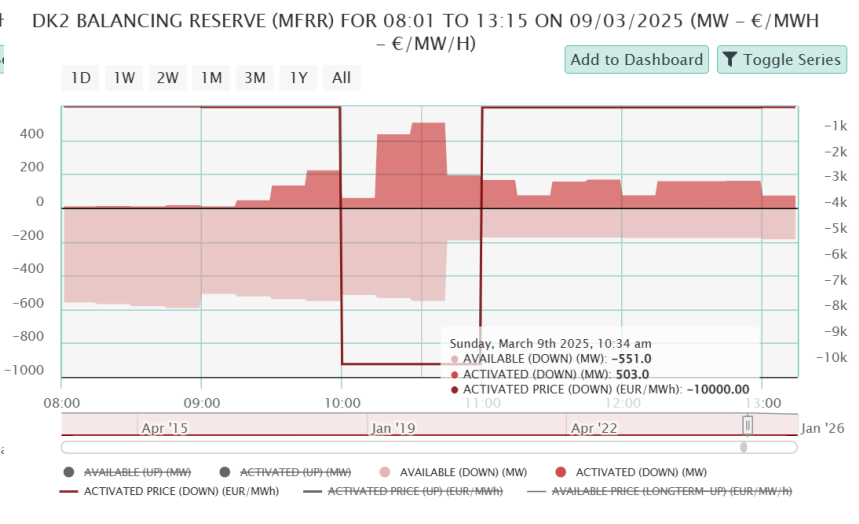
Some recent observations after mFRR EAM launch

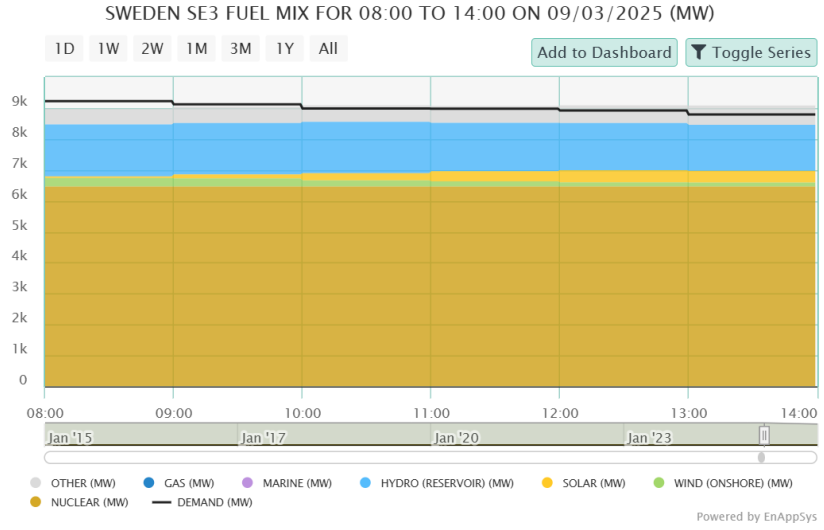
- Delays in imbalance price publication for certain hours: temporary pricing issues.
- 4th March, price spike in SE2, SE3, SE4 close to EUR 2000/MWh.
- 6th March at 16:00, the imbalance price for DK1 went close to EUR 4890/MWh.
  The highest imbalance price in recent years for this zone.
- 9th March at 10 am in DK2, SE3, SE4 imbalance price was -10000 EUR/MWh.

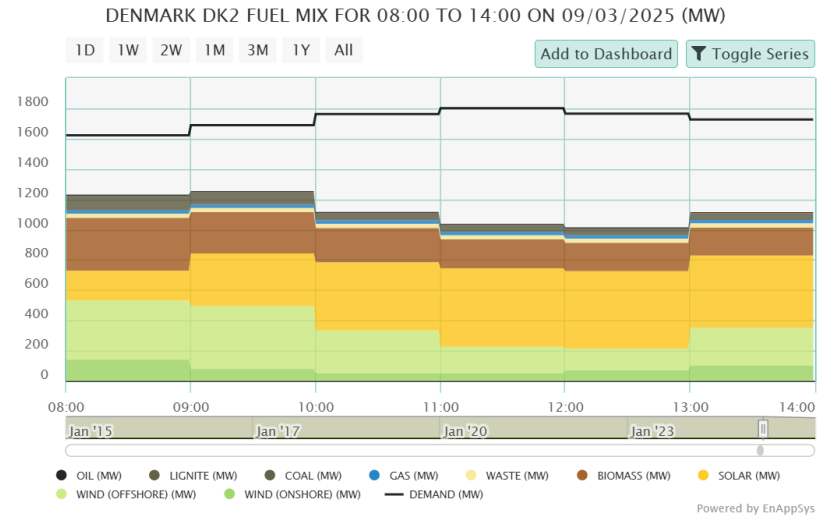
How was the floor reached on 9th March?

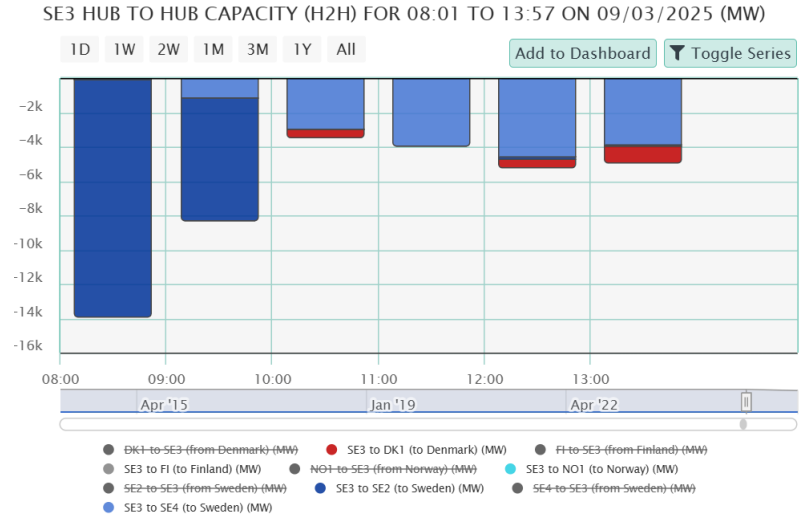












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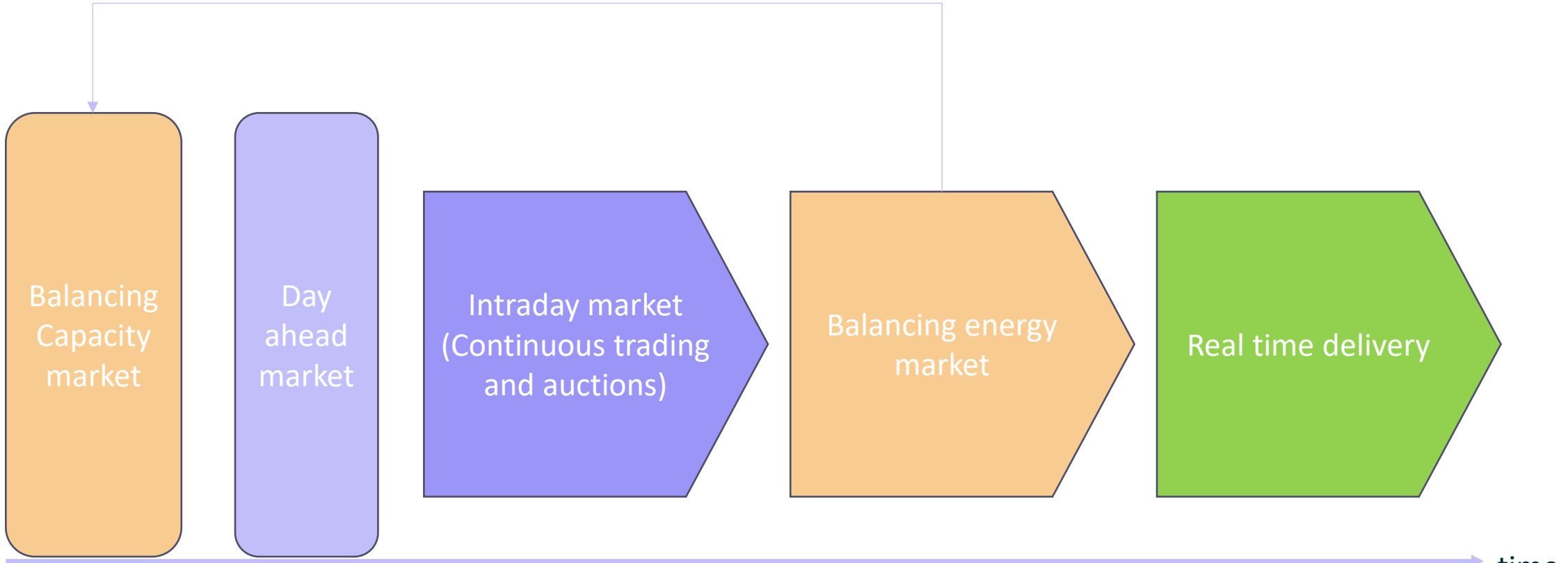


Topics to be covered

Automated mFRR clearing

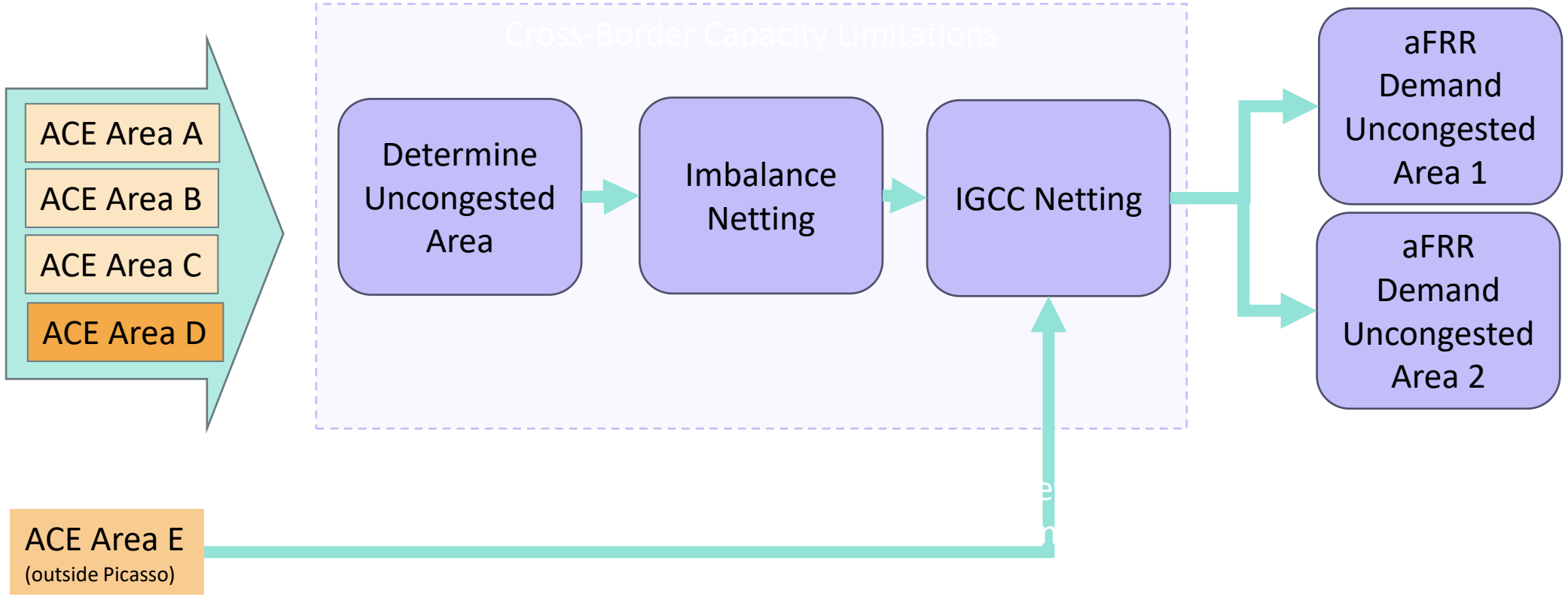
PICASSO

PICASSO in Denmark

Launched on 2nd October 2024

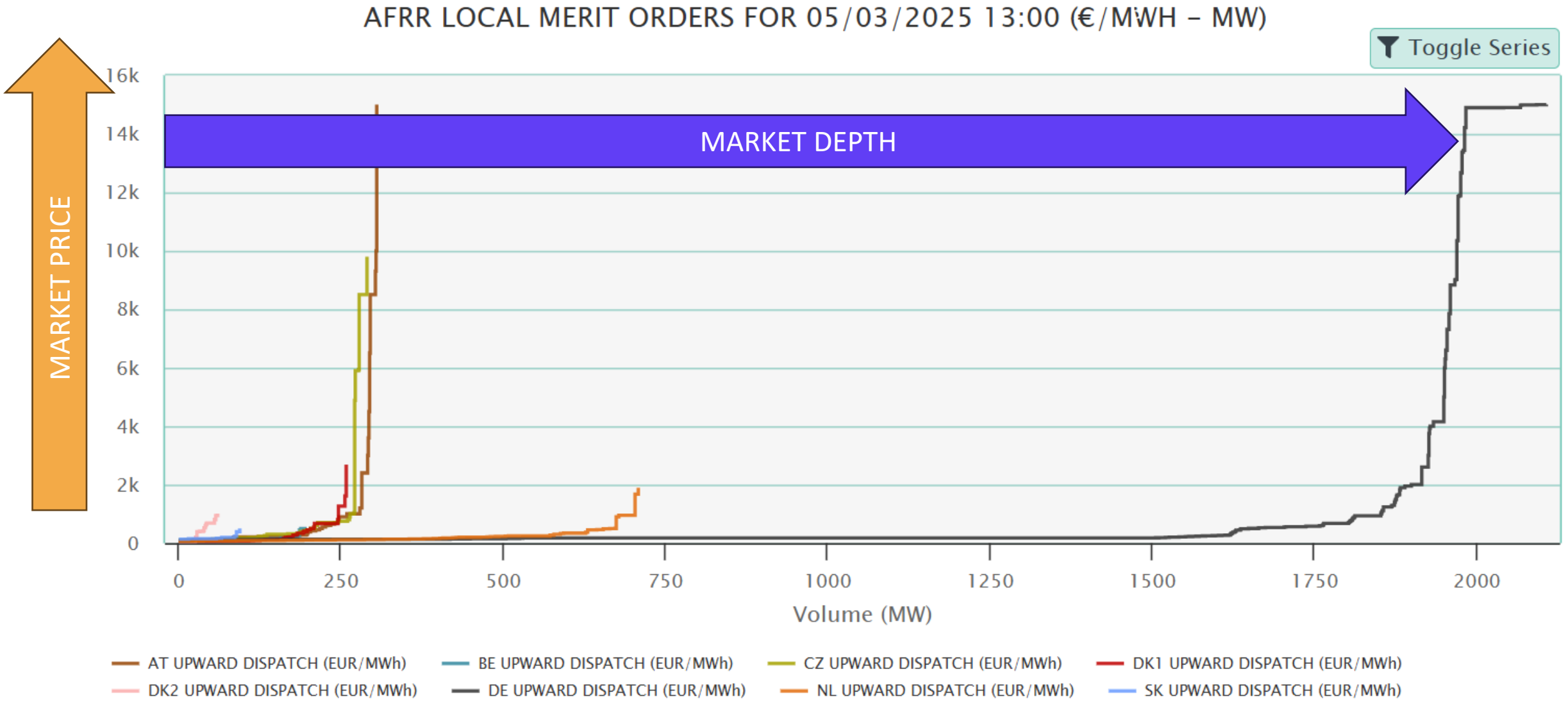
PICASSO: Platform for the International Coordination of Automated **Frequency** Restoration and Stable **System** Operation

Optimization Steps Before Selecting a Bid for Activation



ACE- Area Control Error; IGCC- International Grid Control Cooperation

Upward Activation Prices in the European Context



- Different market sizes affect the depth of the curve.
- Different market rules affect 'extreme' bids.
- Scarcity can drive the 'tails' of the activation merit-order.

aFRR: automatic Frequency Restoration Reserve

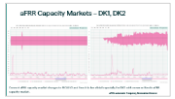
aFRR markets in the Nordics

Nordic aFRR capacity market (D-1)
results published 9:15 am

aFRR at the real time

Imbalance prices

Common market



All bidding zones of Sweden

All bidding zones of Norway

Finland

DK2

No separate aFRR energy market (contracted capacity is obliged to be available)

Local aFRR energy market (contracted capacity is obliged to bid in)

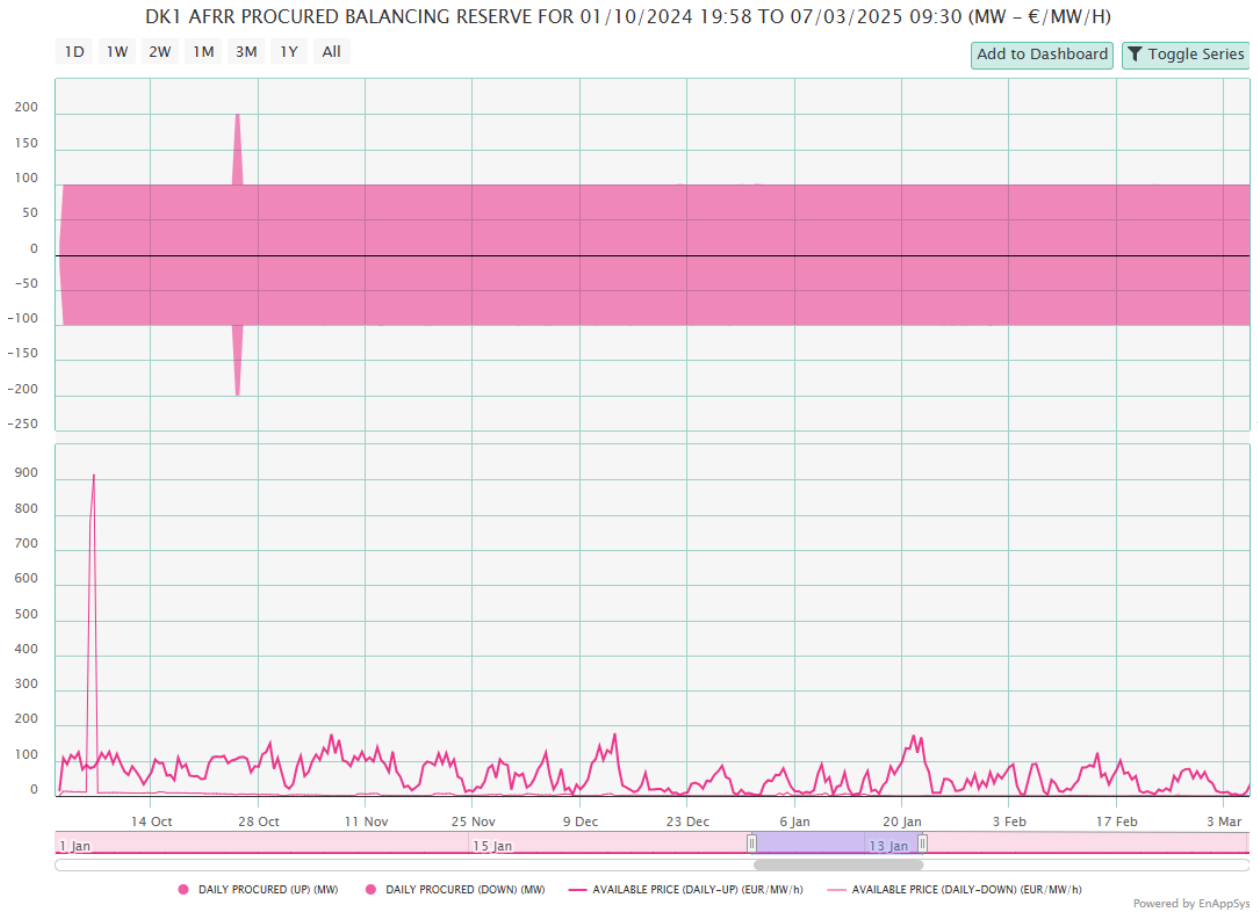
Denmark’s accession to PICASSO since 2nd Oct’24

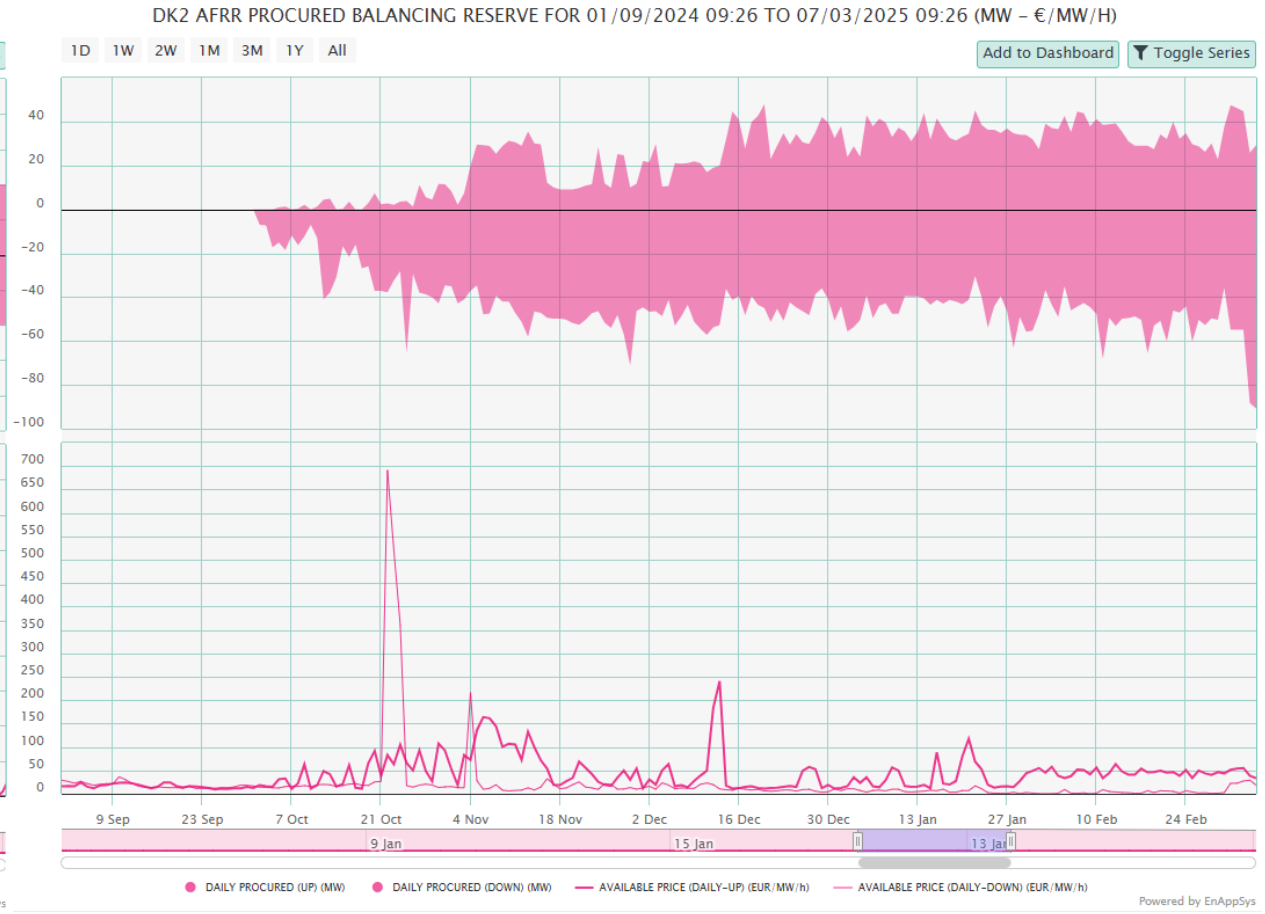
Domestic market

DK1
(new market introduced on 1st Oct 2024)

In case of activations, and failing to deliver the resources penalty according to imbalance prices. If this occurs several times then it could lead to disqualification from aFRR market.

aFRR Capacity Markets – DK1, DK2





Connect aFRR capacity market changes to PICASSO and how it is beneficial especially for DK2 with common Nordic aFRR capacity market.

aFRR: automatic Frequency Restoration Reserve

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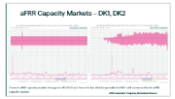

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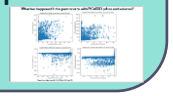

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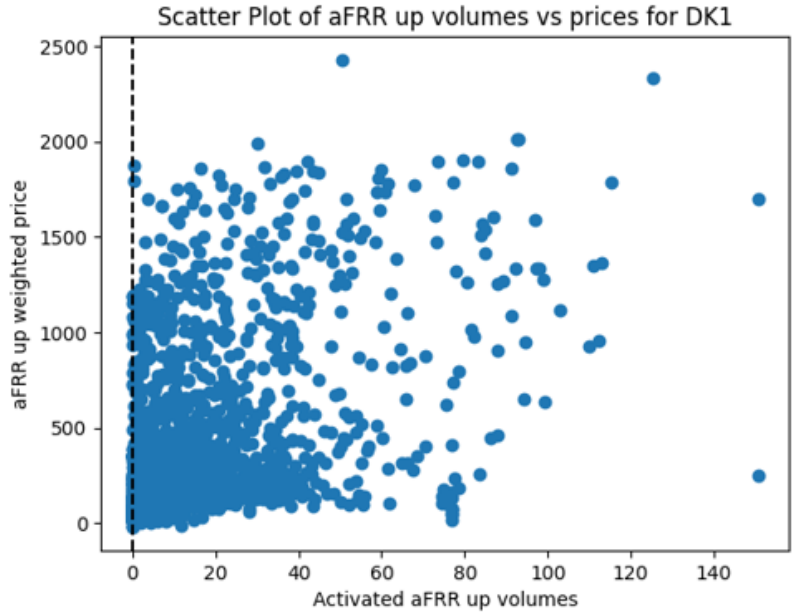
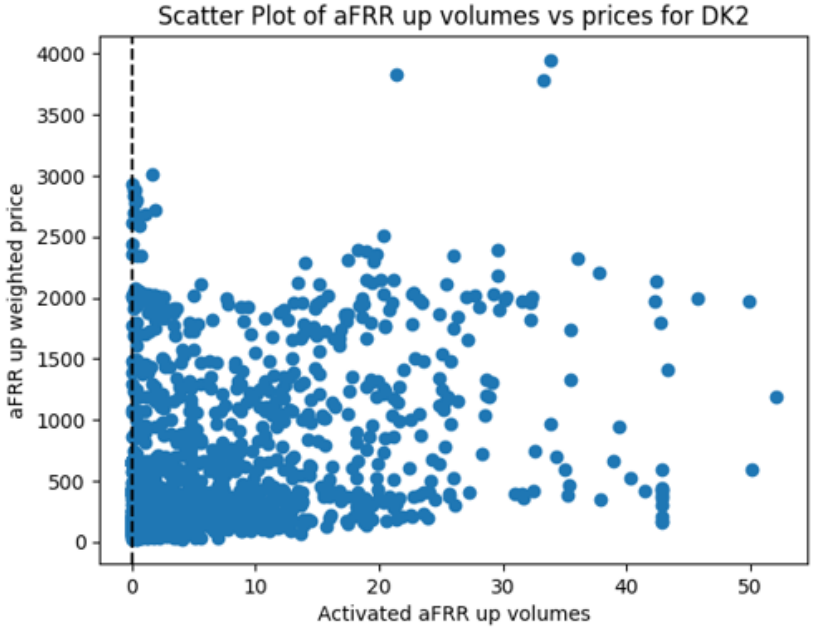
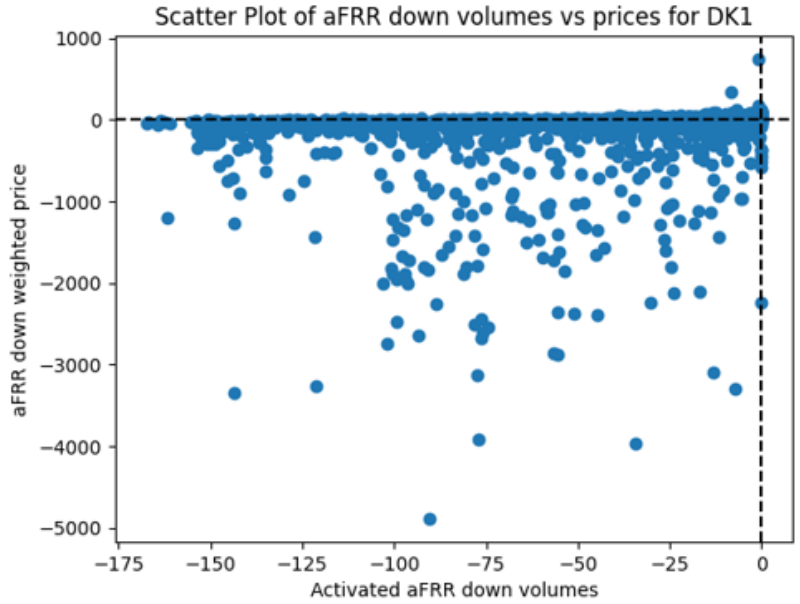
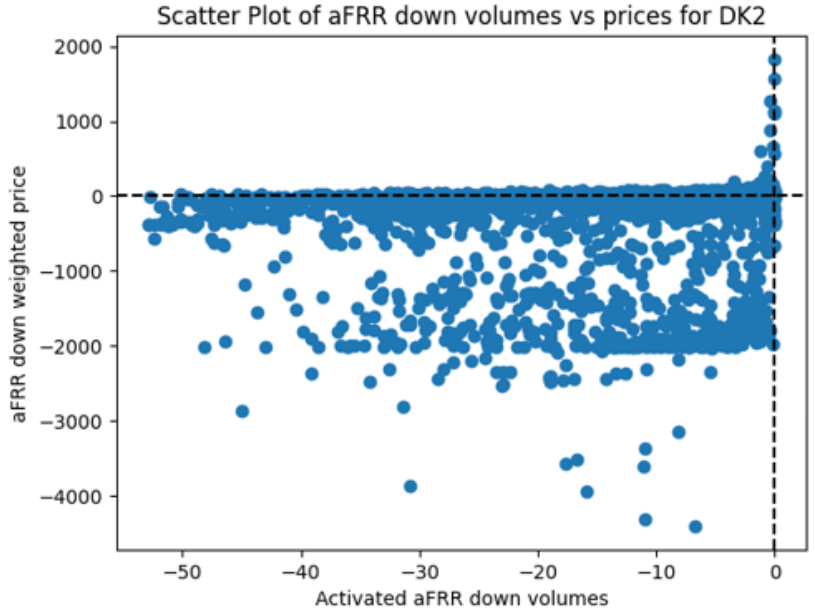
What has happened in the past months with PICASSO prices and volumes?









Based on data from 3rd Oct'24 to 23rd Jan'25

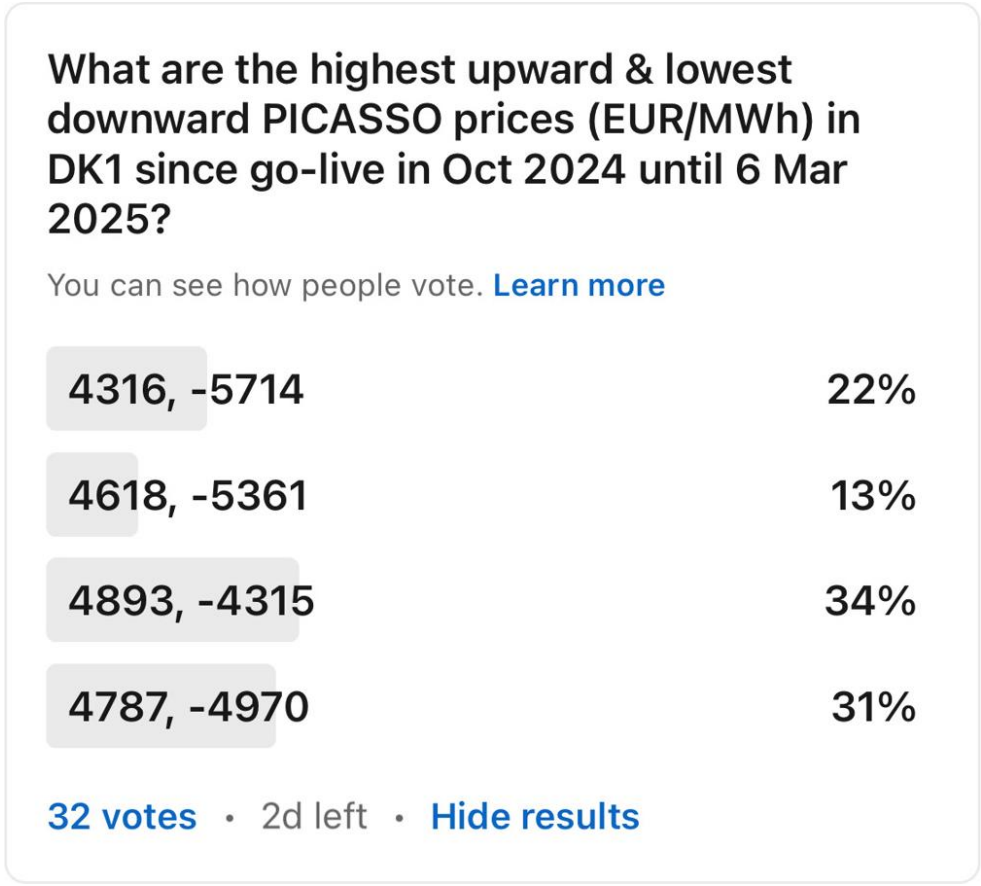
Poll on DK1 PICASSO prices

What are the highest upward & lowest downward PICASSO prices (EUR/MWh) in DK1 since go-live in Oct 2024 until 6 Mar 2025?

The author can see how you vote. Learn more

- 4316, -5714
- 4618, -5361
- 4893, -4315
- 4787, -4970

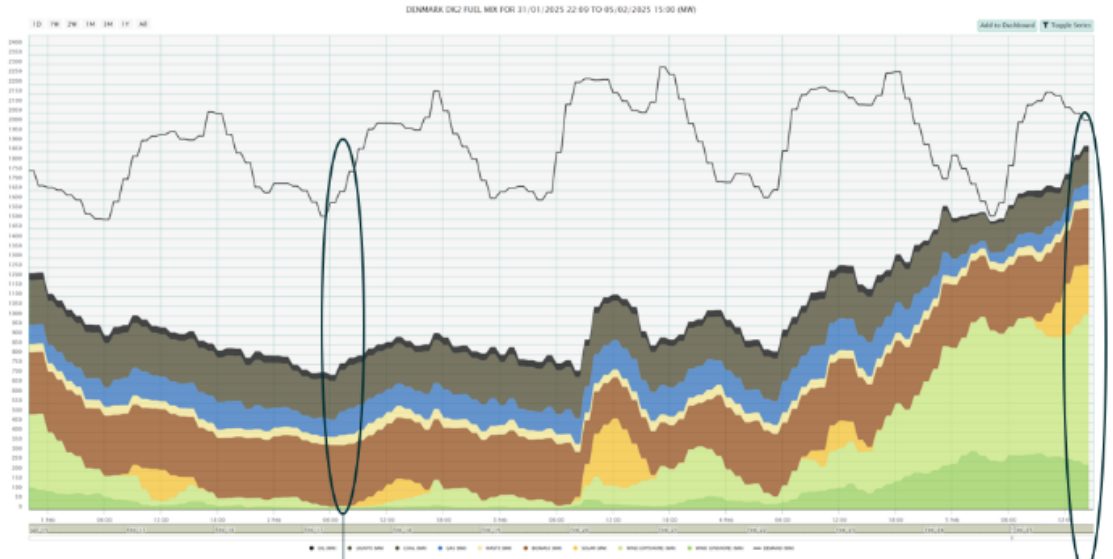
32 votes • 2d left

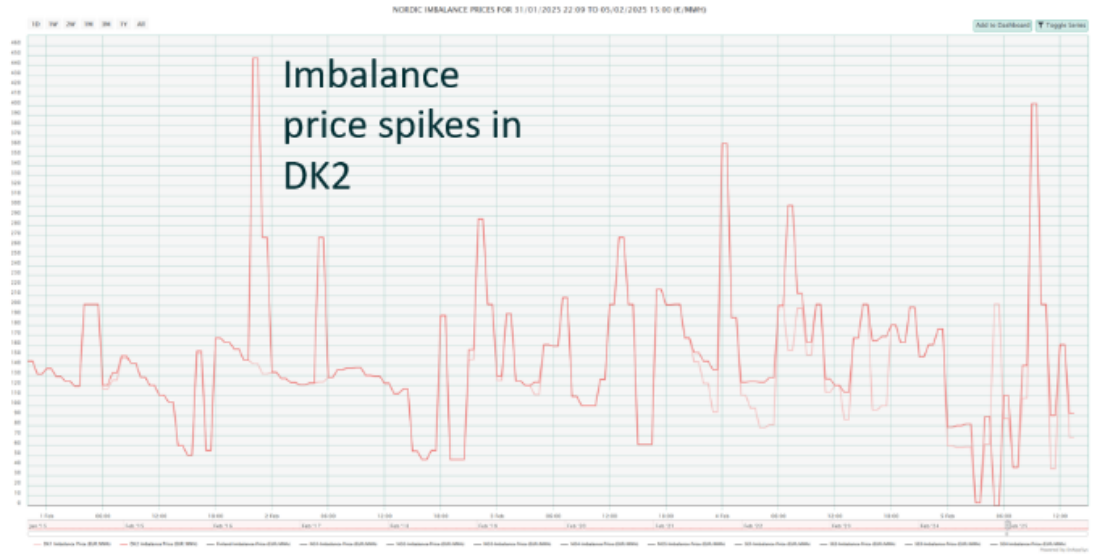


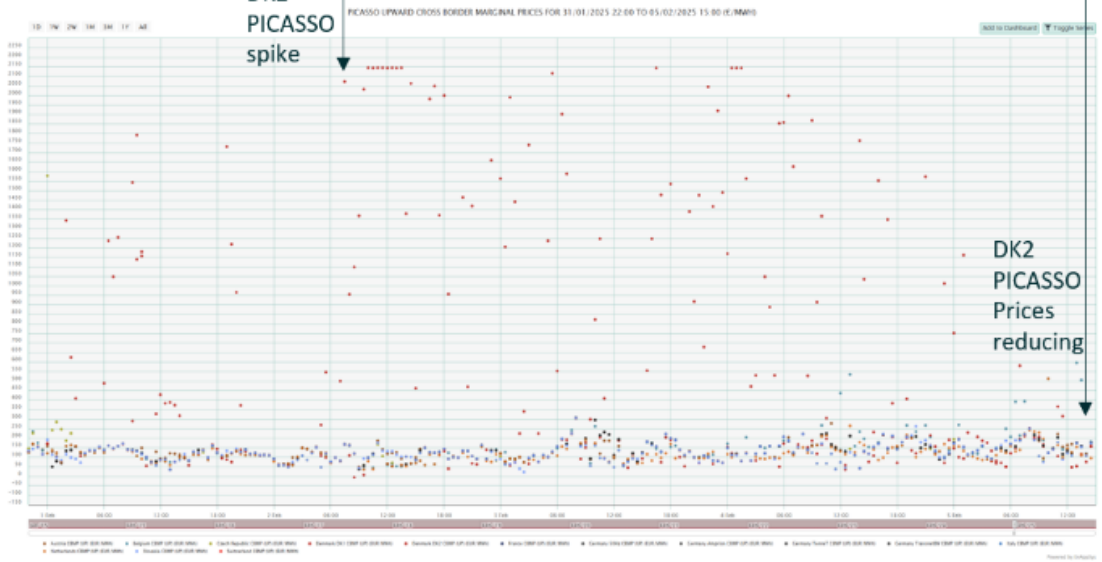
Details: -5361 EUR/MWh was observed on 16th Oct early morning hours around 3 am then again close to 4-5 am; 4618 EUR/MWh was on 12th Feb in the morning around 9 am for few minutes.

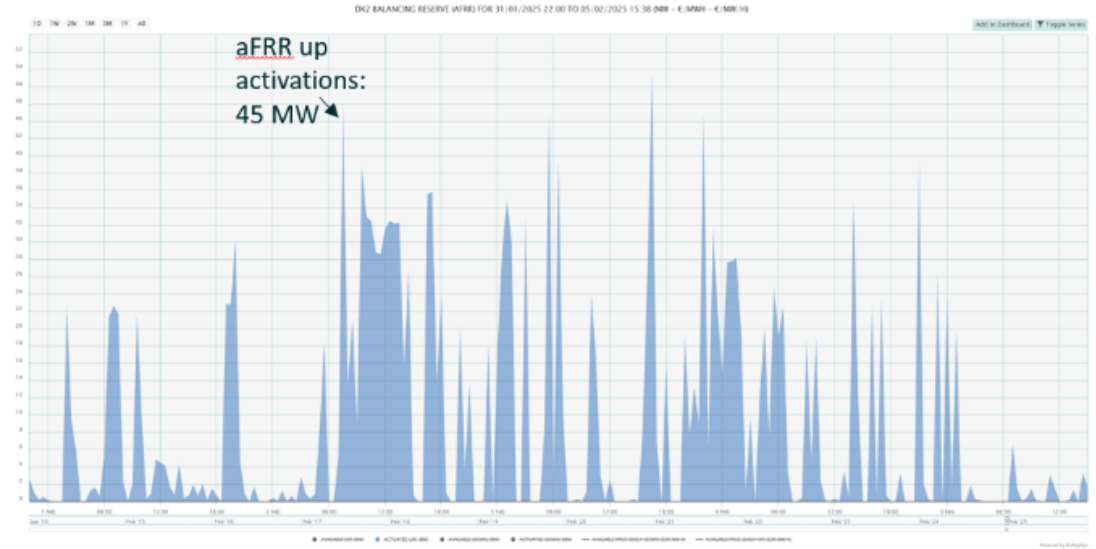
PICASSO Price spikes in DK2

Case study: DK2 price at EUR 2145/MWh for 3rd Feb 2025

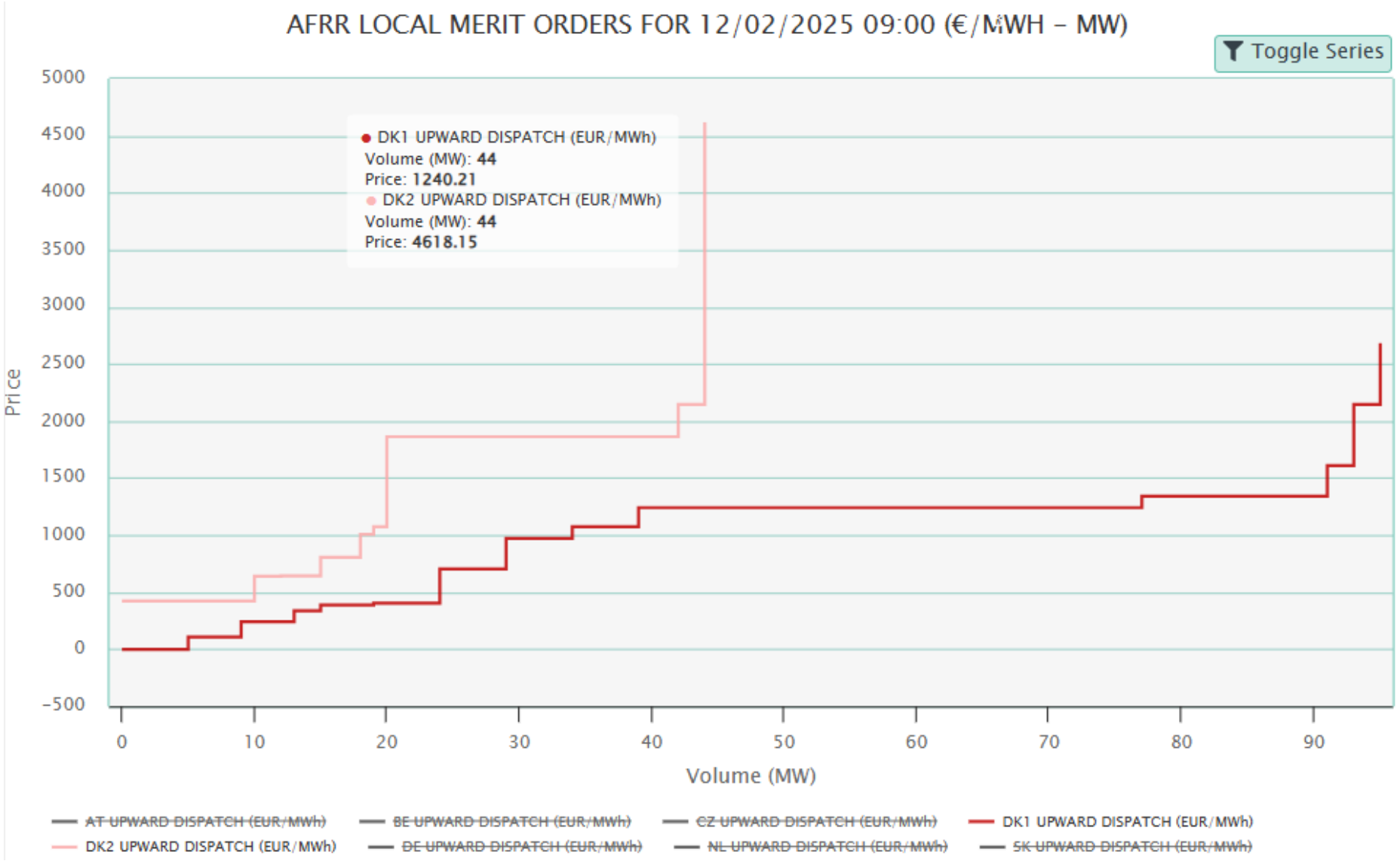




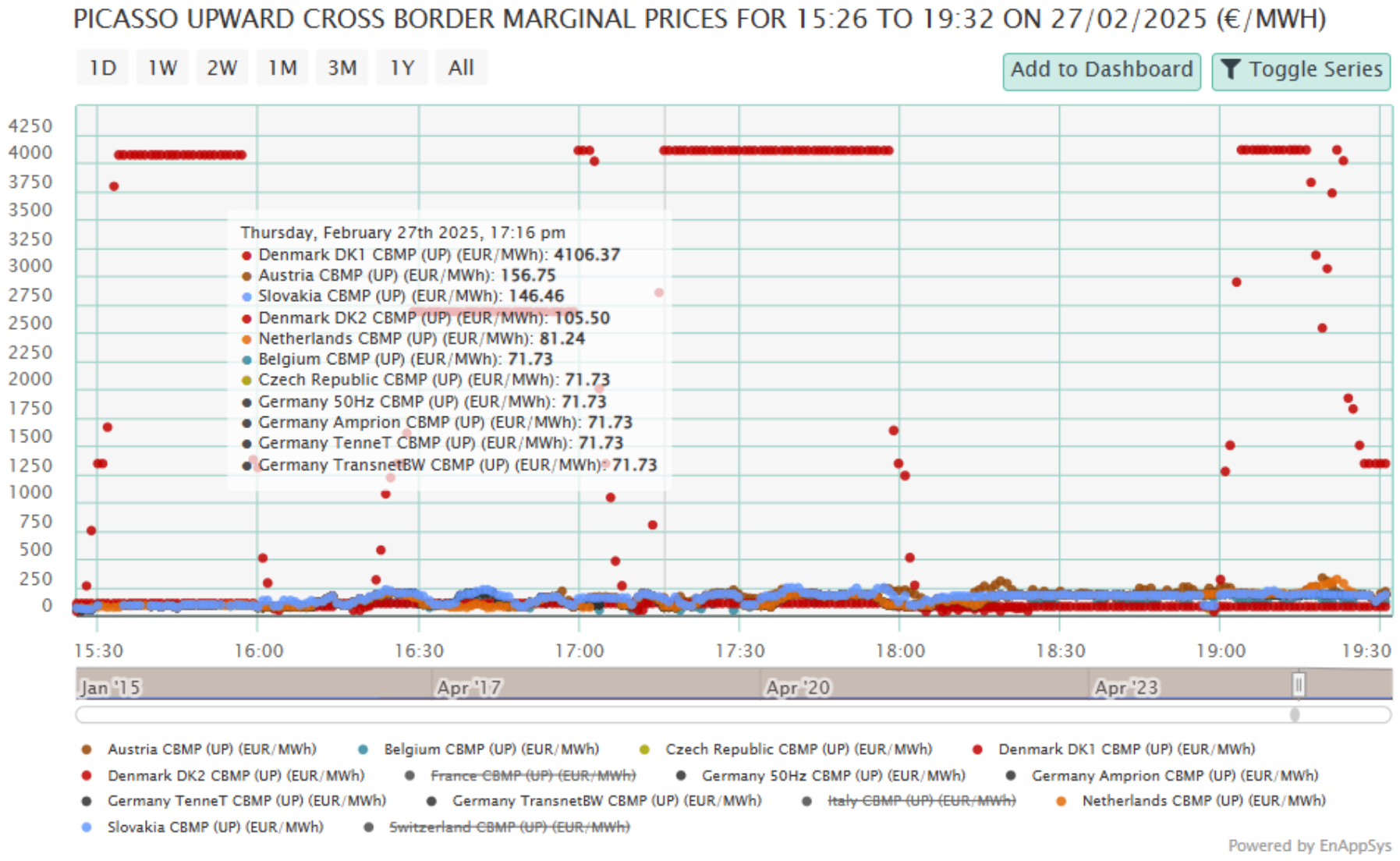




Price spikes in both DK1 and DK2



Price spikes in DK1

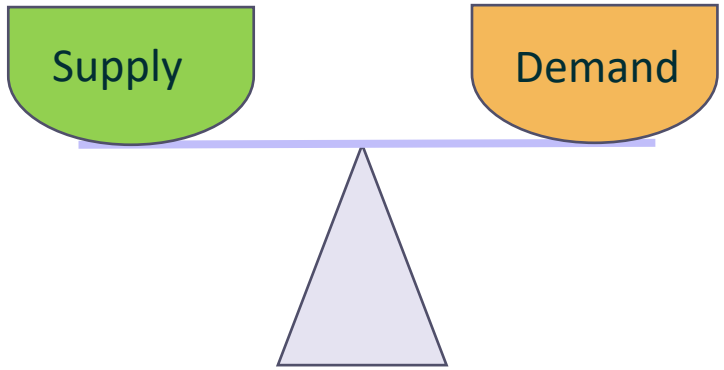


Who did the heavy weight-lifting?

Reality
(from 2nd Oct 2024 until 18th March 2025)

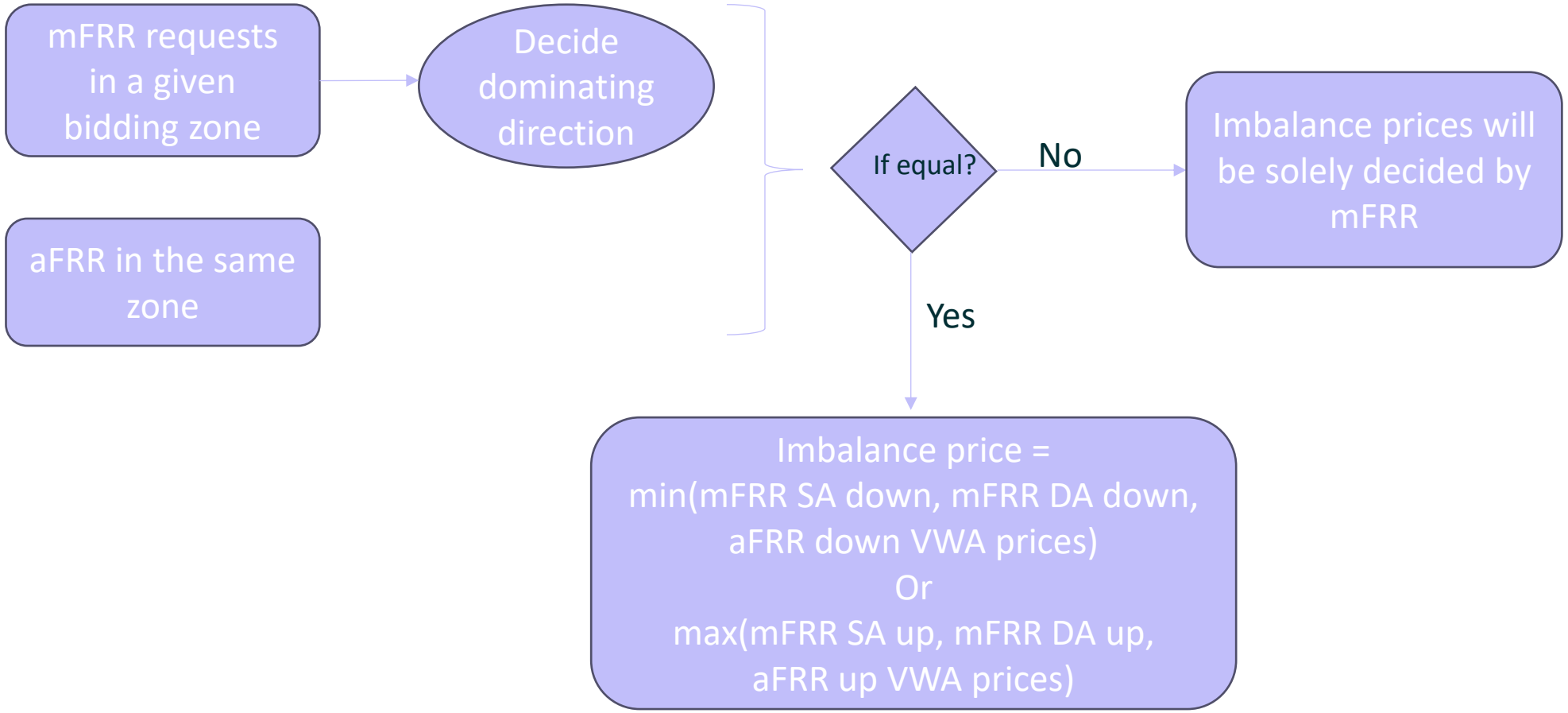
versus

What could have been the reality?

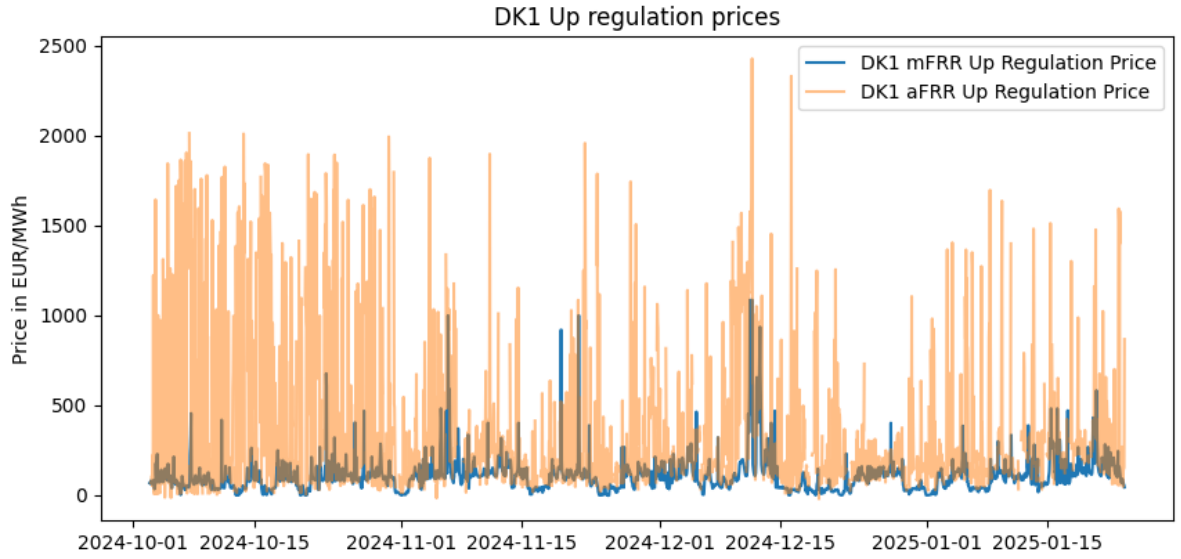


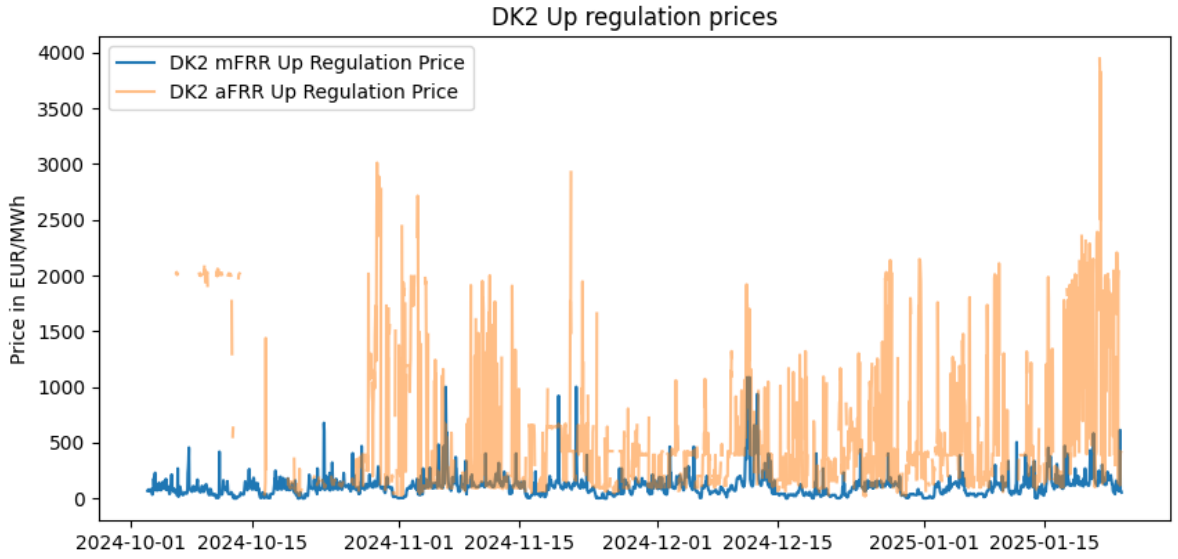
Energinet

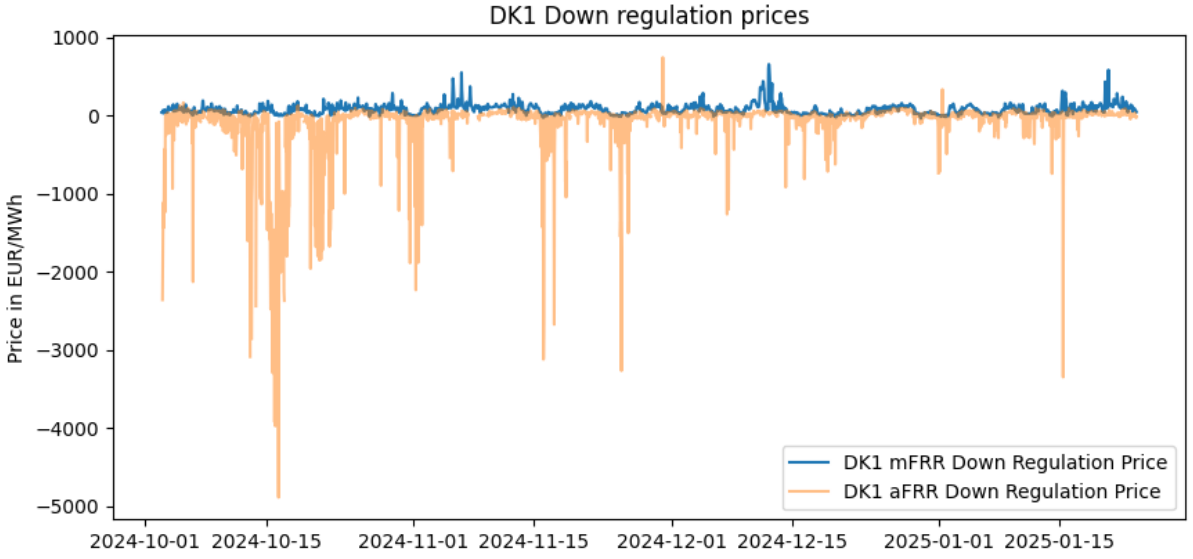
New imbalance pricing method

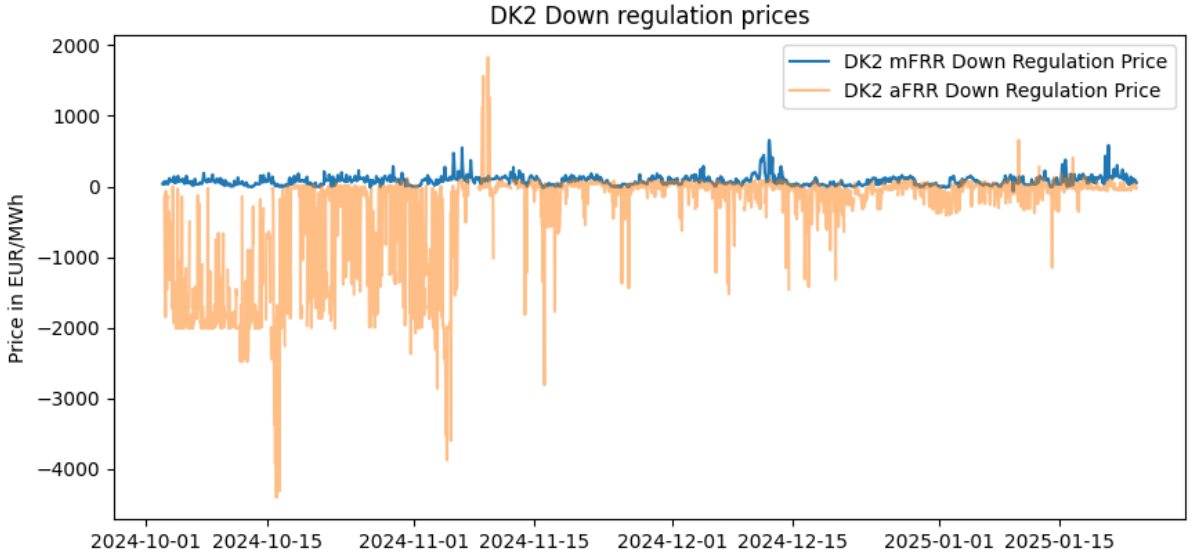


Comparing mFRR and aFRR prices

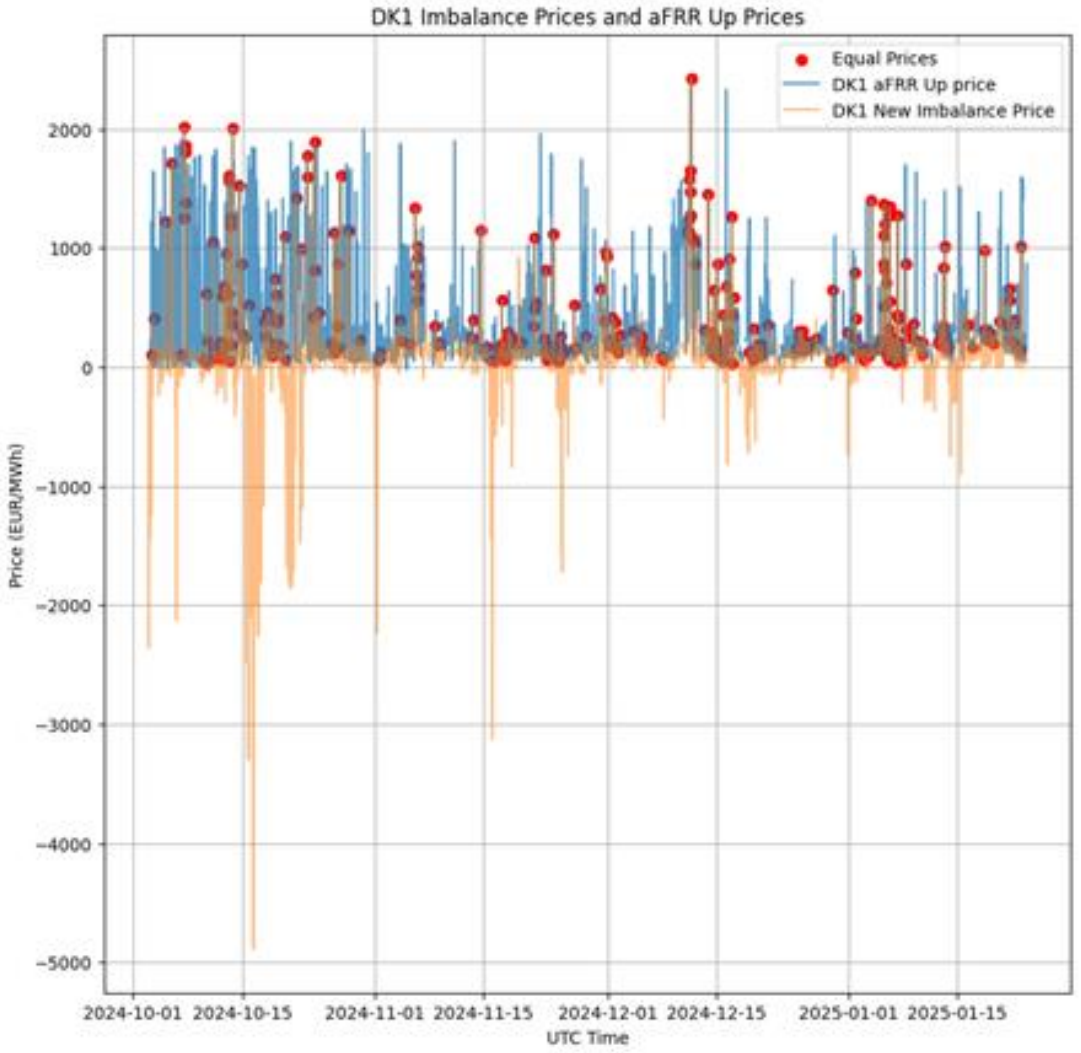


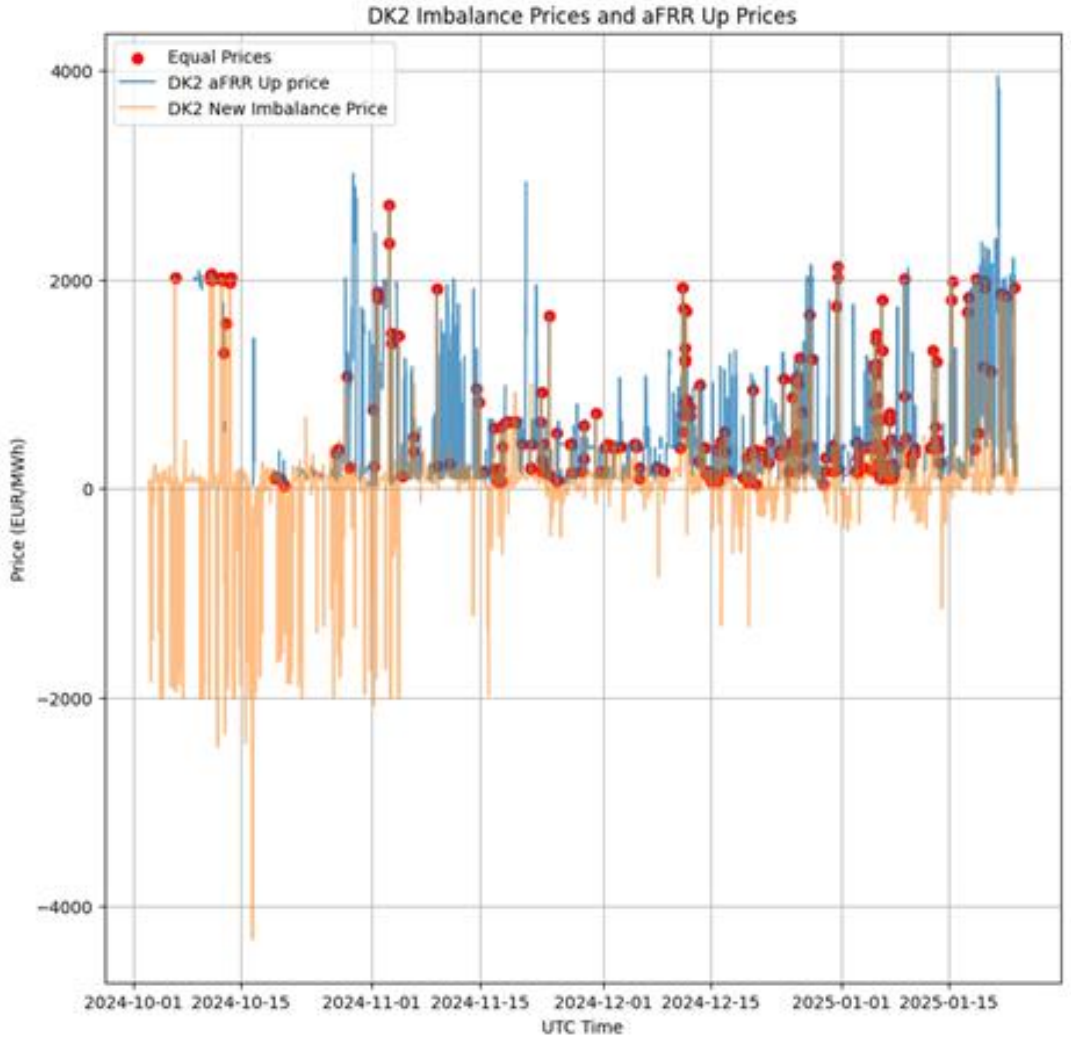






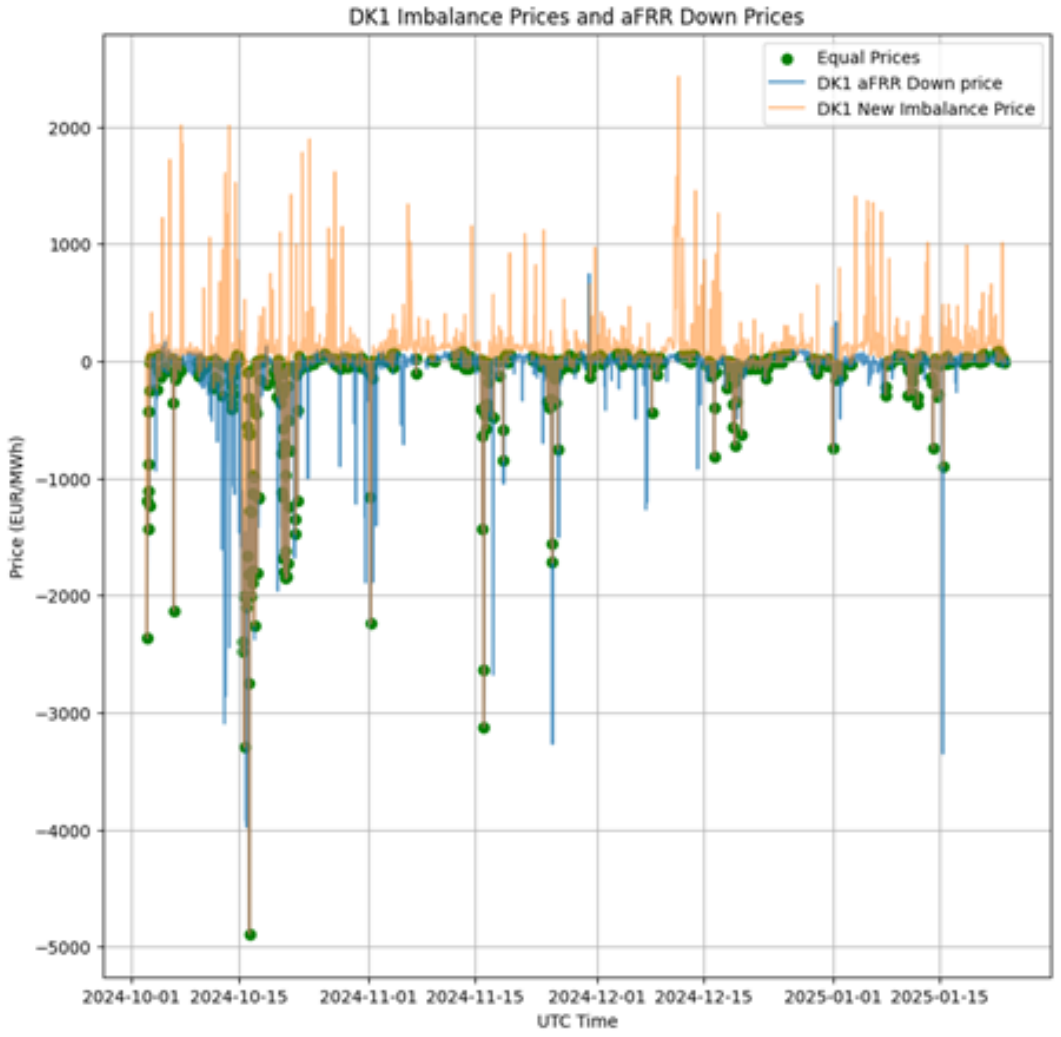
Impact of aFRR up on new imbalance prices

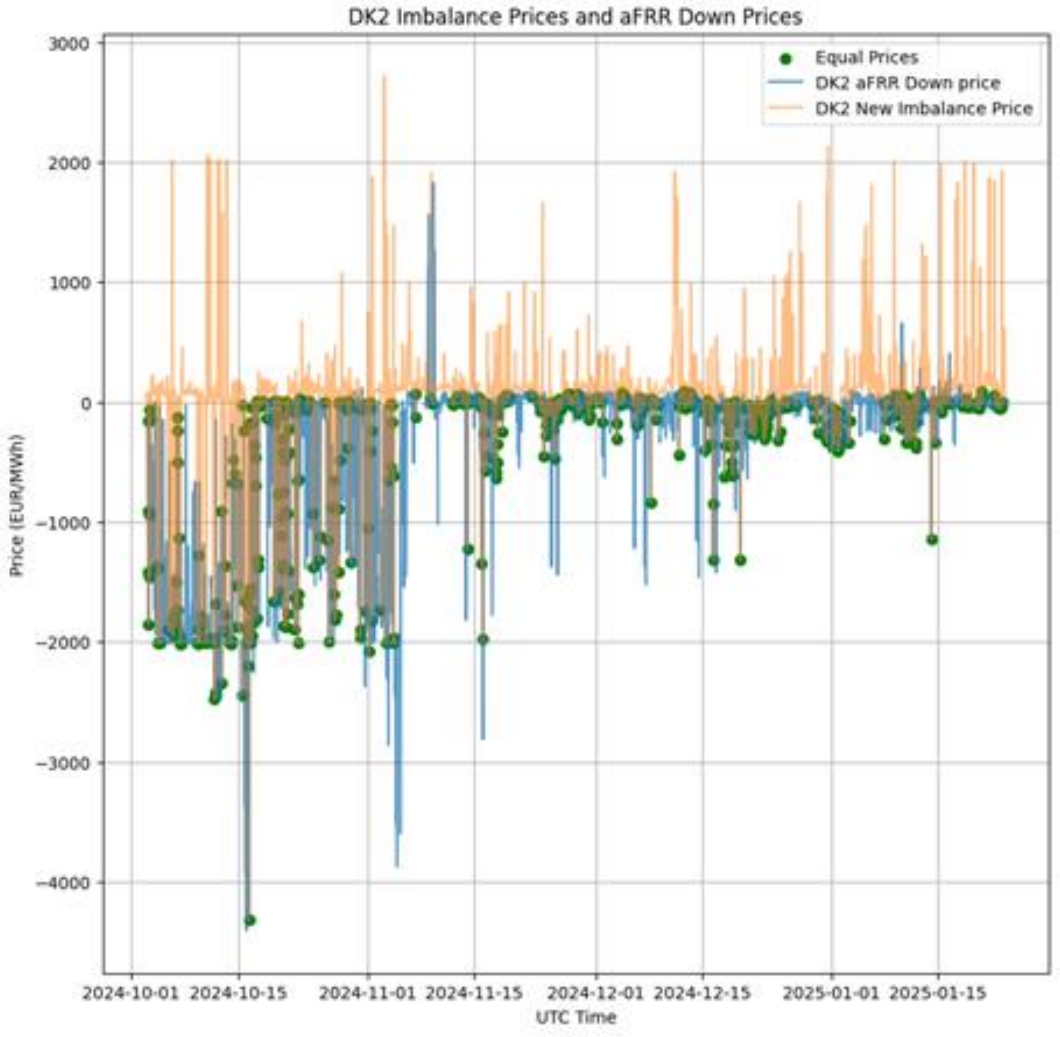




- aFRR upward activations overlapped with the dominating direction 13% of the time in DK1 and 11% in DK2.

Impact of aFRR down on new imbalance prices

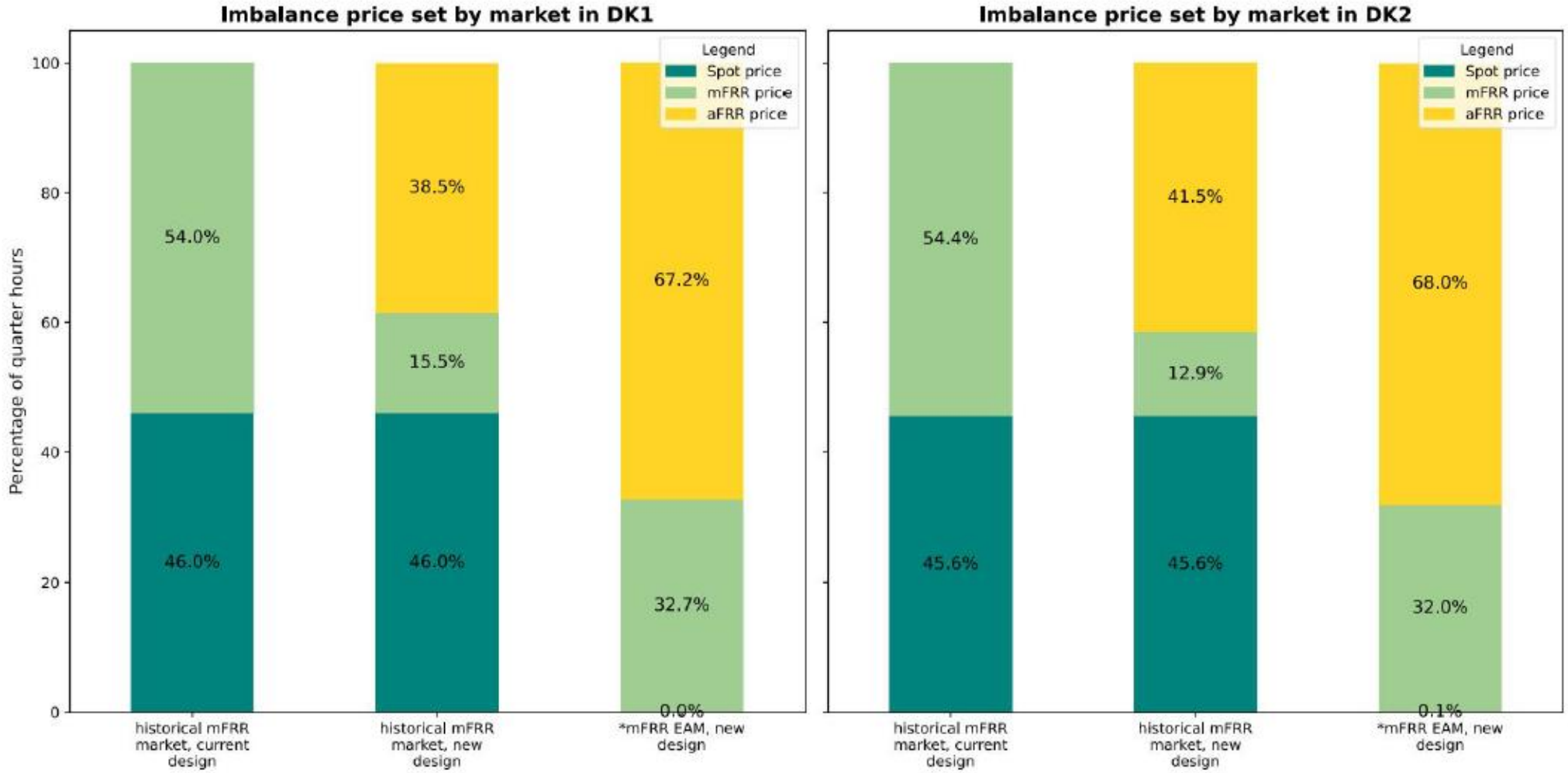




- aFRR downward activations overlapped with the dominating direction 24% of the time in both DK1 and DK2.

Superimposed effect?

How do the two market design changes – mFRR EAM and PICASSO, impact the imbalance prices?



Source of fig: Energinet, data period: 23-11-2024 to 03-02-2025

Pros and cons

- PICASSO introduced in October 2024, imbalance pricing method to be changed from 19th March 2025:

Effect- on one hand it has shielded market actors from volatile imbalance prices as a result of immature aFRR market

- on the other hand, it takes away the market signals to act based on market changes.

- From 19th March 2025, if the imbalance prices turn out to be higher:

Effect- It might especially impact the variable renewable assets to sell less than the expected production to avoid paying a large imbalance price if they are unable to produce. This could lead to much more underselling with higher risk for the system to down regulate.

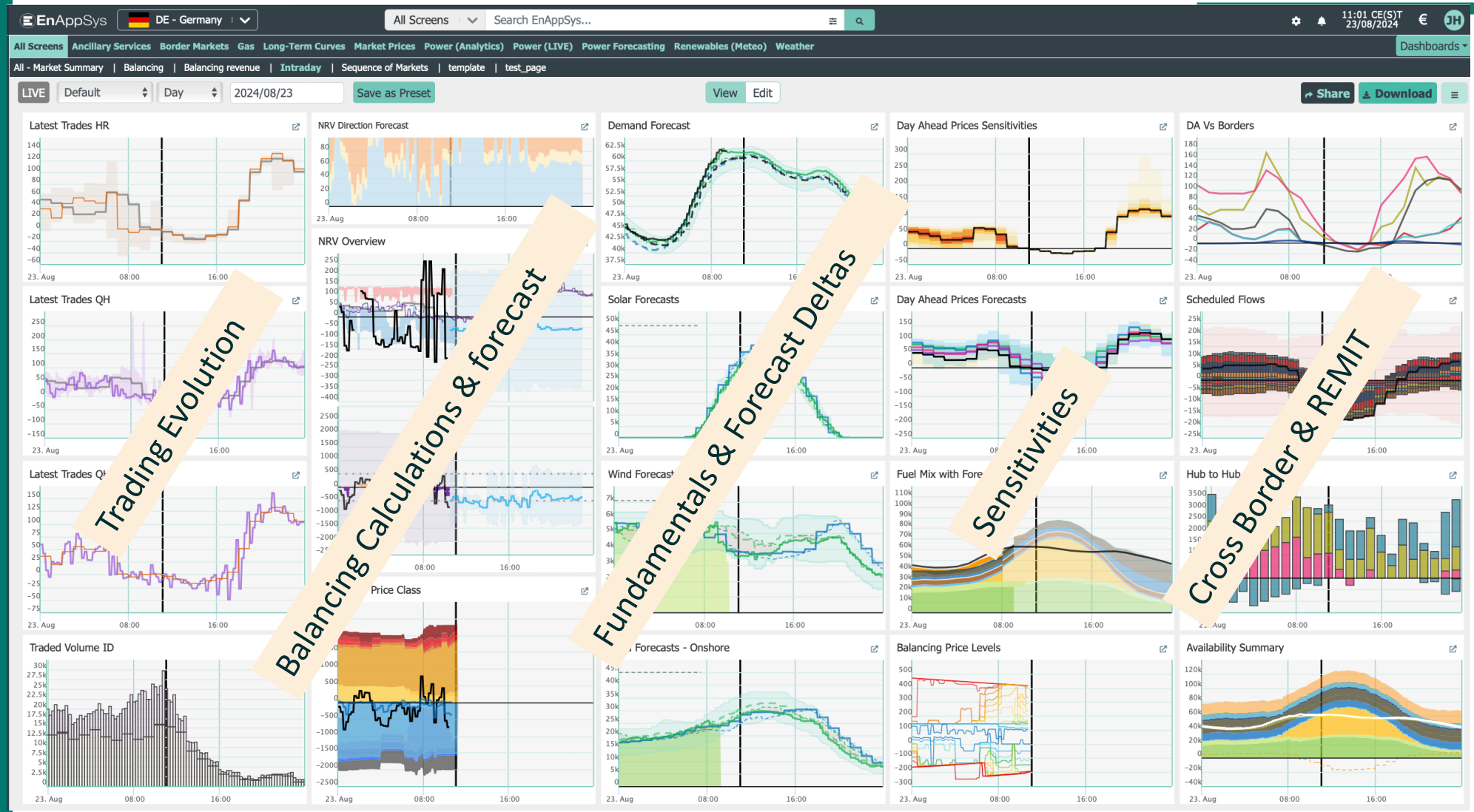
Conclusion

- mFRR EAM
  - requires more local flexibility and therefore serves as an encouragement to take part in balancing markets.
  - Some extreme imbalance prices were observed in the early days of implementation of mFRR EAM. The activations per bidding zone seem to be higher and in line with shadow operations.

- PICASSO
  - Wind generation is strongly correlated with aFRR volumes available in PICASSO merit order curve. Cross-border capacities play an important role in price formation. These factors are having a direct impact on PICASSO prices and soon on imbalance prices.

- What is needed?
  - More transparency in the data publication and creating level-playing field for market actors.
  - Advanced analysis of the short-term markets to capture the opportunities that arise with the new balancing market changes.

Analysing 96 QH Periods in Context



- Large amounts of data to be processed
- Updates until 25 minutes before delivery
- Analysing individual curves too complex and time consuming
- Customizable Dashboards

Thank You

For more details on our analytical products:
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